HAFB 2003

BHATE
Environmental Engineers and Scientists
1608 13th Avenue South, Suite 300
Birmingham ■ Alabama ■ 35205
(205) 918-4000
(205) 918-4050 (FAX)

RECEIVED
NOV 2003
NMED Hazardous
Waste Bureau

November 13, 2003

NMED/Hazardous Waste Bureau
2905 Rodeo Park Dr. East
Santa Fe, NM 87505-6303

Attention: Ms. Sandra Martin

Subject: ***Final Basewide Quality Assurance Project Plan***
Holloman AFB, New Mexico
Contract No.: DACA45-02-D-0012
Delivery Order No.: 5
Bhate Project No.: 9030024

Dear Ms. Martin:

Please find attached the Final Basewide Quality Project Plan, Revision 01, at the Holloman AFB, New Mexico.

If you have any questions or need additional assistance, please feel free to call me at (970) 216-7819.

Sincerely,
**BHATE ENVIRONMENTAL ASSOCIATES, INC.**

for Frank Gardner
Program Manager

cc w/ enclosures: Cornelius Amindyas (NMED)
Steve Jetter (NMED)
James Harris (USEPA)

G:\Archived Projects\2003\9030024 HOLLOMAN 03\Final FS Work Plan\NMED cover letter1.doc

**DISTRIBUTION LIST**
**Work Plan Final**

| | |
|---|---|
| U.S. Army Corps of Engineers Omaha District<br>Attn: CENWO-PM-HA (Tom Zink)<br>106 South 15th Street<br>Omaha, NE 68102-1618 | 3 |
| Holloman Air Force Base<br>Attn: 49 CES/CEV (Dan Holmquist)<br>550 Tabosa Avenue<br>Holloman AFB, NM 88330-8458 | 2 |
| Ms. Sandra Martin<br>NMED/Hazardous Waste Bureau<br>2905 Rodeo Park Dr. East<br>Santa Fe NM 87505-6303 | 1 |
| Mr. Cornelius Amindyas<br>NMED/Hazardous Waste Bureau<br>4131 Montgomery NE<br>Albuquerque, NM 87109 | 1 |
| Mr. Steve Jetter<br>NMED/Hazardous Waste Bureau<br>4131 Montgomery NE<br>Albuquerque, NM 87109 | 1 |
| Mr. James Harris<br>USEPA Region 6 PD-N<br>1445 Ross Ave., Suite 12<br>Dallas, TX 75202-2733 | 1 |
| HQ ACC/CEVR-W<br>Attn: Mr. Jim Haggins<br>129 Andrews St, STE 102<br>Langley AFB, VA 23665-4969 | 2 |
| Chuck Schick<br>14 Chelsea Lane<br>Peralta, NM 87042 | 1 |
| Jerry Pelfrey<br>Bhate Environmental Associates,<br>1641 Vandergrift Rd, Bldg 1266<br>Holloman AFB, NM 88330 | 3 |
| Frank Gardner<br>107 Park Dr.<br>Grand Junction, CO 81501 | 1 |
| Bhate Archive Copy | 2 |
| Total | 18 |

# BASEWIDE QUALITY ASSURANCE PROJECT PLAN

## Holloman Air Force Base
## New Mexico

## November 2003

Contract No. DACA45-03-D-0008
BHATE Project No. 9030025

**Headquarters, Air Combat Command**
**Langley Air Force Base, Virginia**

**49 CES/CEV**
**Holloman Air Force Base, New Mexico**

# BASEWIDE QUALITY ASSURANCE PROJECT PLAN

## HOLLOMAN AIR FORCE BASE
## HOLLOMAN AFB, NEW MEXICO
## CONTRACT NUMBER: DACA-45-03-D-0008

Prepared For:

**49 CES/CEV**
**550 TABOSA AVENUE**
**Holloman AFB, NM 88330-8458**

**Attention: Mr. Holmquist**

**November 2003**

**Bhate Project No.: 9030025**

Prepared By:

BHATE ENVIRONMENTAL
1608 13TH AVENUE SOUTH, SUITE 300
BIRMINGHAM, ALABAMA 35205
Fort Walton Beach, FL • Jacksonville, FL • Tampa, FL
Alamogordo, NM • Nashville, TN • Norfolk, VA
1-800-806-4001
www.bhate.com

# BASEWIDE QUALITY ASSURANCE PROJECT PLAN
# HOLLMAN AIR FORCE BASE
# NEW MEXICO

Prepared for:

**49CES/CEV**
**Holloman Air Force Base**
**New Mexico**

Under Contract To:

**U.S. Army Corps of Engineers**
**Omaha, NE**
**Under Contract No. DACA45-03-D-0008**

**November 2003**

Prepared by:

**Bhate Environmental Associates, Inc.**
**1608 13th Avenue South, Suite 300**
**Birmingham, Alabama 35205**

**Bhate Project No. 9030025**

This page is intentionally blank.

# BASEWIDE QUALITY ASSURANCE PROJECT PLAN
# HOLLMAN AIR FORCE BASE
# NEW MEXICO

## REVIEW SHEET

COMMITMENT TO IMPLEMENT THIS BASEWIDE QUALITY ASSURANCE PROJECT PLAN

| | | |
|---|---|---|
| Mike D'Auben | | 11/19/03 |
| Project Chemist | Signature | Date |
| for Frank Gardner | | 11/19/03 |
| Project Manager | Signature | Date |
| Jerry Pelfrey | | 11/19/03 |
| Site Manager | Signature | Date |

This page is intentionally blank.

# FINAL

# BASEWIDE QUALITY ASSURANCE PROJECT PLAN
# HOLLMAN AIR FORCE BASE
# NEW MEXICO

## TABLE OF CONTENTS

LIST OF ACRONYMS ..... ix

QUALITY ASSURANCE PROJECT PLAN ..... xii

1 INTRODUCTION ..... xiv
- 1.1 Base History ..... xiv
- 1.2 Base Description ..... xiv

2 PROJECT OBJECTIVES ..... 2-1

3 DATA QUALITY OBJECTIVES AND QUALITY PROGRAM ..... 3-1

4 DATA CATEGORIES ..... 4-1

5 DATA QUALITY OBJECTIVES ..... 5-1

6 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY ..... 6-1
- 6.1 Precision ..... 6-1
- 6.2 Accuracy ..... 6-1
- 6.3 Representativeness ..... 6-2
- 6.4 Completeness ..... 6-2
- 6.5 Comparability ..... 6-3

7 DETECTION/QUANTITATION LIMITS AND CALIBRATION REQUIREMENTS ..... 7-1
- 7.1 Detection and Quantitation Limits ..... 7-1
  - 7.1.1 Instrument Detection Limit ..... 7-1
  - 7.1.2 Method Detection Limit ..... 7-1

7.1.3 Method Quantitation Limit ..... 7-2
7.1.4 Method Reporting Limits ..... 7-2
7.2 Instrument Calibration for Definitive Methodologies ..... 7-3

8 QUALITY CONTROL ELEMENTS ..... 8-1

8.1 Laboratory Control Sample ..... 8-1
8.2 Matrix Spike/Matrix Spike Duplicates ..... 8-2
8.3 Surrogates ..... 8-3
8.4 Internal Standards ..... 8-3
8.5 Retention Time Windows ..... 8-3
8.6 Interference Check Sample ..... 8-4
8.7 Method Blank ..... 8-4
8.8 Ambient Blank ..... 8-5
8.9 Source Water Blank ..... 8-5
8.10 Equipment Blank ..... 8-5
8.11 Trip Blank ..... 8-5
8.12 Field Duplicates ..... 8-5
8.13 Field Split ..... 8-6
8.14 Temperature Blank ..... 8-6

9 QUALITY CONTROL PROCEDURES ..... 9-1

9.1 Holding Time Evaluation ..... 9-1
9.2 Confirmation of Identification ..... 9-1
9.3 Standard Materials ..... 9-1
9.4 Supplies and Consumables ..... 9-2

10 FIELD SAMPLING PROCEDURES ..... 10-1

10.1 General Considerations ..... 10-1
10.2 Sample Locations ..... 10-1
10.3 Decontamination, Containerization, and Preservation ..... 10-1
10.4 Sampling Procedures ..... 10-2
10.5 Field Documentation ..... 10-2
10.5.1 Field Log Book ..... 10-3
10.6 Data Management ..... 10-3

11 SAMPLE CUSTODY ..... 11-1

11.1 Sample Identification ..... 11-1
11.1.1 Site Type Designations ..... 11-1
11.1.2 Sample Type Designations ..... 11-2
11.1.3 Sample Depth Designations ..... 11-3
11.1.4 QC Extensions ..... 11-3
11.2 Sample Types ..... 11-4
11.2.1 Soils ..... 11-4
11.2.2 Sediment ..... 11-4

11.2.3 Surface Water ..... 11-4
11.2.4 Monitoring Well Groundwater ..... 11-5
11.2.5 Field Screening ..... 11-5
11.3 Documentation ..... 11-6
11.4 Field Custody Procedures ..... 11-7
11.4.1 Sample Collection ..... 11-8
11.4.1.1 Sample Containers ..... 11-8
11.4.1.2 Sample Location, Sample Media, and Intended Parameters 11-8
11.4.1.3 Date, Time, Personnel, and Ambient Conditions ..... 11-8
11.4.1.4 Preliminary Sampling Activities ..... 11-9
11.4.1.5 Sample Collection ..... 11-9
11.4.1.6 Quality Control Sample Collection ..... 11-10
11.5 Sample Management ..... 11-10
11.5.1 Sample Packing ..... 11-10
11.5.2 Sample Shipping ..... 11-11
11.6 Laboratory Custody Procedures ..... 11-11

12 CALIBRATION PROCEDURES ..... 12-1

12.1 Laboratory Instruments and Equipment ..... 12-1
12.2 Field Procedures ..... 12-1
12.2.1 Field Equipment Standards ..... 12-1
12.2.2 Field Equipment Calibration Procedures ..... 12-2
12.2.3 Field Equipment Calibration Frequency ..... 12-4

13 ANALYTICAL METHODS AND PROCEDURES ..... 13-1

13.1 Definitive Data ..... 13-1
13.2 Field Screening ..... 13-2

14 DATA REDUCTION, REVIEW, VERIFICATION, VALIDATION, REPORTING AND RECORD MANAGEMENT ..... 14-1

14.1 Data Review, Validation, and Reporting Requirements for Screening Data 14-1
14.2 Data Review, Validation, and Reporting Requirements for Definitive Data 14-1
14.2.1 Laboratory ..... 14-4
14.2.2 Contractor Reduction, Validation, and Reporting ..... 14-4
14.3 ERPIMS Data Reporting ..... 14-5
14.4 Record Management ..... 14-5

15 PERFORMANCE AND SYSTEMS AUDITS ..... 15-1

15.1 Performance and System Audits of the Laboratory ..... 15-1
15.2 Performance and System Audits of Field Activities ..... 15-1
15.2.1 Systems Audits ..... 15-1
15.2.2 Performance Audits ..... 15-2

16 PREVENTATIVE MAINTENANCE ..... 16-1

16.1 Laboratory Instruments and Equipment ..... 16-1
16.2 Field Equipment ..... 16-1

17 CORRECTIVE ACTIONS ..... 17-1

16.1 Laboratory ..... 17-1
17.1 Field Activities ..... 17-1

18 QUALITY ASSURANCE REPORTS ..... 18-1

18.1 Laboratory QA Reports ..... 18-1
18.1.1 Non-Routine Occurrences ..... 18-1
18.1.2 Data Storage ..... 18-1
18.2 Field Activities QA Reports ..... 18-1

19 REPORTING REQUIREMENTS ..... 19-1

19.1 Daily Quality Control Reports ..... 19-1
19.2 Monthly Progress Reports ..... 19-1
19.3 Partnering Meetings ..... 19-2
19.4 Analytical Data Quality Report ..... 19-2

20 REFERENCES ..... 20-1

**Tables**

3-1 Project Data Quality Objectives
4-1 General Data Quality Levels for Specific Project Objectives
5-1 Comprehensive Analyte and Data Quality Objectives – Groundwater
5-2 Comprehensive Analyte and Data Quality Objectives – Surface Water
5-3 Comprehensive Analyte and Data Quality Objectives – Soil
6-1 Definitions and Uses of Statistical Calculations
7-1 Calibration Frequency
8-1 Data Validation Qualifiers
10-1 Sample Containers, Preservatives, and Holding Times
13-1 Extraction and Digestion Procedures
13-2 Analytical Procedures
13-3 Quality Assurance Objectives for Field Screening Methods

## Appendices

**Appendix A STANDARD OPERATING PROCEDURES**

| | |
|---|---|
| HAFB SOP-1 | Documentation, Sample Handling, Chain-of-Custody, and Shipping |
| HAFB SOP-2 | Sampling Equipment Decontamination |
| HAFB SOP-3 | Staking, Utility Clearance, and Permitting |
| HAFB SOP-4 | Direct Push Sampling for Soil and Groundwater |
| HAFB SOP-5 | Soil Sampling for Chemical Analysis |
| HAFB SOP-6 | Procedure for Field Screening of Volatile Organics |
| HAFP SOP-7 | Lithologic Description and Geotechnical Sampling |
| HAFB SOP-8 | Groundwater Sampling for Chemical Analysis |
| HAFB SOP-9 | Field Management of Investigation-Derived Waste (IDW) |
| HAFB SOP-10 | Borehole Abandonment and Site Restoration |

**Appendix B TECHNICAL REFERENCES**

**Appendix C SUMMARY OF QUALITY CONTROL REQUIREMENTS**

**Appendix D FIELD FORMS**

This page intentionally blank.

# LIST OF ACRONYMS

| | |
|---|---|
| %R | Percent Recovery |
| A2LA | American Association of Laboratory Accreditation |
| AFCEE | Air Force Center for Environmental Excellence |
| ADQR | Analytical Data Quality Report |
| ASTM | American Society for Testing and Materials |
| BTEX | Benzene, Toluene, Ethylbenzene and Xylenes |
| CCV | Continuing Calibration Verification |
| CFR | Code of Federal Regulations |
| CLP | Contract Laboratory Program |
| COC | Chain-of-Custody |
| CQAP | Comprehensive Quality Assurance Plan |
| DO | Dissolved Oxygen |
| DoD | Department of Defense |
| DQCRs | Daily Quality Control Reports |
| DQOs | Data Quality Objectives |
| ECB Lab | Environmental Chemistry Branch Laboratory |
| EDB | Ethylene Dibromide |
| ERPIMS | Environmental Resources Program Information Management System |
| FID | Flame Ionization Detector |
| FSP | Field Sampling Plan |
| GC | Gas Chromatography |
| GC/MS | Gas Chromatography/Mass Spectroscopy |
| HAFB | Holloman Air Force Base |
| HPLC | High Performance Liquid Chromatography |
| HAFB SOP | Holloman Air Force Base Standard Operating Procedure |
| ICP | Inductively Coupled Plasma |
| ICS | Interference Check Sample |
| ICV | Initial Calibration Verification |
| ID | Identification |
| IDL | Instrument Detection Limit |
| IS | Internal Standard |
| LCS | Laboratory Control Sample |
| LD | Laboratory Duplicate |
| LIMS | Laboratory Information Management System |
| MDL | Method Detection Limit |
| mg/kg | milligrams per kilogram |
| MQL | Method Quantitation Limit |
| MRL | Method Reporting Limit |
| msl | Mean Sea Level |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NIST | National Institute Standards and Technology |

# LIST OF ACRONYMS - CONTINUED

| | |
|---|---|
| NMED | New Mexico Environment Department |
| NMWQCC | New Mexico Water Quality Control Commission |
| ORP | Oxidation Reduction Potential |
| OVA | Organic Vapor Analyzer |
| PAH | Polynuclear Aromatic Hydrocarbons |
| PARCC | Precision, Accuracy, Representativeness, Comparability, and Completeness |
| PCB | Polychlorinated Biphenyls |
| PE | Performance Evaluation |
| PID | Photoionization Detector |
| PRG | Preliminary Remediation Goal |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| QSM | Quality System Manual |
| RCRA | Resource Conservation and Recovery Act |
| RF | Response Factor |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| RSD | Relative Standard Deviation |
| SCS | Single Control Sample |
| SOPs | Standard Operating Procedures |
| SOW | Statement of Work |
| SVOC | Semivolatile Organic Compounds |
| TAL | Target Analyte List |
| TCL | Target Compound List |
| TDS | Total Dissolved Solids |
| TIC | Tentatively Identified Compound |
| TOC | Total Organic Carbon |
| TOX | Total Organic Halides |
| ug/L | micrograms per liter |
| USACE | United States Army Corps of Engineers |
| USAF | U.S. Air Force |
| USEPA | United States Environmental Protection Agency |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |
| WP | Work Plan |

This page intentionally blank.

# QUALITY ASSURANCE PROJECT PLAN

This Basewide Quality Assurance Project Plan (QAPP) has been developed to assure that sample collection, analyses, and evaluations are legally and scientifically defensible for each of the sites at Holloman Air Force Base (HAFB). The characteristics of data quality and the data quality objectives are described in detail. Field and laboratory quality assurance and quality control methods, equipment, procedures, and evaluations are specified in this QAPP. These protocols include methodology, maintenance, calibration, and corrective action for each aspect of the Work Plan. In the event that conflicts arise between the procedures defined in this QAPP (or a site-specific QAPP addendum) and other requirements, the approved QAPP will take precedence.

The purpose of this Basewide QAPP is to create a document providing the basic QA requirements that will be employed for environmental work performed at Holloman Air Force Base. The Basewide QAPP provides not only the general information which will be common to all projects (definitions of the PARCC parameters, quality control elements, etc), but also provides a "default" set of QC limits which would be suitable for most intended data uses (when there is no need or desire to generate individual site specific limits for a project). With the Basewide QAPP in place, the specific requirements for each site (laboratory, site specific QC limits, etc.) can be contained within the Work Plan, or in a QAPP Addendum, alleviating the need to generate and approve an entire new QAPP for each site.

This page intentionally blank.

# 1 INTRODUCTION

Bhate Environmental Associates, Inc. (Bhate) has been retained by the U.S. Army Corps of Engineers (USACE), under contract DACA45-03-D-0008 to conduct multiple tasks at the Holloman Air Force Base (HAFB), New Mexico.

## 1.1 Base History

HAFB (originally Alamogordo Army Air Field) was first established in 1942. From 1942-1945, Alamogordo Army Air Field served as the training grounds for over 20 different groups, flying primarily B-17s, B-24s, and B-29s. After World War II, most operations had ceased at the base. However, in 1947 Air Materiel Command announced the air field would be the primary base for the testing and development of pilot less aircraft, guided missiles, and other research programs. On January 13, 1948, the Alamogordo installation was renamed Holloman Air Force Base, in honor of the late Col. George V. Holloman, a pioneer in guided missile research. In 1968 the 49th Tactical Fighter Wing was assigned to HAFB. Currently, HAFB continues to serve as the home of the 49th Tactical Fighter Wing and is the German Air Force's Tactical Training Center.

## 1.2 Base Description

HAFB is approximately 59,600 acres in area, and at a mean elevation of 4,093 feet above sea level. The base is located in Otero County six miles west of Alamogordo, New Mexico. Holloman AFB is located in the Tularosa Sub-basin which is part of the Central Closed Basins. The San Andres Mountains bound the basin to the west (about 30 miles) with the Sacramento Mountains approximately 10 miles to the east. At its widest, the basin is about 60 miles east to west and stretches approximately 150 miles north to south.

This page intentionally blank.

# 2 PROJECT OBJECTIVES

The main objective of the site investigations is to obtain technically valid and defendable environmental data that will meet or exceed the project specific Data Quality Objectives (DQOs). Therefore, this QAPP is written in accordance with the requirements of *USACE Requirements for the Preparation of Sampling and Analysis Plans* (EM 200-1-3, 1 February 2001) and *EPA Requirements for Quality Assurance Project Plans*, QA/R-5, (EPA/240B-01/003 March 2001).

All field activities shall follow the applicable collection and quality control protocols and requirements described in the appropriate Work Plan or Field Sampling Plan (FSP), unless specifically exempted by the rules of a particular Department program.

Analytical laboratories used under this QAPP generating environmental data for submission to the Department or for use in the Department-regulated or Department sponsored activities shall hold certification from the National Environmental Laboratory Accreditation Program (NELAP). NELAP accreditation requires the laboratory have an approved Laboratory Quality Manual (LQM). The LQM describes the management policies, objectives, principles, and procedures, which will be used to produce the required data quality. In addition, all laboratories contracted for analytical services at HAFB must have current USACE Lab Validation as required by the Hazardous, Toxic and Radioactive Waste Center of Expertise (HTRW CX) and approval from the U.S. Air Force Center of Environmental Excellence (AFCEE), for projects under AFCEE purview as required. The QAPP defines the Quality Assurance (QA) program for oversight of field and laboratory activities and for the review of the environmental data. The QA program is a system of documented checks, which ensures the authenticity, and validity of environmental data. Quality Control (QC) includes the tools provided in the QA program for performing the data validation process.

The activities associated with the collection of physical and chemical data include sampling, analysis, and data management. The activities that generate data will follow a QA program, which adheres to the USACE and USEPA requirements. These requirements are defined by the use of DQOs as outlined in Section 3.

This page intentionally blank.

# 3 DATA QUALITY OBJECTIVES AND QUALITY PROGRAM

The DQO process will be used to define investigation requirements at HAFB. DQOs are statements of expectations of the performance capabilities of the entire program that aid in the environmental decision-making processes. DQOs are the expression of the degree of uncertainty that the decision-maker can tolerate in the environmental data being employed to make the decision. DQOs specify the data type, quality, quantity, and uses required to make decisions and are the basis for designing data collection activities. They are often expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC). The PARCC criteria are provided in Table 3-1. Project-specific DQOs will be provided in the project-specific addenda to this QAPP, site-specific Work Plans, or FSPs. The DQO planning process follows these steps:

1. State the problem to be resolved.
2. Identify the decision.
3. State the inputs.
4. Define the boundaries of the study.
5. Develop a decision rule.
6. Specify the limits of uncertainty.
7. Optimize design for data collection.

The terms QC and QA have been used synonymously within the environmental industry when in fact they are not. QC indicates nothing about the systems, while QA tells nothing specific about the validity of the results on a particular sample. They are defined as follows:

- ***Quality Assurance*** – An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process or service meets the requirements of the customer.
- ***Quality Control*** – The routine technical activities that quantitatively measure the success of a process or service against standards of performance established to meet the needs of the customer.

This page is intentionally blank.

# 4 DATA CATEGORIES

The data use determines the required levels of data quality. Under this QAPP, the levels of data quality to be utilized in this investigation to achieve the various project objectives are presented in Table 4-1. The two levels of data quality established by the USACE are screening and definitive. These are defined as follows:

***Screening data*** are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements as compared to the requirements for producing definitive data. Sample preparation steps are commonly restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Physical test methods such as dissolved oxygen (DO) measurements, temperature and pH measurements, moisture content, turbidity, conductance, etc., have been designated, by definition, as screening techniques.

Depending on the DQOs, screening methods may require confirmation samples that generate definitive data. Confirmation samples shall be selected to include samples with both detected and nondetected results from the screening technique.

The QA/QC elements associated with the collection of screening data include the following:

- Sample documentation (location, date and time collected, batch number, etc.);
- Sample tracking (documenting details of sample during screening process);
- Sampling design approach (systematic, simple or stratified, judgmental, etc.);
- Initial and continuing calibration;
- Determination and documentation of detection limits;
- Analyte identification and quantification;
- Analytical error determination: An appropriate number of replicate aliquots are taken from at least one thoroughly homogenized sample. The replicate aliquots are analyzed and standard laboratory QC parameters (such as variance, mean, and coefficient of variation) are calculated and compared to method-specific performance requirements; and,
- Definitive confirmation: If confirmation sampling is required by DQOs, then at least ten percent of the screening data will be confirmed with definitive data as described below. As a minimum, at least three screening samples reported above the action level (if any) and three

screening samples reported below the action level (or as non-detects) should be randomly selected from the appropriate group and submitted for confirmation analysis.

***Definitive data*** are generated using rigorous analytical methods such as approved USEPA reference methods as discussed in Section 3.12 and Appendix C. The data can be generated in a mobile or off-site laboratory. Definitive data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements as discussed in Sections 3.12 and 3.13 and Appendix C. Definitive data are not restricted in their use unless quality problems require data qualification, as explained in Section 14.

The QA/QC elements associated with the collection of definitive data include the following:

- Sample documentation (location, date and time collected, batch number, etc.);
- COC tracking;
- Sample design approach (systematic, simple or stratified random, judgmental, etc.);
- Initial and continuing calibration;
- Determination and documentation of detection limits;
- Analyte identification and quantification;
- QC blanks (trip, method, rinsate);
- Matrix spike recoveries;
- Performance Evaluation (PE) samples (when specified);
- Analytical error documentation (measures precision of analytical method): An appropriate number of replicate aliquots are taken from at least one thoroughly homogenized sample. The replicate aliquots are analyzed and standard laboratory QC parameters (such as variance, mean, and coefficient of variation) are calculated and compared to method-specific performance requirements; and,
- Total measurement error determination (measures overall precision of measurement system from sample acquisition through analysis): An appropriate number of duplicate samples are independently collected from the same location and analyzed following SOPs. Based upon these analytical results, standard laboratory QC parameters such as variance mean, and coefficient of variation should be calculated and compared to established measurement error goals. This procedure may be required for each matrix under investigation and may be repeated for a given matrix at more than one location at the site.

# 5 DATA QUALITY OBJECTIVES

The DQOs for each project will be summarized in the associated site-specific Work Plan or QAPP Addendum. A set of representative method quantitation limits (MQLs) for contaminants of concern and their target levels are listed by method and media in Table 5-1 through 5-3. Site specific laboratory MQLs will be included in each QAPP Addendum.

For sites at HAFB, the clean-up Target Levels for compounds in groundwater and surface water are based on New Mexico Water Quality Control Commission Regulations (20.6.2 NMAC, September 15, 2002 and 20.6.4 NMAC, October 11, 2002). Federal Primary Maximum Contaminant Levels (MCLs) (Summer 2000), are also considered for groundwater and surface water.

Soil Target Levels are based on the *Technical Background Document for Development of Soil Screening Levels* (NMED, December 18, 2000). The values for Direct Exposure for Residential, Industrial/Occupational and Construction Worker exposure are considered. The USEPA Region 9 Preliminary Remediation Goals (PRGs) for Industrial and Residential soils are also considered.

This page is intentionally blank.

# 6 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

The basis for assessing each of these elements of data quality is discussed in the following subsections. Precision and accuracy QC limits for each method and matrix are identified in Table 3-1 and Appendix C.

## 6.1 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The laboratory control samples (LCSs), single and duplicate control samples (DCSs), are used to determine the precision of the analytical method. If the percent differences of the analytes in the LCSs are within established control limits, then precision is within limits.

Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field procedures. Field duplicate samples and matrix spike duplicate samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. The formula for the calculation of precision is provided in Table 6-1as RPD. Fór replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of RSD is also provided in Table 6-1.

## 6.2 Accuracy

Accuracy is a concept from quantitative analysis that attempts to address the question of how close the analytical result is to the true value of the analyte in the sample. Accuracy is a statistical measurement of correctness. It includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement.

A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a LCS to a control limit. With some methods for organic analysis, surrogate compound and matrix spike recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of Performance

Evaluation (PE) samples shall also be used to provide additional information for assessing the accuracy of the analytical method as implemented.

The formula for calculation of accuracy is provided in Table 6-1 as percent recovery (%R) from pure and sample matrices.

## 6.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is achieved through use of the standard sampling, field, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper sample locations and field procedures (e.g., well construction, etc.).

## 6.4 Completeness

Completeness is defined as the percentage of measurements made which are determined to be valid measurements. The completeness goal is essentially the same for all data uses in that a sufficient amount of valid data is generated. It is important that critical samples are identified and valid data obtained.

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified as rejected. The requirement for completeness is 95 percent for aqueous samples and 90 percent for soil samples.

For any instances of samples that could not be analyzed for any reason (holding time violations in which re-sampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

The formula for calculation of completeness is presented below:

$$\% \text{ completeness} = \frac{\text{number of valid results}}{\text{number of possible results}} \times 100$$

## 6.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved by using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.

The objective is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms supports the assessment of comparability. Analysis of PE samples and reports from audits shall also be used to provide additional information for assessing the comparability of analytical data. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

This page intentionally blank.

# 7 DETECTION/QUANTITATION LIMITS AND CALIBRATION REQUIREMENTS

## 7.1 Detection and Quantitation Limits

The following discussion is intended to provide an understanding of the various ways that detection or quantitation limits can be reported. The term "detection limit" is frequently used without qualification. The definitions for the different types of detection and quantitation limits are provided below.

### 7.1.1 Instrument Detection Limit

The instrument detection limit (IDL) includes only the instrument portion of the detection, not sample preparation, concentration/dilution factors, or method-specific parameters. The IDL is operationally defined as three times the standard deviation of seven replicate analyses at the lowest concentration that is statistically different from a blank. This represents 99% confidence that the signal identified is the result of the presence of the analyte, not random noise. The IDL is not the same as the method detection limit. There is no formal procedure for IDL outside the USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for inorganic analysis.

### 7.1.2 Method Detection Limit

The method detection limit (MDL) is the minimum amount of an analyte that can be routinely identified using a specific method and instrument measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The estimate of detection limit may be biased low because recovery is frequently less than 100%. MDLs are operationally determined as three times the standard deviation of seven replicate spiked samples run according to the complete method. Since this estimate includes sample preparation effects, the procedure is more accurate than reported IDLs. However, the evaluation is routinely completed on reagent grade water. As a result, potentially significant matrix interferences that decrease analyte recoveries are not addressed.

When the concentration of concern (or project-specific action level) is greater than the MDL, to the extent that the confidence limits of both the MDL and concentration of concern do not overlap, then both "non-detect" and "detect" results can be used with confidence. There will be a possibility of false positives and false negatives if the confidence limits of the MDL and the concentration of concern overlap. When the concentration of concern is sufficiently less than the MDL that the confidence limits do not overlap, then there is a strong possibility of false negatives and only "detect" results are useable.

The contracted analytical laboratory shall establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use in support of environmental investigation and

restoration activities for the project. The laboratory shall revalidate these MDLs and verify with the Method Quantitation Limit (MQL) check standard when MDLs are updated, annually is the minimum frequency. The laboratory shall provide the MDL data at the beginning of the project for the applicable method as required.

Laboratories participating in any project at HAFB shall demonstrate the MDLs for each instrument, including confirmatory columns, method of analysis, analyte, and matrix (i.e., water and soil). The least sensitive MDL of each instrument/detector is used for reporting purposes. The procedures for determining MDLs are published in 40 CFR 136, Appendix B. MDL studies for each laboratory approved for use at HAFB must be reviewed by the Contractor QA/QC Manager/Chemist for the program.

### 7.1.3 Method Quantitation Limit

The MQL is defined as the lowest level that can be reliably detected within specified limits of precision and accuracy during routine laboratory operating conditions. The MQL will be set at 3 to 5 times the MDL and shall be the lowest standard used during calibration procedures for each analytical method. The appropriate factor applied to the MDL establishes the MQL which is based upon the acceptable amount of error the data user is willing to accept for the data generated. The MQL represents the value that the laboratory has demonstrated the ability to reliably quantitate target analytes within a prescribed performance criterion for the method. All results shall be reported at or above the MQL, any detection of targeted analytes at or below the MQL, but greater than or equal to the MDL, will be reported as estimated (J-flagged). The MQLs for analysis performed under this QAPP are provided in Tables 5-1 through 5-3.

### 7.1.4 Method Reporting Limits

The Method Reporting Limit (MRL) is a threshold value below which the laboratory reports results as non-detected, "<" or "ND". The MRLs may be based upon project-specific concentrations of concern, regulatory action levels or sensitivity capabilities of the method and instrumentation. The MRL is synonymous with Reporting Limit (RL).

The laboratories shall also verify MRLs by including a standard at the MQL as the lowest point on the calibration curve. The MRLs are MQLs adjusted based on the sample matrix, necessary sample dilutions, inadequate sample volume/mass and/or clean-up procedures. The MRL is also adjusted for dry weight correction based on the percent moisture found in soil and sediment samples. Soil and sediment samples containing high percent moisture will therefore have higher MRLs than samples with low percent moisture. Sample matrix effects, volume/mass, clean-up procedures, if required, and percent moisture may often elevate the MRL above project specific requirements and should be considered for each site investigation.

## 7.2 Instrument Calibration for Definitive Methodologies

Analytical instruments shall be calibrated in accordance with the analytical methods. All target analytes reported shall be present in the initial and continuing calibrations, and these calibrations shall meet the acceptance criteria specified in Table 7-1 and Appendix C. All results reported must be within the calibration range for all detected analytes. All re-analysis for matrix or dilutions must be performed within the USEPA recommended holding time for all target analytes. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards shall be traceable to standard materials.

Instrument calibration shall be checked using all target analytes specified in Tables 5-1 through 5-3 for the method employed. This applies equally to multi-response analytes (except as noted in Appendix C). All calibration criteria shall satisfy SW-846, Update III requirements and DoD Quality Systems Manual (QSM) requirements. The initial calibration shall be checked at the frequency specified in the method using materials prepared independently of the calibration standards. Multipoint calibrations shall contain the minimum number of calibration standards specified in the applicable method. Acceptance criteria for the calibration check are presented in Appendix C. Analyte concentrations are determined with either calibration curves or response factors (RFs). For gas chromatography (GC) and gas chromatography/mass spectroscopy (GC/MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five point calibration shall be used. An Initial Calibration Verification (ICV) sample shall be used as an independent source standard to verify the initial calibration curve. The ICV shall be analyzed after each initial calibration. Continuing Calibration Verifications (CCVs) shall not be used to update the RFs from the initial five point calibration. The CCVs cannot be used as the LCS.

This page intentionally blank.

# 8 QUALITY CONTROL ELEMENTS

This section presents QC requirements relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data. The philosophy of this QAPP is that the methods used need only be "appropriate" for the analytes of interest in the matrix of interest at the target action levels. The project-specific target analytes and action levels dictate the required spiking analytes and levels for QC elements such as calibration, LCSs, matrix spikes, etc. A comprehensive list of target analytes and MQLs are provided in Tables 5-1 through 5-3. If based on other data collected, i.e., similar compounds are present in the same and/or other media, additional investigation will be done. QC acceptance criteria for LCSs, surrogates, and matrix spike/matrix spike duplicates (MS/MSDs) are listed in Table 3-1.

The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements.

Laboratory QC samples (e.g., LCSs and blanks) shall be included in the "preparation batch" with the field samples. A "preparation batch" is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. Matrix spikes and matrix spike duplicates count as environmental samples.

The term "analytical batch" includes samples that are analyzed in a single procedure (e.g., volatile analyses by purge and trap). The size of the "analytical batch" is limited to those samples that can be analyzed between passing CCVs. The identity of the analytical batch shall be unambiguously reported, QC batch number, with the analyses so that a data reviewer can identify the QC samples and the associated environmental samples.

The type of QC samples and the frequency of use of these samples are discussed below and in the method-specific subsections of Appendix C.

## 8.1 Laboratory Control Sample

The LCSs are analyte-free water (for aqueous analyses) or reagents and glassware only (for soil analysis) spiked with all target analytes of interest for each analytical method. The LCS is analyzed to assess general method performance by the laboratory's ability to recover analytes from a control matrix. The spiking level must be greater than the lowest concentration standard used for calibration and less than or equal to the midpoint of the linear range calibrated (Appendix C). The LCS results are evaluated in conjunction with other related QC information to determine the acceptability of the data generated for the associated samples.

The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS cannot be used as the continuing calibration verification. One LCS shall be included in every analytical batch. The performance of the LCS is evaluated against the QC acceptance limits provided in Table 3-1. This evaluation will include the use of control charts for establishing the internal lab limits and for identifying non-conformances.

Whenever an analyte in a LCS is outside the acceptance limit, corrective action shall be performed (see Section 17). After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch shall be reanalyzed for only the out-of-control analyte(s). When an analyte in a LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the appropriate validation flag, such as those described in Tables 8-1 and Appendix C shall be applied to all affected results.

## 8.2 Matrix Spike/Matrix Spike Duplicates

The Matrix Spike (MS) is used to access the performance of the method as applied to a particular matrix. The MS and Matrix Spike Duplicate (MSD) are aliquots of samples spiked with known amounts of all target analytes. The spiking occurs prior to sample preparation and analysis. The spiking level must be greater than the lowest concentration standard used for calibration and less than or equal to the midpoint of the linear range calibration (Appendix C). Ideally, the laboratory should use the same spike solution used for the LCS (Appendix C).

Only project-specific samples shall be used for spiking. The MS/MSD is designated on the chain of custody. The MS/MSD is used to document the bias of a method due to sample matrix. These sample results should not be used to control the analytical process.

A minimum of one MS/MSD sample shall be analyzed for every 20 site samples submitted (5%).

The performance of the MS and MSD is evaluated against the QC acceptance limits provided in Table 3-1. If either the MS or the MSD is outside the QC acceptance limits, the analytes in all related samples shall be qualified using data flags such as those shown in Table 8-1 and Appendix C. If performance criteria are not being met by the MS and MSD samples, the analytical procedures and methods must be re-evaluated for appropriateness and correctness. For example, clean-up procedures may be needed to remove matrix interferences. Sampling locations selected for the purpose of assigning a MS/MSD should be an area anticipated to be free from or have low concentrations of targeted analytes. During the acquisition of soil MS/MSD samples, field personnel should avoid areas that are stained or known to have high levels of targeted materials. Similar precautions should be taken for aqueous samples; wells containing free product or having a history of high concentrations of targeted analytes should be avoided for MS/MSD.

## 8.3 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical structure and chemical behavior in the analytical process, but that are not normally found in environmental samples. The surrogate results are used to evaluate accuracy, method performance, and extraction efficiency. These surrogate compounds are spiked in environmental samples, control samples, and blank samples per the method requirements. The surrogate should be spiked at a concentration less than or equal to the midpoint of the linear range calibrated.

When the acceptance criterion of a surrogate recovery is not met, corrective action must be performed (see Section 17). Once the system problems have been resolved and system control has been reestablished, the sample is re-prepared and re-analyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Appendix C, shall be applied to the sample results. Additionally, all surrogates for all methods must yield a minimum of 10% recovery, regardless of method criteria or surrogate recovery limits based on laboratory practice. If surrogate recovery is less than 10%, the sample must be re-extracted and re-analyzed. If the surrogate recovery is less than 10% of the re-extracted and re-analyzed sample, discussion of the anomaly must be referenced in the case narrative (i.e., observed matrix interference).

## 8.4 Internal Standards

Internal standards (ISs) are known amounts of certain compounds added after preparation or extraction of a sample. These compounds are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects. ISs shall be added to environmental samples, control samples, and blanks in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Tables 13-1 and 13-2, and in Appendix C, shall be applied to the sample results.

## 8.5 Retention Time Windows

Retention time windows are used in GC and high performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in USEPA *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846, April 1998) Method 8000A.

Retention time windows are established to compensate for minor shifts in absolute retention times resulting from normal chromatographic variability. Absolute retention times are used for analyte identification in all GC and HPLC methods that do not employ internal standard calibration.

When the retention time is outside of the acceptance limits, new chromatographic columns are installed or significant changes are made to the operating conditions, then new retention time windows must be re-established. After the system problems have been resolved and system control has been reestablished, all samples analyzed since the last acceptable retention time check shall be reanalyze.

## 8.6 Interference Check Sample

The interference check sample (ICS), used in inductively coupled plasma (ICP) analyses only, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and interelement correction factors. The ICS is run at the beginning and end of each run sequence.

When the ICS results are outside of the acceptance limits as prescribed in the method, corrective action shall be performed (see Section 17). After the system problems have been resolved and system control has been re-established, the ICS shall be re-analyzed. If the ICS result is now acceptable, all affected samples shall be re-analyzed. If corrective action is not performed or the corrective action was ineffective, the appropriate validation flag, as described in Sections 3.12 and 3.13 and Appendix C, shall be applied to all affected results.

## 8.7 Method Blank

The method blank is an analyte-free matrix which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The purpose of this sample is to document contamination resulting from the analytical process. A method blank shall be included in every analytical batch.

The detection of analytes in a method blank must not exceed the MQL. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples in the preparation batch shall be re-prepared and re-analyzed. Analytical data are not corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, the appropriate validation flag, such as those described in Tables 8-1, and Appendix C, shall be applied to the sample results.

## 8.8 Source Water Blank

A source water blank is a sample of water used for decontamination of sampling equipment. Collection of source water blanks will be determined in the task-specific Work Plan addendums.

## 8.9 Equipment Blank

An equipment blank, sometimes referred to as a rinsate blank, is a sample of ASTM Type II reagent grade water poured through the sampling device and collected in a sample container for analysis. The results from these blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks shall be collected, when appropriate, once per day, immediately after the equipment has been decontaminated. Collection of equipment blanks is only required in the case of non-dedicated sampling equipment. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

When an analyte is detected in the equipment blank, the appropriate validation flag, as described in Appendix C, shall be applied to all sample results from samples collected.

## 8.10 Trip Blank

The trip blank consists of a VOA sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site with the sample containers, handled like an environmental sample and returned to the laboratory with the samples collected for analysis. These samples are not opened in the field and are submitted to the laboratory only when samples are collected for volatile analysis (VOC, BTEX, TPH-GRO, etc.).

Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation, field exposure, and storage procedures. When an analyte is detected in the trip blank, the appropriate validation flag, as described in Section 3.13 shall be applied to all sample results from samples in the cooler with that trip blank.

One trip blank will accompany each cooler of samples sent to the laboratory that contains samples for the analysis of volatile organics.

## 8.11 Field Duplicates

A field duplicate sample is a second sample collected at the same location, depth and timer interval as the original sample. These samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. For fish samples, the duplicate samples are collected from the same regions of opposite fillets. The field duplicate's sample identification is assigned an extension that identifies the sample as a field duplicate to the sample collector but is blind to the laboratory.

The results from duplicate samples are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for volatile organics is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of target volatile compounds.

The frequency of collection for field duplicates will be specified in the site-specific Work Plan or QAPP addendum.

## 8.12 Quality Assurance Sample

A QA sample, also called a field split or replicate sample, is a single sample divided into two equal parts for analysis by separate laboratories. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by the laboratory(s) personnel performing the analysis. Specific locations are typically designated for collection of field replicate samples prior to the beginning of sample collection. The sample results are used to assess precision.

If specified, field split samples will be collected at a rate of 5 to 10%. The rate of field split sample collection will be determined on a site-specific basis. The split samples will be collected from each matrix of concern where the anticipated concentrations of contaminants are near the cleanup target level (if this information is known). Split samples may be analyzed by the Environmental Chemistry Branch of the US Army Engineer Research and Development Center (ECB Lab). The LIMS number will be provided for each site. It will be included on the labels and chain-of-custody (COC) records for all field split samples shipped to the ECB Lab.

Alternately, split samples may be analyzed by a third party contract lab as determined on a site-specific basis.

## 8.13 Temperature Blank

A temperature blank (a volatile organics compounds sampling vial filled with tap water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. If the temperature of the samples upon receipt exceeds the temperature requirements, the exceedances shall be documented in laboratory records and discussed with the contractor. The decision regarding the potentially affected samples shall also be documented.

# 9 QUALITY CONTROL PROCEDURES

This section presents QC procedures relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data.

## 9.1 Holding Time Evaluation

Sample preparation and analysis shall be completed within the holding times specified for that method. The holding time begins at the time of sample collection. Some methods have more than one holding time requirement (e.g., time to extraction, time to analysis, etc.). The preparation holding time is calculated from the time of sample collection to the time of completion of the sample preparation process as described in the applicable method, prior to any necessary extract cleanup and/or volume reduction procedures. If no preparation is required, the analysis holding time is calculated from the time of sample collection to the time of completion of all analytical runs, including dilutions, second column confirmations, and any required reanalyses. In methods requiring sample preparation prior to analysis, the analysis holding time is calculated from the time of preparation completion to the time of completion of all analytical runs, including dilutions, second column confirmations, and any required reanalyses.

Field personnel will be in regular communication with the contract laboratory regarding the status of samples shipped via commercial carrier. In the event that a cooler of samples is not received on time, the sample shipment will be immediately tracked via the shipping label. Samples may be analyzed if the samples are received after the holding time has expired on a case by case basis. However, the laboratory must contact the contractor Project Manager for guidance regarding the analysis of expired samples. The contractor Project Manager will contact the USACE Project Manager regarding any expired samples. If the holding time is exceeded before the laboratory can prepare or analyze the sample, the appropriate validation flag, as described in Appendix C shall be applied to all affected samples.

## 9.2 Confirmation of Identification

Quantitative confirmation of results at or above the MRL for samples analyzed by GC or HPLC shall be required and shall be completed within the method-required holding times. For GC methods, a second column is used for confirmation. For HPLC methods, a second column or a different detector is used. The result of the first column/detector shall be the result reported. If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures as described in Appendix C.

## 9.3 Standard Materials

Standard materials, including second source materials, used in calibration and to prepare samples shall be traceable to National Institute Standards and Technology (NIST), USEPA, American

Association of Laboratory Accreditation (A2LA) or other equivalent approved source, if available. If an NIST, USEPA or A2LA standard material is not available, the standard material proposed for use shall be included in an addendum to the QAPP and approved before use. The standard materials shall be current, and the following expiration policy shall be followed:

- The expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date or one year from the date of receipt, whichever comes first.
- Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first.
- Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions.
- Expired standard materials shall be either revalidated prior to use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard.
- The laboratory shall label standard and QC materials with expiration dates.

A second source standard is used to independently confirm initial calibration. A second source standard is a standard purchased from a different vendor than the vendor supplying the material used in the initial calibration standards. The second source material shall be used only for the initial calibration verification sample. The primary source shall be used in the preparation of other QC samples (e.g., LCSs).

## 9.4 Supplies and Consumables

The laboratory shall inspect supplies and consumables prior to their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored by analysis of reagent blanks. An inventory and storage system for these materials shall assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

# 10 FIELD SAMPLING PROCEDURES

Field activities for projects may include drilling and subsurface soil sampling, surficial soil sampling, groundwater sampling, air monitoring, and soil vapor sampling. Information resulting from these investigations will provide defensible data for preparing site reports, as appropriate.

Sampling procedures, including equipment and sample collection, containerization, preservation, and documentation are presented in HAFB Standard Operating Procedures (SOPs) No. 5: *Soil Sampling for Chemical Analysis*, and No. 8: *Groundwater Sampling for Chemical Analysis.*. Sample screening to be used in the field are provided in SOP No. 6: *Procedures for Field Screening of Volatile Organics*. Decontamination procedures to be used for both sampling devices and large field equipment are presented in SOP No. 2: *Sampling Equipment Decontamination.*

## 10.1 General Considerations

Field activities affecting data quality and any deviation from SOPs will be documented. Activities affecting data quality include sample management, reagent/standard preparation, decontamination, sample collection, field measurements, equipment calibration and maintenance, and corrective action, all of which are discussed in Section 17 of this QAPP.

Where feasible, samples will be collected from areas of least contamination to those of higher contamination based on previous data where available. Analytical fractions from each sample location will be collected in order from most sensitive (i.e., volatiles) to least sensitive (i.e., metals).

## 10.2 Sample Locations

Information regarding sampling locations, frequency, and rationale will be presented in the site-specific Work Plan prepared for each investigation. Sampling locations to be surveyed will be surveyed by a professional surveyor licensed with the State of New Mexico to establish a horizontal location and elevation data for each sample point. For sample locations within visual contact with an established benchmark, the elevations of the ground surface will be determined to within 0.01 feet. Surveyed horizontal control will utilize NAD 1983 UTM and surveyed elevations will be referenced to Mean Sea Level (MSL) (National Geodetic Vertical Datum of 1929).

## 10.3 Decontamination, Containerization, and Preservation

Prior to collection of any environmental sample, sampling equipment must be decontaminated according to the procedures outlined in SOP No. 2 to avoid cross contamination of samples. The use of reagent grade nitric acid as part of the decontamination process will be employed only

when high levels of metals contamination are encountered. If nitric acid is required, its use must be documented by field personnel on the COC on a per sample basis.

Sample containers will be furnished by the laboratory or will be supplied by a commercial laboratory supply vendor. Sample containers will be pre-preserved at the laboratory when applicable. Preservation requirements of each analytical method for each matrix can be found in Table 10-1.

Samples collected for VOCs analyses will be poured into pre-preserved vials and capped immediately. Any occurrence where samples appear to react with the preservative, or require additional preservative will be noted and logged in the sampling personnel's field logbook, and reported on the chain of custody form.

## 10.4 Sampling Procedures

Tables detailing the sampling scheme for each site will be included in the site-specific Work Plans. The table will specify the number of samples by media, analytical parameters, and QC samples to be collected at each site. This sampling plan will be designed to obtain representative data.

Table 10-1 outlines the specific sample volume, sample containers, preservation requirements, and holding times required for each analytical method.

## 10.5 Field Documentation

Sampling personnel will record, in a permanently bound field log book, the preparation activities that may be pertinent to the sampling event at each sampling location. For soil sampling, this documentation may include information on the presence of surface staining, water logging or ponding; proximity to roads or waste piles; apparent upgradient physiographic or hydrogeologic features of significance; background volatile vapor concentrations; the depth the samples were collected from; and the drilling method, equipment, and materials (such as drilling mud) that were used to construct the boring, to the degree that this information is known by the sampling personnel.

For groundwater sampling, field documentation may include the well construction materials and diameter of the riser pipe; the observed integrity of the well at the surface; the volatile vapor concentrations in the well riser, breathing zone, and background; total depth of the well, the water level, and water column volume; presence of any light, non-aqueous phase liquid; the calculated well purge volume and actual volume purged; and the field monitoring results of purge water (pH, specific conductance, DO, turbidity, redox, and temperature).

For surface water sampling, this documentation may include the volatile vapor concentrations in the breathing zone and background; presence of a light, non-aqueous phase liquid; depth sample

was taken; type of water (quiescent or moving); and the field results of the surface water (pH, specific conductance, and temperature).

For sediment sampling, this documentation may include information on presence of staining; proximity to roads or waste piles; apparent upgradient physiographic or hydrogeologic features of significance; background and sample vapor concentrations; the depth the samples were collected from; and equipment and materials that were used to collect the samples.

### 10.5.1 Field Log Book

Sampling personnel will use a bound field log book with moisture resistant pages to record pertinent sampling information with waterproof ink. The log book will identify project name, project number, project manager and telephone number, and principal street address or geographic location of the site. Daily field activities and sampling information will be entered in the log book on dated, initialed, and serially-numbered pages. Corrections will be made to entries by initialed and dated line-out deletions. A diagonal line will be drawn across the remaining blank space of the last page of each day's entry. Each day's entry will be signed and dated by the author.

The date and time of sample preparation, collection and personnel who conducted sampling will be recorded with the sample identification number in the field log book and on the COC form. The names of visitors and any other persons on site will also be recorded in the field log book. Sampling personnel will record the ambient weather conditions and other conditions at the sampling location that may affect sample collection, the apparent representativeness of the sample, or sample analysis.

## 10.6 Data Management

Data management involves maintaining and controlling field data, laboratory analytical data, and any other data relevant to the project. Bound field log books will be used for recording field data. This project will have dedicated field log books which will not be used for other projects. Entries in the field log book will be dated and the time of entry will be recorded. Sample collection data as well as visual observations will be documented in the field log book. Any sample collection equipment, field analytical equipment, and equipment used to make physical measurements will be identified in the field log book. Calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment will also be recorded. Once completed, the field log book will become part of the project file.

# 11 SAMPLE CUSTODY

Sample collection and sample custody are designed so that field custody of samples will be fully and continuously maintained and documented. These procedures provide complete identification and documentation of the sampling event and the sample COC from shipment of sample bottleware, through sample collection, to receipt of the samples by the subcontracted laboratory. When used in conjunction with the laboratory's custody procedures and the sample bottleware documentation, these procedures will establish full legal custody and allow complete traceability of a sample from preparation and receipt of sample bottleware to sample collection, preservation, and shipping, through laboratory receipt, sample analysis, and data validation.

## 11.1 Sample Identification

The sample identification (ID) format contains specific information about the sample matrix and location. Each sample is sequentially designated according to site, matrix, and location. Additional designation letters and numbers will be used to denote sample depths or identify QC samples. Prior to collecting each sample, the sample containers will be labeled with the following information: date and time, sample ID, sampling personnel, preservatives (if any), and analytical parameters. All information pertaining to a particular sample is referenced by the sample ID which is recorded on the sample bottle(s), in the field log book, and on the Chain of Custody Report form (Appendix D). The sample ID format is discussed below.

Sample ID will include the following sections in this order:

1. Site type designation (i.e., LF, SS, etc) followed by the number of the AOCs, SWMU, or UST site (Section 11.1.1);

2. Sample type designation (i.e., soil boring, monitoring well, etc.) (Section 11.1.2);

3. Sample location or sequence number, two digits;

4. For soil samples or discrete groundwater samples (e.g., hydropunch), sample ending depth, in feet (Section 11.1.3); and

5. QC extension (if applicable).

### 11.1.1 Site Type Designations

The site type designations are as follows:

- ES - Excavation Site

- LF - Landfill

- MBS - Munitions Burial Site
- SS - Surface Spill
- ST - Storage Tank
- TA - Target Area
- WP - Waste Pit
- OT - Other

### 11.1.2 Sample Type Designations

The sample type designations (item 2 above) are as follows:

- MW - Monitoring Well
- TW - Temporary Well
- PZ - Temporary Piezometer
- RW - Recovery Well
- PW - Private Well
- HC - Hydrocone
- HP - Hydropunch
- SP - Spring Water
- SW - Surface Water
- SD - Sediment
- SB - Soil Boring
- SL - Sludge
- ST- Storm Water
- TS- Tissue sample
- WS- Waste

- WW- Waste Water

### 11.1.3 Sample Depth Designations

All soil samples collected from a monitoring well boring will have the monitoring well designation followed by the sample ending depth (groundwater samples will not contain a sample depth designator). If surface soils and subsurface soil samples are collected from the same location, all samples will be designated "SB" and can be distinguished by the sample interval (the surface soil depth indicator will be "-1" or "-0.5").

### 11.1.4 QC Extensions

QC samples are denoted by adding a QC extension at the end of the sample ID (item 5 above). The extensions are as follows:

| Order | Extension | Description |
|---|---|---|
| 1 | dis | dissolved phase (field filtered) |
| 1 | s | field screening |
| 2 | a | field duplicate |
| 2 | b | field split (to quality assurance lab) |
| 2 | c | trip blank |
| 2 | d | rinsate or equipment blank |
| 2 | e | field blank |
| 3 | ms | matrix spike |
| 3 | msd | matrix spike duplicate |
| 3 | f | blind regulatory performance evaluation sample |
| 3 | g | water used for decontamination, blank collection, etc. |

If multiple quality control extensions are required, list in the order specified above, separated by a comma.

Sample ID examples are provided below.

## 11.2 Sample Types

### 11.2.1 Soils

Soil samples collected from a soil boring, geocone, hand auger, etc., are identified with the matrix designation -SB and from a monitoring well installation boring are identified with the matrix designation -MW. These qualifiers are preceded by the Site ID number and are followed by a sequential sampling location number corresponding to either the soil boring location or the monitoring well location and the sample depth in feet. Soil boring location numbers will begin with -01 (i.e., SS60-SB01) at each site and continue consecutively for additional soil boring locations at that site.

For example, a soil sample collected at Site SS-60 from well boring MW-10 at a depth of 0 to 2 feet would be denoted as:

- SS60-MW10-2

QA/QC samples will use the same ID scheme, with the appropriate extension included in the sample code field. For example, a duplicate soil sample collected at Site SS-60 from soil boring number 2 at a sample interval of 0 to 2 feet would be as follows:

- SS60-SB02-2-a

### 11.2.2 Sediment

Sediment samples are denoted with the location designation -SD, preceded by the Site ID number and followed by the sediment location number and sampling depth (i.e., "0.5"). The sediment location number at a given site begins with -01 and continues consecutively for additional sediment samples at the site. QA/QC samples will be labeled in the same manner as soils, with the appropriate extension included at the end of the sample ID. For example, the third sediment sample collected at Site SS-60 would be identified as:

- SS60-SD03-0.5

The QA split sample for this location would be:

- SS60-SD03-0.5-b

### 11.2.3 Surface Water

Surface water samples are designated by -SW-, preceded by the Site ID number and followed by the surface water sample number. The surface water location number at a given site will be the

same as the sediment sample number at the same location. QA/QC samples will be labeled in the same manner as soils, with the appropriate extension in the sample code field number. For example, the surface water sample collected from the second location at Site SS-60 would be identified as:

- SS60-SW02

The QA/QC rinsate blank for this sample would be:

- SS60-SW02-d

### 11.2.4 Monitoring Well Groundwater

Groundwater samples collected from a monitoring well are designated by -MW, which denotes a monitoring well, preceded by the appropriate Site ID number and followed by the monitoring well number. Monitoring well numbers at a site will begin with -01 and continue consecutively.

For example, a groundwater sample collected from well MW-14 at Site SS-60 would be identified as:

- SS60-MW14

A duplicate sample from this well would be:

- SS60-MW14-a

### 11.2.5 Field Screening

Field screening samples collected during this project may be analyzed with immunoassay test kits, GC unit, mobile laboratory, etc. Field screening tests may be conducted on any media (i.e., groundwater, soil, sediment, etc.). Therefore, in order to track a laboratory analytical sample with its associated field screening sample, the field screening sample ID will include all of the ID components discussed above, followed by the sample code "s". For example, a field screening sample collected of soil collected at Site SS-60 from well boring MW-14 at a sample interval of 23 to 25 feet would be denoted as:

- SS60-MW14-25-s

A field screening sample of groundwater collected from well MW14 at Site SS-60 would be identified as:

- SS60-MW14-s

## 11.3 Documentation

The sample identification number will be logged in the field log book along with the following information:

- Sampling personnel
- Date and time of collection
- Field sample location and depth (if appropriate)
- Observations on ambient conditions
- Type of sampling (composite or grab)
- Method of sampling
- Sampling matrix or source
- Results of field screening
- Intended analyses
- Preservation method
- Observations of significant characteristics of the sample
- Observations of any significant changes to the sampling procedure

Once the soil or water sample has been collected, steps must be taken to preserve the sample's chemical and physical integrity during storage and transport prior to analysis. Inclusion of a COC form (Appendix D) in each cooler containing samples will document that the integrity of the samples has been maintained during transport. The COC form should be completed as the samples are collected. Because the information included on the COC form may be entered into the Environmental Resources Program Information Management System (ERPIMS) database, it is important that these procedures are followed so that valid ERPIMS information is generated. The following fields should be completed on the COC by the field crew:

- Project/Location
- Client Name
- Collected By

- Contractor Project No. and WBS Code
- Contractor Project Name
- COC Number
- Sample ID
- Date
- Time (on 24-hour clock)
- Type of Sample Collection (mark Composite, Grab, or Well)
- Sample Information
- # of Containers
- Sample Analysis (Including Method Number)
- Comments (Specify sample Matrix)
- Custody Transfers Prior to Receipt By Laboratory
- Sample Delivery Details (except Lab Recipient/Date/Time)

## 11.4 Field Custody Procedures

Field custody procedures are described below as two groups: (1) sample collection procedures that document the bottleware, sample identification, sampling personnel, sample collection procedures, sample preservation, and ambient conditions during sampling activities; and (2) sample shipment procedures that document handling, packing, and shipping of samples to the laboratory.

The persons responsible for sample custody, and a brief description of their duties, are:

- Laboratory Representative or Commercial Supplier - verifies that the bottleware is certified clean; arranges for bottleware shipment to field sampling personnel.
- Equipment Manager - receives and stores bottleware that is shipped from a laboratory or a commercial supplier; relinquishes bottleware to field sampling personnel; initiates COC from bottleware in storage.

- Field Staff - receives sample bottleware from laboratory commercial supplier; inspects bottleware for physical integrity; retains bill of lading from shipping courier as documentation of transfer of bottleware; records manufacturer and lot number of bottleware for each sample; collects and preserves samples; retains bottleware and samples under custody until sample shipment; relinquishes samples to shipping courier or to laboratory representative.

- Project Manager - Verifies reported laboratory analyses to the sample COC form; assures that COC documentation is incorporated into the project file.

## 11.4.1 Sample Collection

The following procedures will be conducted during sample collection activities, and will be recorded in a project field log book and on the sample COC form (Appendix D).

### 11.4.1.1 Sample Containers

Field personnel will use sample containers furnished by the subcontracted laboratory or a commercial supplier. They will verify that the laboratory is utilizing approved cleaning or that the commercial supplier furnishes laboratory grade, certified clean containers. The source of sample containers used in the sampling event will be recorded in the project field log book for each sample collected. Sample bottles provided to the client by the laboratory will be transported under proper custody. When bottleware is shipped directly from the supplier to the field, a formal COC will not normally be initiated, however, manufacturers certificates of analysis provided with the bottleware will be maintained with the project/site file. In this instance, the airway bill receipt or packing slip will serve as the initiation of COC and will be maintained as a custody record.

### 11.4.1.2 Sample Location, Sample Media, and Intended Parameters

The specific sampling location of each sample will be recorded with each sample ID number in the field log book. Sampling locations will be referenced to a site location map in the QAPP addendum for each project. Other location references may be distance and bearing from a prominent landmark.

The type of sample media will be recorded with the sample ID number in the field log book and on the COC. Laboratory analyses to be conducted on the sample will be recorded with the sample identification number in the field log book and on the COC.

### 11.4.1.3 Date, Time, Personnel, and Ambient Conditions

The date and time of sampling preparation and collection along with the sample personnel are recorded with the sample identification number in the field log book and on the COC. The names of visitors and any other persons on site are also recorded in the field log book. Sampling

personnel also record in the field log book the ambient weather conditions and other conditions at the sampling location that may affect sample collection, the apparent representativeness of the sample, or sample analysis.

#### 11.4.1.4 Preliminary Sampling Activities

Sampling personnel will record the preparation activities that may be pertinent to the sampling event at each sampling location in the field log book.

#### 11.4.1.5 Sample Collection

Sampling personnel will record the type of equipment used to purge and conduct sampling, the order of sample collection (typically from most sensitive to least sensitive parameter), field screening results measured during sample collection (such as vapor headspace readings of soil samples), special collection procedures, and aberrations to sampling procedures. The contents of all sample containers will be preserved in the field at the time of collection in the field log book. Duplicate QC samples, as described in Section 7.12, will have the same information recorded in the field log book.

During sample collection, field personnel will wear new, clean disposable gloves for each sampling location. Care will be taken to prevent contact of the sample with the gloves. Sample collection will be done in accordance with SOP Nos. 4, 5, and 8. After each sample is collected, the sample will be labeled by completing and affixing the sampling tag. Labels will be completed using waterproof ink. The following information will be included on the sample label:

- Initials of collector
- Date and time of collection
- Location of collection
- Analysis required
- Sample identification
- Preservative (if any)

Following collection of the sample, the sample identification number and other information on the sample label will be verified against the entry in the field log book. Sample ID number, time, and date of collection will be recorded on the COC form. The sample label will be covered with clear tape to prevent deterioration by water.

Following sample labeling verification, the sample will be placed in a cooler with ice and be maintained in the sampler's presence or in a secure location for the remainder of the daily

sampling activities, or until custody is transferred to another responsible party. A sample is considered to be in a person's custody whenever it is in a person's physical possession, when it is in view of the sampler or responsible party, or when it is in a secure location. Custody of a sample is also maintained when the sample is shipped in a container that is properly sealed against tampering, with custody seals.

#### 11.4.1.6 Quality Control Sample Collection

Information on QC samples will also be recorded in the field log book, on the sample bottleware label, and on the COC. Duplicate and split samples, if required, will have the same information recorded in the field logbook as a regular sample. Trip blanks will have most of this same information recorded, with the exception that sample location, sample screening, and preliminary activities will not be applicable. The trip blank will also be referenced to the actual samples that it will accompany in shipment and handling.

## 11.5 Sample Management

The following procedures will be conducted during sample handling and shipping, and will be recorded in the project field log book, sample COC form, and Analytical Request form, as indicated below. Common carrier documents will be maintained by the Project Manager as custody records.

### 11.5.1 Sample Packing

Samples will be immediately packed for shipping in waterproof ice chests or coolers. The sample containers may be individually sealed in self-sealing plastic bags prior to packing in the cooler with bubble wrap packing to prevent breakage during shipment. All volatile samples should be packed together when possible to minimize the number of Trip Blanks required. Wet ice, double-bagged in self-sealing plastic bags (to inhibit cross contamination of samples by meltwater) will be placed with the samples in the cooler to maintain the samples at a temperature of 4° C during shipping. Prior to shipment, any melted ice will be drained from the bags and fresh ice will be added.

One or more COC forms (Appendix D) that identifies the samples for each cooler will be signed as "relinquished" by the principal sampler or responsible party. The form will be sealed in a waterproof plastic bag and will be placed inside the cooler, typically by taping the bag to the inside lid.

Following packing, the cooler lid will be sealed with strapping tape. Two custody seals will be signed and dated, affixed about two corners of the cooler (across the seal of the lid), and additionally covered with clear tape. All coolers shall be labeled in accordance with U.S. Department of Transportation regulations and cooler to be shipped by air transport shall also meet International Air Transport Association rules.

### 11.5.2 Sample Shipping

The sample coolers will typically be shipped by overnight express carrier to the laboratory. No sample will be retained on site for more than 48 hours. Encore™ samples for soil VOCs will be shipped the day of collection. A copy of the bill of lading will be retained within the project file and will become part of the sample custody documentation. Concurrent with shipping, the sampler will telephone the laboratory that will receive the samples.

## 11.6 Laboratory Custody Procedures

Upon receipt by the laboratory, samples will proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

All samples received by the laboratory will be carefully checked for label identification and completed, accurate COC records. The sample temperature will be measured upon arrival by measuring a temperature blank that will be shipped with the samples. Each sample will then be assigned a unique laboratory ID number through a computerized Laboratory Information Management System (LIMS) that stores all identifications and essential information. The LIMS system will track the sample from storage through the laboratory system until the analytical process is completed and the sample is properly disposed of. Access to the laboratory is restricted to prevent any unauthorized contact with samples, extracts, or documentation.

This page intentionally blank.

# 12 CALIBRATION PROCEDURES

Calibration procedures for the field and laboratory equipment are described below.

## 12.1 Laboratory Instruments and Equipment

Calibration procedures depend upon the reference material and the type of equipment used to make the analytical measurements. These procedures have specific criteria for evaluating a successful calibration. Sample analysis must not proceed without successful calibration. The project final report will clearly justify the acceptance of any sample data obtained from a measurement system which had not demonstrated acceptable calibration. Any data reported from such a system, which cannot be clearly justified, must be flagged as suspect in all data tables and fully discussed in the report.

All reference material used to calibrate analytical systems comes from sources that attest to the purity and identity of the material. For standard USEPA analyses (e.g., metals, GC, HPLC and GC/MS), certified solutions are purchased for instrument calibration.

Specific calibration procedures are provided in Appendix C.

## 12.2 Field Procedures

Field screening equipment will also be used to screen samples prior to shipment and analysis by the laboratory. These field screening instruments include pH meters, Eh meter, specific conductance meters, turbidity meters, salinity meters, thermometers, DO meters, PIDs, ORPs explosimeters and Ovals. The brands and model numbers of these instruments are described below in conjunction with the calibration procedures. Serial numbers corresponding to the instrument used in the field will be recorded in the field log book. All equipment will be decontaminated in accordance with SOP No. 3 prior to its use in the field.

### 12.2.1 Field Equipment Standards

Field equipment calibration standards are received, stored, prepared, and used following procedures that allow tracing of the standard from suppliers, through storage and preparation, to instrument calibration and use of the instrument in the field.

Small amounts of standards for field instruments are received directly from the equipment manufacturer, analytical laboratory, or commercial laboratory supplier on an as-needed basis. Standards are received either pre-prepared or are prepared as needed, typically in association with instrument calibration. These standards are stored according to the supplier's specifications, with the lot number or supplier's identification number, the date that the standard was received, and the expiration date of the standard written on the standard storage container. This procedure references the standards to specific lots of the supplier. When the instrument is

calibrated, the standard's lot number or product identifier, expiration date, and preparation date is recorded in the instrument log book. This procedure references instrument calibration to a specific standard and date of standard preparation.

### 12.2.2 Field Equipment Calibration Procedures

Calibration procedures for the each of the field instruments to be used are described below. Calibration frequencies and acceptance/rejection criteria are shown in Table 7-1.

#### pH-meter

The pH meter should be allowed to equilibrate with ambient temperatures, and then be calibrated using two pH points, either pH 4 and 7, or pH 7 and 10, whichever interval will bracket the pH of the sample collected.

#### Combination meter

#### Horiba Water Quality Checker U-10 or Equivalent

This instrument can be used to measure pH, ORP, conductivity, turbidity, and temperature. Temperature is not to be calibrated except by the manufacturer. The calibration procedures for other parameters are provided below. This is a 4-parameter auto-calibration procedure.

1. Fill the calibration beaker to about 2/3 with the standard solution. Note the line on the beaker. Make sure the rubber probe cover is removed.

2. Fit the probe over the beaker.

3. With the power on, press the MODE key to put the unit into the MAINT mode. The lower cursor should be on the AUTO sub-mode; if it is not, use the MODE key to move the lower cursor to AUTO.

4. With the lower cursor in AUTO, press the ENT key. The readout will show "CAL". Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one-by-one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show "END" and then will switch to the MEAS mode.

5. The upper cursor will blink while the auto-calibration is being made. When the auto-calibration is stabilized, the upper cursor will stop blinking.

6. After calibration, the DO reading for a reference solution such as sodium sulfate should be checked to insure that the meter can read in the less than 1 mg/L range.

## Turbidity Meter

### 2100P – Hach Turbidity Meter

The 2100P – Hach turbidity meter should only be calibrated by a qualified technician. However, three turbidity standards should be measured, and their values recorded in the 2100P – Hach turbidity meter log book prior to use each day.

## DO Meter

### YSI DO Meter

Air calibration is the quickest and by far the simplest calibration technique for the YSI DO meter. It is shown to be an effective method of calibration and is the manufacturer recommended technique. Air calibration for the YSI DO meter is as follows:

1. Place a moist sponge or towel into the calibration chamber.
2. Place the probe into the calibration chamber, and allow the meter to stabilize. Usually about 15 minutes.
3. Press both up and down keys simultaneously.
4. At this time, the display will ask for elevation. Enter elevation to the nearest 100ft using the up and down arrows.
5. Press Enter Button.
6. Press Mode Button.
7. At this time, the display will ask for salinity. Enter salinity to the nearest percent using the up and down arrows.
8. Press Enter Button.

At this time the YSI DO meter is calibrated and ready for use.

## Organic Vapor Analyzers (OVAs)

### Foxboro OVA or Equivalent

The Foxboro OVA Flame Ionization Detector (FID) should be calibrated by a qualified service technician every six to nine months. Field calibration using methane gas is conducted daily during use according to procedures provided by the manufacturer.

**Photoionization Detectors (PID)**

**HNu PID or Equivalent**

The HNu PID should be calibrated by a qualified service technician every six to nine months. Field calibration using methane gas is conducted daily during use according to procedures provided by the manufacturer.

**Explosimeter**

**Industrial Scientific Model HMX 270 or 271 or Equivalent**

The Industrial Scientific Model HMX 270 or 271 is calibrated whenever the instrument is serviced by the manufacturer or licensed representative. The instrument is calibrated daily during use. Procedures for this daily calibration are included in the operating instructions.

### 12.2.3 Field Equipment Calibration Frequency

Calibration frequencies and acceptance/rejection criteria are shown in Table 7-1. At a minimum, calibration and maintenance intervals for field instruments will be those recommended by the respective manufacturers, unless experience dictates a shorter interval. When the manufacturer does not specify a calibration interval for the equipment, the interval shall be established in writing by the user of such equipment and approved by the QA Task Manager. Adherence to the calibration schedule is mandatory. The fact that these calibrations may be performed by an outside source does not exempt the user from the responsibility for identifying, monitoring, and controlling calibration intervals and ensuring that maintenance checks are made on time.

Documentation of field instrument calibrations will be the responsibility of the Field Task Manager. All calibration records shall be maintained in the field log book. In addition, the following information shall be recorded in the log book:

- Equipment type (e.g., pH meter),
- Manufacturer and model number,
- Serial number,
- Recommended calibration frequency,
- Date of latest calibration,
- Dates of field measurement (use),
- Name of person who calibrated instrument,

- Calibration standards used, and
- Source of calibration standards.

Entries in the log book will be made at the beginning of each sampling or measuring effort and when each instrument is calibrated.

This page intentionally blank.

# 13 ANALYTICAL METHODS AND PROCEDURES

The philosophy of this QAPP is that the analytical methods and procedures used need only be "appropriate" for the analytes of interest in the matrix of interest at the regulatory level or target action level of interest. For example, given the diversity to which SW-846 Methods may be used, the methods do not contain the degree of specific QC criteria and specifications that are characteristic of the USEPA CLP methods. Rather the QC criteria develop out of the DQOs for the specific project.

The general DQOs for this program are summarized in Table 3-1. Project-specific DQOs will be provided in the project-specific Work Plan.

This QAPP provides a summary of analytical methods and procedures that may be applicable to the program but not to all projects. Tables 13-1 and 13-2 provide lists of preparation and analytical methods that may be applicable to this program. Site-specific Work Plans shall define in more detail the relevant analytical methods and procedures. A key consideration in selecting the proper analytical methodology is that the desired quantitation limit can be achieved with matrix interferences. Along with the chemical constituents, all biological tissues will be analyzed for lipids and percent moisture.

All geotechnical testing will be conducted in general accordance with standards of the ASTM. Geotechnical parameters to be analyzed include grain size distribution (ASTM D421 and D422), moisture content (ASTM D-2216) and Atterberg Limits (ASTM D4316).

## 13.1 Definitive Data

Table 3-1 contains QC Acceptance Criteria, and Appendix C contains tables that include calibration procedures, QC procedures, and data validation requirements for definitive data. Extraction and digestion procedures for liquid and solid matrices presented in this section are outlined in Table 3-8. The analytical procedures presented in this section are outlined in Table 11-2

This information was obtained from the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (USEPA SW-846, Third Edition, and its third update); *USEPA Guidance for Quality Assurance Project Plans*, USEPA, Office of Research and Development, Washington, D.C., EPA/240/R-02/009, December 2002; *USEPA Requirements for Quality Assurance Project Plans*, USEPA, Quality Assurance Division, Washington, D.C., USEPA QA/R-5, March 2001; *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, USEPA, Office of Solid Waste and Emergency Response, Washington, D.C., EPA 540-R-01-008, July 2002; and *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, USEPA, Office of Solid Waste and Emergency Response, Washington, D.C., EPA-540/R-99-008 (PB99-963506), October 1999. Data review guidelines are presented in Section 13.

The tables in Appendix C provide the calibration and QC procedures for each method. Corrective actions and data flagging criteria are also included in these tables. The first column lists the method-required calibration and QC elements. The second column designates the minimum frequency for performing each calibration and QC element. The third column designates the acceptance criteria for each calibration and QC element. The fourth column designates the corrective action in the event that a calibration or QC element does not meet the acceptance criteria. The last column designates the data flagging criteria that shall be applied in the event that the method-required calibration and QC acceptance criteria are not met.

## 13.2 Field Screening

Field screening of pH, specific conductance, turbidity, DO, Eh, and temperature of groundwater and surface water samples will be conducted at a minimum. At some sites such as petroleum sites, volatile vapor headspace will be conducted on soil samples. Field screening QA objectives are shown in Table 13-3. Specific field screening procedures for volatile organics are described in SOP No. 6.

# 14 DATA REDUCTION, REVIEW, VERIFICATION, VALIDATION, REPORTING AND RECORD MANAGEMENT

Data reduction, review, validation, and reporting procedures are provided below to ensure: (1) minimization of transcription and data reduction errors, (2) review of all data and documentation of review, (3) document management, and (4) appropriate qualification of the reported results. Laboratory data reduction, review, and verification procedures are required to ensure the overall objectives of analysis and reporting meet the DQOs.

## 14.1 Data Review, Validation, and Reporting Requirements for Screening Data

The data reviewer shall perform a review of the definitive data in accordance with the specifications and requirements of the QAPP addendum or site specific Work Plan. The data reviewer, percentage of the data to be reviewed, and the level or review required will be specified on a project by project basis. The calibration, QC requirements, and corrective action requirements are provided in Section 11 and Table 8-2. The data packages for screening data shall include at least the following:

- sample ID number
- preparation method
- analysis method
- detection limits
- identity and quantity of analyte(s) present
- date and time of sample collection
- date of sample analysis

The data reviewer shall review the entire screening data report package with the field records. The data reviewer shall determine if the DQOs have been met and shall calculate the data completeness for the project.

## 14.2 Data Review, Validation, and Reporting Requirements for Definitive Data

The data reviewer shall perform a review of the definitive data in accordance with the specifications and requirements of the QAPP addendum or site specific Work Plan. The data reviewer, percentage of the data to be reviewed, and the level or review required will be specified on a project by project basis. The calibration, QC requirements, corrective action requirements, and flagging criteria required for definitive data are provided in Appendix C. The flagging criteria are applied when acceptance criteria were not met and corrective action was not

successful or not performed. The data packages for definitive data shall include at least the following:

(1) Cover Sheet. The cover sheet should specify the following information:
- name and location of laboratory
- contract number
- project name & site location
- statement of data authenticity and official signature of release

(2) Table of Contents. Laboratory data packages should be organized in a format that allows for easy ID and retrieval of information. An index and/or table of contents should be included for this purpose.

(3) Case Narrative. A case narrative should be included in each report, outlining any problems with analysis. The case narrative should also list all methods used. The case narrative should contain a table correlating field sample numbers and laboratory sample numbers, and indicate which analytical test methods were performed and by which laboratories. Samples that were received but not analyzed should also be identified. Extractions or analyses that are performed out of holding times should be appropriately noted. The case narrative should define all data qualifiers or flags. Deviations of QC sample results from laboratory acceptance limits should be noted and associated corrective actions taken by the laboratory should be addressed. Any other factors that could affect the sample results (e.g., air bubbles in VOC sample vials, excess headspace in soil VOC containers, the presence of multiple phases, inappropriate sample temperature, pH, container type or volume, etc.) should be discussed.

(4) Analytical Results. The results for each sample should contain the following information at a minimum:
- project name and unique ID number
- field sample ID number as written on custody form
- laboratory name and location (city and state)
- laboratory sample ID number
- preparation and analysis batch numbers
- date sample collected
- date sample received
- date sample extracted or prepared
- date sample analyzed
- analysis time when holding time limit is less than forty-eight hours
- method numbers for all preparation and cleanup procedures
- analysis procedure including method numbers
- analyte or parameter

- detection limits (DL) - Estimated sample detection limits based on method detection limits adjusted for sample-specific factors (*e.g.,* aliquot size, dilution or concentration factors, moisture content of a soil or sediment)
- quantitation limits (QL)
- analytical results with correct number of significant figures (Results for solid matrices should be reported on a dry weight basis)
- concentration units
- dilution factor: All reported data shall reflect any dilutions and/or concentrations. The dilution factor, if applicable, should be noted on the analytical report. If dilution is required for organic analytes, data from both runs should be recorded and reported.
- matrix (soil, water, oil, etc.)
- percent moisture or percent solids
- chromatograms, as needed
- sample aliquot analyzed
- final extract volume
- sample preservation

(5) Lower Limit Reporting. The laboratory may use a reporting limit (RL) expressed in terms of DL, QL, regulatory action level, or project-specific threshold limit, however the laboratory's use of these terms must be well defined. In addition, if the non-detect "ND", "U", "<", or other lower limit reporting convention is used, then these terms must also be defined.

(6) Sample Documentation. Original COC record, shipping documents, and sample cooler receipt forms should be attached to each data package.

(7) QC/QA Information. The minimum data package must include internal laboratory QC/QA data with their respective acceptance criteria. The data package should also include the laboratory's method detection limits for project-specific parameters. The data package should correlate the method QC data with the corresponding environmental samples on a per batch basis. Method QC data include all spike recoveries, including surrogate spike recoveries; all measures of precision, including relative percent difference (RPD); and all control limits for accuracy and precision. This would include laboratory performance information such as results for method blanks (MBs), recoveries for Laboratory Control Standard (LCS) and Laboratory Control Standard Duplicate (LCSD), RPD for LCS/LCSD pairs, and recoveries for QC sample surrogates; and matrix-specific information such as sample duplicate RPDs, MS and MSD recoveries, MS/MSD RPDs, and field sample surrogate recoveries, serial dilutions, and post-digestion spikes. At a minimum, internal QC samples should be analyzed and reported at rates specified in the specific methods or as specified in the contract, whichever is greater. Any deviations from the control limits should be noted. For example, the data package should document the matrix spike(MS) and duplicate spike level, the MS and duplicate spike sample result, the percent recovery of the MS and duplicate, the respective RPD, and the acceptance criteria for spike recovery and RPD.

If specified by the QAPP Addendum, the Definitive Data will be reported in a Comprehensive Data Package. A comprehensive data package contains sufficient information to completely reconstruct the analyses that were performed. Hence, comprehensive data packages include all batch QC results, instrument QC results (e.g., initial calibration verification and continuing calibration verification), method detection limit studies, and raw data (e.g., run logs, sample preparation logs, standard preparation logs, and printed instrumental output such as chromatograms). Typically, comprehensive data packages are required if third-party data validation is to be performed.

### 14.2.1 Laboratory Turn-Around-Time

The routine turn-around-time for all laboratory analytical results will be 21 calendar days. Special requirements for quicker turn-around-time will be addressed in the site specific Work Plan or QAPP Addendum

### 14.2.2 Laboratory

All analytical data generated by the laboratory are extensively reviewed prior to report generation to assure the validity of the reported data. At the laboratory, the data validation process consists of data generation, reduction, and documented reviews. In each stage, the review process is documented by the signature of the reviewer and the date reviewed.

The laboratory analyst performing the tests shall review 100 percent of the definitive data. After the analyst's review has been completed, 100 percent of the data shall be reviewed independently by the laboratory supervisor of the respective analytical section using the same criteria. After the first and second level of laboratory data reviews have been performed, "Result" data qualifiers shall be added by the laboratory supervisor of the respective analytical section. Case narratives shall be added to the first page of the report certificates to explain any nonconformance or other issues. An example of the data qualifiers and their definitions are shown in Table 8-1. Any deviation from the data qualifiers shown in Table 8-1 will be identified and defined in the site specific QAPP Addendum.

The laboratory QA section shall review 10 percent of the completed data packages, and the laboratory project manager shall perform a completeness check review on all the completed data packages.

### 14.2.3 Contractor Reduction, Validation, and Reporting

The contractor Project Chemist shall review the entire definitive data report package and with the field records, apply appropriate final data qualifiers for the definitive data. The laboratory shall apply data qualifying flags to each environmental field QC sample, e.g., ambient blanks, equipment blanks, trip blanks, field duplicates, MS samples, and MSD samples. The contractor Project Chemist shall review the field QC samples and field logs, and shall then appropriately

flag any of the associated samples identified with the field QC sample, using the procedures and guidance of the USEPA *National Function Guidelines for Inorganic Data Review* and *National Function Guidelines for Inorganic Data Review*. The analytical data documented in project reports will be presented in "mg/kg" for solid matrices and "µg/L" for aqueous matrices.

## 14.3 ERPIMS Data Reporting

The ERPIMS is a relational database maintained by the AFCEE to store and manage data collected (historical or current) for the Air Force ERP projects. ERP projects generate technical reports containing large volumes of hydrogeological and chemical data that are difficult to manage with manually maintained systems.

All data to be maintained by ERPIMS will be submitted in formats that meet ERPIMS requirements described in the ERPIMS Data Loading Handbook (Version 4.0) for data entry. In accordance with this handbook, an ERP Contractor may use either the ERPTOOLS or other ERPIMS compatible software packages which meet the criteria set forth for each table.

When the data is to be maintained by ERPIMS, the work performed at HAFB will utilize computerized Environmental Information Management Systems (EIMSs) that provide assistance in loading data to the ERPIMS. These systems were designed to minimize the need for manual data entry (i.e., use electronic transfer of both field and laboratory data) and provide document control, tracking, data validation, relational query capabilities, statistical analyses, computer programming, password protection of information, sophisticated reporting capabilities, and communication with outside information management systems. These systems will allow for the upload and download of data to USACE's specified systems which in this case is ERPIMS.

For the sites at HAFB, ERPIMS electronic files will at least be submitted for: 1) lithologic data and construction details from new wells (including pumping wells and observation wells), and 2) results of spatially distributed baseline or quarterly groundwater analyses. ERPIMS files will not be submitted for any data collected in support of excavation activities (i.e., treatability samples or borrow pit samples). ERPIMS data QC checks will be performed using EIMS utilities. ERPIMS submittals will generally be provided to USACE within 40 working days of receipt of analytical results from the contract lab.

## 14.4 Record Management

The laboratory shall maintain electronic and hardcopy records sufficient to recreate each analytical event conducted pursuant to the SOW. All records shall be maintained for a minimum of five years. The records maintained by the laboratory will be identified by analytical batch number. The analytical batch number will allow for correlation of all sample analytical results to laboratory QC results (i.e., method blanks, spikes, etc.). The minimum records the laboratory shall keep contain the following: (1) COC forms, (2) initial and continuing calibration records including standards preparation traceable to the original material and lot number, (3) instrument

tuning records (as applicable), (4) method blank results, (5) IS results, (6) surrogate spiking records and results (as applicable), (7) spike and spike duplicate records and results, (8) laboratory records, (9) raw data, including instrument printouts, bench work sheets, and/or chromatograms with compound identification and quantitation reports, (10) corrective action reports, (11) other method and project required QC samples and results, and (12) laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples.

Office data management will involve establishing and maintaining a project file for each project. The project file will contain the following information:

- Correspondence
  –External and internal correspondence
  –Notes/minutes of meetings and phone conversations
  –Personnel, organization, and responsibilities
  –Planning and scheduling
  –QA auditing and inspection reports

- Field
  –Field sampling
  –Project operations
  –Calculations

- Quotes/Misc./Lab
  –Contract/purchase order
  –Change order
  –Bid evaluations
  –Laboratory Analytical Data

- Submittals/Reports

The project file will be maintained by document control personnel.

This page intentionally blank.

# 15 PERFORMANCE AND SYSTEMS AUDITS

The contractor will conduct both performance and systems audits of field screening and sampling activities. Routine audits of laboratory operations will be conducted both internally and externally in order to assure that the QC program objectives are achieved and maintained. Following is a discussion of both field and laboratory audits.

## 15.1 Performance and System Audits of the Laboratory

The laboratory selected for each project will be one that participates in a variety of federal and state certification programs that subject the laboratory to stringent system and performance audits on a regular basis. A system audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff, and procedures in place to generate acceptable data. A performance audit verifies the ability of the laboratory to correctly identify and quantify compounds in blind check samples submitted by the auditing agency. A data quality audit assures that the final project deliverable meets the requirements and needs of the client as expressed in the proposal, contract, Work Plan, QAPP, SOPs, and any subsequent changes in these requirements. The purpose of these audits is to identify those laboratories that are capable of generating scientifically sound data. In addition to external audits conducted by certifying agencies or clients, the laboratory will be one which regularly conducts internal audits. Laboratory control samples (DCSs, single control samples (SCSs), and method blanks) are also analyzed at a frequency equal to at least ten percent of the total number of samples analyzed. The results of these check samples are used to identify areas where additional training is needed or classification of procedures is required.

## 15.2 Performance and System Audits of Field Activities

Following is a discussion of performance and systems audits performed in the field.

### 15.2.1 Systems Audits

Systems audits of field operations will be conducted to assure that proper field screening and sampling procedures are selected and executed in the field for the particular media and analytes of interest to the project.

Proper selection of field screening and sampling methods will be audited by the QA Manager who reviews the appropriate QAPP sampling plans (provided in site-specific sampling plans) prepared for the project under the direction of the Project Manager. The QA Manager will audit the QAPP and sampling plans to verify that they have adequately identified the sampling media and analytes of interest, and that the proper field screening, sampling methods, and laboratory analytical methods have been selected to obtain representative samples for the appropriate analyses.

Proper execution of the field screening and sampling procedures will be audited by the Project Manager and the QA Manager who will audit these project operations over the life of the project through review of the field log book and audit forms, and through discussion with the Field Task Manager, as described below.

The model and serial numbers of the field screening instruments and their daily calibration results are identified and documented by the field staff and the project hydrogeologist/geologist in the field log book. The sampling procedures, the number of samples collected for each medium, and the number of QC samples obtained are also recorded in the field log book.

Information recorded in the field log book and dedicated field forms will be reviewed regularly by the Project Manager and the QA Manager so that systematic project-specific problems with field screening and sampling may be rapidly identified, and remedial action or operational changes initiated during the life of the project. In addition, these findings will be reported to the QA Manager on a regular basis, who will compile and analyze these findings and similar reports on other projects. On the basis of this information and discussion with project managers, the QA Manager will identify systematic difficulties and problems with the field screening and sampling procedures that may be modified or eliminated from future programmatic operational requirements, and will recommend such changes to the Program Manager.

### 15.2.2 Performance Audits

Performance audits of field screening and sampling activities will be conducted utilizing field instrument calibration procedures and QC samples.

Proper measurement accuracy of field screening instruments will be verified by daily and periodic instrument calibration procedures described in Section 11.2. This information will be recorded in the field log book and in the instrument log book. This information will be reviewed by the QA Manager, who will audit the calibration accuracy of a field screening instrument and consequent field screening accuracy.

The suitability of the samples for proper laboratory analysis will be determined by the performance audit of the sample collection procedures. Volatiles possessing free air, insufficient sample volume for analysis, or improper preservation of samples will be noted by the analytical laboratory. Such reports of samples unsuitable for analysis will indicate that the sampling procedures are poor or unacceptable. These analytical results are reviewed by the Project Manager and the QA Manager to assess the performance and adequacy of sample collection procedures.

# 16 PREVENTATIVE MAINTENANCE

This Section presents preventative maintenance procedures for field and laboratory equipment.

## 16.1 Laboratory Instruments and Equipment

Laboratory-specific preventative maintenance procedures for instruments and equipment are included in the laboratory QAPP, and shall be submitted as part of any QAPP Addendum.

## 16.2 Field Equipment

Most field instruments designed for field use operate by solid-state circuitry. Little preventative maintenance of the instruments is regularly required, other than cleaning. Specific preventative maintenance procedures are described below.

Each field screening instrument has its own log book that is carried in the instrument case. Preventative maintenance actions, with the exception of battery recharging, are documented in each instrument's log book by the equipment manager or the person conducting the maintenance in the field.

### Combination Meters

Preventative maintenance of these instruments requires periodic cleaning and checking probes, battery replacement, and recharging the reference sensor with reference solution about once every two months.

### DO Meters (membrane)

Preventive maintenance of the DO meter requires periodic cleaning, battery replacement, and proper storage of the DO probe. The DO probe should be cleaned with Alconox and water only. Use of Isopropanol on the DO probe could damage the probe membrane. The probe should be wrapped in a moist towel and sealed in a plastic zipper bag to keep the membrane from drying. Occasional replacement of the probe membrane may be necessary, especially if the membrane does not remain moist.

### pH Meters

Preventative maintenance of these instruments requires periodic cleaning, battery replacement, and storage of the probe in a neutral buffer solution.

### Specific Conductance Meters

Preventative maintenance of these instruments requires periodic cleaning and battery replacement.

## Organic Vapor Analyzers

Preventative maintenance of the Foxboro OVA is conducted by the manufacturer at six to nine month intervals. Other preventative maintenance measures are battery charging and cleaning of the instrument.

## Photoionization Detectors

Preventative maintenance of the HNu PIDs is conducted by the manufacturer at six to nine month intervals. Other preventative maintenance measures are battery charging and cleaning of the instrument.

## Explosimeters

Preventative maintenance of the Industrial Scientific Model HMX 270 and 271 is conducted by the manufacturer at regularly scheduled intervals. Other preventative maintenance measures are battery charging and cleaning of the instrument.

# 17 CORRECTIVE ACTIONS

This Section describes the corrective actions performed in the field and laboratory.

## 17.1 Laboratory

Analysts shall assess each QC analysis they perform. If the result is not acceptable, it will be brought to the attention of the Supervisor and the Supervisor will recommend the appropriate corrective action. The Section Manager, along with the QC Chemist and the QA/QC Coordinator, will then be responsible for the implementation of the corrective action measures.

If a blank, calibration standard, laboratory control sample, sample replicate, or spike recovery analysis fail to meet the quality control criteria established by the laboratory, an investigation will be conducted to find the cause of the problem and a documented report will be initiated. After the problem has been corrected, as verified by acceptable performance on blanks and standards, the analytes for the batch in question are repeated.

A situation also demanding corrective measures exists when quality assurance data for blanks, laboratory control samples, sample replicates, or matrix spikes are reported beyond the warning limits (two standard deviations), or a trend or shift is observed for the reference standard. In this case, samples need not be re-analyzed, provided the data are within acceptable limits.

## 17.1 Field Activities

The Field Task Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, documentation, labeling, and shipping will be checked for accuracy and completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be documented and reported to the Project Manager. Corrective actions will be defined by the Field Task Manager, Project Manager, and QA Manager. Upon implementing the corrective action, the Field Task Manager will provide the Project Manager with a written memorandum documenting field implementation. The memorandum will become part of the project file.

This page intentionally blank.

# 18 QUALITY ASSURANCE REPORTS

Data quality control reports (DQCR) will be submitted routinely as appropriate for each activity. Field DQCRs will be submitted as necessary to document problems experienced while field activities are in progress. Laboratory DQCRs will be submitted as necessary to document problems experienced by the laboratory. Corrective action reports will be submitted as required.

## 18.1 Laboratory QA Reports

Laboratory DQCRs will be submitted as necessary to document problems experienced by the laboratory. Corrective action reports will be submitted as required.

### 18.1.1 Non-Routine Occurrences

Corrective action reports will be submitted as whenever corrective action is performed. Information to be included in such reports should include, but will not be limited to, problems identified and corrective actions employed. Non-routine occurrence reports will be sent to the Project Manager within 48 hours of the occurrence.

### 18.1.2 Data Storage

Field and laboratory data will be stored in hard copy and on the laboratory LIMS system for a period of one year as part of the active project file. Additional backup copies of this information will be stored in the Project Manager's, data analyst's, and principal authority's files for working purposes. This information will be retained in the project file until project completion and close-out. Upon project close-out, all records will be archived for a period of five years after submission of the final project report.

## 18.2 Field Activities QA Reports

These reports will QA problems with document field measurements, sample collection and management procedures, number of samples collected from each medium, and the number of QC samples obtained, along with corrective actions taken. Problems with calibration and maintenance of field instruments will also be reported along with corrective actions. Deviations from SOPs and corrective actions taken will be documented in the DQCRs and the Project Manager will be notified immediately. Reports will be compiled and mailed to the USACE Program Manager (PM) within two days.

Integrity of information and data on field activities will be maintained by the project team. Integrity of the field sample custody will be accomplished by the field staff, according to the sample custody procedures discussed in Section 11. This information, generated in the field and recorded in the project field log book and on the sample COC form, will be verified before sample shipping, and confirmed at the subcontract laboratory upon their receipt of the samples.

The proper performance of these procedures will be audited by the Project Manager and the QA Manager.

Integrity of daily field instrument calibrations will be accomplished by the field staff and the Field Task Manager according to instrument calibration procedures discussed in Section 3.11. The equipment manager will be informed of instrument calibration problems so that instrument replacement and repair may be initiated. The equipment manager will also be responsible for acquisition and storage of calibration standards, preventative maintenance, and periodic manufacturers calibration of field instruments.

Validation of information and data on field activities will be conducted as a QC procedure. The Project Manager will review laboratory results and field data before the data is used for site assessment of contaminant distributions and magnitudes. The field instrument QC measurements will be reviewed to assure the accuracy and precision of the field screening measurements. This information will be used to qualify the field screening results. Field log books and COC forms will be cross checked to each other and to the laboratory results to assure conformity of sample identification numbers. This information will be compared to results of duplicate and blank samples and to information on field conditions at the time of sample collection in order to qualify the sample analytical results.

# 19 REPORTING REQUIREMENTS

Final project reports are typically generated as minor revisions to draft reports. The revisions are based on comments from the client and from the regulatory agency, when applicable, on the draft report.

A draft report will be generated under the direction of the Project Manager, who will assign report tasks to project personnel as a function of their expertise and the complexity of data analysis and interpretation. The report task analyst will be responsible for entry of laboratory and field data to the report. This information will be verified by the Project Manager or the report's principal authority, who will cross check the data values contained in the report to the field log book, sample COC forms, and reported laboratory results. The principal authority, or Project Manager, will then assemble the report sections from the task analysts. The Project Manager will review and edit the assembled sections for agreement and logical consequence of the interpretations. The draft report will then undergo a QC review in-house by a senior level scientist. Changes to the draft report may be made based on this senior level QC review. Following senior level review, the draft report will be delivered to the client, and to the regulatory agency, when applicable. Following client and regulatory review, if applicable, the draft report is revised to a final report. The final report is then submitted to the client and, when applicable, to the regulatory agency.

A variety of report mechanisms will be utilized throughout the investigation to facilitate communication between HAFB, USEPA, USACE, NMED and Contractors. These reports will include DQCRs, Monthly Progress Reports, Quarterly Meetings, Analytical Data Quality Reports (ADQRs), and Draft and Final Reports. Each of these reports will be instrumental in maintaining adequate continuing communication between various entities involved in the investigations.

## 19.1 Daily Quality Control Reports

DQCRs (Appendix D) will be submitted to the USACE-PM whenever QA problems have been encounters, at the end of each day of field work. These reports will document summary of work performed, personnel, equipment, field measurements, sample collection and management procedures, number of samples collected from each medium, and the number of QC samples obtained, and the corrective actions performed. Calibration and maintenance of field instruments will also be reported. Deviations from SOPs and corrective actions taken will be documented and the Project Manager will be notified immediately.

## 19.2 Monthly Progress Reports

Each month, the contractor will submit a progress report to the USACE and to the HAFB identifying accomplishments, noting deficiencies, and describing corrective actions associated with the project. Information from the DQCRs will be summarized in the Monthly Progress

Reports. The percentage of the contract amount consumed by each task will be identified. In the event of schedule changes, an updated schedule in bar chart form will be included in the Monthly Progress Report.

## 19.3 Partnering Meetings

Periodic partnering meetings between USACE, Contractors, the USEPA and NMED will be held periodically to discuss progress on the investigations and to conduct a technical review. Available analytical data and field observations will be reviewed at this time and the need for reassessment of field activities in the forthcoming quarter may be discussed.

## 19.4 Analytical Data Quality Report

After field activities are completed, the contractor will compile an ADQR. The samples will be evaluated with respect to holding times, method blanks, LCS, system monitoring compounds (surrogate spike), initial and continuing calibrations, MS/MSD, ISs, instrument performance checks, and cleanup checks in accordance with Appendix C. The ADQR will present the results of the data evaluation.

The report will be issued as an Appendix to the draft report the data is supporting. The review period is anticipated to be 30 days. All comments will be responded to, resolved, and incorporated into the Final as necessary.

# 20 REFERENCES

NMED, December 18, 2000. Technical Background Document for Development of Soil Screening Levels.

NMED, June 24, 2003. New Mexico Environmental Department TPH Screening Guidelines.

NMWQCC, September 15, 2002. New Mexico Water Quality Control Commission Regulations, "Environmental Protection, Water Quality, Ground and Surface Water Protection", 20.6.2 NMAC.

NMWQCC, October 11, 2002. New Mexico Water Quality Control Commission Regulations, "Standards for Interstate and Intrastate Surface Waters", 20.6.4 NMAC.

USEPA, 1993. Data Quality Objectives Process For Superfund, Interim Final Guidance, Office of Emergency and Remedial Response, Washington, D.C., Pub. No. 9355.9-01.

USEPA, June 1997. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, Update III.

USEPA, November 2002, National Recommended Water Quality Criteria – Correction, EPA 822-R-02-047.

USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, USEPA, Office of Solid Waste and Emergency Response, Washington, D.C., EPA 540-R-01-008, July 2002.

USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, USEPA, Office of Solid Waste and Emergency Response, Washington, D.C., EPA-540/R-99-008 (PB99-963506), October 1999.

USEPA, October 1, 2002. Preliminary Remediation Goals, Region 9, Office of Waste Programs.

USEPA, Summer 2002. Drinking Water Standards and Health Advisories, Office of Water, EPA 822-B-00-001

This page intentionally blank.

# TABLES

# Table 3-1
# PROJECT DATA QUALITY OBJECTIVES
# Holloman Air Force Base, New Mexico

**Project Objectives**

Determine if contamination exists at any of the sites included in the investigation.
If contamination does exist, determine the nature and extent of contamination.
Collect soil screening samples to determine where contamination may exist and where soil samples should be collected for chemical analyses.
Screen soil samples for VOCs using an OVA or PID.
Collect soil, groundwater, surface water, and/or sediment samples from across the site for chemical analysis.
Collect and generate defensible data per EPA Data Quality Objective Guidance documents.
Meet the requirements set forth in the NMED and EPA regulations.

**Sample Location Determination**

Initial screening sample locations will be distributed across the site to include suspected areas of contamination as well as background locations. Subsequent sample locations will be selected based on screening results.
Permanent monitoring wells will be placed within the area believed to be the source area as well as down-gradient of this area. At least one monitoring well will be placed in a location believed to represents background at each site.
Background locations will be selected based on existing analytical data adequate to determine contamination and proximity to current and historical site activities.

**Field Screening**

Soils
- VOCs by OVA or PID, pH, Field description by ASTM Visual-Manual Method.

Groundwater
- Temperature, pH, specific conductivity, DO, ORP and turbidity

Surface Water
- Temperature, pH, specific conductivity, DO, ORP and turbidity

**Sample Collection Equipment**

Soil, Sediment
- Stainless-Steel Hand Auger
- Split-Spoon Sampler
- Encore Sampler
- Stainless-Steel Scoop
- Stainless-Steel Bowl and Spoon
- Dredges (Ponar, petite-Ponar, Peterson, Eckman)

Groundwater
- Bladder Pump
- Disposable Bailer
- Peristaltic Pump

Surface Water
- Pond sampler
- Kemmerer, Bomb or Van Dorn Sampler, niskin and beta type devices
- Peristaltic pump
- Stainless-Steel Scoop
- Teflon Bailer

**Sample Collection Technique**

Refer to BSOP 1 for soil sampling, BSOP 7 for surface water and sediment sampling, and BSOP 10 for groundwater sampling procedures.

**Sample Volume and Preservation**

Refer to Table 10-1.

# Table 3-1
# PROJECT DATA QUALITY OBJECTIVES
# Holloman Air Force Base, New Mexico

**Completeness Goals for Sample Collection**

Greater than or equal to 90% for soil and groundwater samples.
Greater than or equal to 95% for surface water and sediment samples.

**Analytical Program**

Soil, groundwater, surface water and sediment samples will be analyzed according to the tables included in the site-specific Work Plans. All analyses will be according to EPA methodologies. EPA methods referenced are for the most recent version. Methods included in this sampling program are:

| Media | Parameter | Method |
|---|---|---|
| Soil/Sediment | VOCs/EDB | 8260B |
| | SVOCs | 8270C |
| | Pesticides | 8081A |
| | PCBs | 8082 |
| | BTEX/MTBE | 8021B |
| | Dioxins and Furans | 8290 |
| | PAHs | 8310 |
| | Explosives | 8330 |
| | TPH | 8015 |
| | Herbicides | 8151A |
| | Metals | 6010B/7000s |
| | Metals | 6020 |
| | TOC | 9060 |
| | TOX | 9020B |
| | Cyanide | 9010B |
| | Grain Size | ASTMD422 |

| Media | Parameter | Method |
|---|---|---|
| Groundwater/ Surface Water | VOCs | 8260B |
| | SVOCs | 8270C |
| | Pesticides | 8081A |
| | PCBs | 8082 |
| | BTEX/MTBE | 8021B |
| | EDB | 8260B |
| | PAHs | 8310 |
| | Dioxins and Furans | 8290 |
| | Explosives | 8330 |
| | TPH | 8015 |
| | Herbicides | 8151A |
| | Metals | 6010B/7000s |
| | Metals | 6020 |
| | TOC | 9060 |
| | TOX | 9020B |
| | Cyanide | 9010B |
| | Nitrate/Nitrite | 353.2/300.0 |
| | Sulfate, Chloride | 300.0 |
| | Sulfide | 376.2 |
| | Phosphorous, total | 365.1 |
| | Orthophosphate | 365.1/300.0 |
| | Manganese | 6010B/200.7 |
| | Alkalinity | 310.1 |
| | Ethane/Ethene/ Methane | RSK 175 |
| | TDS | 160.1 |
| | Hardness | 130.2 |
| | Perchlorate | 314.0 |

* MDEP "Method for the Determination of Volatile Petroleum Hydrocarbons" and "Method for the Determination of Extractable Petroleum Hydrocarbons"

Note: See Table 3-9 for preparation methods.

**Reporting Limits**

Analytical results between the respective reporting limit and detection limit will be reported as estimated concentrations. The purpose of this reporting procedure is to be able to meet target clean-up levels.

**Precision**

Sampling Program

Collection and analysis of Field Duplicates for each media and method.
Collection and analysis of Matrix Spike Duplicates for each media and method.
The performance criteria are prescribed in Appendix C.

Analytical Program

Will include laboratory duplicates, duplicate control samples, etc., as specified in the analytical methods.
The performance criteria are prescribed in Appendix C.

# Table 3-1
# PROJECT DATA QUALITY OBJECTIVES
# Holloman Air Force Base, New

**Accuracy**

Sampling Program

Collection and analysis of Matrix Spike Samples.

The performance criteria are prescribed in Appendix C.

Analytical Program

Will include blanks, surrogates, lab control samples, calibration checks, tuning, as specified in the analytical methods.

The performance criteria are prescribed in Appendix C.

**Representativeness of Samples**

The measure of relative percent difference derived by the field duplicate analysis is an indicator of precision of the entire sampling and analytical program. The results of field duplicate data alone will not be used for data qualification or data rejection. Typical relative percent differences for soil and sediment samples have been provided below for guidance purposes only.

| For soil and sediment: | Relative Percent Difference |
|---|---|
| TCL 8260B | 40 |
| TCL 8270C | 40 |
| TCL 8081A/8082 | 40 |
| 8021B | 40 |
| 8151A | 40 |
| 8310 | 40 |
| 8330 | 40 |
| 8015 | 50 |
| TAL Metals 6010B/7471A | 35 |
| TAL Metals 6020 | 35 |
| Grain Size ASTM D422 | 40 |
| TAL Cyanide 9010B | 35 |
| TOX 9020B | 35 |
| TOC 9060 | 35 |
| Dioxins 8290 | 40 |

| For Water: | Relative Percent Difference |
|---|---|
| TCL 8260B | 35 |
| TCL 8270C | 35 |
| TCL 8081A/8082 | 35 |
| 8021B | 35 |
| 8151A | 35 |
| 8310 | 35 |
| 8330 | 35 |
| 8015 | 50 |
| Ethane/Ethene/Methane RSK 175 | 35 |
| TAL Metals 6010B/7471A | 30 |
| TAL Metals 6020 | 30 |
| TAL Cyanide 9010B | 30 |
| TOX 9020B | 30 |
| TOC 9060 30 | |
| Dioxins 8290 | 35 |
| EDB 8011 | 35 |
| Perchlorate (314.0) | 30 |
| Nitrate/Nitrite 353.2/300.0 | 30 |
| Sulfate, Chloride 300.0 | 30 |
| Sulfide (376.2) | 30 |
| Phosphorous, total 365.1 | 30 |
| Orthophosphate 365.1/300.0 | 30 |
| Manganese 6010B/200.7 | 30 |
| Alkalinity 310.1 | 30 |
| Hardness 130.2 | 30 |
| TDS 160.1 | 30 |

Completeness Goals for Analytical Program

These goals are relative to the analytical laboratory's ability to analyze the sample within method-specific procedures.

| | % Completeness |
|---|---|
| For soil and sediment: | 90 |
| For groundwater and surface water | 95 |

**Table 4-1**
**GENERAL DATA QUALITY LEVELS**
**FOR SPECIFIC PROJECT OBJECTIVES**
**Holloman Air Force Base, New Mexico**

| Project Objectives | Objective Approach | Data Collection | Data Quality Level |
|---|---|---|---|
| Health and Safety | On-Site Monitoring | Organic Vapor Concentration | Screening |
| Nature and Extent of Contamination | On-Site Monitoring | Organic Vapor Concentration | Screening |
| | Ground-water Sampling and Analysis from hydro punch or Geoprobe | Chemical Composition | Screening/ Definitive |
| | Ground-water Sampling and Analysis from permanent monitoring wells | Chemical Composition | Definitive |
| | Surface Water Sampling and Analysis | Chemical Composition | Definitive |
| | Soil Sampling and Analysis | Chemical Composition | Definitive |
| | Sediment Sampling and Analysis | Chemical Composition | Definitive |
| Treatment System Performance | System Performance Monitoring | Organic Vapor Concentration | Screening |
| | Groundwater Influent, Effluent Sampling and Analysis | Chemical Composition | Definitive |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NM Groundwater Standards 20.6.2 NMAC | | Federal Primary MCLs | EPA Region 9 PRGs Tap Water Screening Levels* | | NRWQC | | | | | | | Aqueous MQL |
| | | | | | | | Priority | | | | Non-Priority | | | |
| | | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | | Human Health | |
| | | A. Human Health | B. Other Standards | Non-Risk Based | Risk-Based | | Risk-Based | | | | | | | |
| beta-BHC | 319-85-7 | | | | 0.037 | C | | | 0.014 | B,C | | | | 0.05 |
| delta-BHC [10] | 319-86-8 | | | 0.2 | 0.052 | C | | | | | | | | 0.05 |
| gamma-BHC (Lindane) | 58-89-9 | | | 0.2 | 0.052 | C | | | 0.019 | C | | | | 0.1 |
| gamma-Chlordane [9] | 5103-74-2 | | | 2 | 0.19 | C | 0.0043 | G,aa | 0.0021 | B,C | | | | 0.05 |
| **PCBs: Method 8082** | | | | | | | | | | | | | | |
| Aroclor 1016 [11] | 12674-11-2 | | | 0.5 | 0.96 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| Aroclor 1221 [11] | 11104-28-2 | | | 0.5 | 0.034 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| Aroclor 1232 [11] | 11141-16-5 | | | 0.5 | 0.034 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| Total PCBs | -- | 1 | | | | | | | | | | | | |
| **PCBs: Method 8082** | | | | | | | | | | | | | | |
| Aroclor 1242 [11] | 53469-21-9 | | | 0.5 | 0.034 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| Aroclor 1248 [11] | 12672-29-6 | | | 0.5 | 0.034 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| Aroclor 1254 [11] | 11097-69-1 | | | 0.5 | 0.034 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| Aroclor 1260 [11] | 11096-82-5 | | | 0.5 | 0.034 | C | 0.014 | N,aa | 0.00017 | B,C,P | | | | 0.5 |
| **Chlorinated Herbicides: Method 8151A** | | | | | | | | | | | | | | |
| 2,4,5-T | 93-76-5 | | | | 36.5 | N | | | | | | | | 2 |
| 2,4,5-TP (Silvex) | 93-72-1 | | | 50 | 29.2 | N | | | | | | | 10 A | 2 |
| 2,4-D | 94-75-7 | | | 70 | 36.5 | N | | | | | | | 100 A,C | 10 |
| 2,4-DB | 94-82-6 | | | | 29.2 | N | | | | | | | | 10 |
| Dalapon | 75-99-0 | | | 200 | 109 | N | | | | | | | | 50 |
| Dicamba | 1918-00-9 | | | | 109 | N | | | | | | | | 5 |
| Dichloroprop | 120-36-5 | | | | | | | | | | | | | 5 |
| **Chlorinated Herbicides: Method 8151A** | | | | | | | | | | | | | | |
| Dinoseb | 88-85-7 | | | 7 | 3.65 | N | | | | | | | | 2 |
| MCPA | 94-74-6 | | | | 1.82 | N | | | | | | | | 200 |
| MCPP (Mecoprop) | 93-65-2 | | | | 3.65 | N | | | | | | | | 200 |
| Pentachlorophenol | 87-86-5 | | | 1 | 0.56 | C | 15 | F,K | 0.28 | B,C | | | | 1 |
| Picloram | 1918-02-1 | | | 500 | 255 | N | | | | | | | | 1 |
| **Volatile Organics: Method 8260B** | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | 71-55-6 | 60 | | 200 | 317.1 | N | | | | J,Z | | | | 1 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 10 | | | 0.055 | C | | | 0.17 | B,C | | | | 1 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 | | | | 5918 | N | | | | | | | | 1 |
| 1,1,2-Trichloroethane | 79-00-5 | 100 | | 5 | 0.20 | C | | | 0.6 | B,C | | | | 1 |
| 1,1-Dichloroethane | 75-34-3 | | | | 81.1 | N | | | | | | | | 1 |
| 1,1-Dichloroethene | 75-35-4 | 5 | | 7 | 33.8 | N | | | 0.057 | B,C | | | | 1 |
| 1,2,4-Trichlorobenzene | 120-82-1 | | | 70 | 19.4 | N | | | | | | | | 1 |
| 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | | | 0.2 | 0.048 | C | | | | | | | | 1 |
| 1,2-Dibromoethane (EDB) | 106-93-4 | | | 0.05 | 0.0008 | C | | | | | | | | 1 |
| 1,2-Dichlorobenzene | 95-50-1 | | | 600 | 37 | N | | | 2700 | B,Z | | | | 1 |
| 1,2-Dichloroethane | 107-06-2 | 10 | | 5 | 0.12 | C | | | 0.38 | B,C | | | | 1 |
| 1,2-Dichloropropane | 78-87-5 | | | 5 | 0.16 | C | | | 0.52 | B,C | | | | 1 |
| 1,3-Dichlorobenzene | 541-73-1 | | | | 0.55 | N | | | 400 | | | | | 1 |

**TABLE 5-1**
**COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES**
**GROUNDWATER**

| Analyte | CAS Number | Groundwater (ug/L) | | |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | | | | | | | | | | | Aqueous MQL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NM Groundwater Standards 20.6.2 NMAC | | Federal Primary MCLs | EPA Region 9 PRGs Tap Water Screening Levels* | | NRWQC | | | | | | | |
| | | | | | | | Priority | | | | Non-Priority | | | |
| | | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | | Human Health | |
| | | A. Human Health | B. Other Standards | Non-Risk Based | Risk-Based | | Risk-Based | | | | | | | |
| **Semi-Volatiles Organics: Method 8270C** | | | | | | | | | | | | | | |
| 1,1'-Biphenyl | 92-52-4 | | | | 30.4 | N | | | | | | | | 10 |
| 1-Methylnaphthalene | 90-12-0 | | | | | | | | | | | | | 10 |
| 2,4,5-Trichlorophenol | 95-95-4 | | | | 365 | N | | | | | | | 2600 | B,E | 10 |
| 2,4,6-Trichlorophenol | 88-06-2 | | | | 0.365 | N | | | 2.1 | B,C,U | | | | | 10 |
| 2,4-Dichlorophenol | 120-83-2 | | | | 10.9 | N | | | 93 | B,U | | | | | 10 |
| 2,4-Dimethylphenol | 105-67-9 | | | | 73 | N | | | 540 | B,U | | | | | 10 |
| 2,4-Dinitrophenol | 51-28-5 | | | | 7.3 | N | | | 70 | B | | | | | 50 |
| 2,4-Dinitrotoluene | 121-14-2 | | | | 7.3 | N | | | 0.11 | C | | | | | 10 |
| 2,6-Dinitrotoluene | 606-20-2 | | | | 3.65 | N | | | | | | | | | 10 |
| 2-Chloronaphthalene | 91-58-7 | | | | 48.7 | N | | | 1700 | B | | | | | 10 |
| 2-Chlorophenol | 95-57-8 | | | | 3.04 | N | | | 120 | B,U | | | | | 10 |
| 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol) | 534-52-1 | | | | | | | | 13.4 | | | | | | 10 |
| 2-Methylnaphthalene | 91-57-6 | | | | | | | | | | | | | | 10 |
| **Semi-Volatiles Organics: Method 8270C** | | | | | | | | | | | | | | |
| 2-Methylphenol (o-Cresol) | 95-48-7 | | | | 182.5 | N | | | | | | | | 10 |
| 2-Nitroaniline | 88-74-4 | | | | 0.104 | N | | | | | | | | 50 |
| 2-Nitrophenol [15] | 88-75-5 | | | | | | | | | | | | | 10 |
| 3,3'-Dichlorobenzidine | 91-94-1 | | | | 0.15 | C | | | 0.04 | B,C | | | | | 20 |
| 3-Nitroaniline | 99-09-2 | | | | | | | | | | | | | 50 |
| 4-Bromophenyl phenyl ether | 101-55-3 | | | | | | | | | | | | | 10 |
| 4-Chloro-3-methylphenol | 59-50-7 | | | | | | | | | U | | | | 10 |
| 4-Chloroaniline | 106-47-8 | | | | 14.6 | N | | | | | | | | 10 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | | | | | | | | | | | | | 10 |
| 4-Methylphenol (p-Cresol) | 106-44-5 | | | | 18.2 | N | | | | | | | | 10 |
| 4-Nitroaniline | 100-01-6 | | | | | | | | | | | | | 50 |
| 4-Nitrophenol | 100-02-7 | | | | | | | | | | | | | 10 |
| Acenaphthene | 83-32-9 | | | | 36.5 | N | | | 1200 | B,U | | | | | 10 |
| Acenaphthylene [16] | 208-96-8 | | | | 36.5 | N | | | | | | | | 10 |
| Acetophenone | 98-86-2 | | | | | | | | | | | | | 10 |
| Anthracene | 120-12-7 | | | | 183 | N | | | 9600 | B | | | | | 10 |
| Atrazine | 1912-24-9 | | | 3 | 0.30 | C | | | | | | | | 10 |
| Benzaldehyde | 100-52-7 | | | | 365 | N | | | | | | | | 10 |
| Benzo(a)anthracene [17] | 56-55-3 | | | | 0.092 | C | | | 0.0044 | B,C | | | | | 10 |
| Benzo(a)pyrene [17] | 50-32-8 | | | 0.2 | 0.009 | C | | | 0.0044 | B,C | | | | | 10 |
| Benzo(b)fluoranthene [17] | 205-99-2 | | | | 0.092 | C | | | 0.0044 | B,C | | | | | 10 |
| Benzo(g,h,i)perylene [18] | 191-24-2 | | | | 18.3 | N | | | | | | | | 10 |
| Benzo(k)fluoranthene [17] | 207-08-9 | | | | 0.92 | C | | | 0.0044 | B,C | | | | | 10 |
| bis(2-Chloroethoxy)methane | 111-91-1 | | | | | | | | | | | | | 10 |
| bis(2-Chloroethyl)ether | 111-44-4 | | | | 0.01 | C | | | 0.031 | B,C | | | | | 10 |
| bis(2-Chloroisopropyl)ether [2,2'-oxybis(1-chloropropane)] | 108-60-1 | | | | 0.27 | C | | | 1400 | B | | | | | 10 |
| bis(2-ethylhexyl)phthalate | 117-81-7 | | | | 4.80 | C | | | 1.8 | B,C,X | | | | | 10 |
| Butyl benzyl phthalate | 85-68-7 | | | | 730 | N | | | 3000 | B,W | | | | | 10 |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | | | | | | | | | | | | | | | Aqueous MQL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NM Groundwater Standards 20.6.2 NMAC | | Federal Primary MCLs | EPA Region 9 PRGs Tap Water Screening Levels* | | NRWQC | | | | | | | | | | | |
| | | | | | | | Priority | | | | | | Non-Priority | | | | | |
| | | | | | | | Freshwater - CCC | | Human Health | | | | Freshwater - CCC | | Human Health | | | |
| | | A. Human Health | B. Other Standards | Non-Risk Based | Risk-Based | | Risk-Based | | | | | | | | | | | |
| Caprolactam | 105-60-2 | | | | 1825 | N | | | | | | | | | | | | 10 |
| Carbazole | 86-74-8 | | | | 3.36 | C | | | | | | | | | | | | 10 |
| Chrysene [17] | 218-01-9 | | | | 9.21 | C | | | 0.0044 | B,C | | | | | | | | 10 |
| Dibenz(a,h)anthracene [17] | 53-70-3 | | | | 0.009 | C | | | 0.0044 | B,C | | | | | | | | 10 |
| Dibenzofuran | 132-64-9 | | | | 2.43 | N | | | | | | | | | | | | 10 |
| Diethyl phthalate | 84-66-2 | | | | 2920 | N | | | 23000 | B,W | | | | | | | | 10 |
| Dimethyl phthalate | 131-11-3 | | | | 36487 | N | | | 313000 | W | | | | | | | | 10 |
| **Semi-Volatiles Organics: Method 8270C** | | | | | | | | | | | | | | | | | | |
| Di-n-butyl phthalate | 84-74-2 | | | | 365 | N | | | 2700 | B,W | | | | | | | | 10 |
| Di-n-octyl phthalate | 117-84-0 | | | | 145.9 | N | | | | | | | | | | | | 10 |
| Fluoranthene | 206-44-0 | | | | 146 | N | | | 300 | B | | | | | | | | 10 |
| Fluorene | 86-73-7 | | | | 24.3 | N | | | 1300 | B | | | | | | | | 10 |
| Hexachlorobenzene | 118-74-1 | | | 1 | 0.042 | C | | | 0.00075 | B,C | | | | | | | | 10 |
| Hexachlorobutadiene | 87-68-3 | | | | 0.86 | C | | | 0.44 | B,C | | | | | | | | 10 |
| Hexachlorocyclopentadiene | 77-47-4 | | | 50 | 21.9 | N | | | 240 | B,U,Z | | | | | | | | 10 |
| Hexachloroethane | 67-72-1 | | | | 4.8 | C | | | 1.9 | B,C | | | | | | | | 10 |
| Indeno(1,2,3-cd)pyrene [17] | 193-39-5 | | | | 0.092 | C | | | 0.0044 | B,C | | | | | | | | 10 |
| Isophorone | 78-59-1 | | | | 70.8 | C | | | 36 | B,C | | | | | | | | 10 |
| Naphthalene | 91-20-3 | | | | 0.62 | N | | | | | | | | | | | | 10 |
| Nitrobenzene | 98-95-3 | | | | 0.34 | N | | | 17 | B | | | | | | | | 10 |
| N-Nitroso-di-n-propylamine | 621-64-7 | | | | 0.0096 | C | | | 0.005 | B,C | | | | | | | | 10 |
| N-Nitrosodiphenylamine | 86-30-6 | | | | 13.7 | C | | | 5 | B,C | | | | | | | | 10 |
| Pentachlorophenol | 87-86-5 | | | 1 | 0.56 | C | 15 | F,K | 0.28 | B,C | | | | | | | | 10 |
| Phenanthrene [18] | 85-01-8 | | | | 18.3 | N | | | | | | | | | | | | 10 |
| Phenol | 108-95-2 | | | | 2190 | N | | | 21000 | B,U | | | | | | | | 10 |
| Pyrene | 129-00-0 | | | | 18.3 | N | | | 960 | B | | | | | | | | 10 |
| **Dioxins: Method 8290** | | | | | | | | | | | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) [19] | 1746-01-6 | | | 0.00003 | 0.0000004 | C | | | 1.3E-08 | C | | | | | | | | ~0.00001 |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) [19] | 40321-76-4 | | | | | | | | | | | | | | | | | ~0.00001 |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) [19] | 57653-85-7 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) [19] | 39227-28-6 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) [19] | 19408-74-3 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) [19] | 35822-39-4 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) [19] | 3268-87-9 | | | | | | | | | | | | | | | | | ~0.00005 |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) [19] | 51207-31-9 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) [19] | 57117-41-6 | | | | | | | | | | | | | | | | | ~0.000025 |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) [19] | 57117-31-4 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) [19] | 57117-44-9 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) [19] | 72918-21-9 | | | | | | | | | | | | | | | | | ~0.000025 |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) [19] | 70648-26-9 | | | | | | | | | | | | | | | | | ~0.000025 |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | | | | | | | | | Aqueous MQL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NM Groundwater Standards 20.6.2 NMAC | | Federal Primary MCLs | EPA Region 9 PRGs Tap Water Screening Levels* | | NRWQC | | | | | |
| | | | | | | | Priority | | | Non-Priority | | |
| | | | | | | | Freshwater - CCC | Human Health | | Freshwater - CCC | Human Health | |
| | | A. Human Health | B. Other Standards | Non-Risk Based | Risk-Based | | Risk-Based | | | | | |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) [19] | 60851-34-5 | | | | | | | | | | | ~ 0.000025 |
| **Dioxins: Method 8290** | | | | | | | | | | | | |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) [19] | 67562-39-4 | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) [19] | 55673-89-7 | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) [19] | 39001-02-0 | | | | | | | | | | | ~ 0.00005 |
| **PAHs: Method 8310** | | | | | | | | | | | | |
| 1-Methylnaphthalene | 90-12-0 | | | | | | | | | | | 2 |
| 2-Methylnaphthalene | 91-57-6 | | | | | | | | | | | 2 |
| Acenaphthene | 83-32-9 | | | | 36.5 | N | | 1200 | B,U | | | 2 |
| Acenaphthylene [16] | 208-96-8 | | | | 36.5 | N | | | | | | 2 |
| Anthracene | 120-12-7 | | | | 183 | N | | 9600 | B | | | 1 |
| Benzo(a)anthracene [17] | 56-55-3 | | | | 0.092 | C | | 0.0044 | B,C | | | 0.2 |
| Benzo(a)pyrene [17] | 50-32-8 | 0.7 | | 0.2 | 0.009 | C | | 0.0044 | B,C | | | 0.2 |
| Benzo(b)fluoranthene [17] | 205-99-2 | | | | 0.092 | C | | 0.0044 | B,C | | | 0.2 |
| Benzo(g,h,i)perylene [17] | 191-24-2 | | | | 18.3 | N | | | | | | 0.5 |
| Benzo(k)fluoranthene [17] | 207-08-9 | | | | 0.921 | C | | 0.0044 | B,C | | | 0.5 |
| Total Naphthalene plus mononaphthalenes | -- | 30 | | | | | | | | | | |
| **PAHs: Method 8310** | | | | | | | | | | | | |
| Chrysene [17] | 218-01-9 | | | | 9.21 | C | | 0.0044 | B,C | | | 0.5 |
| Dibenz(a,h)anthracene [17] | 53-70-3 | | | | 0.009 | C | | 0.0044 | B,C | | | 0.2 |
| Fluoranthene | 206-44-0 | | | | 146 | N | | 300 | B | | | 0.5 |
| Fluorene | 86-73-7 | | | | 24.3 | N | | 1300 | B | | | 2 |
| Indeno(1,2,3-cd)pyrene [17] | 193-39-5 | | | | 0.092 | C | | 0.0044 | B,C | | | 0.2 |
| Naphthalene | 91-20-3 | | | | 0.62 | N | | | | | | 2 |
| Phenanthrene [18] | 85-01-8 | | | | 18.3 | N | | | | | | 1 |
| Pyrene | 129-00-0 | | | | 18.3 | N | | 960 | B | | | 0.5 |
| **Explosives: Method 8330** | | | | | | | | | | | | |
| 1,3,5-Trinitrobenzene | 99-35-4 | | | | 109 | N | | | | | | 2 |
| 1,3-Dinitrobenzene | 99-65-0 | | | | 0.36 | N | | | | | | 2 |
| 2,4,6-Trinitrotoluene | 118-96-7 | | | | 2.24 | C | | | | | | 2 |
| 2,4-Dinitrotoluene | 121-14-2 | | | | 7.3 | N | | 0.11 | C | | | 2 |
| 2,6-Dinitrotoluene | 606-20-2 | | | | 3.65 | N | | | | | | 2 |
| 2-Amino-4,6-dinitrotoluene | 35572-78-2 | | | | | | | | | | | 2 |
| 2-Nitrotoluene | 88-72-2 | | | | 6.1 | N | | | | | | 2 |
| 3-Nitrotoluene | 99-08-1 | | | | 6.1 | N | | | | | | 2 |
| 4-Amino-2,6-dinitrotoluene | 19406-51-0 | | | | | | | | | | | 2 |
| 4-Nitrotoluene | 99-99-0 | | | | 6.1 | N | | | | | | 2 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 121-82-4 | | | | 0.61 | C | | | | | | 1 |
| **Explosives: Method 8330** | | | | | | | | | | | | |
| Methyl-2,4,6-trinitrophenylnitramine (Tetryl) | 479-45-8 | | | | 36.5 | N | | | | | | 2 |
| Nitrobenzene | 98-95-3 | | | | 0.34 | N | | 17 | B | | | 2 |
| Nitroglycerin | 55-63-0 | | | | 4.8 | C | | | | | | 5 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 2691-41-0 | | | | 182 | N | | | | | | 2 |
| Pentaerythritol tetranitrate | 78-11-5 | | | | | | | | | | | 5 |

# TABLE 5-1
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# GROUNDWATER

| Analyte | CAS Number | Groundwater (ug/L) | | |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | NM Surface Water Criteria 20.6.4 NMAC | | NRWQC | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | Aqueous MQL |
| | | | | | | Priority | | | | Non-Priority | | | | |
| | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | Human Health | | | |
| | | Risk-Based | | Risk-Based | | Risk-Based | | | | | | Risk-Based | | |
| **TPH** | | | | | | | | | | | | | | |
| Diesel #2 / crankcase oil | | | | 1800 | | | | | | | | 0.01 | CC | 500 |
| #3 and #6 Fuel Oil | | | | 1400 | | | | | | | | | | |
| Kerosene and jet fuel | | | | 3000 | | | | | | | | | | |
| Mineral oil dielectric fluid | | | | 3700 | | | | | | | | | | |
| Unknown oil | | | | 2300 | | | | | | | | | | |
| Waste oil[1] | | | | NA | | | | | | | | | | |
| Gasoline[2] | | | | NA | | | | | | | | | | |
| **Method 6020B/6010B** | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 3650 | N | 13 | | | | | | 87 | G,I,L | 87 | CC | 200 |
| Antimony | 7440-36-0 | 1.46 | N | 4300 | P | | | 14 | B,Z | | | 160 | | 6 |
| Arsenic | 7440-38-2 | 0.045 | C | 24.2 | C,P | 150 | A,D,K,TR | 0.018 | C,M,S | | | | | 5 |
| Barium | 7440-39-3 | 255 | N | | | | | | | | 1000 A | | | 10 |
| Beryllium | 7440-41-7 | 7.3 | N | | | | | | J,Z | | | 0.53 | | 5 |
| Cadmium | 7440-43-9 | 1.82 | N | | | 0.271 | D,E,K,FC | | J,Z | | | 0.66 | CC, 2 | 5 |
| Calcium | 7440-70-2 | | | | | | | | | | | | | 500 |
| Chromium, Total[1] | 7440-47-3 | 10.9 | N | | | 11.4 | D,K,TR | | J,Z (total) | | | 11 | CC | 5 |
| Cobalt | 7440-48-4 | 72.9 | N | | | | | | | | | | | 20 |
| Copper | 7440-50-8 | 145.9 | N | | | 9.4 | D,E,K,cc,TR | 1300 | U | | | 6.54 | CC, 2 | 20 |
| Iron | 7439-89-6 | 1095 | N | | | | | | | 1000 | F | 300 A | 1000 CC | 40 |
| Lead | 7439-92-1 | | | | | 3.2 | D,E,bb,gg, FL,TR | | J | | | 1.32 | CC, 2 | 5 |
| Magnesium | 7439-95-4 | | | | | | | | | | | | | 500 |
| Manganese | 7439-96-5 | 87.6 | N | | | | | | | | 50 A | | | 10 |
| Nickel | 7440-02-0 | 73 | N | 4600 | P | 52.2 | D,E,K,TR | 610 | B | | | 87.71 | CC, 2 | 40 |
| Potassium | 7440-09-7 | | | | | | | | | | | | | 1000 |
| Selenium | 7782-49-2 | 18.2 | N | 11000 | P | 5 | T | 170 | Z | | | 5 | CC | 5 |
| Silver | 7440-22-4 | 18.2 | N | | | | | | | | | 0.012 | 2 | 10 |
| Sodium | 7440-23-5 | | | | | | | | | | | | | 500 |
| Strontium | 7440-24-6 | 2190 | N | | | | | | | | | | | 50 |
| Tin | 7440-31-5 | 2190 | N | | | | | | | | | | | 100 |
| Titanium | 7440-32-6 | | | | | | | | | | | | | 50 |
| Vanadium | 7440-62-2 | 25.5 | N | | | | | | | | | | | 10 |
| Zinc | 7440-66-6 | 1095 | N | 69000 | P | 122 | D,E,K,TR | 9100 | U | | | 58.91 | CC, 2 | 20 |
| **Method 7041 GFAA** | | | | | | | | | | | | | | |
| Antimony | 7440-36-0 | 1.46 | N | 4300 | P | | | 14 | B,Z | | | 160 | | 6 |
| **Method 7060A GFAA** | | | | | | | | | | | | | | |
| Arsenic | 7440-38-2 | 0.045 | C | 24.2 | C,P | 150 | A,D,K,TR | 0.018 | C,M,S | | | | | 5 |
| **Method 7421 GFAA** | | | | | | | | | | | | | | |
| Lead | 7439-92-1 | | | | | 3.2 | D,E,bb,gg,FL,TR | | J | | | 1.32 | CC, 2 | 5 |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | | NM Surface Water Criteria 20.6.4 NMAC | | | NRWQC | | | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | | Aqueous MQL |
| | | | | | | | | Priority | | | | Non-Priority | | | | | | | |
| | | | | | | | | Freshwater - CCC | | | Human Health | | Freshwater - CCC | | Human Health | | | | |
| | | Risk-Based | | | Risk-Based | | | Risk-Based | | | | | | | | Risk-Based | | | |
| **Mercury (Inorganic), Method 7470A** | | | | | | | | | | | | | | | | | | | |
| Mercury [2] | 7439-97-6 | 1.09 | N | | | | | 0.91 | D,K,hh,TR | | 0.05 | B | | | | 0.012 | 3, CC | | 0.2 |
| **Selenium, Method 7742A** | | | | | | | | | | | | | | | | | | | |
| Selenium | 7782-49-2 | 18.2 | N | | 11000 | P | | 5 | T | | 170 | Z | | | | 5 | CC | | 5 |
| **Thallium, Method 7841** | | | | | | | | | | | | | | | | | | | |
| Thallium [3] | 7440-28-0 | 0.24 | N | | 6.3 | P | | | | | 1.7 | B | | | | 4 | | | 2 |
| **Method 8011 (Halogenated)** | | | | | | | | | | | | | | | | | | | |
| 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | 0.048 | C | | | | | | | | | | | | | | | | 0.2 |
| 1,2-Dibromoethane (EDB) | 106-93-4 | 0.001 | C | | | | | | | | | | | | | | | | 0.02 |
| **Petroleum Hydrocarbons, Method 8015B** | | | | | | | | | | | | | | | | | | | |
| Diesel Range Organics | DRO | | | | | | | | | | | | | | | | | | 100 |
| Gasoline Range Organics | GRO | | | | | | | | | | | | | | | | | | 25 |
| **RSK 175** | | | | | | | | | | | | | | | | | | | |
| Methane | 74-82-8 | | | | | | | | | | | | | | | | | | 1 |
| Ethane | 74-84-0 | | | | | | | | | | | | | | | | | | 1 |
| Ethene | 74-55-1 | | | | | | | | | | | | | | | | | | 1 |
| **Volatile Organics, Method 8021B** | | | | | | | | | | | | | | | | | | | |
| Benzene | 71-43-2 | 0.34 | C | | 710 | C | | | | | 1.2 | B,C | | | | 53 | | | 1 |
| Ethylbenzene | 100-41-4 | 2.9 | C | | 2900 | | | | | | 3100 | B,Z | | | | 453 | | | 1 |
| Methyl tert-butyl ether (MTBE) | 1634-04-4 | 13.3 | C | | | | | | | | | | | | | | | | 5 |
| Toluene | 108-88-3 | 72.3 | N | | 200000 | | | | | | 6800 | B,Z | | | | 175 | | | 1 |
| Xylenes (total) | 1330-20-7 | 20.9 | N | | | | | | | | | | | | | | | | 1 |
| **Pesticides, Method 8081A** | | | | | | | | | | | | | | | | | | | |
| 4,4'-DDD | 72-54-8 | 0.28 | C | | 0.0059 | C,P | | | | | 0.00083 | B,C | | | | 0.0064 | | | 0.1 |
| 4,4'-DDE | 72-55-9 | 0.20 | C | | 0.0059 | C,P | | | | | 0.00059 | B,C | | | | 10.5 | | | 0.1 |
| 4,4'-DDT | 50-29-3 | 0.20 | C | | 0.0059 | C,P | | 0.001 | G,aa | | 0.00059 | B,C | | | | 0.001 | CC | | 0.1 |
| Aldrin | 309-00-2 | 0.004 | C | | 0.0014 | C,P | | | | | 0.00013 | B,C | | | | 0.3 | | | 0.05 |
| Chlordane [4] | 57-74-9 | 0.19 | C | | 0.022 | C,P | | 0.0043 | G,aa | | 0.0021 | B,C | | | | 0.0043 | 3, CC | | 0.5 |
| **Pesticides, Method 8081A** | | | | | | | | | | | | | | | | | | | |
| Dieldrin | 60-57-1 | 0.004 | C | | 0.0014 | C,P | | 0.056 | K,O | | 0.00014 | B,C | | | | 0.0019 | 3, CC | | 0.05 |
| Endosulfan I [5] | 959-98-8 | 21.9 | N | | 240 | | | 0.056 | G,Y | | 110 | B | | | | 0.056 | CC | | 0.1 |
| Endosulfan II [5] | 33213-65-9 | 21.9 | N | | 240 | | | 0.056 | G,Y | | 110 | B | | | | 0.056 | CC | | 0.1 |
| Endosulfan sulfate [5] | 1031-07-8 | 21.9 | N | | 240 | | | 0.056 | G,Y | | 110 | B | | | | 0.056 | CC | | 0.1 |
| Endrin | 72-20-8 | 1.09 | N | | 0.81 | | | 0.036 | K,O | | 0.76 | B | | | | 0.0023 | 3, CC | | 0.1 |
| Endrin aldehyde [6] | 7421-93-4 | 1.09 | N | | 0.81 | | | 0.036 | K,O | | 0.76 | B | | | | 0.0023 | 3, CC | | 0.05 |
| Endrin ketone [6] | 53494-70-5 | 1.09 | N | | | | | 0.036 | K,O | | 0.76 | B | | | | 0.0023 | 3, CC | | 0.05 |
| Heptachlor | 76-44-8 | 0.015 | C | | 0.0021 | C | | 0.0038 | G,aa | | 0.00021 | B,C | | | | 0.0038 | 3, CC | | 0.1 |
| Heptachlor epoxide | 1024-57-3 | 0.007 | C | | 0.0011 | C | | 0.0038 | G,V,aa | | 0.0001 | B,C | | | | 0.0038 | 3, CC | | 0.1 |
| Methoxychlor | 72-43-5 | 18.2 | N | | | | | | | | | | 0.03 | F | 100 | A,C | 0.03 | CC | 0.1 |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | NM Surface Water Criteria 20.6.4 NMAC | | NRWQC | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | Aqueous MQL |
| | | | | | | Priority | | | | Non-Priority | | | | |
| | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | Human Health | | | |
| | | Risk-Based | | Risk-Based | | Risk-Based | | | | | | Risk-Based | | |
| Toxaphene | 8001-35-2 | 0.06 | C | 0.0075 | C | 0.0002 | aa | 0.00073 | B,C | | | 0.0002 | 3, CC | 2 |
| alpha-BHC | 319-84-6 | 0.011 | C | 0.13 | C | | | 0.0039 | B,C | | | 500 | 5 | 0.05 |
| alpha-Chlordane [7] | 5103-71-9 | 0.19 | C | | | 0.0043 | G,aa | 0.0021 | B,C | | | 0.0043 | 3, CC | 0.1 |
| beta-BHC | 319-85-7 | 0.037 | C | 0.46 | C | | | 0.014 | B,C | | | 5000 | 5 | 0.05 |
| delta-BHC [8] | 319-86-8 | 0.052 | C | | | | | | | | | 0.08 | CC | 0.05 |
| gamma-BHC (Lindane) | 58-89-9 | 0.052 | C | 0.63 | C | | | 0.019 | C | | | 0.08 | CC | 0.1 |
| gamma-Chlordane [7] | 5103-74-2 | 0.19 | C | | | 0.0043 | G,aa | 0.0021 | B,C | | | 0.0043 | 3, CC | 0.05 |
| **PCBs: Method 8082** | | | | | | | | | | | | | | |
| Aroclor 1016 [9] | 12674-11-2 | 0.96 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| Aroclor 1221 [9] | 11104-28-2 | 0.034 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| Aroclor 1232 [9] | 11141-16-5 | 0.034 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| Aroclor 1242 [9] | 53469-21-9 | 0.034 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| Aroclor 1248 [9] | 12672-29-6 | 0.034 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| Aroclor 1254 [9] | 11097-69-1 | 0.034 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| Aroclor 1260 [9] | 11096-82-5 | 0.034 | C | 0.0017 | C,P | 0.014 | N,aa | 0.00017 | B,C,P | | | 0.014 | CC | 0.5 |
| **Chlorinated Herbicides: Method 8151A** | | | | | | | | | | | | | | |
| 2,4,5-T | 93-76-5 | 36.5 | N | | | | | | | | | | | 2 |
| 2,4,5-TP (Silvex) | 93-72-1 | 29.2 | N | | | | | | | | 10 | A | | 2 |
| 2,4-D | 94-75-7 | 36.5 | N | | | | | | | | 100 | A,C | | 10 |
| 2,4-DB | 94-82-6 | 29.2 | N | | | | | | | | | | | 10 |
| **Chlorinated Herbicides: Method 8151A** | | | | | | | | | | | | | | |
| Dalapon | 75-99-0 | 109 | N | | | | | | | | | | | 50 |
| Dicamba | 1918-00-9 | 109 | N | | | | | | | | | | | 5 |
| Dichloroprop | 120-36-5 | | | | | | | | | | | | | 5 |
| Dinoseb | 88-85-7 | 3.65 | N | | | | | | | | | | | 2 |
| MCPA | 94-74-6 | 1.82 | N | | | | | | | | | | | 200 |
| MCPP (Mecoprop) | 93-65-2 | 3.65 | N | | | | | | | | | | | 200 |
| Pentachlorophenol | 87-86-5 | 0.56 | C | 82 | C | 15 | F,K | 0.28 | B,C | | | 13 | CC | 1 |
| Picloram | 1918-02-1 | 255 | N | | | | | | | | | | | 1 |
| **Volatile Organics: Method 8260B** | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | 71-55-6 | 317.1 | N | | | | | | J,Z | | | 528 | | 1 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 0.055 | C | 110 | C | | | 0.17 | B,C | | | 240 | | 1 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 | 5918 | N | | | | | | | | | | | 1 |
| 1,1,2-Trichloroethane | 79-00-5 | 0.20 | C | 420 | C | | | 0.6 | B,C | | | 940 | | 1 |
| 1,1-Dichloroethane | 75-34-3 | 81.1 | N | | | | | | | | | | | 1 |
| 1,1-Dichloroethene | 75-35-4 | 33.8 | N | 32 | C | | | 0.057 | B,C | | | 303 | | 1 |
| 1,2,4-Trichlorobenzene | 120-82-1 | 19.4 | N | 940 | | | | | | | | 44.9 | | 1 |
| 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | 0.048 | C | | | | | | | | | | | 1 |

**TABLE 5-2**
**COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES**
**SURFACE WATER**

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | NM Surface Water Criteria 20.6.4 NMAC | | NRWQC | | | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | Aqueous MQL |
| | | | | | | Priority | | | | Non-Priority | | | | | | |
| | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | | Human Health | | | | |
| | | Risk-Based | | Risk-Based | | Risk-Based | | | | | | | | Risk-Based | | |
| 1,2-Dibromoethane (EDB) | 106-93-4 | 0.0008 | C | | | | | | | | | | | | | 1 |
| 1,2-Dichlorobenzene | 95-50-1 | 37 | N | 17000 | | | | 2700 | B,Z | | | | | 15.8 | | 1 |
| 1,2-Dichloroethane | 107-06-2 | 0.12 | C | 990 | C | | | 0.38 | B,C | | | | | 2000 | | 1 |
| 1,2-Dichloropropane | 78-87-5 | 0.16 | C | 390 | C | | | 0.52 | B,C | | | | | 525 | | 1 |
| 1,3-Dichlorobenzene | 541-73-1 | 0.55 | N | 2600 | | | | 400 | | | | | | 50.2 | | 1 |
| 1,4-Dichlorobenzene | 106-46-7 | 0.50 | C | 2600 | | | | 400 | Z | | | | | 11.2 | | 1 |
| 2-Butanone (MEK) | 78-93-3 | 190 | N | | | | | | | | | | | | | 10 |
| 2-Hexanone (Methyl Butyl Ketone) [10] | 591-78-6 | 15.8 | N | | | | | | | | | | | | | 10 |
| 4-Methyl-2-pentanone (MIBK) | 108-10-1 | 15.8 | N | | | | | | | | | | | | | 10 |
| Acetone | 67-64-1 | 60.8 | N | | | | | | | | | | | | | 10 |
| Benzene | 71-43-2 | 0.34 | C | 710 | C | | | 1.2 | B,C | | | | | 53 | | 1 |
| Bromochloromethane [11] | 74-97-5 | 0.18 | C | | | | | | | | | | | | | 1 |
| Bromodichloromethane | 75-27-4 | 0.18 | C | 460 | C | | | | | | | | | | | 1 |
| Bromoform | 75-25-2 | 8.51 | C | | | | | 4.3 | B,C | | | | | 293 | | 1 |
| Bromomethane (Methyl Bromide) | 74-83-9 | 0.87 | N | | | | | | | | | | | 110 | | 1 |
| Carbon disulfide | 75-15-0 | 104 | N | | | | | | | | | | | | | 1 |
| **Volatile Organics - Method 8260B** | | | | | | | | | | | | | | | | |
| Carbon tetrachloride | 56-23-5 | 0.17 | C | 44 | C | | | 0.25 | B,C | | | | | 352 | | 1 |
| Chlorobenzene | 108-90-7 | 10.6 | N | 21000 | | | | 680 | B,Z | | | | | 195 | | 1 |
| Chloroethane (Ethyl Chloride) | 75-00-3 | 4.64 | C | | | | | | | | | | | | | 1 |
| Chloroform | 67-66-3 | 6.17 | N | 4700 | C | | | 5.7 | B,C | | | | | 289 | | 1 |
| Chloromethane (Methyl Chloride) | 74-87-3 | 1.51 | C | 16000 | C | | | | | | | | | 5500 | | 1 |
| cis-1,2-Dichloroethene | 156-59-2 | 6.08 | N | | | | | | | | | | | | | 1 |
| cis-1,3-Dichloropropene [12] | 10061-01-5 | 0.4 | C | | | | | | | | | | | 24.4 | | 1 |
| Cyclohexane | 110-82-7 | 3467 | N | | | | | | | | | | | | | 1 |
| Dibromochloromethane | 124-48-1 | 0.13 | C | | | | | | | | | | | | | 1 |
| Dichlorodifluoromethane | 75-71-8 | 39.5 | N | | | | | | | | | | | | | 1 |
| Ethylbenzene | 100-41-4 | 2.9 | C | 29000 | | | | 3100 | B,Z | | | | | 453 | | 1 |
| Isopropylbenzene (Cumene) | 98-82-8 | 65.8 | N | | | | | | | | | | | | | 1 |
| Methyl Acetate | 79-20-9 | 608 | N | | | | | | | | | | | | | 1 |
| Methyl tert-butyl ether (MTBE) | 1634-04-4 | 13.3 | C | | | | | | | | | | | | | 1 |
| Methylcyclohexane | 108-87-2 | 522 | N | | | | | | | | | | | | | 1 |
| Methylene Chloride (Dichloromethane) | 75-09-2 | 4.28 | C | 16000 | C | | | | | | | | | 1930 | | 1 |
| Styrene | 100-42-5 | 164 | N | | | | | | | | | | | | | 1 |
| Tetrachloroethene | 127-18-4 | 0.66 | C | 88.5 | C,P | | | 0.8 | C | | | | | 84 | | 1 |
| Toluene | 108-88-3 | 72.3 | N | 200000 | | | | 6800 | B,Z | | | | | 175 | | 1 |
| trans-1,2-Dichloroethene | 156-60-5 | 12.2 | N | | | | | 700 | B,Z | | | | | 1350 | | 1 |
| trans-1,3-Dichloropropene [12] | 10061-02-6 | 0.4 | C | | | | | 10 | B | | | | | 24.4 | | 1 |
| Trichloroethene | 79-01-6 | 0.03 | C | 810 | C | | | 2.7 | C | | | | | | | 1 |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | NM Surface Water Criteria 20.6.4 NMAC | | NRWQC | | | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | Aqueous MQL |
| | | | | | | Priority | | | | Non-Priority | | | | | | |
| | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | | Human Health | | | | |
| | | Risk-Based | | Risk-Based | | Risk-Based | | | | | | | | Risk-Based | | |
| Trichlorofluoromethane | 75-69-4 | 129 | N | | | | | | | | | | | | | 1 |
| Vinyl chloride | 75-01-4 | 0.02 | C | 5250 | C | | | 2 | C | | | | | | | 1 |
| Xylenes (total) | 1330-20-7 | 20.9 | N | | | | | | | | | | | | | 1 |
| **Semi-Volatile Organics: Method 8270C** | | | | | | | | | | | | | | | | |
| 1,1'-Biphenyl | 92-52-4 | 30.4 | N | | | | | | | | | | | | | 10 |
| 1-Methylnaphthalene | 90-12-0 | | | | | | | | | | | | | | | 10 |
| 2,4,5-Trichlorophenol | 95-95-4 | 365 | N | | | | | | | | | 2600 | B,E | | | 10 |
| 2,4,6-Trichlorophenol | 88-06-2 | 0.365 | N | | | | | 2.1 | B,C,U | | | | | 3.2 | | 10 |
| 2,4-Dichlorophenol | 120-83-2 | 10.9 | N | 790 | | | | 93 | B,U | | | | | 36.5 | | 10 |
| 2,4-Dimethylphenol | 105-67-9 | 73 | N | 2300 | | | | 540 | B,U | | | | | 21.2 | | 10 |
| **Semi-Volatile Organics: Method 8270C** | | | | | | | | | | | | | | | | |
| 2,4-Dinitrophenol | 51-28-5 | 7.3 | N | 14000 | | | | 70 | B | | | | | 6.2 | | 50 |
| 2,4-Dinitrotoluene | 121-14-2 | 7.3 | N | 91 | C | | | 0.11 | C | | | | | 310 | | 10 |
| 2,6-Dinitrotoluene | 606-20-2 | 3.65 | N | | | | | | | | | | | | | 10 |
| 2-Chloronaphthalene | 91-58-7 | 48.7 | N | 4300 | | | | 1700 | B,U | | | | | | | 10 |
| 2-Chlorophenol | 95-57-8 | 3.04 | N | 400 | | | | 120 | B,U | | | | | 43.8 | | 10 |
| 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol) | 534-52-1 | | | 765 | | | | 13.4 | | | | | | 2.3 | | 10 |
| 2-Methylnaphthalene | 91-57-6 | | | | | | | | | | | | | | | 10 |
| 2-Methylphenol (o-Cresol) | 95-48-7 | 182 | N | | | | | | | | | | | | | 10 |
| 2-Nitroaniline | 88-74-4 | 0.10 | N | | | | | | | | | | | | | 50 |
| 2-Nitrophenol [13] | 88-75-5 | | | | | | | | | | | | | 3500 | | 10 |
| 3,3'-Dichlorobenzidine | 91-94-1 | 0.15 | C | 0.77 | C | | | 0.04 | B,C | | | | | | | 20 |
| 3-Nitroaniline | 99-09-2 | | | | | | | | | | | | | | | 50 |
| 4-Bromophenyl phenyl ether | 101-55-3 | | | | | | | | | | | | | | | 10 |
| 4-Chloro-3-methylphenol | 59-50-7 | | | | | | | | U | | | | | 0.3 | | 10 |
| 4-Chloroaniline | 106-47-8 | 14.6 | N | | | | | | | | | | | | | 10 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | | | | | | | | | | | | | | | 10 |
| 4-Methylphenol (p-Cresol) | 106-44-5 | 18.2 | N | | | | | | | | | | | | | 10 |
| 4-Nitroaniline | 100-01-6 | | | | | | | | | | | | | | | 50 |
| 4-Nitrophenol | 100-02-7 | | | | | | | | | | | | | 82.8 | | 10 |
| Acenaphthene | 83-32-9 | 36.5 | N | 2700 | | | | 1200 | B,U | | | | | 17 | | 10 |
| Acenaphthylene [14] | 208-96-8 | 36.5 | N | | | | | | | | | | | 17 | | 10 |
| Acetophenone | 98-86-2 | | | | | | | | | | | | | | | 10 |
| Anthracene | 120-12-7 | 183 | N | 110000 | | | | 9600 | B | | | | | | | 10 |
| Atrazine | 1912-24-9 | 0.30 | C | | | | | | | | | | | | | 10 |
| Benzaldehyde | 100-52-7 | 365 | N | | | | | | | | | | | | | 10 |
| Benzo(a)anthracene [15] | 56-55-3 | 0.092 | C | 0.49 | C | | | 0.0044 | B,C | | | | | | | 10 |
| Benzo(a)pyrene [15] | 50-32-8 | 0.009 | C | 0.49 | C,P | | | 0.0044 | B,C | | | | | | | 10 |
| Benzo(b)fluoranthene [15] | 205-99-2 | 0.092 | C | 0.49 | C | | | 0.0044 | B,C | | | | | | | 10 |
| Benzo(g,h,i)perylene [10] | 191-24-2 | 18.3 | N | | | | | | | | | | | | | 10 |

**TABLE 5-2**
**COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES**
**SURFACE WATER**

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | NM Surface Water Criteria 20.6.4 NMAC | | NRWQC | | | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | Aqueous MQL |
| | | | | | | Priority | | | | Non-Priority | | | | | | |
| | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | | Human Health | | | | |
| | | Risk-Based | | Risk-Based | | Risk-Based | | | | | | | | Risk-Based | | |
| Benzo(k)fluoranthene [15] | 207-08-9 | 0.92 | C | 0.49 | C | | | 0.0044 | B,C | | | | | | | 10 |
| bis(2-Chloroethoxy)methane | 111-91-1 | | | | | | | | | | | | | | | 10 |
| bis(2-Chloroethyl)ether | 111-44-4 | 0.01 | C | 14 | C | | | 0.031 | B,C | | | | | 2380 | | 10 |
| bis(2-Chloroisopropyl)ether [2,2'-oxybis(1-chloropropane)] | 108-60-1 | 0.27 | C | 170000 | | | | 1400 | B | | | | | | | 10 |
| [illegible] | | | | | | | | | | | | | | | | |
| bis(2-ethylhexyl)phthalate | 117-81-7 | 4.80 | C | 59 | | | | 1.8 | B,C,X | | | | | 0.3 | | 10 |
| Butyl benzyl phthalate | 85-68-7 | 730 | N | | | | | 3000 | B,W | | | | | 22 | | 10 |
| Caprolactam | 105-60-2 | 1825 | N | | | | | | | | | | | | | 10 |
| Carbazole | 86-74-8 | 3.36 | C | | | | | | | | | | | | | 10 |
| Chrysene [15] | 218-01-9 | 9.21 | C | 0.49 | C | | | 0.0044 | B,C | | | | | | | 10 |
| Dibenz(a,h)anthracene [15] | 53-70-3 | 0.009 | C | 0.49 | C | | | 0.0044 | B,C | | | | | | | 10 |
| Dibenzofuran | 132-64-9 | 2.43 | N | | | | | | | | | | | | | 10 |
| Diethyl phthalate | 84-66-2 | 2920 | N | 12000 | | | | 23000 | B,W | | | | | 521 | | 10 |
| Dimethyl phthalate | 131-11-3 | 36487 | N | 2900000 | | | | 313000 | W | | | | | 330 | | 10 |
| Di-n-butyl phthalate | 84-74-2 | 365 | N | | | | | 2700 | B,W | | | | | 9.4 | | 10 |
| Di-n-octyl phthalate | 117-84-0 | 145.9 | N | | | | | | | | | | | | | 10 |
| Fluoranthene | 206-44-0 | 146.0 | N | 370 | | | | 300 | B | | | | | 39.8 | | 10 |
| Fluorene | 86-73-7 | 24.3 | N | 1400 | | | | 1300 | B | | | | | | | 10 |
| Hexachlorobenzene | 118-74-1 | 0 | C | 0.0077 | C,P | | | 0.00075 | B,C | | | | | | | 10 |
| Hexachlorobutadiene | 87-68-3 | 0.86 | C | 500 | C | | | 0.44 | B,C | | | | | 0.93 | | 10 |
| Hexachlorocyclopentadiene | 77-47-4 | 25.5 | N | 17000 | | | | 240 | B,U,Z | | | | | 0.07 | | 10 |
| Hexachloroethane | 67-72-1 | 4.8 | C | 89 | C | | | 1.9 | B,C | | | | | 9.8 | | 10 |
| Indeno(1,2,3-cd)pyrene [15] | 193-39-5 | 0.09 | C | 0.49 | C | | | 0.0044 | B,C | | | | | | | 10 |
| Isophorone | 78-59-1 | 70.8 | C | 26000 | C | | | 36 | B,C | | | | | 1170 | | 10 |
| Naphthalene | 91-20-3 | 0.62 | N | | | | | | | | | | | 62 | | 10 |
| Nitrobenzene | 98-95-3 | 0.34 | N | 1900 | | | | 17 | B | | | | | 270 | | 10 |
| N-Nitroso-di-n-propylamine | 621-64-7 | 0.01 | C | 14 | C | | | 0.005 | B,C | | | | | | | 10 |
| N-Nitrosodiphenylamine | 86-30-6 | 13.7 | C | 160 | C | | | 5 | B,C | | | | | 58.5 | | 10 |
| Pentachlorophenol | 87-86-5 | 0.56 | C | 82 | C | 15 | F,K | 0.28 | B,C | | | | | 13 | CC | 10 |
| Phenanthrene [16] | 85-01-8 | 18.3 | N | | | | | | | | | | | | | 10 |
| Phenol | 108-95-2 | 2190 | N | 4600000 | | | | 21000 | B,U | | | | | 256 | | 10 |
| Pyrene | 129-00-0 | 18.3 | N | 11000 | | | | 960 | B | | | | | | | 10 |
| Dioxins Method 8290 | | | | | | | | | | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) [17] | 1746-01-6 | 0.0000004 | C | 0.00000014 | C,P | | | 1.3E-08 | C | | | | | 0.00001 | 3 | ~ 0.00001 |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) [17] | 40321-76-4 | | | | | | | | | | | | | | | ~ 0.00001 |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) [17] | 57653-85-7 | | | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) [17] | 39227-28-6 | | | | | | | | | | | | | | | ~ 0.000025 |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | | NM Surface Water Criteria 20.6.4 NMAC | | NRWQC | | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | | Aqueous MQL |
| | | | | | | Priority | | | | Non-Priority | | | | |
| | | | | | | Freshwater - CCC | | Human Health | | Freshwater - CCC | | Human Health | | |
| | | Risk-Based | | Risk-Based | | Risk-Based | | | | | | | Risk-Based | |
| **Dioxins: Method 8290** | | | | | | | | | | | | | | |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) [17] | 19408-74-3 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) [17] | 35822-39-4 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) [17] | 3268-87-9 | | | | | | | | | | | | | ~ 0.00005 |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) [17] | 51207-31-9 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) [17] | 57117-41-6 | | | | | | | | | | | | | ~ 0.000025 |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) [17] | 57117-31-4 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) [17] | 57117-44-9 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) [17] | 72918-21-9 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) [17] | 70648-26-9 | | | | | | | | | | | | | ~ 0.000025 |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) [17] | 60851-34-5 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) [17] | 67562-39-4 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) [17] | 55673-89-7 | | | | | | | | | | | | | ~ 0.000025 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) [17] | 39001-02-0 | | | | | | | | | | | | | ~ 0.00005 |
| **PAHs: Method 8310** | | | | | | | | | | | | | | |
| 1-Methylnaphthalene | 90-12-0 | | | | | | | | | | | | | 2 |
| 2-Methylnaphthalene | 91-57-6 | | | | | | | | | | | | | 2 |
| Acenaphthene | 83-32-9 | 36.5 | N | 2700 | | | | 1200 | B,U | | | | 17 | 2 |
| Acenaphthylene [14] | 208-96-8 | 36.5 | N | | | | | | | | | | 17 | 2 |
| Anthracene | 120-12-7 | 183 | N | 110000 | | | | 9600 | B | | | | | 1 |
| Benzo(a)anthracene [15] | 56-55-3 | 0.092 | C | 0.49 | C | | | 0.0044 | B,C | | | | | 0.2 |
| Benzo(a)pyrene [15] | 50-32-8 | 0.009 | C | 0.49 | C,P | | | 0.0044 | B,C | | | | | 0.2 |
| Benzo(b)fluoranthene [15] | 205-99-2 | 0.092 | C | 0.49 | C | | | 0.0044 | B,C | | | | | 0.2 |
| Benzo(g,h,i)perylene [16] | 191-24-2 | 18.3 | N | | | | | | | | | | | 0.5 |
| Benzo(k)fluoranthene [15] | 207-08-9 | 0.92 | C | 0.49 | C | | | 0.0044 | B,C | | | | | 0.5 |
| Chrysene [15] | 218-01-9 | 9.21 | C | 0.49 | C | | | 0.0044 | B,C | | | | | 0.5 |
| Dibenz(a,h)anthracene [15] | 53-70-3 | 0.009 | C | 0.49 | C | | | 0.0044 | B,C | | | | | 0.2 |
| Fluoranthene | 206-44-0 | 146 | N | 370 | | | | 300 | B | | | | 39.8 | 0.5 |
| Fluorene | 86-73-7 | 24 | N | 14000 | | | | 1300 | B | | | | | 2 |
| Indeno(1,2,3-cd)pyrene [15] | 193-39-5 | 0.1 | C | 0.49 | C | | | 0.0044 | B,C | | | | | 0.2 |
| **PAHs: Method 8310** | | | | | | | | | | | | | | |
| Naphthalene | 91-20-3 | 0.62 | N | | | | | | | | | | 62 | 2 |
| Phenanthrene [16] | 85-01-8 | 18.3 | N | | | | | | | | | | | 1 |
| Pyrene | 129-00-0 | 18.3 | N | 11000 | | | | 960 | B | | | | | 0.5 |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | NM Surface Water Criteria 20.6.4 NMAC | NRWQC | | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | Aqueous MQL |
| | | | | Priority | | Non-Priority | | | | |
| | | | | Freshwater - CCC | Human Health | Freshwater - CCC | Human Health | | | |
| | | Risk-Based | Risk-Based | Risk-Based | | | | | Risk-Based | |
| [illegible] | | | | | | | | | | |
| 1,3,5-Trinitrobenzene | 99-35-4 | 109 N | | | | | | | | 2 |
| 1,3-Dinitrobenzene | 99-65-0 | 0.36 N | | | | | | | | 2 |
| 2,4,6-Trinitrotoluene | 118-96-7 | 2.24 C | | | | | | | | 2 |
| 2,4-Dinitrotoluene | 121-14-2 | 7.3 N | | | 0.11 C | | | | 310 | 2 |
| 2,6-Dinitrotoluene | 606-20-2 | 3.65 N | | | | | | | | 2 |
| 2-Amino-4,6-dinitrotoluene | 35572-78-2 | | | | | | | | | 2 |
| 2-Nitrotoluene | 88-72-2 | 6.1 N | | | | | | | | 2 |
| 3-Nitrotoluene | 99-08-1 | 6.1 N | | | | | | | | 2 |
| 4-Amino-2,6-dinitrotoluene | 19406-51-0 | | | | | | | | | 2 |
| 4-Nitrotoluene | 99-99-0 | 6.1 N | | | | | | | | 2 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 121-82-4 | 0.61 C | | | | | | | | 1 |
| Methyl-2,4,6-trinitrophenylnitramine (Tetryl) | 479-45-8 | 36.5 N | | | | | | | | 2 |
| Nitrobenzene | 98-95-3 | 0.34 N | | | 17 B | | | | 270 | 2 |
| Nitroglycerin | 55-63-0 | 4.8 C | | | | | | | | 5 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 2691-41-0 | 182 N | | | | | | | | 2 |
| Pentaerythritol tetranitrate | 78-11-5 | | | | | | | | | 5 |
| [illegible] Method 9010B | | | | | | | | | | |
| Cyanide | 57-12-5 | 0.62 N | | 5.2 K,Q | 700 B,Z | | | | 5.2 CC | 10 |
| Total Organic Halides Method 9020B | | | | | | | | | | |
| Total Organic Halides | TOX | | | | | | | | | 500 |
| Total Organic Carbon: Method 9060 | | | | | | | | | | |
| Total Organic Carbon | TOC | | | | | | | | | 1000 |
| Method 160.1 | | | | | | | | | | |
| Total Dissolved Solids | TDS | | | | | | | | | 10000 |
| Method 200.7 | | | | | | | | | | |
| Manganese | 7439-96-5 | 87.6 N | | | | | 50 A | | | 15 |
| Method 300.0 | | | | | | | | | | |
| Chloride | 16887-00-6 | | | | | 230000 G | | | 230000 CC | 1000 |
| Nitrate | 14797-55-8 | 1000 N | | | | | | | | 500 |
| Nitrite | 14797-65-0 | 100 N | | | | | | | | 500 |
| Orthophosphate | PO4 | | | | | | | | | 500 |
| Method 300.0 | | | | | | | | | | |
| Perchlorate | 14797-73-0 | | | | | | | | | 4 |
| Sulfate | 14808-79-8 | | | | | | | | | 1000 |
| Method 310.1 | | | | | | | | | | |
| Alkalinity | ALK | | | | | 20000 F | | | | 5000 |
| Method 314.0 | | | | | | | | | | |
| Perchlorate | 14797-73-0 | | | | | | | | | 4 |
| Method 353.2 | | | | | | | | | | |
| Nitrate | 14797-55-8 | 1000 N | | | | | | | | 100 |
| Nitrite | 14797-65-0 | 100 N | | | | | | | | 100 |

**TABLE 5-2**
**COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES**
**SURFACE WATER**

| Analyte Name | CAS Number | Surface Water (ug/L) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | EPA Region 9 PRGs Tap Water Screening Levels* | NM Surface Water Criteria 20.6.4 NMAC | NRWQC | | | | EPA Region 4 Freshwater Surface Water Chronic Screening Values | Aqueous MQL |
| | | | | Priority | | Non-Priority | | | |
| | | | | Freshwater - CCC | Human Health | Freshwater - CCC | Human Health | | |
| | | Risk-Based | Risk-Based | Risk-Based | | | | Risk-Based | |
| Method 365.1 | | | | | | | | | |
| Orthophosphate | PO4 | | | | | | | | 50 |
| Phosphorous, total | P | | | | | | | | 100 |
| Method 376.2 | | | | | | | | | |
| Sulfide | 18496-25-8 | | | | | | | 2 CC | 1000 |

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

**List of Analytes**

1 - The value for hexavalent chromium (CAS No. 18540-29-9) is used as surrogate Region 9 PRG, SW 62-777, 62-302, NRWQC, and Region 4 SW Chronic values for this compound.
2 - The value for mercury chloride (CAS No. 7487-94-7) is used as a surrogate Region 9 PRG value for this compound.
3 - The value for thallium and compounds (CAS No. 7446-18-6) is used as a surrogate Region 9 PRG value for this compound.
4 - The value for technical chlordane (CAS No. 12789-03-6) is used as a surrogate Region 9 PRG value for this compound.
5 - The value for endosulfan (CAS No. 115-29-7) is used as a surrogate value for this compound.
6 - The value for endrin (CAS No. 72-20-8) is used as a surrogate value for this compound.
7 - The value for chlordane (CAS No. 54-74-9) is used as a surrogate value for this compound.
The value for technical chlordane (CAS No. 12789-03-6) is used as a surrogate Region 9 PRG value for this compound.
8 - The value for gamma-BHC (CAS No. 58-89-9) is used as a surrogate Region 9 PRG, SW 62-777, 62-302, and Region 4 SW Chronic values for this compound.
9 - The value for total PCBs (CAS No. 1336-36-3) is used as a surrogate value for this compound, except for Region 9 PRG value.
10 - The value for methyl isobutyl ketone (CAS No. 108-10-1) is used as surrogate Region 9 PRG and SW 62-777 values for this compound.
11 - The value for bromodichloromethane (CAS No. 75-27-4) is used as Region 9 PRG, SW 62-777, and 62-302 surrogate values for this compound.
12 - The value for 1,3-dichloropropene (CAS No. 542-75-6) is used as a surrogate value for this compound.
13 - The value for 4-nitrophenol (CAS No. 100-02-7) is used as a surrogate value for this compound.
14 - The value for acenaphthene (CAS No. 83-32-9) is used as surrogate Region 9 PRG and Region 4 SW values and total PAHs is used as surrogate SW 62-777 and 62-302 values for this compound.
15 - The value for total PAHs is used as surrogate SW 62-777 and 62-302 values for this compound.
16 - The value for pyrene (CAS No. 129-00-0) is used as a surrogate Region 9 PRG value and the value for total PAHs is used as surrogate SW 62-777 and 62-302 values for this compound.
17 - This GC/MS method uses matrix-specific extraction, analyte-specific cleanup, and high-resolution capillary column GC/high resolution mass spectrometry techniques to separate and identify the analytes of interest. The sensitivity of the method is dependent on the level of matrix interference. Selected cleanup methods may be used to reduce or eliminate interferences. Target analytes may include all congener classes, tetra- through octa-dioxins and furans. Achieved detection limits vary according to matrix and analyte.

**EPA Region 9 PRGs - Tap Water (10/01/02)**

* Values for noncarcinogens are adjusted by a Hazard Index (HI) of 0.1 to account for additive effects.
C Carcinogenic effects.
N Noncarcinogenic effects.
Note: Significant figures are based on electronic download from the EPA Region 9 website (www.epa.gov/region09/waste/sfund/prg/)

**New Mexico Surface Water Criteria (Human Health) - 20.6.4 NMAC, October 11, 2002**

C Cancer Causing
P Persiostant

**NRWQC-CCC: Priority Pollutants - Freshwater 40 CFR 131 (4/99)**

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (EPA 440/5-84-033, January 1985), Species Mean Acute Values are give for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to 1.7. Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.
B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of April 8, 1998. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.
C This criterion is based on carcinogenicity of 10-6 risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10-5, move the decimal point in the recommended criterion one place to the right).
D Freshwater criteria for metals are expressed in terms of the dissolved metal in the water column. The recommended water quality criteria value was calculated by using the previous 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria," October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource Center, USEPA, 401 M St., SW, mail code RC4100, Washington, DC 20460; and 40CFR 131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble- Conversion Factors for Dissolved Metals.
E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 100 mg/L. Criteria values for other hardness may be calculated from the following: CMC (dissolved) = exp{mA [ln(hardness)]+ bA}(CF), or CCC (dissolved) = exp{mC [ln(hardness)]+ bC} (CF) and the parameters specified in Appendix B to the Preamble- Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent.
F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC = exp(1.005(pH)-4.869; CCC = exp(1.005(pH)-5.134). Values displayed in table correspond to a pH of 7.8.
G This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
J EPA has not calculated human health criterion for this contaminant. However, permit authorities should address this contaminant in NPDES permit actions using the State's existing narrative criteria for toxics.
K This recommended criterion is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*, (EPA-820-B-96-001, September 1996). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A); the difference between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. None of the decisions concerning the derivation of this criterion were affected by any considerations that are specific to the Great Lakes.
M EPA is currently reassessing the criteria for arsenic. Upon completion of the reassessment the Agency will publish revised criteria as appropriate.
N PCBs are a class of chemicals which include aroclors, 1242, 1254, 1221, 1232, 1248, 1260, and 1016, CAS numbers 53469219, 11097691, 11104282, 11141165, 12672296, 11096825 and 12674112 respectively. The aquatic life criteria apply to this set of PCBs.
O The derivation of the CCC for this pollutant did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.
P This criterion applies to total pcbs, I.e., the sum of all congener or all isomer analyses.
Q This recommended water quality criterion is expressed as µg free cyanide (as CN)/L.
S This recommended water quality criterion refers to the inorganic form only.
T This recommended water quality criterion is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor of 0.922 that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.
U The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.
V This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.
W Although EPA has not published a final criteria document for this compound it is EPA's understanding that sufficient data exist to allow calculation of aquatic criteria. It is anticipated that industry intends to publish in the peer reviewed literature draft aquatic life criteria generated in accordance with EPA Guidelines. EPA will review such criteria for possible issuance as national WQC.
X There is a full set of aquatic life toxicity data that show that DEHP is not toxic to aquatic organisms at or below its solubility limit.
Y This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

# TABLE 5-2
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SURFACE WATER

Z A more stringent MCL has been issued by EPA. Refer to drinking water regulations (40 CFR 141) or Safe Drinking Water Hotline (1-800-426-4791) for values.

aa This CCC is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

bb This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (EPA 440/5-84-033), Cadmium (EPA 440/5-84-032), Chromium (EPA 440/5-84-029), Copper (EPA 440/5-84-031), Cyanide (EPA 440/5-84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87-003).

cc When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be appropriate.

ee This recommended water quality criterion was derived on page 43 of the mercury criteria document (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

ff This recommended water quality criterion was derived in Ambient Water Quality Criteria Saltwater Copper Addendum (Draft, April 14, 1995) and was promulgated in the Interim final National Toxics Rule (60FR22228-222237, May 4, 1995).

gg EPA is actively working on this criterion and so this recommended water quality criterion may change substantially in the near future.

hh This recommended water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

FC Total recoverable cadmium is calculated from the following formula with an assumed hardness of 100 mg/L as $CaCO_3$: $e^{(0.7852*(\ln hardness) - 4.705)}$

FL Total recoverable lead conversion factor: 1.46203 - [(ln hardness)(0.145712)]

TR Result is a total recoverable concentration based on an assumed hardness of 100 mg/L as $CaCO_3$.

**NRWQC-CCC: Non-Priority Pollutants - Freshwater 40 CFR 131 (4/99)**

A This human health criterion is the same as originally published in the Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value is now published in the Gold Book.

B The organoleptic effect criterion is more stringent than the value presented in the non priority pollutants table.

C A more stringent Maximum Contaminant Level (MCL) has been issued by EPA under the Safe Drinking Water Act. Refer to drinking water regulations 40CFR141 or Safe Drinking Water Hotline (1-800-426-4791) for values.

E This criterion has been revised to reflect the Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of April 8, 1998. The fish tissue bioconcentration factor (BCF) used to derive the original criterion was retained in each case.

F The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July, 1976).

G This value is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Aluminum (EPA 440/5-86-008); Chloride (EPA 440/5-88-001); Chloropyrifos (EPA 440/5-86-005).

I This value is expressed in terms of total recoverable metal in the water column.

L There are three major reasons why the use of Water-Effect Ratios might be appropriate. (1) The value of 87 µg/L is based on a toxicity test with the striped bass in water with pH = 6.5-6.6 and hardness <10 mg/L. Data in "Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia" (May 1994) indicated that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified at this time. (2) In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide. (3) EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 µg aluminum/L, when either total recoverable or dissolved is measured.

**EPA Region 4 Surface Water Screening Values (Chronic) - Freshwater (6/23/00)**

2 Hardness-dependant

3 Based on the marketability of fish. The use of other values which may have greater ecological significance may be considered.

5 Lowest plant value reported.

CC Criteria

**Acronyms:**

CCC - Criterion Continuous Concentration

FAC - Florida Administrative Code

MQL - Method Quantitation Limit

NRWQC- National Recommended Water Quality Criteria

PRG - Preliminary Remediation Goal

**Note:**

The MQL is defined as the lowest level that can be reliably detected within specified limits of precision and accuracy during routine laboratory operating conditions.

The MQL will be set at 3 to 5 times the MDL and shall be the **lowest standard used during calibration procedures for each analytical method.**

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | | | Risk-Based | | | |
| **MA-TPH** | | | | | | | | | | | | | |
| Diesel #2 / crankcase oil | -- | 880 | | 2200 | | | | | | | | | 10 |
| #3 and #6 Fuel Oil | -- | 860 | | 2150 | | | | | | | | | |
| Kerosene and jet fuel | -- | 940 | | 2350 | | | | | | | | | |
| Mineral oil dielectric fluid | -- | 1560 | | 3400 | | | | | | | | | |
| Unknown oil | -- | 800 | | 2000 | | | | | | | | | |
| Waste oil[1] | -- | 2500 | | 5000 | | | | | | | | | |
| Gasoline[2] | -- | NA | | NA | | | | | | | | | |
| **Metals: Method 6010B/6020** | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 74000 | nc | 100000 | max | 0.75 | nc | | | 100000 | max | 7600 nc | 10 |
| Antimony | 7440-36-0 | 30 | nc | 92 | nc | 110 | nc | | | 41 | nc | 3.1 nc | 0.5 |
| Arsenic | 7440-38-2 | 3.9 | ca | 17 | ca | 0.019 | ca | | | 1.6 | ca | 0.39 ca | 0.8 |
| Barium | 7440-39-3 | 5200 | nc | 15000 | nc | 0.077 | nc | | | 6700 | nc | 540 nc | 0.5 |
| Beryllium | 7440-41-7 | 150 | nc | 440 | nc | 0.0031 | nc | | | 1900 | ca | 15 nc | 0.5 |
| Cadmium | 7440-43-9 | 70 | nc | 190 | nc | 0.047 | ca | | | 45 | nc | 3.7 nc | 0.2 |
| Calcium | 7440-70-2 | | | | | | | | | | | | 10 |
| Chromium, Total [1] | 7440-47-3 | | | | | | | | | 448 | ca | 211 ca | 0.5 |
| Cobalt | 7440-48-4 | 4500 | nc | 13000 | nc | 0.16 | nc | | | 1900 | ca | 900 ca | 1 |
| Copper | 7440-50-8 | 2800 | nc | 8500 | nc | 10000 | nc | | | 4100 | nc | 310 nc | 1 |
| Iron | 7439-89-6 | 23000 | nc | 69000 | nc | 80000 | nc | | | 100000 | max | 2300 nc | 5 |
| Lead | 7439-92-1 | 400 | NC | 1000 | nc | 1 | nc | | | 75 | nc | 40 nc | 0.25 |
| Magnesium | 7439-95-4 | | | | | | | | | | | | 25 |
| Manganese | 7439-96-5 | 7800 | nc | 14000 | nc | 0.0075 | nc | | | 1900 | nc | 180 nc | 0.5 |
| Nickel | 7440-02-0 | 1500 | nc | 4400 | nc | 0.031 | nc | | | 2000 | nc | 160 nc | 2 |
| Potassium | 7440-09-7 | | | | | | | | | | | | 50 |
| Selenium | 7782-49-2 | 380 | nc | 1200 | nc | 1300 | nc | | | 510 | nc | 39 nc | 0.25 |
| Silver | 7440-22-4 | 380 | nc | 1200 | nc | 1300 | nc | | | 510 | nc | 39 nc | 1 |
| Sodium | 7440-23-5 | | | | | | | | | | | | 50 |
| **Metals: Method 6010B/6020** | | | | | | | | | | | | | |
| Strontium | 7440-24-6 | 37000 | nc | 89000 | nc | 150000 | max | | | 100000 | max | 4700 nc | 5 |
| Thallium [2] | 7440-28-0 | 6.1 | nc | 18 | nc | 21 | nc | | | 6.7 | nc | 0.52 nc | 0.5 |
| Tin | 7440-31-5 | | | | | | | | | 100000 | max | 4690 nc | 5 |
| Titanium | 7440-32-6 | | | | | | | | | | | | 5 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | Risk-Based | | | | | |
| Vanadium | 7440-62-2 | 530 | nc | 1600 | nc | 1900 | nc | 720 | nc | 55 | nc | | 2.5 |
| Zinc | 7440-66-6 | 23000 | nc | 69000 | nc | 80000 | nc | 100000 | max | 2300 | nc | | 5 |
| Method 7060A GFAA | | | | | | | | | | | | | |
| Arsenic | 7440-38-2 | 3.9 | ca | 17 | ca | 0.019 | ca | 1.6 | ca | 0.39 | ca | | 0.5 |
| Method 7421 GFAA | | | | | | | | | | | | | |
| Lead | 7439-92-1 | 400 | NC | 1000 | nc | 1 | nc | 75 | nc | 40 | nc | | 0.5 |
| Mercury (soil): Method 7471A | | | | | | | | | | | | | |
| Mercury [3] | 7439-97-6 | 23 | nc | 69 | nc | 80 | nc | 31 | nc | 2.3 | nc | | 0.1 |
| Method 7740 GFAA | | | | | | | | | | | | | |
| Selenium | 7782-49-2 | 380 | nc | 1200 | nc | 1300 | nc | 510 | nc | 39 | nc | | 0.5 |
| Petroleum Hydrocarbons: Method 8015B | | | | | | | | | | | | | |
| Diesel Range Organics | DRO | | | | | | | | | | | | 10 |
| Gasoline Range Organics | GRO | | | | | | | | | | | | 1 |
| Aromatic Volatile Organics: Method 8021B | | | | | | | | | | | | | |
| Benzene | 71-43-2 | 6.4 | ca | 5.6 | nc | 29 | nc | 1.3 | ca | 0.6 | ca | | 0.005 |
| Ethylbenzene | 100-41-4 | 68 | sat | 68 | sat | 68 | sat | 20 | ca | 8.9 | ca | | 0.005 |
| Methyl tert-butyl ether | 1634-04-4 | | | | | | | 160 | ca | 62 | ca | | 0.005 |
| Toluene | 108-88-3 | 180 | sat | 180 | sat | 180 | sat | 520 | sat | 520 | sat | | 0.005 |
| Xylenes (total) | 1330-20-7 | 63 | sat | 63 | sat | 63 | sat | 420 | sat | 27 | nc | | 0.005 |
| Pesticides: Method 8081A | | | | | | | | | | | | | |
| 4,4'-DDD | 72-54-8 | 24 | ca | 100 | nc | 0.27 | nc | 10 | ca | 2.4 | ca | | 0.003 |
| 4,4'-DDE | 72-55-9 | 17 | ca | 75 | ca | 0.27 | nc | 7 | ca | 1.7 | ca | | 0.003 |
| 4,4'-DDT | 50-29-3 | 17 | ca | 75 | ca | 0.27 | nc | 7 | ca | 1.7 | ca | | 0.003 |
| Pesticides: Method 8081A | | | | | | | | | | | | | |
| Aldrin | 309-00-2 | 0.29 | ca | 1.2 | ca | 0.016 | nc | 0.1 | ca | 0.029 | ca | | 0.0017 |
| Chlordane [4] | 57-74-9 | 16 | ca | 70 | ca | 0.11 | nc | 6.5 | ca | 1.6 | ca | | 0.017 |
| Dieldrin | 60-57-1 | 0.3 | ca | 1.3 | ca | 0.018 | ca | 0.11 | ca | 0.03 | ca | | 0.003 |
| Endosulfan I [5] | 959-98-8 | 370 | nc | 890 | nc | 3.2 | nc | 370 | nc | 37 | nc | | 0.003 |
| Endosulfan II [5] | 33213-65-9 | 370 | nc | 890 | nc | 3.2 | nc | 370 | nc | 37 | nc | | 0.003 |
| Endosulfan sulfate [5] | 1031-07-8 | 370 | nc | 890 | nc | 3.2 | nc | 370 | nc | 37 | nc | | 0.003 |
| Endrin | 72-20-8 | 18 | nc | 44 | nc | 0.16 | nc | 18 | nc | 1.8 | nc | | 0.003 |
| Endrin aldehyde [6] | 7421-93-4 | 18 | nc | 44 | nc | 0.16 | nc | 18 | nc | 1.8 | nc | | 0.003 |
| Endrin ketone [6] | 53494-70-5 | 18 | nc | 44 | nc | 0.16 | nc | 18 | nc | 1.8 | nc | | 0.003 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | Risk-Based | | | |
| Heptachlor | 76-44-8 | 1.1 | ca | 4.5 | ca | 0.062 | ca | 0.38 | ca | 0.11 ca | 0.0017 |
| Heptachlor epoxide | 1024-57-3 | | | | | | | 0.19 | ca | 0.053 ca | 0.0017 |
| Methoxychlor | 72-43-5 | | | | | | | 3100 | nc | 310 nc | 0.0017 |
| Toxaphene | 8001-35-2 | 4.4 | ca | 19 | ca | 0.26 | ca | 1.6 | ca | 0.44 ca | 0.05 |
| alpha-BHC | 319-84-6 | | | | | | | 0.36 | ca | 0.09 ca | 0.0017 |
| alpha-Chlordane [7] | 5103-71-9 | | | | | | | | | | 0.003 |
| beta-BHC | 319-85-7 | 0.9 | ca | 3.9 | ca | 0.046 | ca | 1.3 | ca | 0.32 ca | 0.0017 |
| delta-BHC [8] | 319-86-8 | | | | | | | | | | 0.0017 |
| gamma-BHC (Lindane) | 58-89-9 | 4.4 | ca | 19 | ca | 0.16 | nc | 1.7 | ca | 0.44 ca | 0.0017 |
| gamma-Chlordane [7] | 5103-74-2 | | | | | | | | | | 0.003 |
| **PCBs: Method 8082** | | | | | | | | | | | |
| Aroclor 1016 [9] | 12674-11-2 | 3.9 | nc | 8.9 | nc | 0.038 | nc | 21 | ca | 0.39 nc | 0.5 |
| Aroclor 1221 [9] | 11104-28-2 | 2.2 | ca | 9.2 | ca | 0.15 | ca | 0.74 | ca | 0.22 ca | 0.5 |
| Aroclor 1232 [9] | 11141-16-5 | 2.2 | ca | 9.2 | ca | 0.15 | ca | 0.74 | ca | 0.22 ca | 0.5 |
| **PCBs: Method 8082** | | | | | | | | | | | |
| Aroclor 1242 [9] | 53469-21-9 | 2.2 | ca | 9.2 | ca | 0.15 | ca | 0.74 | ca | 0.22 ca | 0.5 |
| Aroclor 1248 [9] | 12672-29-6 | 1.1 | nc | 2.5 | nc | 0.011 | nc | 0.74 | ca | 0.22 ca | 0.5 |
| Aroclor 1254 [9] | 11097-69-1 | 1.1 | nc | 2.5 | nc | 0.011 | nc | 0.74 | ca | 0.22 ca | 0.5 |
| Aroclor 1260 [9] | 11096-82-5 | 1.1 | nc | 2.5 | nc | 0.011 | nc | 0.74 | ca | 0.22 ca | 0.5 |
| **Chlorinated Herbicides: Method 8151A** | | | | | | | | | | | |
| 2,4,5-T | 93-76-5 | | | | | | | 620 | nc | 61 nc | 0.04 |
| 2,4,5-TP Silvex | 93-72-1 | | | | | | | 490 | nc | 49 nc | 0.04 |
| 2,4-D | 94-75-7 | | | | | | | 770 | nc | 69 nc | 0.2 |
| 2,4-DB | 94-82-6 | | | | | | | 490 | nc | 49 nc | 0.2 |
| Dinoseb | 88-85-7 | | | | | | | 62 | nc | 6.1 nc | 0.2 |
| Dalapon | 75-99-0 | | | | | | | 1800 | nc | 180 nc | 1.2 |
| Dicamba | 1918-00-9 | | | | | | | 1800 | nc | 180 nc | 1.2 |
| Dichloroprop | 120-36-5 | | | | | | | | | | 0.2 |
| MCPA | 94-74-6 | | | | | | | 31 | nc | 3.1 nc | 1.2 |
| MCPP (Mecoprop) | 93-65-2 | | | | | | | 62 | nc | 6.1 nc | 4 |
| Pentachlorophenol | 87-86-5 | | | | | | | 9 | ca | 3 ca | 0.2 |
| Picloram | 1918-02-1 | | | | | | | 4300 | nc | 430 nc | 0.2 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | Risk-Based | | | | | |
| [illegible] | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | 71-55-6 | 510 | sat | 510 | sat | 510 | sat | 1200 | sat | 1200 | sat | 0.05 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 3.6 | ca | 8.2 | ca | 160 | ca | 0.93 | ca | 0.41 | ca | 0.005 |
| 1,2,2-Trichloro-1,1,2-trifluoroethane | 76-13-1 | | | | | | | 5600 | sat | 5600 | sat | 0.005 |
| 1,1,2-Trichloroethane | 79-00-5 | 7.9 | ca | 18 | ca | 160 | nc | 1.6 | ca | 0.73 | ca | 0.005 |
| 1,1-Dichloroethane | 75-34-3 | | | | | | | 170 | nc | 51 | nc | 0.05 |
| 1,1-Dichloroethene | 75-35-4 | | | | | | | 41 | nc | 12 | nc | 0.05 |
| 1,2,4-Trichlorobenzene | 120-82-1 | 520 | nc | 530 | sat | 530 | sat | 3000 | sat | 65 | nc | 0.005 |
| 1,2-Dibromo-3-chloropropane (DBCP) | 96-12-8 | | | | | | | 0.046 | ca | 0.019 | ca | 0.005 |
| 1,2-Dibromoethane (EDB) | 106-93-4 | | | | | | | 0.028 | ca | 0.0069 | ca | 0.005 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | |
|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | EPA Region 9 PRGs Industrial # | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | Industrial/ Occupational | Construction Worker | Risk-Based | | |
| **Volatile Organics: Method 8260B** | | | | | | | |
| 1,2-Dichlorobenzene | 95-50-1 | | | | 370 sat | 370 sat | 0.005 |
| 1,2-Dichloroethane | 107-06-2 | | | | 0.6 ca | 0.28 ca | 0.005 |
| 1,2-Dichloropropane | 78-87-5 | | | | 0.74 ca | 0.34 ca | 0.005 |
| 1,3-Dichlorobenzene | 541-73-1 | | | | 6.3 nc | 1.6 nc | 0.005 |
| 1,4-Dichlorobenzene | 106-46-7 | | | | 7.9 ca | 3.4 ca | 0.005 |
| 2-Butanone (MEK) | 78-93-3 | | | | 2700 nc | 730 nc | 0.1 |
| 2-Hexanone (Methyl Butyl Ketone) [10] | 591-78-6 | | | | 280 nc | 79 nc | 0.1 |
| 4-Methyl-2-pentanone (MIBK) | 108-10-1 | | | | 280 nc | 79 nc | 0.1 |
| Acetone | 67-64-1 | | | | 600 nc | 160 nc | 0.1 |
| Benzene | 71-43-2 | 6.4 ca | 5.6 nc | 29 nc | 1.3 ca | 0.6 ca | 0.005 |
| Bromochloromethane [11] | 74-97-5 | | | | 1.8 ca | 0.82 ca | 0.005 |
| Bromodichloromethane | 75-27-4 | 9.6 ca | 22 ca | 450 ca | 1.8 ca | 0.82 ca | 0.05 |
| Bromoform | 75-25-2 | | | | 220 ca | 62 ca | 0.05 |
| Bromomethane (Methyl Bromide) | 74-83-9 | 3.7 nc | 3 nc | 15 nc | 1.3 nc | 0.39 nc | 0.05 |
| Carbon disulfide | 75-15-0 | | | | 720 sat | 36 nc | 0.05 |
| Carbon tetrachloride | 56-23-5 | 1.6 nc | 1.3 nc | 6.8 nc | 0.55 ca | 0.25 ca | 0.05 |
| Chlorobenzene | 108-90-7 | 140 nc | 120 nc | 190 nc | 53 nc | 15 nc | 0.05 |
| Chloroethane (Ethyl Chloride) | 75-00-3 | | | | 6.5 ca | 3 ca | 0.05 |
| Chloroform | 67-66-3 | 0.38 nc | 0.3 nc | 1.6 nc | 12 ca | 3.6 ca | 0.05 |
| Chloromethane (Methyl Chloride) | 74-87-3 | | | | 2.6 ca | 1.2 ca | 0.05 |
| cis-1,2-Dichloroethene | 156-59-2 | 41 ca | 33 ca | 170 nc | 15 nc | 4.3 nc | 0.005 |
| cis-1,3-Dichloropropene [12] | 10061-01-5 | | | | 1.76 ca | 0.78 ca | 0.005 |
| Cyclohexane | 110-82-7 | | | | 140 sat | 140 sat | 0.005 |
| Dibromochloromethane | 124-48-1 | | | | 2.6 ca | 1.1 ca | 0.05 |
| Dichlorodifluoromethane | 75-71-8 | | | | 31 nc | 9.4 nc | 0.005 |
| Ethylbenzene | 100-41-4 | 68 sat | 68 sat | 68 sat | 20 ca | 8.9 ca | 0.005 |
| Isopropylbenzene (Cumene) | 98-82-8 | | | | 200 nc | 57 nc | 0.005 |
| **Semi-Volatiles Organics: Method 8270C** | | | | | | | |
| Methyl Acetate | 79-20-9 | | | | 9200 nc | 2200 nc | 0.005 |
| Methyl tert-butyl ether (MTBE) | 1634-04-4 | | | | 160 ca | 62 ca | 0.05 |
| Methylcyclohexane | 108-87-2 | | | | 870 nc | 260 nc | 0.005 |
| Methylene Chloride (Dichloromethane) | 75-09-2 | | | | 21 ca | 9.1 ca | 0.05 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | |
|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | EPA Region 9 PRGs Industrial # | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | Industrial/ Occupational | Construction Worker | Risk-Based | | |
| Styrene | 100-42-5 | | | | 1700 sat | 1700 sat | 0.05 |
| Tetrachloroethene | 127-18-4 | 49 ca | 100 sat | 100 sat | 3.4 ca | 1.5 ca | 0.005 |
| Toluene | 108-88-3 | 180 sat | 180 sat | 180 sat | 520 sat | 520 sat | 0.005 |
| trans-1,2-Dichloroethene | 156-60-5 | 60 nc | 49 nc | 250 nc | 23 nc | 6.9 nc | 0.005 |
| trans-1,3-Dichloropropene [12] | 10061-02-6 | | | | 1.76 ca | 0.78 ca | 0.005 |
| Trichloroethene | 79-01-6 | 16 ca | 18 nc | 92 nc | 0.11 ca | 0.053 ca | 0.005 |
| Trichlorofluoromethane | 75-69-4 | | | | 2000 sat | 39 nc | 0.005 |
| Vinyl chloride | 75-01-4 | 0.21 ca | 0.45 ca | 10 nc | | 0.08 ca | 0.005 |
| Xylenes (total) | 1330-20-7 | 63 sat | 63 sat | 63 sat | 420 sat | 27 nc | 0.005 |
| 1,1'-Biphenyl | 92-52-4 | | | | 350 sat | 350 sat | 0.33 |
| 1-Methylnaphthalene | 90-12-0 | | | | | | 0.33 |
| 2,4,5-Trichlorophenol | 95-95-4 | 6100 nc | 15000 nc | 54 nc | 6200 nc | 610 nc | 0.33 |
| 2,4,6-Trichlorophenol | 88-06-2 | 440 ca | 1900 ca | 27 ca | 6.2 nc** | 0.61 nc** | 0.33 |
| 2,4-Dichlorophenol | 120-83-2 | | | | 180 nc | 18 nc | 0.33 |
| 2,4-Dimethylphenol | 105-67-9 | | | | 1200 nc | 120 nc | 0.33 |
| 2,4-Dinitrophenol | 51-28-5 | | | | 120 nc | 12 nc | 1.6 |
| 2,4-Dinitrotoluene | 121-14-2 | | | | 120 nc | 12 nc | 0.33 |
| 2,6-Dinitrotoluene | 606-20-2 | | | | 62 nc | 6.1 nc | 0.33 |
| 2-Chloronaphthalene | 91-58-7 | | | | 2300 nc | 490 nc | 0.33 |
| 2-Chlorophenol | 95-57-8 | | | | 24 nc | 6.3 nc | 0.33 |
| 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol) | 534-52-1 | | | | | | 0.7 |
| 2-Methylnaphthalene | 91-57-6 | | | | | | 0.33 |
| 2-Methylphenol (o-Cresol) | 95-48-7 | | | | 3100 nc | 310 nc | 0.33 |
| **Soil Volatile Organics Method 8270C** | | | | | | | |
| 2-Nitroaniline | 88-74-4 | | | | 1.8 nc | 0.17 nc | 1.6 |
| 2-Nitrophenol [13] | 88-75-5 | | | | | | 0.33 |
| 3,3'-Dichlorobenzidine | 91-94-1 | | | | 3.8 ca | 1.1 ca | 1.6 |
| 3-Nitroaniline | 99-09-2 | | | | | | 1.6 |
| 4-Bromophenyl phenyl ether | 101-55-3 | | | | | | 0.33 |
| 4-Chloro-3-methylphenol | 59-50-7 | | | | | | 0.33 |
| 4-Chloroaniline | 106-47-8 | | | | 250 nc | 24 nc | 0.33 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | | | | | | 0.33 |
| 4-Methylphenol (p-Cresol) | 106-44-5 | | | | 310 nc | 31 nc | 0.33 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | | | Risk-Based | | | |
| 4-Nitroaniline | 100-01-6 | | | | | | | | | | | | 1.6 |
| 4-Nitrophenol | 100-02-7 | | | | | | | | | | | | 1.6 |
| Acenaphthene | 83-32-9 | | | | | | | | | 2900 | nc | 370 nc | 0.33 |
| Acenaphthylene [14] | 208-96-8 | | | | | | | | | | | | 0.33 |
| Acetophenone | 98-86-2 | | | | | | | | | | | | 0.33 |
| Anthracene | 120-12-7 | 16000 | nc | 34000 | nc | 62000 | nc | | | 100000 | max | 2200 nc | 0.33 |
| Atrazine | 1912-24-9 | | | | | | | | | 7.8 | ca | 2.2 ca | 0.33 |
| Benzaldehyde | 100-52-7 | | | | | | | | | 6200 | nc | 610 nc | 0.33 |
| Benzo(a)anthracene | 56-55-3 | 6.2 | ca | 26 | ca | 0.94 | ca | | | 2.1 | ca | 0.62 ca | 0.33 |
| Benzo(a)pyrene | 50-32-8 | 0.62 | ca | 2.6 | ca | 0.094 | ca | | | 0.21 | ca | 0.062 ca | 0.33 |
| Benzo(b)fluoranthene | 205-99-2 | 6.2 | ca | 26 | ca | 0.94 | ca | | | 2.1 | ca | 0.62 ca | 0.33 |
| Benzo(g,h,i)perylene [15] | 191-24-2 | | | | | | | | | 2900 | nc | 230 nc | 0.33 |
| Benzo(k)fluoranthene | 207-08-9 | 62 | ca | 260 | ca | 9.4 | ca | | | 21 | ca | 6.2 ca | 0.33 |
| bis(2-Chloroethoxy)methane | 111-91-1 | | | | | | | | | | | | 0.33 |
| bis(2-Chloroethyl)ether | 111-44-4 | 4.4 | ca | 19 | ca | 0.25 | ca | | | 0.55 | ca | 0.21 ca | 0.33 |
| bis(2-Chloroisopropyl)ether [2,2'-oxybis(1-chloropropane)] | 108-60-1 | 69 | ca | 290 | ca | 8.3 | ca | | | 7.4 | ca | 2.9 ca | 0.33 |
| bis(2-ethylhexyl)phthalate | 117-81-7 | | | | | | | | | 120 | ca | 35 ca | 0.33 |
| Butyl benzyl phthalate | 85-68-7 | | | | | | | | | 100000 | max | 1200 nc | 0.33 |
| Semi-volatile Organics Method 8270C | | | | | | | | | | | | | |
| Caprolactam | 105-60-2 | | | | | | | | | 100000 | max | 3100 nc | 0.33 |
| Carbazole | 86-74-8 | | | | | | | | | 86 | ca | 24 ca | 0.33 |
| Chrysene | 218-01-9 | 610 | ca | 2500 | ca | 6400 | nc | | | 210 | ca | 62 ca | 0.33 |
| Dibenz(a,h)anthracene | 53-70-3 | 0.62 | ca | 2.6 | ca | 0.094 | ca | | | 0.21 | ca | 0.062 ca | 0.33 |
| Dibenzofuran | 132-64-9 | | | | | | | | | 310 | nc | 29 nc | 0.33 |
| Diethyl phthalate | 84-66-2 | 49000 | nc | 100000 | max | 430 | nc | | | 100000 | max | 49000 nc | 0.33 |
| Dimethyl phthalate | 131-11-3 | 100000 | max | 100000 | max | 5400 | nc | | | 100000 | max | 100000 max | 0.33 |
| Di-n-butyl phthalate | 84-74-2 | 6100 | nc | 15000 | nc | 54 | nc | | | 6200 | nc | 610 nc | 0.33 |
| Di-n-octyl phthalate | 117-84-0 | | | | | | | | | 2500 | nc | 240 nc | 0.33 |
| Fluoranthene | 206-44-0 | 2300 | nc | 5300 | nc | 21 | nc | | | 2200 | nc | 230 nc | 0.33 |
| Fluorene | 86-73-7 | 2100 | nc | 4000 | nc | 8000 | nc | | | 2600 | nc | 270 nc | 0.33 |
| Hexachlorobenzene | 118-74-1 | 3 | ca | 13 | ca | 0.18 | ca | | | 1.1 | ca | 0.3 ca | 0.33 |
| Hexachlorobutadiene | 87-68-3 | 12 | nc | 30 | nc | 0.11 | nc | | | 22 | ca | 6.2 ca | 0.33 |
| Hexachlorocyclopentadiene | 77-47-4 | 420 | nc | 1000 | nc | 0.011 | nc | | | 370 | nc | 37 nc | 0.33 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | | | Risk-Based | | | |
| Hexachloroethane | 67-72-1 | 61 | nc | 150 | nc | 0.054 | nc | | | 120 | ca | 35 ca | 0.33 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | 6.2 | ca | 26 | ca | 0.94 | ca | | | 2.1 | ca | 0.62 ca | 0.33 |
| Isophorone | 78-59-1 | 5100 | ca | 22000 | ca | 110 | nc | | | 1800 | ca | 510 ca | 0.33 |
| Naphthalene | 91-20-3 | 53 | nc | 43 | nc | 220 | nc | | | 19 | nc | 5.6 nc | 0.33 |
| Nitrobenzene | 98-95-3 | 17 | nc | 21 | nc | 66 | nc | | | 10 | nc | 2 nc | 0.33 |
| N-Nitroso-di-n-propylamine | 621-64-7 | | | | | | | | | 0.25 | ca | 0.069 ca | 0.33 |
| N-Nitrosodiphenylamine | 86-30-6 | | | | | | | | | 350 | ca | 99 ca | 0.33 |
| Pentachlorophenol | 87-86-5 | | | | | | | | | 9 | ca | 3 ca | 1.6 |
| Phenanthrene [16] | 85-01-8 | 1800 | nc | 4400 | nc | 16 | nc | | | 2900 | nc | 230 nc | 0.33 |
| Phenol | 108-95-2 | 37000 | nc | 89000 | nc | 320 | nc | | | 100000 | max | 3700 nc | 0.33 |
| Pyrene | 129-00-0 | 1800 | nc | 4300 | nc | 6700 | nc | | | 2900 | nc | 230 nc | 0.33 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | |
|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | EPA Region 9 PRGs Industrial # | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | Industrial/ Occupational | Construction Worker | Risk-Based | | |
| **Dioxin Method 8290** | | | | | | | |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) [17] | 1746-01-6 | | | | 0.000016 ca | 0.0000039 ca | ~ 0.000001 |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) [17] | 40321-76-4 | | | | | | ~ 0.000001 |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) [17] | 57653-85-7 | | | | | | ~ 0.0000025 |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) [17] | 39227-28-6 | | | | | | ~ 0.0000025 |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) [17] | 19408-74-3 | | | | | | ~ 0.0000025 |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) [17] | 35822-39-4 | | | | | | ~ 0.0000025 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) [17] | 3268-87-9 | | | | | | ~ 0.000005 |
| 2,3,7,8-Tetrachlorodibenzofuran (TCDF) [17] | 51207-31-9 | | | | | | ~ 0.0000025 |
| 1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) [17] | 57117-41-6 | | | | | | ~ 0.0000025 |
| 2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) [17] | 57117-31-4 | | | | | | ~ 0.0000025 |
| 1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) [17] | 57117-44-9 | | | | | | ~ 0.0000025 |
| 1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) [17] | 72918-21-9 | | | | | | ~ 0.0000025 |
| 1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) [17] | 70648-26-9 | | | | | | ~ 0.0000025 |
| **Dioxin Method 8290** | | | | | | | |
| 2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) [17] | 60851-34-5 | | | | | | ~ 0.0000025 |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) [17] | 67562-39-4 | | | | | | ~ 0.0000025 |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) [17] | 55673-89-7 | | | | | | ~ 0.0000025 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) [17] | 39001-02-0 | | | | | | ~ 0.000005 |
| **PAH Method 8310** | | | | | | | |
| 1-Methylnaphthalene | 90-12-0 | | | | | | 0.05 |
| 2-Methylnaphthalene | 91-57-6 | | | | | | 0.05 |
| Acenaphthene | 83-32-9 | 2800 nc | 4900 nc | 11000 nc | 2900 nc | 370 nc | 0.05 |
| Acenaphthylene [14] | 208-96-8 | | | | 2900 nc | 370 nc | 0.05 |
| Anthracene | 120-12-7 | 16000 nc | 34000 nc | 62000 nc | 100000 max | 2200 nc | 0.05 |
| Benzo(a)anthracene | 56-55-3 | 6.2 ca | 26 ca | 0.94 ca | 2.1 ca | 0.62 ca | 0.005 |
| Benzo(a)pyrene | 50-32-8 | 0.62 ca | 2.6 ca | 0.094 ca | 0.21 ca | 0.062 ca | 0.005 |
| Benzo(b)fluoranthene | 205-99-2 | 6.2 ca | 26 ca | 0.94 ca | 2.1 ca | 0.62 ca | 0.005 |
| **PAH Method 8310** | | | | | | | |
| Benzo(g,h,i)perylene [15] | 191-24-2 | | | | 2900 nc | 230 nc | 0.005 |
| Benzo(k)fluoranthene | 207-08-9 | 62 ca | 260 ca | 9.4 ca | 21 ca | 6.2 ca | 0.005 |
| Chrysene | 218-01-9 | 610 ca | 2500 ca | 6400 nc | 210 ca | 62 ca | 0.005 |
| Dibenz(a,h)anthracene | 53-70-3 | 0.62 ca | 2.6 ca | 0.094 ca | 0.21 ca | 0.062 ca | 0.005 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

| Analyte Name | CAS Number | Soil (mg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NMED Soil Screening Levels | | | | | | | | EPA Region 9 PRGs Industrial # | | EPA Region 9 PRGs Residential # | Solids MQL |
| | | Residential | | Industrial/ Occupational | | Construction Worker | | | | Risk-Based | | | |
| Fluoranthene | 206-44-0 | 2300 | nc | 5300 | nc | 21 | nc | | | 2200 | nc | 230 nc | 0.005 |
| Fluorene | 86-73-7 | 2100 | nc | 4000 | nc | 8000 | nc | | | 2600 | nc | 270 nc | 0.005 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | 6.2 | ca | 26 | ca | 0.94 | ca | | | 2.1 | ca | 0.62 ca | 0.005 |
| Naphthalene | 91-20-3 | 53 | nc | 43 | nc | 220 | nc | | | 19 | nc | 5.6 nc | 0.005 |
| Phenanthrene [10] | 85-01-8 | 1800 | nc | 4400 | nc | 16 | nc | | | 2900 | nc | 230 nc | 0.005 |
| Pyrene | 129-00-0 | 1800 | nc | 4300 | nc | 6700 | nc | | | 2900 | nc | 230 nc | 0.005 |
| **Explosives: Method 8330** | | | | | | | | | | | | | |
| 1,3,5-Trinitrobenzene | 99-35-4 | | | | | | | | | 1800 | nc | 180 nc | 0.25 |
| 1,3-Dinitrobenzene | 99-65-0 | | | | | | | | | 6.2 | nc | 0.61 nc | 0.25 |
| 2,4,6-Trinitrotoluene | 118-96-7 | 31 | nc | 74 | nc | 0.27 | nc | | | 57 | ca | 16 ca | 0.25 |
| 2,4-Dinitrotoluene | 121-14-2 | | | | | | | | | 120 | nc | 12 nc | 0.25 |
| 2,6-Dinitrotoluene | 606-20-2 | | | | | | | | | 62 | nc | 6.1 nc | 0.25 |
| 2-Amino-4,6-dinitrotoluene | 35572-78-2 | | | | | | | | | | | | 0.25 |
| 2-Nitrotoluene | 88-72-2 | | | | | | | | | 1000 | sat | 36.7 nc | 0.25 |
| 3-Nitrotoluene | 99-08-1 | | | | | | | | | 1000 | sat | 37 nc | 0.25 |
| 4-Amino-2,6-dinitrotoluene | 19406-51-0 | | | | | | | | | | | | 0.25 |
| 4-Nitrotoluene | 99-99-0 | | | | | | | | | 1000 | sat | 37 nc | 0.25 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 121-82-4 | 44 | ca | 190 | ca | 1.6 | nc | | | 16 | ca | 4.4 ca | 1 |
| Methyl-2,4,6-trinitrophenylnitramine (Tetryl) | 479-45-8 | | | | | | | | | 620 | nc | 61 nc | 0.65 |
| Nitrobenzene | 98-95-3 | 17 | nc | 21 | nc | 66 | nc | | | 10 | nc | 2 nc | 0.25 |
| **Explosives: Method 8330** | | | | | | | | | | | | | |
| Nitroglycerin | 55-63-0 | 350 | ca | 1500 | ca | 21 | ca | | | 120 | ca | 35 ca | 5 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 2691-41-0 | 3100 | nc | 7400 | nc | 11 | nc | | | 3100 | nc | 310 nc | 2.5 |
| Pentaerythritol tetranitrate | 78-11-5 | | | | | | | | | | | | 5 |
| **Cyanide: Method 9010B** | | | | | | | | | | | | | |
| Cyanide | 57-12-5 | 1200 | nc | 3000 | nc | 11 | nc | | | 1200 | nc | 120 nc | 0.5 |
| **Total Organic Halides: Method 9020B** | | | | | | | | | | | | | |
| Total Organic Halides | TOX | | | | | | | | | | | | 10 |
| **Total Organic Carbon: Method 9060** | | | | | | | | | | | | | |
| Total Organic Carbon | TOC | | | | | | | | | | | | 5 |
| **Method 300.0** | | | | | | | | | | | | | |
| Chloride | 16887-00-6 | | | | | | | | | | | | 5 |
| Sulfate | 14808-79-8 | | | | | | | | | | | | 5 |

# TABLE 5-3
# COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES
# SOIL

**List of Analytes**

1 - The value for hexavalent chromium (CAS No. 18540-29-9) is used as a surrogate SCTL value for this compound.
2 - The value for thallium and compounds (CAS No. 7446-18-6) is used as a surrogate Region 9 PRG value for this compound.
3 - The value for mercury chloride (CAS No. 7487-94-7) is used as a surrogate Region 9 PRG value for this compound.
4 - The value for technical chlordane (CAS No. 12789-03-6) is used as a surrogate Region 9 PRG value for this compound.
5 - The value for endosulfan (CAS No. 115-29-7) is used as a surrogate value for this compound.
6 - The value for endrin (CAS No. 72-20-8) is used as a surrogate value for this compound.
7 - The value for chlordane (CAS No. 54-74-9) is used as a surrogate value for this compound.
The value for technical chlordane (CAS No. 12789-03-6) is used as a surrogate Region 9 PRG value for this compound.
8 - The value for gamma-BHC (CAS No. 58-89-9) is used as surrogate Region 9 PRG, and Region 4 SSV values for this compound.
9 - The value for total PCBs (CAS No. 1336-36-3) is used as surrogate SCTL, and Region 4 SSV values for this compound.
10 - The value for methyl isobutyl ketone (CAS No. 108-10-1) is used as a surrogate Region 9 PRG value for this compound.
11 - The value for bromodichloromethane (CAS No. 75-27-4) is used as a surrogate Region 9 PRG value for this compound.
12 - The value for 1,3-dichloropropene (CAS No. 542-75-6) is used as surrogate SCTL and Region 9 PRG values for this compound.
13 - The value for 4-nitrophenol (CAS No. 100-02-7) is used as a surrogate value for this compound.
14 - The value for acenaphthene (CAS No. 83-32-9) is used as surrogate Region 9 PRG and Region 4 SSV values for this compound.
15 - The value for pyrene (CAS No. 129-00-0) is used as surrogate Region 9 PRG, and Region 4 SSV values for this compound.
16 - The value for pyrene (CAS No. 129-00-0) is used as a surrogate Region 9 PRG value for this compound.
17 - This GC/MS method uses matrix-specific extraction, analyte-specific cleanup, and high-resolution capillary column GC/high resolution mass spectrometry techniques to separate and identify the analytes of interest. The sensitivity of the method is dependent on the level of matrix interference. Selected cleanup methods may be used to reduce or eliminate interferences. Target analytes may include all congener classes, tetra- through octa-dioxins and furans. Achieved detection limits vary according to matrix and analyte.

**NMED Soil Screening Levels "Technical Background Document for Development of Soil Screening Levels, Appendix A"**

ca carcinogenic effect basis
nc noncarcinogenic effect basis
sat soil saturation limit basis
max low toxicity, health based SSL exceeds [$10^5$] mg/kg

**EPA Region 9 PRGs (10/01/02)**

# Values for noncarcinogens are adjusted by a Hazard Index (HI) of 0.1 to account for additive effects.
ca Cancer PRG
ca* Cancer PRG (where nc < 100X ca)
ca** Cancer PRG (where nc < 10X ca)
ca/nc Cancer PRG / Noncancer PRG (no need to make a decision here.)
max Ceiling limit
nc Noncancer PRG
nc ** Noncancer PRG is more stringent than cancer PRG set at one-in-one-million risk.
sat Soil Saturation
+++ Non-Standard Method
Note: Significant figures are based on electronic download from the EPA Region 9 website (www.epa.gov/region09/waste/sfund/prg/)

**EPA Region 4 Soil Screening Values (6/23/00)**

None

**Solid MQLs**

The MQL is defined as the lowest level that can be reliably detected within specified limits of precision and accuracy during routine laboratory operating conditions.
The **MQL** will be set at 3 to 5 times the MDL and shall be the **lowest standard used during calibration procedures for each analytical method.**

**Acronyms:**

**TABLE 5-3**
**COMPREHENSIVE ANALYTE AND DATA QUALITY OBJECTIVES**
**SOIL**

DQO - Data Quality Objective
FAC - Florida Administrative Code
MQL - Method Quantitation Limit
PRG - Preliminary Remediation Goal

**Table 6-1**
**DEFINITIONS AND USES OF STATISTICAL CALCULATIONS**
**Holloman Air Force Base, New Mexico**

| Statistic | Symbol | Formula | Definition | Uses |
|---|---|---|---|---|
| Average or Mean | $\overline{X}$ | $\frac{\left(\sum_{i=1}^{n} x_i\right)}{n}$ | Measure of central tendency | To determine average value of measurements |
| Standard Deviation | S | $\left(\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2}{(n-1)}\right)^{1/2}$ | Measure of relative scatter of the data | Used in calculating variation of measurements |
| Relative Standard Deviation | RSD | $(s/\overline{x}) \times 100$ | Relative standard deviation, adjusts for magnitude of observations | Used to assess precision for replicate results |
| Percent Difference | %D | $\frac{x_1 - x_2}{x_1} \times 100$ | Measure of the difference of 2 observations | Used to assess precision |
| Relative Percent Difference | RPD | $\left(\frac{x_1 - x_2}{(x_1 + x_2)/2}\right) \times 100$ | Measure of variability that adjusts for the magnitude of observations | Used to assess total and analytical precision of duplicate measurements |
| Percent Recovery | %R | $\left(\frac{x_{meas}}{x_{true}}\right) \times 100$ | Recovery of spiked compound in pure matrix | Used to assess accuracy |
| Percent Recovery | %R | $\frac{\left(\text{value of spiked sample} - \text{value of unspiked sample}\right)}{\text{Value of added spike}} \times 100$ | Recovery of spiked compound in sample matrix | Used to assess matrix effects |

x = Observation (concentration)
n = Number of observations

**Table 7-1**
**CALIBRATION FREQUENCY**
**Holloman Air Force Base, New**

| Equipment Type | Calibration Type | Number of Standards | Acceptance/Rejection Criteria | Frequency |
|---|---|---|---|---|
| pH Meter | Daily<br>Continuing | 2<br>1 | > ± 0.1 units<br>> ± 0.1 units | Before use/daily<br>Every 4 hours |
| Conductivity Meter | Daily<br>Continuing | 2<br>1 | > ± 5% of true value<br>> ± 5% of true value | Before use/daily<br>Every 4 hours |
| Temperature Meter | Continuing | N/A | > ± 5% of thermometer value<br>> ± 5% of thermometer value | First sample daily<br>Every 4 hours |
| DO Meter | Daily<br>Continuing<br>Annual | N/A<br>N/A<br>3 | N/A<br>N/A<br>> 95% of Winkler value | Before use/daily<br>Every 4 hours<br>Yearly |
| Oxidation-Reduction Potential (ORP) | Daily<br>Annual | 1 | Redox solution standard<br>200-275 mV @ 25$^0$C | Before use/daily<br>Every 4 hours |
| Turbidity Meter | Daily<br>Continuing<br>Semi-annual | 2 gel<br>1 gel<br>3 Formazin | > ± 5% of true value<br>> ± 5% of true value<br>> ± 5% of Formazin's true value | Before use/daily<br>Every 4 hours<br>Every 3 months |
| Combination Meters | (see individual calibration frequencies above) | | | |
| OVA (FID) | Daily | 2 | > ± 5% of true value | Before use/daily |
| OVA (PID) | Daily | 2 | > ± 5% of true value | Before use/daily |
| Explosimeter | Daily | 1 | > ± 5% of true value | Before use/daily |

**Table 8-1**
**DATA VALIDATION QUALIFIERS**
**Holloman Air Force Base, New Mexico**

| Inorganic Data Qualifiers | |
|---|---|
| **Qualifier** | **Description** |
| U | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. |
| J | The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. |
| N | The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification". |
| NJ | The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration. |
| UJ | The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. |
| R | The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified. |

| Organic Data Qualifiers | |
|---|---|
| **Qualifier** | **Description** |
| U | The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit. |
| J | The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. |
| J+ | The result is an estimated quantity, but the result may be biased high. |
| J- | The result is an estimated quantity, but the result may be biased low. |
| UJ | The analyte was analyzed for but not detected. The reported concentration limit is approximate and may be inaccurate or imprecise. |
| R | The data are unusable. The sample results are rejected due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample. |

**Table 8-2**
**DATA QUALIFICATION GUIDELINES**
**Holloman Air Force Base, New Mexico**

| QC Requirement | Criteria | Result Flag | Analysis Flag | Flag Applied To |
|---|---|---|---|---|
| Holding Time | Time exceeded for extraction or analysis by: | | | All analytes in the sample |
| | less than 2x | | h | |
| | greater than 2x | J | H | |
| LCS | % R > UCL | J for the positive results | C | The specific analyte(s) in all samples in the associated analytical batch |
| | %R < LCL | J for the positive results, R for the non-detects | c | |
| | %Diff > CL | J for all results | E | |
| Method Blank | Analyte(s) detected | B | B | The specific analyte(s) in all samples in the associated analytical batch |
| | Sample concentration of common lab artifact: | | | |
| | < 10x Max. Blank Conc. | U | L | |
| | > 10x Max Blank Conc. | | K | |
| | Sample concentration of non-common lab artifact: | | | |
| | < 5x Max Blank Conc. | U | L | |
| | > 5x Max Blank Conc. | | K | |

**Table 8-2**
**DATA QUALIFICATION GUIDELINES**
**Holloman Air Force Base, New Mexico**

| QC Requirement | Criteria | Result Flag | Analysis Flag | Flag Applied To |
|---|---|---|---|---|
| Equipment Blank | Analyte(s) detected | B | V | The specific analyte(s) in all samples with the sampling date |
| Trip Blank (VOC samples only) | Analyte(s) detected | B | T | The specific analyte(s) in all samples shipped in the same cooler. |
| Ambient Blank (VOC samples only) | Analyte(s) detected | B | F | The specific analyte(s) in all samples with the same matrix and sampling date |
| Surrogates | any surrogate % R >UCL | J for detects | I | All analytes in the sample |
| | any surrogate % R < LCL | J for all results | i | |
| | any surrogate recovery < 10% | J for detects<br>R for non-detects | G | |
| MS/MSD | MS % R > UCL | M for all results | M | The specific analyte(s) in the primary sample |
| | MS % R < LCL | M for all results | m | |
| | MSD RPD > CL | M for all results | D | |
| Sample Preservation/ Collection | Preservation/ collection requirements not met | R for all results | P | All analytes in the sample |
| Sample Storage | > 6°C and < 10°C | J for the positive results<br>R for the nondetects | y | All analytes in the sample |
| | > 10°C | J for the positive results<br>R for the nondetects | Y | |

**Table 8-2**
**DATA QUALIFICATION GUIDELINES**
**Holloman Air Force Base, New Mexico**

| QC Requirement | Criteria | Result Flag | Analysis Flag | Flag Applied To |
|---|---|---|---|---|
| Tentatively Identified Compounds (TICs) | | T | | All TICs |
| Encore holding time | Prepped within 48 hours | J | q | prepped < 96 hours |
| Encore holding time | Prepped within 48 hours | J | Q | prepped ∃ 96 hours |

UCL = upper control limit LCL = lower control limit CL = control limit

| | Criteria | Flag* |
|---|---|---|
| Quantitation | ≤ MDL | U |
| | > MDL < RL | J |
| | ≥ RL | as needed |

# Table 10-1
# SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
## Holloman Air Force Base, New Mexico

| Matrix | Parameters | Container | Preservation | Maximum Holding Times[1] | |
|---|---|---|---|---|---|
| | | | | Extraction | Analysis |
| **Water** | TCL VOCs 8260B<br>BTEX 8021B | 3 x 40ml G,<br>Septa vial<br>Teflon lined septum sealed cap | Ice to 4°C<br>HCl pH <2 | -- | 14d |
| | TCL SVOCs 8270C | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 7d | 40d[2] |
| | TCL Pesticides 8081A | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 7d | 40d[2] |
| | Polychlorinated Biphenyls (PCBs)<br>(8082) | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 7d | 40d[2] |
| | EDB 8011 | 3 x 40ml G,<br>Septa vial<br>Teflon lined septum sealed cap | Ice to 4°C<br>HCl pH <2 | 14d | 24h |
| | PAHs 8310 | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 7d | 40d[2] |
| | Explosives 8330 | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 7d | 40d[2] |
| | Herbicides 8151A | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 7d | 40d[2] |
| | 8015 | 2 x 40ml VOC Vial (VPH)<br>1 x 1L AG (EPH) | HCL <2/<br>Ice to 4°C | 14d | 40d |
| | RSK 175 | 3 x 40 ml G | Ice to 4°C<br>HCL pH < 2 | -- | 14d |
| | Dioxins/Furans 8290 | 2 x 1 L<br>Amber G<br>Teflon lined cap | Ice to 4°C | 30d | 45d |
| | RCRA or TAL Metals 6010B/7470A | 1 x 1 500ml P | $HNO_3$ pH <2/<br>Ice to 4°C | -- | 6 mo<br>(28 d Hg) |
| | RCRA or TAL Metals 6020 | 1 x 1 500ml P | $HNO_3$ pH <2/<br>Ice to 4°C | -- | 6 mo<br>(28 d Hg) |

## Table 10-1
## SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
## Holloman Air Force Base, New Mexico

| Matrix | Parameters | Container | Preservation | Maximum Holding Times[1] | |
|---|---|---|---|---|---|
| | | | | Extraction | Analysis |
| **Water (continued)** | TOC 9060 | 2 x 40ml G,<br>Septa vial<br>Teflon lined septum sealed cap | HCL or$H_2SO_4$ pH <2/<br>Ice to 4°C | -- | 28d |
| | TOX 9020B | 2 x 40ml G,<br>Septa vial<br>Teflon lined septum sealed cap | $H_2SO_4$ pH <2/<br>Ice to 4°C | -- | 28d |
| | Cyanide 9010B | 1 x 500 ml P | NaOH to pH>12<br>Cool, 4°C | -- | 14d |
| | Alkalinity<br>(310.1) | 1 x 500 mL P, G | Ice to $4^0$C | --- | 28d |
| | Anions (Br, Cl, F, $NO_2$, $NO_3$, $PO_4$ & $SO_4$)<br>(300.0) | 1 x 500 mL P, G | Ice to $4^0$C | --- | 28d for Br, F, Cl, and $SO_4^{-2}$;<br>48 hrs for $NO_3$, $NO_2$ and $PO_4^{-3}$ |
| | Biochemical Oxygen Demand (BOD, 405.1 | 1 x 500 ml P | Ice to $4^0$C | --- | 48h |
| | Hardness<br>(130.2) | 1 x 250 ml P, G | Ice to $4^0$C<br>$HNO_3$ pH<2 | --- | 180d |
| | Nitrogen, Ammonia<br>(350.3) | 1 x 250 L P, G | Ice to $4^0$C<br>$H_2SO_4$ to pH < 2 | --- | 28d |
| | Nitrogen, Nitrate<br>(352.1) | 1 x 250 L P, G | Ice to $4^0$C | --- | 48h |
| | Nitrogen, Nitrite<br>(354.1) | 1 x 250 L P, G | Ice to $4^0$C | --- | 48h |
| | Nitrogen, Nitrate + Nitrite<br>(353.2) | 1 x 250 L P, G | Ice to $4^0$C<br>$H_2SO_4$ to pH < 2 | --- | 28d |

# Table 10-1
# SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
## Holloman Air Force Base, New Mexico

| Matrix | Parameters | Container | Preservation | Maximum Holding Times[1] | |
|---|---|---|---|---|---|
| | | | | Extraction | Analysis |
| **Water (continued)** | Phosphorus, Total (365.4) | 1 x 1 250 ml P,G | Ice to $4^0C$<br>$H_2SO_4$ to pH < 2 | --- | 28d |
| | Residue, Total Solids (TS) (160.3) | 1 x 250 L P, G | Ice to $4^0C$ | --- | 7d |
| | Residue, Filterable Solids (TDS) (160.1) | 1 x 250 L P, G | Ice to $4^0C$ | --- | 7d |
| | Residue, Non-Filterable Solids (TSS, 160.2) | 1 x 250 L P, G | Ice to $4^0C$ | --- | 7d |
| | Sulfide (376.2) | 1 x 1 L P, G | Ice to $4^0C$<br>Zinc Acetate and NaOH to pH > 9 | --- | 7d |
| | Surfactants (MBAS) (425.1) | 1 x 1 L P, G | Ice to $4^0C$ | --- | 48h |
| | Turbidity (180.1) | 1 x 500 ml P, G | Ice to $4^0C$ | --- | 48h |
| | Perchlorate (314.0) | 1 x 500 mL P | Ice to $4^0C$ | --- | 28d |
| **Soils** | TCL VOCs 8260B | 3 x 5g Encore and 1 x 4 oz G, Teflon lined septum sealed cap | Ice to 4°C | 48h | 14d |
| | BTEX 8021B | 2 x 5g Encore, 2 x 25g Encore, and 1 x 4 oz G,Teflon lined septum sealed cap | Ice to 4°C | 48h | 14d |
| | TCL SVOCs 8270C | 1 x 4 oz G, Teflon lined septum sealed cap | Ice to 4°C | 7d | 40d |
| | TCL Pesticides 8081A | 1 x 4 oz G, Teflon lined septum sealed cap | Ice to 4°C | 7d | 40d |

# Table 10-1
# SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
## Holloman Air Force Base, New Mexico

| Matrix | Parameters | Container | Preservation | Maximum Holding Times[1] | |
|---|---|---|---|---|---|
| | | | | Extraction | Analysis |
| **Soils (continued)** | Polychlorinated Biphenyls (PCBs) (8082) | Teflon lined cap<br>1 x 4 oz G | Ice to 4°C | 14d | 40d[2] |
| | PAHs 8310 | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | 7d | 40d |
| | Explosives 8330 | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | 7d | 40d |
| | Herbicides 8151A | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | 7d | 40d |
| | Dioxins/Furans 8290 | 1 x 8 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | 30d | 45d |
| | 8015 | 2 x EnCore (VPH)<br>1 x 4 oz AG (EPH),<br>Teflon lined septum sealed cap | Ice to 4°C | 48h (VPH)<br>7d (EPH) | 28d (VPH)<br>40d (EPH) |
| | Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) | 1 x 8 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | 14d | 40d |
| | RCRA or TAL Metals 6010B/7471A | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | -- | 6 mo<br>(28d Hg) |
| | RCRA or TAL Metals 6020 | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | -- | 6 mo<br>(28d Hg) |
| | TOC 9060 | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | -- | 28d |
| | TOX 9020B | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | -- | 28d |
| | Cyanide 9010B | 1 x 4 oz G,<br>Teflon lined septum sealed cap | Ice to 4°C | -- | 14d |
| | Grain Size ASTM D422 | Mason jar or plastic Ziploc bag | -- | -- | -- |

# Table 10-1
# SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
## Holloman Air Force Base, New Mexico

| | | | | | | |
|---|---|---|---|---|---|---|
| [1] Holding time begins at time of collection | TCL | Target Compound List | mo | month | P | Plastic |
| [2] Following extraction | PCB | Polychlorinated Biphenyls | d | day | G | Glass |
| | TAL | Target Analyte List | h | hour | | |

**Table 7-1**
**CALIBRATION FREQUENCY**
**Holloman Air Force Base, New**

| Equipment Type | Calibration Type | Number of Standards | Acceptance/Rejection Criteria | Frequency |
|---|---|---|---|---|
| pH Meter | Daily<br>Continuing | 2<br>1 | > ± 0.1 units<br>> ± 0.1 units | Before use/daily<br>Every 4 hours |
| Conductivity Meter | Daily<br>Continuing | 2<br>1 | > ± 5% of true value<br>> ± 5% of true value | Before use/daily<br>Every 4 hours |
| Temperature Meter | Continuing | N/A | > ± 5% of thermometer value<br>> ± 5% of thermometer value | First sample daily<br>Every 4 hours |
| DO Meter | Daily<br>Continuing<br>Annual | N/A<br>N/A<br>3 | N/A<br>N/A<br>> 95% of Winkler value | Before use/daily<br>Every 4 hours<br>Yearly |
| Oxidation-Reduction Potential (ORP) | Daily<br>Annual | 1 | Redox solution standard<br>200-275 mV @ $25^0$C | Before use/daily<br>Every 4 hours |
| Turbidity Meter | Daily<br>Continuing<br>Semi-annual | 2 gel<br>1 gel<br>3 Formazin | > ± 5% of true value<br>> ± 5% of true value<br>> ± 5% of Formazin's true value | Before use/daily<br>Every 4 hours<br>Every 3 months |
| Combination Meters | (see individual calibration frequencies above) | | | |
| OVA (FID) | Daily | 2 | > ± 5% of true value | Before use/daily |
| OVA (PID) | Daily | 2 | > ± 5% of true value | Before use/daily |
| Explosimeter | Daily | 1 | > ± 5% of true value | Before use/daily |

**Table 13-1**
**EXTRACTION AND DIGESTION PROCEDURES**
**Holloman Air Force Base, New Mexico**

| Method | Parameter |
|---|---|
| SW1311 | Toxicity Characteristic Leaching Procedure |
| SW3005A | Acid Digestion of Water Samples for Total Recoverable or Dissolved Metals Analysis by FLAA or ICP Spectroscopy |
| SW3010A | Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis by FLAA or ICP Spectroscopy |
| SW3015 | Microwave Assisted Acid Digestion of Aqueous Samples and Extracts |
| SW3020A | Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis by GFAA Spectroscopy |
| SW3031 | Acid Digestion of Oils for Metals Analysis by AA or ICP |
| SW3050B | Acid Digestion of Solids, Sediments, and Sludges |
| SW3051 | Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils |
| SW3052 | Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices |
| SW3510C | Separatory Funnel Liquid-Liquid Extraction |
| SW3520C | Continuous Liquid-Liquid Extraction |
| SW3535 | Solid-Phase Extraction |
| SW3540C/SW3541 | Soxhlet Extraction |
| SW3545 | Pressurized Fluid Extraction |
| SW3550B | Ultrasonic Extraction |
| SW3560 | Supercritical Fluid Extraction of Total Recoverable Petroleum Hydrocarbons |
| SW3561 | Supercritical Fluid Extraction of Polynuclear Aromatic Hydrocarbons |
| SW3580A | Waste Dilution |
| SW3585 | Waste Dilution for Volatile Organics |
| SW5021 | Volatile Organic Compounds in Soils and Other Solid Matrices Using Equilibrium Headspace Analysis |
| SW5030B | Purge and Trap for Aqueous Samples |
| SW5031 | Volatile, Non-purgeable, Water-Soluble Compounds by Azeotropic Distillation |
| SW5035 | Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples |
| SW5041 | Analysis for Desorption of Sorbent Cartridges from Volatile Organic Sampling Train |

**Table 13-2**
**ANALYTICAL PROCEDURES**
**Holloman Air Force Base, New Mexico**

| Analytical Method | Parameter | Preparatory Methods |
|---|---|---|
| 8011 | Ethylene dibromide (EDB) (water) | (see analytical method) |
| 8021B | Aromatic and Halogenated volatile organics (water and soil) | 5030B, 5035 |
| 8081A | Organochlorine pesticides (water and soil) | 3510C, 3520C, 3540C, 3541, 3550B |
| 8082 | PCBs (water and soil) | 3510C, 3520C, 3540C, 3541, 3550B |
| 8151A | Chlorinated herbicides (water and soil) | 3510C, 3520C, 3540C, 3541, 3550B |
| 8260B | Volatile organics (water and soil) | 5030B, 5035 |
| 8270C | Semivolatile organics (water and soil) | 3510C, 3520C, 3540C, 3541, 3550B |
| 8310 | Polynuclear aromatic hydrocarbons (PAHs) (water and soil) | 3510C, 3520C, 3540C, 3541, 3550B |
| 8330 | Explosive residues (water and soil) | 3510C, 3520C, 3540C, 3541, 3550B |
| 6010B | Trace metals by ICP (water and soil) | 3005A, 3010A, 3015, 3050B, 3051 |
| 6020 | Trace metals by ICP (water and soil) | 3005A, 3010A, 3015, 3050B, 3051 |
| 7041 | Antimony (water) | (see analytical method) |
| 7060A | Arsenic (water and soil) | (see analytical method), 3050B, 3051 |
| 7470A | Mercury (water) | (see analytical method) |
| 7471A | Mercury (soil) | (see analytical method) |
| 7740 | Selenium (water and soil) | (see analytical method), 3050B |
| 7841 | Thallium (water) | 3015, 3020A, 3051 |
| 8290 | Polychlorinated Dibenzodioxins and Furans | 3510C, 3520C, 3540C, 3541 |
| 9010B | Cyanide (water) | (see analytical method) |
| 9056/300.0 | Common anions ((Br, Cl, F, $NO_2$, $NO_3$, $PO_4$ & $SO_4$) | (see analytical method |
| 8015 | Exrtactable Petroleum Hydrocarbons and Volatile Petroleum Hydrocarbons | (see analytical method) |
| RSK-175 | methane, ethane and ethene | (see analytical method) |
| 310.1 | Alkalinity | (see analytical method) |
| 405.1 | Biochemical Oxygen Demand | (see analytical method) |
| 130.2 | Hardness | (see analytical method) |
| 350.3 | Ammonia Nitrogen | (see analytical method) |
| 352.2 | Nitrate Nitrogen | (see analytical method) |
| 354.1 | Nitrite Nitrogen | (see analytical method) |
| 353.2 | Nitrate/Nitrite Nitrogen | (see analytical method) |
| 314.0 | Perchlorate | (see analytical method) |
| 365.4 | Phosphorus, Total | (see analytical method) |
| 160.1 | Total Dissolved (filterable) Solids | (see analytical method) |

**Table 13-2**
**ANALYTICAL PROCEDURES**
**Holloman Air Force Base, New Mexico**

| Analytical Method | Parameter | Preparatory Methods |
|---|---|---|
| 160.2 | Total Suspended (non-filterable) Solids | (see analytical method) |
| 160.3 | Total Solids | (see analytical method) |
| 376.2 | Sulfide | (see analytical method) |
| 425.1 | Surfactants (MBAS) | (see analytical method) |
| 180.1 | Turbidity | (see analytical method) |

**Table 13-3**
**QUALITY ASSURANCE OBJECTIVES FOR FIELD SCREENING METHODS**
**Holloman Air Force Base, New Mexico**

| Analyte | Matrix | Method | Precision | Accuracy |
|---|---|---|---|---|
| Temperature | Water | Any high quality mercury-filled thermometer or thermistor with analog or digital read-out device (1); U.S. EPA Method 170.1 (3). | Not determined (1) | Not determined (1) |
| pH | Water | Electromagnetically using either a glass electrode in combination with a reference potential or a combination electrode, and a pH meter (1); U.S. EPA Method 150.1 (3). | ±0.1 pH unit (1) in laboratory test<br>±0.5 pH unit in field conditions | ±0.1 pH unit (1) in laboratory test<br>±0.5 pH unit in field conditions |
| Specific Conductance/ Salinity | Water | Measured by use of a self-contained conductivity meter, wheatstone bridge-type or equivalent (1); U.S. EPA Method 120.1 (3). | ±1% of true value (1) in laboratory test<br>±5% of true value in field conditions | ±1% of true value (1) in laboratory test<br>±5% of true value in field conditions |
| Turbidity | Water | Measured using self-contained turbidimeter | RPD < 20% | ±0.1 NTU |
| Dissolved Oxygen | Water | Measured using a membrane electrode (1). U.S. EPA 360.1 | ±0.1 mg/L | ±1% of true value |
| Organic Vapor PID | Air | Measures concentration of trace volatile gases present in the atmosphere by photoionization. | ±0.5% of true value | ±20% of Individual Full Scale |
| Organic Vapor OVA 128 | Air | Measures concentration of trace volatile gases present in the atmosphere by flame ionization (2). | ±0.5% of true value | ±20% of Individual Full Scale (2) |
| Eh | Water | ORP measured by platinum and gold electrode (Orion Model 108) | +\- 1 mV | +\- 5 mV |


References:
(1) U.S. EPA SOP and Quality Assurance Manual, Region IV, February 1, 1991
(2) Instruction Manual Model OVA 128 Century Organic Vapor Analyzer
(3) U.S. EPA Methods for Chemical Analysis of Water and Wastes, 3rd Edition, 1979.

# APPENDIX A
# HOLLOMAN AIR FORCE BASE
# STANDARD OPERATING PROCEDURES (SOPs)

| | |
|---|---|
| HAFB SOP-1 | Documentation, Sample Handling, Chain-of-Custody, and Shipping |
| HAFB SOP-2 | Sampling Equipment Decontamination |
| HAFB SOP-3 | Staking, Utility Clearance, and Permitting |
| HAFB SOP-4 | Direct Push Sampling for Soil and Groundwater |
| HAFB SOP-5 | Soil Sampling for Chemical Analysis |
| HAFB SOP-6 | Procedure for Field Screening of Volatile Organics |
| HABP SOP-7 | Lithologic Description and Geotechnical Sampling |
| HAFB SOP-8 | Groundwater Sampling for Chemical Analysis |
| HAFB SOP-9 | Field Management of Investigation-Derived Waste (IDW) |
| HAFB SOP-10 | Borehole Abandonment and Site Restoration |

# SOP HAFB-1
# DOCUMENTATION, SAMPLE HANDLING, CHAIN-OF-CUSTODY, AND SHIPPING

## 1.0 OBJECTIVE

This SOP contains specific details concerning sample control, documentation, and transportation procedures.

## 2.0 EQUIPMENT AND MATERIAL

The following equipment will be necessary to complete sample documentation, handling, and shipment:

Forms and Records

- Log books;
- Chain-of-custody forms;
- Custody seals;
- Sample identification labels; and,

Shipping Supplies

- Clear tape;
- Rigid plastic coolers;
- Strapping tape;

- "This Side Up" arrow labels;
- Address labels;
- Heavy-duty plastic trash bags and ties;
- Small and large re-sealable plastic bags;
- Protective mesh for various sample bottle sizes;
- Absorbent material for packing samples; and
- Ice.

## 3.0 METHODOLOGY

Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include field logbooks, instrument calibration logbooks, sample logs, correspondence, sample labels, chain-of-custody forms, photographs, and analytical records. All information pertinent to a field activity must be entered into a logbook, including uncompleted work.

## 3.1 SAMPLE CONTROL AND DOCUMENTATION

All logbooks should be numbered and are to be bound with consecutively numbered pages; log book pages and data should never be removed. Loose-leaf forms, sample logs, and figures used for sample location will be kept in a 3-ring binder. Indelible black ink will be used for recording all data. At minimum, the following data should be recorded during the course of the investigation:

- Date, field observations, and weather conditions, including any unusual circumstances;

- ☐ Calibration of field equipment before sample analysis;
- ☐ Names of field crew members;
- ☐ Name of the sample collector;
- ☐ Identification of sampling location and depth of sample;
- ☐ Rough sketch of sampling location related to significant physical objects;
- ☐ Depth to water at groundwater sampling locations;
- ☐ Purge method and purge volume;
- ☐ Sample collection method;
- ☐ Types and numbers of sample containers used;
- ☐ Preservatives used;
- ☐ Results of field analysis; and
- ☐ Sample observations (color, turbidity, odor, soil type, etc.).

To change an incorrect entry, draw a line through the entry, write the change above or adjacent to the entry, and date and initial the change. If anyone other than the person to whom a logbook is assigned makes an entry, that person should date and sign the entry. All project logbooks are to be turned over to the document control officer at the end of each work period and to a central file at the end of the field activity.

## 3.2 SAMPLE LABELING

In addition to the field logbook, a complete sample label should be filled out for each sample.

All sample containers should be sealed immediately after sample collection. Samplers should place the completed sample label onto the sample container and secure it with clear tape. Sample labels must identify the sample ID, site, sample type, sampler's initials, sampling location, depth, time, date, analyses requested, laboratory, containers, and any special instructions. Labels should be completed with black waterproof ink.

## 3.3 SAMPLE CONTROL/CHAIN-OF-CUSTODY/SHIPMENT

Once the samples have been collected and labeled, they should be kept cool with ice or in a refrigerator. The following procedures are for sample handling and shipment to a laboratory for analysis:

A. Fill out a chain-of-custody form for every sample shipping container (cooler). Information recorded on this form includes the following:

- ☐ Samples collected and corresponding laboratory analyses;
- ☐ Time and date of sample;
- ☐ Sample number;
- ☐ Type of sample;
- ☐ Sampler's initials;
- ☐ Preservatives used;
- ☐ MS/MSD analysis;
- ☐ Relinquisher's signature, date, and time; and
- ☐ Special instructions.

B. Double check the information on the chain-of-custody form against the sample labels and sample logs. Make sure each sample is accounted for and that samples are being sent to the correct laboratory.

C. Wipe the sample container exteriors clean with a paper towel dampened with clean water.

D. Ensure that each container has a properly completed label.

E. Place the sample containers in resealable plastic bags. Containers from the same sample location and depth can be placed in the same bag, but separate samples from different sites will not be placed in the same bag to prevent cross-contamination.

F. Place the sample container(s) in a cooler lined with a large plastic garbage bag.

G. Pack the container(s) with ample amounts of packing material to prevent possible breakage and absorb liquid material released should breakage occur. This material should be place under the container(s) and between all containers for multiple container shipments to prevent the containers from touching each other or the bottom of the shipping container.

H. Place ice among the sample containers to maintain the samples at or below 4□C during transport.

I. Add any needed absorbent to fill all void spaces.

J. Seal the completed chain-of-custody form for the appropriate cooler in a resealable plastic bag and tape it to the inside of the top lid of the cooler. The sample custodian should retain the pink copy of the form and maintain it in a file of field documentation.

K. Securely close the outer shipping container with strapping tape around both ends. If there is a drain on the cooler, tape it shut.

L. Affix signed and dated custody seals to all closures on the shipping container to prevent tampering.

M Affix "This Side Up" arrows on two opposing sides of the cooler. No DOT placards are required.

Compliance with all applicable DOT and International Air Transport Association (IATA) shipping regulations is required.

## 4.0 COMMENTS

- To expedite the sampling and shipping process, it is recommended that preprinted sample labels, chain-of-custody forms, address labels, and overnight delivery forms be used.

- If using a refrigerator to store sample, monitor the temperature using a thermometer and be careful not to freeze water samples.

# SOP HAFB-2
# SAMPLING EQUIPMENT DECONTAMINATION

## 1.0 OBJECTIVE

Decontamination of boring equipment and sampling tools is performed as a QA measure and safety precaution. It helps prevent cross-contamination among samples and helps maintain a clean working environment for the safety of field personnel. The methodology for decontamination was prepared in accordance with the following documents:

EPA. 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual* (SOPQAM), U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

NIOSH, OSHA, USCG, and EPA. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.* Prepared by the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and EPA. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

- Soap: Laboratory grade, non-phosphated - or equivalent;
- Tap water;
- Reagent-grade water;
- Pesticide-grade isopropanol;
- Cleaning brushes;

- Cleaning containers: plastic bucket and galvanized steel pans;
- Waste containers as outlined in SOP A-14; and
- Health and safety equipment as outlined in the SSHP.

## 3.0 METHODOLOGY

Small, reusable equipment, including sampling equipment, is mainly decontaminated by rinsing with liquids that include soap or detergent solutions, tap water, deionized water, or solvents. Following decontamination, if the equipment is not to be reused immediately, it will be stored, protected from recontamination by wrapping in aluminum foil, and appropriately rinsed before the next use.

### 3.1 PRE-SAMPLING DECONTAMINATION ACTIVITIES

A. Don the appropriate PPE, as specified in the SSHP and as required for the specific work area.

B. Assemble containers and equipment for decontamination, designing the decontamination station in such a manner as to prevent liquid from spilling onto the ground.

C. Decontaminate all new equipment or equipment not previously decontaminated before use.

D. If the protective wrapping on a piece of precleaned equipment has been torn, or if there is any question about its cleanliness, the equipment should be considered contaminated and undergo the full decontamination procedures before it is used.

### 3.2 DECONTAMINATING SAMPLING EQUIPMENT

A. Remove any solid particles from the equipment or material by brushing and rinsing with available potable water. This will remove gross contamination.

B. Wash equipment with a brush and a phosphate-free detergent solution.

C. Rinse equipment thoroughly with potable water.

D. Double rinse the equipment with reagent-grade water.

E. Allow equipment to air dry thoroughly. If there is not enough time to air dry completely, the equipment should be rinsed with copious amounts of reagent water. Equipment may then be reused immediately.

F. Unless the equipment is going to be used immediately, it must be wrapped in new aluminum foil, shiny side out, to keep it clean until needed. For large bulky equipment, new plastic sheeting can be substituted for the aluminum foil.

## 3.3 DECONTAMINATION OF LARGE EQUIPMENT

Drilling equipment (rigs, drill rods, augers, bits, etc.), DPT equipment, and other large pieces of field equipment, unable to be decontaminated using the method described above, must be high-pressure steam cleaned before and after each use.

Steam cleaning will be performed at an appropriate central decontamination area specified by the Base. The decontamination area must be capable of containing decontamination fluids and allow for managing of investigation-derived wastes (IDW) as specified in the appropriate SOP.

## 3.4 COMMENTS

- Any field equipment not used during a field activity must be decontaminated before its return to the equipment stock for reuse at another site. This requirement applies even if the aluminum foil on precleaned equipment is not torn. This requirement can be waived only if after initial decontamination, the equipment was sealed in plastic.

- ☐ At each phase of the decontamination process, decontamination fluids and rinsates should be collected and managed as outlined in the appropriate SOP.

- ☐ Isopropanol rinse should be omitted for any equipment such as plastic well-sounding tapes.

- ☐ Solvents should not be used on any type of non-Teflon plastic equipment that will contact an environmental sample or be introduced into a monitoring well.

# SOP B-3
# STAKING, UTILITY CLEARANCE, AND PERMITTING

## 1.0 OBJECTIVE

To ensure the health and safety of field sampling personnel and prevent damage to underground utilities during soil sampling, precautions must be taken to properly locate hazards such as gas lines, high-voltage electrical lines, water mains, communication lines, sewer lines, and so forth.

Before any intrusive work (including hand-auger borings) can begin at Holloman Air Force Base (AFB), sampling locations at each site must be cleared and a proper digging permit must be obtained.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

- ☐ Wooden stakes, lathes, hubs, surveyor flags, and/or spray paint;
- ☐ Small sledge-type hammer;
- ☐ Permanent marker;
- ☐ Site maps from Section 2; and
- ☐ Base Civil Engineering Clearance Request (Air Force Form #103).

## 3.0 METHODOLOGY

A) Begin the site clearance procure by locating and marking all soil boring locations at each site, using the following guidelines:

- ☐ If possible, procure ahead of time utility maps so that the preliminary positioning of sample locations will avoid underground obstructions.
- ☐ Visually scan each sample location to be sure that there are no obvious underground lines or obstructions.

- ☐ Pound the flag and the hub/stake firmly into the ground, making sure that it is clearly marked with the site number and the borehole number (DP-01). If the location is on a paved surface, it should be marked with spray paint.

B) To obtain all utility clearances, site tours must be completed with appropriate representatives of the Base utilities (electric, plumbing, and Army cable) and New Mexico One Call.

New Mexico One Call coordinates the location of on-Base utilities, including US West phone lines, Simmons' cable lines, and Standard Transport pipe fuel lines. They will provide you with a control number and submit locator requests for you. New Mexico One Call can be reached at (800) 321-2537.

- ☐ During the site tours, have the locators mark utility locations with flags or spray paint.

- ☐ If possible, obtain a blanket site clearance to cover possible additional boring locations at the site. (For certain utilities, this may not be possible. In which case, inquire about the procedure necessary to gain additional clearances).

- If obstructions exist or if a borehole must be moved to avoid utilities, it should be relocated to a position that satisfies the intent of the original location.

C) To obtain the actual digging permit, a Base Civil Engineering Clearance Request Forms (AF103) must be completed and signed by appropriate parties. (Note that the locators should also sign the form in the appropriate space, as well as initial the site figures.) This process is usually expedited through coordination with representative of Civil Engineering's Environmental Flight (CEV). Once a digging permit has been issued, it is valid for one month.

## 4.0 COMMENTS

- Proper preparation in the initial location and staking is critical for expediting the sampling process. If sampling locations are not properly marked and cleared, significant costs could be incurred through delays while waiting for drilling permits.

- NM One Call requires a 48-hour advance notice before drilling may proceed.

- Utility locators may require information about how long the job will last, the type of marker being used, and the location of the boreholes. Be prepared to provide the various utility locators and signatories on the drilling permit with multiple copies of site figures and location maps.

- When doing any intrusive work on the Base, the contractor must have a valid permit on hand.

# SOP HAFB-4
# DIRECT PUSH SAMPLING FOR SOIL AND GROUNDWATER

## 1.0 OBJECTIVE

Direct push technology (DPT) will be used to rapidly collect soil and water samples. This technique provides for collection of undisturbed samples and does not generate soil cuttings. This SOP discusses the DPT method only; for actual soil and groundwater sampling procedures. Please refer to the appropriate SOPs for soil and groundwater sampling.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

The DPT operator will need a copy of the subcontractor work plan, waste containers and appropriate health and safety gear. The DPT subcontractor will provide all additional equipment and materials. The DPT subcontractor should be equipped with a rig capable of pushing 20 ft and collecting soil and groundwater samples from any interval within that depth. Equipment should include at minimum the following items:

- Hydraulic ram with hammer assembly;
- 1- to 1.5-inch diameter drill rods;
- Piston-type, split-spoon, or equivalent soil sampling device that allows for lithologic characterization and retrieval of at least 400 mL of sample volume;
- GeoProbe, Hydrocone, bailer, Teflon tubing and peristaltic pump, or equivalent water sampling device;
- Small diameter PVC riser and screen to make temporary wells if recovery is too slow;
- Decontamination equipment; and
- Health and safety equipment, as outlined in the SSHP.

## 3.0 METHODOLOGY

A) Verify that the subcontractor has the necessary drilling and sampling equipment, as well as proper decontamination supplies.

B) Confirm that sampling locations are staked and that the clearances from all on-Base and off-Base utilities have been obtained. Do not begin the sampling until proper digging permits have been obtained and all of the utilities have been marked.

C) Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use hammer-drill or equivalent to drill a hole through the pavement.

D) Verify that the sampling tip has been properly decontaminated.

E) For soil sampling, hydraulically advance the sampler to above the target sample interval, unlock the piston point, and advance the sampling device through the sampling interval:

- Pull the rods using the hydraulic apparatus and remove the sample insert or split spoon.
- Log the soil and collect the required samples as specified in the field sampling plan.

F) Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location.

G) If groundwater sampling is necessary, advance the sampler into the water table and collect a sample with the sampling device.

H) Collect and manage all wastes as specified in IDW SOP.

l) Abandon all boreholes and repair pavement before moving to a new site (see the SOP for abandonment).

## 4.0 COMMENTS

- If a buried object impedes the DPT sampler or if an insufficient sample volume is recovered, reposition the rig in a location to satisfy the intent of the original sample point and try again. Note this on the borehole logging form.

- If the total recovered sample volume is insufficient for both screening and laboratory analysis, a second hole will be pushed as close as possible to the original hole and an additional sample will be taken from the same depth interval. The two samples will be composited prior to sampling for chemical analysis.

- If a situation arises in which the groundwater recharge is too slow to allow sampling, a PVC well can be inserted temporarily for sampling at a later time.

# SOP HAFB-5
# SOIL SAMPLING FOR CHEMICAL ANALYSIS

## 1.0 OBJECTIVE

Soil samples will be collected for chemical analysis to enable determination of the nature and extent of contamination in soil. Groundwater samples will be collected from monitoring wells or from with inert tubing through the direct push sampling methods.

The following procedures were designed to ensure consistent and high quality data collection and are in accordance with EPA procedures for sample collection as detailed in the following document:

EPA. 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual* (SOPQAM), U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

- ☐ Appropriate number and types of sample containers (see Table HAFB5-1);
- ☐ Precleaned stainless steel sampling spoons and knife;
- ☐ Sample coolers and ice;
- ☐ Appropriate field documentation forms and an indelible ink pen;
- ☐ Sampling equipment decontamination supplies;
- ☐ Waste containers;
- ☐ Health and safety equipment, as specified in the SSHP.

## 3.0 METHODOLOGY

A) Verify that the subcontractor has the necessary drilling and sampling equipment, as well as proper decontamination supplies.

B) Confirm that sampling locations are staked and that the clearances from all on-Base and off-Base utilities have been obtained. Do not begin the sampling until proper digging permits have been obtained and all of the utilities have been marked.

C) Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use hammer-drill or equivalent to drill a hole through the pavement.

D) Verify that the sampling tip has been properly decontaminated, as specified in decontamination SOP before beginning penetration.

E) For soil sampling, hydraulically advance the sampler to above the target sample interval, unlock the piston point, and advance the sampling device through the sampling interval:

- □ Pull the rods using the hydraulic apparatus and remove the sample insert or split spoon.
- ■ Log the soil and collect the required samples as specified in Field Sampling Plan (FSP).

F) Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location. To determine if sufficient depth has been covered, see the FSP section of this document.

G) If groundwater sampling is necessary, advance the sampler into the water table and collect a sample with the sampling device as specified in appropriate SOP.

H) Collect and manage all wastes as specified in the appropriate SOP.

I) Abandon all boreholes and repair pavement before moving to a new site as specified in appropriate SOP.

## 4.0 COMMENTS

- The supervising geologist should be prepared and have all the supplies available on site to conduct all planned sampling at each site.
- Container and preservation requirements for various analytical methods are detailed in Table HAFB5-1.

## TABLE HAFB5-1
## CONTAINER AND PRESERVATION REQUIREMENTS FOR SOIL SAMPLING

| REFERENCE METHOD | PARAMETER | CONTAINER[1] | SAMPLE PRESERVATION[2] | MAXIMUM HOLDING TIME[3] EXTRACTION | ANAL |
|---|---|---|---|---|---|
| EPA 8015 | TPH-gas/diesel/BTEX | 1.4 oz wide mouth jar, G | Ice to 4°C | -- | 14d |
| EPA 418.1 | TRPH | 1x8 oz wide mouth jar, G | Ice to 4°C | -- | 14 d |
| EPA 8260 | Volatile Organics | 2x40 mL G, Septa vial | Ice to 4°C | -- | 14 d |
| EPA 8270 | B/N/A | 1x8 oz wide mouth jar, G | Ice to 4°C | 7 d | 40 d |
| TAL 6000/7010 series | Metals | 1x8 oz wide mouth jar, G | Ice to 4°C | -- | 6 months |
| SW-846:9045 | pH | 1x2 oz wide moth jar, G | Not specified | -- | ASAP |
| EPA 8080 | PCBs/Pesticides | 1x8 oz wide mouth jar, G | Ice to 4°C | 7 d | 40 d |
| Full suite (8240, 8270, 6000/7010) | TCLP | 2x8 oz wide mouth jar, G | Ice to 4°C | -- | 14d |

1 All containers must have Teflon-lined seals (Teflon-lined septa for all VOA vials). G= Glass, P = High-density polyethylene.
2 Container volume may vary slightly depending upon laboratory specific requirements.
3 When only one holding time is given, it implies total holding time from sampling until analysis.

# SOP HAFB-6
# PROCEDURE FOR FIELD SCREENING OF VOLATILE ORGANICS

## 1.0 OBJECTIVE

Soil samples can be screened in the field for relative concentrations of total volatile organic constituents (VOCs) rapidly and inexpensively. It is important to note, however, that the screening technique is relative and will not quantify the exact concentration of the particular constituents present in the sample matrix. The procedure is only used to determine the relative concentrations of VOCs between sets of soil samples. For example, if 10 soil samples are collected vertically from one soil boring, the screening technique can be used to determine which samples may have relatively higher concentrations of VOCs with respect to the other samples. Section 2.0 covers equipment required to perform the screening. Section 3.0 presents the steps required to perform the sampling.

## 2.0 EQUIPMENT AND MATERIAL

The following equipment is required for field VOC screening:

- A photoionization detector (PID) or a flame ionization detector (FID);
- Sample containers such as glass jars and aluminum foil or resealable plastic bags; and,
- Calibration gas for the FID or PID (Isobutylene for PIDs, methane for FIDs).

## 3.0 METHODOLOGY

The following steps are employed when screening soil samples for total concentrations of VOCs. The procedure assumes that a fraction of the soil sample has already been collected using the soil sample procedure SOPs.

A) Place a fraction of the soil sample collected in a glass jar and cover the jar mouth with aluminum foil or place the sample in a resealable plastic bag. Place the samples in a warm place or area of stable temperature such as a building or temperature controlled environment.

B) Allow all the samples to equilibrate to the temperature-controlled environment.

C) Turn the PID and FID on and calibrate the instrument using the appropriate calibration gas (i.e. methane for a FID and isobutylene for a PID) using the procedures specified by the manufacturer.

D) Insert the probe from the PID or FID into the headspace of the jar (i.e., through the aluminum foil lined lid or through the plastic bag and collect a sample of the air in the headspace of the jar.

E) Observe and record the headspace measurement as parts per million (ppm) in the field notebook or soil boring log. Note which type of instrument and the calibration gas that was used.

F) Repeat steps D and F until all the samples have been screened.

## 4.0 COMMENTS

- Obtaining a good sample for chemical analysis for VOCs is the first priority.
- Field screening the sample for VOCs using a PID or FID is second priority.
- Transcribing the lithologic descriptions and collecting geotechnical samples is the last priority.

# SOP HAFB-7
# LITHOLOGIC DESCRIPTION AND GEOTECHNICAL SAMPLING

## 1.0 OBJECTIVE

Lithologic logging will be performed to define the subsurface geology. All soils will be described using the Unified Soils Classification System (ASTM Designation D 2488-84: Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]).

## 2.0 EQUIPMENT AND MATERIAL NEEDS

- ☐ Tape measure;
- ☐ Munsall soil color chart;
- ☐ Hand lens;
- ☐ Knife or spatula;
- ☐ Dropper with 10% HCl for calcium carbonate test;
- ☐ LaMotte soil texture kit or small vial;
- ☐ Water;
- ☐ Borehole log forms (Attached); and
- ☐ Health and safety equipment, as specified in the SSHP.

## 3.0 METHODOLOGY

A) Note penetration rates and comments in "remarks" section of logging form (e.g., "easy penetration", "hammering required", "2 ft in 3 minutes", etc.). If using a drop hammer, record blow counts.

B) Measure entire sample length and record recovery (as total footage recovered over the total length that sampler was pushed) to nearest tenth of a foot. Mark lithologic changes on logging form.

C) Separate a small, representative portion of each distinct soil to be identified.

D) Identify the color using the Munsall chart.

E) Identify the soil type using the field tests outlined in the ASTM guidance. All required tests considered appropriate for soil type should be performed (i.e. tests for fine-grained soils, such as plasticity, need not be performed on coarse-grained soil).

F) Record descriptions of the soil on the borehole log form. To facilitate the comparison of logs, all descriptions should use the following order and style:

- ☐ Soil type (*Silty SAND w/Clay*);
- ☐ Soil Color (*Moderate yellow brown (10YR5/4)*;
- ☐ Moisture content;
- ☐ Angularity and shape of particles (if a sand or gravel);
- ☐ Consistency;
- ☐ Cementation;
- ☐ Structure;
- ☐ Dry strength;
- ☐ Dilatancy;
- ☐ Toughness;
- ☐ Plasticity;
- ☐ Miscellaneous descriptors (roots, nodules, odors, texture percentages from the LaMotte kit, etc.);

- USCS Code (*SM*).

G) Note all visible contamination, PID/FID measurements, odor, or any observed evidence of contamination in the sample.

H) As necessary, identify the percentages of sand, silt, and clay in each sample using a LaMotte soil texture kit, or by settling using a small vial or bottle.

I) The sample should be placed in a soil jar or steel tube and sealed with as little air as possible (Table A8-1).

J) Label the contained for shipment to a lab for geotechnical grain size distribution (without the hydrocarbons portion of the test) (ASTM D421 and D422). Atterberg Limits (ASTM D4318), and moisture content (ASTM D2216).

## 4.0 COMMENTS

- Obtaining a good sample for chemical analysis is the first priority; collect chemical samples for volatile organic compounds (VOCs) before logging the soil core or taking geotechnical samples.

- Because visible contamination and field screening by FID/PID is used to define extent of contamination, it is essential that all observations concerning odor and staining and PID or FID readings are recorded on the logging form.

- Consistent logging is important for accurate characterization of site geology. Although the geologist may need to use his/her professional judgement to infer contacts and lithology, using the tests listed in the ASTM method will ensure consistent results.

**TABLE B7-1**
**CONTAINER AND PRESERVATION**
**REQUIREMENTS FOR GEOTECHNICAL**

| | | | |
|---|---|---|---|

| Reference Method | Parameter | Minimum Volume | Container |
|---|---|---|---|
| ASTM D4318 | Atterberg Limits | 100 grams | 4 oz glass jar[1] |
| ASTM D2216 | Moisture content | 50-100 grams | 4 oz glass jar[1] |
| ASTM D421 & 422 | Grain size | 30-40 grams | 2- to 4- oz glass jar[1] |

1 OK to combine these analyses into a larger container

# SOP HAFB-8
# GROUNDWATER SAMPLING FOR CHEMICAL ANALYSIS

## 1.0 OBJECTIVE

Water samples will be collected for chemical analysis to enable determination of the nature and extent of contamination in groundwater. Groundwater samples will be collected from monitoring wells or from with inert tubing through the direct push sampling methods.

The following procedures were designed to ensure consistent and high quality data collection and are in accordance with EPA procedures for sample collection as detailed in the following document:

EPA. 1991. *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual* (SOPQAM), U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

- Appropriate number and types of sample containers (see Table HAFB8-1);
- Precleaned stainless steel sampling spoons and knife;
- Sample coolers and ice;
- Appropriate field documentation forms and an indelible ink pen;
- Sampling equipment decontamination supplies;
- Waste containers;
- Health and safety equipment, as specified in the SSHP.

## 3.0 METHODOLOGY

A) Ensure that all equipment is properly calibrated and operating by following the manuals provided by the equipment manufacturer. Record results of the equipment in the logbook.

B) Calculate the approximate volume of the inert tubing (Teflon) using the formula

$V = 3.1415 \times r^2 \times \text{Length} \times 7.48\ \text{gal/ft}^3$.

Or if the tubing is ¼-inch diameter, simply multiply the tubing length by 0.0102 gal/foot.

C) Attach the peristaltic pump to the tubing as indicted in the pump instructions.

D) Purge the tubing slowly at first to avoid entraining air in the tube. Purge the appropriate volume and store it in the appropriate waste container.

E) Fill sample bottles in the following order:

- Volatile organic compounds
- Semi-volatile organic compounds
- Metals
- Wet tests,

F) Place sample containers on Ice and handle as indicted in the appropriate SOP.

G) When sampling is complete, remove tubing from the DPT rods and dispose of all IDW as directed in the SOP.

H) Abandon the boring as directed in the appropriate SOP.

## 4.0 COMMENTS

- The supervising geologist should be prepared and have all the supplies available on site to conduct all planned sampling at each site.
- Container and preservation requirements for various analytical methods are detailed in Table HAFB5-1.

## TABLE HAFB8-1
## CONTAINER AND PRESERVATION REQUIREMENTS FOR GROUNDWATER SAMPLING

| REFERENCE METHOD | PARAMETER | CONTAINER[1] | SAMPLE PRESERVATION[2] | MAXIMUM HOLDING TIME[3] EXTRACTION | ANAL |
|---|---|---|---|---|---|
| EPA 8015 | TPH-gas/diesel/BTEX | 500 ml brown glass bottle | Ice to 4°C | -- | 14d |
| EPA 8260 | Volatile organic compounds | 3x40 mL G, Septa vials | Ice to 4°C, pH <2 with HCl | -- | 14 d |
| EPA 8270 | B/N/A | 2 x 1 L brown glass | Ice to 4°C | 7 d | 40 d |
| TAL 6000/7010 series | Metals | 500 ml plastic bottle | Ice to 4°C pH <2 with HNO3 | -- | 6 months |
| SW-846:9045 | pH | 500 ml plastic | Ice to 4°C | -- | 24 hrs |
| EPA 8080 | PCBs/Pesticides | 2 x 1 L brown glass | Ice to 4°C | 7 d | 40 d |
| xxxx | Radionuclides | 1 L plastic | Ice to 4°C | -- | 14d |

1 All containers must have Teflon-lined seals (Teflon-lined septa for all VOA vials). Glass = brown glass, Plastic = High-density polyethylene.
2 Container volume may vary slightly depending upon laboratory specific requirements.
3 When only one holding time is given, it implies total holding time from sampling until analysis.

# SOP HAFB-9

# FIELD MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

## 1.0 OBJECTIVE

To collect and manage IDW in accordance with state and federal regulations, this SOP provides easy-to-follow procedures for characterizing, handling, storing and disposing of IDW generated during the additional characterization program. IDW management techniques emphasize waste minimization.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

- DOT-approved drums and containers;
- IDW "Analysis Pending" labels (Attached);
- "Hazardous Waste" labels and Non Hazardous labels (Attached);
- Indelible markers (i.e., Sharpie);
- Clear adhesive tape;
- Ratchet, socket, and crescent wrench for opening/closing drums;
- PPE;
- Plastic buckets for carrying purge water to drums;
- Absorbent pads or booms for cleaning up spills;
- Wooden pallets;
- Waste inventory form (Attached); and
- PID or FID.

## 3.0 METHODOLOGY

### 3.1 SOIL AND WATER IDW

A) Conduct sampling in accordance with the soil and groundwater sampling SOPs.

B) If soil is stained, place excess soil (and any excess water sample) in appropriately sized DOT-approved drums or cans. DO NOT PUT SOIL AND WATER IN SAME CONTAINER.

C) Place an adhesive label on the side of the container. Using an indelible marker, write the following information on the label

- ☐ The phrase "Analysis Pending"
- ☐ Accumulation start date
- ☐ Name of waste (e.g., soil from soil or well boring ID numbers)
- ☐ Name and phone number of Holloman AFB contact (CES/CEV)

D) When label is complete, cover it with a piece of clear adhesive tape.

E) If soil is not stained, conduct VOC screening with a PID or FID.

F) If no VOCs are detected in headspace analysis, spread excess soil and water (if any) around borehole.

G) If VOCs are detected in the soil, place excess soil and water (if any) in DOT-approved drums, and label the drum (or container) in accordance with step C) above. DO NOT PUT SOIL AND WATER IN SAME CONTAINER.

H) If the site is developed and will not accommodate the spreading of soils then soils containing TPH concentration less than 940 ppm will be spread at a site to be designated by the Base.

I) If soils are containerized move to IDW drum storage area.

J) Waste characterization will be conducted utilizing previously collected soil analytical results and additional characterization results. No soil generated during the POL remediation activities at the SWMUs was characterized as hazardous waste. If soils contain TPH in excess of 940 ppm, arrangements will be made for off-site disposal at a permitted petroleum-contaminated soil disposal facility. Decontamination solutions will either be spread on site or placed in the Base sanitary sewer system, following approval from the Base.

## 3.2 PPE AND DISPOSABLE SAMPLING EQUIPMENT WASTE

A) Remove excess solid and liquid waste from PPE and disposable sampling equipment.

B) Place all PPE and sampling equipment to be disposed of in sealed plastic trash bags.

C) Dispose of trash bags in a dumpster at the IDW staging area.

D) If a Base dumpster is not located near the IDW staging area, arrange for one that can be used during the course of the investigation.

## SOP B-10
## BOREHOLE ABANDONMENT AND SITE RESTORATION

### 1.0 OBJECTIVE

All boreholes must be sealed to prevent the spread of contaminants with depth and to eliminate direct pathways from the surface to the subsurface and groundwater. Surface materials such as asphalt and cement that have been drilled or pushed through must also be repaired to a satisfactory condition.

### 2.0 EQUIPMENT AND MATERIAL NEEDS

- ☐ Bentonite chips or granular bentonite and funnel;
- ☐ Cold-patch asphalt material and quick-set concrete;
- ☐ Ample amounts of water; and
- ☐ Health and safety equipment, as specified in the SSHP.

### 3.0 METHODOLOGY

In general, borehole abandonment will be completed by the DPT or HSA subcontractor under supervision of the rig geologist. The subcontractor will supply all necessary materials listed above. The contractor, however, may need small amounts of bentonite to seal hand-auger boreholes.

A) After a boring has been completed by **DPT technique**, leave the drive rods in place pending abandonment.

B) Add bentonite chips or granular bentonite slowly into the top of the drive rods using a funnel. As the rods are being slowly pulled from the borehole, add bentonite to complete the seal to the surface.

C) If the rods have been driven into groundwater, it will not be possible to seal the borehole through the rods. (The bentonite chips will stick to the inside of

the rods, clogging the end). In this case, carefully extract the rods and slowly add bentonite chips, being careful not to allow bridging.

D) Hydrate the seal using ample amounts of potable water.

E) If the borehole is through asphalt or concrete, leave the seal below the bottom of the pavement to allow for sufficient fill and patching material.

United States
Environmental Protection
Agency

# 2002 Edition of the Drinking Water Standards and Health Advisories

# 2002 Edition of the Drinking Water Standards and Health Advisories

EPA 822-R-02-038

Office of Water
U.S. Environmental Protection Agency
Washington, DC

Summer 2002

**Recycled/Recyclable**
Printed on paper that contains
at least 50% recycled fiber.

The *Drinking Water Standards and Health Advisories* tables are revised periodically by EPA's Office of Water on an "as needed" basis. The Summer 2002 edition of the tables has retained the content and format changes introduced in the Summer 2000 edition and has added the Chemical Abstracts Service Registry Numbers (CASRN) for the chemical contaminants. The following changes should be kept in mind when using the Tables:

Reference dose (RfD) values have been updated to reflect the values in the Integrated Risk Information System (IRIS), and the Drinking Water Equivalent Level (DWEL) has been calculated accordingly. Thus, both the RfD and DWEL will differ from the values in the Health Advisory document if the IRIS RfD is more recent than the Health Advisory value. The RfD values from IRIS that differ from the values in the Health Advisory documents are given in **BOLD** type. For unregulated chemicals with a new IRIS RfD, the lifetime Health Advisory was calculated from the DWEL using the relative source contribution value published in the Health Advisory. For regulated chemicals, where the revised lifetime value differed from the Maximum Contaminant Level Goal (MCLG), no lifetime value was provided in the Table.

For regulated chemicals, the cancer group designation and $10^{-4}$ cancer risk reflect the status at the time of regulation. For unregulated chemicals, the cancer group designation and $10^{-4}$ cancer risk reflect the values presently on IRIS. New cancer group designations and $10^{-4}$ cancer risk values are given in **BOLD** type.

Several pesticides listed in IRIS have been re-evaluated by the Office of Pesticide Programs (OPP) resulting in an RfD other than that in IRIS. For these pesticides, the IRIS value is listed in the Table, and the newer OPP value is given in a footnote.

In some cases there is a Health Advisory value for a contaminant but there is no reference to a Health Advisory document. These Health Advisory values can be found in the Drinking Water Criteria Document for the contaminant.

With a few exceptions, the Health Advisory values have been rounded to one significant figure.

The *Drinking Water Standards and Health Advisories* tables may be reached from the Water Science home page at

http://www.epa.gov/waterscience

The tables are accessed under the Health Advisories heading.

Copies may be ordered free of charge from

SAFE DRINKING WATER HOTLINE
1-800-426-4791
Monday thru Friday, 9:00 AM to 5:30 PM EST

Copies of the supporting technical documentation for the health advisories can be ordered for a fee on the Internet at

http://www.epa.gov/OST/orderpubs.html

or from

Educational Resources Information Center (ERIC)
1929 Kenny Road
Columbus, OH 43210-1080
Telephone number 614-292-6717; 1-800-276-0462
FAX 614-292-0263
e-mail ERICSE@osu.edu
Payment by Purchase Order/Check/Visa or Mastercard

For further information regarding the *Drinking Water Standards and Health Advisories*, call the Safe Drinking Water Hotline at 1-800-426-4791 or 703-285-1093.

## DEFINITIONS

The following definitions for terms used in the Tables are not all-encompassing, and should not be construed to be "official" definitions. They are intended to assist the user in understanding terms found on the following pages.

**Action Level:** The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow. For lead or copper it is the level which, if exceeded in over 10% of the homes tested, triggers treatment.

**Cancer Group:** A qualitative weight-of-evidence judgement as to the likelihood that a chemical may be a carcinogen for humans. Each chemical is placed into one of the following five categories:

| Group | Category |
|---|---|
| A | Human carcinogen |
| B | Probable human carcinogen:<br>B1 indicates limited human evidence<br>B2 indicates sufficient evidence in animals and inadequate or no evidence in humans |
| C | Possible human carcinogen |
| D | Not classifiable as to human carcinogenicity |
| E | Evidence of noncarcinogenicity for humans |

This categorization is based on EPA's 1986 *Guidelines for Carcinogen Risk Assessment.* The *Proposed Guidelines for Carcinogen Risk Assessment* which were published in 1996, when final, will replace the 1986 cancer guidelines.

**$10^{-4}$ Cancer Risk:** The concentration of a chemical in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 10,000.

**Drinking Water Advisory:** A nonregulatory concentration of a contaminant in water that is likely to be without adverse effects on both health and aesthetics.

**DWEL:** Drinking Water Equivalent Level. A lifetime exposure concentration protective of adverse, non-cancer health effects, that assumes all of the exposure to a contaminant is from drinking water.

**HA:** Health Advisory. An estimate of acceptable drinking water levels for a chemical substance based on health effects information; a Health Advisory is not a legally enforceable Federal standard, but serves as technical guidance to assist Federal, State, and local officials.

**One-Day HA:** The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to one day of exposure. The One-Day HA is normally designed to protect a 10-kg child consuming 1 liter of water per day.

**Ten-Day HA:** The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to ten days of exposure. The Ten-Day HA is also normally designed to protect a 10-kg child consuming 1 liter of water per day.

**Lifetime HA:** The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure. The Lifetime HA is based on exposure of a 70-kg adult consuming 2 liters of water per day. The Lifetime HA for Group C carcinogens includes an adjustment for possible carcinogenicity.

**$LED_{10}$:** Lower Limit on Effective $Dose_{10}$. The 95% lower confidence limit of the dose of a chemical needed to produce an adverse effect in 10% of those exposed to the chemical, relative to the control.

**MCLG:** Maximum Contaminant Level Goal. A non-enforceable health goal which is set at a level at which no known or anticipated adverse effect on the health of persons occurs and which allows an adequate margin of safety.

**MCL:** Maximum Contaminant Level. The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLG as feasible using the best available analytical and treatment technologies and taking cost into consideration. MCLs are enforceable standards.

**RfD:** Reference Dose. An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

**SDWR:** Secondary Drinking Water Regulations. Non-enforceable Federal guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

**TT:** Treatment Technique. A required process intended to reduce the level of a contaminant in drinking water.

## ABBREVIATIONS

| | |
|---|---|
| **D** | Draft |
| **F** | Final |
| **NA** | Not Applicable |
| **NOAEL** | No-Observed-Adverse-Effect Level |
| **OPP** | Office of Pesticide Programs |
| **P** | Proposed |
| **Reg** | Regulation |
| **TT** | Treatment Technique |

# Drinking Water Standards and Health Advisories



| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | 10-kg Child | | | | | | |
| | | | | | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| **ORGANICS** | | | | | | | | | | | | |
| Acenaphthene | 83-32-9 | - | - | - | - | - | - | 0.06 | 2 | - | - | - |
| Acifluorfen (sodium) | 62476-59-9 | | - | - | F '88 | 2 | 2 | 0.01 | 0.4 | - | 0.1 | B2 |
| Acrylamide | 79-06-1 | F | zero | TT[1] | F '87 | 1.5 | 0.3 | 0.0002 | 0.007 | - | **0.0008** | B2 |
| Acrylonitrile | 107-13-1 | | - | - | - | - | - | - | - | - | 0.006 | B1 |
| Alachlor | 15972-60-8 | F | zero | 0.002 | F '88 | 0.1 | 0.1 | 0.01 | 0.4 | - | 0.04[2] | B2 |
| Aldicarb[3] | 116-06-3 | F[4] | 0.001 | 0.003 | F '95 | 0.01 | 0.01 | 0.001 | 0.04 | - | - | D |
| Aldicarb sulfone[3] | 1646-88-4 | F[4] | 0.001 | 0.003 | F '95 | 0.01 | 0.01 | 0.001 | 0.04 | - | - | D |
| Aldicarb sulfoxide[3] | 1646-87-3 | F[4] | 0.001 | 0.004 | F '95 | 0.01 | 0.01 | 0.001 | 0.04 | - | - | D |
| Aldrin | 309-00-2 | - | - | - | F '92 | 0.0003 | 0.0003 | 0.00003 | 0.001 | - | 0.0002 | B2 |
| Ametryn | 834-12-8 | - | - | - | F '88 | 9 | 9 | 0.009 | 0.3 | 0.06 | - | D |
| Ammonium sulfamate | 7773-06-0 | - | - | - | F '88 | 20 | 20 | 0.2 | 8 | 2 | - | D |
| Anthracene (PAH)[5] | 120-12-7 | - | - | - | - | - | - | 0.3 | 10 | - | - | D |
| Atrazine[6] | 1912-24-9 | F | 0.003 | 0.003 | F '88 | - | - | 0.035 | 1 | | - | C |
| Baygon | 114-26-1 | - | - | - | F '88 | 0.04 | 0.04 | 0.004 | 0.1 | 0.003 | - | C |
| Bentazon | 25057-89-0 | - | - | - | F '99 | 0.3 | 0.3 | 0.03 | 1 | 0.2 | - | E |
| Benz[a]anthracene (PAH) | 56-55-3 | - | - | - | - | - | - | - | - | - | - | B2 |
| Benzene | 71-43-2 | F | zero | 0.005 | F '87 | 0.2 | 0.2 | - | - | - | 0.1 | A |
| Benzo[a]pyrene (PAH) | 50-32-8 | F | zero | 0.0002 | - | - | - | - | - | - | **0.0005** | B2 |
| Benzo[b]fluoranthene (PAH) | 205-99-2 | - | - | - | - | - | - | - | - | - | - | B2 |
| Benzo[g,h,i]perylene (PAH) | 191-24-2 | - | - | - | - | - | - | - | - | - | - | D |
| Benzo[k]fluoranthene (PAH) | 207-08-9 | - | - | - | - | - | - | - | - | - | - | B2 |
| bis-2-Chloroisopropyl ether | 39638-32-9 | - | - | - | F '89 | 4 | 4 | 0.04 | 1 | 0.3 | - | D |
| Bromacil | 314-40-9 | - | - | - | F '88 | 5 | 5 | 0.1 | 5 | 0.09 | - | C |
| Bromobenzene | 108-86-1 | - | - | - | D '86 | 4 | 4 | - | - | - | - | D |

[1] When acrylamide is used in drinking water systems, the combination (or product) of dose and monomer level shall not exceed that equivalent to a polyacrylamide polymer containing 0.05% monomer dosed at 1 mg/L.
[2] Determined not to be carcinogenic at low doses by OPP.
[3] The MCL value for any combination of two or more of these three chemicals should not exceed 0.007 mg/L because of similar mode of action.
[4] Administrative stay of the effective date.
[5] PAH = Polycyclic aromatic hydrocarbon.
[6] Under review.

| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | 10-kg Child | | | | | | |
| | | | | | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| Bromochloromethane | 74-97-5 | - | - | - | F '89 | 50 | 1 | 0.01 | 0.5 | 0.09 | - | D |
| Bromodichloromethane[1] (THM) | 75-27-4 | F | zero | 0.08[2] | D '93 | 6 | 6 | 0.02 | 0.7 | - | 0.06 | B2 |
| Bromoform (THM) | 75-25-2 | F | zero | 0.08[2] | D '93 | 5 | 2 | 0.02 | 0.7 | - | 0.4 | B2 |
| Bromomethane | 74-83-9 | - | - | - | D '89 | 0.1 | 0.1 | 0.001 | 0.05 | 0.01 | - | D |
| Butyl benzyl phthalate (PAE)[3] | 85-68-7 | - | - | - | - | - | - | 0.2 | 7 | - | - | C |
| Butylate | 2008-41-5 | - | - | - | F '89 | 2 | 2 | 0.05 | 2 | 0.4 | - | D |
| Carbaryl | 63-25-2 | - | - | - | F '88 | 1 | 1 | 0.1 | 4 | 0.7 | - | D |
| Carbofuran[1] | 1563-66-2 | F | 0.04 | 0.04 | F '87 | 0.05 | 0.05 | 0.005 | 0.2 | 0.04 | - | E |
| Carbon tetrachloride | 56-23-5 | F | zero | 0.005 | F '87 | 4 | 0.2 | 0.0007 | 0.03 | - | 0.03 | B2 |
| Carboxin | 5234-68-4 | - | - | - | F '88 | 1 | 1 | 0.1 | 4 | 0.7 | - | D |
| Chloramben | 133-90-4 | - | - | - | F '88 | 3 | 3 | 0.015 | 0.5 | 0.1 | - | D |
| Chlordane | 57-74-9 | F | zero | 0.002 | F '87 | 0.06 | 0.06 | **0.0005** | 0.02 | - | **0.01** | B2 |
| Chloroform (THM) | 67-66-3 | F | zero | 0.08[1] | D '93 | 4 | 4 | **0.01** | 0.4 | - | - | B2[4] |
| Chloromethane | 74-87-3 | - | - | - | F '89 | 9 | 0.4 | 0.004 | 0.1 | 0.03 | - | D |
| Chlorophenol (2-) | 95-57-8 | - | - | - | D '94 | 0.5 | 0.5 | 0.005 | 0.2 | 0.04 | - | D |
| Chlorothalonil | 1897-45-6 | - | - | - | F '88 | 0.2 | 0.2 | 0.015 | 0.5 | - | 0.15 | B2 |
| Chlorotoluene o- | 95-49-8 | - | - | - | F '89 | 2 | 2 | 0.02 | 0.7 | 0.1 | - | D |
| Chlorotoluene p- | 106-43-4 | - | - | - | F '89 | 2 | 2 | 0.02 | 0.7 | 0.1 | - | D |
| Chlorpyrifos[5] | 2921-88-2 | - | - | - | F '92 | 0.03 | 0.03 | 0.003 | 0.1 | 0.02 | - | D |
| Chrysene (PAH) | 218-01-9 | - | - | - | - | - | - | - | - | - | - | B2 |
| Cyanazine | 21725-46-2 | - | - | - | D '96 | 0.1 | 0.1 | 0.002 | 0.07 | 0.001 | - | |

[1] Under review.
[2] 1998 Final Rule for Disinfectants and Disinfection By-products: The total for trihalomethanes is 0.08 mg/L.
[3] PAE = phthalate acid ester.
[4] By the 1999 Draft Guidelines for Carcinogen Risk Assessment, chloroform is *likely to be carcinogenic to humans* by all routes of exposure under high-dose conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues. Chloroform is *not likely to be carcinogenic to humans* by all routes of exposures at a dose level that does not cause cytotoxicity and cell regeneration
[5] New OPP RfD = 0.0003 mg/kg/day.

# Drinking Water Standards and Health Advisories



| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 10-kg Child | | | | | | |
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| Cyanogen chloride[1] | 506-77-4 | - | - | - | - | 0.05 | 0.05 | 0.05 | 2 | - | - | D |
| 2,4-D (2,4-dichlorophenoxyacetic acid) | 94-75-7 | F | 0.07 | 0.07 | F '87 | 1 | 0.3 | 0.01 | 0.4 | 0.07 | - | D |
| DCPA (Dacthal) | 1861-32-1 | - | - | - | F '88 | 80 | 80 | **0.01** | 0.4 | 0.07 | - | D |
| Dalapon (sodium salt) | 75-99-0 | F | 0.2 | 0.2 | F '89 | 3 | 3 | 0.03 | 0.9 | 0.2 | - | D |
| Di(2-ethylhexyl)adipate | 103-23-1 | F | 0.4 | 0.4 | - | 20 | 20 | 0.6 | 20 | 0.4 | 3 | C |
| Di(2-ethylhexyl)phthalate (PAE) | 117-81-7 | F | zero | 0.006 | - | - | - | 0.02 | 0.7 | - | 0.3 | B2 |
| Diazinon | 333-41-5 | - | - | - | F '88 | 0.02 | 0.02 | 0.00009 | 0.003 | 0.0006 | - | E |
| Dibromochloromethane[1] (THM) | 124-48-1 | F | 0.06 | 0.08[2] | D '93 | 6 | 6 | 0.02 | 0.7 | 0.06 | 0.04 | C |
| Dibromochloropropane (DBCP) | 96-12-8 | F | zero | 0.0002 | F '87 | 0.2 | 0.05 | - | - | - | 0.003 | B2 |
| Dibutyl phthalate (PAE) | 84-74-2 | - | - | - | - | - | - | 0.1 | 4 | - | - | D |
| Dicamba | 1918-00-9 | - | - | - | F '88 | 0.3 | 0.3 | 0.03 | 1 | 0.2 | - | D |
| Dichloroacetic acid[1] | 76-43-6 | F | zero | 0.06[3] | D '95 | 5 | 5 | 0.004 | 0.1 | - | -[4] | B2 |
| Dichlorobenzene o- | 95-50-1 | F | 0.6 | 0.6 | F '87 | 9 | 9 | 0.09 | 3 | 0.6 | - | D |
| Dichlorobenzene m-[5] | 541-73-1 | - | - | - | F '87 | 9 | 9 | 0.09 | 3 | 0.6 | - | D |
| Dichlorobenzene p- | 106-46-7 | F | 0.075 | 0.075 | F '87 | 11 | 11 | 0.1 | 4 | 0.075 | - | C |
| Dichlorodifluoromethane | 75-71-8 | - | - | - | F '89 | 40 | 40 | 0.2 | 5 | 1 | - | D |
| Dichloroethane (1,2-) | 107-06-2 | F | zero | 0.005 | F '87 | 0.7 | 0.7 | - | - | - | 0.04 | B2 |
| Dichloroethylene (1,1-) | 75-35-4 | F | 0.007 | 0.007 | F '87 | 2 | 1 | **0.009** | 0.3 | 0.006 | **0.006** | C |
| Dichloroethylene (cis-1,2-) | 156-59-2 | F | 0.07 | 0.07 | F '90 | 4 | 1 | 0.01 | 0.4 | 0.07 | - | D |
| Dichloroethylene (trans-1,2-) | 156-60-5 | F | 0.1 | 0.1 | F '87 | 20 | 1 | **0.02** | 0.7 | 0.1 | - | D |
| Dichloromethane | 75-09-2 | F | zero | 0.005 | D '93 | 10 | 2 | 0.06 | 2 | - | 0.5 | B2 |
| Dichlorophenol (2,4-) | 120-83-2 | - | - | - | D '94 | 0.03 | 0.03 | 0.003 | 0.1 | 0.02 | - | E |
| Dichloropropane (1,2-) | 78-87-5 | F | zero | 0.005 | F '87 | - | 0.09 | - | - | - | 0.06 | B2 |
| Dichloropropene (1,3-) | 542-75-6 | - | - | - | F '88 | 0.03 | 0.03 | **0.03** | 1 | | **0.04** | B2 |
| Dieldrin | 60-57-1 | - | - | - | F '88 | 0.0005 | 0.0005 | 0.00005 | 0.002 | - | 0.0002 | B2 |
| Diethyl phthalate (PAE) | 84-66-2 | - | - | - | - | - | - | 0.8 | 30 | - | - | D |

[1] Under review.
[2] 1998 Final Rule for Disinfectants and Disinfection By-products: The total for trihalomethanes is 0.08 mg/L.
[3] 1998 Final Rule for Disinfectants and Disinfection By-products: The total for five haloacetic acids is 0.06 mg/L.
[4] A quantitative risk estimate has not been determined.
[5] The values for m-dichlorobenzene are based on data for o-dichlorobenzene.

| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 10-kg Child | | | | | | |
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| Diisopropyl methylphosphonate | 1445-75-6 | - | - | - | F '89 | 8 | 8 | 0.08 | 3 | 0.6 | - | D |
| Dimethrin | 70-38-2 | - | - | - | F '88 | 10 | 10 | 0.3 | 10 | 2 | - | D |
| Dimethyl methylphosphonate | 756-79-6 | - | - | - | F '92 | 2 | 2 | 0.2 | 7 | 0.1 | 0.7 | C |
| Dimethyl phthalate (PAE) | 131-11-3 | - | - | - | - | - | - | - | - | - | - | D |
| Dinitrobenzene (1,3-) | 99-65-0 | - | - | - | F '91 | 0.04 | 0.04 | 0.0001 | 0.005 | 0.001 | - | D |
| Dinitrotoluene (2,4-) | 121-14-2 | - | - | - | F '92 | 0.50 | 0.50 | 0.002 | 0.1 | - | 0.005 | B2 |
| Dinitrotoluene (2,6-) | 606-20-2 | - | - | - | F '92 | 0.40 | 0.40 | 0.001 | 0.04 | - | 0.005 | B2 |
| Dinitrotoluene (2,6 & 2,4) [1] | | - | - | - | F '92 | - | - | - | - | - | 0.005 | B2 |
| Dinoseb | 88-85-7 | F | 0.007 | 0.007 | F '88 | 0.3 | 0.3 | 0.001 | 0.04 | 0.007 | - | D |
| Dioxane p- | 123-91-1 | - | - | - | F '87 | 4 | 0.4 | - | - | - | **0.3** | B2 |
| Diphenamid | 957-51-7 | - | - | - | F '88 | 0.3 | 0.3 | 0.03 | 1 | 0.2 | - | D |
| Diquat | 85-00-7 | F | 0.02 | 0.02 | - | - | - | **0.002**[2] | 0.07 | - | - | D |
| Disulfoton | 298-04-4 | - | - | - | F '88 | 0.01 | 0.01 | 0.00004 | 0.001 | 0.0003 | - | E |
| Dithiane (1,4-) | 505-29-3 | - | - | - | F '92 | 0.4 | 0.4 | 0.01 | 0.4 | 0.08 | - | D |
| Diuron | 330-54-1 | - | - | - | F '88 | 1 | 1 | 0.002[3] | 0.07 | 0.01 | - | D |
| Endothall | 145-73-3 | F | 0.1 | 0.1 | F '88 | 0.8 | 0.8 | 0.02 | 0.7 | 0.1 | - | D |
| Endrin | 72-20-8 | F | 0.002 | 0.002 | F '87 | 0.02 | 0.005 | **0.0003** | 0.01 | 0.002 | - | D |
| Epichlorohydrin | 106-89-8 | F | zero | TT[4] | F '87 | 0.1 | 0.1 | 0.002 | 0.07 | - | **0.3** | B2 |
| Ethylbenzene | 100-41-4 | F | 0.7 | 0.7 | F '87 | 30 | 3 | 0.1 | 3 | 0.7 | - | D |
| Ethylene dibromide (EDB)[5] | 106-93-4 | F | zero | 0.00005 | F '87 | 0.008 | 0.008 | - | - | - | **0.00004** | B2 |
| Ethylene glycol | 107-21-1 | - | - | - | F '87 | 20 | 6 | 2 | 70 | 14 | - | D |
| Ethylene Thiourea (ETU) | 96-45-7 | - | - | - | F '88 | 0.3 | 0.3 | **0.00008** | 0.003 | - | 0.02 | B2 |
| Fenamiphos | 22224-92-6 | - | - | - | F '88 | 0.009 | 0.009 | 0.00025 | 0.009 | 0.002 | - | D |

[1] Technical grade.
[2] New OPP RfD = 0.005 mg/kg/day
[3] New OPP RfD = 0.003 mg/kg/day.
[4] When epichlorohydrin is used in drinking water systems, the combination (or product) of dose and monomer level shall not exceed that equivalent to an epichlorohydrin-based polymer containing 0.01% monomer dosed at 20 mg/L.
[5] 1,2-dibromoethane.

# Drinking Water Standards and Health Advisories



| Chemicals | CAS Number | Standards | | | Status HA Standards | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | 10-kg Child | | | | | | |
| | | | | | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| Fluometuron | 2164-17-2 | - | - | - | F '88 | 2 | 2 | 0.01 | 0.5 | 0.09 | | D |
| Fluorene (PAH) | 86-73-7 | - | - | - | - | - | - | 0.04 | 1 | - | - | D |
| Fonofos | 944-22-9 | - | - | - | F '88 | 0.02 | 0.02 | 0.002 | 0.07 | 0.01 | - | D |
| Formaldehyde | 50-00-0 | - | - | - | D '93 | 10 | 5 | **0.2** | 7 | 1 | - | B1[1] |
| Glyphosate | 1071-83-6 | F | 0.7 | 0.7 | F '88 | 20 | 20 | 0.1[2] | 4 | 0.7 | - | D |
| Heptachlor | 76-44-8 | F | zero | 0.0004 | F '87 | 0.01 | 0.01 | 0.0005 | 0.02 | - | 0.0008 | B2 |
| Heptachlor epoxide | 1024-57-3 | F | zero | 0.0002 | F '87 | 0.01 | - | 0.00001 | 0.0004 | - | 0.0004 | B2 |
| Hexachlorobenzene | 118-74-1 | F | zero | 0.001 | F '87 | 0.05 | 0.05 | 0.0008 | 0.03 | - | 0.002 | B2 |
| Hexachlorobutadiene[3] | 87-68-3 | - | - | - | D '98 | 0.3 | 0.3 | **0.0002[4]** | **0.007** | 0.001 | 0.05 | C |
| Hexachlorocyclopentadiene | 77-47-4 | F | 0.05 | 0.05 | - | - | - | **0.006** | 0.2 | - | - | E |
| Hexachloroethane | 67-72-1 | - | - | - | F '91 | 5 | 5 | 0.001 | 0.04 | 0.001 | **0.3** | C |
| Hexane (n-) | 110-54-3 | - | - | - | F '87 | 10 | 4 | - | - | - | - | D |
| Hexazinone | 51235-04-2 | - | - | - | F '96 | 3 | 2 | 0.05[5] | 2 | 0.4 | - | D |
| HMX[6] | 2691-41-0 | - | - | - | F '88 | 5 | 5 | 0.05 | 2 | 0.4 | - | D |
| Indeno[1,2,3,-c,d]pyrene (PAH) | 193-39-5 | - | - | - | - | - | - | - | - | - | - | B2 |
| Isophorone | 78-59-1 | - | - | - | F '92 | 15 | 15 | 0.2 | 7 | 0.1 | 4 | C |
| Isopropyl methylphosphonate | 1832-54-8 | - | - | - | F '92 | 30 | 30 | 0.1 | 4 | 0.7 | - | D |
| Isopropylbenzene (cumene) | 98-82-8 | - | - | - | D '87 | 11 | 11 | 0.1 | 4 | - | - | D |
| Lindane [7] | 58-89-9 | F | 0.0002 | 0.0002 | F '87 | 1 | 1 | 0.0003 | 0.01 | 0.0002 | - | C |
| Malathion | 121-75-5 | - | - | - | F '92 | 0.2 | 0.2 | 0.02 | 0.8 | 0.1 | - | D |
| Maleic hydrazide | 123-33-1 | - | - | - | F '88 | 10 | 10 | 0.5 | 20 | 4 | - | D |
| MCPA [8] | 94-74-6 | - | - | - | F '88 | 0.1 | 0.1 | 0.0005[9] | 0.02 | 0.004 | - | D |
| Methomyl | 16752-77-5 | - | - | - | F '88 | 0.3 | 0.3 | 0.025 | 0.9 | 0.2 | - | E |
| Methoxychlor | 72-43-5 | F | 0.04 | 0.04 | F '87 | 0.05 | 0.05 | **0.005** | 0.2 | 0.04 | - | D |
| Methyl ethyl ketone | 78-93-3 | - | - | - | F '87 | 75 | 7.5 | **0.6** | **20** | **4** | - | D |
| Methyl parathion | 298-00-0 | - | - | - | F '88 | 0.3 | 0.3 | 0.00025 | 0.009 | 0.002 | - | D |

[1] Carcinogenicity based on inhalation exposure.
[2] New OPP RfD = 2 mg/kg/day.
[3] Under review.
[4] Draft Ambient Water Quality Criteria for the protection of human health (EPA 822-R-98-004)
[5] The Health Advisory is based on a new OPP RfD rather than the IRIS RfD.
[6] HMX = octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
[7] Lindane = $\gamma$ – hexachlorocyclohexane.
[8] MCPA = 4(chloro-2-methoxyphenoxy)acetic acid.
[9] New OPP RfD = 0.0015 mg/kg/day.

| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | 10-kg Child | | | | | | |
| | | | | | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| Metolachlor | 51218-45-2 | - | - | - | F '88 | 2 | 2 | 0.15[1] | 5 | 0.1 | - | C |
| Metribuzin | 21087-64-9 | - | - | - | F '88 | 5 | 5 | 0.025[2] | 0.9 | 0.2 | - | D |
| Monochloroacetic acid[3] | 79-11-8 | F | - | 0.06[4] | - | - | - | - | - | - | - | - |
| Monochlorobenzene | 108-90-7 | F | 0.1 | 0.1 | F '87 | 4 | 4 | 0.02 | 0.7 | 0.1 | - | D |
| Naphthalene | 91-20-3 | - | - | - | F '90 | 0.5 | 0.5 | 0.02 | 0.7 | 0.1 | - | C |
| Nitrocellulose[5] | 9004-70-0 | - | - | - | F '88 | - | - | - | - | - | - | - |
| Nitroguanidine | 556-88-7 | - | - | - | F '90 | 10 | 10 | 0.1 | 4 | 0.7 | - | D |
| Nitrophenol p- | 100-02-7 | - | - | - | F '92 | 0.8 | 0.8 | 0.008 | 0.3 | 0.06 | - | D |
| Oxamyl (Vydate) | 23135-22-0 | F | 0.2 | 0.2 | F '87 | 0.2 | 0.2 | 0.025[6] | 0.9 | 0.2 | - | E |
| Paraquat | 1910-42-5 | - | - | - | F '88 | 0.1 | 0.1 | 0.0045 | 0.2 | 0.03 | - | C |
| Pentachlorophenol | 87-86-5 | F | zero | 0.001 | F '87 | 1 | 0.3 | 0.03 | 1 | - | 0.03 | B2 |
| Phenanthrene (PAH) | 85-01-8 | - | - | - | - | - | - | - | - | - | - | D |
| Phenol | 108-95-2 | - | - | - | D '92 | 6 | 6 | 0.6 | 20 | 4 | - | D |
| Picloram | 1918-02-1 | F | 0.5 | 0.5 | F '88 | 20 | 20 | 0.07[7] | 2 | 0.5 | - | D |
| Polychlorinated biphenyls (PCBs) | 1336-36-3 | F | zero | 0.0005 | D '93 | - | - | - | - | - | 0.01 | B2 |
| Prometon | 1610-18-0 | - | - | - | F '88 | 0.2 | 0.2 | 0.015 | 0.5 | 0.1 | - | D |
| Pronamide | 23950-58-5 | - | - | - | F '88 | 0.8 | 0.8 | 0.075 | 3 | 0.05 | - | C |
| Propachlor | 1918-16-7 | - | - | - | F '88 | 0.5 | 0.5 | 0.01 | 0.5 | 0.09 | - | D |
| Propazine | 139-40-2 | - | - | - | F '88 | 1 | 1 | 0.02 | 0.7 | 0.01 | - | C |
| Propham | 122-42-9 | - | - | - | F '88 | 5 | 5 | 0.02 | 0.6 | 0.1 | - | D |
| Pyrene (PAH) | 129-00-0 | - | - | - | - | - | - | 0.03 | - | - | - | D |
| RDX[8] | 121-82-4 | - | - | - | F '88 | 0.1 | 0.1 | 0.003 | 0.1 | 0.002 | 0.03 | C |
| Simazine | 122-34-9 | F | 0.004 | 0.004 | F '88 | 0.5 | 0.5 | 0.005 | 0.2 | 0.004 | - | C |
| Styrene | 100-42-5 | F | 0.1 | 0.1 | F '87 | 20 | 2 | 0.2 | 7 | 0.1 | - | C |
| 2,4,5-T (Trichlorophenoxy-acetic acid) | 93-76-5 | - | - | - | F '88 | 0.8 | 0.8 | 0.01 | 0.4 | 0.07 | - | D |

[1] New OPP RfD = 0.1 mg/kg/day.
[2] New OPP RfD = 0.013 mg/kg/day.
[3] Under review.
[4] 1998 Final Rule for Disinfectants and Disinfection By-products: the total for five haloacetic acids is 0.06mg/L.
[5] The Health Advisory Document for nitrobenzene does not include HA values and describes this compounds as relatively nontoxic.
[6] New OPP RfD = 0.001 mg/kg/day.
[7] New OPP RfD = 0.2 mg/kg/day.
[8] RDX = hexahydro -1,3,5-trinitro-1,3,5-triazine.

# *Drinking Water Standards and Health Advisories*



| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 10-kg Child | | | | | | |
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| 2,3,7,8-TCDD (Dioxin) | 1746-01-6 | F | zero | 3E-08 | F '87 | 1E-06 | 1E-07 | 1E-09 | 4E-08 | - | 2E-08 | B2 |
| Tebuthiuron | 34014-18-1 | - | - | - | F '88 | 3 | 3 | 0.07 | 2 | 0.5 | - | D |
| Terbacil | 5902-51-2 | - | - | - | F '88 | 0.3 | 0.3 | 0.01 | 0.4 | 0.09 | - | E |
| Terbufos | 13071-79-9 | - | - | - | F '88 | 0.005 | 0.005 | 0.0001 | 0.005 | 0.0009 | - | D |
| Tetrachloroethane (1,1,1,2-) | 630-20-6 | - | - | - | F '89 | 2 | 2 | 0.03 | 1 | 0.07 | 0.1 | C |
| Tetrachloroethane (1,1,2,2-) | 79-34-5 | - | - | - | F '89 | 0.04 | 0.04 | 0.00005 | 0.002 | 0.0003 | 0.02 | C |
| Tetrachloroethylene | 127-18-4 | F | zero | 0.005 | F '87 | 2 | 2 | 0.01 | 0.5 | 0.01 | - | - |
| Trichlorofluoromethane | 75-69-4 | - | - | - | F '89 | 7 | 7 | 0.3 | 10 | 2 | - | D |
| Toluene | 108-88-3 | F | 1 | 1 | D '93 | 20 | 2 | 0.2 | 7 | 1 | - | D |
| Toxaphene | 8001-35-2 | F | zero | 0.003 | F '96 | 0.004 | 0.004 | 0.0004 | 0.01 | - | 0.003 | B2 |
| 2,4,5-TP (Silvex) | 93-72-1 | F | 0.05 | 0.05 | F '88 | 0.2 | 0.2 | 0.008 | 0.3 | 0.05 | - | D |
| Trichloroacetic acid[1] | 76-03-9 | F | 0.3 | 0.06[2] | D '96 | 4 | 4 | 0.1 | 4.0 | 0.3 | - | C |
| Trichlorobenzene (1,2,4-) | 120-82-1 | F | 0.07 | 0.07 | F '89 | 0.1 | 0.1 | **0.01** | 0.4 | 0.07 | - | D |
| Trichlorobenzene (1,3,5-) | 108-70-3 | - | - | - | F '89 | 0.6 | 0.6 | 0.006 | 0.2 | 0.04 | - | D |
| Trichloroethane (1,1,1-) | 71-55-6 | F | 0.2 | 0.2 | F '87 | 100 | 40 | 0.035 | 1 | 0.2 | - | D |
| Trichloroethane (1,1,2-) | 79-00-5 | F | 0.003 | 0.005 | F '89 | 0.6 | 0.4 | 0.004 | 0.1 | 0.003 | 0.06 | C |
| Trichloroethylene [1] | 79-01-6 | F | zero | 0.005 | F '87 | - | - | 0.007 | 0.2 | - | 0.3 | B2 |
| Trichlorophenol (2,4,6-) | 88-06-2 | - | - | - | D '94 | 0.03 | 0.03 | 0.0003 | 0.01 | - | 0.3 | B2 |
| Trichloropropane (1,2,3-) | 96-18-4 | - | - | - | F '89 | 0.6 | 0.6 | 0.006 | 0.2 | 0.04 | - | - |
| Trifluralin | 1582-09-8 | - | - | - | F '90 | 0.08 | 0.08 | 0.0075[3] | 0.3 | 0.005 | 0.5 | C |
| Trimethylbenzene (1,2,4-) | 95-63-6 | - | - | - | D '87 | - | - | - | - | - | - | D |
| Trimethylbenzene (1,3,5-) | 108-67-8 | - | - | - | D '87 | 10 | - | - | - | - | - | D |
| Trinitroglycerol | 55-63-0 | - | - | - | F '87 | 0.005 | 0.005 | - | - | 0.005 | 0.2 | - |
| Trinitrotoluene (2,4,6-) | 118-96-7 | - | - | - | F '89 | 0.02 | 0.02 | 0.0005 | 0.02 | 0.002 | 0.1 | C |
| Vinyl chloride | 75-01-4 | F | zero | 0.002 | F '87 | 3 | 3 | **0.003** | 0.1 | - | **0.002** | A |
| Xylenes | 1330-20-7 | F | 10 | 10 | D '93 | 40 | 40 | 2 | 70 | 10 | - | D |

[1] Under review.
[2] 1998 Final Rule for Disinfectants and Disinfection By-products: The total for five haloacetic acids is 0.06 mg/L.
[3] New OPP RfD = 0.024 mg/kg/day.

| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 10-kg Child | | | | | | |
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| INORGANICS | | | | | | | | | | | | |
| Ammonia | 7664-41-7 | - | - | - | D '92 | - | - | - | - | 30 | - | D |
| Antimony | 7440-36-0 | F | 0.006 | 0.006 | F '92 | 0.01 | 0.01 | 0.0004 | 0.01 | 0.006 | - | D |
| Arsenic | 7440-38-2 | F | zero | 0.01 | D '95 | - | - | **0.0003** | 0.01 | - | - | A |
| Asbestos (fibers/l >10μm length) | 1332-21-4 | F | 7 MFL[1] | 7 MFL | - | - | - | - | - | - | 700-MFL | A[2] |
| Barium | 7440-39-3 | F | 2 | 2 | D '93 | 0.7 | 0.7 | **0.07** | 2 | 2 | - | D |
| Beryllium | 7440-41-7 | F | 0.004 | 0.004 | F '92 | 30 | 30 | **0.002** | 0.07 | - | - | - |
| Boron[3] | 7440-42-8 | - | - | - | D '92 | 4 | 0.9 | 0.09 | 3 | 0.6 | - | D |
| Bromate | 7789-38-0 | F | zero | 0.01 | D '98 | 0.2 | - | **0.004** | 0.14 | - | 0.005 | B2 |
| Cadmium | 7440-43-9 | F | 0.005 | 0.005 | F '87 | 0.04 | 0.04 | 0.0005 | 0.02 | 0.005 | - | D |
| Chloramine[4] | 10599-90-3 | F | 4[5] | 4[5] | D '95 | 1 | 1 | 0.1 | 3.5 | 3.0 | - | - |
| Chlorine | 7782-50-5 | F | 4[5] | 4[5] | D '95 | 3 | 3 | 0.1 | 5 | 4 | - | D |
| Chlorine dioxide | 10049-04-4 | F | 0.8[5] | 0.8[5] | D '98 | 0.84 | 0.84 | 0.03 | 1 | 0.8 | - | D |
| Chlorite | 7758-19-2 | F | 0.8 | 1 | D '98 | 0.84 | 0.84 | 0.03 | 1 | 0.8 | - | D |
| Chromium (total) | 7440-47-3 | F | 0.1 | 0.1 | F '87 | 1 | 1 | **0.003[6]** | 0.1 | - | - | D |
| Copper (at tap) | 7440-50-8 | F | 1.3 | TT[7] | D '98 | - | - | - | - | - | - | D |
| Cyanide[3] | 143-33-9 | F | 0.2 | 0.2 | F '87 | 0.2 | 0.2 | 0.02[8] | 0.8 | 0.2 | - | D |
| Fluoride | 7681-49-4 | F | 4 | 4 | - | - | - | **0.06[9]** | - | - | - | - |
| Lead (at tap) | 7439-92-1 | F | zero | TT[7] | - | - | - | - | - | - | - | B2 |
| Manganese | 7439-96-5 | - | - | - | - | - | - | 0.14[10] | - | - | - | D |
| Mercury (inorganic) | 7487-94-7 | F | 0.002 | 0.002 | F '87 | 0.002 | 0.002 | **0.0003** | 0.01 | 0.002 | - | D |
| Molybdenum | 7439-98-7 | - | - | - | D '93 | 0.08 | 0.08 | 0.005 | 0.2 | 0.04 | - | D |
| Nickel | 7440-02-0 | F | - | - | F '95 | 1 | 1 | 0.02 | 0.7 | 0.1 | - | - |

[1] MFL = million fibers per liter.
[2] Carcinogenicity based on inhalation exposure.
[3] Under review.
[4] Monochloramine; measured as free chlorine.
[5] 1998 Final Rule for Disinfectants and Disinfection By-products: MRDLG=Maximum Residual Disinfection Level Goal; and MRDL=Maximum Residual Disinfection Level.
[6] IRIS value for chromium VI.
[7] Copper action level 1.3 mg/L; lead action level 0.015 mg/L.
[8] This RfD is for hydrogen cyanide.
[9] Based on dental fluorosis in children, a cosmetic effect. MCLG based on skeletal fluorosis.
[10] Dietary manganese.

| Chemicals | CASRN Number | Standards | | | Status HA Document | Health Advisories | | | | | | Cancer Group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 10-kg Child | | | | | | |
| | | Status Reg. | MCLG (mg/L) | MCL (mg/L) | | One-day (mg/L) | Ten-day (mg/L) | RfD (mg/kg/day) | DWEL (mg/L) | Life-time (mg/L) | mg/L at $10^{-4}$ Cancer Risk | |
| Nitrate (as N) | 14797-55-8 | F | 10 | 10 | D '93 | 10[1] | 10[1] | 1.6 | - | - | - | - |
| Nitrite (as N) | 14797-65-0 | F | 1 | 1 | D '93 | 1[1] | 1[1] | 0.16 | - | - | - | - |
| Nitrate + Nitrite (both as N) | | F | 10 | 10 | D '93 | - | - | - | - | - | - | - |
| Selenium | 7782-49-2 | F | 0.05 | 0.05 | - | - | - | 0.005 | 0.2 | 0.05 | - | D |
| Silver | 7440-22-4 | - | - | - | F '92 | 0.2 | 0.2 | 0.005[2] | 0.2 | 0.1 | - | D |
| Strontium | 7440-24-6 | - | - | - | D '93 | 25 | 25 | 0.6 | 20 | 4 | - | D |
| Thallium | 7440-28-0 | F | 0.0005 | 0.002 | F '92 | 0.007 | 0.007 | 0.00007 | 0.002 | 0.0005 | - | - |
| White phosphorous | 7723-14-0 | - | - | - | F '90 | - | - | 0.00002 | 0.0005 | 0.0001 | | D |
| Zinc | 7440-66-6 | - | - | - | D '93 | 6 | 6 | 0.3 | 10 | 2 | - | D |
| **RADIONUCLIDES** | | | | | | | | | | | | |
| Beta particle and photon activity (formerly man-made radionuclides) | | F | zero | 4 mrem/yr | - | - | - | - | - | - | 4 mrem/yr | A |
| Gross alpha particle activity | | F | zero | 15 pCi/L | - | - | - | - | - | - | 15 pCi/L | A |
| Combined Radium 226 & 228 | 7440-14-4 | F | zero | 5 pCi/L | - | - | - | - | - | - | - | A |
| Radon | 10043-92-2 | P | zero | 300 pCi/L AMCL[3] 4000 pCi/L | - | - | - | - | - | - | 150 pCi/L | A |
| Uranium | 7440-61-1 | F | zero | 30 µg/L | - | - | - | 0.003[4] | 0.1 | - | - | A |

[1] These values are calculated for a 4-kg infant and are protective for all age groups.
[2] Based on a cosmetic effect.
[3] AMCL = Alternative Maximum Contaminant Level
[4] Soluble uranium salts.

# *Secondary Drinking Water Regulations*



| Chemicals | CAS Number | Status | SDWR |
|---|---|---|---|
| Aluminum | 7429-90-5 | F | 0.05 to 0.2 mg/L |
| Chloride | 7647-14-5 | F | 250 mg/L |
| Color | NA | F | 15 color units |
| Copper | 7440-50-8 | F | 1.0 mg/L |
| Corrosivity | NA | F | non-corrosive |
| Fluoride | 7681-49-4 | F | 2.0 mg/L |
| Foaming agents | NA | F | 0.5 mg/L |
| Iron | 7439-89-6 | F | 0.3 mg/L |
| Manganese | 7439-96-5 | F | 0.05 mg/L |
| Odor | NA | F | 3 threshold odor numbers |
| pH | NA | F | 6.5 – 8.5 |
| Silver | 7440-22-4 | F | 0.1 mg/L |
| Sulfate | 7757-82-6 | F | 250 mg/L |
| Total dissolved solids (TDS) | NA | F | 500 mg/L |
| Zinc | 7440-66-6 | F | 5 mg/L |

# Microbiology



| | Status Reg. | Status HA Document | MCLG | MCL | Treatment Technique |
|---|---|---|---|---|---|
| *Cryptosporidium* | F | F 01 | - | TT | Systems that filter must remove 99% of *Cryptosporidium* |
| *Giardia lamblia* | F | F 98 | - | TT | 99.9% killed/inactivated |
| *Legionella* | F[1] | F 98 | zero | TT | No limit; EPA believes that if *Giardia* and viruses are inactivated, *Legionella* will also be controlled |
| Heterotrophic Plate Count (HPC) | F[1] | - | NA | TT | No more than 500 bacterial colonies per milliliter. |
| Total Coliforms | F | - | zero | 5% | No more than 5.0% samples total coliform-positive in a month. Every sample that has total coliforms must be analyzed for fecal coliforms; no fecal coliforms are allowed. |
| Turbidity | F | - | NA | TT | At no time can turbidity go above 5 NTU (nephelometric turbidity units) |
| Viruses | F[1] | - | zero | TT | 99.99% killed/inactivated |

[1] Final for systems using surface water; also being considered for regulation under groundwater disinfection rule.

# *Drinking Water Advisory Table*



| Chemicals | Status | Health-based Value | Taste Threshold | Odor Threshold |
|---|---|---|---|---|
| Ammonia | D '92 | Not Available | 30 mg/L | |
| Methyl tertiary butyl ether (MtBE) | F '98 | Not Available | 40 µg/L | 20 µg/L |
| Sodium | D '02 | 20 mg/L (for individuals on a 500 mg/day restricted sodium diet). | 30-60 mg/L | |
| Sulfate | D '02 | 500 mg/L | 250 mg/L | |

Taste Threshold: Concentration at which the majority of consumers do not notice an adverse taste in drinking water; it is recognized that some sensitive individuals may detect a chemical at levels below this threshold.

Odor Threshold: Concentration at which the majority of consumers do not notice an adverse odor in drinking water; it is recognized that some sensitive individuals may detect a chemical at levels below this threshold.

OSWER 9240.1-35
EPA 540-R-01-008
July 2002

# USEPA CONTRACT LABORATORY PROGRAM NATIONAL FUNCTIONAL GUIDELINES FOR INORGANIC DATA REVIEW

**FINAL**

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

## NOTICE

The policies and procedures set forth here are intended as guidance to the United States Environmental Protection Agency (hereafter referred to as USEPA) and other governmental employees. They do not constitute rule making by USEPA, and may not be relied upon to create a substantive or procedural right enforceable by any other person. The Government may take action that is at variance with the policies and procedures in this manual.

This document can be obtained from the USEPA's Contract Laboratory Program (CLP) Web site at:

**http://www.epa.gov/superfund/programs/clp/guidance.htm**

## TABLE OF CONTENTS

**INTRODUCTION** . . . . . 1

**PRELIMINARY REVIEW** . . . . . 2

**ICP-AES DATA REVIEW** . . . . . 4

An Example Analytical Sequence for ICP-AES . . . . . 5

I. Preservation and Holding Times . . . . . 6

II. Calibration . . . . . 8

III. Blanks . . . . . 14

IV. Inductively Coupled Plasma - Interference Check Sample (ICP-ICS) . . . . . 18

V. Laboratory Control Sample (LCS) . . . . . 22

VI. Duplicate Sample Analysis . . . . . 25

VII. Spike Sample Analysis . . . . . 28

VIII. ICP Serial Dilution . . . . . 32

IX. Field Duplicates . . . . . 34

X. Overall Assessment . . . . . 35

Calculations for ICP-AES . . . . . 37

**ICP-MS DATA REVIEW** . . . . . 39

An Example Analytical Sequence for ICP-MS . . . . . 40

I. Preservation and Holding Times . . . . . 41

II. ICP-MS Tune Analysis . . . . . 43

III. Calibration . . . . . 46

IV. Blanks . . . . . 52

V. Inductively Coupled Plasma-Interference Check Sample (ICP-ICS) . . . . . 56

VI. Laboratory Control Sample (LCS) . . . . . 60

VII. Duplicate Sample Analysis . . . . . 63

VIII. Spike Sample Analysis . . . . . 66

IX. ICP Serial Dilution . . . . . 70

X. ICP-MS Internal Standards ..... 72

XI. Field Duplicates ..... 75

XII. Overall Assessment ..... 76

Calculations for ICP-MS ..... 78

**MERCURY DATA REVIEW** ..... 79

An Example Analytical Sequence for Mercury ..... 80

I. Preservation and Holding Times ..... 81

II. Calibration ..... 83

III. Blanks ..... 89

IV. Laboratory Control Sample (LCS) ..... 93

V. Duplicate Sample Analysis ..... 96

VI. Spike Sample Analysis ..... 99

VII. Field Duplicates ..... 102

VIII. Overall Assessment ..... 103

Calculations for Mercury ..... 105

**CYANIDE DATA REVIEW** ..... 106

An Example Analytical Sequence for Cyanide ..... 107

I. Preservation and Holding Times ..... 108

II. Calibration ..... 110

III. Blanks ..... 116

IV. Laboratory Control Sample (LCS) ..... 120

V. Duplicate Sample Analysis ..... 122

VI. Spike Sample Analysis ..... 125

VII. Field Duplicates ..... 129

VIII. Overall Assessment ..... 130

Calculations for Cyanide ..... 132

**APPENDIX A: GLOSSARY** ..... 135

**APPENDIX B: INORGANIC DATA REVIEW SUMMARY** ..... 139

## LIST OF TABLES

Table 1. Technical Holding Time Actions for ICP-AES Analysis ..... 7
Table 2. Acceptance Criteria for ICVs, CCVs, and CRIs ..... 9
Table 3. Calibration Actions for ICP-AES Analysis ..... 13
Table 4. Blank Actions for ICP-AES Analysis ..... 17
Table 5. Interference Check Actions for ICP-AES Analysis ..... 21
Table 6. LCS Actions for ICP-AES Analysis ..... 24
Table 7. Duplicate Sample Actions for ICP-AES Analysis ..... 27
Table 8. Spike Sample Actions for ICP-AES Analysis ..... 31
Table 9. Serial Dilution Actions for ICP-AES Analysis ..... 33
Table 10. Technical Holding Time Actions for ICP-MS Analysis ..... 42
Table 11. ICP-MS Tune Actions for ICP-MS Analysis ..... 45
Table 12. Acceptance Criteria for ICV, CCV, and CRI Standards ..... 47
Table 13. Calibration Actions for ICP-MS Analysis ..... 50
Table 14. Blank Actions for ICP-MS Analysis ..... 55
Table 15. Interference Check Actions for ICP-MS Analysis ..... 58
Table 16. LCS Actions for ICP-MS Analysis ..... 62
Table 17. Duplicate Sample Actions for ICP-MS Analysis ..... 65
Table 18. Spike Sample Actions for ICP-MS Analysis ..... 69
Table 19. Serial Dilution Actions for ICP-MS Analysis ..... 71
Table 20. Internal Standard Actions for ICP-MS Analysis ..... 74
Table 21. Technical Holding Time Actions for Mercury Analysis ..... 82
Table 22. Acceptance Criteria for ICVs, CCVs, and CRIs ..... 84
Table 23. Calibration Actions for Mercury Analysis ..... 87
Table 24. Blank Actions for Mercury Analysis ..... 92
Table 25. LCS Actions for Mercury Analysis ..... 95
Table 26. Duplicate Sample Actions for Mercury Analysis ..... 98
Table 27. Spike Sample Actions for Mercury Analysis ..... 101
Table 28. Technical Holding Time Actions for Cyanide Analysis ..... 109
Table 29. Acceptance Criteria for ICVs, CCVs, and CRIs ..... 111
Table 30. Calibration Actions for Cyanide Analysis ..... 115
Table 31. Blank Actions for Cyanide Analysis ..... 119
Table 32. LCS Actions for Cyanide Analysis ..... 121
Table 33. Duplicate Sample Actions for Cyanide Analysis ..... 124
Table 34. Spike Sample Actions for Cyanide Analysis ..... 128

## ACRONYMS

| | |
|---|---|
| **AA** | Atomic Absorption |
| **AOC** | Analytical Operations/Data Quality Center |
| **CADRE** | Computer-Aided Data Review and Evaluation |
| **CCB** | Continuing Calibration Blank |
| **CCS** | Contract Compliance Screening |
| **CCV** | Continuing Calibration Verification |
| **CLP** | Contract Laboratory Program |
| **CO** | Contracting Officer |
| **CRI** | CRQL Check Standard |
| **CRQL** | Contract Required Quantitation Limit |
| **CSF** | Complete SDG File |
| **CVAA** | Cold Vapor AA |
| **DART** | Data Assessment Rapid Transmittal |
| **DAT** | Data Assessment Tool |
| **DF** | Dilution Factor |
| **DQO** | Data Quality Objective |
| **ICB** | Initial Calibration Blank |
| **ICP** | Inductively Coupled Plasma |
| **ICP-AES** | Inductively Coupled Plasma - Atomic Emission Spectroscopy |
| **ICP-MS** | Inductively Coupled Plasma - Mass Spectrometry |
| **ICS** | Interference Check Sample |
| **ICV** | Initial Calibration Verification |
| **LCS** | Laboratory Control Sample |
| **LRS** | Linear Range Sample |
| **MDL** | Method Detection Limit |
| **NIST** | National Institute of Standards and Technology |
| **OERR** | Office of Emergency and Remedial Response |
| **OSWER** | Office of Solid Waste and Emergency Response |
| **PB** | Preparation Blank |
| **PE** | Performance Evaluation |
| **%D** | Percent Difference |
| **%R** | Percent Recovery |
| **%RI** | Percent Relative Intensity |
| **%RSD** | Percent Relative Standard Deviation |
| **%S** | Percent Solids |
| **PO** | Project Officer |
| **QA** | Quality Assurance |
| **QAPP** | Quality Assurance Project Plan |
| **QC** | Quality Control |
| **RPD** | Relative Percent Difference |
| **RSCC** | Regional Sample Control Center |
| **SDG** | Sample Delivery Group |
| **SMO** | Sample Management Office |
| **SOP** | Standard Operating Procedure |
| **SOW** | Statement of Work |
| **TAL** | Target Analyte List |
| **TR/COC** | Traffic Report/Chain of Custody Documentation |
| **USEPA** | United States Environmental Protection Agency |

## TARGET ANALYTE LIST

| | |
|---|---|
| **Al** | Aluminum |
| **Sb** | Antimony |
| **As** | Arsenic |
| **Ba** | Barium |
| **Be** | Beryllium |
| **Cd** | Cadmium |
| **Ca** | Calcium |
| **Cr** | Chromium |
| **Co** | Cobalt |
| **Cu** | Copper |
| **CN** | Cyanide |
| **Fe** | Iron |
| **Pb** | Lead |
| **Mg** | Magnesium |
| **Mn** | Manganese |
| **Hg** | Mercury |
| **Ni** | Nickel |
| **K** | Potassium |
| **Se** | Selenium |
| **Ag** | Silver |
| **Na** | Sodium |
| **Tl** | Thallium |
| **V** | Vanadium |
| **Zn** | Zinc |

# INTRODUCTION

This document is designed to offer the data reviewer guidance in determining the usability of analytical data generated through the USEPA Contract Laboratory Program (CLP) multi-media Inorganic Statement of Work (SOW), ILM05.X (ILM05.2 and any future editorial revisions of ILM05.2). This guidance is somewhat limited in scope and is intended to be used as an aid in the formal technical review process. It should not be used to establish specific contract compliance (use of this document to evaluate data generated under Inorganic SOWs other than ILM05.X is cautioned). Definitive guidance is provided where performance should be fully under a Laboratory's control [e.g., blanks, calibration verification standards, Interference Check Samples (ICSs), Quality Control (QC) audit samples, and instrument performance checks (tuning)], while general guidance is provided for evaluating subjective data that is affected by site conditions.

The guidelines presented in the document will aid the data reviewer in establishing (a) if data meets the specific technical and QC criteria established in the SOW, and (b) the usability and extent of bias of any data not meeting the specific technical and QC criteria established in the SOW. It must be understood by the reviewer that acceptance of data not meeting technical requirements is based upon many factors, including, but not limited to, site-specific technical requirements, the need to facilitate the progress of specific projects, and availability for re-sampling. To make judgments at this level requires the reviewer to have a complete understanding of the intended use of the data. The reviewer is strongly encouraged to establish a dialogue with the user prior to, and after data review, to discuss usability issues and to answer questions regarding the review. It should also be understood that in all Cases, data which do not meet specified criteria are never to be fully acceptable without qualification.

The reviewer should note that while this document is to be used as an aid in the formal data review process, other sources of guidance and information, as well as professional judgment, should also be used to determine the ultimate usability of data, especially in those Cases where all data does not meet specific technical criteria. The reviewer should also be aware that minor modifications to some of the analytical methods may be made through the "Flexibility Clause" to meet site-specific requirements, and that these modifications could affect certain validation criteria such as Contract Required Quantitation Limits (CRQLs) and Target Analyte Lists (TALs). A copy of any modification request made to the analytical method should be included in the data package by the Laboratory.

Please visit the CLP Web site at http://www.epa.gov/superfund/programs/clp/index.htm for more information on how to obtain service through the CLP.

## DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If the Regions choose to use additional qualifiers, a complete explanation of those qualifiers should accompany the data review.

| | |
|---|---|
| U | The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit. |
| J | The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample. |
| J+ | The result is an estimated quantity, but the result may be biased high. |
| J- | The result is an estimated quantity, but the result may be biased low. |
| R | The data are unusable. The sample results are rejected due to serious deficiencies in meeting Quality Control (QC) criteria. The analyte may or may not be present in the sample. |
| UJ | The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

## DATA PACKAGE INSPECTION

For data obtained from the Contract Laboratory Program (CLP), the Data Assessment Tool (DAT) reports may be used as a tool in the validation process. The DAT report incorporates Contract Compliance Screening (CCS) and Computer-Aided Data Review and Evaluation (CADRE) results, and is transmitted via the Data Assessment Rapid Transmittal (DART) system. For more information about DAT, please refer to the following CLP Web site:

**http://www.epa.gov/superfund/programs/clp/dat.htm**

The DAT report will identify any missing and/or incorrect information in the data package. The CLP Laboratory may submit a reconciliation package for any missing items or to correct data.

To obtain the DAT report and/or the reconciliation package, or if there are any other concerns regarding the data package, contact the CLP Project Officer (PO) from the Region where the samples were taken. Please refer to the following CLP Web site for the most recent list of Regional CLP POs:

**http://www.epa.gov/superfund/programs/clp/contacts.htm**

## PRELIMINARY REVIEW

This document is for the review of analytical data generated through the USEPA CLP Inorganic Statement of Work (SOW), ILM05.X (ILM05.2 and any future editorial revisions of ILM05.2). To use this document effectively, the reviewer should have a general overview of the Sample Delivery Group (SDG) or sample Case at hand. The exact number of samples, their assigned numbers, their matrix, and the number of Laboratories involved in the analysis are essential information.

It is suggested that an initial review of the data package be performed taking into consideration all information specific to the sample data package (e.g., flexible analysis approval notices, Traffic Report/Chain of Custody (TR/COC) documentation, SDG Narratives, etc.).

The reviewer should also have a copy of the Quality Assurance Project Plan (QAPP) or similar document for the project for which the samples were analyzed. The reviewer should contact the appropriate Regional CLP PO to obtain copies of the QAPP and relevant site information. This information is necessary in determining the final usability of the analytical data.

The SDGs or Cases routinely have unique samples that require special attention by the reviewer. These include field blanks, field duplicates, and performance audit samples which must be identified. The sampling records (e.g., TR/COC documentation, field logs, and/or contractor tables) should identify:

1. The Region where the samples were taken, and
2. The complete list of samples with information on:
   a. Sample matrix;
   b. Field blanks*;
   c. Field duplicates*;
   d. Field spikes*;
   e. Quality Control (QC) audit samples*;
   f. Shipping dates;
   g. Preservatives;
   h. Types of analysis; and
   i. Laboratories involved.

   * If applicable.

The TR/COC documentation includes sample descriptions and date(s) of sampling. The reviewer must consider lag times between sampling and start of analysis when assessing technical sample holding times.

The Laboratory's SDG Narrative is another source of general information. Notable problems with matrices, insufficient sample volume for analysis or reanalysis, samples received in broken containers, preservation, and unusual events should be documented in the SDG Narrative. The reviewer should also inspect any telephone or communication logs detailing any discussion of sample or analysis issues between the Laboratory, the CLP Sample Management Office (SMO), and the USEPA Region.

## DATA REVIEW NARRATIVE

A Data Review Narrative, including the Inorganic Data Review Summary form (see Appendix B), must accompany the Laboratory data forwarded to the intended data recipient (client) or user to promote communication. A copy of the Data Review Narrative should be submitted to the CLP PO assigned oversight responsibility for the Laboratory producing the data.

The Data Review Narrative should include comments that clearly identify the problems associated with a Case or SDG and state the limitations of the data. Documentation should also include the Sample Number, analytical method, extent of the problem, and assigned qualifiers.

# ICP-AES DATA REVIEW

The inorganic data requirements for Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) to be reviewed during validation are listed below:

I. Preservation and Holding Times

II. Calibration
   A. Initial
   B. Initial and Continuing Calibration Verification (ICV/CCV)
   C. Contract Required Quantitation Limit (CRQL) Check Standard (CRI)

III. Blanks

IV. ICP Interference Check Sample (ICS)

V. Laboratory Control Sample (LCS)

VI. Duplicate Sample Analysis

VII. Spike Sample Analysis

VIII. ICP Serial Dilution

IX. Field Duplicates

X. Overall Assessment

## An Example Analytical Sequence for ICP-AES

S0
S
ICV
ICB
CRI
ICSA
ICSAB
CCV
CCB
ten samples
CCV
CCB
seven samples
CRI
ICSA
ICSAB
CCV
CCB

# I. Preservation and Holding Times

## A. Review Items:

Form IA-IN, Form IB-IN, Form XII-IN, Form XIII-IN, Traffic Report/Chain of Custody (TR/COC) documentation, Form DC-1, raw data, and the Sample Delivery Group (SDG) Narrative checking for: pH; cooler temperature; holding time; and other sample conditions.

## B. Objective:

The objective is to ascertain the validity of the analytical results based on the sample condition, and the holding time of the sample from the date of collection to the date of analysis.

## C. Criteria:

1. Technical requirements for sample holding times have only been established for aqueous matrices. The addition of nitric acid to adjust the pH is only required for aqueous samples.

2. The technical holding time criteria for aqueous metal samples is 180 days, preserved (with nitric acid) to pH <2.

3. Aqueous samples shall be maintained at 4°C ±2°C until preparation and analysis to allow for re-preparation and for the direct analysis of dissolved metals.

4. Soil/sediment samples shall be maintained at 4°C ±2°C until preparation and analysis.

## D. Evaluation:

Technical holding times are established by comparing the sampling date(s) on the TR/COC documentation with the dates of analysis on Form XIII-IN, and the raw data. Information contained in the Complete SDG File (CSF) should also be considered in the determination of holding times. Verify that the analysis dates on the Form XIIIs and the raw data are identical. Review the SDG Narrative and raw data preparation logs to determine if samples were properly preserved. If there is an indication that there were problems with the samples, the integrity of the samples may be compromised and professional judgment should be used to evaluate the effect of the problem on the sample results.

## E. Action:

**NOTE:** Apply the action to each sample for which the preservation or holding time criteria was not met.

1. If the pH of aqueous metal samples was ≥2 at the time of sample receipt, use professional judgment to qualify the samples based on the pH of the sample and the chemistry of the metal(s) of interest. Qualify results that are ≥ Method Detection Limit (MDL) as estimated low (J-), and qualify non-detects as unusable (R).

2. If technical holding times were exceeded, use professional judgment to determine the reliability of the data, based on the magnitude of the additional time compared to the technical requirement and whether the samples were properly preserved. The expected bias

would be low. Qualify results that are ≥MDL as estimated low (J-), and qualify non-detects as unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer whether to apply water holding time criteria to soil samples. If they are applied, it must be clearly documented in the Data Review Narrative.

4. When the holding times are exceeded, the reviewer should comment in the Data Review Narrative on any possible consequences for the analytical results.

5. When holding times are grossly exceeded, note it for Contract Laboratory Program Project Officer (CLP PO) action.

**Table 1. Technical Holding Time Actions for ICP-AES Analysis**

| Preservation & Holding Time Results | Action for Samples |
|---|---|
| Aqueous metals samples received with pH ≥2 | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Technical Holding Time exceeded:<br>Metals > 180 days | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |

## II. Calibration

### A. Review Items:

Form II-IN (Parts A & B), Form XI-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data.

### B. Objective:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for the metals on the Inorganic Target Analyte List (TAL). Initial Calibration Verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing Calibration Verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

### C. Criteria:

#### 1. Initial Calibration

The instruments shall be successfully calibrated daily (or once every 24 hours), and each time the instrument is set up. The calibration date and time shall be included in the raw data.

a. A blank and at least one calibration standard shall be used to establish each analytical curve. All measurements shall be within the instrument linear working range where the interelement correction factors are valid. A minimum of two replicate exposures are required for standardization, all Quality Control (QC), and sample analyses. The average result of the multiple exposures for the standardization, QC, and sample analyses shall be used.

b. The instrumental calibration near the Contract Required Quantitation Limit (CRQL) must be verified for each analyte. A CRQL Check Standard (CRI) solution shall be prepared and analyzed at the beginning and end of each sample analysis run and every 20 analytical samples, immediately preceding the Interference Check Sample (ICS) analyses, but not before ICV analysis.

c. The CRI shall be run per Inductively Coupled Plasma (ICP) for every wavelength used for analysis, and for all analytes except for Al, Ba, Ca, Fe, Mg, Na, and K. All results and Percent Recoveries (%R) shall be reported on Form ICB-IN. If the results for the CRI do not fall within the fixed acceptance limits, the Laboratory shall immediately reanalyze the CRI for those analytes. If the results of the reanalysis do not fall within the acceptance limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the new calibration then reverified.

## 2. Initial and Continuing Calibration Verification (ICV and CCV)

The acceptance criteria for the ICVs, CCVs, and CRIs are presented in Table 2:

**Table 2. Acceptance Criteria for ICVs, CCVs, and CRIs**

| Analytical Method | Inorganic Analytes | ICV/CCV Low Limit (% of True Value) | ICV/CCV High Limit (% of True Value) | CRI Low Limit (% of True Value) | CRI High Limit (% of True Value) |
|---|---|---|---|---|---|
| ICP-AES | Metals | 90 | 110 | 70 (50 for Sb, Pb, Tl) | 130 (150 for Sb, Pb, Tl) |

### a. Initial Calibration Verification (ICV)

1) Immediately after each system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). If the ICV %R falls outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and all affected samples reanalyzed.

2) If the ICV is not available from USEPA, or where a certified solution of an analyte is not available from any source, analyses shall be conducted on an independent standard at a concentration level other than that used for instrument calibration (or the CRI), but within the calibrated range.

3) The ICV solution shall be run at each analytical wavelength used for analysis.

### b. Continuing Calibration Verification (CCV)

1) To ensure accuracy during the course of each analytical run, the CCV shall be analyzed and reported for each wavelength used for the analysis of each analyte.

2) The CCV standard shall be analyzed at a frequency of 10% or every two hours during an analytical run, whichever is more frequent. The CCV standard shall also be analyzed at the beginning of the run, and again after the last analytical sample.

3) The analyte concentration(s) in the CCV standard(s) shall be different than the concentration used for the ICV, and shall be one of the following solutions at, or near, the mid-range levels of the calibration curve:

   A. USEPA solutions;
   B. National Institute of Standards and Technology (NIST) standards; or
   C. A Laboratory-prepared standard solution (self-prepared or commercially available).

4) The same CCV standard solution shall be used throughout the analysis runs for a Sample Delivery Group (SDG).

5) The CCV shall be analyzed in the same fashion as an actual sample. Operations such as the number of replicate analyses, the number and duration of the instrument rinses,

etc., affect the measured CCV result and are not to be applied to the CCV to an extent greater than was applied to the associated analytical samples. If the %R of the CCV was outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration verification reanalyzed.

## D. Evaluation:

1. Verify that the instrument was calibrated daily (once every 24 hours) and each time the instrument was set up, utilizing a blank and at least one calibration standard.

2. Confirm that the measurements were within the documented linear working range, and were the average result of at least two replicate exposures.

3. Evaluate the reported CRI to confirm that it was analyzed at the proper concentration, frequency, and location within the analytical run sequence. Verify that acceptable %R results were obtained.

4. Verify that the ICV and CCV standards were analyzed for each analyte at the proper frequency (10%) and at the appropriate concentration. Verify that acceptable %R results were obtained.

5. Recalculate one or more of the ICV, CCV, and CRI %R using the following equation and verify that the recalculated value agrees with the Laboratory-reported values on Forms II (A & B)-IN.

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration (in µg/L) of each analyte <u>measured</u> in the analysis of the ICV, CCV, or CRI solution

True(value) = Concentration (in µg/L) of each analyte in the ICV, CCV, or CRI source

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTES:** For initial calibrations or ICVs that do not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCVs or CRIs that do not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the QC sample and a subsequent technically acceptable analysis of the QC sample in the analytical run.

1. If the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable (R). If the instrument was not calibrated with at least the minimum number of standards, or if the calibration curve does not include standards at required concentrations (e.g., a blank), use professional judgment to qualify results that are ≥ Method Detection Limit (MDL) as estimated (J) or unusable (R), and non-detects as estimated (UJ) or unusable (R).

2. If the CRIs are outside the acceptance criteria, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the CRI %R is <50% (<30% for Sb, Pb, Tl), qualify all sample results that are ≥MDL but < two times (2x) the CRQL and all non-detects as unusable (R). Qualify detects that are ≥2x the CRQL as estimated (J).

   b. If the CRI %R falls within the range of 50-69% (30-49% for Sb, Pb, Tl), qualify all sample results that are ≥MDL but <2x the CRQL as estimated low (J-), and all non-detects as estimated (UJ). Detects ≥2x the CRQL should not be qualified based on this criterion.

   c. If the CRI %R is >130% but ≤180% (>150% but ≤200 for Sb, Pb, Tl), qualify all sample results that are ≥MDL but <2x the CRQL as estimated high (J+). Non-detects and detects ≥2x the CRQL should not be qualified based on this criterion.

   d. If the CRI %R is >180% (>200% for Sb, Pb, Tl), qualify all sample results that are ≥MDL as unusable (R).

3. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the ICV or CCV %R is <75%, qualify non-detects as unusable (R). Use professional judgment to qualify all results that are ≥MDL as estimated low (J-) or unusable (R).

   b. If the ICV or CCV %R falls within the range of 75-89%, qualify sample results that are ≥MDL as estimated low (J-), and qualify non-detects as estimated (UJ).

   c. If the ICV or CCV %R falls within the range of 111-125%, qualify sample results that are ≥MDL as estimated high (J+).

d. If the ICV or CCV %R is within the range of 111-125%, non-detects should not be qualified.

e. If the ICV or CCV %R is >125%, use professional judgment to qualify results that are ≥MDL as estimated high (J+) or unusable (R). Non-detects should not be qualified.

f. If the %R is >160%, qualify all results that are ≥MDL as unusable (R).

4. If the Laboratory failed to provide adequate calibration information, the Region's designated representative should contact the Laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgment to assess the data.

5. Note the potential effects on the reported data due to exceeding the calibration criteria in the Data Review Narrative.

6. If calibration criteria are grossly exceeded, note this for CLP Project Officer (PO) action.

**NOTE:** For truly critical samples, a further in-depth evaluation of the calibration curve may be warranted to determine if additional qualification is necessary.

**Table 3. Calibration Actions for ICP-AES Analysis**

| Calibration Result | Action for Samples |
|---|---|
| Calibration not performed | Qualify all results as unusable (R) |
| Calibration incomplete | Use professional judgment<br>Qualify results that are ≥MDL as estimated (J) or unusable (R)<br>Qualify non-detects as estimated (UJ) or unusable (R) |
| CRI %R <50% (<30% for Sb, Pb, Tl) | Qualify results that are ≥MDL but <2x the CRQL and all non-detects as unusable (R)<br>Qualify all results that are ≥2x the CRQL as estimated (J) |
| CRI %R 50-69% (30-49% for Sb, Pb, Tl) | Qualify results that are ≥MDL but <2x the CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ)<br>Results that are ≥2x the CRQL are not qualified |
| CRI %R >130% but ≤180% (>150% but ≤200% for Sb, Pb, Tl) | Qualify results that are ≥MDL but <2x the CRQL as estimated high (J+)<br>Non-detects and results that are ≥2x the CRQL are not qualified |
| CRI %R >180% (>200% for Sb, Pb, Tl) | Qualify results that are ≥MDL as unusable (R) |
| ICV/CCV %R <75% | Qualify results that are ≥MDL as estimated low (J-) or unusable (R)<br>Qualify all non-detects as unusable (R) |
| ICV/CCV %R 75-89% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| ICV/CCV %R 111-125% | Qualify results that are ≥MDL as estimated (J) |
| ICV/CCV %R >125% | Qualify results that are ≥MDL as estimated high (J+) or unusable (R) |
| ICV/CCV %R >160% | Qualify results that are ≥MDL as unusable (R) |

## III. Blanks

### A. Review Items:

Form I-IN, Form III-IN, Form XII-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, and raw data.

### B. Objective:

The objective of blank analysis results assessment is to determine the existence and magnitude of contamination resulting from Laboratory (or field) activities. The criteria for evaluation of blanks applies to any blank associated with the samples (e.g., method blanks, calibration blanks, field blanks, etc.). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

### C. Criteria:

1. No contaminants should be found in the blank(s).

2. The Initial Calibration Blank (ICB) shall be analyzed after the analytical standards, but not before analysis of the Initial Calibration Verification (ICV) during the initial calibration of the instrument (see Section II.C.1).

3. A Continuing Calibration Blank (CCB) shall be analyzed at each wavelength used for the analysis, immediately after every ICV and Continuing Calibration Verification (CCV). The CCB shall be analyzed at a frequency of 10% or every two hours during the run, whichever is more frequent. The CCB shall be analyzed at the beginning of the run, and again after the last CCV that was analyzed after the last analytical sample of the run. The CCB result (absolute value) shall not exceed the Contract Required Quantitation Limit (CRQL) of each analyte for which analysis is performed.

4. At least one Preparation Blank (PB) shall be prepared and analyzed for each matrix, with every Sample Delivery Group (SDG), or with each batch of samples digested, whichever is more frequent. The PB consists of reagent water processed through the appropriate sample preparation and analysis procedure.

5. If any analyte concentration in the PB is >CRQL, the lowest concentration of that analyte in the associated samples must be 10 times (10x) the PB concentration. Otherwise, all samples associated with that PB with the analyte's concentration <10x the PB concentration, and >CRQL, should be redigested and reanalyzed for that analyte (except for an identified field blank). The Laboratory is not to correct the sample concentration for the blank value.

6. If the concentration of the PB for a certain analyte is <(−CRQL), all samples reported <10x the CRQL (associated with that analyte in that blank), should be redigested and reanalyzed.

## D. Evaluation:

1. Verify that an ICB was analyzed after the calibration, the CCB was analyzed at the proper frequency and location during the run, and PBs were prepared and analyzed as appropriate for the SDG (e.g., total number of samples, various types of matrices present, number of digestion batches, etc.).

2. Review the results reported, as well as the raw data (e.g., instrument printouts, strip charts, printer tapes, bench sheets, etc.) for all blanks, and verify that the results were accurately reported.

3. Evaluate all of the associated blanks for the presence of target analytes. Verify that if target analytes were present in a PB, or if a concentration was <(−CRQL), the affected samples were redigested and reanalyzed. Verify that if target analytes were present in an ICB or a CCB, the analysis was terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration blank reanalyzed.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), many of the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTES:** For ICBs that do not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCBs that do not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the CCB and a subsequent technically acceptable analysis of the CCB in the analytical run.

For PBs that do not meet the technical criteria, apply the action to all samples prepared in the same preparation batch.

1. If the appropriate blanks were not analyzed with the correct frequency, the data reviewer should use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. The situation should then be recorded in the Data Review Narrative, and noted for CLP Project Officer (PO) action.

2. Action regarding unsuitable blank results depends on the circumstances and origin of the blank. The reviewer should note that in instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of contaminant.

3. Some general "technical" review actions include:

   a. Any blank (including PB) reported with a negative result, whose value is ≤(−MDL) but ≥(−CRQL), should be carefully evaluated to determine its effect on the sample data. The reviewer shall then use professional judgment to assess the data. For any

blank (including PB) reported with a negative result, whose value is <(−CRQL), qualify results that are ≥CRQL as estimated low (J-) and non-detects as estimated (UJ).

b. The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. In particular, soil sample results reported on Form I-IN will not be on the same basis (units, dilution) as the calibration blank data reported on Form III-IN. The reviewer may find it easier to work with the raw data.

4. Specific "method" actions include:

a. If the absolute value of an ICB or a CCB result is >CRQL, the analysis should be terminated. If the analysis was not terminated and the affected samples were not reanalyzed, report non-detects and results that are ≥MDL, but ≤CRQL as CRQL-U. For results that are >CRQL but < Blank Result, use professional judgment to qualify the data as unusable (R) or to report the results at the level of the blank with a "U" qualifier. Use professional judgment to qualify results that are > Blank Result. Note this situation for CLP PO action and record it in the Data Review Narrative.

b. If the absolute value of the concentration of the PB is ≤CRQL, no correction of the sample results should be performed.

c. If any analyte concentration in the PB is >CRQL, the lowest concentration of that analyte in the associated samples must be 10x the PB concentration. Otherwise, all samples associated with that blank with concentrations <10x the PB concentration and >CRQL should be redigested and reanalyzed. Raise the CRQL to the concentration found in the PB and report those samples that do not require redigestion (that are ≥MDL but ≤CRQL) as CRQL-U. Note for CLP PO action and record in the Data Review Narrative if the Laboratory failed to redigest and reanalyze the affected samples. The reviewer shall then use professional judgment to assess the data.

**Table 4. Blank Actions for ICP-AES Analysis**

| Blank Type | Blank Result | Sample Result | Action for Samples |
|---|---|---|---|
| ICB/CCB | ≥MDL but ≤CRQL | Non-detect | No action |
| | | ≥MDL but ≤CRQL | Report CRQL value with a"U" |
| | | >CRQL | Use professional judgment |
| ICB/CCB | >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <Blank Result | Report at level of Blank Result with a "U" or qualify data as unusable (R) |
| | | >Blank Result | Use professional judgment |
| ICB/CCB | ≤(-MDL) but ≥(-CRQL) | ≥MDL, or non-detect | Use professional judgment |
| ICB/CCB | <(-CRQL) | <10x the CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| PB | >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <10x the Blank Result | Qualify results as unusable (R) or estimated high (J+) |
| | | ≥10x the Blank Result | No action |
| PB | ≥MDL but ≤CRQL, or non-detect | ≥MDL, or non-detect | No action |
| PB | <(-CRQL) | <10x the CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## IV. Inductively Coupled Plasma - Interference Check Sample (ICP-ICS)

### A. Review Items:

Form IVA-IN, Form IVB-IN, Form XIII-IN, instrument printouts, and raw data.

### B. Objective:

The Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) verifies the analytical instrument's ability to overcome interferences typical of those found in samples.

**NOTE:** The Laboratory should have analyzed and reported ICS results for all elements being reported from the analytical run and for all interferents (target and non-target) for these reported elements.

### C. Criteria:

1. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents. An ICS analysis consists of analyzing both solutions consecutively, starting with Solution A, for all wavelengths used for each analyte reported by Inductively Coupled Plasma - Atomic Emissions Spectroscopy (ICP-AES).

2. An ICS must be run at the beginning and end of each sample analysis run and every 20 analytical samples. The ICS is not to be run prior to the Initial Calibration Verification (ICV), and is to be immediately followed by a Continuing Calibration Verification (CCV), which will be followed by a Continuing Calibration Blank (CCB).

3. Results for the analysis of ICS Solution A must fall within the control limits of ± two times (2x) the Contract Required Quantitation Limit (CRQL), or ±20% of the true value (whichever is greater) for the analytes and interferents.

4. Results for the analysis of ICS Solution AB must fall within the control limits of ±2x the CRQL, or ±20% of the true value (whichever is greater) for the analytes and interferents included in the solution.

5. If the value of an ICS result exceeds ±2x the CRQL, or ±20% of true value (whichever is greater) criteria, the analysis shall be terminated, the problem corrected, the instrument recalibrated, the new calibration then reverified, and the affected samples reanalyzed.

6. The ICS should be obtained from USEPA if available, and analyzed according to the instructions supplied with the solutions. The ICS may be prepared with the interferents at 2x the level specified in the Statement of Work (SOW) if high levels of interferents are found in the field samples. If the ICS is not available from USEPA, an independent ICS solution shall be prepared with the interferent and analyte concentrations at the levels specified in the method.

### D. Evaluation:

1. Verify using the raw data (ICP instrumental printout) that the ICS was analyzed at the proper frequency and location during the analytical run.

2. Evaluate the ICS raw data for results with an absolute value that is > Method Detection Limit (MDL) for those analytes which are not present in the ICS solution.

3. Recalculate using the raw data and the following equation, one or more of the analyte Percent Recoveries (%R), and verify that the recalculated value agrees with the Laboratory- reported values on Form IV-IN.

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration (in µg/L) of each analyte interferent measured in the analysis of ICS Solution A or ICS Solution AB

True(value) = Concentration (in µg/L) of each analyte or interferent in ICS Solution A or ICS Solution AB

4. If the value of an ICS result exceeds the ±2x the CRQL, or ±20% of true value (whichever is greater) criteria, and the Laboratory failed to terminate the analysis, and take the appropriate corrective action, note this for Contract Laboratory Project Officer (CLP PO) action and record in the Data Review Narrative. Use professional judgment to assess the data.

**NOTE:** For data obtained from the CLP, the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For an ICS that does not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the ICS and a subsequent technically acceptable analysis of the ICS in the analytical run.

1. The raw data should, but may not, contain results for interferents. If not, the reviewer shall use professional judgment to qualify the data. If the data does contain results for interferents, the reviewer should apply the following actions to samples with concentrations of interferents that are comparable to, or greater than, their respective levels in the ICS:

   a. If the ICS %R for an analyte or interferent is >120% (or greater than the true value + 2x the CRQL, as applicable) and the sample results are non-detects, the data should not be qualified.

   b. If the ICS %R for an analyte or interferent is >120% (or greater than the true value + 2x the CRQL, as applicable) qualify sample results that are ≥MDL as estimated high (J+). If the ICS %R (or true value) grossly exceeds the limits, use professional judgment to qualify the data.

c. If the ICS %R for an analyte or interferent falls within the range of 50-79% (or less than the true value - 2x the CRQL, as applicable) qualify sample results that are ≥MDL as estimated low (J-).

d. If the ICS recovery for an analyte falls within the range of 50-79% (or less than the true value - 2x the CRQL, as applicable), the possibility of false negatives exists. Qualify sample non-detects as estimated (UJ).

e. If the ICS %R for an analyte or interferent is <50%, qualify all sample results that are ≥MDL and all sample non-detects as unusable (R).

2. If results that are ≥MDL are observed for analytes that are not present in the ICS solution, the possibility of false positives exists. An evaluation of the associated sample data for the affected elements should be made. For samples with comparable or higher levels of interferents and with analyte concentrations that approximate those levels found in the ICS, qualify sample results that are ≥MDL as estimated high (J+). Non-detects should not be qualified.

3. If negative results are observed for analytes that are not present in the ICS solution, and their absolute value is ≥MDL, the possibility of false negatives in the samples exists. An evaluation of the associated sample data for the affected analytes should be made. For samples with comparable or higher levels of interferents, qualify non-detects for the affected analytes as estimated (UJ), and results that are ≥MDL but <10x the absolute value of the negative result as estimated low (J-).

4. In general, ICP-AES sample data can be accepted if the concentrations of Al, Ca, Fe, and Mg in the sample are found to be less than or equal to their respective concentrations in the ICS. If these elements are present at concentrations greater than the level in the ICS, or other elements are present in the sample at >10 mg/L, the reviewer should investigate the possibility of other interference effects as given in the ICP-AES method or as indicated by the Laboratory's interelement correction factors reported on Forms XA-IN and XB-IN for that particular instrument. The analyte concentration equivalents presented in the method should be considered only as <u>estimated values</u> since the exact value of any analytical system is instrument-specific. Therefore, estimate the concentration produced by an interfering element. If the estimate is >2x the CRQL, and also >10% of the reported concentration of the affected element, qualify the affected results as estimated (J).

5. If the raw data does not contain results for the interferents, note it in the Data Review Narrative.

6. Actions regarding the interpretation and/or the subsequent qualification of ICP data due to the ICS analytical results can be extremely complex. Use professional judgment to determine the need for the associated sample data to be qualified. The reviewer may need to obtain additional information from the Laboratory. All interpretive situations should then be recorded in the Data Review Narrative.

7. If the ICS acceptance criteria are grossly exceeded, note the specifics for CLP PO action.

**Table 5. Interference Check Actions for ICP-AES Analysis**

| Interference Check Sample Results | Action for Samples |
|---|---|
| ICS %R >120% (or greater than true value + 2x the CRQL) | Qualify results that are ≥MDL as estimated high (J+) |
| ICS %R 50-79% (or less than true value - 2x the CRQL) | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| ICS %R <50% | Qualify all sample data as unusable (R) |
| Potential false positives in field samples with interferents | Qualify results that are ≥MDL as estimated high (J+) |
| Potential false negatives in field samples with interferents | Qualify results that are ≥MDL but <10x(\|negative value\|) as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## V. Laboratory Control Sample (LCS)

### A. Review Items:

Form VII-IN, Form XII-IN, preparation logs, instrument printouts, and raw data.

### B. Objective:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation.

### C. Criteria:

1. Aqueous and solid LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and Quality Assurance/Quality Control (QA/QC) procedures as employed for the samples. The aqueous LCS solution shall be obtained from USEPA, if available. However, if the LCS is unavailable from USEPA, the Initial Calibration Verification (ICV) solution(s) may be used.

    a. One aqueous LCS shall be prepared and analyzed for every group of aqueous samples in a Sample Delivery Group (SDG), or with each batch of aqueous samples digested, whichever is more frequent.

    b. All aqueous LCS Percent Recoveries (%R) must fall within the control limits of 80-120%, except for Sb and Ag which have no fixed control limits. If the %R for the aqueous LCS falls outside of the control limits (except for Ag and Sb), the analysis should be terminated, the problem corrected, and the samples prepared with that LCS redigested and reanalyzed.

    c. A solid LCS shall be prepared and analyzed utilizing each of the preparation and analytical procedures applied to the soil/sediment samples received, with one exception: the Percent Solids (%S) determination is <u>not required</u>. If the solid LCS is not available from USEPA, other USEPA QA samples or certified materials may be used.

    d. One solid LCS shall be prepared and analyzed for each group of soil sediment samples in an SDG, for each batch of samples digested or distilled, whichever is more frequent.

    e. All solid LCS results shall fall within the control limits reported on Form VII-IN. If the results for the solid LCS fall outside of the control limits, the analyses should be terminated, the problem corrected, and the samples prepared with that LCS redigested and reanalyzed.

### D. Evaluation:

1. Verify using Form VII-IN, Form XII-IN, and raw data that the appropriate number of required LCSs were prepared and analyzed for the SDG.

2. Evaluate Form VII-IN and verify that all results for each analyte fall within the established control limits.

**NOTE:** Certain elements have only advisory limits for the LCS. Professional judgment should be used when evaluating these elements.

3. Check the raw data (e.g., instrument printouts, strip charts, bench sheets, etc.) to verify that the %Rs on Form VII-IN were accurately transcribed. Recalculate one or more of the reported %Rs using the following equation:

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration of each analyte (in µg/L or mg/kg) measured in the analysis of the LCS

True(value) = Concentration of each analyte (in µg/L or mg/kg) in the LCS

4. Verify that the LCS was prepared at the same time as the associated samples using the same procedures.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

If the LCS criteria are not met, the Laboratory performance and method accuracy are in question. Professional judgment should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data associated with an LCS that does not meet the required criteria.

For an LCS that does not meet the technical criteria, apply the action to all samples in the same preparation batch.

### 1. Aqueous LCS:

a. If the LCS %R falls within the range of 50-79%, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated low (J-). If the LCS %R is >120%, qualify sample results that are ≥MDL as estimated high (J+).

b. If the LCS recovery is >120% and the sample results are non-detects, the data should not be qualified.

c. If the LCS recovery falls within the range of 50-79%, qualify non-detects as estimated (UJ).

d. If LCS %R is <50%, qualify all results that are ≥MDL as estimated low (J-) and all non-detects as unusable (R).

e. If the LCS %R is >150%, qualify all affected data (both detects and non-detects) as unusable (R).

2. **Solid LCS:**

a. If the LCS results are greater than the reported control limits, qualify sample results that are ≥MDL as estimated high (J+). If the LCS results are less than the reported control limits, qualify sample results that are ≥MDL as estimated low (J-).

b. If the LCS results are greater than the reported control limits and the sample results are non-detects, the data should not be qualified.

c. If the LCS results are less than the reported control limits, qualify non-detects as estimated (UJ).

3. If a Laboratory fails to analyze an LCS with each SDG, or if a Laboratory consistently fails to generate acceptable LCS recoveries, note this for CLP Project Officer (PO) action.

4. Whenever possible, the potential effects on the data due to out-of-control LCS results should be noted in the Data Review Narrative.

**Table 6. LCS Actions for ICP-AES Analysis**

| LCS Result | Action for Samples |
|---|---|
| Aqueous %R 50-79% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| Aqueous %R >120% | Qualify results that are ≥MDL as estimated high (J+) |
| Aqueous %R <50% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Aqueous %R >150% | Qualify all results as unusable (R) |
| Soil result > upper limit | Qualify results that are ≥MDL as estimated high (J+) |
| Soil result < lower limit | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## VI. Duplicate Sample Analysis

### A. Review Items:

Cover Page, Form VI-IN, Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The objective of duplicate sample analysis is to demonstrate acceptable method precision by the Laboratory at the time of analysis. Duplicate analyses are also performed to generate data that determines the long-term precision of the analytical method on various matrices. Non-homogenous samples can impact the apparent method precision. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for duplicate sample analysis.

2. At least one duplicate sample shall be prepared and analyzed from each group of samples of a similar matrix type (e.g., water or soil) or for each Sample Delivery Group (SDG). Duplicates cannot be averaged for reporting on Form I-IN. Additional duplicate sample analyses may be required by USEPA Regional request. Alternately, the Region may require that a specific sample be used for the duplicate sample analysis.

3. Duplicate sample analyses are required for Percent Solids (%S) determination.

4. A control limit of 20% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values ≥ five times (5x) the Contract Required Quantitation Limit (CRQL).

5. A control limit of the CRQL shall be used if either the sample or duplicate value is <5x the CRQL. The absolute value of the control limit (CRQL) shall be entered in the "Control Limit" column on Form VI-IN. If both samples are non-detects, the RPD is not calculated for Form VI-IN.

**NOTE:** The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project Data Quality Objectives (DQOs) may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples.

### D. Evaluation:

1. Verify from the Cover Page, Form XII-IN, and the raw data that the appropriate number of required duplicate samples were prepared and analyzed for the SDG.

2. Evaluate Form VI-IN and the raw data to verify that all duplicate results for each analyte and method fall within the established control limits.

3. Verify that a field blank or PE sample was not used for duplicate analysis.

4. Check the raw data and recalculate one or more of the RPD values using the following equation to verify that the results were correctly reported on Form VI-IN:

$$RPD = \frac{|S - D|}{(S+D)/2} \times 100$$

**Where,**

RPD = Relative Percent Difference

S = Sample Result (original)

D = Duplicate Result

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a duplicate sample analysis that does not meet the technical criteria, apply the action to all samples of the same matrix if the reviewer considers the samples to be sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data when determining similarity, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions]. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the duplicate sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the duplicate, and thus that only the field sample used to prepare the duplicate sample should be qualified.

1. If the appropriate number of duplicate samples was not analyzed for each matrix using the correct frequency, use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If the results from a duplicate analysis for a particular analyte fall outside the appropriate control limits, qualify sample results that are ≥MDL as estimated (J) and non-detects as estimated (UJ).

3. If a field blank or PE sample was used for the duplicate sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgment exercised by the data reviewer when evaluating the data.

4. Note the potential effects on the data due to out-of-control duplicate sample results in the Data Review Narrative.

**Table 7. Duplicate Sample Actions for ICP-AES Analysis**

| Duplicate Sample Results | Action for Samples |
|---|---|
| Both original sample and duplicate sample >5x the CRQL and RPD >20%* | Qualify those results that are ≥MDL that professional judgment determines to be affected as estimated (J) and non-detects as estimated (UJ) |
| Original sample or duplicate sample ≤5x the CRQL (including non-detects) and absolute difference between sample and duplicate >CRQL* | Qualify those results that are ≥MDL that professional judgment determines to be affected as estimated (J) and non-detects as estimated (UJ) |

*The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project DQOs may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples.

## VII. Spike Sample Analysis

### A. Review Items:

Cover Page, Form V-IN (Part A & B), Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. Non-homogenous samples can impact the apparent method recovery. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three. If the spike is added to the sample prior to the digestion (e.g., prior to the addition of other reagents), it is referred to as a spiked sample, pre-digestion, or Matrix Spike. If the spike is added to the sample after the completion of the digestion procedures, it is referred to as a post-digestion spike, or analytical spike.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for spiked sample analysis.

2. At least one spiked sample (pre-digestion) shall be prepared and analyzed from each group of samples with a similar matrix type (e.g., water or soil), or for each Sample Delivery Group (SDG).

3. When the pre-digestion spike recovery falls outside of the control limits and the sample result is < four times (4x) the spike added, a post-digestion spike shall be performed for those analytes that do not meet the specified criteria. An aliquot of the remaining unspiked sample shall be spiked at 2x the indigenous level or 2x the Contract Required Quantitation Limit (CRQL), whichever is greater.

   **NOTE:** Post-digestion spikes are not required for Ag.

4. The spike Percent Recovery (%R) shall be within the established acceptance limits. However, spike recovery limits do not apply when the sample concentration is ≥4x the spike added. In such an event, the data shall be reported unflagged, even if the %R does not meet the acceptance criteria.

5. If the spiked sample analysis was performed on the same sample that was chosen for the duplicate sample analysis, spike calculations shall be performed using the results of the sample designated as the "original sample". The average of the duplicate results cannot be used for the purpose of determining %R.

   **NOTE:** The final spike concentrations required for the various target analytes are presented in the methods described in the Statement of Work (SOW).

### D. Evaluation:

1. Verify using the Cover Page, Form VA-IN, Form XII-IN, and raw data, that the appropriate number of required spiked samples were prepared and analyzed for the SDG.

2. Verify that a field blank or PE sample was not used for the spiked sample analysis.

3. Evaluate Form VA-IN and the raw data to verify that all pre-digestion spiked sample results for each required analyte fall within the established control limits. If not, verify that a post-digestion/post-distillation spike was prepared and analyzed.

4. Recalculate using the raw data, one or more of the %R using the following equation, and verify that the recalculated value agrees with the Laboratory-reported values on Forms V(A & B)-IN:

$$\% \text{ Recovery} = \frac{SSR - SR}{SA} \times 100$$

**Where,**

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

**NOTE:** When the sample concentration is < Method Detection Limit (MDL), use SR = 0 only for the purpose of calculating the %R. The actual spiked sample results, sample results, and %R (positive or negative) shall still be reported on Forms VA-IN and VB-IN.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For a Matrix Spike that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the Matrix Spike sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the Matrix Spike, and thus that only the field sample used to prepare the Matrix Spike sample should be qualified.

1. If the appropriate number of Matrix Spike samples was not analyzed for each matrix using the correct frequency, use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If a field blank or PE sample was used for the spiked sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgment exercised by the data reviewer when evaluating the data.

3. If the Matrix Spike recovery does not meet the evaluation criteria and a required post-digestion spike was not performed, note this for CLP PO action.

4. If the Matrix Spike %R is <30%, verify that a post-digestion spike was analyzed if required. If the post-digestion spike %R is <75% or is not performed, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated low (J-) and non-detects as unusable (R). If the post-digestion spike %R is ≥75%, qualify sample results that are ≥MDL as estimated (J) and non-detects as estimated (UJ).

5. If the Matrix Spike %R is 30-74% and the sample results are ≥MDL, verify that a post-digestion spike was analyzed if required. If the %R for the post-digestion is also <75% or is not performed, qualify the affected data as estimated low (J-). If the %R for the post-digestion spike is ≥75%, qualify the affected data as estimated (J).

6. If the Matrix Spike %R falls within the range of 30-74% and the sample results are non-detects, qualify the affected data as estimated (UJ).

7. If the Matrix Spike %R is >125% and the reported sample results are non-detects, the sample data should not be qualified.

8. If the Matrix Spike %R is >125% and the sample results are ≥MDL, verify that a post-digestion spike was analyzed if required. If the %R for the post-digestion spike is also >125% or is not performed, qualify the affected data as estimated high (J+). If the %R for the post-digestion spike is ≤125%, qualify the affected data as estimated (J).

9. Note the potential effects on the data due to out-of-control spiked sample results in the Data Review Narrative.

**Table 8. Spike Sample Actions for ICP-AES Analysis**

| Spike Sample Results | Action for Samples |
|---|---|
| Matrix Spike %R <30%<br>Post-digestion spike %R <75% | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as unusable (R) |
| Matrix Spike %R <30%<br>Post-digestion spike %R ≥75% | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R 30-74%<br>Post-digestion Spike %R <75% | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as estimated (UJ) |
| Matrix Spike %R 30-74%<br>Post-digestion spike %R ≥75% | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R >125%<br>Post-digestion spike %R >125% | Qualify affected results that are ≥MDL as estimated high (J+) |
| Matrix Spike %R >125%<br>Post-digestion spike %R ≤125% | Qualify affected results that are ≥MDL as estimated (J) |
| Matrix Spike %R <30%<br>No post-digestion spike performed (e.g., not required for Ag) | Qualify affected results that are ≥MDL as estimated low (J-) and affected non detects as unusable (R) |
| Matrix Spike %R 30-74%<br>No post-digestion spike performed (e.g., not required for Ag) | Qualify affected results that are ≥MDL as estimated low (J-) and non-detects as estimated (UJ) |
| Matrix Spike %R >125%<br>No post-digestion spike performed (e.g., not required for Ag) | Qualify affected results that are ≥MDL as estimated high (J+)<br>Non-detects are not qualified |

## VIII. ICP Serial Dilution

### A. Review Items:

Form I-IN, Form VIII-IN, instrument printouts, and raw data.

### B. Objective:

The serial dilution of samples quantitated by Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES) determines whether or not significant physical or chemical interferences exist due to sample matrix.

### C. Criteria:

1. An ICP Serial Dilution analysis shall be performed on a sample from each group of samples with a similar matrix type (e.g., water or soil) or for each Sample Delivery Group (SDG), whichever is more frequent.

2. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for the ICP Serial Dilution analysis.

3. If the analyte concentration is sufficiently high [concentration in the original sample is >50 times (50x) the Method Detection Limit (MDL)], the serial dilution analysis (a five-fold dilution) shall then agree within a 10 Percent Difference (%D) of the original determination after correction for dilution. Note that serial dilutions of soil samples are reported in µg/L, but the MDL is in mg/kg. The units will need to be adjusted.

### D. Evaluation:

1. Verify that a field blank or PE sample was not used for the serial dilution analysis.

2. Check the raw data and recalculate the %D using the following equation. Verify that the serial dilution analysis results, and the calculated %D results agree with the values reported by the Laboratory on Form VIII-IN:

$$\% \text{ Difference} = \frac{|I - S|}{I} \times 100$$

**Where,**

I = Initial Sample Result (instrument reading)

S = Serial Dilution Result (instrument reading x5)

3. Check the raw data for any evidence of positive or negative interference (results from the diluted sample which are significantly different than the original sample), possibly due to high levels of dissolved solids in the sample, ionization effects, etc.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For a serial dilution that does not meet the technical criteria, apply the action to all samples of the same matrix if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the serial dilution sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for serial dilution, and thus that only the field sample used to prepare the serial dilution sample should be qualified.

1. If the required %D criteria are not met, qualify all affected results that are ≥MDL as estimated (J) and all affected non-detects as estimated (UJ).

2. If evidence of positive or negative interference is found, use professional judgment to qualify the associated sample data. Note the potential effects on the reported data in the Data Review Narrative.

3. It should be noted for CLP Project Officer (PO) action and in the Data Review Narrative if a field blank or PE sample was used for the serial dilution analysis.

**Table 9. Serial Dilution Actions for ICP-AES Analysis**

| Serial Dilution Result | Action for Samples |
|---|---|
| Sample concentration >50x MDL and %D >10 | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Interferences present | Use professional judgment |

## IX. Field Duplicates

### A. Review Items:

Form I-IN, instrument printouts, and raw data.

### B. Objective:

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and Laboratory precision. The results, therefore, may have more variability than Laboratory duplicates that measure only Laboratory performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

### C. Criteria:

There are no "required" review criteria for determining comparability of field duplicate analyses.

### D. Evaluation:

Identify samples that are field duplicates using Traffic Report/Chain of Custody (TR/COC) documentation or sample field sheets. Compare the results reported for each sample and calculate the Relative Percent Difference (RPD), if appropriate.

### E. Action:

Provide any evaluation of the field duplicates in the Data Review Narrative.

## X. Overall Assessment

### A. Review Items:

Entire sample data package, data review results, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data (including any confirmation data).

### B. Objective:

The objective is to ensure that the reported sample quantitation results are accurate. It is appropriate for the data reviewer to make professional judgments and express concerns, as well as to comment on the validity of the overall data for a Case. This is particularly appropriate when there are several Quality Control (QC) criteria that are outside of the specification parameters. The additive nature of QC factors that fall outside of specification parameters is difficult to objectively assess. The reviewer has a responsibility to inform the user of data quality and data limitations to help the user to avoid inappropriate use of the data, while not precluding any consideration of the data. If qualifiers other than those used in this document are necessary to describe or qualify the data, it is necessary to thoroughly document/explain the additional qualifiers used. The data reviewer would be greatly assisted in this endeavor if the acceptance or performance criteria were provided. The Inorganic Review Summary (see Appendix B) and supplementary documentation must be included with the review.

### C. Criteria:

1. Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

2. Reported analyte concentrations must be quantitated according to the appropriate analytical method, as listed in the method.

### D. Evaluation:

Examine the raw data to verify that correct calculations of the sample results were reported by the Laboratory. Digestion and distillation logs, instrument printouts, strip charts, etc., should be compared to the reported sample results recorded on the appropriate Inorganic Summary Forms (Form I-IN through Form XIII-IN).

1. Evaluate any technical problems not previously addressed.

2. Examine the raw data for any anomalies (e.g., baseline shifts, negative absorbance, omissions, illegibility, etc.).

3 Verify that appropriate methods and amounts were used in preparing the samples for analysis.

4. Verify that there are no transcription or reduction errors [e.g., dilutions, Percent Solids (%S), sample weights, etc.] on one or more samples.

5. Verify that results fall within the linear range(s) of the Inductively Coupled Plasma (ICP) instrument(s) (Form XI).

6. If appropriate information is available, the reviewer may assess the usability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the Quality Assurance Project Plan (QAPP), focusing specifically on the acceptance or performance criteria, the Standard Operating Procedure(s) (SOPs), and communication with the user concerning the intended use and desired quality of these data.

## E. Action:

1. Use professional judgment to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief Data Review Narrative to give the user an indication of the analytical limitations of the data. Note any discrepancies between the data and the SDG Narrative for Contract Laboratory Program Project Officer (CLP PO) action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include an assessment of the data usability within the given context.

3. If any discrepancies are found, the Laboratory may be contacted by the Region's designated representative to obtain additional information for resolution. If a discrepancy remains unresolved, the reviewer may determine that qualification of the data is warranted.

## Calculations for ICP-AES

### Aqueous Samples by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES):

The concentrations determined in the digestate are to be reported in units of µg/L:

$$\text{Concentration } (\mu g/L) = C \times \frac{V_f}{V_i} \times DF$$

**Where,**

C = Instrument value in µg/L

$V_f$ = Final digestion volume (mL)

$V_i$ = Initial digestion volume (mL)

DF = Dilution Factor

### Soil Samples by ICP-AES:

The concentrations determined in the digestate are to be reported on the basis of the dry weight of the sample, in units of mg/kg:

$$\text{Concentration (dry wt.) } (mg/kg) = \frac{C \times V}{W \times S} \times DF$$

**Where,**

C = Concentration (mg/L)

V = Final sample volume in Liters (L)

W = Wet sample weight (kg)

S = % Solids/100 (see SOW ILM05.2 Exhibit D - Introduction to Analytical Methods, Section 1.6)

DF = Dilution Factor

### Adjusted Method Detection Limit (MDL)/Adjusted Contract Required Quantitation Limit (CRQL) Calculation:

To calculate the adjusted MDL or adjusted CRQL for water/aqueous samples, substitute the value of the MDL (µg/L) or CRQL (µg/L) into the "C" term in the equation above.

Calculate the adjusted MDL or adjusted CRQL for soil samples as follows:

$$\textbf{Adjusted Concentration (dry wt.)(mg/kg)} = C \times \frac{W_M}{W_R} \times \frac{V_R}{V_M} \times \frac{1}{S} \times DF$$

**Where,**

| | | |
|---|---|---|
| C | = | MDL or CRQL concentration (mg/kg) |
| $W_M$ | = | Minimum method required wet sample weight (g) |
| $W_R$ | = | Reported wet sample weight (g) |
| $V_M$ | = | Method required final sample volume (mL) |
| $V_R$ | = | Reported final sample volume (mL) |
| S | = | % Solids/100 (see Exhibit D - Introduction to Analytical Methods, Section 1.6) |
| DF | = | Sample Dilution Factor |

# ICP-MS DATA REVIEW

The inorganic data requirements for Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) to be reviewed during validation are listed below:

I. Preservation and Holding Times

II. ICP-MS Tune Analysis

III. Calibration
   A. Initial
   B. Initial and Continuing Calibration Verification (ICV/CCV)
   C. Contract Required Quantitation Limit (CRQL) Check Standard (CRI)

IV. Blanks

V. ICP Interference Check Sample (ICS)

VI. Laboratory Control Sample (LCS)

VII. Duplicate Sample Analysis

VIII. Spike Sample Analysis

IX. ICP Serial Dilution

X. ICP-MS Internal Standards

XI. Field Duplicates

XII. Overall Assessment

**NOTE:** At this time, the ICP-MS method in SOW ILM05.X is for water samples only. If soil samples are analyzed by a modified version of this method, the reviewer must use professional judgement to modify the review criteria [e.g., for duplicate sample analyses, spike sample analyses, serial dilution analyses, Laboratory Control Samples (LCSs), and internal standards]. These modifications must be detailed in the Data Review Narrative.

## An Example Analytical Sequence for ICP-MS

Tune(s)
S0
S
ICV
ICB
CRI
ICSA
ICSAB
CCV
CCB
ten samples
CCV
CCB
seven samples
CRI
CCV
CCB

## I. Preservation and Holding Times

### A. Review Items:

Form IA-IN, Form IB-IN, Form XII-IN, Form XIII-IN, Traffic Report/Chain of Custody (TR/COC) documentation, Form DC-1, raw data, and the Sample Delivery Group (SDG) Narrative checking for: pH; cooler temperature; holding time; and other sample conditions.

### B. Objective:

The objective is to determine the validity of the analytical results based on the sample condition, and the holding time of the sample from the date of collection to the date of analysis.

### C. Criteria:

1. The technical holding time criteria for aqueous metal samples is 180 days; preserved (with nitric acid) to pH <2.

2. Aqueous samples shall be maintained at 4°C ±2°C until preparation and analysis to allow for re-preparation and for the direct analysis of dissolved metals.

### D. Evaluation:

Technical holding times are established by comparing the sampling date(s) on the TR/COC documentation with the dates of analysis on Form XIII-IN, and the raw data. Information contained in the Complete SDG File (CSF) should also be considered in the determination of holding times. Verify that the analysis dates on the Form XIIIs and the raw data are identical. Review the SDG Narrative and raw data preparation logs to determine if samples were properly preserved. If there is an indication that there were problems with the samples, the integrity of the samples may be compromised and professional judgment should be used to evaluate the effect of the problem on the sample results.

### E. Action:

**NOTE:** Apply the action to each sample for which the preservation or holding time criteria was not met.

1. If the pH of aqueous metals samples is ≥2 at the time of sample receipt, use professional judgment to qualify the samples based on the pH of the sample and the chemistry of the metal(s) of interest. Qualify results that are ≥ Method Detection Limit (MDL) as estimated low (J-), and qualify non-detects as unusable (R).

2. If technical holding times are exceeded, use professional judgment to determine the reliability of the data based on the magnitude of the additional time compared to the technical requirement and whether the samples were properly preserved. The expected bias would be low. Qualify results that are ≥MDL as estimated low (J-), and qualify non-detects as unusable (R).

3. When the holding times are exceeded, the reviewer should comment in the Data Review Narrative on any possible consequences for the analytical results.

4. When holding times are grossly exceeded, note this for Contract Laboratory Program Project Officer (CLP PO) action.

**Table 10. Technical Holding Time Actions for ICP-MS Analysis**

| Preservation & Holding Time Results | Action for Samples |
|---|---|
| Aqueous metals samples received with pH ≥2 | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Technical Holding Time exceeded:<br>Metals >180 days. | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |

## II. ICP-MS Tune Analysis

### A. Review Items:

Form XIV-IN, instrument printouts, and raw data.

### B. Objective:

The Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) tune serves as an initial demonstration of instrument stability and precision.

### C. Criteria:

1. Prior to calibration, the Laboratory shall analyze the ICP-MS tuning solution at least five times (5x) consecutively. The tuning solution contains 100 µg/L of Be, Mg, Co, In, and Pb. The solution shall contain all required isotopes of the above elements. The Laboratory shall make any adjustments necessary to bring peak width to 0.75 atomic mass unit (amu) at 5% peak height and to bring mass resolution to within 0.1 amu over the range of 6-210 amu.

   **NOTE:** Certain instruments may need to use a criteria of 0.65 - 0.80 amu at 10% peak height.

2. The Percent Relative Standard Deviation (%RSD) of the absolute signals for all analytes in the tuning solution must be <5%.

### D. Evaluation:

1. Verify using the raw data and Form XIV-IN that the appropriate number of analyses of the ICP-MS tuning solution were performed, and that the appropriate analytes were present in the solution.

2. Verify using the raw data and Form XIV-IN that the mass calibration and resolution fall within the limits for each isotope of each analyte.

3. Verify using the raw data and Form XIV-IN that the %RSD is <5% for each isotope of each analyte.

4. Check the raw data to verify that the reported average mass and %RSD on Form XIV-IN were accurately calculated. Recalculate one or more of the average masses and %RSDs for an isotope using the following equations:

$$\text{Mean} = \frac{\sum x}{n}$$

**Where,**

x = Mass from analysis

n = Number of analyses

$$\text{Percent Relative Standard Deviation} = \frac{\sigma_{n-1} \times 100}{\bar{x}}$$

**Where,**

$\bar{x}$ = Mean

$\sigma_{n-1}$ = Standard Deviation

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), many of the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For ICP-MS tunes that does not meet the technical criteria, apply the action to all samples reported from the analytical run.

1. If the ICP-MS instrument was not tuned prior to calibration, the sample data should be qualified as unusable (R).

2. If the tuning solution was not analyzed at least 5x consecutively or the tuning solution does not contain the required analytes spanning the analytical range, the reviewer should use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. The situation should be recorded in the Data Review Narrative and noted for CLP Project Officer (PO) action.

3. If the peak width at 5% peak height exceeds 0.75 amu (or exceeds 0.80 at 10% peak height for certain manufacturers' instruments) for any isotope in the tuning solution, qualify all sample results that are ≥ Method Detection Limit (MDL), associated with that tune, as estimated (J), and all non-detects associated with that tune as estimated (UJ). The situation should be recorded in the Data Review Narrative and noted for CLP PO action.

4. If the mass calibration is not within 0.1 amu for any isotope in the tuning solution, qualify all analyte results that are ≥MDL associated with that isotope as estimated (J), and all non-detects associated with that isotope as estimated (UJ). The situation should be recorded in the Data Review Narrative and noted for CLP PO action.

5. If the %RSD exceeds 5% for any isotope in the tuning solution, qualify all sample results that are ≥MDL associated with that tune as estimated (J), and all non-detects associated with that tune as estimated (UJ). The situation should be recorded in the Data Review Narrative and noted for CLP PO action.

**Table 11. ICP-MS Tune Actions for ICP-MS Analysis**

| ICP-MS Tune Results | Action for Samples |
|---|---|
| Tune not performed | Qualify all results as unusable (R) |
| Tune not performed properly | Use professional judgment |
| Peak width >0.75 amu at 5% peak height | Qualify results that are ≥MDL as estimated (J)<br>Qualify non-detects as estimated (UJ) |
| Mass calibration not within 0.1 amu | Qualify results that are ≥MDL as estimated (J)<br>Qualify non-detects as estimated (UJ) |
| %RSD >5% | Qualify results that are ≥MDL as estimated (J)<br>Qualify non-detects as estimated (UJ) |

# III. Calibration

## A. Review Items:

Form II-IN (Parts A & B), Form XI-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data.

## B. Objective:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for the metals on the Inorganic Target Analyte List (TAL). Initial Calibration Verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing Calibration Verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continual basis.

## C. Criteria:

### 1. Initial Calibration

The instruments shall be successfully calibrated daily (or once every 24 hours), and each time the instrument is set up. The calibration date and time shall be included in the raw data.

a. A blank and at least one calibration standard shall be used to establish each analytical curve. All measurements shall be within the instrument linear working range. A minimum of three replicate scans are required for standardization and all Quality Control (QC) and sample analyses. The average result of the multiple scans for the standardization, QC, and sample analyses shall be used.

b. The instrumental calibration near the Contract Required Quantitation Limit (CRQL) must be verified for each analyte. A CRQL Check Standard (CRI) solution shall be prepared and analyzed at the beginning and end of each sample analysis run and every 20 analytical samples, but not before the ICV analysis. The initial CRI shall immediately precede the Interference Check Sample (ICS) analyses.

c. The CRI shall be run by ICP-MS for every mass used for analysis. All results and Percent Recoveries (%Rs) shall be reported on Form ICB-IN. If the results for the CRI do not fall within the fixed acceptance limits, the Laboratory shall immediately reanalyze the CRI for those analytes. If the results of the reanalysis do not fall within the acceptance limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the new calibration then reverified.

### 2. Initial and Continuing Calibration Verification (ICV and CCV)

The acceptance criteria for the ICVs, CCVs, and CRIs are presented in Table 11:

**Table 12. Acceptance Criteria for ICV, CCV, and CRI Standards**

| Analytical Method | Inorganic Analytes | ICV/CCV Low Limit (% of True Value) | ICV/CCV High Limit (% of True Value) | CRI Low Limit (% of True Value) | CRI High Limit (% of True Value) |
|---|---|---|---|---|---|
| ICP-MS | Metals | 90 | 110 | 70 (50 for Co, Mn, Zn) | 130 (150 for Co, Mn, Zn) |

**a. Initial Calibration Verification (ICV)**

1) Immediately after each ICP-MS system has been calibrated, the accuracy of the initial calibration must be verified and documented for each target analyte by the analysis of an ICV solution(s). If the ICV Percent Recovery (%R) falls outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and all affected samples reanalyzed.

2) If the ICV is not available from USEPA, or where a certified solution of an analyte is not available from any source, analyses shall be conducted on an independent standard at a concentration level other than that used for instrument calibration (or the CRI), but within the calibrated range.

3) The ICV solution shall be run at each analytical mass used for analysis.

**b. Continuing Calibration Verification (CCV)**

1) To ensure accuracy during the course of each analytical run, the CCV shall be analyzed and reported for each mass used for the analysis of each analyte.

2) The CCV standard shall be analyzed at a frequency of 10% or every two hours during an analytical run, whichever is more frequent. The CCV standard shall also be analyzed at the beginning of the run, and again after the last analytical sample.

3) The analyte concentration(s) in the CCV standard(s) shall be different than the concentration used for the ICV, and shall be one of the following solutions at, or near, the mid-range levels of the calibration curve:

   A. USEPA solutions;
   B. National Institute of Standards and Technology (NIST) standards; or
   C. A Laboratory-prepared standard solution (self-prepared or commercially available).

4) The same CCV standard solution shall be used throughout the analysis runs for a Sample Delivery Group (SDG).

5) The CCV shall be analyzed in the same fashion as an actual sample. Operations such as the number of replicate analyses, the number and duration of the instrument rinses, etc., affect the measured CCV result and are not to be applied to the CCV to an extent greater than was applied to

the associated analytical samples. If the %R of the CCV was outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration verification reanalyzed.

## D. Evaluation:

1. Verify that the instrument was calibrated daily (once every 24 hours) and each time the instrument was set up, utilizing a blank and at least one calibration standard.

2. Confirm that the measurements were within the documented linear working range, and were the average result of at least three replicate exposures.

3. Evaluate the reported CRI to confirm that it was analyzed at the proper concentration, frequency, and location within the analytical run sequence. Verify that acceptable %R results were obtained.

4. Verify that the ICV and CCV standards were analyzed for each analyte at the proper frequency (10%) and at the appropriate concentration. Verify that acceptable %R results were obtained.

5. Recalculate one or more of the ICV, CCV, and CRI %Rs using the following equation and verify that the recalculated value agrees with the Laboratory-reported values on Forms II (A & B)-IN.

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration (in µg/L) of each analyte <u>measured</u> in the analysis of the ICV, CCV, or CRI solution

True(value) = Concentration (in µg/L) of each analyte in the ICV, CCV, or CRI source

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For initial calibrations or ICVs that does not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCVs or CRIs that does not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the QC

sample and a subsequent technically acceptable analysis of the QC sample in the analytical run.

1. If the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable (R). If the instrument was not calibrated with at least the minimum number of standards, or if the calibration curve does not include standards at required concentrations (e.g., a blank), use professional judgment to qualify results that are ≥MDL as estimated (J) or unusable (R), and non-detects as estimated (UJ) or unusable (R).

2. If the CRIs are outside the acceptance criteria, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the CRI %R is <50% (<30% for Co, Mn, Zn), qualify all sample results that are ≥MDL but < two times (2x) the CRQL and all non-detects as unusable (R). Qualify detects that are ≥2x the CRQL as estimated (J).

   b. If the CRI %R falls within the range of 50-69% (30-49% for Co, Mn, Zn), qualify all sample results that are ≥MDL but <2x the CRQL as estimated low (J-), and all non-detects as estimated (UJ). Detects that are ≥2x the CRQL should not be qualified based on this criterion.

   c. If the CRI %R is >130% but ≤180% (>150% but ≤200% for Co, Mn, Zn), qualify all sample results that are ≥MDL but <2x the CRQL as estimated high (J+). Non-detects and detects that are ≥2x the CRQL should not be qualified based on this criterion.

   d. If the CRI %R is >180% (>200% for Co, Mn, Zn), qualify all sample results that are ≥MDL as unusable (R).

3. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the ICV or CCV %R is <75%, qualify non-detects as unusable (R). Use professional judgment to qualify all results that are ≥MDL as estimated low (J-) or unusable (R).

   b. If the ICV or CCV %R falls within the range of 75-89%, qualify sample results that are ≥MDL as estimated low (J-), and qualify non-detects as estimated (UJ).

   c. If the ICV or CCV %R falls within the range of 111-125%, qualify sample results that are ≥MDL as estimated high (J+).

   d. If the ICV or CCV %R falls within the range of 111-125%, non-detects should not be qualified.

   e. If the ICV or CCV %R is >125%, use professional judgment to qualify results that are ≥MDL as estimated high (J+) or unusable (R). Non-detects should not be qualified.

   f. If the %R is >160%, qualify all results that are ≥MDL as unusable (R).

4. If the Laboratory failed to provide adequate calibration information, the USEPA Region's designated representative should contact the Laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgment to assess the data.

5. Note the potential effects on the reported data due to exceeding the calibration criteria in the Data Review Narrative.

6. If calibration criteria are grossly exceeded, note this for CLP Project Officer (PO) action.

**NOTE:** For truly critical samples, a further in-depth evaluation of the calibration curve may be warranted to determine if additional qualification is necessary.

**Table 13. Calibration Actions for ICP-MS Analysis**

| Calibration Result | Action for Samples |
|---|---|
| Calibration not performed | Qualify all results as unusable (R) |
| Calibration incomplete | Use professional judgment<br>Qualify results that are ≥MDL as estimated (J) or unusable (R)<br>Qualify non-detects as estimated (UJ) or unusable (R) |
| CRI %R <50% (<30% for Co, Mn, Zn) | Qualify all results that are ≥MDL but <2x the CRQL and all non-detects as unusable (R)<br>Qualify all results that are ≥2x the CRQL as estimated (J) |
| CRI %R 50-69% (30-49% for Co, Mn, Zn) | Qualify results that are ≥MDL but <2x the CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ)<br>Results that are ≥2x the CRQL are not qualified |
| CRI %R >130% but ≤180% (>150% but ≤200% for Co, Mn, Zn) | Qualify results that are ≥MDL but <2x the CRQL as estimated high (J+)<br>Non-detects and results that are ≥2x the CRQL are not qualified |
| CRI %R >180% (>200% for Co, Mn, Zn) | Qualify all results that are ≥MDL as unusable (R) |
| ICV/CCV %R <75% | Qualify results that are ≥MDL as estimated low (J-) or unusable (R)<br>Qualify all non-detects as unusable (R) |
| ICV/CCV %R 75-89% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| ICV/CCV %R 111-125% | Qualify results that are ≥MDL as estimated (J) |
| ICV/CCV %R >125% | Qualify results that are ≥MDL as estimated high (J+) or unusable (R) |
| ICV/CCV %R >160% | Qualify results that are ≥MDL as unusable (R) |

## IV. Blanks

### A. Review Items:

Form I-IN, Form III-IN, Form XII-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, and raw data.

### B. Objective:

The objective of blank analysis results assessment is to determine the existence and magnitude of contamination resulting from Laboratory (or field) activities. The criteria for evaluation of blanks applies to any blank associated with the samples (e.g., method blanks, calibration blanks, field blanks, etc.). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

### C. Criteria:

1. No contaminants should be found in the blank(s).

2. The Initial Calibration Blank (ICB) shall be analyzed after the analytical standards, but not before analysis of the Initial Calibration Verification (ICV) during the initial calibration of the instrument (see Section II.C.1).

3. A Continuing Calibration Blank (CCB) shall be analyzed at each mass used for the analysis, immediately after every ICV and Continuing Calibration Verification (CCV). The CCB shall be analyzed at a frequency of 10% or every two hours during the run, whichever is more frequent. The CCB shall be analyzed at the beginning of the run, and again after the last CCV that was analyzed after the last analytical sample of the run. The CCB result (absolute value) shall not exceed the Contract Required Quantitation Limit (CRQL) of each analyte for which analysis is performed.

4. At least one Preparation Blank (PB) shall be prepared and analyzed, with every Sample Delivery Group (SDG), or with each batch of samples digested, whichever is more frequent. The PB consists of reagent water processed through the appropriate sample preparation and analysis procedure.

5. If any analyte concentration in the PB is >CRQL, the lowest concentration of that analyte in the associated samples must be 10 times (10x) the PB concentration. Otherwise, all samples associated with that PB with the analyte's concentration <10x the PB concentration, and >CRQL, should be redigested and reanalyzed for that analyte (except for an identified field blank). The Laboratory is not to correct the sample concentration for the blank value.

6. If the concentration of the PB for a certain analyte is <(−CRQL), all samples reported <10x the CRQL (associated with that analyte in that blank), should be redigested and reanalyzed.

## D. Evaluation:

1. Verify that an ICB was analyzed after the calibration, the CCB was analyzed at the proper frequency and location during the run, and PBs were prepared and analyzed as appropriate for the SDG (e.g., total number of samples, various types of matrices present, number of digestion batches, etc.).

2. Review the results reported on the Blank Summary (Form III-IN), as well as the raw data (e.g., instrument printouts, strip charts, printer tapes, bench sheets, etc.) for all blanks, and verify that the results were accurately reported.

3. Evaluate all of the associated blanks for the presence of target analytes. Verify that if target analytes were present in a PB, or if a concentration was <(−CRQL), the affected samples were redigested and reanalyzed. Verify that if target analytes were present in an ICB or a CCB, the analysis was terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration blank reanalyzed.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), many of the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTES:** For ICBs that does not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCBs that does not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the CCB and a subsequent technically acceptable analysis of the CCB in the analytical run.

For PBs that does not meet the technical criteria, apply the action to all samples prepared in the same preparation batch.

1. If the appropriate blanks were not analyzed with the correct frequency, the data reviewer should use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. The situation should then be recorded in the Data Review Narrative, and noted for CLP Project Officer (PO) action.

2. Action regarding unsuitable blank results depends on the circumstances and origin of the blank. The reviewer should note that in instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of contaminant.

3. Some general "technical" review actions include:

   a. Any blank (including PB) reported with a negative result, whose value is ≤(−Method Detection Limit) (MDL) but ≥(−CRQL), should be carefully evaluated to determine its effect on the sample data. The reviewer shall then use professional

judgment to assess the data. For any blank (including PB) reported with a negative result, whose value is <(−CRQL), qualify results that are ≥CRQL as estimated low (J-) and non-detects as estimated (UJ).

4. Specific "method" actions include:

   a. If the absolute value of an ICB or a CCB result >CRQL, the analysis should be terminated. If the analysis was not terminated and the affected samples were not reanalyzed, report non-detect and results that are ≥MDL but ≤CRQL as CRQL-U. For results that are >CRQL but < Blank Result, use professional judgment to qualify the data as unusable or to report the results at the level of the blank with a "U" qualifier. Use professional judgment to qualify results that are > Blank Result. Note this situation for CLP PO action and record it in the Data Review Narrative.

   b. If the absolute value of the concentration of the PB is ≤CRQL, no correction of the sample results should be performed.

   c. If any analyte concentration in the PB is >CRQL, the lowest concentration of that analyte in the associated samples must be 10x the PB concentration. Otherwise, all samples associated with that blank with concentrations <10x the PB concentration and >CRQL should be redigested and reanalyzed. Raise the CRQL to the concentration found in the PB and report those samples that does not require redigestion (that are ≥MDL but ≤CRQL) as CRQL-U. Note for CLP PO action and record in the Data Review Narrative if the Laboratory failed to redigest and reanalyze the affected samples. The reviewer shall then use professional judgment to assess the data.

**Table 14. Blank Actions for ICP-MS Analysis**

| Blank Type | Blank Result | Sample Result | Action for Samples |
|---|---|---|---|
| ICB/CCB | ≥MDL but ≤CRQL | Non-Detect | No action |
| | | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL | Use professional judgment |
| ICB/CCB | >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <Blank Result | Report at level of Blank Result with a "U" or qualify data as unusable (R) |
| | | >Blank Result | Use professional judgment |
| ICB/CCB | ≤(-MDL), but ≥(-CRQL) | ≥MDL, or non-detect | Use professional judgment |
| ICB/CCB | <(-CRQL) | <10x CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| PB | >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <10x the Blank Result | Qualify results as unusable (R) or estimated high (J+) |
| | | ≥10x the Blank Result | No action |
| PB | ≥MDL but ≤CRQL | ≥MDL, or non-detect | No action |
| PB | <(-CRQL) | <10x CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## V. Inductively Coupled Plasma-Interference Check Sample (ICP-ICS)

### A. Review Items:

Form IVA-IN, Form IVB-IN, Form XIII-IN, instrument printouts, and raw data.

### B. Objective:

The Inductively Coupled Plasma-Interference Check Sample (ICP-ICS) verifies the analytical instrument's ability to overcome isobaric interferences typical of those found in samples.

### C. Criteria:

1. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and Solution AB consists of the analytes mixed with the interferents. An ICS analysis consists of analyzing both solutions consecutively, starting with Solution A, for all masses used for each analyte or interferent reported by Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS).

2. An ICS must be run at the beginning of each analysis run. The ICS is not to be run prior to the Initial Calibration Verification (ICV), and shall be immediately followed by a Continuing Calibration Verification/Continuing Calibration Blank (CCV/CCB).

3. Results for the ICP-MS analysis of the ICS Solution A shall fall within the control limits of ±3x the CRQL, or ±20% of the true value (whichever is greater) for the analytes and interferents (±20% of the true value for the non-target analyte interferents) included in the solution.

4. Results for the ICP-MS analysis of the ICS Solution AB must fall within the control limits of ±3x the CRQL, or ±20% of the true value (whichever is greater) for the analytes and interferents (±20% of the true value for the non-target analyte interferents) included in the solution.

5. If the value of an ICS result exceeds ±3x the CRQL, or ±20% of true value (whichever is greater) criteria, the analysis shall be terminated, the problem corrected, the instrument recalibrated, the new calibration then reverified, and all analytical samples analyzed since the last compliant ICS reanalyzed.

6. The ICS should be obtained from USEPA, if available, and analyzed according to the instructions supplied with the solutions. If the ICS is not available from USEPA, an independent ICS solution shall be prepared with the interferent and analyte concentrations at the levels specified in the method.

### D. Evaluation:

1. Verify using the raw data (ICP instrumental printout) that the ICS was analyzed at the proper frequency and location during the analytical run.

2. Evaluate the ICS raw data for results with an absolute value that is > Method Detection Limit (MDL) for those analytes that are not present in the ICS solution.

3. Recalculate using the raw data and the following equation, one or more of the analyte Percent Recoveries (%R), and verify that the recalculated value agrees with the Laboratory- reported values on Form IV-IN.

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration (in µg/L) of each analyte interferent measured in the analysis of ICS Solution A or ICS Solution AB

True(value) = Concentration (in µg/L) of each analyte or interferent in ICS Solution A or ICS Solution AB

4. If the value of an ICS result exceeds ±3x the CRQL, or ±20% of true value (whichever is greater) criteria, and the Laboratory failed to terminate the analysis and take the appropriate corrective action, note this for Contract Laboratory Program Project Officer (CLP PO) action and record in the Data Review Narrative. Use professional judgment to assess the data.

**NOTE:** For data obtained from the CLP, the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For an ICS for ICP-MS that does not meet the technical criteria, apply the action to all samples reported from the analytical run.

1. The raw data may not contain results for interferents. In this case, the reviewer shall use professional judgment to qualify the data. If the data does contain results for interferents, the reviewer should apply the following actions to samples with concentrations of interferents that are comparable to, or greater than, their respective levels in the ICS:

   a. If the ICS %R for an analyte or interferent is >120% (or greater than the true value + 3x the CRQL as applicable) and the sample results are non-detects, the data should not be qualified.

   b. If the ICS %R for an analyte or interferent is >120% (or greater than the true value + 3x the CRQL as applicable) qualify sample results that are ≥MDL as estimated high (J+). If the ICS %R (or true value) grossly exceeds the limits, use professional judgment to qualify the data.

   c. If the ICS %R for an analyte or interferent falls within the range of 50-79% (or less than the true value - 3x the CRQL as applicable) qualify sample results that are ≥MDL as estimated low (J-).

   d. If the ICS recovery for an analyte falls within the range of 50-79% (or less than the true value - 3x the CRQL as applicable), the possibility of false negatives exists. Qualify sample non-detects as estimated (UJ).

e. If the ICS %R for an analyte or interferent is <50%, qualify all sample results that are ≥MDL and all sample non-detects as unusable (R).

2. If results that are ≥MDL are observed for analytes which are not present in the ICS solution, the possibility of false positives exists. An evaluation of the associated sample data for the affected elements should be made. For samples with comparable or higher levels of interferents and with analyte concentrations that approximate those levels found in the ICS, qualify sample results that are ≥MDL as estimated high (J+). Non-detects should not be qualified.

3. If negative results are observed for analytes that are not present in the ICS solution, and their absolute value is ≥MDL, the possibility of false negatives in the samples exists. An evaluation of the associated sample data for the affected analytes should be made. For samples with comparable or higher levels of interferents, qualify non-detects for the affected analytes as estimated (UJ), and results that are ≥MDL but <10x the absolute value of the negative result as estimated low (J-).

4. If the raw data does not contain results for the interferents, note this in the Data Review Narrative.

5. Actions regarding the interpretation and/or the subsequent qualification of ICP data due to the ICS analytical results can be extremely complex. Use professional judgment to determine the need for the associated sample data to be qualified. The reviewer may need to obtain additional information from the Laboratory. All interpretive situations should then be recorded in the Data Review Narrative.

6. If the ICS acceptance criteria are grossly exceeded, note the specifics for CLP PO action.

**Table 15. Interference Check Actions for ICP-MS Analysis**

| Interference Check Sample Results | Action for Samples |
|---|---|
| ICS %R >120% (or > true value + 3x the CRQL) | Qualify results that are ≥MDL as estimated high (J+) |
| ICS %R 50-79% (or < true value - 3x the CRQL) | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| ICS %R <50% | Qualify all sample data as unusable (R) |
| Potential false positives in field samples with interferents | Qualify results that are ≥MDL as estimated high (J+) |
| Potential false negatives in field samples with interferents | Qualify results that are ≥MDL but <10x(\|negative value\|) as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## VI. Laboratory Control Sample (LCS)

### A. Review Items:

Form VII-IN, Form XII-IN, preparation logs, instrument printouts, and raw data.

### B. Objective:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation.

### C. Criteria:

1. Aqueous LCSs shall be analyzed for each analyte utilizing the same sample preparations, analytical methods, and Quality Assurance/Quality Control (QA/QC) procedures as employed for the samples. The aqueous LCS solution shall be obtained from USEPA if available. However, if the LCS is unavailable from USEPA, the Initial Calibration Verification (ICV) solution(s) may be used.

   a. One aqueous LCS shall be prepared and analyzed for every group of aqueous samples in a Sample Delivery Group (SDG), or with each batch of aqueous samples digested, whichever is more frequent.

   b. All aqueous LCS Percent Recoveries (%R) must fall within the control limits of 80-120%. If the %R for the aqueous LCS falls outside of the control limits, the analysis should be terminated, the problem corrected, and the samples prepared with that LCS redigested and reanalyzed.

### D. Evaluation:

1. Verify using Form VII-IN, Form XII-IN, and raw data that the appropriate number of required LCSs were prepared and analyzed for the SDG.

2. Evaluate Form VII-IN and verify that all results for each analyte fall within the established control limits.

3. Check the raw data (e.g., instrument printouts, strip charts, bench sheets, etc.) to verify that the %Rs on Form VII-IN were accurately transcribed. Recalculate one or more of the reported %Rs using the following equation:

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration of each analyte (in µg/L) <u>measured</u> in the analysis of the LCS

True(value) = Concentration of each analyte (in µg/L) in the LCS

4. Verify that the LCS was prepared at the same time as the associated samples using the same procedures.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

If the LCS criteria are not met, the Laboratory performance and method accuracy are in question. Professional judgment should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data associated with an LCS that does not meet the required criteria.

For an LCS that does not meet the technical criteria, apply the action to all samples in the same preparation batch.

1. If the LCS %R falls within the range of 50-79%, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated low (J-). If the LCS %R is >120%, qualify sample results that are ≥MDL as estimated high (J+).

2. If the LCS recovery is >120% and the sample results are non-detects, the data should not be qualified.

3. If the LCS recovery falls within the range of 50-79%, qualify non-detects as estimated (UJ).

4. If LCS %R is <50%, qualify all results that are ≥MDL as estimated low (J-) and all non-detects as unusable (R).

5. If the LCS %R is >150%, qualify all affected data (both detects and non-detects) as unusable (R).

6. If a Laboratory fails to analyze an LCS with each SDG, or if a Laboratory consistently fails to generate acceptable LCS recoveries, note this for CLP Project Officer (PO) action

7. Whenever possible, the potential effects on the data due to out-of-control LCS results should be noted in the Data Review Narrative.

**Table 16. LCS Actions for ICP-MS Analysis**

| LCS Result | Action for Samples |
|---|---|
| Aqueous %R 50-79% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| Aqueous %R >120% | Qualify results that are ≥MDL as estimated high (J+) |
| Aqueous %R <50% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Aqueous %R >150% | Qualify all results as unusable (R) |

## VII. Duplicate Sample Analysis

### A. Review Items:

Cover Page, Form VI-IN, Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The objective of duplicate sample analysis is to demonstrate acceptable method precision by the Laboratory at the time of analysis. Duplicate analyses are also performed to generate data that determines the long-term precision of the analytical method on various matrices. Non-homogenous samples can impact the apparent method precision. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for duplicate sample analysis.

2. At least one duplicate sample shall be prepared and analyzed from each group of samples of a similar matrix type or for each Sample Delivery Group (SDG). Duplicates cannot be averaged for reporting on Form I-IN. Additional duplicate sample analyses may be required by USEPA Regional request. Alternately, the Region may require that a specific sample be used for the duplicate sample analysis.

3. Duplicate sample analyses are required for Percent Solids (%S) determination.

4. A control limit of 20% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values ≥ five times (5x) the Contract Required Quantitation Limit (CRQL).

5. A control limit of the CRQL shall be used if either the sample or duplicate value is <5x the CRQL. The absolute value of the control limit (CRQL) shall be entered in the "Control Limit" column on Form VI-IN. If both samples are non-detects, the RPD is not calculated for Form VI-IN.

### D. Evaluation:

1. Verify from the Cover Page, Form XII-IN, and the raw data that the appropriate number of required duplicate samples were prepared and analyzed for the SDG.

2. Evaluate Form VI-IN and the raw data to verify that all duplicate results for each analyte and method fall within the established control limits.

3. Verify that a field blank or PE sample was not used for duplicate analysis.

4. Check the raw data and recalculate one or more of the RPD values using the following equation to verify that the results were correctly reported on Form VI-IN:

$$RPD = \frac{|S - D|}{(S+D)/2} \times 100$$

**Where,**

RPD = Relative Percent Difference

S = Sample Result (original)

D = Duplicate Result

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a duplicate sample analysis that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the duplicate sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the duplicate, and thus only the field sample used to prepare the duplicate sample should be qualified.

1. If the appropriate number of duplicate samples were not analyzed, use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If the results from a duplicate analysis for a particular analyte fall outside the appropriate control limits, qualify sample results that are ≥MDL as estimated (J) and non-detects as estimated (UJ).

3. If a field blank or PE sample was used for the duplicate sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgment exercised by the data reviewer when evaluating the data.

4. Note the potential effects on the data due to out-of-control duplicate sample results in the Data Review Narrative.

**Table 17. Duplicate Sample Actions for ICP-MS Analysis**

| Duplicate Sample Results | Action for Samples |
|---|---|
| Both original sample and duplicate sample >5x the CRQL and RPD>20% | Qualify those results that are ≥MDL that professional judgment determines to be affected as estimated (J) and non-detects as estimated (UJ) |
| Original sample or duplicate sample ≤5x the CRQL (including non-detects) and absolute difference between sample and duplicate >CRQL | Qualify those results that are ≥MDL that professional judgment determines to be affected as estimated (J) and non-detects as estimated (UJ) |

*The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project Data Quality Objectives (DQOs) may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples.

## VIII. Spike Sample Analysis

### A. Review Items:

Cover Page, Form V-IN (Part A & B), Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. Non-homogenous samples can impact the apparent method recovery. However, aqueous samples are generally homogenous. If the spike is added to the sample before the digestion (e.g., prior to the addition of other reagents), it is referred to as a spiked sample, pre-digestion spike, or Matrix Spike. If the spike is added to the sample after the completion of the digestion procedures, it is referred to as a post-digestion spike, or analytical spike.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for spiked sample analysis.

2. At least one spiked sample shall be prepared and analyzed for each Sample Delivery Group (SDG).

3. When the Matrix Spike recovery falls outside of the control limits and the sample result is < four times (4x) the spike added, a post-digestion spike shall be performed for those analytes that do not meet the specified criteria. An aliquot of the remaining unspiked sample shall be spiked at 2x the indigenous level or 2x the Contract Required Quantitation Limit (CRQL), whichever is greater.

4. The spike Percent Recovery (%R) shall be within the established acceptance limits. However, spike recovery limits do not apply when the sample concentration is ≥4x the spike added. In such an event, the data shall be reported unflagged, even if the %R does not meet the acceptance criteria.

5. If the spiked sample analysis was performed on the same sample that was chosen for the duplicate sample analysis, spike calculations shall be performed using the results of the sample designated as the "original sample". The average of the duplicate results cannot be used for the purpose of determining %R.

**NOTE:** The final spike concentrations required for the various target analytes are presented in the methods described in the Statement of Work (SOW).

### D. Evaluation:

1. Verify using the Cover Page, Form VA-IN, Form XII-IN, and raw data that the appropriate number of required spiked samples were prepared and analyzed for the SDG.

2. Verify that a field blank or PE sample was not used for the spiked sample analysis.

3. Evaluate Form VA-IN and the raw data to verify that all pre-digestion spiked sample results for each required analyte fall within the established control limits. If not, verify that a post-digestion spike was prepared and analyzed.

4. Recalculate using the raw data, one or more of the %R using the following equation, and verify that the recalculated value agrees with the Laboratory-reported values on Forms V(A & B)-IN:

$$\% \text{ Recovery} = \frac{SSR - SR}{SA} \times 100$$

**Where,**

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

**NOTE:** When the sample concentration is < Method Detection Limit (MDL), use SR = 0 only for the purposes of calculating the %R. The actual spiked sample results, sample results, and %R (positive or negative) shall still be reported on Form V (A & B)-IN.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a Matrix Spike that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the Matrix Spike sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the Matrix Spike, and thus that only the field sample used to prepare the Matrix Spike sample should be qualified.

1. If the appropriate number of Matrix Spike samples was not analyzed, use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If a field blank or PE sample was used for the spiked sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgment exercised by the data reviewer when evaluating the data.

3. If the Matrix Spike recovery does not meet the evaluation criteria and a required post-digestion spike was not performed, note this for CLP PO action.

4. If the Matrix Spike %R is <30%, verify that a post-digestion spike was analyzed if required. If the post-digestion spike %R is <75% or is not performed, qualify sample results that are ≥MDL as estimated low (J-) and non-detects as unusable (R). If the post-digestion spike %R is ≥75%, qualify sample results that are ≥MDL as estimated (J) and non-detects as estimated (UJ).

5. If the Matrix Spike %R is 30-74% and the sample results are ≥MDL, verify that a post-digestion spike was analyzed, if required. If the %R for the post-digestion spike is also <75% or is not performed, qualify the affected data as estimated low (J-). If the %R for the post-digestion spike is ≥75%, qualify the affected data as estimated (J).

6. If the Matrix Spike %R falls within the range of 30-74% and the sample results are non-detects, qualify the affected data as estimated (UJ).

7. If the Matrix Spike %R is >125% and the reported sample results are non-detects, the sample data should not be qualified.

8. If the Matrix Spike %R is >125% and the sample results are ≥MDL, verify that a post-digestion spike was analyzed, if required. If the %R for the post-digestion spike is also >125% or is not performed, qualify the affected data as estimated high (J+). If the %R for the post-digestion spike is ≤125%, qualify the affected data as estimated (J).

9. Note the potential effects on the data due to out-of-control spiked sample results in the Data Review Narrative.

**Table 18. Spike Sample Actions for ICP-MS Analysis**

| Spike Sample Results | Action for Samples |
|---|---|
| Matrix Spike %R <30%<br>Post-digestion spike %R <75% | Qualify affected results that are ≥MDL as estimated low (J-)<br>Qualify affected non-detects as unusable (R) |
| Matrix Spike %R <30%<br>Post-digestion spike %R ≥75% | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R 30-74%<br>Post-digestion spike %R <75% | Qualify affected results that are ≥MDL as estimated low (J-)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R 30-74%<br>Post-digestion spike %R ≥75% | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R >125%<br>Post-digestion spike %R >125% | Qualify affected results that are ≥MDL as estimated high (J+) |
| Matrix Spike %R >125%<br>Post-digestion spike %R ≤125% | Qualify affected results that are ≥MDL as estimated (J) |
| Matrix Spike %R <30%<br>No post-digestion spike performed | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as unusable (R) |
| Matrix Spike %R 30-74%<br>No post-digestion spike performed | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as estimated (UJ) |
| Matrix Spike %R >125%<br>No post-digestion spike performed | Qualify affected results that are ≥MDL as estimated high (J+)<br>Non-detects are not qualified |

# IX. ICP Serial Dilution

## A. Review Items:

Form I-IN, Form VIII-IN, instrument printouts, and raw data.

## B. Objective:

The serial dilution of samples quantitated by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) determines whether or not significant physical or chemical interferences exist due to sample matrix.

## C. Criteria:

1. An ICP serial dilution analysis shall be performed on a sample for each Sample Delivery Group (SDG), whichever is more frequent.

2. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for the ICP serial dilution analysis.

3. If the analyte concentration is sufficiently high [concentration in the original sample is >50 times (50x) the Method Detection Limit (MDL)], the serial dilution analysis (a five-fold dilution) shall then agree within a 10 Percent Difference (%D) of the original determination after correction for dilution.

## D. Evaluation:

1. Verify that a field blank or PE sample was not used for the serial dilution analysis.

2. Check the raw data and recalculate the %D using the following equation. Verify that the serial dilution analysis results, and the calculated %D results agree with the values reported by the Laboratory on Form VIII-IN:

$$\% \text{ Difference} = \frac{|I - S|}{I} \times 100$$

**Where,**

I = Initial sample result (instrument reading)

S = Serial dilution result (instrument reading x 5)

3. Check the raw data for any evidence of positive or negative interference (results from the diluted sample which are significantly different than the original sample), possibly due to high levels of dissolved solids in the sample, ionization effects, etc.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a serial dilution that does not meet the technical criteria, apply the action to all samples of the same matrix if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the serial dilution sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for serial dilution, and thus only the field sample used to prepare the serial dilution sample should be qualified.

1. If the required %D criteria are not met, qualify all affected results that are ≥MDL as estimated (J) and all affected non-detects as estimated (UJ).

2. If evidence of positive or negative interference is found, use professional judgment to qualify the associated sample data. Note the potential effects on the reported data in the Data Review Narrative.

3. It should be noted for CLP Project Officer (PO) action and in the Data Review Narrative if a field blank or PE sample was used for the serial dilution analysis.

**Table 19. Serial Dilution Actions for ICP-MS Analysis**

| Serial Dilution Result | Action for Samples |
|---|---|
| Sample concentration >50x MDL and %D >10 | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Interferences present | Use professional judgment |

# X. ICP-MS Internal Standards

## A. Review Items:

Form XIII-IN, Form XV-IN, instrument printouts, and raw data.

## B. Objective:

The analysis of Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) internal standards determines the existence and magnitude of instrument drift and physical interferences. The criteria for evaluation of internal standard results applies to all analytical and Quality Control (QC) samples analyzed during the run, beginning with the calibration.

## C. Criteria:

1. All samples analyzed during a run, with the exception of the ICP-MS tune, shall contain internal standards. A minimum of three internal standards from the following list shall be added to each sample: Li (the $Li^6$ isotope); Sc; Y; Rh; In (the $In^{115}$ isotope); Tb; Ho; Lu; and Bi. If the Laboratory uses lithium as an internal standard, the Laboratory shall use an $Li^6$-enriched standard. The masses of the internal standards shall bracket the masses of the target analytes.

2. The intensity of the internal standard response in a sample is monitored and compared to the intensity of the response for that internal standard in the calibration blank. The Percent Relative Intensity (%RI) in the sample shall fall within 60-125% of the response in the calibration blank.

3. If the %RI of the response in the sample falls outside of these limits, the Laboratory shall immediately reanalyze the calibration blank and monitor the internal standard intensities. If the %RI for that calibration blank are within the limits, the Laboratory shall reanalyze the original sample at a two-fold dilution.

4. If the %RI for the reanalyzed calibration blank is outside the limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, the new calibration verified, and the samples reanalyzed.

## D. Evaluation:

1. Verify using Form XV-IN and the raw data that a minimum of three internal standards from the specified list were used for the analysis and that the masses of the internal standards bracket the masses of the target analytes.

2. Verify using Form XV-IN and the raw data that these internal standards were added to each sample in the run, including calibrations, samples, and QC samples (except tune).

3. Verify using Form XV-IN that the %RI between an internal standard in a sample and the internal standard in the calibration blank was reported for each sample.

4. Verify using Form XIII-IN, Form XV-IN, and the raw data that if the %RI for a sample was outside the limits (60-125%), the calibration blank was reanalyzed immediately following this sample.

5. Verify using Form XIII-IN, Form XV-IN, and the raw data that if the %RI for that calibration blank was within the 60-125% limits, the affected sample was subsequently reanalyzed at a two-fold dilution.

6. Verify using Form XIII-IN, Form XV-IN, and the raw data, that if the %RI for the reanalyzed calibration blank was not within the 60-125% limits, the analysis was terminated and the samples were reanalyzed in a subsequent run.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** Apply the action to the affected analytes for each sample that does not meet the internal standard criteria.

1. If no internal standards were analyzed with the run, the sample data should be qualified as unusable (R). Record this in the Data Review Narrative and note for CLP Project Officer (PO) action.

2. If less than three of the required internal standards were analyzed with the run, or the masses of the internal standards does not bracket the masses of the target analytes, the analyte sample data not bracketed by the internal standard masses should be qualified as unusable (R). Record this in the Data Review Narrative and note for CLP PO action.

3. If the %RIs for all internal standards in a sample are within the 60-125% limit, the sample data should not be qualified.

4. If the %RI for an internal standard in a sample is not within the 60-125% limit, qualify the data for those analytes with atomic masses that fall between the atomic mass of the internal standard lighter than the affected internal standard, and the atomic mass of the internal standard heavier than the affected internal standard, or between the limit (upper or lower) of the mass range and the nearest unaffected internal standard, as follows:

   a. If the calibration blank was immediately reanalyzed, the %RI for that internal standard in that calibration blank was within the limits, and the sample was reanalyzed at a two-fold dilution with internal standard %RI within the limits, report the result of the diluted analysis without qualification. If the %RI of the diluted analysis was not within the 60-125% limit, qualify the data for all analytes that are ≥ Method Detection Limit (MDL) in the sample associated with the internal standard as estimated (J), and non-detected analytes associated with the internal standard as estimated (UJ).

   b. If the calibration blank was immediately reanalyzed but the sample was not reanalyzed at a two-fold dilution, the reviewer should use professional judgment to determine the reliability of the data. The reviewer may determine that the results are estimated (J) or unusable (R).

   c. If the calibration blank was not reanalyzed immediately after a sample with an internal standard %RI outside the 60-125% control limits, or if the %RI of the internal standard in the reanalyzed calibration blank was outside the 60-125% limits and the analysis was not

terminated, the reviewer should use professional judgment to determine the reliability of the data. The reviewer may determine that the results are estimated (J) or unusable (R).

**Table 20. Internal Standard Actions for ICP-MS Analysis**

| Internal Standard Results | Action for Samples |
|---|---|
| No internal standards | Qualify all results as unusable (R) |
| <3 of the required internal standards | Qualify all analyte results not bracketed by internal standard masses as unusable (R) |
| Masses of internal standards do not bracket masses of target analytes | Qualify all analyte results not bracketed by internal standard masses as unusable (R) |
| %RI <60% or >125%, reanalysis of calibration blank has %RI 60-125%, and original sample reanalyzed at 2-fold dilution | If %RI of diluted sample analysis 60-125%, do not qualify the data<br>If the %RI of the diluted sample analysis is outside the 60-125% limit, qualify results that are ≥MDL as estimated (J) and qualify non-detects as estimated (UJ) |
| %RI <60% or >125% reanalysis of calibration blank has %RI 60-125%, but original sample not reanalyzed at 2-fold dilution | Use professional judgment<br>Qualify sample results as estimated (J) or unusable (R) |
| %RI <60% or >125%, reanalysis of calibration blank has %RI <60% or >125%, or no reanalysis of calibration blank | Use professional judgment<br>Qualify sample results as estimated (J) or unusable (R) |

## XI. Field Duplicates

### A. Review Items:

Form I-IN, instrument printouts, and raw data.

### B. Objective:

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and Laboratory precision. The results, therefore, may have more variability than Laboratory duplicates that measure only Laboratory performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

### C. Criteria:

There are no "required" review criteria for determining comparability of field duplicate analyses.

### D. Evaluation:

Identify samples that are field duplicates using Traffic Report/Chain of Custody (TR/COC) documentation or sample field sheets. Compare the results reported for each sample and calculate the Relative Percent Difference (RPD), if appropriate.

### E. Action:

Provide any evaluation of the field duplicates in the Data Review Narrative.

## XII. Overall Assessment

### A. Review Items:

Entire data package, data review results, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data (including any confirmation data).

### B. Objective:

The objective is to ensure that the reported sample quantitation results are accurate. It is appropriate for the data reviewer to make professional judgments and express concerns, as well as to comment on the validity of the overall data for a Case. This is particularly appropriate when there are several Quality Control (QC) criteria that are outside of the specification parameters. The additive nature of QC factors that fall outside of specification parameters is difficult to assess in an objective manner, but the reviewer has a responsibility to inform the user concerning data quality and data limitations to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. If qualifiers other than those used in this document are necessary to describe or qualify the data, it is necessary to thoroughly document/explain the additional qualifiers used. The data reviewer would be greatly assisted in this endeavor if the acceptance or performance criteria were provided. The Inorganic Review Summary (see Appendix B) and supplementary documentation must be included with the review.

### C. Criteria:

1. Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

2. Reported analyte concentrations must be quantitated according to the appropriate analytical method, as listed in the method.

### D. Evaluation:

Examine the raw data to verify that the correct calculation of the sample results was reported by the Laboratory. Digestion logs, instrument printouts, strip charts, etc., should be compared to the reported sample results recorded on the appropriate Inorganic Summary Forms (Form I-IN through Form XV-IN).

1. Evaluate any technical problems not previously addressed.

2. Examine the raw data for any anomalies (e.g., baseline shifts, negative absorbance, omissions, illegibility, etc.).

3 Verify that appropriate methods and volumes were used in preparing the samples for analysis. Verify that the turbidity was measured prior to method selection. If reduced volumes were used, verify that the Laboratory had received Contract Laboratory Program Project Officer (CLP PO) approval for the use of the reduced volume.

4. Verify that there are no transcription or reduction errors [e.g., dilutions, Percent Solids (%S), sample weights, etc.] on one or more samples.

5. Verify that results fall within the linear range(s) of the Inductively Coupled Plasma (ICP) instrument(s) (Form XI).

6. If appropriate information is available, the reviewer may assess the usability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the Quality Assurance Project Plan (QAPP), focusing specifically on the acceptance or performance criteria, the Standard Operating Procedure(s) (SOPs), and communication with the user concerning the intended use and desired quality of these data.

## E. Action

1. Use professional judgment to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief Data Review Narrative to give the user an indication of the analytical limitations of the data. Note any discrepancies between the data and the Sample Delivery Group (SDG) Narrative for CLP PO action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include an assessment of the data usability within the given context.

3. If any discrepancies are found, the Laboratory may be contacted by the Region's designated representative to obtain additional information for resolution. If a discrepancy remains unresolved, the reviewer may determine that qualification of the data is warranted.

## Calculations for ICP-MS

**Non-Prepared Sample Concentration:**

$$\text{Concentration } (\mu g/L) = C \times DF$$

**Where,**

C = Instrument value in µg/L. (the average of all replicate integrations)

DF = Dilution Factor

**Prepared Sample Concentration:**

$$\text{Concentration } (\mu g/L) = C \times \frac{V_f}{V_i} \times \frac{V_f}{20} \times DF$$

**Where,**

C = Instrument value in µg/L (the average of all replicate integrations)

$V_f$ = Final digestion volume (50 mL)

$V_i$ = Initial digestion volume (100 mL)

DF = Dilution Factor

# MERCURY DATA REVIEW

The inorganic data requirements for mercury data review to be reviewed during validation are listed below:

I. Preservation and Holding Times

II. Calibration
   A. Initial
   B. Initial and Continuing Calibration Verification (ICV/CCV)
   C. Contract Required Quantitation Limit (CRQL) Check Standard (CRI)

III. Blanks

IV. Laboratory Control Sample (LCS)

V. Duplicate Sample Analysis

VI. Spike Sample Analysis

VII. Field Duplicates

VIII. Overall Assessment

## An Example Analytical Sequence for Mercury

S0
S0.2
S0.5
S1.0
S5.0
S10.0
ICV
ICB
CRI
CCV
CCB
ten samples
CCV
CCB
nine samples
CRI
CCV
CCB

## I. Preservation and Holding Times

### A. Review Items:

Form IA-IN, Form IB-IN, Form XII-IN, Form XIII-IN, Traffic Report/Chain of Custody (TR/COC) documentation, Form DC-1, raw data, and the Sample Delivery Group (SDG) Narrative checking for: pH; cooler temperature; holding time; and other sample conditions.

### B. Objective:

The objective is to ascertain the validity of the analytical results based on the sample condition, and the holding time of the sample from the date of collection to the date of analysis.

### C. Criteria:

1. Technical requirements for sample holding times have only been established for aqueous matrices. The addition of nitric acid to adjust the pH is only required for aqueous samples.

2. The technical holding time criteria for aqueous mercury samples is 28 days; preserved (with nitric acid) to pH<2.

3. Aqueous samples shall be maintained at 4°C ±2°C until preparation and analysis to allow for re-preparation and for the direct analysis of dissolved metals.

4. The preservation for soil/sediment samples is maintenance at 4°C ±2°C until preparation and analysis.

### D. Evaluation:

Technical holding times are established by comparing the sampling date(s) on the TR/COC documentation with the dates of analysis on Form XIII-IN, and the raw data. Information contained in the Complete SDG File (CSF) should also be considered in the determination of holding times. Verify that the analysis dates on the Form XIIIs and the raw data are identical. Review the SDG Narrative and raw data preparation logs to determine if samples were properly preserved. If there is an indication that there were problems with the samples, the integrity of the samples may be compromised and professional judgment should be used to evaluate the effect of the problem on the sample results.

### E. Action:

**NOTE:** Apply the action to each sample for which the preservation or holding time criteria was not met.

1. If the pH of aqueous metals samples is ≥2 at the time of sample receipt, use professional judgment to qualify the samples based on the pH of the sample and the chemistry of the metal(s) of interest. Qualify results that are ≥MDL as estimated low (J-), and qualify non-detects as unusable (R).

2. If technical holding times are exceeded, use professional judgment to determine the reliability of the data based on the magnitude of the additional time compared to the technical requirement and whether the samples were properly preserved. The expected

bias would be low. Qualify results that are ≥MDL as estimated low (J-), and non-detects as unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer whether to apply water holding time criteria to soil samples. If they are applied, it must be clearly documented in the Data Review Narrative.

4. When the holding times are exceeded, the reviewer should comment in the Data Review Narrative on any possible consequences for the analytical results.

5. When holding times are grossly exceeded, note this for Contract Laboratory Program Project Officer (CLP PO) action.

6. When shipping or storage temperatures grossly exceed the requirements, the loss of volatile mercury compounds or metallic mercury is possible. The expected bias would be low. Use professional judgment to qualify the samples and note for CLP PO action.

**Table 21. Technical Holding Time Actions for Mercury Analysis**

| Preservation & Holding Time Results | Action for Samples |
|---|---|
| Aqueous metals samples received with pH ≥2 | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Technical holding time exceeded:<br>mercury >28 days | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |

## II. Calibration

### A. Review Items:

Form II-IN (Parts A & B), Form XI-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data.

### B. Objective:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for mercury. Initial Calibration Verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing Calibration Verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

### C. Criteria:

#### 1. Initial Calibration

The instruments shall be successfully calibrated daily (or once every 24 hours), and each time the instrument is set up. The calibration date and time shall be included in the raw data. The calibration curve shall be prepared by the same method used to prepare the samples for analysis.

##### a. Cold Vapor Mercury Analysis

1) A blank and at least four calibration standards shall be employed to establish the analytical curve. One of the calibration standards shall be at the Contract Required Quantitation Limit (CRQL). The calibration curves for mercury shall possess a correlation coefficient of $\geq 0.995$ to ensure the linearity over the calibrated range. All sample results shall be reported from an analysis within the calibrated range.

2) The linearity of the analytical curve shall be verified near the CRQL. A CRQL Check Standard (CRI) solution shall be prepared and analyzed at the beginning and end of each sample analysis run and every 20 analytical samples, but not before the ICV analysis.

3) Analysis of the CRI for mercury is required for both the manual and automated cold vapor methods, and the results and Percent Recovery (%R) are to be reported on Form ICB-IN.

4) If the results for the CRI do not fall within the fixed acceptance limits, the Laboratory shall reanalyze a CRI. If the results of the reanalysis do not fall within the acceptance limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, the CRI and associated samples redigested if necessary, and the new calibration then reverified.

## 2. Initial and Continuing Calibration Verification (ICV and CCV)

The acceptance criteria for the ICVs, CCVs, and CRIs are presented in Table 23. These standards shall be prepared by the same method used to prepare the samples for analysis.

**Table 22. Acceptance Criteria for ICVs, CCVs, and CRIs**

| Analytical Method | Inorganic Analyte | ICV/CCV Low Limit (% of True Value) | ICV/CCV High Limit (% of True Value) | CRI Low Limit (% of True Value) | CRI High Limit (% of True Value) |
|---|---|---|---|---|---|
| Cold Vapor AA | Mercury | 80 | 120 | 70 | 130 |

### a. Initial Calibration Verification (ICV)

1) Immediately after each Atomic Absorption (AA) system has been calibrated, the accuracy of the initial calibration must be verified and documented for mercury by the analysis of an ICV solution(s). If the ICV %R falls outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and all affected samples reanalyzed.

2) If the ICV is not available from USEPA, or where a certified solution of the analyte is not available from any source, analyses shall be conducted on an independent standard at a concentration level other than that used for instrument calibration (or the CRI), but within the calibrated range.

### b. Continuing Calibration Verification (CCV)

1) To ensure accuracy during the course of each analytical run, the CCV shall be analyzed and reported.

2) The CCV standard shall be analyzed at a frequency of 10% or every two hours during an analytical run, whichever is more frequent. The CCV standard shall also be analyzed at the beginning of the run, and again after the last analytical sample.

3) The analyte concentration in the CCV standard shall be different than the concentration used for the ICV, and shall be one of the following solutions at, or near, the mid-range levels of the calibration curve:

   A. USEPA solutions;
   B. National Institute of Standards and Technology (NIST) standards; or
   C. A Laboratory-prepared standard solution (self-prepared or commercially available).

4) The same CCV standard solution shall be used throughout the analysis runs for a Sample Delivery Group (SDG).

5) The CCV shall be analyzed in the same fashion as an actual sample. Operations such as the number of replicate analyses, the number and duration of the instrument rinses, etc., affect the measured CCV result and are not to be applied to the CCV to an extent greater than was applied to the associated analytical samples. If the %R of the CCV

was outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant CCV reanalyzed.

## D. Evaluation

1. Verify that the instrument was calibrated daily (once every 24 hours) and each time the instrument was set up, utilizing a blank and at least four calibration standards. Confirm that one of the calibration standards was analyzed at the CRQL.

2. Evaluate the reported CRI to confirm that it was analyzed at the proper frequency, concentration, and location within the analytical run sequence. Verify that acceptable %R results were obtained.

3. Verify that the ICV and CCV standards were analyzed for mercury at the proper frequency (10%) and at the appropriate concentration. Verify that acceptable %R results were obtained.

4. Recalculate one or more of the ICV, CCV, or CRI %R using the following equation and verify that the recalculated value agrees with the Laboratory-reported values on Forms II (A & B)-IN.

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration (in µg/L) of mercury <u>measured</u> in the analysis of the ICV, CCV, or CRI solution

True(value) = Concentration (in µg/L) of mercury in the ICV, CCV, or CRI source

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTES:** For initial calibrations or ICVs that do not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCVs or CRIs that do not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the QC sample and a subsequent technically acceptable analysis of the QC sample in the analytical run.

1. If the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable (R). If the instrument was not calibrated with at least the minimum number of standards, or if the calibration curve does not include standards at required

concentrations (e.g., a blank, or a standard at the CRQL), use professional judgment to qualify results that are ≥ Method Detection Limit (MDL) as estimated (J) or unusable (R), and non-detects as estimated (UJ) or unusable (R).

2. If the correlation coefficient is <0.995, qualify sample results that are ≥MDL as estimated (J), and non-detects as estimated (UJ). Depending on the degree of the deviation from linearity, further qualification of the data may be required depending on the professional judgment of the reviewer [e.g., unusable data (R)].

3. If the CRIs are outside the acceptance criteria, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the CRI %R is <50%, qualify all sample results that are ≥MDL but < two times (2x) the CRQL and all non-detects as unusable (R). Qualify detects that are ≥2x the CRQL as estimated (J).

   b. If the CRI %R falls within the range of 50-69%, qualify all sample results that are ≥MDL but <2x the CRQL as estimated low (J-), and all non-detects as estimated (UJ). Detects that are ≥2x the CRQL should not be qualified based on this criterion.

   c. If the CRI %R is >130% but ≤180%, qualify all sample results that are ≥MDL but <2x the CRQL as estimated high (J+). Non-detects and detects that are ≥2x the CRQL should not be qualified based on this criterion.

   d. If the CRI %R is >180%, qualify all sample results that are ≥MDL as unusable (R).

4. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the ICV or CCV %R is <65%, qualify non-detects as unusable (R). Use professional judgment to qualify all results that are ≥MDL as estimated low (J-) or unusable (R).

   b. If the ICV or CCV %R falls within the range of 65-79%, qualify sample results that are ≥MDL as estimated low (J-) and qualify non-detects as estimated (UJ).

   c. If the ICV or CCV %R falls within the range of 121-135%, qualify sample results that are ≥MDL as estimated high (J+).

   d. If the ICV or CCV %R falls within the range of 121-135%, non-detects should not be qualified.

   e. If the ICV or CCV %R is >135%, use professional judgment to qualify results that are ≥MDL as estimated high (J+) or unusable (R). Non-detects should not be qualified.

   f. If the %R is >170%, qualify all results that are ≥MDL as unusable (R).

5. If the Laboratory failed to provide adequate calibration information, the Region's designated representative should contact the Laboratory and request the necessary

information. If the information is not available, the reviewer must use professional judgment to assess the data.

6. Note the potential effects on the reported data due to exceeding the calibration criteria in the Data Review Narrative.

7. If calibration criteria are grossly exceeded, note this for CLP Project Officer (PO) action.

**NOTE:** For truly critical samples, a further in-depth evaluation of the calibration curve may be warranted to determine if additional qualification is necessary.

**Table 23. Calibration Actions for Mercury Analysis**

| Calibration Result | Action for Samples |
|---|---|
| Calibration not performed | Qualify all results as unusable (R) |
| Calibration incomplete | Use professional judgement<br>Qualify results that are ≥MDL as estimated (J) or unusable (R)<br>Qualify non-detects as estimated (UJ) or unusable (R) |
| Correlation coefficient <0.995 | Qualify results that are ≥MDL as estimated (J)<br>Qualify non-detects as estimated (UJ) |
| CRI %R <50% | Qualify all results that are ≥MDL but <2x the CRQL and all non-detects as unusable (R)<br>Qualify all results that are ≥2x the CRQL as estimated (J) |
| CRI %R 50-69% | Qualify results that are ≥MDL but <2x the CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ)<br>Results that are ≥2x the CRQL are not qualified |
| CRI %R >130% but ≤180% | Qualify results that are ≥MDL but <2x the CRQL as estimated high (J+)<br>Non-detects and results that are ≥2x the CRQL are not qualified |
| CRI %R >180% | Qualify all results that are ≥MDL as unusable (R) |
| ICV/CCV %R <65% | Qualify results that are ≥MDL as estimated low (J-) or unusable (R)<br>Qualify all non-detects as unusable (R) |
| ICV/CCV %R 65-79% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| ICV/CCV %R 121-135% | Qualify results that are ≥MDL as estimated (J) |
| ICV/CCV %R >135% | Qualify results that are ≥MDL as estimated high (J+) or unusable (R) |
| ICV/CCV %R >170% | Qualify results that are ≥MDL as unusable (R) |

## III. Blanks

### A. Review Items:

Form I-IN, Form III-IN, Form XII-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, and raw data.

### B. Objective:

The objective of blank analysis results assessment is to determine the existence and magnitude of contamination resulting from Laboratory (or field) activities. The criteria for evaluation of blanks applies to any blank associated with the samples (e.g., method blanks, calibration blanks, field blanks, etc.). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

### C. Criteria:

1. No contaminants should be found in the blank(s).

2. The Initial Calibration Blank (ICB) shall be analyzed after the analytical standards, but not before analysis of the Initial Calibration Verification (ICV) during the initial calibration of the instrument (see Section II.C.1). The ICB shall be prepared by the same method used to prepare the samples for analysis.

3. A Continuing Calibration Blank (CCB) shall be analyzed immediately after every ICV and Continuing Calibration Verification (CCV). The CCB shall be prepared by the same method used to prepare the samples for analysis. The CCB shall be analyzed at a frequency of 10%, or every two hours during the run, whichever is more frequent. The CCB shall be analyzed at the beginning of the run, and again after the last CCV that was analyzed after the last analytical sample of the run. The CCB result (absolute value) shall not exceed the Contract Required Quantitation Limit (CRQL) for mercury.

4. At least one Preparation Blank (PB) shall be prepared and analyzed for each matrix, with every Sample Delivery Group (SDG), or with each batch of samples digested, whichever is more frequent. The PB consists of reagent water processed through the appropriate sample preparation and analysis procedure.

5. If the mercury concentration in the PB is >CRQL, the lowest concentration of mercury in the associated samples must be 10 times (10x) the PB concentration. Otherwise, all samples associated with that PB with a mercury concentration <10x the PB concentration, and >CRQL, should be redigested and reanalyzed (except for an identified field blank). The Laboratory is not to correct the sample concentration for the blank value.

6. If the concentration of the PB for mercury is <(−CRQL), all samples reported <10x the CRQL (associated with that analyte in that blank), should be redigested and reanalyzed.

## D. Evaluation:

1. Verify that an ICB was analyzed after the calibration, the CCB was analyzed at the proper frequency and location during the run, and PBs are prepared and analyzed as appropriate for the SDG (e.g., total number of samples, various types of matrices present, number of digestion batches, etc.).

2. Review the results reported on the Blank Summary (Form III-IN), as well as the raw data (e.g., instrument printouts, strip charts, printer tapes, bench sheets, etc.) for all blanks, and verify that the results are accurately reported.

3. Evaluate all of the associated blanks for the presence of mercury. Verify that if mercury was present in a PB, or if a concentration was <(−CRQL), the affected samples were redigested and reanalyzed. Verify that if mercury was present in an ICB or a CCB, the analysis was terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration blank reanalyzed.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), many of the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTES:** For ICBs that do not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCBs that do not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the CCB and a subsequent technically acceptable analysis of the CCB in the analytical run.

For PBs that do not meet the technical criteria, apply the action to all samples prepared in the same preparation batch.

1. If the appropriate blanks are not analyzed with the correct frequency, the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. The situation should then be recorded in the Data Review Narrative, and noted for CLP Project Officer (PO) action.

2. Action regarding unsuitable blank results depends on the circumstances and origin of the blank. The reviewer should note that in instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of contaminant.

3. Some general "technical" review actions include:

   a. Any blank (including PB) reported with a negative result, whose value is ≤[−Method Detection Limit (MDL)] but ≥(−CRQL), should be carefully evaluated to determine its effect on the sample data. The reviewer shall then use professional

judgement to assess the data. For any blank (including PB) reported with a negative result, whose value is <(−CRQL), qualify results that are ≥CRQL as estimated low (J-) and non-detects as estimated (UJ).

b. The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. In particular, soil sample results reported on Form I-IN will not be on the same basis (units, dilution) as the calibration blank data reported on Form III-IN. The reviewer may find it easier to work with the raw data.

4. Specific "method" actions include:

a. If the absolute value of an ICB or a CCB result is >CRQL, the analysis should be terminated. If the analysis was not terminated and the affected samples are not reanalyzed, report non-detects and results that are ≥MDL but ≤CRQL as CRQL-U. For results that are >CRQL but < Blank Result, use professional judgement to qualify the data as unusable (R), or to report the results at the level of the blank with a "U" qualifier. Use professional judgement to qualify results that are > Blank Result. Note this situation for CLP PO action and record it in the Data Review Narrative.

b. If the absolute value of the concentration of the PB is ≤CRQL, no correction of the sample results should be performed.

c. If the mercury concentration in the PB is >CRQL, the lowest concentration of mercury in the associated samples must be 10x the PB concentration. Otherwise, all samples associated with that blank with concentrations <10x the PB concentration and >CRQL should be redigested and reanalyzed. Raise the CRQL to the concentration found in the PB and report those samples that do not require redigestion (that are ≥MDL but ≤CRQL) as CRQL-U. Note for CLP PO action and record in the Data Review Narrative if the Laboratory failed to redigest and reanalyze the affected samples. The reviewer shall then use professional judgement to assess the data.

**Table 24. Blank Actions for Mercury Analysis**

| Blank Type | Blank Result | Sample Result | Action for Samples |
|---|---|---|---|
| ICB/CCB | Absolute value is ≥MDL but ≤CRQL | Non-detect | No action |
| | | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL | Use professional judgement |
| ICB/CCB | Absolute value is >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <Blank Result | Report at level of Blank Result with a "U" or qualify data as unusable (R) |
| | | >Blank Result | Use professional judgement |
| ICB/CCB | ≤(-MDL), but ≥(-CRQL) | ≥MDL, or non-detect | Use professional judgement |
| ICB/CCB | <(-CRQL) | <10x the CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| PB | >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <10x the Blank Result | Qualify results as unusable (R) or estimated high (J+) |
| | | ≥10x the Blank Result | No action |
| PB | ≥MDL but ≤CRQL | ≥MDL, or non-detect | No action |
| PB | <(-CRQL) | <10x the CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## IV. Laboratory Control Sample (LCS)

### A. Review Items:

Form VII-IN, Form XII-IN, preparation logs, instrument printouts, and raw data.

### B. Objective:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation.

### C. Criteria:

1. Solid LCSs shall be analyzed utilizing the same sample preparations, analytical methods, and Quality Assurance/Quality Control (QA/QC) procedures as employed for the samples.

   a. A solid LCS shall be prepared and analyzed utilizing each of the preparation and analytical procedures applied to the soil/sediment samples received, with one exception: The Percent Solids (%S) determination is not required. If the solid LCS is not available from USEPA, other USEPA QA samples or certified materials may be used.

   b. One solid LCS shall be prepared and analyzed for each group of soil sediment samples in an Sample Delivery Group (SDG), or for each batch of samples digested, whichever is more frequent.

   c. All solid LCS results shall fall within the control limits reported on Form VII-IN. If the results for the solid LCS fall outside of the control limits, the analyses should be terminated, the problem corrected, and the samples prepared with that LCS redigested and reanalyzed.

### D. Evaluation:

1. Verify using Form VII-IN, Form XII-IN, and raw data that the appropriate number of required LCSs were prepared and analyzed for the SDG.

2. Evaluate Form VII-IN and verify that all results for mercury fall within the established control limits.

3. Check the raw data (e.g., instrument printouts, strip charts, bench sheets, etc.) to verify that the Percent Recoveries (%Rs) on Form VII-IN were accurately transcribed. Recalculate one or more of the reported %Rs using the following equation:

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration of mercury (in mg/kg) measured in the analysis of the LCS

True(value) = Concentration of mercury (in mg/kg) in the LCS

4. Verify that the LCS was prepared at the same time as the associated samples using the same procedures.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

If the LCS criteria are not met, the Laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data associated with an LCS that does not meet the required criteria.

For an LCS that does not meet the technical criteria, apply the action to all samples in the same preparation batch.

1. Solid LCS:

   a. If the LCS results are greater than the reported control limits, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated high (J+). If the LCS results are less than the reported control limits, qualify sample results that are ≥MDL as estimated low (J-).

   b. If the LCS results are greater than the reported control limits and the sample results are non-detects, the data should not be qualified.

   c. If the LCS results are less than the reported control limits, qualify non-detects as estimated (UJ).

   d. If a Laboratory fails to analyze an LCS with each SDG, or if a Laboratory consistently fails to generate acceptable LCS recoveries, note this for CLP Project Officer (PO) action.

   e. Whenever possible, the potential effects on the data due to out-of-control LCS results should be noted in the Data Review Narrative.

**Table 25. LCS Actions for Mercury Analysis**

| LCS Result | Action for Samples |
|---|---|
| Soil Result > upper limit | Qualify results that are ≥MDL as estimated high (J+) |
| Soil Result < lower limit | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## V. Duplicate Sample Analysis

### A. Review Items:

Cover Page, Form VI-IN, Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The objective of duplicate sample analysis is to demonstrate acceptable method precision by the Laboratory at the time of analysis. Duplicate analyses are also performed to generate data that determines the long-term precision of the analytical method on various matrices. Non-homogenous samples can impact the apparent method precision. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for duplicate sample analysis.

2. At least one duplicate sample shall be prepared and analyzed from each group of samples of a similar matrix type (e.g., water or soil) or for each Sample Delivery Group (SDG). Duplicates cannot be averaged for reporting on Form I-IN. Additional duplicate sample analyses may be required by USEPA Regional request. Alternately, the Region may require that a specific sample be used for the duplicate sample analysis.

3. Duplicate sample analyses are required for Percent Solids (%S) determination.

4. A control limit of 20% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values ≥ five times (5x) the Contract Required Quantitation Limit (CRQL).

5. A control limit of the CRQL shall be used if either the sample or duplicate value is <5x the CRQL. The absolute value of the control limit (CRQL) shall be entered in the "Control Limit" column on Form VI-IN. If both samples are non-detects, the RPD is not calculated for Form VI-IN.

**NOTE:** The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project Data Quality Objectives (DQOs) may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples.

### D. Evaluation:

1. Verify from the Cover Page, Form XII-IN, and the raw data that the appropriate number of required duplicate samples were prepared and analyzed for the SDG.

2. Evaluate Form VI-IN and the raw data to verify that all mercury duplicate results for each method fall within the established control limits.

3. Verify that a field blank or PE sample was not used for duplicate analysis.

4. Check the raw data and recalculate one or more of the RPD values using the following equation to verify that the results were correctly reported on Form VI-IN:

$$RPD = \frac{|S - D|}{(S+D)/2} \times 100$$

**Where,**

RPD = Relative Percent Difference

S = Sample Result (original)

D = Duplicate Result

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a duplicate sample analysis that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgement in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the duplicate sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the duplicate, and thus that only the field sample used to prepare the duplicate sample should be qualified.

1. If the appropriate number of duplicate samples was not analyzed for each matrix using the correct frequency, use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If the results from a duplicate analysis for mercury fall outside the appropriate control limits, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated (J) and non-detects as estimated (UJ).

3. If a field blank or PE sample was used for the duplicate sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgement exercised by the data reviewer when evaluating the data.

4. Note the potential effects on the data due to out-of-control duplicate sample results in the Data Review Narrative.

**Table 26. Duplicate Sample Actions for Mercury Analysis**

| Duplicate Sample Results | Action for Samples |
|---|---|
| Both original sample and duplicate sample >5x the CRQL and RPD>20%* | Qualify those results that are ≥MDL that professional judgement determines to be affected as estimated (J) and non-detects as estimated (UJ) |
| Original sample or duplicate sample ≤5x the CRQL (including non-detects) and absolute difference between sample and duplicate >CRQL* | Qualify those results that are ≥MDL that professional judgement determines to be affected as estimated (J) and non-detects as estimated (UJ) |

*The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project DQOs may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples

## VI. Spike Sample Analysis

### A. Review Items:

Cover Page, Form V-IN (Part A & B), Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. Non-homogenous samples can impact the apparent method recovery. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three. If the spike is added to the sample before the digestion (e.g., prior to the addition of other reagents), it is referred to as a spiked sample, pre-digestion spike, or Matrix Spike.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for spiked sample analysis.

2. At least one spiked sample (pre-digestion) shall be prepared and analyzed from each group of samples with a similar matrix type (e.g., water or soil), or for each Sample Delivery Group (SDG).

3. The spike Percent Recovery (%R) shall be within the established acceptance limits. However, spike recovery limits do not apply when the sample concentration is ≥ four times (4x) the spike added. In such an event, the data shall be reported unflagged, even if the %R does not meet the acceptance criteria.

4. If the spiked sample analysis was performed on the same sample that was chosen for the duplicate sample analysis, spike calculations shall be performed using the results of the sample designated as the "original sample". The average of the duplicate results cannot be used for the purpose of determining %R.

**NOTE:** The final spike concentrations required for mercury are presented in the method described in the Statement of Work (SOW).

### D. Evaluation:

1. Verify using the Cover Page, Form VA-IN, Form XII-IN, and raw data that the appropriate number of required spiked samples were prepared and analyzed for the SDG.

2. Verify that a field blank or PE sample was not used for the spiked sample analysis.

3. Evaluate Form VA-IN and the raw data to verify that all Matrix Spike sample results for mercury fall within the established control limits.

4. Recalculate using the raw data, one or more of the %R using the following equation, and verify that the recalculated value agrees with the Laboratory-reported values on Forms V(A & B)-IN:

$$\% \text{ Recovery} = \frac{SSR - SR}{SA} \times 100$$

**Where,**

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

**NOTE:** When the sample concentration is < Method Detection Limit (MDL), use SR = 0 only for the purposes of calculating the %R. The actual spiked sample results, sample results, and %R (positive or negative) shall still be reported on Form V (A & B)-IN.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a Matrix Spike that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgement in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the Matrix Spike sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the Matrix Spike, and thus that only the field sample used to prepare the Matrix Spike sample should be qualified.

1. If the appropriate number of Matrix Spike samples was not analyzed for each matrix using the correct frequency, use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If a field blank or PE sample was used for the spiked sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgement exercised by the data reviewer when evaluating the data.

3. If the Matrix Spike %R is <30%, qualify affected results that are ≥MDL as estimated low (J-). Qualify affected non-detects as unusable (R).

4. If the Matrix Spike %R falls within the range of 30-74% and the sample results are ≥MDL, qualify the affected data as estimated low (J-).

5. If the Matrix Spike %R falls within the range of 30-74% and the sample results are non-detects, qualify the affected data as estimated (UJ).

6. If the Matrix Spike %R is >125% and the reported sample results are non-detects, the sample data should not be qualified.

7. If the Matrix Spike %R is >125% and the sample results are ≥MDL, qualify the affected data as estimated high (J+).

8. Note the potential effects on the data due to out-of-control spiked sample results in the Data Review Narrative.

**Table 27. Spike Sample Actions for Mercury Analysis**

| Spike Sample Results | Action for Samples |
|---|---|
| Matrix Spike %R <30% | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as unusable (R) |
| Matrix Spike %R 30-74% | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as estimated (UJ) |
| Matrix Spike %R >125% | Qualify affected results that are ≥MDL as estimated high (J+)<br>Non-detects are not qualified |

## VII. Field Duplicates

### A. Review Items:

Form I-IN, instrument printouts, and raw data.

### B. Objective:

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and Laboratory precision. The results, therefore, may have more variability than Laboratory duplicates that measure only Laboratory performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

### C. Criteria:

There are no "required" review criteria for determining comparability of field duplicate analyses.

### D. Evaluation:

Identify samples that are field duplicates using Traffic Report(s)/Chain of Custody (TR/COC) documentation or sample field sheets. Compare the results reported for each sample and calculate the Relative Percent Difference (RPD), if appropriate.

### E. Action:

Provide any evaluation of the field duplicates in the Data Review Narrative.

## VIII. Overall Assessment

### A. Review Items:

Entire data package, data review results, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data (including any confirmation data).

### B. Objective:

The objective is to ensure that the reported sample quantitation results are accurate. It is appropriate for the data reviewer to make professional judgments and express concerns, as well as to comment on the validity of the overall data for a Case. This is particularly appropriate when there are several Quality Control (QC) criteria that are outside of the specification parameters. The additive nature of QC factors that fall outside of specification parameters is difficult to assess in an objective manner, but the reviewer has a responsibility to inform the user concerning data quality and data limitations to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. If qualifiers other than those used in this document are necessary to describe or qualify the data, it is necessary to thoroughly document/explain the additional qualifiers used. The data reviewer would be greatly assisted in this endeavor if the acceptance or performance criteria are provided. The Inorganic Review Summary (see Appendix B) and supplementary documentation must be included with the review.

### C. Criteria:

1. Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

2. Reported analyte concentrations must be quantitated according to the appropriate analytical method, as listed in the method.

### D. Evaluation:

Examine the raw data to verify that the correct calculation of the sample results was reported by the Laboratory. Digestion logs, instrument printouts, strip charts, etc., should be compared to the reported sample results recorded on the appropriate Inorganic Summary Forms (Form I-IN through Form XV-IN).

1. Evaluate any technical problems not previously addressed.

2. Examine the raw data for any anomalies (e.g., baseline shifts, negative absorbance, omissions, illegibility, etc.).

3 Verify that the appropriate methods and amounts were used to prepare samples and standards for analysis. If reduced volumes are used, verify that the Laboratory had received Contract Laboratory Program Project Officer (CLP PO) approval for the use of the reduced volume.

4. Verify that there are no transcription or reduction errors [e.g., dilutions, Percent Solids (%S), sample weights, etc.] on one or more samples.

5. Verify that results fall within the calibrated range for mercury.

6. If appropriate information is available, the reviewer may assess the usability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the Quality Assurance Project Plan (QAPP), focusing specifically on the acceptance or performance criteria, the Standard Operating Procedure(s) (SOPs), and communication with the user concerning the intended use and desired quality of these data.

## E. Action:

1. Use professional judgment to determine if there is any need to qualify data which are not qualified based on the QC criteria previously discussed.

2. Write a brief Data Review Narrative to give the user an indication of the analytical limitations of the data. Note any discrepancies between the data and the SDG Narrative for CLP PO action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include an assessment of the data usability within the given context.

3. If any discrepancies are found, the Laboratory may be contacted by the Region's designated representative to obtain additional information for resolution. If a discrepancy remains unresolved, the reviewer may determine that qualification of the data is warranted.

## Calculations for Mercury

**Aqueous Samples:**

$$\text{Hg Concentration } (\mu g/L) = \frac{\mu g \text{ Hg, curve}}{\text{aliquot volume, mL}} \times \frac{1000 \text{ mL}}{1 \text{ L}}$$

**Soil Samples:**

$$\text{Hg Concentration (mg/kg)} = \text{Hg } \mu g/g = \frac{C}{W \times S} \times (0.1L)$$

**Where,**

C = Concentration from curve (µg/L)

W = Wet sample weight (g)

S = % Solids/100 (see Exhibit D - Introduction to Analytical Methods, Section 1.6)

**Adjusted Method Detection Limit (MDL)/Adjusted Contract Required Quantitation Limit (CRQL) Calculation:**

To calculate the adjusted MDL or adjusted CRQL for water/aqueous samples, multiply the value of the MDL (µg/L) or CRQL (µg/L) by the Dilution Factor (DF). Calculate the adjusted MDL or adjusted CRQL for soil samples as follows:

$$\text{Adjusted Concentration (dry wt.)(mg/kg)} = C \times \frac{W_M}{W_R} \times \frac{1}{S} \times DF$$

**Where,**

C = MDL or CRQL concentration (mg/kg)

$W_M$ = Method required wet sample weight (g)

$W_R$ = Reported wet sample weight (g)

S = % Solids/100 (see Exhibit D - Introduction to Analytical Methods, Section 1.6)

DF = Dilution Factor

# CYANIDE DATA REVIEW

The inorganic data requirements for cyanide data review to be reviewed during validation are listed below:

I. Preservation and Holding Times

II. Calibration
   A. Initial
   B. Initial and Continuing Calibration Verification (ICV/CCV)
   C. Contract Required Quantitation Limit (CRQL) Check Standard (CRI)

III. Blanks

IV. Laboratory Control Sample (LCS)

V. Duplicate Sample Analysis

VI. Spike Sample Analysis

VII. Field Duplicates

VIII. Overall Assessment

## An Example Analytical Sequence for Cyanide

S0
S10
S20
S50
S100
S200
S400
MIDRANGE
ICV
ICB
CRI
CCV
CCB
ten samples
CCV
CCB
nine samples
CRI
CCV
CCB

## I. Preservation and Holding Times

### A. Review Items:

Form IA-IN, Form IB-IN, Form XII-IN, Form XIII-IN, Traffic Report/Chain of Custody (TR/COC) documentation, Form DC-1, raw data, and the Sample Delivery Group (SDG) Narrative checking for: pH; cooler temperature; holding time; and other sample conditions.

### B. Objective:

The objective is to ascertain the validity of the analytical results based on the sample condition, and the holding time of the sample from the date of collection to the date of analysis.

### C. Criteria:

1. Technical requirements for sample holding times have only been established for aqueous matrices. The addition of sodium hydroxide to adjust the pH is only required for aqueous samples.

2. The technical holding time criteria for aqueous cyanide samples are 14 days; oxidizing agents removed, then preserved (with sodium hydroxide) to pH>12.

3. Aqueous samples shall be maintained at 4°C ±2°C until preparation and analysis to allow for re-preparation and for the direct analysis of dissolved metals.

4. The preservation for soil/sediment samples is maintenance at 4°C ±2°C until preparation and analysis.

### D. Evaluation:

Technical holding times are established by comparing the sampling date(s) on the TR/COC documentation with the dates of analysis on Form XIII-IN, and the raw data. Information contained in the Complete SDG File (CSF) should also be considered in the determination of holding times. Verify that the analysis dates on the Form XIIIs and the raw data are identical. Review the SDG Narrative and raw data preparation logs to determine if samples were properly preserved. If there is an indication that there are problems with the samples, the integrity of the samples may be compromised and professional judgment should be used to evaluate the effect of the problem on the sample results. For aqueous cyanide samples, the reviewer should look for evidence that the samples were tested for the presence of sulfides or oxidizing agents, and whether the appropriate preservation steps were taken.

### E. Action:

**NOTE:** Apply the action to each sample for which the preservation or holding time criteria were not met.

1. If oxidizing agents are detected in aqueous cyanide samples at the time of sample preparation, qualify results that are ≥ Method Detection Limit (MDL) as estimated low (J-) and non-detects as unusable (R). If sulfides are detected in aqueous cyanide samples at the time of sample preparation and there is no evidence that the Laboratory removed the sulfides (using precipitation and filtration), qualify results that are ≥MDL as

estimated (J) and non-detects as unusable (R). If the pH of aqueous cyanide samples is ≤12 at the time of sample receipt, use professional judgment to qualify the samples based on the pH of the sample. Qualify results that are ≥MDL as estimated low (J-) and qualify non-detects as unusable (R).

2. If technical holding times are exceeded, use professional judgment to determine the reliability of the data based on the magnitude of the additional time compared to the technical requirement and whether the samples are properly preserved. The expected bias would be low. Qualify results that are ≥MDL as estimated low (J-) and non-detects as unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer whether to apply water holding time criteria to soil samples. If they are applied, it must be clearly documented in the Data Review Narrative.

4. When the holding times are exceeded, the reviewer should comment in the Data Review Narrative on any possible consequences for the analytical results.

5. When holding times are grossly exceeded, note this for Contract Laboratory Program Project Officer (CLP PO) action.

**Table 28. Technical Holding Time Actions for Cyanide Analysis**

| Preservation & Holding Time Results | Action for Samples |
|---|---|
| Aqueous cyanide samples received with oxidizing agents present. | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Aqueous cyanide samples received with sulfides present, and sulfides are not removed | Qualify results that are ≥MDL as estimated (J)<br>Qualify non-detects as unusable (R) |
| Aqueous cyanide samples received with pH ≤12 | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |
| Technical holding time exceeded:<br>Cyanide >14 days | Use professional judgment<br>Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as unusable (R) |

## II. Calibration

### A. Review Items:

Form II-IN (Parts A & B), Form XI-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data.

### B. Objective:

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for cyanide. Initial Calibration Verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing Calibration Verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

### C. Criteria:

#### 1. Initial Calibration

The instruments shall be successfully calibrated daily (or once every 24 hours), and each time the instrument is set up. The calibration date and time shall be included in the raw data.

a. A blank and at least three calibration standards, one of which shall be at the Contract Required Quantitation Limit (CRQL), shall be employed to establish the analytical curve. The calibration curve for cyanide shall possess a correlation coefficient of $\geq 0.995$ to ensure the linearity over the calibrated range.

b. All sample results shall be reported from an analysis within the calibrated range.

c. At least one calibration standard (mid-level) shall be distilled and compared to similar values on the curve to ensure that the distillation technique is reliable. The distilled standard shall agree within ±15% of the undistilled standard. This mid-level standard shall be prepared at least once for each distillation method used to prepare samples for analysis.

d. The linearity of the analytical curve shall be verified near the CRQL. A CRQL Check Standard (CRI) solution shall be prepared and analyzed at the beginning and end of each sample analysis run and every 20 analytical samples, but not before the ICV analysis.

e. Analysis of the CRI for cyanide is required for both the manual and semi-automated spectrophotometric methods, and the results and Percent Recovery (%R) are to be reported on Form ICB-IN.

f. If the results for the CRI do not fall within the fixed acceptance limits, the Laboratory must reanalyze the CRI. If the results of the reanalysis do not fall within the acceptance limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the new calibration then reverified.

## 2. Initial and Continuing Calibration Verification (ICV and CCV)

The acceptance criteria for the ICVs, CCVs, and CRIs are presented in Table 30:

**Table 29. Acceptance Criteria for ICVs, CCVs, and CRIs**

| Analytical Method | Inorganic Analyte | ICV/CCV Low Limit (% of True Value) | ICV/CCV High Limit (% of True Value) | CRI Low Limit (% of True Value) | CRI High Limit (% of True Value) |
|---|---|---|---|---|---|
| Other | Cyanide | 85 | 115 | 70 | 130 |

### a. Initial Calibration Verification (ICV)

1) Immediately after each cyanide system has been calibrated, the accuracy of the initial calibration must be verified and documented by the analysis of an ICV solution(s). If the ICV %R falls outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and all affected samples reanalyzed.

2) If the ICV is not available from USEPA, or where a certified solution of the analyte is not available from any source, analyses shall be conducted on an independent standard at a concentration level other than that used for instrument calibration (or the CRI), but within the calibrated range.

3) For cyanide analysis, the ICV standard solution shall be distilled with each batch of samples analyzed. An ICV distilled with a particular set of samples must be analyzed only with that sample set.

### b. Continuing Calibration Verification (CCV)

1) To ensure accuracy during the course of each analytical run, the CCV shall be analyzed and reported.

2) The CCV standard shall be analyzed at a frequency of 10% or every two hours during an analytical run, whichever is more frequent. The CCV standard shall also be analyzed at the beginning of the run, and again after the last analytical sample.

3) The analyte concentration in the CCV standard shall be different from the concentration used for the ICV, and shall be one of the following solutions at, or near, the mid-range levels of the calibration curve:

   A. USEPA solutions;
   B. National Institute of Standards and Technology (NIST) standards; or
   C. A Laboratory-prepared standard solution (self-prepared or commercially available).

4) The same CCV standard solution shall be used throughout the analysis runs for a Sample Delivery Group (SDG).

5) The CCV shall be analyzed in the same fashion as an actual sample. Operations such as the number of replicate analyses, the number and duration of the instrument rinses, etc., affect the measured CCV result and are not to be applied to the CCV to an extent greater than was applied to the associated analytical samples. If the %R of the CCV was outside of the control limits, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration verification reanalyzed.

## D. Evaluation:

### 1. Cyanide Analysis

a. Verify that the instrument was calibrated daily (once every 24 hours) and each time the instrument was set up, utilizing a blank and at least three calibration standards. Confirm that one of the calibration standards was analyzed at the CRQL.

b. Check the distillation log and verify that a mid-level cyanide standard and the ICV were distilled and analyzed. Verify that the distilled mid-level cyanide standard agrees within ±15% of the undistilled standard.

c. Evaluate the reported CRI to confirm that it was analyzed at the proper frequency, concentration, and location within the analytical run sequence. Verify that acceptable %R results were obtained.

d. Verify that the ICV and CCV standards were analyzed for cyanide at the proper frequency (10%) and at the appropriate concentration. Verify that acceptable %R results were obtained.

e. Recalculate one or more of the ICV, CCV, or CRI %R using the following equation and verify that the recalculated value agrees with the Laboratory-reported values on Forms II (A & B)-IN.

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration (in µg/L) of cyanide <u>measured</u> in the analysis of the ICV, CCV, or CRI solution

True(value) = Concentration (in µg/L) of cyanide in the ICV, CCV, or CRI source

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For initial calibrations or non-distilled ICVs that do not meet the technical criteria, apply the action to all samples reported from the analytical run. For distilled ICV, apply the action to all samples prepared in the same preparation batch.

**NOTE:** For CCVs or CRIs that do not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the QC sample and a subsequent technically acceptable analysis of the QC sample in the analytical run.

1. If the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable (R). If the instrument was not calibrated with at least the minimum number of standards, or if the calibration curve does not include standards at required concentrations (e.g., a blank, or a standard at the CRQL), use professional judgment to qualify results that are ≥ Method Detection Limit (MDL) as estimated (J) or unusable (R), and non-detects as estimated (UJ) or unusable (R).

2. If the correlation coefficient is <0.995, qualify sample results that are ≥MDL as estimated (J), and non-detects as estimated (UJ). Depending on the degree of the deviation from linearity, further qualification of the data may be required depending on the professional judgment of the reviewer [e.g., unusable data (R)].

3. If one of the mid-range standards and the ICV are not distilled for cyanide, or the distilled standard(s) does not agree with the undistilled standard (>±15% but <±30%) qualify sample results that are ≥MDL as estimated (J). If the distilled standard disagrees with the undistilled standard by more than 30%, qualify sample results that are ≥MDL as unusable (R).

4. If the CRIs are outside the acceptance criteria, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the CRI %R is <50%, qualify all sample results are ≥MDL but < two times (2x) the CRQL and all non-detects as unusable (R). Qualify detects ≥2x the CRQL as estimated (J).

   b. If the CRI %R falls within the range of 50-69%, qualify all sample results that are ≥MDL but <2x the CRQL as estimated low (J-) and all non-detects as estimated (UJ). Detects that are ≥2x the CRQL should not be qualified based on this criterion.

   c. If the CRI %R is >130%, qualify all sample results that are ≥MDL but <2x the CRQL as estimated high (J+). Non-detects and detects ≥2x the CRQL should not be qualified based on this criterion.

   d. If the CRI %R is >180%, qualify all sample results that are ≥MDL as unusable (R).

5. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify all associated data. If possible, indicate the bias in the review. The following guidelines are recommended:

   a. If the ICV or CCV %R is <70%, qualify non-detects as unusable (R). Use professional judgment to qualify all results that are ≥MDL as estimated low (J-) or unusable (R).

   b. If the ICV or CCV %R falls within the range of 70-84%, qualify sample results that are ≥MDL as estimated low (J-), qualify non-detects as estimated (UJ).

   c. If the ICV or CCV %R falls within the range of 116-130%, qualify sample results that are ≥MDL as estimated high (J+).

   d. If the ICV or CCV %R is within the range of 116-130%, non-detects should not be qualified.

   e. If the ICV or CCV %R is >130%, use professional judgment to qualify results that are ≥MDL as estimated high (J+) or unusable (R). Non-detects should not be qualified.

   f. If the %R is >165%, qualify all results that are ≥MDL as unusable (R).

6. If the Laboratory failed to provide adequate calibration information, the Region's designated representative should contact the Laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgment to assess the data.

7. Note the potential effects on the reported data due to exceeding the calibration criteria in the Data Review Narrative.

8. If calibration criteria are grossly exceeded, note this for Contract Laboratory Program Project Officer (CLP PO) action.

**NOTE:** For truly critical samples, a further in-depth evaluation of the calibration curve may be warranted to determine if additional qualification is necessary.

**Table 30. Calibration Actions for Cyanide Analysis**

| Calibration Result | Action for Samples |
|---|---|
| Calibration not performed | Qualify all results as unusable (R) |
| Calibration incomplete | Use professional judgment<br>Qualify results that are ≥MDL as estimated (J) or unusable (R)<br>Qualify non-detects as estimated (UJ) or unusable (R) |
| Correlation coefficient <0.995 | Qualify results that are ≥MDL as estimated (J)<br>Qualify non-detects as estimated (UJ) |
| No distilled ICV or mid-range standard for cyanide, or distilled standards do not agree (>±15% but ≤±30%) with undistilled standard | Qualify results that are ≥MDL as estimated (J) |
| Distilled standards do not agree (>±30%) with undistilled standard | Qualify results that are ≥MDL as unusable (R) |
| CRI %R <50% | Qualify all results that are ≥MDL but <2x the CRQL and all non-detects as unusable (R)<br>Qualify all results that are ≥2x the CRQL as estimated (J) |
| CRI %R 50-69% | Qualify results that are ≥MDL but <2x the CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ)<br>Results that are ≥2x the CRQL are not qualified |
| CRI %R >130% but ≤165% | Qualify results that are ≥MDL but <2x the CRQL as estimated high (J+)<br>Non-detects and results that are ≥2x the CRQL are not qualified |
| CRI %R >165% | Qualify all results that are ≥MDL as unusable (R) |
| ICV/CCV %R <70% | Qualify results that are ≥MDL as estimated low (J-) or unusable (R)<br>Qualify all non-detects as unusable (R) |
| ICV/CCV %R 70-84% | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| ICV/CCV %R 116-130% | Qualify results that are ≥MDL as estimated (J) |
| ICV/CCV %R >130% | Qualify results that are ≥MDL as estimated high (J+) or unusable (R) |
| ICV/CCV %R >165% | Qualify results that are ≥MDL as unusable (R) |

## III. Blanks

### A. Review Items:

Form I-IN, Form III-IN, Form XII-IN, Form XIII-IN, preparation logs, calibration standard logs, instrument logs, and raw data.

### B. Objective:

The objective of blank analysis results assessment is to determine the existence and magnitude of contamination resulting from Laboratory (or field) activities. The criteria for evaluation of blanks applies to any blank associated with the samples (e.g., method blanks, calibration blanks, field blanks, etc.). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

### C. Criteria:

1. No contaminants should be found in the blank(s).

2. The Initial Calibration Blank (ICB) shall be analyzed after the analytical standards, but not before analysis of the Initial Calibration Verification (ICV) during the initial calibration of the instrument (see Section II.C.1).

3. A Continuing Calibration Blank (CCB) shall be analyzed immediately after every ICV and Continuing Calibration Verification (CCV). The CCB shall be analyzed at a frequency of 10% or every two hours during the run, whichever is more frequent. The CCB shall be analyzed at the beginning of the run, and again after the last CCV that was analyzed after the last analytical sample of the run. The CCB result (absolute value) shall not exceed the Contract Required Quantitation Limit (CRQL) of cyanide.

4. At least one Preparation Blank (PB) shall be prepared and analyzed for each matrix, with every Sample Delivery Group (SDG), or with each batch of samples distilled, whichever is more frequent. The PB consists of reagent water processed through the appropriate sample preparation and analysis procedure.

5. If the cyanide concentration in the PB is >CRQL, the lowest concentration of cyanide in the associated samples must be 10 times (10x) the PB concentration. Otherwise, all samples associated with that PB with a cyanide concentration <10x the PB concentration, and >CRQL, should be redistilled and reanalyzed cyanide (except for an identified field blank). The Laboratory is not to correct the sample concentration for the blank value.

6. If the concentration of the PB for cyanide is <(−CRQL), all samples reported <10x the CRQL (associated with that blank), should be redistilled and reanalyzed.

## D. Evaluation:

1. Verify that an ICB was analyzed after the calibration, the CCB was analyzed at the proper frequency and location during the run, and PBs are prepared and analyzed as appropriate for the SDG (e.g., total number of samples, various types of matrices present, number of digestion batches, etc.).

2. Review the results reported on the Blank Summary (Form III-IN), as well as the raw data (e.g., instrument printouts, strip charts, printer tapes, bench sheets, etc.) for all blanks, and verify that the results were accurately reported.

3. Evaluate all of the associated blanks for the presence of cyanide. Verify that if cyanide was present in a PB, or if a concentration was <(−CRQL), the affected samples were redistilled and reanalyzed. Verify that if cyanide was present in an ICB or a CCB, the analysis was terminated, the problem corrected, the instrument recalibrated, and the preceding 10 analytical samples or all analytical samples analyzed since the last compliant calibration blank reanalyzed.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), many of the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For ICBs that do not meet the technical criteria, apply the action to all samples reported from the analytical run.

For CCBs that do not meet the technical criteria, apply the action to all samples analyzed between a previous technically acceptable analysis of the CCB and a subsequent technically acceptable analysis of the CCB in the analytical run.

For PBs that do not meet the technical criteria, apply the action to all samples prepared in the same preparation batch.

1. If the appropriate blanks are not analyzed with the correct frequency, the data reviewer should use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. The situation should then be recorded in the Data Review Narrative, and noted for CLP Project Officer (PO) action.

2. Action regarding unsuitable blank results depends on the circumstances and origin of the blank. The reviewer should note that in instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of contaminant.

3. Some general "technical" review actions include:

   a. Any blank (including PB) reported with a negative result, whose value is ≤[−Method Detection Limit (MDL)] but ≥(−CRQL), should be carefully evaluated to determine its effect on the sample data. The reviewer shall then use professional

judgment to assess the data. For any blank (including PB) reported with a negative result, whose value is <(−CRQL), qualify results that are ≥CRQL as estimated low (J-) and non-detects as estimated (UJ).

b. The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. In particular, soil sample results reported on Form I-IN will not be on the same basis (units, dilution) as the calibration blank data reported on Form III-IN. The reviewer may find it easier to work with the raw data.

4. Specific "method" actions include:

a. If the absolute value of an ICB or a CCB result is >CRQL, the analysis should be terminated. If the analysis was not terminated and the affected samples are not reanalyzed, report non-detects and results that are ≥MDL but ≤CRQL as CRQL-U. For results that are >CRQL but < Blank Result, use professional judgment to qualify the data as unusable (R), or report the results at the level of the blank with a "U" qualifier. Use professional judgment to qualify results that are > Blank Result. Note this situation for CLP PO action and record it in the Data Review Narrative.

b. If the absolute value of the concentration of the PB is ≤CRQL, no correction of the sample results should be performed.

c. If the cyanide concentration in the PB is >CRQL, the lowest concentration of cyanide in the associated samples must be 10x the PB concentration. Otherwise, all samples associated with that blank with concentrations <10x the PB concentration and >CRQL should be redistilled and reanalyzed. Raise the CRQL to the concentration found in the PB and report those samples that do not require redigestion (≥MDL but ≤CRQL) as CRQL-U. Note for CLP PO action and record in the Data Review Narrative if the Laboratory failed to redistill and reanalyze the affected samples. The reviewer shall then use professional judgment to assess the data.

**Table 31. Blank Actions for Cyanide Analysis**

| Blank Type | Blank Result | Sample Result | Action for Samples |
|---|---|---|---|
| ICB/CCB | Absolute value is ≥MDL but ≤CRQL | Non-detect | No action |
| | | ≥MDL but ≤CRQL | Report CRQL value with a"U" |
| | | >CRQL | Use professional judgment |
| ICB/CCB | Absolute value is >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <Blank Result | Report at level of Blank Result with a "U" or qualify data as unusable (R) |
| | | >Blank Result | Use professional judgment |
| ICB/CCB | ≤(−MDL), but ≥(−CRQL) | ≥MDL, or non-detects | Use professional judgment |
| ICB/CCB | <(−CRQL) | <10x the CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |
| PB | >CRQL | ≥MDL but ≤CRQL | Report CRQL value with a "U" |
| | | >CRQL but <10x the Blank Result | Qualify results as unusable (R) or estimated high (J+) |
| | | ≥10x the Blank Result | No action |
| PB | ≥MDL but ≤CRQL | ≥MDL, or non-detect | No action |
| PB | <(−CRQL) | <10x the CRQL | Qualify results that are ≥CRQL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## IV. Laboratory Control Sample (LCS)

### A. Review Items:

Form VII-IN, Form XII-IN, preparation logs, instrument printouts, and raw data.

### B. Objective:

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation.

### C. Criteria:

1. A solid LCS shall be prepared and analyzed utilizing each of the preparation and analytical procedures applied to the soil/sediment samples received, with one exception: The Percent Solids (%S) determination is not required. If the solid LCS is not available from USEPA, other USEPA Quality Assurance (QA) samples or certified materials may be used.

2. One solid LCS shall be prepared and analyzed for each group of soil sediment samples in a Sample Delivery Group (SDG), or for each batch of samples distilled, whichever is more frequent.

3. All solid LCS results shall fall within the control limits reported on Form VII-IN. If the results for the solid LCS fall outside of the control limits, the analyses should be terminated, the problem corrected, and the samples prepared with that LCS redistilled and reanalyzed.

### D. Evaluation:

1. Verify using Form VII-IN, Form XII-IN, and raw data that the appropriate number of required LCSs were prepared and analyzed for the SDG.

2. Evaluate Form VII-IN and verify that all results for cyanide fall within the established control limits.

3. Check the raw data (e.g., instrument printouts, strip charts, bench sheets, etc.) to verify that the Percent Recoveries ( %Rs) on Form VII-IN were accurately transcribed. Recalculate one or more of the reported %Rs using the following equation:

$$\%R = \frac{\text{Found(value)}}{\text{True(value)}} \times 100$$

**Where,**

Found(value) = Concentration of cyanide (in mg/kg) measured in the analysis of the LCS

True(value) = Concentration of cyanide (in mg/kg) in the LCS

4. Verify that the LCS was prepared at the same time as the associated samples using the same procedures

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with these criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

If the LCS criteria are not met, the Laboratory performance and method accuracy are in question. Professional judgment should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data associated with an LCS that does not meet the required criteria.

For an LCS that does not meet the technical criteria, apply the action to all samples in the same preparation batch.

1. If the LCS results are greater than the reported control limits, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated high (J+). If the LCS results are less than the reported control limits, qualify sample results that are ≥MDL as estimated low (J-).

2. If the LCS results are greater than the reported control limits and the sample results are non-detects, the data should not be qualified.

3. If the LCS results are less than the reported control limits, qualify non-detects as estimated (UJ).

4. If a Laboratory fails to analyze an LCS with each SDG, or if a Laboratory consistently fails to generate acceptable LCS recoveries, note this for CLP Project Officer (PO) action.

5. Whenever possible, the potential effects on the data due to out-of-control LCS results should be noted in the Data Review Narrative.

**Table 32. LCS Actions for Cyanide Analysis**

| LCS Result | Action for Samples |
|---|---|
| Soil Result > upper limit | Qualify results that are ≥MDL as estimated high (J+) |
| Soil Result < lower limit | Qualify results that are ≥MDL as estimated low (J-)<br>Qualify non-detects as estimated (UJ) |

## V. Duplicate Sample Analysis

### A. Review Items:

Cover Page, Form VI-IN, Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The objective of duplicate sample analysis is to demonstrate acceptable method precision by the Laboratory at the time of analysis. Duplicate analyses are also performed to generate data that determines the long-term precision of the analytical method on various matrices. Non-homogenous samples can impact the apparent method precision. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for duplicate sample analysis.

2. At least one duplicate sample shall be prepared and analyzed from each group of samples of a similar matrix type (e.g., water or soil) or for each Sample Delivery Group (SDG). Duplicates cannot be averaged for reporting on Form I-IN. Additional duplicate sample analyses may be required by USEPA Regional request. Alternately, the Region may require that a specific sample be used for the duplicate sample analysis.

3. Duplicate sample analyses are required for Percent Solids (%S) determination.

4. A control limit of 20% for the Relative Percent Difference (RPD) shall be used for original and duplicate sample values ≥ five times (5x) the Contract Required Quantitation Limit (CRQL).

5. A control limit of the CRQL shall be used if either the sample or duplicate value is <5x the CRQL. The absolute value of the control limit (CRQL) shall be entered in the "Control Limit" column on Form VI-IN. If both samples are non-detects, the RPD is not calculated for Form VI-IN.

**NOTE:** The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project Data Quality Objectives (DQOs) may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples.

### D. Evaluation:

1. Verify from the Cover Page, Form XII-IN, and the raw data that the appropriate number of required duplicate samples were prepared and analyzed for the SDG.

2. Evaluate Form VI-IN and the raw data to verify that all cyanide duplicate results for each method fall within the established control limits.

3. Verify that a field blank or PE sample was not used for duplicate analysis.

4. Check the raw data and recalculate one or more of the RPD values using the following equation to verify that the results were correctly reported on Form VI-IN:

$$RPD = \frac{|S - D|}{(S+D)/2} \times 100$$

**Where,**

RPD = Relative Percent Difference

S = Sample result (original)

D = Duplicate result

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

**E. Action:**

**NOTE:** For a duplicate sample analysis that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the duplicate sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the duplicate, and thus that only the field sample used to prepare the duplicate sample should be qualified.

1. If the appropriate number of duplicate samples was not analyzed for each matrix using the correct frequency, use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If the results from a duplicate analysis for cyanide fall outside the appropriate control limits, qualify sample results that are ≥ Method Detection Limit (MDL) as estimated (J) and non-detects as estimated (UJ).

3. If a field blank or PE sample was used for the duplicate sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgment exercised by the data reviewer when evaluating the data.

4. Note the potential effects on the data due to out-of-control duplicate sample results in the Data Review Narrative.

**Table 33. Duplicate Sample Actions for Cyanide Analysis**

| Duplicate Sample Results | Action for Samples |
|---|---|
| Both original sample and duplicate sample >5x the CRQL and RPD>20%* | Qualify those results that are ≥MDL that professional judgment determines to be affected as estimated (J) and non-detects as estimated (UJ) |
| Original sample or duplicate sample ≤5x the CRQL (including non-detects) and absolute difference between sample and duplicate >CRQL* | Qualify those results that are ≥MDL that professional judgment determines to be affected as estimated (J) and non-detects as estimated (UJ) |

*The above control limits are **method requirements** for duplicate samples, regardless of the sample matrix type. However, it should be noted that Laboratory variability arising from the sub-sampling of non-homogenous soil samples is a common occurrence. Therefore, for **technical review purposes only**, Regional policy or project Data Quality Objectives (DQOs) may allow the use of less restrictive criteria (e.g., 35% RPD, 2x the CRQL) to be assessed against duplicate soil samples.

## VI. Spike Sample Analysis

### A. Review Items:

Cover Page, Form V-IN (Part A & B), Form XII-IN, instrument printouts, and raw data.

### B. Objective:

The spiked sample analysis is designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. Non-homogenous samples can impact the apparent method recovery. However, aqueous samples are generally homogenous and most soil samples are homogenous within a factor of two or three. If the spike is added to the sample prior to any distillation steps (e.g., cyanide), it is referred to as a spiked sample, pre-distillation spike, or Matrix Spike. If the spike is added to the sample after the completion of the distillation procedures, it is referred to as a post-distillation spike, or analytical spike.

### C. Criteria:

1. Samples identified as field blanks or Performance Evaluation (PE) samples cannot be used for spiked sample analysis.

2. At least one spiked sample (pre-distillation) shall be prepared and analyzed from each group of samples with a similar matrix type (e.g., water or soil), or for each Sample Delivery Group (SDG).

3. When the pre-distillation spike recovery falls outside of the control limits and the sample result is < four times (4x) the spike added, a post-distillation spike shall be performed An aliquot of the remaining unspiked sample shall be spiked at 2x the indigenous level or 2x the Contract Required Quantitation Limit (CRQL), whichever is greater.

4. The spike Percent Recovery (%R) shall be within the established acceptance limits. However, spike recovery limits do not apply when the sample concentration is ≥4x the spike added. In such an event, the data shall be reported unflagged, even if the %R does not meet the acceptance criteria.

5. If the spiked sample analysis was performed on the same sample that was chosen for the duplicate sample analysis, spike calculations shall be performed using the results of the sample designated as the "original sample". The average of the duplicate results cannot be used for the purpose of determining %R.

**NOTE:** The final spike concentrations required are presented in the method described in the Statement of Work (SOW).

### D. Evaluation:

1. Verify using the Cover Page, Form VA-IN, Form XII-IN, and raw data that the appropriate number of required spiked samples were prepared and analyzed for the SDG.

2. Verify that a field blank or PE sample was not used for the spiked sample analysis.

3. Evaluate Form VA-IN and the raw data to verify that all pre-distillation spiked sample results fall within the established control limits. If not, verify that a post-distillation spike was prepared and analyzed.

4. Recalculate using the raw data, one or more of the %R using the following equation, and verify that the recalculated value agrees with the Laboratory-reported values on Forms V(A & B)-IN:

$$\% \text{ Recovery} = \frac{SSR - SR}{SA} \times 100$$

**Where,**

SSR = Spiked Sample Result

SR = Sample Result

SA = Spike Added

**NOTE:** When the sample concentration is < Method Detection Limit (MDL), use SR = 0 only for the purposes of calculating the %R. The actual spiked sample results, sample results, and %R (positive or negative) shall still be reported on Form V(A & B)-IN.

**NOTE:** For data obtained from the Contract Laboratory Program (CLP), the above criteria are evaluated as part of the Contract Compliance Screening (CCS) process. Information regarding the Laboratory's compliance with the above criteria can be obtained from the Data Assessment Tool (DAT) reports, and may be used as part of the evaluation process.

## E. Action:

**NOTE:** For a Matrix Spike that does not meet the technical criteria, apply the action to all samples of the same matrix, if the reviewer considers the samples sufficiently similar. The reviewer will need to exercise professional judgment in determining sample similarity. The reviewer should make use of all available data, including: site and sampling documentation (e.g., location and type of sample, descriptive data, soil classification); field test data (e.g., pH, Eh, conductivity, chlorine); and Laboratory data for other parameters [e.g., Total Suspended Solids (TSSs), Total Dissolved Solids (TDSs), Total Organic Carbon (TOC), alkalinity or buffering capacity, reactive sulfide, anions], in determining similarity. The reviewer should also use the sample data (e.g., similar concentrations of analytes) in determining similarity between samples in the SDG. The reviewer may determine that only some of the samples in the SDG are similar to the Matrix Spike sample, and that only these samples should be qualified. Or, the reviewer may determine that no samples are sufficiently similar to the sample used for the Matrix Spike, and thus that only the field sample used to prepare the Matrix Spike sample should be qualified.

1. If the appropriate number of Matrix Spike samples was not analyzed for each matrix using the correct frequency, use professional judgment to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the

Laboratory. Note the situation in the Data Review Narrative, and for CLP Project Officer (PO) action.

2. If a field blank or PE sample was used for the spiked sample analysis, note this for CLP PO action. All of the other Quality Control (QC) data must then be carefully checked, and professional judgment exercised by the data reviewer when evaluating the data.

3. If the Matrix Spike recovery does not meet the evaluation criteria and a required post-distillation spike was not performed, note this for CLP PO action

4. If the Matrix Spike %R is <30%, verify that a post-distillation spike was analyzed if required. If the post-distillation spike %R is <75% or is not performed, qualify sample results that are ≥MDL as estimated low (J-) and non-detects as unusable (R). If the post-distillation spike %R is ≥75%, qualify sample results that are ≥MDL as estimated (J) and non-detects as estimated (UJ).

5. If the Matrix Spike %R falls within the range of 30-74% and the sample results are ≥MDL, verify that a post-distillation spike was analyzed if required. If the %R for the post-distillation spike is also <75% or not performed, qualify the affected data as estimated low (J-). If the %R for the post-distillation spike is ≥75%, qualify the affected data as estimated (J).

6. If the Matrix Spike %R falls within the range of 30-74% and the sample results are non-detects, qualify the affected data as estimated (UJ).

7. If the Matrix Spike %R is >125% and the reported sample results are non-detects, the sample data should not be qualified.

8. If the Matrix Spike %R is >125% and the sample results are ≥MDL, verify that a post-distillation spike was analyzed if required. If the %R for the post-distillation spike is also >125% or is not performed, qualify the affected data as estimated high (J+). If the %R for the post-distillation spike is ≤125%, qualify the affected data as estimated (J).

9. Note the potential effects on the data due to out-of-control spiked sample results in the Data Review Narrative.

**Table 34. Spike Sample Actions for Cyanide Analysis**

| Spike Sample Results | Action for Samples |
|---|---|
| Matrix Spike %R <30%<br>Post-distillation spike %R <75% | Qualify affected results that are ≥MDL as estimated low (J-)<br>Qualify affected non-detects as unusable (R) |
| Matrix Spike %R <30%<br>Post-distillation spike %R ≥75% | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R 30-74%<br>Post-distillation spike %R <75% | Qualify affected results that are ≥MDL as estimated low (J-)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R 30-74%<br>Post-distillation spike %R ≥75% | Qualify affected results that are ≥MDL as estimated (J)<br>Qualify affected non-detects as estimated (UJ) |
| Matrix Spike %R >125%<br>Post-distillation spike %R >125% | Qualify affected results that are ≥MDL as estimated high (J+) |
| Matrix Spike %R >125%<br>Post-distillation spike %R ≤125% | Qualify affected results that are ≥MDL as estimated (J) |
| Matrix Spike %R <30%<br>No post-distillation spike performed | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as unusable (R) |
| Matrix Spike %R 30-74<br>No post-distillation spike performed | Qualify affected results that are ≥MDL as estimated low (J-) and affected non-detects as estimated (UJ) |
| Matrix Spike %R >125%<br>No post-distillation spike performed | Qualify affected results that are ≥MDL as estimated high (J+)<br>Non-detects are not qualified |

## VII. Field Duplicates

### A. Review Items:

Form I-IN, instrument printouts, and raw data.

### B. Objective:

Field duplicate samples may be collected and analyzed as an indication of overall precision. These analyses measure both field and Laboratory precision. The results, therefore, may have more variability than Laboratory duplicates that measure only Laboratory performance. It is also expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples.

### C. Criteria:

There are no "required" review criteria for determining comparability of field duplicate analyses.

### D. Evaluation:

Identify samples that are field duplicates using Traffic Report/Chain of Custody (TR/COC) documentation or sample field sheets. Compare the results reported for each sample and calculate the Relative Percent Difference (RPD), if appropriate.

### E. Action:

Provide any evaluation of the field duplicates in the Data Review Narrative.

## VIII. Overall Assessment

### A. Review Items:

Entire data package, data review results, preparation logs, calibration standard logs, instrument logs, instrument printouts, and raw data (including any confirmation data).

### B. Objective:

The objective is to ensure that the reported sample quantitation results are accurate. It is appropriate for the data reviewer to make professional judgments and express concerns, as well as to comment on the validity of the overall data for a Case. This is particularly appropriate when there are several Quality Control (QC) criteria that are outside of the specification parameters. The additive nature of QC factors that fall outside of specification parameters is difficult to assess in an objective manner, but the reviewer has a responsibility to inform the user concerning data quality and data limitations to assist that user in avoiding inappropriate use of the data, while not precluding any consideration of the data at all. If qualifiers other than those used in this document are necessary to describe or qualify the data, it is necessary to thoroughly document/explain the additional qualifiers used. The data reviewer would be greatly assisted in this endeavor if the acceptance or performance criteria were provided. The Inorganic Review Summary (see Appendix B) and supplementary documentation must be included with the review.

### C. Criteria:

1. Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

2. Reported analyte concentrations must be quantitated according to the appropriate analytical method, as listed in the method.

### D. Evaluation:

Examine the raw data to verify that the correct calculation of the sample results was reported by the Laboratory. Distillation logs, instrument printouts, strip charts, etc., should be compared to the reported sample results recorded on the appropriate Inorganic Summary Forms (Form I-IN through Form XV-IN).

1. Evaluate any technical problems not previously addressed.

2. Examine the raw data for any anomalies (e.g., baseline shifts, negative absorbance, omissions, illegibility, etc.).

3 Verify that the appropriate methods and amounts were used to prepare samples for analysis. If reduced volumes were used, verify that the Laboratory had received Contract Laboratory Program Project Officer (CLP PO) approval for the use of the reduced volume.

4. Verify that there were no transcription or reduction errors [e.g., dilutions, Percent Solids (%S), sample weights, etc.] on one or more samples.

5. Verify that results fall within the calibrated range for cyanide.

6. If appropriate information is available, the reviewer may assess the usability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the Quality Assurance Project Plan (QAPP), focusing specifically on the acceptance or performance criteria, the Standard Operating Procedure(s) (SOPs), and communication with user concerning the intended use and desired quality of these data.

## E. Action:

1. Use professional judgment to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief Data Review Narrative to give the user an indication of the analytical limitations of the data. Note any discrepancies between the data and the SDG Narrative for CLP PO action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include an assessment of the data usability within the given context.

3. If any discrepancies are found, the Laboratory may be contacted by the Region's designated representative to obtain additional information for resolution. If a discrepancy remains unresolved, the reviewer may determine that qualification of the data is warranted.

## Calculations for Cyanide

**Aqueous Sample Concentration (Manual):**

$$\text{CN Concentration } (\mu g/L) = \frac{A \times 1000 \text{ mL/L}}{B} \times \frac{50 \text{ mL}}{C}$$

**Where,**

| | | |
|---|---|---|
| A | = | µg cyanide read from standard curve (per 250 mL) |
| B | = | mL of original sample for distillation (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.2.2.1.1) |
| C | = | mL taken for colorimetric analysis (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.3.1.1) |
| 50 mL | = | Volume of original sample aliquot (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.3.1.1) |
| 1000 mL/L | = | Conversion mL to L |

**NOTE:** The minimum value that can be substituted for A is the Method Detection Limit (MDL) value adjusted for volume.

**Soil Sample Concentration (Manual):**

$$\text{CN Concentration } (mg/kg) = \frac{A \times \frac{50 \text{ mL}}{B}}{C \times \frac{\% \text{ solids}}{100}}$$

**Where,**

| | | |
|---|---|---|
| A | = | µg cyanide read from standard curve (per 250 mL) |
| B | = | mL of distillate taken for colorimetric determination (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.3.1.1) |
| C | = | Wet weight of original sample in g (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.2.4.1.1) |
| 50 mL | = | Standard volume taken for colorimetric determination (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.3.1.1) |
| % solids | = | % Solids (see Exhibit D - Introduction to Analytical Methods, Section 1.6) |

**Soil Sample Concentration (Semi-automated):**

$$\text{CN Concentration (mg/kg)} = \frac{A \times .25}{C \times \frac{\%\ \text{solids}}{100}}$$

**Where,**

A = µg/L determined from standard curve

C = Wet weight of original sample in g (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.2.4.1.1)

.25 = Conversion factor for distillate final volume (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.2.2.1.5) % Solids (see Exhibit D - Introduction to Analytical Methods, Section 1.6)

% solids = % Solids (see Exhibit D - Introduction to Analytical Methods, Section 1.6)

**NOTE:** The minimum value that can be substituted for A is the MDL value.

**Calculations for Midi Distillation (Cyanide) of Waters and Soils:**

Aqueous Sample Concentration (Midi):

$$\text{CN Concentration (µg/L)} = \frac{A \times D \times F}{B}$$

**Where,**

A = µg/L cyanide of sample from regression analysis

B = Volume of original sample for distillation (0.050 L) (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.2.3.1.2)

D = Any Dilution Factor (DF) necessary to bracket sample value within standard values

F = Sample receiving solution volume (0.050 L)

**NOTE:** The minimum value that can be substituted for A is the MDL value.

Soil Sample Concentration (Midi):

$$\text{CN Concentration (mg/kg)} = \frac{A \times D \times F}{B \times E}$$

**Where,**

A = µg/L Cyanide of sample from regression analysis curve

B = Wet weight of original sample (see Exhibit D - Analytical Methods for Total Cyanide Analysis, Section 10.2.4.2.2)

D = Any dilution factor necessary to bracket sample value within standard values

E = % Solids/100 (see Exhibit D - Introduction to Analytical Methods, Section 1.6)

F = Sample receiving solution volume (0.050 L)

**NOTE:** The minimum value that can be substituted for A is the MDL value.

**Adjusted Method Detection Limit (MDL)/Adjusted Contract Required Quantitation Limit (CRQL) Calculation:**

To calculate the adjusted aqueous MDL or adjusted aqueous CRQL for the manual colorimetric method, multiply the MDL (µg/L) or CRQL (µg/L) by 0.25 and substitute the result for the "A" term in the appropriate equation above. To calculate the adjusted aqueous MDL or adjusted aqueous CRQL for all other methods, follow the instructions in Exhibit D - Data Analysis and Calculations, Section 11.1.1, or substitute the MDL (µg/L) or CRQL (µg/L) for the "A" term in the appropriate equation above.

The adjusted soil MDL or adjusted soil CRQL for all methods shall be calculated as follows:

$$\text{Adjusted Concentration (mg/kg)} = C \times \frac{W_M}{W_R} \times \frac{1}{S}$$

**Where,**

C = MDL or CRQL concentration (mg/kg)

$W_M$ = Minimum method required wet sample weight (g)

$W_R$ = Reported wet sample weight (g)

S = % Solids/100 (see Exhibit D - Introduction to Analytical Methods, Section 1.6)

**NOTE:** For the midi-distillation, multiply the adjusted concentration value (mg/kg) obtained in the appropriate equation above by any applicable DF.

# APPENDIX A: GLOSSARY

**Analyte** -- The element of interest, ion, or parameter an analysis seeks to determine.

**Analytical Operations/Data Quality Center (AOC)** -- Directs the Contract Laboratory Program (CLP) from within the Office of Emergency and Remedial Response (OERR) in the Office of Solid Waste and Emergency Response (OSWER).

**Analytical Sample** -- Any solution or media introduced into an instrument on which an analysis is performed excluding instrument calibration, Initial Calibration Verification (ICV), Initial Calibration Blank (ICB), Continuing Calibration Verification (CCV), and Continuing Calibration Blank (CCB). Note that the following are all defined as analytical samples: undiluted and diluted samples (USEPA and non-USEPA); Matrix Spike samples; duplicate samples; serial dilution samples, analytical (post-digestion/post-distillation) spike samples; Interference Check Samples (ICSs); Contract Required Quantitation Limit (CRQL) Check Standards (CRIs); Laboratory Fortified Blanks (LFBs); Laboratory Control Samples (LCSs); Preparation Blanks (PBs), and Linear Range Samples (LRSs).

**Associated Samples** -- Any sample related to a particular Quality Control (QC) analysis. For example, for Initial Calibration Verification (ICV), all samples run under the same calibration curve. For duplicates, all Sample Delivery Group (SDG) samples digested/distilled of the same matrix.

**Blank** -- A sample designed to assess specific sources of contamination. See individual definitions for types of blanks.

**Calibration** -- The establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristic of known standards. The calibration standards are to be prepared using the same type of reagents or concentration of acids as used in the sample preparation.

**Calibration Blank** -- A blank solution containing all of the reagents in the same concentration as those used in the analytical sample preparation. This blank is not subject to the preparation method.

**Calibration Curve** -- A plot of instrument response versus concentration of standards.

**Calibration Standards** -- A series of known standard solutions used by the analyst for calibration of the instrument (i.e., preparation of the analytical curve). The solutions may or may not be subjected to the preparation method, but contain the same matrix (i.e., the same amount of reagents and/or preservatives) as the sample preparations to be analyzed.

**Case** -- A finite, usually predetermined number of samples collected over a given time period from a particular site. Case numbers are assigned by the Sample Management Office (SMO). A Case consists of one or more Sample Delivery Groups (SDGs).

**Continuing Calibration Blank (CCB)** -- A reagent water sample that is run every ten samples and designed to detect any carryover contamination.

**Contract Compliance Screening (CCS)** -- A screening of electronic and hardcopy data deliverables for completeness and compliance with the contract. This screening is performed under USEPA direction by the Contract Laboratory Program (CLP) Sample Management Office (SMO) contractor.

**Continuing Calibration Verification (CCV)** -- A single parameter or multi-parameter standard solution prepared by the analyst and used to verify the stability of the instrument calibration with time, and the

instrument performance during the analysis of samples. The CCV can be one of the calibration standards. However, all parameters being measured by the particular system must be represented in this standard and the standard must have the same matrix (i.e., the same amount of reagents and/or preservatives) as the samples. The CCV should have a concentration in the middle of the calibration range and shall be run every 10 analytical samples or every two hours, whichever is more frequent.

**Contract Laboratory Program (CLP)** -- Supports the USEPA's Superfund effort by providing a range of state-of-the-art chemical analytical services of known quality. This program is directed by the Analytical Operations/Data Quality Center (AOC) of the Office of Emergency and Remedial Response (OERR) of USEPA.

**Contract Laboratory Program Project Officer (CLP PO)** -- The Regional USEPA official responsible for monitoring Laboratory performance and/or requesting analytical data or services from a CLP Laboratory.

**Contract Required Quantitation Limit (CRQL)** -- Minimum level of quantitation acceptable under the contract Statement of Work (SOW).

**CRQL Check Standard (CRI)** -- A single parameter or multi-parameter standard solution prepared at the Contract Required Quantitation Limit (CRQL) and used to verify the instrument calibration at low levels.

**Duplicate** -- A second aliquot of a sample that is treated the same as the original sample in order to determine the precision of the method.

**Field Blank** -- Any sample that is submitted from the field and identified as a blank. A field blank is used to check for cross-contamination during sample collection, sample shipment, and in the Laboratory. A field blank includes trip blanks, rinsate blanks, bottle blanks, equipment blanks, preservative blanks, decontamination blanks, etc.

**Field Duplicate** -- A duplicate sample generated in the field, not in the Laboratory.

**Holding Time** -- The maximum amount of time samples may be held before they are processed.

> **Contractual** -- The maximum amount of time that the Contract Laboratory Program (CLP) Laboratory may hold the samples from the sample receipt date until analysis and still be in compliance with the terms of the contract, as specified in the CLP Analytical Services Statement of Work (SOW). These times are the same or less than technical holding times to allow for sample packaging and shipping.
>
> **Technical** -- The maximum amount of time that samples may be held from the collection date until analysis.

**Initial Calibration** -- Analysis of analytical standards for a series of different specified concentrations to define the quantitative response, linearity, and dynamic range of the instrument to target analytes.

**Initial Calibration Blank (ICB)** -- The first blank standard run to confirm the calibration curve.

**Initial Calibration Verification (ICV)** -- Solution(s) prepared from stock standard solutions, metals, or salts obtained from a source separate from that utilized to prepare the calibration standards. The ICV is used to verify the concentration of the calibration standards and the adequacy of the instrument

calibration. The ICV should be traceable to National Institute of Standards and Technology (NIST) or other certified standard sources when USEPA ICV solutions are not available.

**Internal Standard** -- A non-target element added to a sample at a known concentration after preparation but prior to analysis. Instrument responses to internal standards are monitored as a means of assessing overall instrument performance.

**Interference Check Sample (ICS)** -- Verifies the contract Laboratory's ability to overcome interferences typical of those found in samples.

**Laboratory Control Sample (LCS)** -- A control sample of known composition. LCSs are processed using the same sample preparation, reagents, and analytical methods employed for the USEPA samples received.

**Linear Range, Linear Dynamic Range** -- The concentration range over which the instrument response remains linear.

**Matrix** -- The predominant material of which the sample to be analyzed is composed. For the purposes of this document, the matrices are water and soil.

**Matrix Spike** -- Introduction of a known concentration of analyte into a sample to provide information about the effect of the sample matrix on the digestion and measurement methodology (also identified as a pre-distillation/digestion spike).

**Method Detection Limit (MDL)** -- The concentration of a target parameter that, when a sample is processed through the complete method, produces a signal with 99% probability that it is different from the blank. For seven replicates of the sample, the mean value must be 3.14s above the blank, where "s" is the standard deviation of the seven replicates.

**Narrative (SDG Narrative)** -- Portion of the data package which includes Laboratory, contract, Case, Sample Number identification, and descriptive documentation of any problems encountered in processing the samples, along with corrective action taken and problem resolution.

**Office of Solid Waste and Emergency Response (OSWER)** – The USEPA office that provides policy, guidance, and direction for the USEPA's solid waste and emergency response programs, including Superfund.

**Percent Difference (%D)** -- As used in this document and the Statement of Work (SOW), is used to compare two values. The difference between the two values divided by one of the values.

**Performance Evaluation (PE) Sample** -- A sample of known composition provided by USEPA for contractor analysis. Used by USEPA to evaluate Contractor performance.

**Post Digestion Spike** -- The addition of a known amount of standard after digestion or distillation (also identified as an analytical spike).

**Preparation Blank** -- An analytical control that contains reagent water and reagents, which is carried through the entire preparation and analytical procedure.

**Relative Percent Difference (RPD)** -- As used in this document and the Statement of Work (SOW) to compare two values, the RPD is based on the mean of the two values, and is reported as an absolute value (i.e., always expressed as a positive number or zero).

**Regional Sample Control Center (RSCC)** -- In USEPA Regions, coordinates sampling efforts and serves as the central point-of-contact for sampling questions and problems. Also assists in coordinating the level of Regional sampling activities to correspond with the monthly projected demand for analytical services.

**Relative Standard Deviation (RSD)** -- As used in this document and the Statement of Work (SOW), the mean divided by the standard deviation, expressed as a percentage.

**Sample** -- A single, discrete portion of material to be analyzed, which is contained in single or multiple containers and identified by a unique Sample Number.

**Sample Delivery Group (SDG)** -- A unit within a sample Case that is used to identify a group of samples for delivery. An SDG is defined by the following, whichever is most frequent:

a. Each Case of field samples received; or
b. Each 20 field samples [excluding Performance Evaluation (PE) samples] within a Case; or
c. Each 7 calendar day period (3 calendar day period for 7-day turnaround) during which field samples in a Case are received (said period beginning with the receipt of the first sample in the SDG).

In addition, all samples and/or sample fractions assigned to an SDG must be scheduled under the same contractual turnaround time. Preliminary Results have **no impact** on defining the SDG. Samples may be assigned to SDGs by matrix (i.e., all soil samples in one SDG, all water samples in another) at the discretion of the Laboratory.

**Sample Management Office (SMO)** -- A contractor-operated facility operated under the SMO contract, awarded and administered by the USEPA. Provides necessary management, operations, and administrative support to the Contract Laboratory Program (CLP).

**Serial Dilution** -- The dilution of a sample by a factor of five. When corrected by the Dilution Factor (DF), the diluted sample must agree with the original undiluted sample within specified limits. Serial dilution may reflect the influence of interferents [Inductively Coupled Plasma (ICP) only].

**Statement of Work (SOW)** -- A document which specifies how Laboratories analyze samples under a particular Contract Laboratory Program (CLP) analytical program.

**Tune** -- Analysis of a solution containing a range of isotope masses to establish Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) mass-scale accuracy, mass resolution, and precision prior to calibration.

# APPENDIX B:
# INORGANIC DATA REVIEW SUMMARY

CASE NO._____ SITE_____

LABORATORY_____ NO. OF SAMPLES/MATRIX_____

SDG NO._____ SOW NO._____ REGION_____

REVIEWER NAME_____ COMPLETION DATE_____

CLP PO: ACTION_____ FYI_____

| REVIEW CRITERIA | METHOD/ANALYTE | | | |
|---|---|---|---|---|
| | ICP-AES | ICP-MS | Mercury | Cyanide |
| 1. Preservation/Holding Time | _____ | _____ | _____ | _____ |
| 2. Calibration | _____ | _____ | _____ | _____ |
| 3. Blanks | _____ | _____ | _____ | _____ |
| 4. Interference Check Sample | _____ | _____ | | |
| 5. Laboratory Control Sample | _____ | _____ | _____ | _____ |
| 6. Duplicate Sample Analysis | _____ | _____ | _____ | _____ |
| 7. Spike Sample Analysis | _____ | _____ | _____ | _____ |
| 8. ICP Serial Dilution | _____ | _____ | | |
| 9 ICP-MS Tune Analysis | | _____ | | |
| 10. ICP-MS Internal Standards | | _____ | | |
| 11. Field Duplicates | _____ | _____ | _____ | _____ |
| 12. Overall Assessment | _____ | _____ | _____ | _____ |

United States
Environmental Protection
Agency

Office of Water
Office of Science and Technology
(4304T)

EPA-822-R-02-047
November 2002

# National Recommended Water Quality Criteria: 2002

# NOTICE

This document has been reviewed by the Health and Ecological Criteria Division, Office of Science and Technology, U.S. Environmental Protection Agency, and approved for publication.

## CONTENTS

NOTICE . . . . . i

CONTENTS . . . . . ii

I Introduction . . . . . 1

II What is in this Updated Compilation? . . . . . 1

III What is the Relationship Between These Criteria and Your State or Tribal Water Quality Standards? . . . . . 2

IV What is the Status of Existing Recommended Criteria While They Are Under Revision? . . 3

V What's New in the Compilation? . . . . . 3
- Human Health Criteria . . . . . 3
  - Revised Human Health Criteria . . . . . 3
  - Methylmercury . . . . . 5
  - Dioxin . . . . . 5
- Aquatic Life Criteria . . . . . 6
  - Revised Definition of Total PCBs for Aquatic Life Criteria . . . . . 6
  - Saltwater Dissolved Oxygen (Cape Cod to Cape Hatteras) . . . . . 6
  - Freshwater Aquatic Life Criteria for Ammonia . . . . . 7
  - Cadmium . . . . . 7
  - Guidance on the Calculation of Hardness-Dependent Metals Criteria . . . . . 7
  - National Guidance on the Applicability of Freshwater and Saltwater Criteria . . . 9
- Nutrient Criteria . . . . . 9

VI Comments on the December 10, 1998 National Recommended Water Quality Criteria Compilation . . . . . 10

VII Where Can I Find More Information About Water Quality Criteria and Water Quality Standards? . . . . . 10

VIII What Are the National Recommended Water Quality Criteria? . . . . . 11

General Notes . . . . . 29

Appendices . . . . . 31
- Appendix A - Conversion Factors for Dissolved Metals . . . . . 31
- Appendix B - Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent . . . . . 32
- Appendix C - Calculation of Freshwater Ammonia Criterion . . . . . 33

## I Introduction

The U.S. Environmental Protection Agency (EPA) is publishing an updated compilation of its national recommended water quality criteria for 158 pollutants, developed pursuant to section 304(a) of the Clean Water Act (CWA or the Act). Section 304(a)(1) of the Act requires EPA to develop and publish, and from time to time revise, criteria for water quality accurately reflecting the latest scientific knowledge. Water quality criteria developed under section 304(a) are based solely on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects. Section 304(a) criteria do not reflect consideration of economic impacts or the technological feasibility of meeting the chemical concentrations in ambient water.

The recommended water quality criteria contained in this document provide guidance for states and tribes authorized to establish water quality standards under the CWA to protect human health and aquatic life. Under the CWA, states and authorized tribes are to establish water quality standards to protect designated uses. Such standards are used in implementing a number of environmental programs, including setting discharge limits in National Pollutant Discharge Elimination System (NPDES) permits. While this document constitutes the EPA's guidance regarding ambient concentrations for various pollutants, this document does not substitute for the CWA or EPA's regulations; nor is it a regulation itself. Thus, it cannot impose legally binding requirements on the EPA, states, authorized tribes or the regulated community, and might not apply to a particular situation based upon the circumstances. State and tribal decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance when appropriate. The EPA may change this guidance in the future.

## II What is in this Updated Compilation?

EPA developed an updated compilation of its national recommended water quality criteria (NRWQC) for pollutants. The criteria in this document supercede any Clean Water Act (CWA) section 304(a) water quality criteria published in EPA's previous criteria compilations including: the "*Blue Book*," "*Red Book*," "*Gold Book*" and EPA's last compilation of national recommended water quality criteria published on December 10, 1998 (63 FR 68354 or *National Recommended Water Quality Criteria– Correction*, April 1999, EPA 822-Z-99-001). Many of the human health criteria in this compilation have been revised based on EPA's new methodology for deriving human health criteria *(See: Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (2000), EPA-822-B-00-004, October 2000). Water quality criteria contained in this document may be superceded by the publication of section 304(a) water quality criteria subsequent to the publication of this document.

This compilation is presented as a summary table containing EPA's water quality criteria for 158 pollutants. For each set of criteria, EPA lists a **Federal Register** citation, EPA document number or Integrated Risk Information System (IRIS) entry (www.epa.gov/iris/index.html). Information pertinent to the derivation of individual criteria may be found in the cited references or footnotes. Still, these references may not be a single complete source of information for the

criteria derivation. You may need to refer to more than one document for complete information. A calculation matrix that contains all of the components (e.g., cancer potency factors (q1*s), reference doses (RfDs) and bioconcentration factors (BCFs)) and formulas used to derive the human health criteria in the compilation is available at http://www.epa.gov/waterscience/criteria/. EPA does not have national recommended water quality criteria for pollutants with no criteria listed.

The national recommended water quality criteria include: previously published criteria that are unchanged, criteria that have been recalculated from earlier criteria (63 FR68354, 12/10/1998) and newly calculated criteria based on peer-reviewed assessments and data.

The Agency intends to revise this compilation of national recommended water quality criteria from time to time to keep states and authorized tribes informed as to the most current recommended section 304(a) water quality criteria.

## III What is the Relationship Between These Criteria and Your State or Tribal Water Quality Standards?

As part of the water quality standards triennial review process defined in Section 303(c)(1) of the CWA, the states and authorized tribes are responsible for maintaining and revising water quality standards. Water quality standards consist of designated uses, water quality criteria to protect those uses, a policy for antidegradation, and general policies for application and implementation. Section 303(c)(1) requires States and Tribes to review, and modify if appropriate, their water quality standards at least once every three years.

States and authorized tribes must adopt water quality criteria that protect designated uses. Protective criteria are based on a sound scientific rationale and contain sufficient parameters or constituents to protect the designated uses. Criteria may be expressed in either narrative or numeric form. States and authorized tribes have four options when adopting water quality criteria for which EPA has published section 304(a) criteria. They can: (1) establish numerical values based on recommended section 304(a) criteria; (2) adopt section 304(a) criteria modified to reflect site-specific conditions; (3) adopt criteria derived using other scientifically defensible methods; or (4) establish narrative criteria where numeric criteria cannot be determined (40 CFR 131.11).

Consistent with 40 CFR131.21 (See: *EPA Review and Approval of State and Tribal Water Quality Standards* (65 FR 24641, April 27, 2000)), water quality criteria adopted by law or regulation by States and Tribes prior to May 30, 2000, are in effect for CWA purposes unless superseded by federal regulations (see, for example, the *National Toxics Rule*, 40 CFR 131.36; *Water Quality Standards for Idaho*, 40 CFR 131.33). New or revised water quality criteria adopted into law or regulation by States and Tribes on or after May 30, 2000 are in effect for CWA purposes only after EPA approval.

## IV What is the Status of Existing Recommended Criteria While They Are Under Revision?

Water quality criteria published by EPA remain the Agency's recommended water quality criteria until EPA revises or withdraws the criteria. For example, while undertaking recent reassessments of certain chemicals, EPA has consistently supported the use of the existing section 304(a) criteria for these chemicals and considers them to be scientifically sound until the Agency reevaluates the 304(a) criteria, subjects the criteria to appropriate peer review, and subsequently publishes revised 304(a) criteria.

## V What's New in the Compilation?

### Human Health Criteria

Revised Human Health Criteria

EPA revised the methodology it uses to develop water quality criteria for protection of human health. The revised methodology entitled, *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (2000) (EPA-822-B-00-004, October 2000) and a **Federal Register** notice (65 FR 66443, 11/3/2000) both describe the Agency's current approach for deriving national recommended water quality criteria to protect human health.

EPA has revised many of the human health criteria in the compilation based on this new methodology. By and large, these represent partial updates of the 304(a) criteria as described in both the draft Methodology revisions and the **Federal Register** notice that accompanied the final Methodology (65 FR 66443). EPA received much support for revising criteria based on partially updated components of the criteria equations as a way of increasing the frequency of scientific improvements to the nationally recommended criteria that currently available information would allow. For a water quality criterion revision based on a partial update to be considered acceptable to EPA, a component of the criterion (e.g., the toxicological risk assessment) would need to be comprehensive (e.g., a new or revised RfD or cancer dose-response assessment, as opposed to simply a new scaling factor), should stand alone and be based on new national or local data. These recalculations of water quality criteria integrate an updated national default freshwater/estuarine fish consumption rate (17.5 g/day) and, in some cases, previously determined relative source contribution (RSC) values obtained from primary drinking water standards as well as new cancer potency information from the Agency's Integrated Risk Information System (IRIS).

EPA has not revised the human health criteria in today's compilation to include bioaccumulation factors (BAFs) based on the 2000 Methodology. The BAF component of criteria development is comparatively time- and resource-intensive. As previously indicated, EPA received support for partial updates rather than waiting a substantially longer period of time for BAFs to be developed. EPA also received support for the idea of not automatically developing BAFs for all of the currently published criteria, but rather revising criteria for

pollutants of high priority and national importance. EPA intends to focus its limited resources on developing BAFs for pollutants that the Agency considers highest priority in terms of toxicological concern, frequency of occurrence and bioaccumulation potential. EPA is in the process of determining candidate pollutants for BAF derivations. The human health criteria were developed with BCFs or field-measured BAFs previously developed using the 1980 Methodology. The BCFs used in deriving these criteria are consistent with BCFs used in promulgating human health criteria for priority toxic pollutants in rules such as the 1992 *National Toxics Rule* and the 2000 *California Toxics Rule*.

Not all of EPA's national recommended water quality criteria for protection of human health were revised in this compilation. Criteria currently undergoing major reassessments, such as arsenic, chloroform and nickel, were not revised at this time. Water quality criteria that predate EPA's 1980 human health methodology were not revised for this effort. EPA believes revisions for these criteria, which include barium, 2,4-D and 2,4,5-TP, iron, manganese, methoxychlor, nitrates and solids (dissolved) and salinity may warrant major reassessments. Updated IRIS information and/or RSC values are available for vinyl chloride, 1,1-dichloroethylene, 1,3-dichloropropene, thallium, chlorobenzene, cyanide, ethylbenzene, toluene, 1,2-trans-dichloroethylene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, hexachlorocyclopentadiene, 1,2,4-trichlorobenzene, Lindane and Endrin. Yet, EPA did not update the criteria for the preceeding 15 chemicals in this document. EPA intends to publish revisions for the aformentioned chemicals in a separate **Federal Register** notice, soliciting scientific views regarding these revisions.

New IRIS information was available and incorporated for benzene. EPA revised the criteria for benzene based on the new cancer slope factors, which are presented in IRIS as a range. The set of risk estimates falling within this interval reflects both the inherent uncertainties in the risk assessment of benzene and the limitations of the epidemiological studies in determining dose-response and exposure data. EPA modeled the unit risk values for the carcinogenicity of benzene from epidemiological data on occupationally exposed humans. The unit risk is expressed as a range rather than a single value because in the case of this particular pollutant there is no scientific basis for choosing a single result from various model estimates. (See IRIS Benzene CASRN 71-43-2 (01/19/2000) at: www.epa.gov/iris/subst/0276.htm). The resulting ranges of criteria for protection of human health from consumption of water and organisms and consumption of organisms only are 0.61- 2.2 ug/L and 14- 51 ug/L, respectively. The Agency calculated the criteria as ranges, but is recommending the use of the upper limits in the criteria table. EPA considers any criterion in each range scientifically defensible, yet only the upper limit of each range is presented to establish the upper bound of the average ambient concentration that should not be exceeded.

For copper and asbestos, the Agency chose to base the section 304(a) water quality criteria on the Agency's drinking water maximum contaminant levels (MCLs) or action levels which are established on drinking water regulation methodologies.

A notice of intent to revise or develop human health criteria for arsenic, methylmercury and carbofuran was published in the **Federal Register** on October 12, 2000 (65 FR 60664). This

notice informed the public that EPA was in the process of revising or developing criteria for these pollutants and solicited any significant scientific information the public may be aware of that was not identified in EPA's literature search. A human health criterion for methylmercury is now available. Work is ongoing for arsenic and carbofuran.

Methylmercury

On January 8, 2001, EPA announced the availability of a recommended water quality criterion for methylmercury (66 FR 1344). In the January 8, 2001 notice, EPA withdrew its previous ambient human health water quality criteria for mercury (see 63 FR 68354, December 10, 1998; correction in 64 FR 19781, April 22, 1999) as the recommended section 304(a) water quality criteria. This updated compilation contains the new methylmercury criterion. This new water quality criterion describes the concentration of methylmercury in freshwater and estuarine fish and shellfish tissue that should not be exceeded to protect consumers of fish and shellfish among the general population. EPA expects the criterion recommendation to be used as guidance by states, tribes, and EPA in establishing or updating water quality standards for waters of the United States and in issuing fish and shellfish consumption advisories. This is the first time EPA has issued a water quality criterion expressed as a fish and shellfish tissue value rather than as a water column value. This approach is a direct consequence of the scientific consensus that consumption of contaminated fish and shellfish is the primary human route of exposure to methylmercury. EPA recognizes that this approach differs from traditional water column criteria, and will pose implementation challenges. In the January 8, 2001 notice EPA provided suggested approaches for relating the fish and shellfish tissue criterion to concentrations of methylmercury in the water column. EPA also plans to develop more detailed guidance to assist states and authorized tribes with implementation of the methylmercury criterion in water quality standards and related programs.

Dioxin

The section 304(a) water quality criteria for dioxin contained in this compilation is expressed in terms of 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD) and should be used in conjunction with the national/international convention of toxicity equivalence factors (TEF/TEQs) to account for the additive effects of other dioxin-like compounds (dioxins). EPA supports the use of either the 1989 interim procedures or the 1998 World Health Organization (WHO) TEF scheme, but prefers the 1998 WHO TEF scheme because it is based on more recent data and is internationally accepted. (See: *Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -dibenzofurans*, EPA/625/3-89/016, March 1989 and Van den Berg M., 1998). By applying the TEF/TEQ approach, the other highly toxic dioxins will be properly taken into account.

## Aquatic Life Criteria

Revised Definition of Total PCBs for Aquatic Life Criteria

The aquatic life criteria for Polychlorinated Biphenyls (PCBs) in this compilation apply to total PCBs. The definition of total PCBs is the sum of all homolog, all isomer, all congener, or all Aroclor analyses. The aquatic life criteria contained in the previous publication of the NRWQC (63 FR 68354, 12/10/1998) were based on total PCB concentrations, but the definition of total PCBs only applied to the sum of seven particular Aroclors (1242, 1254, 1221, 1232, 1248, 1260 and 1016, CAS numbers 53469219, 11097691, 11104282, 11141165, 12672296, 11096825, and 12674112, respectively). This revision of the aquatic life criteria harmonizes the total PCB definition with that used for EPA's human health criteria for PCBs.

Saltwater Dissolved Oxygen (Cape Cod to Cape Hatteras)

This new compilation of NRWQC contains saltwater criteria for dissolved oxygen (D.O.). EPA's new water quality criteria are the result of a 10-year research effort to produce sufficient information to support their development. The water quality criteria presented today represent EPA's best estimates, based on the data available, of D.O. concentrations necessary to protect aquatic life and uses associated with aquatic life.

EPA published saltwater criteria for dissolved oxygen because hypoxia (low dissolved oxygen) is a significant problem for certain coastal waters that receive runoff containing nutrients (e.g., nitrogen, phosphorous) and other oxygen demanding biological wastes. Excessive amounts of nutrients in aquatic systems stimulate algal growth which can deplete available dissolved oxygen required to maintain healthy fish and shellfish populations. EPA's Environmental Monitoring and Assessment Program (EMAP) for the estuaries in the Virginian Province (defined as Cape Cod to Cape Hatteras) has shown that 25% of the area of the Virginian Province exhibits dissolved oxygen concentrations of less than 5 mg/L. For many fish and shellfish, extended periods of D.O. below 5 mg/L can cause adverse effects to larval life stages. EMAP also has generated field observations that correlate many of the biologically degraded benthic areas with low dissolved oxygen in the lower water column. These two reports emphasize that hypoxia is a major concern within the Virginian Province, among other coastal locations of the United States.

The geographic scope of the saltwater dissolved oxygen water quality criteria are limited to coastal saltwaters of the Virginian Province of the Atlantic coast of the United States (i.e., southern Cape Cod, MA, to Cape Hatteras, NC). However, the saltwater dissolved oxygen criteria can be applied elsewhere if the species and data used to derive the criteria for the Virginia Province are applicable to location-specific biological, physical, and water quality conditions. EPA believes that the overall approach for deriving marine water quality criteria for D.O. contained in *Ambient Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* is applicable to regions outside the Virginian Province.

For additional information see: *Ambient Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* (EPA-822R-00-012).

Freshwater Aquatic Life Criteria for Ammonia

This compilation includes EPA's latest revision (*1999*) of the freshwater aquatic life criteria for ammonia. The new water quality criteria reflect research and data since 1984, including the pH and temperature relationship of the acute and chronic criteria and the averaging period of the chronic criterion. The revised acute criterion for ammonia is now dependent on pH and fish species, and the chronic criterion is dependent on pH and temperature. At lower temperatures, the chronic criterion incorporates the presence or absence of early life stages of fish. The temperature dependency results in a gradual increase in the criterion as temperature decreases. At temperatures below 15 °C the criterion is more stringent, when early life stages of fish are expected to be present. EPA's recommendations in the 1999 criteria represent a change from both the 1984 chronic ammonia criterion, which was dependent mainly on pH, and from the 1998 ammonia criteria, in which the chronic criterion was dependent on pH and the presence of early life stages of fish.

For additional information see: *1999 Update of Ambient Water Quality Criteria for Ammonia* (EPA-822-R-99-014).

Cadmium

EPA revised its aquatic life criteria for cadmium. A notice was published in the **Federal Register** (65 FR 50201, 8/17/2000) announcing the availability of the peer review draft and soliciting any significant scientific input from the public. EPA has addressed the peer review comments and significant issues raised by the public. A notice of availability for the completed document, entitled *2001 Update of Ambient Water Quality Criteria for Cadmium* (EPA-822-R-01-001) was published in the **Federal Register** on April 12, 2001 (66 FR18935).

Guidance on the Calculation of Hardness-Dependent Metals Criteria

Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness can affect the toxicities of these metals. Hardness is used as a surrogate for a number of water quality characteristics which affect the toxicity of metals. Increasing hardness has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness measured in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$).

Appendix B of this document presents the hardness-dependent equations for freshwater metals criteria. The specific values in the table are calculated at a hardness of 100 mg/L ($CaCO_3$) for illustrative purposes only. The hardness equations included in this compilation were developed based on results from laboratory toxicity tests that were conducted in fresh waters encompassing a range of hardness values. Although the amount of data and the strength of the

relationship vary for different metals, almost all data for hardness and toxicity are in the 20 to 400 mg/L hardness range.

In the past, EPA recommended that when the hardness of fresh surface water is less than 25 mg/L, 304(a) criteria concentrations be calculated as if the hardness is 25 mg/L. Available toxicity data in this range for copper, zinc and cadmium (EPA 440/5-84-031, EPA 440/5-87-003,and EPA-822-R-01-001) are somewhat limited, and are quite limited for silver, lead, chromium III and nickel (EPA 440/5-80-071, EPA 440/5-84-027,EPA 440/5-84-029 and EPA 440/5-86-004). Even fewer data are available below 20 mg/L hardness for copper, zinc and cadmium and none are available for silver, lead, chromium III and nickel. EPA evaluated these limited data, available in the current metals' criteria documents, and determined that they are inconclusive. Capping hardness at 25 mg/L without additional data or justification may result in criteria that provide less protection than that intended by EPA's *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (EPA 822/R-85-100) or "the Guidelines." Therefore, EPA now recommends that hardness not be capped at 25 mg/L, or any other hardness on the low end. If there is a state or tribal regulatory requirement that hardness be capped at 25 mg/L, or if there are any situation-specific questions about the applicability of the hardness-toxicity relationship, a Water Effect Ratio (WER) procedure should be used to provide the level of protection intended by the Guidelines. When an ambient hardness of less than 25 mg/L is used to establish criteria for lead or cadmium, the hardness dependent Conversion Factor (CF) should not exceed one.

For hardness over 400 mg/L, EPA recommends two options: (1) calculate the criterion using a default WER of 1.0 and using a hardness of 400 mg/L in the hardness equation; or (2) calculate the criterion using a WER and the actual ambient hardness of the surface water in the equation. The second option is expected to result in the level of protection intended in the Guidelines whereas the first option is thought to result in an even more protective aquatic life criterion. At high hardness there is an indication that hardness and related inorganic water quality characteristics do not have as much of an effect on toxicity of metals as they do at lower hardnesses. Related water quality characteristics do not correlate as well at higher hardnesses as they do at lower hardnesses. There is also increased uncertainty in this range because very limited data are available to clearly quantify the relationship between hardness and toxicity. Therefore, if hardness is over 400 mg/L as $CaCO_3$, EPA continues to recommend that a hardness of 400 mg/L be used with a default WER of 1.0; alternatively, the WER and actual hardness of the surface water may be used.

Where applicable water quality standards require the use of a default hardness (e.g., 25 mg/L) to calculate a criterion, states and authorized tribes should use the WER procedure to adjust that criterion so that it provides the level of protection intended by the Guidelines. As the WER is inherently a site-specific procedure, any WER developed for a given site would be applicable only for that site unless its applicability at other sites is demonstrated. In any case, states and authorized tribes electing to use the WER Guidance should ensure that their water quality standards provide for them. Consistent with the "Performance-Based Approach" discussed in detail in EPA's recent modification of its implementing regulations at 40 CFR

131.21 (See 65 FR 24641, April 27, 2000), EPA encourages states and authorized tribes to identify all opportunities for adoption, and EPA approval of, such site-specific criteria. A performance-based approach relies on the adoption of a standard method or process (e.g., WER procedures) into state or tribal water quality standards, rather than adoption of a specific outcome (e.g., a site-specific criterion). When such an approach is sufficiently detailed and has suitable safeguards to ensure predictable, repeatable outcomes, EPA approval of the approach can serve as approval of the outcomes as well.

National Guidance on the Applicability of Freshwater and Saltwater Criteria

EPA recommends that the aquatic life criteria in this compilation apply as follows:

(1) For water in which the salinity is equal to or less than 1 part per thousand 95% or more of the time, the applicable criteria are the freshwater criteria.

(2) For water in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the time, the applicable criteria are the saltwater criteria in Column C; and

(3) For water in which the salinity is between 1 and 10 parts per thousand the applicable criteria are the more stringent of the freshwater or saltwater criteria, as described in items (1) and (2) of this section. However, an alternative freshwater or saltwater criteria may be used if scientifically defensible information and data demonstrate that on a site-specific basis the biology of the water body is dominated by freshwater aquatic life and that freshwater criteria are more appropriate; or conversely, the biology of the water body is dominated by saltwater aquatic life and that saltwater criteria are more appropriate.

**Nutrient Criteria**

EPA recently developed section 304(a) water quality criteria for nutrients because excessive levels of nutrients are a major cause of the nonattainment of designated uses and more scientific information is needed to evaluate and address these conditions. Availability of these nutrient criteria recommendations was announced in the **Federal Register** on January 9, 2001 (66 FR1671). EPA's nutrient criteria will cover four major types of waterbodies: lakes and reservoirs, rivers and streams, estuarine and coastal areas, and wetlands across 14 major ecoregions of the United States. EPA's section 304(a) criteria are intended to provide for the protection and propagation of aquatic life and recreation. To support the development of the nutrient criteria, EPA published Technical Guidance Manuals that describe a process for assessing nutrient conditions in the four waterbody types. (For example See: *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs*, April 2000; *Nutrient Criteria Technical Guidance Manual; Rivers and Streams*, July 2000; *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters*, October 2001). This information is intended to serve as a starting point for the states, authorized tribes and others to develop more refined

nutrient criteria, as appropriate, using EPA waterbody-specific technical guidance manuals and other scientifically defensible approaches.

In cases where no new ecoregional nutrient criteria are available, the phosphate phosphorus information presented in the Gold Book (*Quality Criteria for Water:1986*, EPA 440/5-86-001) may still be applicable. The phosphate phosphorus information in the Gold Book address eutrophication in freshwater systems on a national basis without any consideration of regional differences that may occur. The new ecoregional nutrient criteria recommendations reflect regional differences in eutrophication for different water body types and ecological conditions. The criteria in the compilation for elemental phosphorus is based on the toxic effects of phosphorus to aquatic organisms and is not intended to prevent eutrophication.

## VI Comments on the December 10, 1998 National Recommended Water Quality Criteria Compilation

When the national recommended water quality criteria compilation was published in 1998, the Agency requested comment and observations on the compilation format and on the revised criteria development process. No comments were received on the format or process. Comments were, however, received on specific criteria and errors in formulas. The comments stated that certain criteria did not reflect the latest scientific knowledge and also that some criteria were derived based on data where an improper form of chemical was tested because of bioavailability issues. The errors in the formulas have been corrected. EPA does not agree that an improper form of the specified chemicals was tested.

## VII Where Can I Find More Information About Water Quality Criteria and Water Quality Standards?

For more information about water quality criteria and Water Quality Standards refer to the following: *Water Quality Standards Handbook* (EPA 823-B94-005a); *Advanced Notice of Proposed Rule Making (ANPRM)*, (63FR36742); *Draft Strategy for Water Quality Standards and Criteria: Strengthening the Foundation of Programs to Protect and Restore the Nation's Water (EPA-823-R-02-001, May 2002); Water Quality Criteria and Standards Plan -- Priorities for the Future* (EPA 822-R-98-003); *Guidelines and Methodologies Used in the Preparation of Health Effects Assessment Chapters of the Consent Decree Water Criteria Documents* (45FR79347); *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (2000), EPA-822-B-00-004, October 2000); *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (EPA 822/R-85-100); *National Strategy for the Development of Regional Nutrient Criteria* (EPA 822-R-98-002); and *EPA Review and Approval of State and Tribal Water Quality Standards* (65FR24641).

These publications may also be accessed through EPA's National Service Center for Environmental Publications (NSCEP, previously NCEPI) or on the Office of Science and Technology's Homepage (www.epa.gov/OST).

## VIII What Are the National Recommended Water Quality Criteria?

The following compilation and its associated footnotes and notes presents the EPA's latest national recommended water quality criteria.

## NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY TOXIC POLLUTANTS

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Antimony | 7440360 | | | | | 5.6 B | 640 B | 65FR66443 |
| 2 | Arsenic | 7440382 | 340 A,D,K | 150 A,D,K | 69 A,D,bb | 36 A,D,bb | 0.018 C,M,S | 0.14 C,M,S | 65FR31682<br>57FR60848 |
| 3 | Beryllium | 7440417 | | | | | Z | | 65FR31682 |
| 4 | Cadmium | 7440439 | 2.0 D,E,K,bb | 0.25 D,E,K,bb | 40 D,bb | 8.8 D,bb | Z | | EPA-822-R-01-001<br>65FR31682 |
| 5a | Chromium (III) | 16065831 | 570 D,E,K | 74 D,E,K | | | Z Total | | EPA820/B-96-001<br>65FR31682 |
| 5b | Chromium (VI) | 18540299 | 16 D,K | 11 D,K | 1,100 D,bb | 50 D,bb | Z Total | | 65FR31682 |
| 6 | Copper | 7440508 | 13 D,E,K,cc | 9.0 D,E,K,cc | 4.8 D,cc,ff | 3.1 D,cc,ff | 1,300 U | | 65FR31682 |
| 7 | Lead | 7439921 | 65 D,E,bb,gg | 2.5 D,E,bb,gg | 210 D,bb | 8.1 D,bb | | | 65FR31682 |
| 8a | Mercury | 7439976 | 1.4 D,K,hh | 0.77 D,K,hh | 1.8 D,ee,hh | 0.94 D,ee,hh | | | 62FR42160 |
| 8b | Methylmercury | 22967926 | | | | | | 0.3 mg/kg J | EPA823-R-01-001 |
| 9 | Nickel | 7440020 | 470 D,E,K | 52 D,E,K | 74 D,bb | 8.2 D,bb | 610 B | 4,600 B | 65FR31682 |
| 10 | Selenium | 7782492 | L,R,T | 5.0 T | 290 D,bb,dd | 71 D,bb,dd | 170 Z | 4200 | 62FR42160<br>65FR31682<br>65FR66443 |
| 11 | Silver | 7440224 | 3.2 D,E,G | | 1.9 D,G | | | | 65FR31682 |
| 12 | Thallium | 7440280 | | | | | 1.7 B | 6.3 B | 65FR31682 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 13 | Zinc | 7440666 | 120 D,E,K | 120 D,E,K | 90 D,bb | 81 D,bb | 7,400 U | 26,000 U | 65FR31682 65FR66443 |
| 14 | Cyanide | 57125 | 22 K,Q | 5.2 K,Q | 1 Q,bb | 1 Q,bb | 700 B | 220,000 B,H | EPA820/B-96-001 57FR60848 |
| 15 | Asbestos | 1332214 | | | | | 7 million fibers/L I | | 57FR60848 |
| 16 | 2,3,7,8-TCDD (Dioxin) | 1746016 | | | | | 5.0E-9 C | 5.1E-9 C | 65FR66443 |
| 17 | Acrolein | 107028 | | | | | 190 | 290 | 65FR66443 |
| 18 | Acrylonitrile | 107131 | | | | | 0.051 B,C | 0.25 B,C | 65FR66443 |
| 19 | Benzene | 71432 | | | | | 2.2 B,C | 51 B,C | IRIS 01/19/00 &65FR66443 |
| 20 | Bromoform | 75252 | | | | | 4.3 B,C | 140 B,C | 65FR66443 |
| 21 | Carbon Tetrachloride | 56235 | | | | | 0.23 B,C | 1.6 B,C | 65FR66443 |
| 22 | Chlorobenzene | 108907 | | | | | 680 B,Z,U, | 21,000 B,H,U | 65FR31682 |
| 23 | Chlorodibromomethane | 124481 | | | | | 0.40 B,C | 13 B,C | 65FR66443 |
| 24 | Chloroethane | 75003 | | | | | | | |
| 25 | 2-Chloroethylvinyl Ether | 110758 | | | | | | | |
| 26 | Chloroform | 67663 | | | | | 5.7 C,P | 470 C,P | 62FR42160 |
| 27 | Dichlorobromomethane | 75274 | | | | | 0.55 B,C | 17 B,C | 65FR66443 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 28 | 1,1-Dichloroethane | 75343 | | | | | | | |
| 29 | 1,2-Dichloroethane | 107062 | | | | | 0.38 B,C | 37 B,C | 65FR66443 |
| 30 | 1,1-Dichloroethylene | 75354 | | | | | 0.057 C | 3.2 C | 65FR66443 |
| 31 | 1,2-Dichloropropane | 78875 | | | | | 0.50 B,C | 15 B,C | 65FR66443 |
| 32 | 1,3-Dichloropropene | 542756 | | | | | 10 | 1,700 | 57FR60848 |
| 33 | Ethylbenzene | 100414 | | | | | 3,100 B | 29,000 B | 65FR31682 |
| 34 | Methyl Bromide | 74839 | | | | | 47 B | 1,500 B | 65FR66443 |
| 35 | Methyl Chloride | 74873 | | | | | | | 65FR31682 |
| 36 | Methylene Chloride | 75092 | | | | | 4.6 B,C | 590 B,C | 65FR66443 |
| 37 | 1,1,2,2-Tetrachloroethane | 79345 | | | | | 0.17 B,C | 4.0 B,C | 65FR66443 |
| 38 | Tetrachloroethylene | 127184 | | | | | 0.69 C | 3.3 C | 65FR66443 |
| 39 | Toluene | 108883 | | | | | 6,800 B,Z | 200,000 B | 65FR31682 |
| 40 | 1,2-Trans-Dichloroethylene | 156605 | | | | | 700 B,Z | 140,000 B | 65FR31682 |
| 41 | 1,1,1-Trichloroethane | 71556 | | | | | Z | | 65FR31682 |
| 42 | 1,1,2-Trichloroethane | 79005 | | | | | 0.59 B,C | 16 B,C | 65FR66443 |
| 43 | Trichloroethylene | 79016 | | | | | 2.5 C | 30 C | 65FR66443 |
| 44 | Vinyl Chloride | 75014 | | | | | 2.0 C | 530 C | 57FR60848 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 45 | 2-Chlorophenol | 95578 | | | | | 81 B,U | 150 B,U | 65FR66443 |
| 46 | 2,4-Dichlorophenol | 120832 | | | | | 77 B,U | 290 B,U | 65FR66443 |
| 47 | 2,4-Dimethylphenol | 105679 | | | | | 380 B | 850 B,U | 65FR66443 |
| 48 | 2-Methyl-4,6-Dinitrophenol | 534521 | | | | | 13 | 280 | 65FR66443 |
| 49 | 2,4-Dinitrophenol | 51285 | | | | | 69 B | 5,300 B | 65FR66443 |
| 50 | 2-Nitrophenol | 88755 | | | | | | | |
| 51 | 4-Nitrophenol | 100027 | | | | | | | |
| 52 | 3-Methyl-4-Chlorophenol | 59507 | | | | | U | U | |
| 53 | Pentachlorophenol | 87865 | 19 F,K | 15 F,K | 13 bb | 7.9 bb | | | 65FR31682 |
| | | | | | | | 0.27 B,C | 3.0 B,C,H | 65FR66443 |
| 54 | Phenol | 108952 | | | | | 21,000 B,U | 1,700,000 B,U | 65FR66443 |
| 55 | 2,4,6-Trichlorophenol | 88062 | | | | | 1.4 B,C | 2.4 B,C,U | 65FR66443 |
| 56 | Acenaphthene | 83329 | | | | | 670 B,U | 990 B,U | 65FR66443 |
| 57 | Acenaphthylene | 208968 | | | | | | | |
| 58 | Anthracene | 120127 | | | | | 8,300 B | 40,000 B | 65FR66443 |
| 59 | Benzidine | 92875 | | | | | 0.000086 B,C | 0.00020 B,C | 65FR66443 |
| 60 | Benzo(a)Anthracene | 56553 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |
| 61 | Benzo(a)Pyrene | 50328 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 62 | Benzo(b)Fluoranthene | 205992 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |
| 63 | Benzo(ghi)Perylene | 191242 | | | | | | | |
| 64 | Benzo(k)Fluoranthene | 207089 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |
| 65 | Bis(2-Chloroethoxy)Methane | 111911 | | | | | | | |
| 66 | Bis(2-Chloroethyl)Ether | 111444 | | | | | 0.030 B,C | 0.53 B,C | 65FR66443 |
| 67 | Bis(2-Chloroisopropyl)Ether | 108601 | | | | | 1,400 B | 65,000 B | 65FR66443 |
| 68 | Bis(2-Ethylhexyl)Phthalate[X] | 117817 | | | | | 1.2 B,C | 2.2 B,C | 65FR66443 |
| 69 | 4-Bromophenyl Phenyl Ether | 101553 | | | | | | | |
| 70 | Butylbenzyl Phthalate[W] | 85687 | | | | | 1,500 B | 1,900 B | 65FR66443 |
| 71 | 2-Chloronaphthalene | 91587 | | | | | 1,000 B | 1,600 B | 65FR66443 |
| 72 | 4-Chlorophenyl Phenyl Ether | 7005723 | | | | | | | |
| 73 | Chrysene | 218019 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |
| 74 | Dibenzo(a,h)Anthracene | 53703 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |
| 75 | 1,2-Dichlorobenzene | 95501 | | | | | 2,700 B | 17,000 B | 65FR31682 |
| 76 | 1,3-Dichlorobenzene | 541731 | | | | | 320 | 960 | 65FR66443 |
| 77 | 1,4-Dichlorobenzene | 106467 | | | | | 400 Z | 2,600 | 65FR31682 |
| 78 | 3,3'-Dichlorobenzidine | 91941 | | | | | 0.021 B,C | 0.028 B,C | 65FR66443 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 79 | Diethyl Phthalate[W] | 84662 | | | | | 17,000 B | 44,000 B | 65FR66443 |
| 80 | Dimethyl Phthalate[W] | 131113 | | | | | 270,000 | 1,100,000 | 65FR66443 |
| 81 | Di-n-Butyl Phthalate[W] | 84742 | | | | | 2,000 B | 4,500 B | 65FR66443 |
| 82 | 2,4-Dinitrotoluene | 121142 | | | | | 0.11 C | 3.4 C | 65FR66443 |
| 83 | 2,6-Dinitrotoluene | 606202 | | | | | | | |
| 84 | Di-n-Octyl Phthalate | 117840 | | | | | | | |
| 85 | 1,2-Diphenylhydrazine | 122667 | | | | | 0.036 B,C | 0.20 B,C | 65FR66443 |
| 86 | Fluoranthene | 206440 | | | | | 130 B | 140 B | 65FR66443 |
| 87 | Fluorene | 86737 | | | | | 1,100 B | 5,300 B | 65FR66443 |
| 88 | Hexachlorobenzene | 118741 | | | | | 0.00028 B,C | 0.00029 B,C | 65FR66443 |
| 89 | Hexachlorobutadiene | 87683 | | | | | 0.44 B,C | 18 B,C | 65FR66443 |
| 90 | Hexachlorocyclopentadiene | 77474 | | | | | 240 U,Z | 17,000 H,U | 57FR60848 |
| 91 | Hexachloroethane | 67721 | | | | | 1.4 B,C | 3.3 B,C | 65FR66443 |
| 92 | Ideno(1,2,3-cd)Pyrene | 193395 | | | | | 0.0038 B,C | 0.018 B,C | 65FR66443 |
| 93 | Isophorone | 78591 | | | | | 35 B,C | 960 B,C | 65FR66443 |
| 94 | Naphthalene | 91203 | | | | | | | |
| 95 | Nitrobenzene | 98953 | | | | | 17 B | 690 B,H,U | 65FR66443 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 96 | N-Nitrosodimethylamine | 62759 | | | | | 0.00069 B,C | 3.0 B,C | 65FR66443 |
| 97 | N-Nitrosodi-n-Propylamine | 621647 | | | | | 0.0050 B,C | 0.51 B,C | 65FR66443 |
| 98 | N-Nitrosodiphenylamine | 86306 | | | | | 3.3 B,C | 6.0 B,C | 65FR66443 |
| 99 | Phenanthrene | 85018 | | | | | | | |
| 100 | Pyrene | 129000 | | | | | 830 B | 4,000 B | 65FR66443 |
| 101 | 1,2,4-Trichlorobenzene | 120821 | | | | | 260 | 940 | IRIS11/01/96 |
| 102 | Aldrin | 309002 | 3.0 G | | 1.3 G | | 0.000049 B,C | 0.000050 B,C | 65FR31682<br>65FR66443 |
| 103 | alpha-BHC | 319846 | | | | | 0.0026 B,C | 0.0049 B,C | 65FR66443 |
| 104 | beta-BHC | 319857 | | | | | 0.0091 B,C | 0.017 B,C | 65FR66443 |
| 105 | gamma-BHC (Lindane) | 58899 | 0.95 K | | 0.16 G | | 0.019 C | 0.063 C | 65FR31682<br>65FR66443 |
| 106 | delta-BHC | 319868 | | | | | | | |
| 107 | Chlordane | 57749 | 2.4 G | 0.0043 G,aa | 0.09 G | 0.004 G,aa | 0.00080 B,C | 0.00081 B,C | 65FR31682<br>65FR66443 |
| 108 | 4,4'-DDT | 50293 | 1.1 G,ii | 0.001 G,aa,ii | 0.13 G,ii | 0.001 G,aa,ii | 0.00022 B,C | 0.00022 B,C | 65FR31682<br>65FR66443 |
| 109 | 4,4'-DDE | 72559 | | | | | 0.00022 B,C | 0.00022 B,C | 65FR66443 |
| 110 | 4,4'-DDD | 72548 | | | | | 0.00031 B,C | 0.00031 B,C | 65FR66443 |

| | Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/ Source |
|---|---|---|---|---|---|---|---|---|---|
| 111 | Dieldrin | 60571 | 0.24 K | 0.056 K,O | 0.71 G | 0.0019 G,aa | 0.000052 B,C | 0.000054 B,C | 65FR31682<br>65FR66443 |
| 112 | alpha-Endosulfan | 959988 | 0.22 G,Y | 0.056 G,Y | 0.034 G,Y | 0.0087 G,Y | 62 B | 89 B | 65FR31682<br>65FR66443 |
| 113 | beta-Endosulfan | 33213659 | 0.22 G,Y | 0.056 G,Y | 0.034 G,Y | 0.0087 G,Y | 62 B | 89 B | 65FR31682<br>65FR66443 |
| 114 | Endosulfan Sulfate | 1031078 | | | | | 62 B | 89 B | 65FR66443 |
| 115 | Endrin | 72208 | 0.086 K | 0.036 K,O | 0.037 G | 0.0023 G,aa | 0.76 B | 0.81 B,H | 65FR31682 |
| 116 | Endrin Aldehyde | 7421934 | | | | | 0.29 B | 0.30 B,H | 65FR66443 |
| 117 | Heptachlor | 76448 | 0.52 G | 0.0038 G,aa | 0.053 G | 0.0036 G,aa | 0.000079 B,C | 0.000079 B,C | 65FR31682<br>65FR66443 |
| 118 | Heptachlor Epoxide | 1024573 | 0.52 G,V | 0.0038 G,V,aa | 0.053 G,V | 0.0036 G,V,aa | 0.000039 B,C | 0.000039 B,C | 65FR31682<br>65FR66443 |
| 119 | Polychlorinated Biphenyls PCBs: | | | 0.014 N,aa | | 0.03 N,aa | 0.000064 B,C,N | 0.000064 B,C,N | 65FR31682<br>65FR66443 |
| 120 | Toxaphene | 8001352 | 0.73 | 0.0002 aa | 0.21 | 0.0002 aa | 0.00028 B,C | 0.00028 B,C | 65FR31682<br>65FR66443 |

**Footnotes:**

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (EPA 440/5-84-033, January 1985), Species Mean Acute Values are given for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to 1.7.

Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.

B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

C This criterion is based on carcinogenicity of $10^{-6}$ risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of $10^{-5}$, move the decimal point in the recommended criterion one place to the right).

D Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. The recommended water quality criteria value was calculated by using the previous 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria," October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource center, USEPA, 401 M St., SW, mail code RC4100, Washington, DC 20460; and 40CFR§131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble- Conversion Factors for Dissolved Metals.

E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 100 mg/L. Criteria values for other hardness may be calculated from the following: CMC (dissolved) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$ (CF), or CCC (dissolved) = $\exp\{m_C [\ln(\text{hardness})] + b_C\}$ (CF) and the parameters specified in Appendix B- Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent.

F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC = exp(1.005(pH)-4.869); CCC = exp(1.005(pH)-5.134). Values displayed in table correspond to a pH of 7.8.

G This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

H No criterion for protection of human health from consumption of aquatic organisms excluding water was presented in the 1980 criteria document or in the *1986 Quality Criteria for Water*. Nevertheless, sufficient information was presented in the 1980 document to allow the calculation of a criterion, even though the results of such a calculation were not shown in the document.

I This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA).

J This fish tissue residue criterion for methylmercury is based on a total fish consumption rate of 0.0175 kg/day.

K This recommended criterion is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*, (EPA-820-B-96-001, September 1996). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A); the difference between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. None of the decisions concerning the derivation of this criterion were affected by any considerations that are specific to the Great Lakes.

L The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/l and 12.82 µg/l, respectively.

M EPA is currently reassessing the criteria for arsenic.

N This criterion applies to total pcbs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)

O The derivation of the CCC for this pollutant (Endrin) did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.

P Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.

Q This recommended water quality criterion is expressed as µg free cyanide (as CN)/L.

R This value for selenium was announced (61FR58444-58449, November 14, 1996) as a proposed GLI 303(c) aquatic life criterion. EPA is currently working on this criterion and so this value might change substantially in the near future.

S This recommended water quality criterion for arsenic refers to the inorganic form only.

T This recommended water quality criterion for selenium is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor (0.996- CMC or 0.922- CCC) that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.

U The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.

V This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

W Although EPA has not published a completed criteria document for butylbenzyl phthalate it is EPA's understanding that sufficient data exist to allow calculation of aquatic criteria. It is anticipated that industry intends to publish in the peer reviewed literature draft aquatic life criteria generated in accordance with EPA Guidelines. EPA will review such criteria for possible issuance as national WQC.

X There is a full set of aquatic life toxicity data that show that DEHP is not toxic to aquatic organisms at or below its solubility limit.

Y This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

Z A more stringent MCL has been issued by EPA. Refer to drinking water regulations (40 CFR 141) or Safe Drinking Water Hotline (1-800-426-4791) for values.

aa This criterion is based on a 304(a) aquatic life criterion issued in 1980 or 1986, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Polychlorinated biphenyls (EPA 440/5-80-068), Toxaphene (EPA 440/5-86-006). This CCC is currently based on the Final Residue Value (FRV) procedure. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria. Therefore, the Agency anticipates that future revisions of this CCC will not be based on the FRV procedure.

bb This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (EPA 440/5-84-033), Cadmium (EPA 882-R-01-001), Chromium (EPA 440/5-84-029), Copper (EPA 440/5-84-031), Cyanide (EPA 440/5- 84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87- 003).

cc When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be appropriate.

dd The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 µg/L in salt water because the saltwater CCC does not take into account uptake via the food chain.

ee This recommended water quality criterion was derived on page 43 of the mercury criteria document (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

ff This recommended water quality criterion was derived in *Ambient Water Quality Criteria Saltwater Copper Addendum* (Draft, April 14, 1995) and was promulgated in the Interim final National Toxics Rule (60FR22228-222237, May 4, 1995).

gg EPA is actively working on this criterion and so this recommended water quality criterion may change substantially in the near future.

hh This recommended water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

ii This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

## NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR NON PRIORITY POLLUTANTS

| | Non Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/Source |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Alkalinity | -- | | 20000 F | | | | | Gold Book |
| 2 | Aluminum pH 6.5 - 9.0 | 7429905 | 750 G,I | 87 G,I,L | | | | | 53FR33178 |
| 3 | Ammonia | 7664417 | FRESHWATER CRITERIA ARE pH, Temperature and Life-stage DEPENDENT -- SEE DOCUMENT D | | | | | | EPA822-R-99-014 |
| | | | SALTWATER CRITERIA ARE pH AND TEMPERATURE DEPENDENT | | | | | | EPA440/5-88-004 |
| 4 | Aesthetic Qualities | -- | NARRATIVE STATEMENT-- SEE DOCUMENT | | | | | | Gold Book |
| 5 | Bacteria | -- | FOR PRIMARY RECREATION AND SHELLFISH USES -- SEE DOCUMENT | | | | | | Gold Book |
| 6 | Barium | 7440393 | | | | | 1,000 A | | Gold Book |
| 7 | Boron | -- | NARRATIVE STATEMENT-- SEE DOCUMENT | | | | | | Gold Book |
| 8 | Chloride | 16887006 | 860,000 G | 230,000 G | | | | | 53FR19028 |
| 9 | Chlorine | 7782505 | 19 | 11 | 13 | 7.5 | C | | Gold Book |
| 10 | Chlorophenoxy Herbicide (2,4,5,-TP) | 93721 | | | | | 10 A | | Gold Book |
| 11 | Chlorophenoxy Herbicide (2,4-D) | 94757 | | | | | 100 A,C | | Gold Book |
| 12 | Chloropyrifos | 2921882 | 0.083 G | 0.041 G | 0.011 G | 0.0056 G | | | Gold Book |
| 13 | Color | -- | NARRATIVE STATEMENT-- SEE DOCUMENT F | | | | | | Gold Book |
| 14 | Demeton | 8065483 | | 0.1 F | | 0.1 F | | | Gold Book |
| 15 | Ether, Bis( Chloromethyl) | 542881 | | | | | 0.00010 E, H | 0.00029 E,H | 65FR66443 |

| | Non Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/Source |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Gases, Total Dissolved | -- | NARRATIVE STATEMENT -- SEE DOCUMENT F | | | | | | Gold Book |
| 17 | Guthion | 86500 | | 0.01 F | | 0.01 F | | | Gold Book |
| 18 | Hardness | -- | NARRATIVE STATEMENT-- SEE DOCUMENT | | | | | | Gold Book |
| 19 | Hexachlorocyclo-hexane-Technical | 319868 | | | | | 0.0123 | 0.0414 | Gold Book |
| 20 | Iron | 7439896 | | 1,000 F | | | 300 A | | Gold Book |
| 21 | Malathion | 121755 | | 0.1 F | | 0.1 F | | | Gold Book |
| 22 | Manganese | 7439965 | | | | | 50 A,O | 100 A | Gold Book |
| 23 | Methoxychlor | 72435 | | 0.03 F | | 0.03 F | 100 A,C | | Gold Book |
| 24 | Mirex | 2385855 | | 0.001 F | | 0.001 F | | | Gold Book |
| 25 | Nitrates | 14797558 | | | | | 10,000 A | | Gold Book |
| 26 | Nitrosamines | -- | | | | | 0.0008 | 1.24 | Gold Book |
| 27 | Dinitrophenols | 25550587 | | | | | 69 | 5300 | 65FR66443 |
| 28 | Nitrosodibutylamine,N | 924163 | | | | | 0.0063 A,H | 0.22 A,H | 65FR66443 |
| 29 | Nitrosodiethylamine,N | 55185 | | | | | 0.0008 A,H | 1.24 A,H | Gold Book |
| 30 | Nitrosopyrrolidine,N | 930552 | | | | | 0.016 H | 34 H | 65FR66443 |
| 31 | Oil and Grease | -- | NARRATIVE STATEMENT -- SEE DOCUMENT F | | | | | | Gold Book |

| | Non Priority Pollutant | CAS Number | Freshwater CMC (µg/L) | Freshwater CCC (µg/L) | Saltwater CMC (µg/L) | Saltwater CCC (µg/L) | Human Health For Consumption of: Water + Organism (µg/L) | Human Health For Consumption of: Organism Only (µg/L) | FR Cite/Source |
|---|---|---|---|---|---|---|---|---|---|
| 32 | Oxygen, Dissolved Freshwater | 7782447 | WARMWATER AND COLDWATER MATRIX -- SEE DOCUMENT N | | | | | | Gold Book |
| | Oxygen, Dissolved Saltwater | | SALTWATER – SEE DOCUMENT | | | | | | EPA-822R-00-012 |
| 33 | Parathion | 56382 | 0.065 J | 0.013 J | | | | | Gold Book |
| 34 | Pentachlorobenzene | 608935 | | | | | 1.4 E | 1.5 E | 65FR66443 |
| 35 | pH | -- | | 6.5 - 9 F | | 6.5 - 8.5 F,K | 5 - 9 | | Gold Book |
| 36 | Phosphorus Elemental | 7723140 | | | | 0.1 F,K | | | Gold Book |
| 37 | Nutrients | -- | See EPA's Ecoregional criteria for Total Phosphorus, Total Nitrogen, Chlorophyll *a* and Water Clarity (Secchi depth for lakes; turbidity for streams and rivers) (& Level III Ecoregional criteria) | | | | | | P |
| 38 | Solids Dissolved and Salinity | -- | | | | | 250,000 A | | Gold Book |
| 39 | Solids Suspended and Turbidity | -- | NARRATIVE STATEMENT -- SEE DOCUMENT F | | | | | | Gold Book |
| 40 | Sulfide-Hydrogen Sulfide | 7783064 | | 2.0 F | | 2.0 F | | | Gold Book |
| 41 | Tainting Substances | -- | NARRATIVE STATEMENT-- SEE DOCUMENT | | | | | | Gold Book |
| 42 | Temperature | -- | SPECIES DEPENDENT CRITERIA -- SEE DOCUMENT M | | | | | | Gold Book |
| 43 | Tetrachlorobenzene,1,2,4,5- | 95943 | | | | | 0.97 E | 1.1 E | 65FR66443 |
| 44 | Tributyltin (TBT) | -- | 0.46 Q | 0.063 Q | 0.37 Q | 0.010 Q | | | EPA 822-F-00-008 |
| 45 | Trichlorophenol,2,4,5- | 95954 | | | | | 1,800 B,E | 3,600 B,E | 65FR66443 |

**Footnotes:**

A This human health criterion is the same as originally published in the Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value is now published in the Gold Book.

B The organoleptic effect criterion is more stringent than the value presented in the non priority pollutants table.

C A more stringent Maximum Contaminant Level (MCL) has been issued by EPA under the Safe Drinking Water Act. Refer to drinking water regulations 40CFR141 or Safe Drinking Water Hotline (1-800-426-4791) for values.

D According to the procedures described in the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, except possibly where a very sensitive species is important at a site, freshwater aquatic life should be protected if both conditions specified in Appendix C to the Preamble- Calculation of Freshwater Ammonia Criterion are satisfied.

E This criterion has been revised to reflect EPA's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) used to derive the original criterion was retained in each case.

F The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July, 1976).

G This value is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Aluminum (EPA 440/5-86-008); Chloride (EPA 440/5-88-001); Chloropyrifos (EPA 440/5-86-005).

H This criterion is based on carcinogenicity of $10^{-6}$ risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of $10^{-5}$, move the decimal point in the recommended criterion one place to the right).

I This value for aluminum is expressed in terms of total recoverable metal in the water column.

J This value is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water* (EPA-820-B-96-001). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A); the differences between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. No decision concerning this criterion was affected by any considerations that are specific to the Great Lakes.

K According to page 181 of the Red Book:

> For open ocean waters where the depth is substantially greater than the euphotic zone, the pH should not be changed more than 0.2 units from the naturally occurring variation or any case outside the range of 6.5 to 8.5. For shallow, highly productive coastal and estuarine areas where naturally occurring pH variations approach the lethal limits of some species, changes in pH should be avoided but in any case should not exceed the limits established for fresh water, i.e., 6.5-9.0.

L There are three major reasons why the use of Water-Effect Ratios might be appropriate. (1) The value of 87 µg/l is based on a toxicity test with the striped bass in water with pH= 6.5-6.6 and hardness <10 mg/L. Data in "Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia" (May 1994) indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified at this time. (2) In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide. (3) EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 µg aluminum/L, when either total recoverable or dissolved is measured.

M U.S. EPA. 1973. Water Quality Criteria 1972. EPA-R3-73-033. National Technical Information Service, Springfield, VA.; U.S. EPA. 1977. Temperature Criteria for Freshwater Fish: Protocol and Procedures. EPA-600/3-77-061. National Technical Information Service, Springfield, VA.

N U.S. EPA. 1986. Ambient Water Quality Criteria for Dissolved Oxygen. EPA 440/5-86-003. National Technical Information Service, Springfield, VA.

O This criterion for manganese is not based on toxic effects, but rather is intended to minimize objectionable qualities such as laundry stains and objectionable tastes in beverages.

P Lakes and Reservoirs in Nutrient Ecoregion: II EPA 822-B-00-007, III EPA 822-B-01-008, IV EPA 822-B-01-009, V EPA 822-B-01-010, VI EPA 822-B-00-008 , VII EPA 822-B-00-009, VIII EPA 822-B-01-015, IX EPA 822-B-00-011, XI EPA 822-B-00-012, XII EPA 822-B-00-013, XIII EPA 822-B-00-014, XIV EPA 822-B-01-011; Rivers and Streams in Nutrient Ecoregion: I EPA 822-B-01-012, II EPA 822-B-00-015, III EPA 822-B-00-016, IV EPA 822-B-01-013, V EPA 822-B-01-014, VI EPA 822-B-00-017, VII EPA 822-B-00-018, VIII EPA 822-B-01-015, IX EPA 822-B-00-019, X EPA 822-B-01-016, XI EPA 822-B-00-020, XII EPA 822-B-00-021, XIV EPA 822-B-00-022; and Wetlands in Nutrient Ecoregion XIII EPA 822-B-00-023.

Q EPA announced the availability of a draft updated tributyltin (TBT) document on August 7, 1997 (62FR42554). The Agency has reevaluated this document and anticipates releasing an updated document for public comment in the near future.

## NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR ORGANOLEPTIC EFFECTS

| | Pollutant | CAS Number | Organoleptic Effect Criteria (µg/L) | FR Cite/Source |
|---|---|---|---|---|
| 1 | Acenaphthene | 83329 | 20 | Gold Book |
| 2 | Monochlorobenzene | 108907 | 20 | Gold Book |
| 3 | 3-Chlorophenol | -- | 0.1 | Gold Book |
| 4 | 4-Chlorophenol | 106489 | 0.1 | Gold Book |
| 5 | 2,3-Dichlorophenol | -- | 0.04 | Gold Book |
| 6 | 2,5-Dichlorophenol | -- | 0.5 | Gold Book |
| 7 | 2,6-Dichlorophenol | -- | 0.2 | Gold Book |
| 8 | 3,4-Dichlorophenol | -- | 0.3 | Gold Book |
| 9 | 2,4,5-Trichlorophenol | 95954 | 1 | Gold Book |
| 10 | 2,4,6-Trichloropehnol | 88062 | 2 | Gold Book |
| 11 | 2,3,4,6-Tetrachlorophenol | -- | 1 | Gold Book |
| 12 | 2-Methyl-4-Chlorophenol | -- | 1,800 | Gold Book |
| 13 | 3-Methyl-4-Chlorophenol | 59507 | 3,000 | Gold Book |
| 14 | 3-Methyl-6-Chlorophenol | -- | 20 | Gold Book |
| 15 | 2-Chlorophenol | 95578 | 0.1 | Gold Book |
| 16 | Copper | 7440508 | 1,000 | Gold Book |
| 17 | 2,4-Dichlorophenol | 120832 | 0.3 | Gold Book |
| 18 | 2,4-Dimethylpehnol | 105679 | 400 | Gold Book |
| 19 | Hexachlorocyclopentadiene | 77474 | 1 | Gold Book |
| 20 | Nitrobenzene | 98953 | 30 | Gold Book |

| | Pollutant | CAS Number | Organoleptic Effect Criteria (µg/L) | FR Cite/Source |
|---|---|---|---|---|
| 21 | Pentachlorophenol | 87865 | 30 | Gold Book |
| 22 | Phenol | 108952 | 300 | Gold Book |
| 23 | Zinc | 7440666 | 5,000 | 45 FR79341 |

**General Notes:**

1. These criteria are based on organoleptic (taste and odor) effects. Because of variations in chemical nomenclature systems, this listing of pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service (CAS) registry numbers, which provide a unique identification for each chemical.

**NATIONAL RECOMMENDED WATER QUALITY CRITERIA**

**Additional Notes:**

**1. Criteria Maximum Concentration and Criterion Continuous Concentration**

The Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are just two of the six parts of an aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedence, and chronic frequency of allowed exceedence. Because 304(a) aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the United States.

**2. Criteria Recommendations for Priority Pollutants, Non Priority Pollutants and Organoleptic Effects**

This compilation lists all priority toxic pollutants and some non priority toxic pollutants, and both human health effect and organoleptic effect criteria issued pursuant to CWA §304(a). Blank spaces indicate that EPA has no CWA §304(a) criteria recommendations. For a number of non-priority toxic pollutants not listed, CWA §304(a) "water + organism" human health criteria are not available, but EPA has published MCLs under the SDWA that may be used in establishing water quality standards to protect water supply designated uses. Because of variations in chemical nomenclature systems, this listing of toxic pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service CAS registry numbers, which provide a unique identification for each chemical.

**3. Human Health Risk**

The human health criteria for the priority and non priority pollutants are based on carcinogenicity of $10^{-6}$ risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of $10^{-5}$, move the decimal point in the recommended criterion one place to the right).

**4. Water Quality Criteria published pursuant to Section 304(a) or Section 303(c) of the CWA**

Many of the values in the compilation were published in the California Toxics Rule. Although such values were published pursuant to Section 303(c) of the CWA, they represent the Agency's most recent calculation of water quality criteria and are thus the Agency's 304(a) criteria.

**5. Calculation of Dissolved Metals Criteria**

The 304(a) criteria for metals, shown as dissolved metals, are calculated in one of two ways. For freshwater metals criteria that are hardness-dependent, the dissolved metal criteria were calculated using a hardness of 100 mg/l as $CaCO_3$ for illustrative purposes only. Saltwater and freshwater metals' criteria that are not hardness-dependent are calculated by multiplying the total recoverable criteria before rounding by the appropriate conversion factors. The final dissolved metals' criteria in the table are rounded to two significant figures. Information regarding the calculation of hardness dependent conversion factors are included in the footnotes.

**6. Maximum Contaminant Levels**

The compilation includes footnotes for pollutants with Maximum Contaminant Levels (MCLs) more stringent than the recommended water quality criteria in the compilation. MCLs for these pollutants are not included in the compilation, but can be found in the appropriate drinking water regulations (40 CFR 141.11-16 and 141.60-63), or can be accessed through the Safe Drinking Water Hotline (800-426-4791) or the Internet (http://www.epa.gov/waterscience/drinking/standards/dwstandards.pdf).

**7. Organoleptic Effects**

The compilation contains 304(a) criteria for pollutants with toxicity-based criteria as well as non-toxicity based criteria. The basis for the non-toxicity based criteria are organoleptic effects (e.g., taste and odor) which would make water and edible aquatic life unpalatable but not toxic to humans. The table includes criteria for organoleptic effects for 23 pollutants. Pollutants with organoleptic effect criteria more stringent than the criteria based on toxicity (e.g., included in both the priority and non-priority pollutant tables) are footnoted as such.

**8. Gold Book**

The "Gold Book" is Quality Criteria for Water: 1986. EPA 440/5-86-001.

**9. Correction of Chemical Abstract Services Number**

The Chemical Abstract Services number (CAS) for Bis(2-Chlorisoprpyl) Ether, has been revised in IRIS and in the table. The correct CAS number for this chemical is 108-60-1. The previous CAS number for this pollutant was 39638-32-9.

**10. Contaminants with Blanks**

EPA has not calculated criteria for contaminants with blanks. However, permit authorities should address these contaminants in NPDES permit actions using the States' existing narrative criteria for toxics.

**11. Specific Chemical Calculations**

**A. Selenium**

Aquatic Life

This compilation contains aquatic life criteria for selenium that are the same as those published in the proposed CTR. In the CTR, EPA proposed an acute criterion for selenium based on the criterion proposed for selenium in the Water Quality Guidance for the Great Lakes System (61 FR 58444). The GLI and CTR proposals take into account data showing that selenium's two prevalent oxidation states in water, selenite and selenate, present differing potentials for aquatic toxicity, as well as new data indicating that various forms of selenium are additive. The new approach produces a different selenium acute criterion concentration, or CMC, depending upon the relative proportions of selenite, selenate, and other forms of selenium that are present.

EPA is currently undertaking a reassessment of selenium, and expects the 304(a) criteria for selenium will be revised based on the final reassessment (63FR26186). However, until such time as revised water quality criteria for selenium are published by the Agency, the recommended water quality criteria in this compilation are EPA's current 304(a) criteria.

## Appendices:

## Appendix A - Conversion Factors for Dissolved Metals

| Metal | Conversion Factor freshwater CMC | Conversion Factor freshwater CCC | Conversion Factor saltwater CMC | Conversion Factor saltwater CCC[1] |
|---|---|---|---|---|
| Arsenic | 1.000 | 1.000 | 1.000 | 1.000 |
| Cadmium | 1.136672-[(ln hardness)(0.041838)] | 1.101672-[(ln hardness)(0.041838)] | 0.994 | 0.994 |
| Chromium III | 0.316 | 0.860 | -- | -- |
| Chromium VI | 0.982 | 0.962 | 0.993 | 0.993 |
| Copper | 0.960 | 0.960 | 0.83 | 0.83 |
| Lead | 1.46203-[(ln hardness)(0.145712)] | 1.46203-[(ln hardness)(0.145712)] | 0.951 | 0.951 |
| Mercury | 0.85 | 0.85 | 0.85 | 0.85 |
| Nickel | 0.998 | 0.997 | 0.990 | 0.990 |
| Selenium | -- | -- | 0.998 | 0.998 |
| Silver | 0.85 | -- | 0.85 | -- |
| Zinc | 0.978 | 0.986 | 0.946 | 0.946 |

## Appendix B - Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

| Chemical | $m_A$ | $b_A$ | $m_C$ | $b_C$ | Freshwater Conversion Factors (CF) | |
|---|---|---|---|---|---|---|
| | | | | | CMC | CCC |
| Cadmium | 1.0166 | -3.924 | 0.7409 | -4.719 | 1.136672-[(ln hardness)(0.041838)] | 1.101672-[(ln hardness)(0.041838)] |
| Chromium III | 0.8190 | 3.7256 | 0.8190 | 0.6848 | 0.316 | 0.860 |
| Copper | 0.9422 | -1.700 | 0.8545 | -1.702 | 0.960 | 0.960 |
| Lead | 1.273 | -1.460 | 1.273 | -4.705 | 1.46203-[(ln hardness)(0.145712)] | 1.46203-[(ln hardness)(0.145712)] |
| Nickel | 0.8460 | 2.255 | 0.8460 | 0.0584 | 0.998 | 0.997 |
| Silver | 1.72 | -6.59 | -- | -- | 0.85 | -- |
| Zinc | 0.8473 | 0.884 | 0.8473 | 0.884 | 0.978 | 0.986 |

Hardness-dependant metals' criteria may be calculated from the following:

CMC (dissolved) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$ (CF)

CCC (dissolved) = $\exp\{m_C [\ln(\text{hardness})] + b_C\}$ (CF)

## Appendix C - Calculation of Freshwater Ammonia Criterion

1. The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC (acute criterion) calculated using the following equations.

Where salmonid fish are present:

$$CMC = \frac{0.275}{1 + 10^{7.204-pH}} + \frac{39.0}{1 + 10^{pH-7.204}}$$

Or where salmonid fish are not present:

$$CMC = \frac{0.411}{1 + 10^{7.204-pH}} + \frac{58.4}{1 + 10^{pH-7.204}}$$

2A The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CCC (chronic criterion) calculated using the following equations.

When fish early life stages are present:

$$CCC = \left( \frac{0.0577}{1 + 10^{7.688-pH}} + \frac{2.487}{1 + 10^{pH-7.688}} \right) \bullet \quad MIN\ (2.85,\ 1.45 \cdot 10^{0.028 \cdot (52-T)})$$

When fish early life stages are absent:

$$CCC = \left( \frac{0.0577}{1 + 10^{7.688-pH}} + \frac{2.487}{1 + 10^{pH-7.688}} \right) \bullet \quad 1.45 \cdot 10^{0.028 \cdot (25-MAX\ (T,7))}$$

2B. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

# STATE OF NEW MEXICO

# STANDARDS FOR INTERSTATE AND INTRASTATE SURFACE WATERS

20.6.4 NMAC

As amended through October 11, 2002

**New Mexico Water Quality Control Commission**
Harold Runnels Building
1190 St. Francis Drive, S2064
P.O. Box 26110
Santa Fe, New Mexico 87502
http://www.nmenv.state.nm.us/oots/wqcc.htm

**BLANK**

**PAGE**

# STATE OF NEW MEXICO

# STANDARDS FOR INTERSTATE AND INTRASTATE SURFACE WATERS

20.6.4 NMAC

Filed with State Records Center
September 12, 2000
Effective October 11, 2002

New Mexico Water Quality Control Commission
Harold Runnels Building
1190 St. Francis Drive P.O. Box 26110
Santa Fe, New Mexico 87502
http://www.nmenv.state.nm.us/oots/wqcc.htm

Constituent Agencies:

Environment Department
State Engineer Office
Game and Fish Department
Oil Conservation Division
Department of Agriculture
State Parks Division
Soil and Water Conservation Commission
Bureau of Mines and Mineral Resources
Members-at-Large

BLANK

PAGE

**STANDARDS FOR**
**INTERSTATE AND INTRASTATE SURFACE WATERS**

**Table of Contents**


| Section | | Page |
|---|---|---|
| **General** | | |
| 20.6.4.1 | Issuing Agency | 1 |
| 20.6.4.2 | Scope | 1 |
| 20.6.4.3 | Statutory Authority | 1 |
| 20.6.4.4 | Duration | 1 |
| 20.6.4.5 | Effective Date | 1 |
| 20.6.4.6 | Objective | 1 |
| 20.6.4.7 | Definitions | 1 |
| 20.6.4.8 | Antidegradation Policy and Implementation Plan | 4 |
| 20.6.4.9 | Review of Standards; Need for Additional Studies | 6 |
| 20.6.4.10 | Applicability of Water Quality Standards | 6 |
| 20.6.4.11 | Compliance with Water Quality Standards | 7 |
| 20.6.4.12 | General Standards | 8 |
| 20.6.4.13 | Sampling and Analysis | 10 |
| 20.6.4.14 | Use Attainability Analysis | 11 |
| **Use Designation and Standards** | | |
| 20.6.4.101 | Rio Grande Basin | 12 |
| 20.6.4.201 | Pecos River Basin | 18 |
| 20.6.4.301 | Canadian River Basin | 22 |
| 20.6.4.401 | San Juan River Basin | 24 |
| 20.6.4.501 | Gila River Basin | 26 |
| 20.6.4.601 | San Francisco River Basin | 26 |
| 20.6.4.701 | Dry Cimarron River | 27 |
| 20.6.4.801 | Closed Basins | 27 |
| **Numeric Standards Applicable to Uses** | | |
| 20.6.4.900 | Standards Applicable to Attainable or Designated Uses. | 29 |
| 20.6.4.901 | Publication References | 38 |
| 20.6.4.902 | Pre-NMAC Regulatory Filing History | 38 |
| 20.6.4.903 | History of Repealed Material | 39 |

**BLANK**

**PAGE**

**TITLE 20 ENVIRONMENTAL PROTECTION**
**CHAPTER 6 WATER QUALITY**
**PART 4 STANDARDS FOR INTERSTATE AND INTRASTATE SURFACE WATERS**

**20.6.4.1 ISSUING AGENCY:** Water Quality Control Commission.
[20.6.4.1 NMAC – Rp 20 NMAC 6.1.1001, 10-12-00]

**20.6.4.2 SCOPE:** Except as otherwise provided by statute or regulation of the water quality control commission, this part governs all surface waters of the state of New Mexico which are subject to the New Mexico Water Quality Act, Sections 74-6-1 through 74-6-17 NMSA 1978.
[20.6.4.2 NMAC – Rp 20 NMAC 6.1.1002, 10-12-00]

**20.6.4.3 STATUTORY AUTHORITY:** This part is adopted by the water quality control commission pursuant to Subsection C of Section 74-6-4 NMSA 1978.
[20.6.4.3 NMAC – Rp 20 NMAC 6.1.1003, 10-12-00]

**20.6.4.4 DURATION:** Permanent.
[20.6.4.4 NMAC – Rp 20 NMAC 6.1.1004, 10-12-00]

**20.6.4.5 EFFECTIVE DATE:** October 12, 2000, unless a later date is indicated in the history note at the end of a section.
[20.6.4.5 NMAC – Rp 20 NMAC 6.1.1005, 10-12-00]

**20.6.4.6 OBJECTIVE:**

**A.** The purpose of this part is to establish water quality standards that consist of the designated use or uses of surface waters of the state, the water quality criteria necessary to protect the use or uses, and an antidegradation policy.

**B.** The state of New Mexico is required under the New Mexico Water Quality Act (Subsection C of Section 74-6-4 NMSA 1978) and the federal Clean Water Act, as amended (33 U.S.C. Section 1251 *et seq.*) to adopt water quality standards that protect the public health or welfare, enhance the quality of water, and are consistent with and serve the purposes of the New Mexico Water Quality Act and the federal Clean Water Act. It is the objective of the federal Clean Water Act to restore and maintain the chemical, physical, and biological integrity of the nation's waters, including those in New Mexico. This part is consistent with Section 101(a)(2) of the federal Clean Water Act, which declares that it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983. Agricultural, municipal, domestic and industrial water supply are other essential uses of New Mexico's surface water; however, water contaminants resulting from these activities will not be permitted to lower the quality of surface waters of the state below that which is required for recreation and maintenance of a fishery and protection of wildlife, where practicable.

**C.** Pursuant to Subsection A of Section 74-6-12 NMSA 1978, this part does not grant to the water quality control commission or to any other entity the power to take away or modify property rights in water.
[20.6.4.6 NMAC – Rp 20 NMAC 6.1.1006, 10-12-00]

**20.6.4.7 DEFINITIONS:** Terms defined in the New Mexico Water Quality Act, but not defined in this part will have the meaning given in the Water Quality Act.

**A.** **"acute toxicity"** means toxicity involving a stimulus severe enough to induce a response in 96 hours of exposure or less. Acute toxicity is not always measured in terms of lethality, but may include other toxic effects that occur within a short time period.

**B.** **"best management practices or BMPs"** means schedules of activities, prohibitions of certain practices, implementation of maintenance procedures, or other measures or practices selected by the state or a designated management agency to achieve control of sources of water pollutants.

**C.** **"bioaccumulation"** refers to the uptake and retention of a substance by an organism from its surrounding medium and food.

**D.** **"bioaccumulation factor"** is the ratio of a substance's concentration in tissue versus its concentration in ambient water, in situations where the organism and the food chain are exposed.

**E.** **"biomonitoring"** means the use of living organisms to test the suitability of effluents for discharge into receiving waters or to test the quality of surface waters of the state.

**F.** **"cfs"** means cubic feet per second.

**G.** **"chronic toxicity"** means toxicity involving a stimulus that lingers or continues for a relatively long period relative to the life span of an organism. Chronic effects include, but are not limited to, lethality, growth impairment, behavioral modifications, disease and reduced reproduction.

**H.** **"classified water of the state"** means a surface water of the state, or reach of a surface water of the state, for which the commission has adopted a segment description, and has designated a use or uses and applicable water quality standards. Segment descriptions, designated use or uses, and water quality standards for classified waters of the state are set forth in this part.

**I.** **"coldwater fishery"** means a surface water of the state where the water temperature and other characteristics are suitable for the support or propagation or both of coldwater fishes.

**J.** **"commission"** means the New Mexico water quality control commission.

**K.** **"criteria"** are elements of state water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a use. When criteria are met, water quality will generally protect the designated use.

**L.** **"department"** means the New Mexico environment department.

**M.** **"designated use or uses"** means those uses specified in Sections 20.6.4.101 through 20.6.4.899 NMAC for each surface water of the state whether or not they are being attained.

**N.** **"dissolved"** means a constituent of a water sample which will pass through a 0.45-micrometer pore-size membrane filter under a pressure differential not exceeding one atmosphere. The "dissolved" fraction is also termed "filterable residue."

**O.** **"domestic water supply"** means a surface water of the state that may be used for drinking or culinary purposes after disinfection.

**P.** **"ephemeral stream"** means a stream or reach of a stream that flows briefly only in direct response to precipitation or snowmelt in the immediate locality; its channel bed is always above the water table of the region adjoining the stream and does not support a self-sustaining population of fish.

**Q.** **"existing use"** means those uses actually attained in a surface water of the state on or after November 28, 1975, whether or not they are included in the water quality standards.

**R.** **"fecal coliform bacteria"** means the portion of the coliform group which is present in the gut or the feces of warmblooded animals. It generally includes organisms which are capable of producing gas from lactose broth in a suitable culture medium within 24 hours at 44.5 ± 0.2°C.

**S.** **"fish culture"** means production of coldwater or warmwater fishes in a hatchery or rearing station.

**T.** **"flow,"** relative to the four definitions of streams herein, means natural flow ensuing from the earth's hydrologic cycle, i.e., atmospheric precipitation resulting in surface and/or ground-water runoff. Natural in-stream flow may be interrupted or eliminated by dams and diversions.

**U.** **"high quality coldwater fishery"** means a perennial surface water of the state in a minimally disturbed condition which has considerable aesthetic value and is a superior coldwater fishery habitat. A surface water of the state to be so categorized must have water quality, stream bed characteristics, and other attributes of habitat sufficient to protect and maintain a propagating coldwater fishery.

**V.** **"intermittent stream"** means a stream or reach of a stream that flows only at certain times of the year, such as when it receives flow from springs, melting snow, or localized precipitation.

**W.** **"interrupted stream"** means a stream that contains perennial reaches with intervening intermittent or ephemeral reaches.

**X.** **"interstate waters"** means all surface waters of the state which cross or form a part of the border between states.

**Y.** **"intrastate waters"** means all surface waters of the state which are not interstate waters.

**Z.** **"irrigation"** means a water of the state used as a supply of water for crops.

**AA.** **"LC-50"** means the concentration of a substance that is lethal to 50 percent of the test organisms within a defined time period. The length of the time period, which may vary from 24 hours to one week or more, depends on the test method selected to yield the information desired.

**BB.** **"limited warmwater fishery"** means a surface water of the state where intermittent flow may severely limit the ability of the reach to sustain a natural fish population on a continuous annual basis; or a surface water of the state where historical data indicate that water temperature may routinely exceed 32.2°C (90°F).

**CC.** **"livestock watering"** means a surface water of the state used as a supply of water for consumption by livestock.

**DD.** **"marginal coldwater fishery"** means a surface water of the state known to support a coldwater fish population during at least some portion of the year, even though historical data indicate that the maximum temperature in the surface water of the state may exceed 20°C (68°F).

**EE.** **"micrograms per liter (µg/L)"** means micrograms of solute per liter of solution; equivalent to parts per billion when the specific gravity of the solution = 1.000.

**FF.** **"milligrams per liter (mg/L)"** means milligrams of solute per liter of solution; equivalent to parts per million when the specific gravity of the solution = 1.000.

**GG.** **"minimum quantification level"** means the minimum quantification level for a constituent determined by official published documents of the United States environmental protection agency.

**HH.** **"natural causes"** means those causal agents which would affect water quality and the effect is not caused by human activity but is due to naturally occurring conditions.

**II.** **"nonpoint source"** means any source of pollutants not regulated as a point source which degrades the quality or adversely affects the biological, chemical, or physical integrity of surface waters of the state.

**JJ.** **"NTU"** means nephelometric turbidity units based on a standard method using formazin polymer or its equivalent as the standard reference suspension. Nephelometric turbidity measurements expressed in units of NTU are numerically identical to the same measurements expressed in units of FTU (formazin turbidity units).

**KK.** **"perennial stream"** means a stream or reach of a stream that flows continuously throughout the year in all years; its upper surface, generally, is lower than the water table of the region adjoining the stream.

**LL.** **"picocurie (pCi)"** means a measure of radioactivity equal to the quantity of a radioactive substance in which the rate of disintegrations is 2.22 per minute.

**MM.** **"point source"** means any discernible, confined, and discrete conveyance from which pollutants are or may be discharged into a surface water of the state, but does not include return flows from irrigated agriculture.

**NN.** **"primary contact"** means any recreational or other water use in which there is prolonged and intimate contact with the water, such as swimming and water skiing, involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard. Primary contact also means any use of surface waters of the state for native American traditional cultural, religious, or ceremonial purposes in which there is intimate contact with the water that involves considerable risk sufficient to pose a significant health risk. The contact may include but is not limited to ingestion or immersion.

**OO.** **"secondary contact"** means any recreational or other water use in which contact with the water may occur and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, commercial and recreational boating and any limited seasonal contact.

**PP.** **"segment"** means a water quality standards segment, the surface waters of which have common hydrologic characteristics or flow regulation regimes, possess common natural physical, chemical, and biological characteristics, and exhibit common reactions to external stresses, such as the discharge of pollutants.

**QQ.** **"state"** means the state of New Mexico.

**RR.** **"surface water(s) of the state"** means all interstate waters including interstate wetlands, and all intrastate waters, such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, reservoirs or natural ponds the use, degradation, or destruction of which would affect interstate or foreign commerce. Surface waters of the state also means all tributaries of such waters, including adjacent wetlands, and any manmade bodies of water which were originally created in surface waters of the state or resulted in the impoundment of surface waters of the state. Surface waters of the state does not include private waters that do not combine with other surface or subsurface water or any water under tribal regulatory jurisdiction pursuant to § 518 of the Clean Water Act. Waste treatment systems, including treatment ponds or lagoons designed to meet requirements of the Clean Water Act (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria of this definition), are not surface waters of the state, unless they were originally created in surface waters of the state or resulted in the impoundment of surface waters of the state.

**SS.** **"TDS"** means total dissolved solids, also termed "total filterable residue."

**TT.** **"technology-based controls"** means the application of technology-based effluent limitations as required under Section 301(b) of the federal Clean Water Act.

**UU.** **"total"** means a constituent of a water sample which is analytically determined without filtration.

**VV.** **"toxic pollutant"** means those pollutants, or combination of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either

directly from the environment or indirectly by ingestion through food chains, will cause death, disease, behavioral malfunctions or physical deformations in such organisms or their offspring.

**WW.** **"turbidity"** is an expression of the optical property in water that causes incident light to be scattered or absorbed rather than transmitted in straight lines.

**XX.** **"warmwater fishery"** means a surface water of the state where the water temperature and other characteristics are suitable for the support or propagation or both of warmwater fishes.

**YY.** **"water contaminant"** means any substance that could alter if discharged or spilled the physical, chemical, biological or radiological qualities of water. "Water contaminant" does not mean source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954, but may include all other radioactive materials, including but not limited to radium and accelerator-produced isotopes.

**ZZ.** **"water pollutant"** means a water contaminant in such quantity and of such duration as may with reasonable probability injure human health, animal or plant life or property, or to unreasonably interfere with the public welfare or the use of property.

**AAA.** **"water quality-based controls"** means effluent limitations, as provided under Section 301(b)(1)(C) of the federal Clean Water Act, which are developed and imposed on point-source dischargers in order to protect and maintain applicable water quality standards. These controls are more stringent than the technology-based effluent limitations required under other paragraphs of Section 301(b).

**BBB.** **"wetlands"** means those areas which are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions in New Mexico. Constructed wetlands used for wastewater treatment purposes are not included in this definition.

**CCC.** **"wildlife habitat"** means a surface water of the state used by plants and animals not considered as pathogens, vectors for pathogens or intermediate hosts for pathogens for humans or domesticated livestock and plants.

[20.6.4.7 NMAC – Rp 20 NMAC 6.1.1007, 10-12-00; A, 7-19-01]

**20.6.4.8 ANTIDEGRADATION POLICY AND IMPLEMENTATION PLAN:**

**A.** **Antidegradation Policy**: This antidegradation policy applies to all surface waters of the state.

**(1)** Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected in all surface waters of the state.

**(2)** Where the quality of a surface water of the state exceeds levels necessary to support the propagation of fish, shellfish, and wildlife, and recreation in and on the water, that quality shall be maintained and protected unless the commission finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the state's continuing planning process, that allowing lower water quality is necessary to accommodate important economic and social development in the area in which the water is located. In allowing such degradation or lower water quality, the state shall assure water quality adequate to protect existing uses fully. Further, the state shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable BMPs for nonpoint source control. Additionally, the state shall encourage the use of watershed planning as a further means to protect surface waters of the state.

**(3)** No degradation shall be allowed in high quality waters designated by the commission as outstanding national resource waters (ONRWs). ONRWs may include, but are not limited to, surface waters of the state within national and state monuments, parks, wildlife refuges, waters of exceptional recreational or ecological significance, and waters identified under the Wild and Scenic Rivers Act.

**(4)** In those cases where potential water quality impairment associated with a thermal discharge is involved, this antidegradation policy and implementing method shall be consistent with Section 316 of the federal Clean Water Act.

**(5)** In implementing this section, the commission through the appropriate regional offices of the United States environmental protection agency will keep the administrator advised and provided with such information concerning the surface waters of the state as he or she will need to discharge his or her responsibilities under the federal Clean Water Act.

**B.** **Procedures for nominating an ONRW**: Any person may nominate a surface water of the state for designation as an ONRW by filing a petition with the commission pursuant to the *Guidelines for water quality control commission regulation hearings*. A petition to classify a surface water of the state as an ONRW shall include:

**(1)** a map of the surface water of the state, including the location and proposed upstream and downstream boundaries;

**(2)** a written statement based on scientific principles in support of the nomination, including specific reference to the applicable criteria for ONRW;

**(3)** supporting scientific evidence demonstrating that one or more of the applicable ONRW criteria listed in Subsection C of this section has been met;

**(4)** water quality data to establish a baseline for the proposed ONRW;

**(5)** a discussion of activities that might contribute to the reduction of water quality in the proposed ONRW;

**(6)** any additional evidence to substantiate such a designation, including an analysis of the economic impact of the designation on the local and regional economy within the state of New Mexico; and

**(7)** affidavit of publication of notice of the petition in a newspaper of general circulation in the affected counties and in a newspaper of general statewide circulation.

**C.** Pursuant to a petition filed under Subsection B of this section, the commission may classify a surface water of the state as an ONRW.

**D.** **Reserved:** This subsection is reserved for a list of waters classified as ONRWs.

**E.** **Implementation Plan**: The department, acting under authority delegated by the commission, implements the water quality standards, including the antidegradation policy, by describing specific methods and procedures in the continuing planning process and by establishing and maintaining controls on the discharge of pollutants to surface waters of the state. The steps summarized in the following paragraphs, which may not all be applicable in every water pollution control action, list the implementation activities of the department. These implementation activities are supplemented by detailed antidegradation review procedures developed under the state's continuing planning process. The department:

**(1)** obtains information pertinent to the impact of the effluent on the receiving water and advises the prospective discharger of requirements for obtaining a permit to discharge;

**(2)** reviews the adequacy of the existing data base, and if additional information is needed, conducts a water quality survey of the receiving water in accordance with an annually reviewed, ranked priority list of surface waters of the state requiring total maximum daily loads pursuant to Section 303(d) of the federal Clean Water Act;

**(3)** assesses the probable impact of the effluent on the receiving water relative to its attainable or designated uses and numeric and narrative standards;

**(4)** requires the highest and best degree of wastewater treatment practicable and commensurate with protecting and maintaining the designated uses and existing water quality of surface waters of the state;

**(5)** develops water quality based effluent limitations and comments on technology based effluent limitations, as appropriate, for inclusion in any federal permit issued to a discharger pursuant to Section 402 of the federal Clean Water Act;

**(6)** requires that these effluent limitations be included in any such permit as a condition for state certification pursuant to Section 401 of the federal Clean Water Act;

**(7)** coordinates its water pollution control activities with other constituent agencies of the commission, and with local, state and federal agencies, as appropriate;

**(8)** develops and pursues inspection and enforcement programs to ensure that dischargers comply with state regulations and standards, and complements EPA's enforcement of federal permits;

**(9)** ensures that the provisions for public participation required by the New Mexico Water Quality Act and the federal Clean Water Act are followed;

**(10)** provides continuing technical training for wastewater treatment facility operators through the utility operators training and certification programs;

**(11)** provides funds to assist the construction of publicly owned wastewater treatment facilities through the wastewater construction program authorized by Section 601 of the federal Clean Water Act, and through funds appropriated by the New Mexico legislature;

**(12)** conducts water quality surveillance of the surface waters of the state to assess the effectiveness of water pollution controls, determines whether water quality standards are being attained, and proposes amendments to improve water quality standards;

**(13)** encourages, in conjunction with other state agencies, voluntary implementation of the best management practices set forth in the New Mexico statewide water quality management plan and the nonpoint source management program;

**(14)** evaluates the effectiveness of BMPs selected to prevent, reduce or abate sources of water pollutants;

**(15)** develops procedures for assessing use attainment as required by 20.6.4.14 NMAC and establishing site-specific standards; and

**(16)** develops list of surface waters of the state not attaining designated uses, pursuant to Sections 305(b) and 303(d) of the federal Clean Water Act.

[20.6.4.8 NMAC – Rp 20 NMAC 6.1.1101, 10-12-00]

**20.6.4.9 REVIEW OF STANDARDS; NEED FOR ADDITIONAL STUDIES:**

**A.** Section 303(c)(1) of the federal Clean Water Act requires that the state hold public hearings at least once every three years for the purpose of reviewing water quality standards and proposing, as appropriate, necessary revisions to water quality standards.

**B.** It is recognized that, in some cases, numeric standards have been adopted which reflect use designations rather than existing conditions of surface waters of the state. Narrative standards are required for many constituents because accurate data on background levels are lacking. More intensive water quality monitoring may identify surface waters of the state where existing quality is considerably better than the established standards. When justified by sufficient data and information, the water quality standards will be modified to protect the designated uses which are attainable.

**C.** It is also recognized that contributions of water contaminants by diffuse nonpoint sources of water pollution may make attainment of certain standards difficult. Revision of these standards may be required as new information is obtained on nonpoint sources and other problems unique to semi-arid regions.

[20.6.4.9 NMAC – Rp 20 NMAC 6.1.1102, 10-12-00]

**20.6.4.10 APPLICABILITY OF WATER QUALITY STANDARDS:**

**A. Livestock Watering and Wildlife Habitat Uses**:

**(1)** When a discharge creates a water which could be used by livestock and/or wildlife in a non-classified, otherwise ephemeral surface water of the state, such water shall be protected for the uses of livestock watering and/or wildlife habitat by the standards applicable to these uses as set forth in 20.6.4.900 NMAC.

**(2)** Designated uses of such water will be limited to livestock watering and/or wildlife habitat only when such a water does not enter a classified surface water of the state with criteria which are more restrictive than those necessary to protect livestock watering and/or wildlife habitat, except in direct response to precipitation or runoff. The commission shall adopt any additional designated uses for such surface waters of the state by rulemaking proceedings.

**(3)** When such a water, except in direct response to precipitation or runoff, enters a classified surface water of the state with criteria which are more restrictive than those necessary to protect livestock watering and/or wildlife habitat, the numeric standards established for the classified surface water of the state shall apply at the point such a water enters the classified surface water of the state. If discharge to such waters of the state ceases or is diverted elsewhere, all uses adopted under this section or subsequently under additional rulemaking proceedings for such waters of the state shall be deemed no longer designated, existing, or attainable.

**B. Critical Low Flow**: The numeric standards set under Subsection F of 20.6.4.12 NMAC, 20.6.4.101 through 20.6.4.899 NMAC and 20.6.4.900 NMAC may not be attainable when streamflow is less than the critical low flow of the stream in question. The critical low flow of a stream at a particular site shall be:

**(1)** for human health criteria, the harmonic mean flow. "Harmonic mean flow" is the number of daily flow measurements divided by the sum of the reciprocals of the flows. That is, it is the reciprocal of the mean of reciprocals. For ephemeral waters the calculation shall be based upon the nonzero flow intervals and modified by including a factor to adjust for the proportion of intervals with zero flow.

$$\text{Harmonic Mean} = \frac{n}{\sum_{i=1}^{n} 1/x}$$

$$\text{Modified Harmonic Mean} = \left[\frac{\sum_{i=1}^{Nt-No} \frac{1}{Qi}}{Nt - No}\right]^{-1} x \left[\frac{Nt - No}{Nt}\right]$$

where, Qi = nonzero flow
Nt = total number of flow values
No = number of zero flow values

**(2)** for all other narrative and numeric criteria, the minimum average four consecutive day flow which occurs with a frequency of once in three years (4Q3). Critical low-flow numeric values may be determined on an annual, a seasonal or a monthly basis, as appropriate, after due consideration of site-specific conditions.

**C. Guaranteed Minimum Flow**: On a case-by-case basis and upon consultation with the interstate stream commission, the commission may allow the use of a contractually guaranteed minimum streamflow in lieu of a critical low flow determined under Subsection B of this section. Should drought, litigation or any other reason interrupt or interfere with minimum flows under a guaranteed minimum flow contract for a period of at least thirty consecutive days, such permission, at the sole discretion of the commission, may then be revoked. Any minimum flow specified under such revoked permission shall be superseded by a critical low flow determined under Subsection B of this section. A public notice of the request for a guaranteed minimum flow shall be published in a newspaper of general circulation by the department at least 30 days prior to scheduled action by the commission. These water quality standards do not grant to the commission or any other entity the power to create, take away or modify property rights in water.

**D. Mixing Zones**: A limited mixing zone, contiguous to a point source wastewater discharge, may be allowed in any stream receiving such a discharge. Mixing zones serve as regions of initial dilution which allow the application of a dilution factor in calculations of effluent limitations. Effluent limitations shall be developed which will protect the most sensitive existing, designated or attainable use of the receiving water.

**E. Mixing Zone Limitations**: Wastewater mixing zones, in which the numeric standards set under Subsection F of 20.6.4.12 NMAC, 20.6.4.101 through 20.6.4.899 NMAC or 20.6.4.900 NMAC may be exceeded, shall be subject to the following limitations:

**(1)** Mixing zones are not allowed for discharges to publicly owned lakes, reservoirs, or playas; these effluents shall meet all applicable standards set under Subsection F of 20.6.4.12 NMAC, 20.6.4.101 through 20.6.4.899 NMAC and 20.6.4.900 NMAC at the point of discharge.

**(2)** The acute numeric standards, as set out in Paragraph (1) of Subsection J, Subsection M, Paragraph (1) of Subsection N, and Paragraph (1) of Subsection O of 20.6.4.900 NMAC, shall be attained at the point of discharge for any discharge to a surface water of the state with a designated fishery use.

**(3)** The general standards set out in Subsections A, B, C, D, E, G, H, J of 20.6.4.12 NMAC, and the provision set out in Subsection D of 20.6.4.13 NMAC are applicable within mixing zones.

**(4)** The areal extent and concentration isopleths of a particular mixing zone will depend on site-specific conditions including, but not limited to, wastewater flow, receiving water critical low flow, outfall design, channel characteristics and climatic conditions and, if needed, shall be determined on a case-by-case basis. When the physical boundaries or other characteristics of a particular mixing zone must be known, the methods presented in Section 4.4.5, "Ambient-induced mixing," in "Technical support document for water quality-based toxics control" (March 1991, EPA/505/2-90-001) shall be used.

**(5)** All applicable water quality standards set under Subsection F of 20.6.4.12 NMAC, 20.6.4.101 through 20.6.4.899 NMAC and 20.6.4.900 NMAC, except Paragraph (1) of Subsection J, acute aquatic life criteria of Subsection M, Paragraph (1) of Subsection N, and Paragraph (1) of Subsection O of 20.6.4.900 NMAC, shall be attained at the boundaries of mixing zones. A continuous zone of passage through or around the mixing zone shall be maintained in which the water quality meets all applicable standards and allows the migration of aquatic life presently common in surface waters of the state with no effect on their populations.

**F. Multiple Uses**: When a classified water of the state has more than a single designated use, the applicable numeric standards shall be the most stringent of those established for such classified water.

**G.** Human health standards shall apply to those waters with a designated, existing or attainable fishery use. The human health standards for persistent toxic pollutants, as identified in Subsection M of Section 20.6.4.900 NMAC, shall also apply to all tributaries of waters with a designated, existing or attainable fishery use. [20.6.4.10 NMAC – Rp 20 NMAC 6.1.1103, 10-12-00; A, 10-11-02]

**20.6.4.11 COMPLIANCE WITH WATER QUALITY STANDARDS:**

**A.** Compliance with acute water quality standards shall be determined from the analytical results of a single grab sample. Acute standards shall not be exceeded.

**B.** Compliance with chronic water quality standards shall be determined from the arithmetic mean of the analytical results of samples collected using applicable protocols. Chronic standards shall not be exceeded more than once every three years.

**C.** Compliance with water quality standards for total ammonia shall be determined by performing the biomonitoring procedures set out in Subsections D and E of 20.6.4.13 NMAC, or by attainment of applicable ammonia standards set out in Subsections N and O of 20.6.4.900 NMAC.

**D.** Compliance with water quality standards for the protection of human health shall be determined from the analytical results of representative grab samples, as defined in the water quality management plan. Human health standards shall not be exceeded.

**E.** The commission may establish a numeric water quality standard at a concentration that is below the minimum quantification level. In such cases, the water quality standard is enforceable at the minimum quantification level.

**F.** In determining compliance with standards for chromium an analysis which measures both the trivalent and hexavalent ions shall be used.

**G.** For compliance with numeric standards dependent on hardness, hardness (as mg $CaCO_3$/L) shall be determined from a sample taken at the same time that the sample for the water contaminant is taken, or from available verifiable data sources including, but not limited to, the U.S. environmental protection agency's STORET water quality database.

**H.** The hardness-dependent formulae for metals shall be valid only for hardness values of 0-400 mg/L. For values above 400 mg/L, the value for 400 mg/L shall apply.

**I.** The total ammonia tables shall be valid only for temperatures of 0 to 30°C and for pH values of 6.5 to 9.0. For temperatures below 0°C, the total ammonia standards for 0°C shall apply; for temperatures above 30°C, the total ammonia standards for 30°C shall apply. For pH values below 6.5, the total ammonia standards for 6.5 shall apply; for pH values above 9.0, the total ammonia standards for 9.0 shall apply.

**J.** **Compliance Schedules**: It shall be the policy of the commission to allow on a case-by-case basis the inclusion of a schedule of compliance in a national pollutant discharge elimination system (NPDES) permit issued to an existing facility. Such schedule of compliance will be for the purpose of providing a permittee with adequate time to make treatment facility modifications necessary to comply with water quality based permit limitations determined to be necessary to implement new or revised water quality standards. Compliance schedules may be included in NPDES permits at the time of permit renewal or modification and shall be written to require compliance at the earliest practicable time. Compliance schedules shall also specify milestone dates so as to measure progress towards final project completion (e.g., design completion, construction start, construction completion, date of compliance).

[20.6.4.11 NMAC – Rp 20 NMAC 6.1.1104, 10-12-00; A, 10-11-02]

**20.6.4.12** **GENERAL STANDARDS:** General standards are established to sustain and protect existing or attainable uses of surface waters of the state. These general standards apply to all surface waters of the state at all times, unless a specified standard is provided elsewhere in this part. Surface waters of the state shall be free of any water contaminant in such quantity and of such duration as may with reasonable probability injure human health, animal or plant life or property, or unreasonably interfere with the public welfare or the use of property. When changes in dissolved oxygen, temperature, dissolved solids, sediment or turbidity in a water of the state is attributable to natural causes or the reasonable operation of irrigation and flood control facilities that are not subject to federal or state water pollution control permitting, numerical standards for temperature, dissolved solids content, dissolved oxygen, sediment or turbidity adopted under the Water Quality Act do not apply. The foregoing provision does not include major reconstruction of storage dams or diversion dams except for emergency actions necessary to protect health and safety of the public, or discharges from municipal separate storm sewers.

**A.** **Bottom Deposits**: Surface waters of the state shall be free of water contaminants from other than natural causes that will settle and damage or impair the normal growth, function, or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.

**B.** **Floating Solids, Oil and Grease**: Surface waters of the state shall be free of oils, scum, grease and other floating materials resulting from other than natural causes that would cause the formation of a visible sheen or visible deposits on the bottom or shoreline, or would damage or impair the normal growth, function or reproduction of human, animal, plant or aquatic life.

**C.** **Color**: Color-producing materials resulting from other than natural causes shall not create an aesthetically undesirable condition nor shall color impair the use of the water by desirable aquatic life presently common in surface waters of the state.

**D.** **Odor and Taste of Fish**: Water contaminants from other than natural causes shall be limited to concentrations that will not impart unpalatable flavor to fish, or result in offensive odor arising in a surface water of the state or otherwise interfere with the reasonable use of the water.

**E.** **Plant Nutrients**: Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in a dominance of nuisance species in surface waters of the state.

**F. Toxic Pollutants:**

**(1)** Surface waters of the state shall be free of toxic pollutants from other than natural causes in amounts, concentrations or combinations which affect the propagation of fish or which are toxic to humans, livestock or other animals, fish or other aquatic organisms, wildlife using aquatic environments for habitation or aquatic organisms for food, or which will or can reasonably be expected to bioaccumulate in tissues of fish, shellfish and other aquatic organisms to levels which will impair the health of aquatic organisms or wildlife or result in unacceptable tastes, odors or health risks to human consumers of aquatic organisms.

**(2)** Pursuant to this section, the human health criteria shall be as set out in 20.6.4.900 NMAC. For a toxic pollutant for human health not listed in 20.6.4.900 NMAC, the following provisions shall be applied in accordance with 20.6.4.10, 20.6.4.11 and 20.6.4.13 NMAC.

**(a)** The human health criterion shall be the recommended human health criterion for "consumption of organisms only" published by the U.S. environmental protection agency pursuant to Section 304(a) of the federal Clean Water Act. In determining such criterion for a cancer-causing toxic pollutant, a cancer risk of $10^{-5}$ (one cancer per 100,000 exposed persons) shall be used.

**(b)** When a numeric criterion for the protection of human health has not been published by the U.S. environmental protection agency, a quantifiable criterion may be derived from data available in the U.S. environmental protection agency's Integrated Risk Information System (IRIS).

**(3)** Pursuant to this section, the chronic aquatic life standard shall be as set out in 20.6.4.900 NMAC. For a toxic pollutant for aquatic life with no chronic standard listed in 20.6.4.900 NMAC, the following provisions shall be applied in sequential order in accordance with 20.6.4.10, 20.6.4.11 and 20.6.4.13 NMAC.

**(a)** The chronic aquatic life criterion shall be the "freshwater criterion continuous concentration" published by the U.S. environmental protection agency pursuant to Section 304(a) of the federal Clean Water Act;

**(b)** If the U.S. environmental protection agency has not published a chronic aquatic life criterion, a geometric mean LC-50 value shall be calculated for the particular species, genus or group, which is representative of the form of life to be preserved, using the results of toxicological studies published in scientific journals.

**(i)** The chronic aquatic life criterion for a toxic pollutant which does not bioaccumulate shall be 10 percent of the calculated geometric mean LC-50 value; and

**(ii)** The chronic aquatic life criterion for a toxic pollutant which does bioaccumulate shall be: the calculated geometric mean LC-50 adjusted by a bioaccumulation factor for the particular species, genus or group representative of the form of life to be preserved, but when such bioaccumulation factor has not been published, the criterion shall be one percent of the calculated geometric mean LC-50 value.

**(4)** Pursuant to this section, the acute aquatic life criteria shall be as set out in 20.6.4.900 NMAC. For a toxic pollutant for aquatic life with no acute criterion listed in 20.6.4.900 NMAC, the acute aquatic life criterion shall be the "freshwater criterion maximum concentration" published by the U.S. environmental protection agency pursuant to Section 304(a) of the federal Clean Water Act.

**(5)** Within 90 days of the issuance of a final NPDES permit containing a numeric criterion selected or calculated pursuant to Paragraph 2, Paragraph 3 or Paragraph 4 of Subsection F of this section, the Department shall petition the Commission to adopt such criterion into these standards.

**(6)** The use of a piscicide registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. Section 136 *et seq.*, and under the New Mexico Pesticide Control Act (NMPCA), Section 76-4-1 *et seq.* NMSA 1978 (1973), shall not be a violation of Subsection F of this section when such use has been approved by the commission. Any person seeking commission approval of the use of a piscicide shall file a written petition with the commission. The petition shall contain, at a minimum, the following information: (1) petitioner's name and address; (2) identity of the piscicide; (3) documentation of registration under FIFRA and NMPCA; (4) target and potential non-target species, including threatened or endangered species; (5) potential environmental consequences and protocols for limiting such impacts; (6) affected surface water of the state; (7) results of pre-treatment survey; (8) evaluation of available alternatives and justification for selecting piscicide use; (9) post-treatment assessment monitoring protocol; and (10) any other information required by the commission. The commission shall review the petition and require a public hearing in the locality affected by the proposed use in accordance with Adjudicatory Procedures, 20.1.3 NMAC. In addition to the public notice requirements in Adjudicatory Procedures, 20.1.3 NMAC, the petitioner shall provide written notice to (1) local political subdivisions; (2) local water planning entities; (3) local conservancy and irrigation districts; and (4) local media outlets, except that the petitioner shall only be required to publish notice in a newspaper of circulation in the locality affected by the proposed use. After a public hearing, the commission may grant the petition in whole or in part, may

grant the petition subject to conditions, or may deny the petition. In granting any petition in whole or part or subject to conditions, the commission shall require the petitioner to implement post-treatment assessment monitoring.

**G. Radioactivity**: The radioactivity of surface waters of the state shall be maintained at the lowest practical level and shall in no case exceed the standards set forth in the New Mexico Radiation Protection Regulations, 20.3.1.400 through 20.3.1.499 NMAC (5-3-95).

**H. Pathogens**: Surface waters of the state shall be virtually free of pathogens. In particular, surface waters of the state used for irrigation of table crops such as lettuce shall be virtually free of *Salmonella* and *Shigella* species.

**I. Temperature**: Maximum temperatures for each classified water of the state have been specified in 20.6.4.101 through 20.6.4.899 NMAC. However, the introduction of heat by other than natural causes shall not increase the temperature, as measured from above the point of introduction, by more than 2.7°C (5°F) in a stream, or more than 1.7°C (3°F) in a lake or reservoir. In no case will the introduction of heat be permitted when the maximum temperature specified for the reach (generally 20°C (68°F) for coldwater fisheries and 32.2°C (90°F) for warmwater fisheries) would thereby be exceeded. These temperature standards shall not apply to impoundments constructed offstream for the purpose of heat disposal. High water temperatures caused by unusually high ambient air temperatures are not violations of these standards.

**J. Turbidity**: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function, or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water.

**K. Salinity**: Where existing information is sufficient, numerical standards for TDS (or conductivity), chlorides and sulfates, have been adopted in 20.6.4.101 through 20.6.4.899 NMAC. The following standards apply at the downstream point of the reach in which they are set:

**(1)** For the tributaries of the Colorado river system, the state of New Mexico will cooperate with the Colorado river basin states and the federal government to support and implement the salinity policy and program outlined in the report "1999 Review, water quality standards for salinity, Colorado river system."

**(2)** Numeric criteria for salinity are established at three points in the Colorado river basin as follows: below Hoover dam, 723 mg/L; below Parker dam, 747 mg/L; and at Imperial dam, 879 mg/L.

**(3)** As a part of the program, objectives for New Mexico shall include the elimination of discharges of water containing solids in solution as a result of the use of water to control or convey fly ash from coal-fired electric generators, wherever practicable.

**(4)** In determining compliance with the numeric criteria hereby adopted, salinity (TDS) shall be determined by either the "calculation method" (sum of constituents) or the filterable residue method. Approved test procedures for these determinations are as set forth in 20.6.4.13 NMAC.

**L. Dissolved Gases**: Surface waters of the state shall be free of nitrogen and other dissolved gases at levels above 110 percent saturation when this supersaturation is attributable to municipal, industrial or other discharges.

[20.6.4.12 NMAC – Rp 20 NMAC 6.1.1105, 10-12-00; A, 10-11-02 ]

**20.6.4.13 SAMPLING AND ANALYSIS:**

**A.** All methods of sample collection, preservation and analysis used in determining water quality and maintenance of these standards shall be in accordance with approved or accepted test procedures published in "Guidelines establishing test procedures for the analysis of pollutants under the Clean Water Act," 40 CFR Part 136, or any test procedure approved or accepted by EPA using procedures provided in 40 CFR Parts 136.3(d), 136.4, and 136.5. Test procedures approved or accepted under 40 CFR Part 136 are published in the references cited herein and in other references.

**(1)** "Standard methods for the examination of water and wastewater," American public health association.

**(2)** "Methods for chemical analysis of water and wastes," U.S. environmental protection agency.

**(3)** "Methods for determination of inorganic substances in water and fluvial sediments," techniques of water-resource investigations of the U.S. geological survey.

**(4)** "Methods for the determination of organic substances in water and fluvial sediments," techniques of water-resource investigations of the U.S. geological survey.

**B. Bacteriological Surveys**: The monthly geometric mean shall be used in assessing attainment of standards when a minimum of five samples is collected in a 30-day period.

**C. Sampling Procedures**:

(1) Streams: Stream monitoring stations below waste discharges shall be located a sufficient distance downstream to ensure adequate vertical and lateral mixing.

(2) Lakes: Sampling stations in lakes shall be located at least 250 feet from a waste discharge.

(3) Lakes: Except for the restriction specified in Paragraph (2) of this subsection, lake sampling stations shall be located at any site where the attainment of a water quality standard is to be assessed. Water quality measurements taken at intervals in the entire water column at a sampling station shall be averaged for the epilimnion, or in the absence of an epilimnion, for the upper one-third of the water column of the lake to determine attainment of standards, except that attainment of standards for toxic pollutants shall be assessed during periods of complete vertical mixing, e.g., during spring or fall turnover, or by taking depth-integrated composite samples of the water column.

**D.** Acute toxicity of effluent to aquatic life shall be determined using the procedures specified in U.S. environmental protection agency "Methods for measuring the acute toxicity of effluents to freshwater and marine organisms" (4th Ed., 1991, EPA/600/4-90/027), or latest edition thereof, which is incorporated herein by reference. Acute toxicities of substances shall be determined using at least two species tested in whole effluent and a series of effluent dilutions. Acute toxicity due to discharges shall not occur within the wastewater mixing zone in any surface water of the state with an existing or designated fishery use.

**E.** Chronic toxicity of effluent or ambient surface waters of the state to aquatic life shall be determined using the procedures specified in U.S. environmental protection agency "Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms" (2nd Ed., 1989, EPA 600/4-89/001), or latest edition thereof, which is incorporated herein by reference. Chronic toxicities of substances shall be determined using at least two species tested in ambient surface water or whole effluent and a series of effluent dilutions. Chronic toxicity due to discharges shall not occur at the critical low flow, or any flow greater than the critical low flow, in any surface water of the state with an existing or designated fishery use more than once every three years.

[20.6.4.13 NMAC – Rp 20 NMAC 6.1.1106, 10-12-00]

**20.6.4.14 USE ATTAINABILITY ANALYSIS:**

**A.** A use attainability analysis is a scientific study which shall be conducted only for the purpose of assessing the factors affecting the attainment of a use. Whenever a use attainability analysis is conducted, it shall be subject to the requirements and limitations set forth in 40 CFR Part 131, Water Quality Standards; specifically, Subsections 131.3(g), 131.10(g), 131.10(h) and 131.10(j) shall be applicable as follows:

(1) The department must conduct a use attainability analysis whenever it proposes to classify a surface water of the state with designated uses which do not include the uses specified in Section 101(a)(2) of the federal Clean Water Act. Section 101(a)(2) uses are also specified in Subsection B of 20.6.4.6 NMAC.

(2) A designated use cannot be removed if it is an existing use.

(3) A use attainability analysis or an equivalent study approved by the department and the regional administrator must be conducted to remove any non-existing designated use from any classified waters of the state.

**B.** Any person proposing to conduct a use attainability analysis or equivalent study shall publish notice of this intent in a newspaper of local and statewide circulation. The cost of publication shall be the responsibility of the person proposing such action. The notice shall describe the surface water of the state and uses to be assessed, identify the persons to contact for complete information, and describe how interested persons can participate in the use attainability analysis or equivalent study.

C. Any person may submit a petition to the department stating that they intend to conduct a use attainability analysis or equivalent study. At a minimum, the department, the New Mexico game and fish department, the state engineer and the U.S. fish and wildlife service shall be consulted during the development of a work plan for such analysis or equivalent study. The petitioner shall develop a work plan to conduct the use attainability analysis or equivalent study and shall submit the work plan to the department and the regional administrator of the EPA for review and approval. A copy of the petition and the work plan must be submitted concurrently to the commission. Upon approval of the work plan by the department and the regional administrator, the petitioner shall conduct the use attainability analysis or equivalent study in accordance with the approved work plan. The cost of such analysis or equivalent study shall be the responsibility of the petitioner.

**D.** Physical, chemical and biological evaluations of surface waters of the state other than lakes and reservoirs for purposes of use attainability analyses or equivalent studies shall be conducted according to the procedures outlined in the "Technical support manual: waterbody surveys and assessments for conducting use attainability analyses," United States environmental protection agency, office of water, regulations and standards,

Washington, D.C., November 1983, or latest edition thereof, which is incorporated herein by reference, or an alternative equivalent study methodology approved by the department.

**E.** Physical, chemical and biological evaluations of lakes and reservoirs for purposes of use attainability analyses or equivalent studies shall be conducted according to the procedures outlined in the "Technical support manual: waterbody surveys and assessments for conducting use attainability analyses, volume III: lake systems," United States environmental protection agency, office of water, regulations and standards, Washington, D.C., November 1984, or latest edition thereof, which is incorporated herein by reference, or an alternative equivalent study methodology approved by the department.

**F.** A use attainability analysis or equivalent study should include any applicable information concerning the following:

**(1)** identification of existing uses of the surface water of the state to be reviewed which have existed since 1975;

**(2)** an evaluation of the best water quality attained in the surface water of the state to be reviewed which has existed since 1975;

**(3)** a technological analysis which identifies available treatment options for point and nonpoint sources to meet applicable water quality standards for the designated uses;

**(4)** an economic analysis which evaluates social and economic impacts associated with available treatment options;

**(5)** a physical and biological evaluation of the surface water of the state to be reviewed to identify any factors unrelated to water quality which impair attainment of designated uses and to determine which designated uses are feasible to attain in such surface water of the state given existing physical limitations;

**(6)** an evaluation of the water chemistry of the surface water of the state to be reviewed to identify chemical constituents which impair the designated uses which are feasible to attain in such water; and

**(7)** an evaluation of the aquatic and terrestrial biota utilizing the surface water of the state to determine resident species and which species could potentially exist in such water if physical and chemical factors impairing a designated use are corrected.

**G.** Upon completion of the use attainability analysis or equivalent study, the petitioner shall submit to the department and the commission the data and their findings and conclusions. If the department determines that the analysis or equivalent study was conducted in accordance with the approved work plan and the findings and conclusions are based upon sound scientific rationale, and demonstrates that it is not feasible to attain the designated use, the department shall request authority from the commission to initiate rulemaking proceedings to modify the designated use for the surface water of the state that was reviewed.
[20.6.4.14 NMAC – Rp 20 NMAC 6.1.1107, 10-12-00]

**20.6.4.15 – 20.6.4.100: [RESERVED]**

**20.6.4.101 RIO GRANDE BASIN - The main stem of the Rio Grande from the international boundary and water commission sampling station above American dam upstream to one mile below Percha dam.** (Sustained flow in the Rio Grande below Caballo reservoir is dependent on release from Caballo reservoir during the irrigation season; at other times of the year, there may be little or no flow.)

**A. Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 34°C (93.2°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

**(3)** At mean monthly flows above 350 cfs, the monthly average concentration for: TDS shall not exceed 2,000 mg/L, sulfate shall not exceed 500 mg/L, and chlorides shall not exceed 400 mg/L.
[20.6.4.101 NMAC – Rp 20 NMAC 6.1.2101, 10-12-00; A, 12-15-01]

**20.6.4.102 RIO GRANDE BASIN - The main stem of the Rio Grande from one mile below Percha dam upstream to the headwaters of Caballo reservoir including Caballo reservoir.** (Sustained flow in the Rio Grande below Caballo reservoir is dependent on release from Caballo reservoir during the irrigation season; at other times of the year, there may be little or no flow.)

**A.** **Designated Uses**: irrigation, livestock watering, wildlife habitat, primary contact, and warmwater fishery.

**B.** **Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.102 NMAC – Rp 20 NMAC 6.1.2102, 10-12-00]

**20.6.4.103** **RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Caballo lake upstream to Elephant Butte dam and perennial reaches of tributaries to the Rio Grande in Sierra and Socorro counties.** (Flow in this reach of the Rio Grande main stem is dependent upon release from Elephant Butte dam.)

**A.** **Designated Uses**: fish culture, irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, secondary contact, and warmwater fishery.

**B.** **Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.103 NMAC – Rp 20 NMAC 6.1.2103, 10-12-00]

**20.6.4.104** **RIO GRANDE BASIN - Elephant Butte reservoir.**

**A.** **Designated Uses**: irrigation storage, livestock watering, wildlife habitat, primary contact, and warmwater fishery.

**B.** **Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.104 NMAC – Rp 20 NMAC 6.1.2104, 10-12-00]

**20.6.4.105** **RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Elephant Butte reservoir upstream to Alameda bridge (Corrales bridge), the Jemez river from the Jemez pueblo boundary upstream to the Rio Guadalupe, and intermittent flow below the perennial reaches of the Rio Puerco and Jemez river which enters the main stem of the Rio Grande.**

**A.** **Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B.** **Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

**(3)** At mean monthly flows above 100 cfs, the monthly average concentration for: TDS shall not exceed 1,500 mg/L, sulfate shall not exceed 500 mg/L, and chloride shall not exceed 250 mg/L.

[20.6.4.105 NMAC – Rp 20 NMAC 6.1.2105, 10-12-00]

**20.6.4.106** **RIO GRANDE BASIN - The main stem of the Rio Grande from Alameda bridge (Corrales bridge) upstream to the Angostura diversion works.**

**A.** **Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B.** **Standards**:

**(1)** In any single sample: dissolved oxygen shall be greater than 5.0 mg/L, pH shall be within the range of 6.6 to 9.0, and temperature shall be less than 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

**(3)** At mean monthly flows above 100 cfs, the monthly average concentration for: TDS shall be less than 1,500 mg/L, sulfate shall be less than 500 mg/L, and chloride shall be less than 250 mg/L.

[20.6.4.106 NMAC – Rp 20 NMAC 6.1.2105.1, 10-12-00]

**20.6.4.107 RIO GRANDE BASIN - The Jemez river from its confluence with the Rio Guadalupe upstream to state highway 4 near the town of Jemez Springs and perennial reaches of Vallecito creek.**

**A. Designated Uses**: coldwater fishery, primary contact, irrigation, livestock watering, and wildlife habitat.

**B. Standards**:

**(1)** In any single sample: temperature shall not exceed 25°C (77°F), pH shall be within the range of 6.6 to 8.8, and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.107 NMAC – Rp 20 NMAC 6.1.2105.5, 10-12-00]

**20.6.4.108 RIO GRANDE BASIN - The Jemez river and all its tributaries above state highway 4 near the town of Jemez Springs, and the Guadalupe river and all its tributaries.**

**A. Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 400 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.108 NMAC – Rp 20 NMAC 6.1.2106, 10-12-00]

**20.6.4.109 RIO GRANDE BASIN - Perennial reaches of Bluewater creek, Rio Moquino, Seboyeta creek, Rio Paguate, the Rio Puerco within the Santa Fe national forest, and all other perennial reaches of tributaries to the Rio Puerco including the Rio San Jose in Cibola county from the USGS gaging station at Correo upstream to Horace springs.**

**A. Designated Uses**: coldwater fishery, domestic water supply, fish culture, irrigation, livestock watering, wildlife habitat, and primary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), total phosphorus (as P) shall not exceed 0.1 mg/L, and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.109 NMAC – Rp 20 NMAC 6.1.2107, 10-12-00]

**20.6.4.110 RIO GRANDE BASIN - The main stem of the Rio Grande from Angostura diversion works upstream to Cochiti dam.**

**A. Designated Uses**: irrigation, livestock watering, wildlife habitat, secondary contact, coldwater fishery, and warmwater fishery.

**B. Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.110 NMAC – Rp 20 NMAC 6.1.2108, 10-12-00]

**20.6.4.111 RIO GRANDE BASIN - Perennial reaches of Las Huertas and San Pedro creeks.**

**A. Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.111 NMAC – Rp 20 NMAC 6.1.2108.5, 10-12-00; A, 7-25-01]

**20.6.4.112 RIO GRANDE BASIN - Cochiti reservoir.**

**A. Designated Uses**: livestock watering, wildlife habitat, warmwater fishery, coldwater fishery, and primary contact.

**B. Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 25°C (77°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.112 NMAC – Rp 20 NMAC 6.1.2109, 10-12-00]

**20.6.4.113 RIO GRANDE BASIN - The Santa Fe river and its tributaries from Cochiti reservoir upstream to the outfall of the Santa Fe wastewater treatment facility.**

**A. Designated Uses**: irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, secondary contact, and warmwater fishery.

**B. Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 30°C (86°F), turbidity shall not exceed 50 NTU, and dissolved oxygen shall not be less than 4.0 mg/L. Dissolved oxygen shall not be less than 5.0 mg/L as a 24-hour average. Values used in the calculation of the 24-hour average for dissolved oxygen shall not exceed the dissolved oxygen saturation value. For a measured value above the dissolved oxygen saturation value, the dissolved oxygen saturation value will be used in calculating the 24-hour average. The dissolved oxygen saturation value shall be determined from the table set out in Subsection P of 20.6.4.900 NMAC. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.113 NMAC – Rp 20 NMAC 6.1.2110, 10-12-00; A, 10-11-02]

**20.6.4.114 RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Cochiti reservoir upstream to Taos Junction bridge, Embudo creek from its mouth on the Rio Grande upstream to the junction of the Rio Pueblo and the Rio Santa Barbara, the Santa Cruz river below Santa Cruz dam, the Rio Tesuque below the Santa Fe national forest and the Pojoaque river below Nambe dam.**

**A. Designated Uses**: irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, primary contact, and warmwater fishery.

**B. Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 22°C (71.6°F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

(3) At mean monthly flows above 100 cfs, the monthly average concentration for: TDS shall not exceed 500 mg/L, sulfate shall not exceed 150 mg/L, and chloride shall not exceed 25 mg/L.

[20.6.4.114 NMAC – Rp 20 NMAC 6.1.2111, 10-12-00]

**20.6.4.115 RIO GRANDE BASIN - The perennial reaches of Rio Vallecitos and its tributaries, and Rio del Oso, and El Rito creek above the town of El Rito.**

A. **Designated Uses**: domestic water supply, irrigation, high quality coldwater fishery, livestock watering, wildlife habitat, and secondary contact.

B. **Standards**:

(1) In any single sample: conductivity shall not exceed 300 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.115 NMAC – Rp 20 NMAC 6.1.2112, 10-12-00]

**20.6.4.116 RIO GRANDE BASIN - The Rio Chama from its mouth on the Rio Grande upstream to Abiquiu reservoir, the Rio Tusas, the Rio Ojo Caliente, Abiquiu creek, and El Rito creek below the town of El Rito.**

A. **Designated Uses**: irrigation, livestock watering, wildlife habitat, coldwater fishery, warmwater fishery, and secondary contact.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 31°C (87.8°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.116 NMAC – Rp 20 NMAC 6.1.2113, 10-12-00]

**20.6.4.117 RIO GRANDE BASIN - Abiquiu reservoir.**

A. **Designated Uses**: irrigation storage, livestock watering, wildlife habitat, primary contact, coldwater fishery, and warmwater fishery.

B. **Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.117 NMAC – Rp 20 NMAC 6.1.2114, 10-12-00]

**20.6.4.118 RIO GRANDE BASIN - The Rio Chama from the headwaters of Abiquiu reservoir upstream to El Vado reservoir and the Rio Gallina and Rio Puerco de Chama north of state highway 96.**

A. **Designated Uses**: irrigation, livestock watering, wildlife habitat, coldwater fishery, warmwater fishery, and secondary contact.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 26°C (78.8°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.118 NMAC – Rp 20 NMAC 6.1.2115, 10-12-00]

**20.6.4.119 RIO GRANDE BASIN - All perennial reaches of tributaries to the Rio Chama above Abiquiu dam except the Rio Gallina and Rio Puerco de Chama north of state highway 96 and the main stem of the Rio Chama from the headwaters of El Vado reservoir upstream to the New Mexico-Colorado line.**

**A. Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 500 µmhos (1,000 µmhos for Coyote creek), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.119 NMAC – Rp 20 NMAC 6.1.2116, 10-12-00]

**20.6.4.120 RIO GRANDE BASIN - El Vado and Heron reservoirs.**

**A. Designated Uses**: irrigation storage, livestock watering, wildlife habitat, primary contact, and coldwater fishery.

**B. Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.120 NMAC – Rp 20 NMAC 6.1.2117, 10-12-00]

**20.6.4.121 RIO GRANDE BASIN - Perennial tributaries to the Rio Grande in Bandelier national monument and their headwaters in Sandoval county, all perennial reaches of tributaries to the Rio Grande in Santa Fe county unless included in other segments.**

**A. Designated Uses**: domestic water supply, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, secondary contact, and primary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 300 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.121 NMAC – Rp 20 NMAC 6.1.2118, 10-12-00]

**20.6.4.122 RIO GRANDE BASIN - The main stem of the Rio Grande from Taos Junction bridge upstream to the New Mexico-Colorado line, the Red river from its mouth on the Rio Grande upstream to the mouth of Placer creek, and the Rio Pueblo de Taos from its mouth on the Rio Grande upstream to the mouth of the Rio Grande del Rancho.**

**A. Designated Uses**: coldwater fishery, fish culture, irrigation, livestock watering, wildlife habitat, and primary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.122 NMAC – Rp 20 NMAC 6.1.2119, 10-12-00]

**20.6.4.123 RIO GRANDE BASIN - The Red river upstream of the mouth of Placer creek, all tributaries to the Red river, and all other perennial reaches of tributaries to the Rio Grande in Taos and Rio Arriba counties unless included in other segments.**

A. **Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

B. **Standards**:

(1) In any single sample: conductivity shall not exceed 400 µmhos (500 µmhos for the Rio Fernando de Taos), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.123 NMAC – Rp 20 NMAC 6.1.2120, 10-12-00]

**20.6.4.124 – 20.6.4.200: [RESERVED]**

**20.6.4.201 PECOS RIVER BASIN - The main stem of the Pecos river from the New Mexico-Texas line upstream to the mouth of the Black river (near Loving).**

A. **Designated Uses**: irrigation, livestock watering, wildlife habitat, secondary contact, and warmwater fishery.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0 and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

(3) At all flows above 50 cfs: TDS shall not exceed 20,000 mg/L, sulfate shall not exceed 3,000 mg/L, and chloride shall not exceed 10,000 mg/L.

[20.6.4.201 NMAC – Rp 20 NMAC 6.1.2201, 10-12-00]

**20.6.4.202 PECOS RIVER BASIN - The main stem of the Pecos river from the mouth of the Black river upstream to lower Tansil dam (diversion for irrigation frequently limits summer flow in this reach to that contributed by springs along the watercourse), including the Black river, the Delaware river and Blue spring.**

A. **Designated Uses**: industrial water supply, irrigation, livestock watering, wildlife habitat, secondary contact, and warmwater fishery.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 34°C (93.2°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

(3) At all flows above 50 cfs: TDS shall not exceed 8,500 mg/L, sulfate shall not exceed 2,500 mg/L, and chloride shall not exceed 3,500 mg/L.

[20.6.4.202 NMAC – Rp 20 NMAC 6.1.2202, 10-12-00]

**20.6.4.203 PECOS RIVER BASIN - The main stem of the Pecos river from lower Tansil dam upstream to Avalon dam, including Tansil lake.**

A. **Designated Uses**: industrial water supply, livestock watering, wildlife habitat, primary contact, and warmwater fishery.

B. **Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 34°C (93.2°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.203 NMAC – Rp 20 NMAC 6.1.2203, 10-12-00]

**20.6.4.204 PECOS RIVER BASIN - The main stem of the Pecos river from Avalon dam upstream to Brantley dam, including Avalon reservoir.**

**A. Designated Uses**: irrigation storage, livestock watering, wildlife habitat, secondary contact, and warmwater fishery.

**B. Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.204 NMAC – Rp 20 NMAC 6.1.2204, 10-12-00]

**20.6.4.205 PECOS RIVER BASIN - Brantley reservoir.**

**A. Designated Uses**: irrigation storage, livestock watering, wildlife habitat, primary contact, and warmwater fishery.

**B. Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.205 NMAC – Rp 20 NMAC 6.1.2205, 10-12-00]

**20.6.4.206 PECOS RIVER BASIN - The main stem of the Pecos river from the headwaters of Brantley reservoir upstream to Salt creek (near Acme), the Rio Peñasco downstream from state highway 24 near Dunken, any flow at the mouth of the Rio Hondo and any flow from the Rio Felix which enters the main stem of the Pecos river.**

**A. Designated Uses**: irrigation, livestock watering, wildlife habitat, secondary contact, and warmwater fishery.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0 and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

**(3)** At all flows above 50 cfs: TDS shall not exceed 14,000 mg/L, sulfate shall not exceed 3,000 mg/L, and chloride shall not exceed 6,000 mg/L.

[20.6.4.206 NMAC – Rp 20 NMAC 6.1.2206, 10-12-00]

**20.6.4.207 PECOS RIVER BASIN - The main stem of the Pecos river from Salt creek (near Acme) upstream to Sumner dam.**

**A. Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0 and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

**(3)** At all flows above 50 cfs: TDS shall not exceed 8,000 mg/L, sulfate shall not exceed 2,500 mg/L, and chloride shall not exceed 4,000 mg/L.

[20.6.4.207 NMAC – Rp 20 NMAC 6.1.2207, 10-12-00]

**20.6.4.208 PECOS RIVER BASIN - Perennial reaches of the Rio Peñasco and its tributaries above state highway 24 near Dunken, perennial reaches of the Rio Bonito downstream from state highway 48 (near**

**Angus), the Rio Ruidoso downstream of the U.S. highway 70 bridge near Seeping Springs lakes, perennial reaches of the Rio Hondo, and Agua Chiquita.**

**A. Designated Uses**: fish culture, irrigation, livestock watering, wildlife habitat, coldwater fishery, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 30°C (86°F) and total phosphorus (as P) shall be less than 0.1 mg/L. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.208 NMAC – Rp 20 NMAC 6.1.2208, 10-12-00]

**20.6.4.209 PECOS RIVER BASIN - Eagle creek above Alto reservoir, the Rio Bonito upstream of state highway 48 (near Angus), and the Rio Ruidoso and its tributaries upstream of the U.S. highway 70 bridge near Seeping Springs lakes.**

**A. Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 600 µmhos in Eagle creek, 1,100 µmhos in Bonito creek, and 1,500 µmhos in the Rio Ruidoso, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.209 NMAC – Rp 20 NMAC 6.1.2209, 10-12-00]

**20.6.4.210 PECOS RIVER BASIN - Sumner reservoir.**

**A. Designated Uses**: irrigation storage, livestock watering, wildlife habitat, primary contact, and warmwater fishery.

**B. Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.210 NMAC – Rp 20 NMAC 6.1.2210, 10-12-00]

**20.6.4.211 PECOS RIVER BASIN - The main stem of the Pecos river from the headwaters of Sumner reservoir upstream to Anton Chico.**

**A. Designated Uses**: fish culture, irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0 and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

**(3)** At all flows above 50 cfs: TDS shall not exceed 3,000 mg/L, sulfate shall not exceed 2,000 mg/L, and chloride shall not exceed 400 mg/L.

[20.6.4.211 NMAC – Rp 20 NMAC 6.1.2211, 10-12-00]

**20.6.4.212 PECOS RIVER BASIN - Perennial tributaries to the main stem of the Pecos river from the headwaters of Sumner reservoir upstream to Santa Rosa dam.**

**A. Designated Uses**: irrigation, coldwater fishery, livestock watering, wildlife habitat, and primary contact.

**B. Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 8.8 and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.212 NMAC – Rp 20 NMAC 6.1.2211.1, 10-12-00]

**20.6.4.213 PECOS RIVER BASIN - McAllister lake.**

**A. Designated Uses**: coldwater fishery, secondary contact, livestock watering, and wildlife habitat.

**B. Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 8.8 and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.213 NMAC – Rp 20 NMAC 6.1.2211.3, 10-12-00]

**20.6.4.214 PECOS RIVER BASIN - Storrie lake.**

**A. Designated Uses**: coldwater fishery, warmwater fishery, primary contact, livestock watering, wildlife habitat, municipal water supply, and irrigation storage.

**B. Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.214 NMAC – Rp 20 NMAC 6.1.2211.5, 10-12-00]

**20.6.4.215 PECOS RIVER BASIN - The Gallinas river and all its tributaries above the diversion for the Las Vegas municipal reservoir and perennial reaches of Tecolote creek and its perennial tributaries.**

**A. Designated Uses**: domestic water supply, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, and secondary contact.

**B. Standards**:

(1) In any single sample: conductivity shall not exceed 300 µmhos except conductivity shall not exceed 450 µmhos in Wright Canyon creek, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.215 NMAC – Rp 20 NMAC 6.1.2212, 10-12-00]

**20.6.4.216 PECOS RIVER BASIN - The main stem of the Pecos river from Anton Chico upstream to the southern boundary of the Pecos national historical park, and perennial reaches of the Gallinas river from its mouth upstream to the diversion for the Las Vegas municipal reservoir.**

**A. Designated Uses**: irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, and secondary contact.

**B. Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0 and temperature shall not exceed 30°C (86°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).

(3) At all flows above 10 cfs: TDS shall not exceed 250 mg/L, sulfate shall not exceed 25 mg/L, and chloride shall not exceed 5 mg/L.

[20.6.4.216 NMAC – Rp 20 NMAC 6.1.2213, 10-12-00]

**20.6.4.217 PECOS RIVER BASIN - Cow creek and all its tributaries and the main stem of the Pecos river from the southern boundary of the Pecos national historical park upstream to its headwaters, including all tributaries thereto.**

**A. Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 300 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.217 NMAC – Rp 20 NMAC 6.1.2214, 10-12-00]

**20.6.4.218 – 20.6.4.300: [RESERVED]**

**20.6.4.301 CANADIAN RIVER BASIN - The main stem of the Canadian river from the New Mexico-Texas line upstream to Ute dam, and any flow which enters the main stem from Revuelto creek.**

**A. Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and TDS shall not exceed 6,500 mg/L at flows above 25 cfs. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.301 NMAC – Rp 20 NMAC 6.1.2301, 10-12-00]

**20.6.4.302 CANADIAN RIVER BASIN - Ute reservoir.**

**A. Designated Uses**: livestock watering, wildlife habitat, municipal and industrial water supply, primary contact, and warmwater fishery.

**B. Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 9.0, turbidity shall not exceed 25 NTU and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.302 NMAC – Rp 20 NMAC 6.1.2302, 10-12-00]

**20.6.4.303 CANADIAN RIVER BASIN - The main stem of the Canadian river from the headwaters of Ute reservoir upstream to Conchas dam, the perennial reaches of Pajarito creek, and Ute creek and its perennial tributaries.**

**A. Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.303 NMAC – Rp 20 NMAC 6.1.2303, 10-12-00]

**20.6.4.304 CANADIAN RIVER BASIN - Conchas reservoir.**

**A. Designated Uses**: irrigation storage, livestock watering, wildlife habitat, primary contact and warmwater fishery.

**B. Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.304 NMAC – Rp 20 NMAC 6.1.2304, 10-12-00]

**20.6.4.305 CANADIAN RIVER BASIN - The main stem of the Canadian river from the headwaters of Conchas reservoir upstream to the New Mexico-Colorado line, the Conchas river, the Mora river downstream from the USGS gaging station near Shoemaker, the Vermejo river and perennial reaches of Raton, Chicorica and Uña de Gato creeks.**

A. **Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and TDS shall not exceed 3,500 mg/L at flows above 10 cfs. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.305 NMAC – Rp 20 NMAC 6.1.2305, 10-12-00]

**20.6.4.306 CANADIAN RIVER BASIN - The Cimarron river downstream from state highway 21 in Cimarron to the Canadian river and all perennial reaches of tributaries to the Cimarron river downstream from state highway 21 in Cimarron.**

A. **Designated Uses**: irrigation, warmwater fishery, livestock watering, wildlife habitat, and secondary contact.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 32.2°C (90°F), and TDS shall not exceed 3,500 mg/L at flows above 10 cfs. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.306 NMAC – Rp 20 NMAC 6.1.2305.1, 10-12-00; A, 7-19-01]

**20.6.4.307 CANADIAN RIVER BASIN - Perennial reaches of the Mora river from the USGS gaging station near Shoemaker upstream to the state highway 434 bridge in Mora, all perennial reaches of tributaries to the Mora river downstream from the USGS gaging station at La Cueva in San Miguel and Mora counties, perennial reaches of Ocate creek and its tributaries downstream of Ocate, and perennial reaches of Rayado creek downstream of Miami lake diversion in Colfax county.**

A. **Designated Uses**: marginal coldwater fishery, warmwater fishery, secondary contact, irrigation, livestock watering, and wildlife habitat.

B. **Standards**:

(1) At any sampling site: temperature shall not exceed 25°C (77°F), and pH shall be within the range of 6.6 to 9.0. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.307 NMAC – Rp 20 NMAC 6.1.2305.3, 10-12-00]

**20.6.4.308 CANADIAN RIVER BASIN - Charette lakes.**

A. **Designated Uses**: coldwater fishery, warmwater fishery, secondary contact, livestock watering, and wildlife habitat.

B. **Standards**:

(1) At any sampling site: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 20°C (68°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL (see Subsection B of 20.6.4.13 NMAC).
[20.6.4.308 NMAC – Rp 20 NMAC 6.1.2305.5, 10-12-00]

**20.6.4.309 CANADIAN RIVER BASIN - The Mora river and its tributaries upstream from the state highway 434 bridge in Mora, all tributaries to the Mora river upstream from the USGS gaging station at La Cueva, perennial reaches of Coyote creek and its tributaries, the Cimarron river and its perennial tributaries above state highway 21 in Cimarron, perennial reaches of Rayado creek and its tributaries above Miami lake diversion, Ocate creek and perennial reaches of its tributaries upstream of Ocate, and all other perennial reaches of tributaries to the Canadian river northwest and north of U.S. highway 64 in Colfa county unless included in other segments.**

A. **Designated Uses**: domestic water supply, irrigation, high quality coldwater fishery, livestock watering, wildlife habitat, municipal and industrial water supply, and secondary contact.

B. **Standards**:

(1) In any single sample: conductivity shall not exceed 500 µmhos/cm (at 25°C), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 m/L; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).
[20.6.4.309 NMAC – Rp 20 NMAC 6.1.2306, 10-12-00; A, 7-19-01]

**20.6.4.310 – 20.6.4.400: [RESERVED]**

**20.6.4.401 SAN JUAN RIVER BASIN - The main stem of the San Juan river from the point where the San Juan leaves New Mexico and enters Colorado upstream to U.S. highway 64 at Blanco, and any flow which enters the San Juan river from the Mancos and Chaco rivers.**

A. **Designated Uses**: municipal and industrial water supply, irrigation, livestock watering, wildlife habitat, secondary contact, marginal coldwater fishery, and warmwater fishery.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).
[20.6.4.401 NMAC – Rp 20 NMAC 6.1.2401, 10-12-00]

**20.6.4.402 SAN JUAN RIVER BASIN - La Plata river from its confluence with the San Juan river upstream to the New Mexico-Colorado line.**

A. **Designated Uses**: irrigation, limited warmwater fishery, marginal coldwater fishery, livestock watering, wildlife habitat, and secondary contact.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 9.0 and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).
[20.6.4.402 NMAC – Rp 20 NMAC 6.1.2402, 10-12-00]

**20.6.4.403 SAN JUAN RIVER BASIN - The Animas river from its confluence with the San Juan upstream to U.S. highway 550 at Aztec.**

A. **Designated Uses**: municipal and industrial water supply, irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, secondary contact, and warmwater fishery.

B. **Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 27°C (80.6°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.403 NMAC – Rp 20 NMAC 6.1.2403, 10-12-00]

**20.6.4.404 SAN JUAN RIVER BASIN - The Animas river from U.S. highway 550 at Aztec upstream to the New Mexico-Colorado line.**

**A. Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and total phosphorus (as P) shall not exceed 0.1 mg/L. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.404 NMAC – Rp 20 NMAC 6.1.2404, 10-12-00]

**20.6.4.405 SAN JUAN RIVER BASIN - The main stem of the San Juan river from U.S. highway 64 at Blanco upstream to the Navajo dam.**

**A. Designated Uses**: high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 400 μmhos/cm (at 25°C), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.405 NMAC – Rp 20 NMAC 6.1.2405, 10-12-00]

**20.6.4.406 SAN JUAN RIVER BASIN - Navajo reservoir in New Mexico.**

**A. Designated Uses**: coldwater fishery, warmwater fishery, irrigation storage, livestock watering, wildlife habitat, municipal and industrial water storage, and primary contact.

**B. Standards**:

**(1)** At any sampling site: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), total phosphorus (as P) shall not exceed 0.1 mg/L, and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.406 NMAC – Rp 20 NMAC 6.1.2406, 10-12-00]

**20.6.4.407 SAN JUAN RIVER BASIN - The Navajo and Los Pinos rivers in New Mexico.**

**A. Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F) and total phosphorus (as P) shall not exceed 0.1 mg/L. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.407 NMAC – Rp 20 NMAC 6.1.2407, 10-12-00]

**20.6.4.408 – 20.6.4.500: [RESERVED]**

**20.6.4.501 GILA RIVER BASIN - The main stem of the Gila river from the New Mexico-Arizona line upstream to state highway 464 in Red Rock, and perennial reaches of streams in Hidalgo county.**

**A. Designated Uses**: irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and primary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.501 NMAC – Rp 20 NMAC 6.1.2501, 10-12-00]

**20.6.4.502 GILA RIVER BASIN - The main stem of the Gila river from state highway 464 in Red Rock upstream to Gila hot springs and perennial reaches of tributaries to the Gila river below the town of Cliff.**

**A. Designated Uses**: industrial water supply, irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, primary contact, and warmwater fishery.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 28°C (82.4°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.502 NMAC – Rp 20 NMAC 6.1.2502, 10-12-00]

**20.6.4.503 GILA RIVER BASIN - The main stem of the Gila river from Gila hot springs upstream to the headwaters and all perennial tributaries to the Gila river at or above the town of Cliff.**

**A. Designated Uses**: domestic water supply, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 300 µmhos for the main stem of the Gila river above Gila hot springs and 400 µmhos for other reaches, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F) except in the east fork of the Gila river and Sapillo creek below Lake Roberts where the temperature shall not exceed 32.2°C (90°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.503 NMAC – Rp 20 NMAC 6.1.2503, 10-12-00]

**20.6.4.504 GILA RIVER BASIN - Wall lake, Lake Roberts, Bear Canyon lake and Snow lake.**

**A. Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 300 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 22°C (72°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.504 NMAC – Rp 20 NMAC 6.1.2504, 10-12-00]

**20.6.4.505 – 20.6.4.600: [RESERVED]**

**20.6.4.601 SAN FRANCISCO RIVER BASIN - The main stem of the San Francisco river from the New Mexico-Arizona line upstream to state highway 12 at Reserve and perennial reaches of Mule creek.**

**A.** **Designated Uses**: irrigation, limited warmwater and marginal coldwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B.** **Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 32.2°C (90°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.601 NMAC – Rp 20 NMAC 6.1.2601, 10-12-00]

**20.6.4.602 SAN FRANCISCO RIVER BASIN - The main stem of the San Francisco river from state highway 12 at Reserve upstream to the New Mexico-Arizona line.**

**A.** **Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, and primary contact.

**B.** **Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 25°C (77°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.602 NMAC – Rp 20 NMAC 6.1.2602, 10-12-00]

**20.6.4.603 SAN FRANCISCO RIVER BASIN - All perennial reaches of tributaries to the San Francisco river at or above the town of Glenwood.**

**A.** **Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B.** **Standards**:

**(1)** In any single sample: conductivity shall not exceed 400 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F) except in Tularosa creek, where the temperature shall not exceed 25°C (77°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.603 NMAC – Rp 20 NMAC 6.1.2603, 10-12-00]

**20.6.4.604 – 20.6.4.700: [RESERVED]**

**20.6.4.701 DRY CIMARRON RIVER - Perennial portions of the Dry Cimarron river in Union and Colfax counties and perennial reaches of Oak creek, Long canyon, and Corrumpa and Carrizozo creeks.**

**A.** **Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B.** **Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 25°C (77°F), TDS shall not exceed 1,200 mg/L, sulfate shall not exceed 600 mg/L, and chloride shall not exceed 40 mg/L. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.701 NMAC – Rp 20 NMAC 6.1.2701, 10-12-00]

**20.6.4.702 – 20.6.4.800: [RESERVED]**

**20.6.4.801 CLOSED BASINS - Rio Tularosa lying east of the old U.S. highway 70 bridge crossing east of Tularosa, and all perennial tributaries to the Tularosa basin except Three Rivers.**

**A.** **Designated Uses**: coldwater fishery, fish culture, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 20°C (68°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.801 NMAC – Rp 20 NMAC 6.1.2801, 10-12-00]

**20.6.4.802 CLOSED BASINS - Perennial reaches of Three Rivers.**

**A. Designated Uses**: irrigation, domestic water supply, high quality coldwater fishery, secondary contact, livestock watering, and wildlife habitat.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 500 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.802 NMAC – Rp 20 NMAC 6.1.2802, 10-12-00]

**20.6.4.803 CLOSED BASINS - Perennial reaches of the Mimbres river downstream of the USGS gaging station at Mimbres and all perennial reaches of tributaries thereto.**

**A. Designated Uses**: coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 8.8, and temperature shall not exceed 20°C (68°F). The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.803 NMAC – Rp 20 NMAC 6.1.2803, 10-12-00]

**20.6.4.804 CLOSED BASINS - The Mimbres river upstream of the USGS gaging station at Mimbres and all perennial tributaries thereto.**

**A. Designated Uses**: irrigation, domestic water supply, high quality coldwater fishery, livestock watering, wildlife habitat, and secondary contact.

**B. Standards**:

**(1)** In any single sample: conductivity shall not exceed 300 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.804 NMAC – Rp 20 NMAC 6.1.2804, 10-12-00]

**20.6.4.805 CLOSED BASINS - Perennial reaches of the Sacramento river (Sacramento-Salt Flat closed basin) and all perennial tributaries thereto.**

**A. Designated Uses**: domestic and municipal water supply, livestock watering, wildlife habitat, marginal coldwater fishery, and secondary contact.

**B. Standards**:

**(1)** In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 25°C (77°F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

**(2)** The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).

[20.6.4.805 NMAC – Rp 20 NMAC 6.1.2805, 10-12-00]

**20.6.4.806 – 20.6.4.899: [RESERVED]**

**20.6.4.900 STANDARDS APPLICABLE TO ATTAINABLE OR DESIGNATED USES UNLESS OTHERWISE SPECIFIED IN 20.6.4.101 THROUGH 20.6.4.899 NMAC.**

**A. Coldwater Fishery**: Dissolved oxygen shall not be less than 6.0 mg/L, temperature shall not exceed 20°C (68°F), and pH shall be within the range of 6.6 to 8.8. The acute and chronic aquatic life standards set out in Subsections J and M of this section are applicable to this use. The total ammonia standards set out in Subsection O of this section and the human health standards listed in Subsection M of this section are applicable to this use.

**B. Domestic Water Supply**: Surface waters of the state designated for use as domestic water supplies shall not contain substances in concentrations that create a lifetime cancer risk of more than one cancer per 100,000 exposed persons. The following numeric standards and those standards listed under domestic water supply in Subsection M of this section shall not be exceeded:

| | | | |
|---|---|---|---|
| **(1)** | dissolved nitrate (as N) | 10. | mg/L |
| **(2)** | radium-226 + radium-228 | 5. | pCi/L |
| **(3)** | strontium-90 | 8 | pCi/L |
| **(4)** | tritium | 20,000 | pCi/L |
| **(5)** | gross alpha (including radium-226, but excluding radon and uranium) | 15 | pCi/L |

**C. High Quality Coldwater Fishery**: Dissolved oxygen shall not be less than 6.0 mg/L, temperature shall not exceed 20°C (68°F), pH shall be within the range of 6.6 to 8.8, turbidity shall not exceed 10 NTU (25 NTU in certain reaches where natural background prevents attainment of lower turbidity), and conductivity (at 25°C) shall not exceed a limit varying between 300 µmhos/cm and 1,500 µmhos/cm depending on the natural background in particular surface waters of the state (the intent of this standard is to prevent excessive increases in dissolved solids which would result in changes in community structure). The acute and chronic aquatic life standards set out in Subsections J and M of this section are applicable to this use. The total ammonia standards set out in Subsection O of this section and the human health standards for pollutants listed in Subsection M of this section are applicable to this use.

**D. Irrigation and Irrigation Storage**: The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 mL; no single sample shall exceed 2,000/100 mL. The following numeric standards and those standards listed under irrigation in Subsection M of this section shall not be exceeded:

| | | | |
|---|---|---|---|
| **(1)** | dissolved selenium | 0.13 | mg/L |
| **(2)** | dissolved selenium in presence of >500 mg/L $SO_4$ | 0.25 | mg/L |

**E. Limited Warmwater Fishery**: Dissolved oxygen shall not be less than 5 mg/L, pH shall be within the range of 6.6 to 9.0, and on a case by case basis maximum temperatures may exceed 32.2°C. The acute and chronic aquatic life standards set out in Subsections J and M of this section are applicable to this use. The total ammonia standards set out in Subsection N of this section and the human health standards listed in Subsection M of this section are applicable to this use.

**F. Marginal Coldwater Fishery**: Dissolved oxygen shall not be less than 6 mg/L, on a case by case basis maximum temperatures may exceed 25°C and the pH may range from 6.6 to 9.0. The acute and chronic aquatic life standards set out in Subsections J and M of this section are applicable to this use. The total ammonia standards set out in Subsection O of this section and the human health standards listed in Subsection M of this section are applicable to this use.

**G. Primary Contact**: The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL, no single sample shall exceed 400/100 mL and pH shall be within the range of 6.6 to 9.0.

**H. Warmwater Fishery**: Dissolved oxygen shall not be less than 5 mg/L, temperature shall not exceed 32.2°C (90°F), and pH shall be within the range of 6.6 to 9.0. The acute and chronic aquatic life standards set out in Subsections J and M of this section are applicable to this use. The total ammonia standards set out in Subsection N of this section and the human health standards listed in Subsection M of this section are applicable to this use.

**I.** Fish culture, secondary contact, and municipal and industrial water supply and storage are also designated in particular classified waters of the state where these uses are actually being realized. However, no numeric standards apply uniquely to these uses. Water quality adequate for these uses is ensured by the general standards and numeric standards for bacterial quality, pH, and temperature which are established for all classified waters of the state listed in 20.6.4.101 through 20.6.4.899 NMAC.

**J.** The following schedule of equations for the determination of numeric standards for the substances listed and those standards listed in Subsection M for aquatic life shall apply to the subcategories of fisheries identified in this section:

**(1) Acute standards**

**(a)** dissolved silver $e^{(1.72[\ln(hardness)]-6.6825)}$ µg/L

**(b)** dissolved cadmium $(e^{(1.128[\ln(hardness)]-3.6867)})cf$ µg/L The hardness-dependent formulae for cadmium must be multiplied by a conversion factor (cf) to be expressed as dissolved values. The acute factor for cadmium is cf = 1.136672 - [(ln hardness)(0.041838)].

**(c)** dissolved chromium $e^{(0.819[\ln(hardness)]+2.5736)}$ µg/L

**(d)** dissolved copper $e^{(0.9422[\ln(hardness)]-1.7408)}$ µg/L

**(e)** dissolved lead $(e^{(1.273[\ln(hardness)]-1.46)})cf$ µg/L The hardness-dependent formulae for lead must be multiplied by a conversion factor (cf) to be expressed as dissolved values. The acute and chronic factor for lead is cf = 1.46203 - [(ln hardness)(0.145712)].

**(f)** dissolved nickel $e^{(0.8460[\ln(hardness)]+2.253)}$ µg/L

**(g)** dissolved zinc $e^{(0.8473[\ln(hardness)]+0.8618)}$ µg/L

**(2) Chronic standards**

**(a)** dissolved cadmium $(e^{(0.7852[\ln(hardness)]-[2.715])})cf$ µg/L

The hardness-dependent formulae for cadmium must be multiplied by a conversion factor (cf) to be expressed as dissolved values. The chronic factor for cadmium is cf = 1.101672 - [(ln hardness)(0.041838)].

**(b)** dissolved chromium $e^{(0.819[\ln(hardness)]+0.534)}$ µg/L

**(c)** dissolved copper $e^{(0.8545[\ln(hardness)]-1.7428)}$ µg/L

**(d)** dissolved lead $(e^{(1.273[\ln(hardness)]-4.705)})cf$ µg/L

The hardness-dependent formulae for lead must be multiplied by a conversion factor (cf) to be expressed as dissolved values. The acute and chronic factor for lead is cf = 1.46203 - [(ln hardness)(0.145712)].

**(e)** dissolved nickel $e^{(0.846[\ln(hardness)]+0.0554)}$ µg/L

**(f)** dissolved zinc $e^{(0.8473[\ln(hardness)]+0.8699)}$ µg/L

**K. Livestock Watering**: The following numeric standards and those standards listed in Subsection M for livestock watering shall not be exceeded:

**(1)** radium-226 + radium-228 30.0 pCi/L

**(2)** tritium 20,000 pCi/L

**(3)** total gross alpha (including radium-226, but excluding radon and uranium) 15 pCi/L

**L. Wildlife Habitat:** Wildlife habitat should be free from any substances at concentrations that are toxic to or will adversely affect plants and animals that use these environments for feeding, drinking, habitat or propagation, or can bioaccumulate and impair the community of animals in a watershed or the ecological integrity of surface waters of the state. In the absence of site-specific information, and subject to the following paragraph, the chronic numeric standards listed in Subsection M for wildlife habitat shall not be exceeded. The discharge of substances which bioaccumulate, in excess of levels listed in Subsection M for wildlife habitat is allowed if, and only to the extent that, the substances are present in the intake waters which are diverted and utilized prior to discharge, and then only if the discharger utilizes best available treatment technology to reduce the amount of bioaccumulating substances which are discharged.

**M. Numeric criteria**

The following table sets forth the numeric criteria adopted by the commission to protect existing, designated and attainable uses. Additional criteria that are not compatible with this table and are found in Subsections A through L of this section.

| | Pollutant<br>total, unless indicated | CAS Number | Domestic Water Supply µg/L | Irrigation µg/L | Livestock Watering µg/L | Wildlife Habitat µg/L | Aquatic Life | | Human Health µg/L | Cancer Causing and/or Persistent |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Acute µg/L | Chronic µg/L | | |
| 1 | Aluminum, dissolved | 7429-90-5 | | 5,000 | 5,000 | | 750 | 87 | | |
| 2 | Antimony, dissolved | 7440-36-0 | 6 | | | | | | 4,300 | P |
| 3 | Arsenic, dissolved | 7440-38-2 | 50 | 100 | 200 | | 340 | 150 | 24.2 | C,P |
| 4 | Barium, dissolved | 7440-39-3 | 2,000 | | | | | | | |
| 5 | Beryllium, dissolved | 7440-41-7 | 4 | | | | 130 | 5.3 | | |
| 6 | Boron, dissolved | 7440-42-8 | | 750 | 5,000 | | | | | |
| 7 | Cadmium, dissolved | 7440-43-9 | 5 | 10 | 50 | | see 20.6.4.900.J | see 20.6.4.900.J | | |
| 8 | Chlorine residual | 7782-50-5 | | | | 11 | 19 | 11 | | |
| 9 | Chromium, dissolved | 18540-29-9 | 100 | 100 | 1,000 | | see 20.6.4.900.J | see 20.6.4.900.J | | |
| 10 | Cobalt, dissolved | 7440-48-4 | | 50 | 1,000 | | | | | |
| 11 | Copper, dissolved | 7440-50-8 | | 200 | 500 | | see 20.6.4.900.J | see 20.6.4.900.J | | |
| 12 | Cyanide, dissolved | 57-12-5 | 200 | | | | | | | |
| 13 | Cyanide, weak acid dissociable | 57-12-5 | | | | 5.2 | 22.0 | 5.2 | 220,000 | |
| 14 | Lead, dissolved | 7439-92-1 | 50 | 5,000 | 100 | | see 20.6.4.900.J | see 20.6.4.900.J | | |
| 15 | Mercury | 7439-97-6 | 2 | | 10 | 0.77 | 2.4 | 0.012 | | |
| 16 | Molybdenum, dissolved | 7439-98-7 | | 1,000 | | | | | | |
| 17 | Nickel, dissolved | 7440-02-0 | 100 | | | | see 20.6.4.900.J | see 20.6.4.900.J | 4,600 | P |
| 18 | Selenium, dissolved | 7782-49-2 | 50 | see 20.6.4.900.D | 50 | | | | 11,000 | P |
| 19 | Selenium, total recoverable | 7782-49-2 | | | | 5.0 | 20.0 | 5.0 | | |
| 20 | Silver, dissolved | 7440-22-4 | | | | | see 20.6.4.900.J | | | |
| 21 | Thallium, dissolved | 7440-28-0 | 2 | | | | | | 6.3 | P |
| 22 | Uranium, dissolved | 7440-61-1 | 5,000 | | | | | | | |

| | Pollutant<br>total, unless indicated | CAS Number | Domestic Water Supply µg/L | Irrigation µg/L | Livestock Watering µg/L | Wildlife Habitat µg/L | Aquatic Life | | Human Health µg/L | Cancer Causing and/or Persistent |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Acute µg/L | Chronic µg/L | | |
| 23 | Vanadium, dissolved | 7440-62-2 | | 100 | 100 | | | | | |
| 24 | Zinc, dissolved | 7440-66-6 | | 2,000 | 25,000 | | see 20.6.4.900.J | see 20.6.4.900.J | 69,000 | P |
| 25 | Acenaphthene | 83-32-9 | | | | | | | 2,700 | |
| 26 | Acrolein | 107-02-8 | | | | | | | 780 | |
| 27 | Acrylonitrile | 107-13-1 | | | | | | | 6.6 | C |
| 28 | Aldrin | 309-00-2 | | | | | 3.0 | | 0.0014 | C,P |
| 29 | Anthracene | 120-12-7 | | | | | | | 110,000 | |
| 30 | Benzene | 71-43-2 | | | | | | | 710 | C |
| 31 | Benzidine | 92-87-5 | | | | | | | 0.0054 | C |
| 32 | Benzo(a)anthracene | 56-55-3 | | | | | | | 0.49 | C |
| 33 | Benzo(a)pyrene | 50-32-8 | | | | | | | 0.49 | C,P |
| 34 | Benzo(b)fluoranthene | 205-99-2 | | | | | | | 0.49 | C |
| 35 | Benzo(k)fluoranthene | 207-08-9 | | | | | | | 0.49 | C |
| 36 | alpha-BHC | 319-84-6 | | | | | | | 0.13 | C |
| 37 | beta-BHC | 319-85-7 | | | | | | | 0.46 | C |
| 38 | Gamma-BHC (Lindane) | 58-89-9 | | | | | 0.95 | | 0.63 | C |
| 39 | Bis(2-chloroethyl) ether | 111-44-4 | | | | | | | 14 | C |
| 40 | Bis(2-chloroisopropyl) ether | 108-60-1 | | | | | | | 170,000 | |
| 41 | Bis(2-ethylhexyl) phthalate | 117817 | | | | | | | 59 | C |
| 42 | Bromoform | 75-25-2 | | | | | | | 3600 | C |
| 43 | Butylbenzyl phthalate | 85-68-7 | | | | | | | 5,200 | |
| 44 | Carbon tetrachloride | 56-23-5 | | | | | | | 44 | C |
| 45 | Chlordane | 57-74-9 | | | | | 2.4 | 0.0043 | 0.022 | C,P |
| 46 | Chlorobenzene | 108-90-7 | | | | | | | 21,000 | |
| 47 | Chlorodibromomethane | 124-48-1 | | | | | | | 340 | C |
| 48 | Chloroform | 67-66-3 | | | | | | | 4,700 | C |
| 49 | 2-Chloronaphthalene | 91-58-7 | | | | | | | 4,300 | |
| 50 | 2-Chlorophenol | 95-57-8 | | | | | | | 400 | |
| 51 | Chrysene | 218-01-9 | | | | | | | 0.49 | C |

| | Pollutant<br>total, unless indicated | CAS Number | Domestic Water Supply µg/L | Irrigation µg/L | Livestock Watering µg/L | Wildlife Habitat µg/L | Aquatic Life | | Human Health µg/L | Cancer Causing and/or Persistent |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Acute µg/L | Chronic µg/L | | |
| 52 | 4,4'-DDT and derivatives | 50-29-3 | | | | 0.001 | 1.1 | 0.001 | 0.0059 | C,P |
| 53 | Dibenzo(a,h)anthracene | 53-70-3 | | | | | | | 0.49 | C |
| 54 | Dibutyl phthalate | 84-74-2 | | | | | | | 12,000 | |
| 55 | 1,2-Dichlorobenzene | 95-50-1 | | | | | | | 17,000 | |
| 56 | 1,3-Dichlorobenzene | 541-73-1 | | | | | | | 2,600 | |
| 57 | 1,4-Dichlorobenzene | 106-46-7 | | | | | | | 2,600 | |
| 58 | 3,3'-Dichlorobenzidine | 91-94-1 | | | | | | | 0.77 | C |
| 59 | Dichlorobromomethane | 75-27-4 | | | | | | | 460 | C |
| 60 | 1,2-Dichloroethane | 107-06-2 | | | | | | | 990 | C |
| 61 | 1,1-Dichloroethylene | 75-35-4 | | | | | | | 32 | C |
| 62 | 2,4-Dichlorophenol | 120-83-2 | | | | | | | 790 | |
| 63 | 1,2-Dichloropropane | 78-87-5 | | | | | | | 390 | C |
| 64 | 1,3-Dichloropropene | 542-75-6 | | | | | | | 1,700 | |
| 65 | Dieldrin | 60-57-1 | | | | | 0.24 | 0.056 | 0.0014 | C,P |
| 66 | Diethyl phthalate | 84-66-2 | | | | | | | 120,000 | |
| 67 | Dimethyl phthalate | 131-11-3 | | | | | | | 2,900,000 | |
| 68 | 2,4-Dimethylphenol | 105-67-9 | | | | | | | 2,300 | |
| 69 | 2,4-Dinitrophenol | 51-28-5 | | | | | | | 14,000 | |
| 70 | 2,4-Dinitrotoluene | 121-14-2 | | | | | | | 91 | C |
| 71 | 2,3,7,8-TCDD Dioxin | 1746-01-6 | | | | | | | 1.4E-07 | C,P |
| 72 | 1,2-Diphenylhydrazine | 122-66-7 | | | | | | | 5.4 | C |
| 73 | alpha-Endosulfan | 959-98-8 | | | | | 0.22 | 0.056 | 240 | |
| 74 | beta-Endosulfan | 33213-65-9 | | | | | 0.22 | 0.056 | 240 | |
| 75 | Endosulfan sulfate | 1031-07-8 | | | | | | | 240 | |
| 76 | Endrin | 72-20-8 | | | | | 0.086 | 0.036 | 0.81 | |
| 78 | Endrin aldehyde | 7421-93-4 | | | | | | | 0.81 | |
| 79 | Ethylbenzene | 100-41-4 | | | | | | | 29,000 | |
| 80 | Fluoranthene | 206-44-0 | | | | | | | 370 | |
| 81 | Fluorene | 86-73-7 | | | | | | | 14,000 | |
| 82 | Heptachlor | 76-44-8 | | | | | 0.52 | 0.0038 | 0.0021 | C |

| | Pollutant<br>total, unless indicated | CAS Number | Domestic Water Supply µg/L | Irrigation µg/L | Livestock Watering µg/L | Wildlife Habitat µg/L | Aquatic Life | | Human Health µg/L | Cancer Causing and/or Persistent |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Acute µg/L | Chronic µg/L | | |
| 83 | Heptachlor epoxide | 1024-57-3 | | | | | 0.52 | 0.0038 | 0.0011 | C |
| 84 | Hexachlorobenzene | 118-74-1 | | | | | | | 0.0077 | C,P |
| 85 | Hexachlorobutadiene | 87-68-3 | | | | | | | 500 | C |
| 86 | Hexachlorocyclopentadiene | 77-47-4 | | | | | | | 17,000 | |
| 87 | Hexachloroethane | 67-72-1 | | | | | | | 89 | C |
| 88 | Ideno(1,2,3-cd)pyrene | 193-39-5 | | | | | | | 0.49 | C |
| 89 | Isophorone | 78-59-1 | | | | | | | 26,000 | C |
| 90 | Methyl bromide | 74-83-9 | | | | | | | 4000 | |
| 91 | 2-Methyl-4,6-dinitrophenol | 534-52-1 | | | | | | | 765 | |
| 92 | Methylene chloride | 75-09-2 | | | | | | | 16,000 | C |
| 93 | Nitrobenzene | 98-95-3 | | | | | | | 1,900 | |
| 94 | N-Nitrosodimethylamine | 62-75-9 | | | | | | | 81 | C |
| 95 | N-Nitrosodi-n-propylamine | 621-64-7 | | | | | | | 14 | C |
| 96 | N-Nitrosodiphenylamine | 86-30-6 | | | | | | | 160 | C |
| 97 | PCBs | 1336-36-3 | | | | 0.014 | | 0.014 | 0.0017 | C,P |
| 98 | Pentachlorophenol | 87-86-5 | | | | | 19 | 15 | 82 | C |
| 99 | Phenol | 108-95-2 | | | | | | | 4,600,000 | |
| 100 | Pyrene | 129-00-0 | | | | | | | 11,000 | |
| 101 | 1,1,2,2-Tetrachloroethane | 79-34-5 | | | | | | | 110 | C |
| 102 | Tetrachloroethylene | 127-18-4 | | | | | | | 88.5 | C,P |
| 103 | Toluene | 108-88-3 | | | | | | | 200,000 | |
| 104 | Toxaphene | 8001-35-2 | | | | | 0.73 | 0.0002 | 0.0075 | C |
| 105 | 1,2-Trans-dichloroethylene | 156-60-5 | | | | | | | 140,000 | |
| 106 | 1,2,4-Trichlorobenzene | 120-82-1 | | | | | | | 940 | |
| 107 | 1,1,2-Trichloroethane | 79-00-5 | | | | | | | 420 | C |
| 108 | Trichloroethylene | 79-01-6 | | | | | | | 810 | C |
| 109 | 2,4,6-Trichlorophenol | 88-06-2 | | | | | | | 65 | C |
| 110 | Vinyl chloride | 75-01-4 | | | | | | | 5,250 | C |

**N. Total Ammonia (mg/L as N), Warmwater Fisheries:**

**(1) acute standards**

pH

| Temperature °C | 6.50 | 6.75 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 | 8.50 | 8.75 | 9.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 29 | 26 | 23 | 19 | 14 | 10 | 6.6 | 3.7 | 2.1 | 1.2 | 0.70 |
| **1** | 28 | 26 | 23 | 19 | 14 | 9.9 | 6.5 | 3.7 | 2.1 | 1.2 | 0.70 |
| **2** | 28 | 26 | 22 | 18 | 14 | 9.7 | 6.4 | 3.6 | 2.1 | 1.2 | 0.69 |
| **3** | 28 | 25 | 22 | 18 | 14 | 9.6 | 6.3 | 3.6 | 2.0 | 1.2 | 0.69 |
| **4** | 27 | 25 | 22 | 18 | 14 | 9.5 | 6.2 | 3.5 | 2.0 | 1.2 | 0.69 |
| **5** | 27 | 25 | 22 | 18 | 13 | 9.4 | 6.1 | 3.5 | 2.0 | 1.2 | 0.68 |
| **6** | 27 | 24 | 21 | 18 | 13 | 9.3 | 6.1 | 3.5 | 2.0 | 1.1 | 0.68 |
| **7** | 26 | 24 | 21 | 17 | 13 | 9.2 | 6.0 | 3.4 | 2.0 | 1.1 | 0.68 |
| **8** | 26 | 24 | 21 | 17 | 13 | 9.1 | 6.0 | 3.4 | 1.9 | 1.1 | 0.68 |
| **9** | 26 | 24 | 21 | 17 | 13 | 9.0 | 5.9 | 3.4 | 1.9 | 1.1 | 0.68 |
| **10** | 25 | 23 | 21 | 17 | 13 | 8.9 | 5.9 | 3.3 | 1.9 | 1.1 | 0.68 |
| **11** | 25 | 23 | 20 | 17 | 13 | 8.9 | 5.8 | 3.3 | 1.9 | 1.1 | 0.68 |
| **12** | 25 | 23 | 20 | 17 | 13 | 8.8 | 5.8 | 3.3 | 1.9 | 1.1 | 0.69 |
| **13** | 25 | 23 | 20 | 16 | 12 | 8.7 | 5.7 | 3.3 | 1.9 | 1.1 | 0.69 |
| **14** | 25 | 23 | 20 | 16 | 12 | 8.7 | 5.7 | 3.3 | 1.9 | 1.1 | 0.70 |
| **15** | 24 | 23 | 20 | 16 | 12 | 8.6 | 5.7 | 3.3 | 1.9 | 1.1 | 0.70 |
| **16** | 24 | 22 | 20 | 16 | 12 | 8.6 | 5.7 | 3.3 | 1.9 | 1.1 | 0.71 |
| **17** | 24 | 22 | 20 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.1 | 0.72 |
| **18** | 24 | 22 | 19 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.2 | 0.73 |
| **19** | 24 | 22 | 19 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.2 | 0.74 |
| **20** | 24 | 22 | 19 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.2 | 0.75 |
| **21** | 24 | 22 | 19 | 16 | 12 | 8.4 | 5.6 | 3.2 | 1.9 | 1.2 | 0.77 |
| **22** | 24 | 22 | 19 | 16 | 12 | 8.4 | 5.6 | 3.3 | 1.9 | 1.2 | 0.78 |
| **23** | 24 | 22 | 19 | 16 | 12 | 8.4 | 5.6 | 3.3 | 1.9 | 1.2 | 0.80 |
| **24** | 24 | 22 | 19 | 16 | 12 | 8.4 | 5.6 | 3.3 | 2.0 | 1.2 | 0.81 |
| **25** | 24 | 22 | 19 | 16 | 12 | 8.4 | 5.6 | 3.3 | 2.0 | 1.2 | 0.83 |
| **26** | 22 | 20 | 18 | 15 | 11 | 7.9 | 5.2 | 3.1 | 1.9 | 1.2 | 0.80 |
| **27** | 20 | 19 | 17 | 14 | 10 | 7.3 | 4.9 | 2.9 | 1.8 | 1.1 | 0.76 |
| **28** | 19 | 18 | 15 | 13 | 9.7 | 6.9 | 4.6 | 2.7 | 1.7 | 1.1 | 0.73 |
| **29** | 18 | 16 | 14 | 12 | 9.1 | 6.4 | 4.3 | 2.6 | 1.6 | 1.0 | 0.70 |
| **30** | 17 | 15 | 13 | 11 | 8.5 | 6.0 | 4.1 | 2.4 | 1.5 | 0.97 | 0.68 |

**(2) chronic standards**

pH

| Temperature °C | 6.50 | 6.75 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 | 8.50 | 8.75 | 9.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.3 | 1.5 | 0.84 | 0.48 | 0.28 | 0.16 |
| **1** | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.3 | 1.5 | 0.83 | 0.47 | 0.27 | 0.16 |
| **2** | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 1.5 | 0.82 | 0.47 | 0.27 | 0.16 |
| **3** | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 1.4 | 0.81 | 0.46 | 0.27 | 0.16 |
| **4** | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 1.4 | 0.80 | 0.46 | 0.27 | 0.16 |
| **5** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.80 | 0.45 | 0.26 | 0.16 |
| **6** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.79 | 0.45 | 0.26 | 0.16 |
| **7** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.78 | 0.45 | 0.26 | 0.16 |
| **8** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.77 | 0.44 | 0.26 | 0.15 |
| **9** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.1 | 1.3 | 0.77 | 0.44 | 0.26 | 0.16 |
| **10** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.76 | 0.44 | 0.26 | 0.16 |
| **11** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.76 | 0.44 | 0.26 | 0.16 |
| **12** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.75 | 0.44 | 0.26 | 0.16 |
| **13** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.75 | 0.43 | 0.26 | 0.16 |
| **14** | 2.1 | 2.1 | 2.1 | 2.1 | 2.2 | 2.0 | 1.3 | 0.75 | 0.43 | 0.26 | 0.16 |
| **15** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.0 | 1.3 | 0.74 | 0.43 | 0.26 | 0.16 |
| **16** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.0 | 1.3 | 0.74 | 0.43 | 0.26 | 0.16 |
| **17** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.9 | 1.3 | 0.74 | 0.43 | 0.26 | 0.16 |
| **18** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.9 | 1.3 | 0.74 | 0.43 | 0.26 | 0.17 |
| **19** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.9 | 1.3 | 0.74 | 0.44 | 0.26 | 0.17 |
| **20** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.9 | 1.3 | 0.74 | 0.44 | 0.27 | 0.17 |
| **21** | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.8 | 1.2 | 0.69 | 0.41 | 0.25 | 0.16 |
| **22** | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.7 | 1.1 | 0.65 | 0.38 | 0.24 | 0.15 |
| **23** | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.6 | 1.0 | 0.60 | 0.36 | 0.22 | 0.15 |
| **24** | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.5 | 0.97 | 0.57 | 0.34 | 0.21 | 0.14 |
| **25** | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.4 | 0.91 | 0.53 | 0.32 | 0.20 | 0.13 |
| **26** | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.3 | 0.85 | 0.50 | 0.30 | 0.19 | 0.13 |
| **27** | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.2 | 0.79 | 0.47 | 0.28 | 0.18 | 0.12 |
| **28** | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.1 | 0.74 | 0.44 | 0.27 | 0.17 | 0.12 |
| **29** | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 0.70 | 0.41 | 0.25 | 0.16 | 0.11 |
| **30** | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.97 | 0.65 | 0.39 | 0.24 | 0.16 | 0.11 |

**O. Total Ammonia (mg/L as N), Coldwater Fisheries:**

**(1) acute standards**

pH

| Temperature °C | 6.50 | 6.75 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 | 8.50 | 8.75 | 9.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 29 | 26 | 23 | 19 | 14 | 10 | 6.6 | 3.7 | 2.1 | 1.2 | 0.70 |
| **1** | 28 | 26 | 23 | 19 | 14 | 9.9 | 6.5 | 3.7 | 2.1 | 1.2 | 0.70 |
| **2** | 28 | 26 | 22 | 18 | 14 | 9.7 | 6.4 | 3.6 | 2.1 | 1.2 | 0.69 |
| **3** | 28 | 25 | 22 | 18 | 14 | 9.6 | 6.3 | 3.6 | 2.0 | 1.2 | 0.69 |
| **4** | 27 | 25 | 22 | 18 | 14 | 9.5 | 6.2 | 3.5 | 2.0 | 1.2 | 0.69 |
| **5** | 27 | 25 | 22 | 18 | 13 | 9.4 | 6.1 | 3.5 | 2.0 | 1.2 | 0.68 |
| **6** | 27 | 24 | 21 | 18 | 13 | 9.3 | 6.1 | 3.5 | 2.0 | 1.1 | 0.68 |
| **7** | 26 | 24 | 21 | 17 | 13 | 9.2 | 6.0 | 3.4 | 2.0 | 1.1 | 0.68 |
| **8** | 26 | 24 | 21 | 17 | 13 | 9.1 | 6.0 | 3.4 | 1.9 | 1.1 | 0.68 |
| **9** | 26 | 24 | 21 | 17 | 13 | 9.0 | 5.9 | 3.4 | 1.9 | 1.1 | 0.68 |
| **10** | 25 | 23 | 21 | 17 | 13 | 8.9 | 5.9 | 3.3 | 1.9 | 1.1 | 0.68 |
| **11** | 25 | 23 | 20 | 17 | 13 | 8.9 | 5.8 | 3.3 | 1.9 | 1.1 | 0.68 |
| **12** | 25 | 23 | 20 | 17 | 13 | 8.8 | 5.8 | 3.3 | 1.9 | 1.1 | 0.69 |
| **13** | 25 | 23 | 20 | 16 | 12 | 8.7 | 5.7 | 3.3 | 1.9 | 1.1 | 0.69 |
| **14** | 25 | 23 | 20 | 16 | 12 | 8.7 | 5.7 | 3.3 | 1.9 | 1.1 | 0.70 |
| **15** | 24 | 23 | 20 | 16 | 12 | 8.6 | 5.7 | 3.3 | 1.9 | 1.1 | 0.70 |
| **16** | 24 | 22 | 20 | 16 | 12 | 8.6 | 5.7 | 3.3 | 1.9 | 1.1 | 0.71 |
| **17** | 24 | 22 | 20 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.1 | 0.72 |
| **18** | 24 | 22 | 19 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.2 | 0.73 |
| **19** | 24 | 22 | 19 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.2 | 0.74 |
| **20** | 24 | 22 | 19 | 16 | 12 | 8.5 | 5.6 | 3.2 | 1.9 | 1.2 | 0.75 |
| **21** | 22 | 20 | 18 | 15 | 11 | 7.9 | 5.2 | 3.0 | 1.8 | 1.1 | 0.71 |
| **22** | 21 | 19 | 17 | 14 | 10 | 7.3 | 4.9 | 2.8 | 1.7 | 1.0 | 0.68 |
| **23** | 19 | 18 | 15 | 13 | 9.7 | 6.8 | 4.5 | 2.7 | 1.6 | 0.98 | 0.65 |
| **24** | 18 | 16 | 14 | 12 | 9.0 | 6.4 | 4.2 | 2.5 | 1.5 | 0.93 | 0.62 |
| **25** | 17 | 15 | 13 | 11 | 8.4 | 6.0 | 4.0 | 2.3 | 1.4 | 0.88 | 0.59 |
| **26** | 16 | 14 | 13 | 10 | 7.9 | 5.6 | 3.7 | 2.2 | 1.3 | 0.84 | 0.56 |
| **27** | 14 | 13 | 12 | 9.6 | 7.3 | 5.2 | 3.5 | 2.1 | 1.2 | 0.79 | 0.54 |
| **28** | 13 | 12 | 11 | 9.0 | 6.9 | 4.9 | 3.3 | 1.9 | 1.2 | 0.76 | 0.52 |
| **29** | 13 | 12 | 10 | 8.4 | 6.4 | 4.6 | 3.1 | 1.8 | 1.1 | 0.72 | 0.50 |
| **30** | 12 | 11 | 10 | 7.8 | 6.0 | 4.3 | 2.9 | 1.7 | 1.1 | 0.69 | 0.48 |

**(2) chronic standards**

pH

| Temperature °C | 6.50 | 6.75 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 | 8.50 | 8.75 | 9.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.3 | 1.5 | 0.84 | 0.48 | 0.28 | 0.16 |
| **1** | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.3 | 1.5 | 0.83 | 0.47 | 0.27 | 0.16 |
| **2** | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 1.5 | 0.82 | 0.47 | 0.27 | 0.16 |
| **3** | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 1.4 | 0.81 | 0.46 | 0.27 | 0.16 |
| **4** | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.2 | 1.4 | 0.80 | 0.46 | 0.27 | 0.16 |
| **5** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.80 | 0.45 | 0.26 | 0.16 |
| **6** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.79 | 0.45 | 0.26 | 0.16 |
| **7** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.78 | 0.45 | 0.26 | 0.16 |
| **8** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.1 | 1.4 | 0.77 | 0.44 | 0.26 | 0.15 |
| **9** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.1 | 1.3 | 0.77 | 0.44 | 0.26 | 0.16 |
| **10** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.76 | 0.44 | 0.26 | 0.16 |
| **11** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.76 | 0.44 | 0.26 | 0.16 |
| **12** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.75 | 0.44 | 0.26 | 0.16 |
| **13** | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.0 | 1.3 | 0.75 | 0.43 | 0.26 | 0.16 |
| **14** | 2.1 | 2.1 | 2.1 | 2.1 | 2.2 | 2.0 | 1.3 | 0.75 | 0.43 | 0.26 | 0.16 |
| **15** | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.0 | 1.3 | 0.74 | 0.43 | 0.26 | 0.16 |
| **16** | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.8 | 1.2 | 0.69 | 0.40 | 0.24 | 0.15 |
| **17** | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.7 | 1.1 | 0.64 | 0.38 | 0.23 | 0.14 |
| **18** | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.6 | 1.0 | 0.60 | 0.35 | 0.21 | 0.14 |
| **19** | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.5 | 0.97 | 0.56 | 0.33 | 0.20 | 0.13 |
| **20** | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 0.90 | 0.52 | 0.31 | 0.19 | 0.12 |
| **21** | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 | 0.84 | 0.49 | 0.29 | 0.18 | 0.12 |
| **22** | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.2 | 0.79 | 0.46 | 0.27 | 0.17 | 0.11 |
| **23** | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.1 | 0.73 | 0.43 | 0.26 | 0.16 | 0.10 |
| **24** | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 0.69 | 0.40 | 0.24 | 0.15 | 0.10 |
| **25** | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.96 | 0.64 | 0.38 | 0.23 | 0.14 | 0.095 |
| **26** | 0.95 | 0.95 | 0.96 | 0.96 | 0.97 | 0.9 | 0.60 | 0.35 | 0.21 | 0.13 | 0.091 |
| **27** | 0.89 | 0.89 | 0.89 | 0.90 | 0.91 | 0.84 | 0.56 | 0.33 | 0.20 | 0.13 | 0.087 |
| **28** | 0.83 | 0.83 | 0.83 | 0.84 | 0.85 | 0.79 | 0.53 | 0.31 | 0.19 | 0.12 | 0.084 |
| **29** | 0.77 | 0.78 | 0.78 | 0.78 | 0.79 | 0.73 | 0.49 | 0.29 | 0.18 | 0.12 | 0.080 |
| **30** | 0.72 | 0.72 | 0.73 | 0.73 | 0.74 | 0.69 | 0.46 | 0.28 | 0.17 | 0.11 | 0.077 |

**P. Dissolved oxygen saturation based on temperature and elevation.**

| Temperature °C | Elevation (feet) 0 | 500 | 1,000 | 1,500 | 2,000 | 2,500 | 3,000 | 3,500 | 4,000 | 4,500 | 5,000 | 5,500 | 6,000 | 6,500 | 7,000 | 7,500 | 8,000 | 8,500 | 9,000 | 9,500 | 10,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 14.6 | 14.3 | 14.1 | 13.8 | 13.6 | 13.3 | 13.1 | 12.8 | 12.6 | 12.3 | 12.1 | 11.9 | 11.6 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.3 | 10.1 | 9.9 |
| 1 | 14.2 | 13.9 | 13.7 | 13.4 | 13.2 | 12.9 | 12.7 | 12.5 | 12.2 | 12.0 | 11.8 | 11.5 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 |
| 2 | 13.8 | 13.6 | 13.3 | 13.1 | 12.8 | 12.6 | 12.4 | 12.1 | 11.9 | 11.7 | 11.5 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 | 9.4 |
| 3 | 13.4 | 13.2 | 13.0 | 12.7 | 12.5 | 12.3 | 12.0 | 11.8 | 11.6 | 11.4 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 |
| 4 | 13.1 | 12.8 | 12.6 | 12.4 | 12.2 | 11.9 | 11.7 | 11.5 | 11.3 | 11.1 | 10.9 | 10.7 | 10.4 | 10.2 | 10.0 | 9.8 | 9.7 | 9.5 | 9.3 | 9.1 | 8.9 |
| 5 | 12.7 | 12.5 | 12.3 | 12.1 | 11.8 | 11.6 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 | 9.4 | 9.2 | 9.0 | 8.9 | 8.7 |
| 6 | 12.4 | 12.2 | 12.0 | 11.8 | 11.5 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.5 | 9.4 | 9.2 | 9.0 | 8.8 | 8.6 | 8.5 |
| 7 | 12.1 | 11.9 | 11.7 | 11.5 | 11.3 | 11.1 | 10.8 | 10.6 | 10.4 | 10.2 | 10.1 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 | 8.9 | 8.8 | 8.6 | 8.4 | 8.2 |
| 8 | 11.8 | 11.6 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 | 9.4 | 9.3 | 9.1 | 8.9 | 8.7 | 8.6 | 8.4 | 8.2 | 8.0 |
| 9 | 11.5 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.8 | 9.6 | 9.4 | 9.2 | 9.0 | 8.9 | 8.7 | 8.5 | 8.3 | 8.2 | 8.0 | 7.8 |
| 10 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.5 | 9.4 | 9.2 | 9.0 | 8.8 | 8.7 | 8.5 | 8.3 | 8.1 | 8.0 | 7.8 | 7.7 |
| 11 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 | 9.0 | 8.8 | 8.6 | 8.5 | 8.3 | 8.1 | 8.0 | 7.8 | 7.6 | 7.5 |
| 12 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 | 9.5 | 9.3 | 9.1 | 8.9 | 8.8 | 8.6 | 8.4 | 8.3 | 8.1 | 7.9 | 7.8 | 7.6 | 7.5 | 7.3 |
| 13 | 10.5 | 10.3 | 10.1 | 9.9 | 9.8 | 9.6 | 9.4 | 9.2 | 9.1 | 8.9 | 8.7 | 8.6 | 8.4 | 8.2 | 8.1 | 7.9 | 7.8 | 7.6 | 7.5 | 7.3 | 7.2 |
| 14 | 10.3 | 10.1 | 9.9 | 9.7 | 9.6 | 9.4 | 9.2 | 9.0 | 8.9 | 8.7 | 8.5 | 8.4 | 8.2 | 8.1 | 7.9 | 7.7 | 7.6 | 7.4 | 7.3 | 7.1 | 7.0 |
| 15 | 10.1 | 9.9 | 9.7 | 9.5 | 9.3 | 9.2 | 9.0 | 8.8 | 8.7 | 8.5 | 8.4 | 8.2 | 8.0 | 7.9 | 7.7 | 7.6 | 7.4 | 7.3 | 7.1 | 7.0 | 6.8 |
| 16 | 9.8 | 9.7 | 9.5 | 9.3 | 9.2 | 9.0 | 8.8 | 8.7 | 8.5 | 8.3 | 8.2 | 8.0 | 7.9 | 7.7 | 7.6 | 7.4 | 7.3 | 7.1 | 7.0 | 6.8 | 6.7 |
| 17 | 9.6 | 9.5 | 9.3 | 9.1 | 9.0 | 8.8 | 8.6 | 8.5 | 8.3 | 8.2 | 8.0 | 7.9 | 7.7 | 7.6 | 7.4 | 7.3 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 |
| 18 | 9.4 | 9.3 | 9.1 | 8.9 | 8.8 | 8.6 | 8.5 | 8.3 | 8.1 | 8.0 | 7.8 | 7.7 | 7.5 | 7.4 | 7.3 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 |
| 19 | 9.3 | 9.1 | 8.9 | 8.8 | 8.6 | 8.4 | 8.3 | 8.1 | 8.0 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 | 6.3 |
| 20 | 9.1 | 8.9 | 8.7 | 8.6 | 8.4 | 8.3 | 8.1 | 8.0 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 | 6.3 | 6.2 |
| 21 | 8.9 | 8.7 | 8.6 | 8.4 | 8.3 | 8.1 | 8.0 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 | 6.3 | 6.2 | 6.0 |
| 22 | 8.7 | 8.6 | 8.4 | 8.2 | 8.1 | 8.0 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 | 6.3 | 6.2 | 6.1 | 5.9 |
| 23 | 8.6 | 8.4 | 8.2 | 8.1 | 7.9 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 | 6.3 | 6.2 | 6.1 | 5.9 | 5.8 |
| 24 | 8.4 | 8.2 | 8.1 | 7.9 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.4 | 6.3 | 6.2 | 6.1 | 5.9 | 5.8 | 5.7 |
| 25 | 8.2 | 8.1 | 7.9 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.5 | 6.3 | 6.2 | 6.1 | 6.0 | 5.8 | 5.7 | 5.6 |
| 26 | 8.1 | 7.9 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.5 | 6.3 | 6.2 | 6.1 | 6.0 | 5.8 | 5.7 | 5.6 | 5.5 |
| 27 | 7.9 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.8 | 6.7 | 6.6 | 6.5 | 6.3 | 6.2 | 6.1 | 6.0 | 5.9 | 5.7 | 5.6 | 5.5 | 5.4 |
| 28 | 7.8 | 7.7 | 7.5 | 7.4 | 7.2 | 7.1 | 7.0 | 6.9 | 6.7 | 6.6 | 6.5 | 6.4 | 6.2 | 6.1 | 6.0 | 5.9 | 5.8 | 5.6 | 5.5 | 5.4 | 5.3 |
| 29 | 7.7 | 7.5 | 7.4 | 7.3 | 7.1 | 7.0 | 6.9 | 6.7 | 6.6 | 6.5 | 6.4 | 6.2 | 6.1 | 6.0 | 5.9 | 5.8 | 5.7 | 5.5 | 5.4 | 5.3 | 5.2 |
| 30 | 7.5 | 7.4 | 7.3 | 7.1 | 7.0 | 6.9 | 6.7 | 6.6 | 6.5 | 6.4 | 6.3 | 6.1 | 6.0 | 5.9 | 5.8 | 5.7 | 5.6 | 5.4 | 5.3 | 5.2 | 5.1 |

[20.6.4.900 NMAC – Rp 20 NMAC 6.1.3100, 10-12-00; A, 10-11-02]

**20.6.4.901 PUBLICATION REFERENCES:** These documents are intended as guidance and are available for public review during regular business hours at the offices of the surface water quality bureau and the New Mexico environment department public library. Copies of these documents have also been filed with the New Mexico state records center in order to provide greater access to this information.

**A.** American public health association. 1992. *Standard methods for the examination of water and wastewater, 18th Edition.* Washington, D.C. 1048 p.

**B.** United States geological survey. 1987. *Methods for determination of inorganic substances in water and fluvial sediments, techniques of water-resource investigations of the United States geological survey.* Washington, D.C. 80 p.

**C.** United States geological survey. 1987. *Methods for the determination of organic substances in water and fluvial sediments, techniques of water-resource investigations of the U.S. geological survey.* Washington, D.C. 80 p.

**D.** United States environmental protection agency. 1974. *Methods for chemical analysis of water and wastes.* National environmental research center, Cincinnati, Ohio. (EPA-625-/6-74-003). 298 p.

**E.** New Mexico water quality control commission. 1978. *(208) state of New Mexico water quality management plan* (updated 1988). Santa Fe, New Mexico. 226. p.

**F.** Colorado river basin salinity control forum. 1993. *1993 Review, water quality standards for salinity, Colorado river system.* Phoenix, Arizona. 154 p.

**G.** United States environmental protection agency. 1991. *Methods for measuring the acute toxicity of effluents to freshwater and marine organisms.* Office of research and development, Washington, D.C. (4th Ed., EPA/600/4-90/027). 293 p. http://www.epa.gov/ost/WET/atx.pdf

**H.** United States environmental protection agency. 1989. *Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms.* Environmental monitoring systems laboratory, Cincinnati, Ohio. (2nd Ed., EPA 600/4-89/001). 250 p. http://www.epa.gov/OST/WET/ctf.pdf

**I.** Ambient-induced mixing, in United States environmental protection agency. 1991. *Technical support document for water quality-based toxics control.* Office of water, Washington, D.C. (EPA/505/2-90-001). 2 p.

**J.** United States environmental protection agency. 1983. *Technical support manual: waterbody surveys and assessments for conducting use attainability analyses.* Office of water, regulations and standards, Washington, D.C. 251 p. http://www.epa.gov/OST/library/wqstandards/uaavol123.pdf

**K.** United States environmental protection agency. 1984. *Technical support manual: waterbody surveys and assessments for conducting use attainability analyses, volume III: lake systems.* Office of water, regulations and standards, Washington, D.C. 208 p. http://www.epa.gov/OST/library/wqstandards/uaavol123.pdf

[20.6.4.901 NMAC – Rp 20 NMAC 6.1.4000, 10-12-00]

**HISTORY of 20.6.4 NMAC:**

**Pre-NMAC History:**

Material in the part was derived from that previously filed with the commission of public records - state records center and archives:

WQC 67-1, Water Quality Standards, filed 7-17-67, effective 8-18-67
WQC 67-1, Amendment Nos. 1-6, filed 3-21-68, effective 4-22-68
WQC 67-1, Amendment No. 7, filed 2-27-69, effective 3-30-69
WQC 67-1, Amendment No. 8, filed 7-14-69, effective 8-15-69
WQC 70-1, Water Quality Standards for Intrastate Waters and Tributaries to Interstate Streams, filed July 17, 1970;
WQC 67-1, Amendment Nos. 9 and 10, filed 2-12-71, effective 3-15-71
WQC 67-1, Amendment No. 11, filed 3-4-71, effective 4-5-71
WQC 73-1, New Mexico Water Quality Standards, filed 9-17-73, effective 10-23-73
WQC 73-1, Amendment Nos. 1 and 2, filed 10-3-75, effective 11-4-75
WQC 73-1, Amendment No. 3, filed 1-19-76, effective 2-14-76
WQC 77-2, Amended Water Quality Standards for Interstate and Intrastate Streams in New Mexico, filed 2-24-77, effective 3-11-77
WQC 77-2, Amendment No. 1, filed 3-23-78, effective 4-24-78
WQC 77-2, Amendment No. 2, filed 6-12-79, effective 7-13-79
WQCC 80-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, filed 8-28-80, effective 9-28-80

WQCC 81-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, filed 5-5-81, effective 6-4-81
WQCC 81-1, Amendment No. 1, filed 5-19-82, effective 6-18-82
WQCC 81-1, Amendment No. 2, filed 6-24-82, effective 7-26-82
WQCC 85-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, filed 1-16-85, effective 2-15-85
WQCC 85-1, Amendment No. 1, filed 8-28-87, effective 9-28-87
WQCC 88-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, filed 3-24-88, effective 4-25-88
WQCC 91-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, filed 5-29-91, effective 6-29-91
WQCC 91-1, Amendment No. 1, filed 10-11-91, effective 11-12-91

**History of the Repealed Material:**
WQC 67-1, Water Quality Standards, - Superseded, 10-23-73
WQC 73-1, New Mexico Water Quality Standards, - Superseded, 3-11-77
WQC 77-2, Amended Water Quality Standards for Interstate and Intrastate Streams in New Mexico, - Superseded, 9-28-80
WQCC 80-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, - Superseded, 6-4-81
WQCC 81-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, - Superseded, 2-15-85
WQCC 85-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, - Superseded, 4-25-88
WQCC 88-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, - Superseded, 6-29-91
WQCC 91-1, Water Quality Standards for Interstate and Intrastate Streams in New Mexico, - Superseded, 1-23-95
20 NMAC 6.1, Standards for Interstate and Intrastate Streams, - Repealed, 2-23-00
20 NMAC 6.1, Standards for Interstate and Intrastate Surface Waters, - Repealed, 10-12-00

# 20.6.2 NMAC

# NEW MEXICO
# WATER QUALITY CONTROL COMMISSION
# REGULATIONS

September 15, 2002

**BLANK**

**PAGE**

## Table of Contents

**TITLE 20 ENVIRONMENTAL PROTECTION**
**CHAPTER 6 WATER QUALITY**
**PART 2 GROUND AND SURFACE WATER PROTECTION**


20.6.2.1. ISSUING AGENCY ..... 1
20.6.2.2. SCOPE ..... 1
20.6.2.3. STATUTORY AUTHORITY ..... 1
20.6.2.4. DURATION ..... 1
20.6.2.5. EFFECTIVE DATE ..... 1
20.6.2.6. OBJECTIVE ..... 1
20.6.2.7. DEFINITIONS ..... 1

**20.6.2.1200. PROCEDURES** ..... 6
20.6.2.1201. NOTICE OF INTENT TO DISCHARGE ..... 6
20.6.2.1202. FILING OF PLANS AND SPECIFICATIONS--SEWERAGE SYSTEMS ..... 6
20.6.2.1203. NOTIFICATION OF DISCHARGE--REMOVAL ..... 7
20.6.2.1210. VARIANCE PETITIONS ..... 8
20.6.2.1220. PENALTIES, ENFORCEMENT, COMPLIANCE ORDERS, PENALTIES, ASSURANCE OF DISCONTINUANCE ..... 9

**20.6.2.2000. SURFACE WATER PROTECTION** ..... 9
20.6.2.2100. APPLICABILITY ..... 9
20.6.2.2101. GENERAL REQUIREMENTS ..... 9
20.6.2.2102. RIO GRANDE BASIN--COMMUNITY SEWERAGE SYSTEMS ..... 10
20.6.2.2200. WATERCOURSE PROTECTION ..... 11
20.6.2.2201. DISPOSAL OF REFUSE ..... 11

**20.6.2.3000. PERMITTING AND GROUND WATER STANDARDS** ..... 11
20.6.2.3101. PURPOSE ..... 11
20.6.2.3103. STANDARDS FOR GROUND WATER OF 10,000 mg/l TDS CONCENTRATION OR LESS ..... 12
20.6.2.3104. DISCHARGE PLAN REQUIRED ..... 13
20.6.2.3105. EXEMPTIONS FROM DISCHARGE PLAN REQUIREMENT ..... 13
20.6.2.3106. APPLICATION FOR DISCHARGE PLAN APPROVALS AND RENEWALS ..... 14
20.6.2.3107. MONITORING, REPORTING, AND OTHER REQUIREMENTS ..... 15
20.6.2.3108. PUBLIC NOTICE AND PARTICIPATION ..... 16
20.6.2.3109. SECRETARY APPROVAL, DISAPPROVAL, MODIFICATION OR TERMINATION OF PROPOSED DISCHARGE PLANS, AND REQUIREMENT FOR ABATEMENT PLANS ..... 17
20.6.2.3110. PUBLIC HEARING PARTICIPATION ..... 19
20.6.2.3111. TRANSFER OF DISCHARGE PLAN ..... 20
20.6.2.3112. APPEALS FROM SECRETARY'S DECISIONS ..... 21
20.6.2.3113. APPEALS FROM COMMISSION DECISIONS ..... 21
20.6.2.3114. FEES ..... 21

## Table of Contents, Continued


**20.6.2.4000** **PREVENTION AND ABATEMENT OF WATER POLLUTION** ....24
20.6.2.4101 PURPOSE ....24
20.6.2.4103 ABATEMENT STANDARDS AND REQUIREMENTS ....24
20.6.2.4104 ABATEMENT PLAN REQUIRED ....25
20.6.2.4105 EXEMPTIONS FROM ABATEMENT PLAN REQUIREMENTS ....26
20.6.2.4106 ABATEMENT PLAN PROPOSAL ....26
20.6.2.4107 OTHER REQUIREMENTS ....28
20.6.2.4108 PUBLIC NOTICE AND PARTICIPATION ....28
20.6.2.4109 SECRETARY APPROVAL OR NOTICE OF DEFICIENCY OF SUBMITTALS ....29
20.6.2.4110 INVESTIGATION AND ABATEMENT ....29
20.6.2.4111 ABATEMENT PLAN MODIFICATION ....30
20.6.2.4112 COMPLETION AND TERMINATION ....30
20.6.2.4113 DISPUTE RESOLUTION ....30
20.6.2.4114 APPEALS FROM SECRETARY'S DECISIONS ....30
20.6.2.4115 COURT REVIEW OF COMMISSION DECISIONS ....31

**20.6.2.5000** **UNDERGROUND INJECTION CONTROL** ....31
20.6.2.5001 PURPOSE ....31
20.6.2.5002 UNDERGROUND INJECTION CONTROL WELL CLASSIFICATIONS ....31
20.6.2.5003 NOTIFICATION AND GENERAL OPERATION REQUIREMENTS FOR ALL UNDERGROUND INJECTION CONTROL WELLS ....32
20.6.2.5004 PROHIBITED UNDERGROUND INJECTION CONTROL ACTIVITIES AND WELLS ....32
20.6.2.5005 PRE-CLOSURE NOTIFICATION AND CLOSURE REQUIREMENTS ....33
20.6.2.5006 DISCHARGE PERMIT REQUIREMENTS FOR CLASS V INJECTION WELLS ....34
20.6.2.5101 DISCHARGE PERMIT AND OTHER REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....34
20.6.2.5102 PRE-CONSTRUCTION REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....36
20.6.2.5103 DESIGNATED AQUIFERS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....38
20.6.2.5104 WAIVER OF REQUIREMENT BY SECRETARY FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....39
20.6.2.5200 TECHNICAL CRITERIA AND PERFORMANCE STANDARDS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....39
20.6.2.5201 PURPOSE ....39
20.6.2.5202 AREA OF REVIEW ....39
20.6.2.5203 CORRECTIVE ACTION FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....41
20.6.2.5204 MECHANICAL INTEGRITY FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....41
20.6.2.5205 CONSTRUCTION REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....42
20.6.2.5206 OPERATING REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....44
20.6.2.5207 MONITORING REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....44
20.6.2.5208 REPORTING REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....45
20.6.2.5209 PLUGGING AND ABANDONMENT FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....46
20.6.2.5210 INFORMATION TO BE CONSIDERED BY THE SECRETARY FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS ....46

**TITLE 20 ENVIRONMENTAL PROTECTION**
**CHAPTER 6 WATER QUALITY**
**PART 2 GROUND AND SURFACE WATER PROTECTION**

**20.6.2.1 ISSUING AGENCY:** Water Quality Control Commission
[12-1-95; 20.6.2.1 NMAC – Rn, 20 NMAC 6.2.I.1000, 1-15-01]

**20.6.2.2 SCOPE:** All persons subject to the Water Quality Act, NMSA 1978, Sections 74-6-1 et seq.
[12-1-95; 20.6.2.2 NMAC – Rn, 20 NMAC 6.2.I.1001, 1-15-01]

**20.6.2.3 STATUTORY AUTHORITY:** Standards and Regulations are adopted by the commission under the authority of the Water Quality Act, NMSA 1978, Sections 74-6-1 through 74-6-17.
[2-18-77, 9-20-82, 12-1-95; 20.6.2.3 NMAC – Rn, 20 NMAC 6.2.I.1002, 1-15-01]

**20.6.2.4 DURATION:** Permanent.
[12-1-95; 20.6.2.4 NMAC – Rn, 20 NMAC 6.2.I.1003, 1-15-01]

**20.6.2.5 EFFECTIVE DATE:** December 1, 1995 unless a later date is cited at the end of a section.
[12-1-95, 11-15-96; 20.6.2.5 NMAC – Rn, 20 NMAC 6.2.I.1004, 1-15-01; A, 1-15-01]

**20.6.2.6 OBJECTIVE:** The objective of this Part is to implement the Water Quality Act, NMSA 1978, Sections 74-6-1 et seq.
[12-1-95; 20.6.2.6 NMAC – Rn, 20 NMAC 6.2.I.1005, 1-15-01]

**20.6.2.7 DEFINITIONS**: Terms defined in the Water Quality Act, but not defined in this Part, will have the meaning given in the Act. As used in this Part:

**A. "abandoned well"** means a well whose use has been permanently discontinued or which is in a state of disrepair such that it cannot be rehabilitated for its intended purpose or other purposes including monitoring and observation;

**B. "abate" or "abatement"** means the investigation, containment, removal or other mitigation of **water pollution;**

**C. "abatement plan"** means a description of any operational, monitoring, contingency and closure requirements and conditions for the prevention, investigation and abatement of water pollution, and includes Stage 1, Stage 2, or Stage 1 and 2 of the abatement plan, as approved by the secretary;

**D. "adjacent properties"** means properties that are contiguous to the discharge site or property that would be contiguous to the discharge site but for being separated by a public or private right of way, including roads and highways.

**E. "background"** means, for purposes of ground-water abatement plans only and for no other purposes in this Part or any other regulations including but not limited to surface-water standards, the amount of ground-water contaminants naturally occurring from undisturbed geologic sources or water contaminants which the responsible person establishes are occurring from a source other than the responsible person's facility. This definition shall not prevent the secretary from requiring abatement of commingled plumes of pollution, shall not prevent responsible persons from seeking contribution or other legal or equitable relief from other persons, and shall not preclude the secretary from exercising enforcement authority under any applicable statute, regulation or common law;

**F. "casing"** means pipe or tubing of appropriate material, diameter and weight used to support the sides of a well hole and thus prevent the walls from caving, to prevent loss of drilling mud into porous ground, or to prevent fluid from entering or leaving the well other than to or from the injection zone;

**G. "cementing"** means the operation whereby a cementing slurry is pumped into a drilled hole and/or forced behind the casing;

**H. "cesspool"** means a **"drywell"** that receives untreated domestic liquid waste containing human excreta, and which sometimes has an open bottom and/or perforated sides. A large capacity cesspool means a cesspool that receives greater than 2,000 gallons per day of untreated domestic liquid waste;

**I. "collapse"** means the structural failure of overlying materials caused by removal of underlying materials;

**J. "commission"** means:

(1) the New Mexico Water Quality Control Commission or

(2) the Department, when used in connection with any administrative and enforcement activity;

**K.** **"confining zone"** means a geological formation, group of formations, or part of a formation that is capable of limiting fluid movement from an injection zone;

**L.** **"conventional mining"** means the production of minerals from an open pit or underground excavation. Underground excavations include mine shafts, workings and air vents, but does not include excavations primarily caused by in situ extraction activities;

**M.** **"daily composite sample"** means a sample collected over any twenty-four hour period at intervals not to exceed one hour and obtained by combining equal volumes of the effluent collected, or means a sample collected in accordance with federal permit conditions where a permit has been issued under the National Pollutant Discharge Elimination System or for those facilities which include a waste stabilization pond in the treatment process where the retention time is greater than twenty (20) days, means a sample obtained by compositing equal volumes of at least two grab samples collected within a period of not more than twenty-four (24) hours;

**N.** **"department", "agency",** or **"division"** means the New Mexico Environment Department or a constituent agency designated by the commission;

**O.** **"discharge permit modification"** means a change in requirements of a discharge permit as requested by the discharger as a result of past, present or anticipated changes in the quality or quantity of effluent or the location of the discharge; or as required by the secretary;

**P.** **"discharge plan"** means a description of any operational, monitoring , contingency, and closure requirements and conditions for any discharge of effluent or leachate which may move directly or indirectly into ground water;

**Q.** **"discharge permit"** means a discharge plan approved by the department;

**R.** **"discharge site"** means the entire site where the discharge and associated activities will take place.

**S.** **"disposal"** means to abandon, deposit, inter or otherwise discard a fluid as a final action after its use has been achieved;

**T.** **"domestic liquid waste"** means human excreta and water-carried waste from typical residential plumbing fixtures and activities, including but not limited to waste from toilets, sinks, bath fixtures, clothes or dishwashing machines and floor drains;

**U.** **"domestic liquid waste treatment unit"** means a watertight unit designed, constructed and installed to stabilize only domestic liquid waste and to retain solids contained in such domestic liquid waste, including but not limited to aerobic treatment units and septic tanks;

**V.** **"drywell"** means a well, other than an improved sinkhole or subsurface fluid distribution system, completed above the water table so that its bottom and sides are typically dry except when receiving fluids;

**W.** **"experimental technology"** means a technology which has not been proven feasible under the conditions in which it is being tested;

**X.** **"fluid"** means material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state;

**Y.** **"ground water"** means interstitial water which occurs in saturated earth material and which is capable of entering a well in sufficient amounts to be utilized as a water supply;

**Z.** **"hazard to public health"** exists when water which is used or is reasonably expected to be used in the future as a human drinking water supply exceeds at the time and place of such use, one or more of the numerical standards of Subsection A of 20.6.2.3103 NMAC, or the naturally occurring concentrations, whichever is higher, or if any toxic pollutant affecting human health is present in the water. In determining whether a discharge would cause a hazard to public health to exist, the secretary shall investigate and consider the purification and dilution reasonably expected to occur from the time and place of discharge to the time and place of withdrawal for use as human drinking water;

**AA.** **"improved sinkhole"** means a naturally occurring karst depression or other natural crevice found in volcanic terrain and other geologic settings which have been modified by man for the purpose of directing and emplacing fluids into the subsurface;

**BB.** **"injection"** means the subsurface emplacement of fluids through a well;

**CC.** **"injection zone"** means a geological formation, group of formations, or part of a formation receiving fluids through a well;

**DD.** **"motor vehicle waste disposal well"** means a well which receives or has received fluids from vehicular repair or maintenance activities;

**EE.** **"non-aqueous phase liquid"** means an interstitial body of liquid oil, petroleum product, petrochemical, or organic solvent, including an emulsion containing such material;

**FF.** **"operational area"** means a geographic area defined in a project discharge permit where a group of wells or well fields in close proximity comprise a single Class III well operation;

**GG.** **"owner of record"** means an owner of property according to the property records of the tax assessor in the county in which the discharge site is located.

**HH.** **"packer"** means a device lowered into a well to produce a fluid-tight seal within the casing;

**II.** **"person"** means an individual or any other entity including partnerships, corporation, associations, responsible business or association agents or officers, the state or a political subdivision of the state or any agency, department or instrumentality of the United States and any of its officers, agents or employees;

**JJ.** **"petitioner"** means a person seeking a variance from a regulation of the commission pursuant to Section 74-6-4(G) NMSA 1978;

**KK.** **"plugging"** means the act or process of stopping the flow of water, oil or gas into or out of a geological formation, group of formations or part of a formation through a borehole or well penetrating these geologic units;

**LL.** **"project discharge permit"** means a discharge permit which describes the operation of similar Class III wells or well fields within one or more individual operational areas;

**MM.** **"refuse"** includes food, swill, carrion, slops and all substances from the preparation, cooking and consumption of food and from the handling, storage and sale of food products, the carcasses of animals, junked parts of automobiles and other machinery, paper, paper cartons, tree branches, yard trimmings, discarded furniture, cans, oil, ashes, bottles, and all unwholesome material;

**NN.** **"responsible person"** means a person who is required to submit an abatement plan or who submits an abatement plan pursuant to this Part;

**OO.** **"secretary"** or **"director"** means the secretary of the New Mexico Department of Environment or the director of a constituent agency designated by the commission;

**PP.** **"sewer system"** means pipelines, conduits, pumping stations, force mains, or other structures, devices, appurtenances or facilities used for collecting or conducting wastes to an ultimate point for treatment or disposal;

**QQ.** **"sewerage system"** means a system for disposing of wastes, either by surface or underground methods, and includes sewer systems, treatment works, disposal wells and other systems;

**RR.** **"significant modification of Stage 2 of the abatement plan"** means a change in the abatement technology used excluding design and operational parameters, or re-location of 25 percent or more of the compliance sampling stations, for any single medium, as designated pursuant to Paragraph (4) of Subsection E of 20.6.2.4106 NMAC;

**SS.** **"subsurface fluid distribution system"** means an assemblage of perforated pipes, drain tiles, or other mechanisms intended to distribute fluids below the surface of the ground;

**TT.** **"subsurface water"** means ground water and water in the vadose zone that may become ground water or surface water in the reasonably foreseeable future or may be utilized by vegetation;

**UU.** **"TDS"** means total dissolved solids as determined by the "calculation method" (sum of constituents), by the "residue on evaporation method at 180 degrees" of the "U.S. Geological Survey Techniques of Water Resource Investigations," or by conductivity, as the secretary may determine;

**VV.** **"toxic pollutant"** means a water contaminant or combination of water contaminants in concentration(s) which, upon exposure, ingestion, or assimilation either directly from the environment or indirectly by ingestion through food chains, will unreasonably threaten to injure human health, or the health of animals or plants which are commonly hatched, bred, cultivated or protected for use by man for food or economic benefit. As used in this definition injuries to health include death, histopathologic change, clinical symptoms of disease, behavioral abnormalities, genetic mutation, physiological malfunctions or physical deformations in such organisms or their offspring. In order to be considered a toxic pollutant a contaminant must be one or a combination of the potential toxic pollutants listed below and be at a concentration shown by scientific information currently available to the public to have potential for causing one or more of the effects listed above. Any water contaminant or combination of the water contaminants in the list below creating a lifetime risk of more than one cancer per 100,000 exposed persons is a toxic pollutant.

acrolein
acrylonitrile
aldrin
benzene

benzidine
carbon tetrachloride
chlordane
chlorinated benzenes
    monochlorobenzene
    hexachlorobenzene
    pentachlorobenzene
1,2,4,5-tetrachlorobenzene
chlorinated ethanes
    1,2-dichloroethane
    hexachloroethane
    1,1,2,2-tetrachloroethane
    1,1,1-trichloroethane
    1,1,2-trichloroethane
chlorinated phenols
    2,4-dichlorophenol
    2,4,5-trichlorophenol
    2,4,6-trichlorophenol
chloroalkyl ethers
    bis (2-chloroethyl) ether
    bis (2-chloroisopropyl) ether
    bis (chloromethyl) ether
chloroform
DDT
dichlorobenzene
dichlorobenzidine
1,1-dichloroethylene
dichloropropenes
dieldrin
2,4-dinitrotoluene
diphenylhydrazine
endosulfan
endrin
ethylbenzene
halomethanes
    bromodichloromethane
    bromomethane
    chloromethane
    dichlorodifluoromethane
    dichloromethane
    tribromomethane
    trichlorofluoromethane
heptachlor
hexachlorobutadiene
hexachlorocyclohexane (HCH)
    alpha-HCH
    beta-HCH
    gamma-HCH
    technical HCH
hexachlorocyclopentadiene
isophorone
nitrobenzene
nitrophenols
    2,4-dinitro-o-cresol
    dinitrophenols
nitrosamines

N-nitrosodiethylamine
N-nitrosodimethylamine
N-nitrosodibutylamine
N-nitrosodiphenylamine
N-nitrosopyrrolidine
pentachlorophenol
phenol
phthalate esters
dibutyl phthalate
di-2-ethylhexyl phthalate
diethyl phthalate
dimethyl phthalate
polychlorinated biphenyls (PCB's)
polynuclear aromatic hydrocarbons (PAH)
anthracene
3,4-benzofluoranthene
benzo (k) fluoranthene
fluoranthene
fluorene
phenanthrene
pyrene
tetrachloroethylene
toluene
toxaphene
trichloroethylene
vinyl chloride
xylenes
o-xylene
m-xylene
p-xylene
1,1-dichloroethane
ethylene dibromide (EDB)
cis-1,2-dichloroethylene
trans-1,2-dichloroethylene
naphthalene
1-methylnaphthalene
2-methylnaphthalene
benzo-a-pyrene

**WW.** **"vadose zone"** means earth material below the land surface and above ground water, or in between bodies of ground water;

**XX.** **"wastes"** means sewage, industrial wastes, or any other liquid, gaseous or solid substance which will pollute any waters of the state;

**YY.** **"water"** means all water including water situated wholly or partly within or bordering upon the state, whether surface or subsurface, public or private, except private waters that do not combine with other surface or subsurface water;

**ZZ.** **"water contaminant"** means any substance that could alter if discharged or spilled the physical, chemical, biological or radiological qualities of water. "Water contaminant" does not mean source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954;

**AAA.** **"watercourse"** means any river, creek, arroyo, canyon, draw, or wash, or any other channel having definite banks and beds with visible evidence of the occasional flow of water;

**BBB.** **"water pollution"** means introducing or permitting the introduction into water, either directly or indirectly, of one or more water contaminants in such quantity and of such duration as may with reasonable probability injure human health, animal or plant life or property, or to unreasonably interfere with the public welfare or the use of property;

**CCC.** **"well"** means: (1) A bored, drilled, or driven shaft; (2) A dug hole whose depth is greater than the largest surface dimension; (3) An improved sinkhole; or (4) A subsurface fluid distribution system;

**DDD. "well stimulation"** means a process used to clean the well, enlarge channels, and increase pore space in the interval to be injected, thus making it possible for fluids to move more readily into the injection zone. Well stimulation includes, but is not limited to, (1) surging, (2) jetting, (3) blasting, (4) acidizing, (5) hydraulic fracturing.
[1-4-68, 4-20-68, 11-27-70, 9-3-72, 4-11-74, 8-13-76, 2-18-77, 6-26-80, 7-2-81, 1-29-82, 9-20-82, 11-17-84, 3-3-86, 8-17-91, 8-19-93, 12-1-95; 20.6.2.7 NMAC – Rn, 20 NMAC 6.2.I.1101, 1-15-01; A, 1-15-01; A, 12-1-01; A, 9-15-02]

**20.6.2.8 SEVERABILITY:** If any Section, Subsection, individual standard or application of these standards or regulations is held invalid, the remainder shall not be affected.
[2-18-77, 12-1-95; 20.6.2.8 NMAC – Rn, 20 NMAC 6.2.I.1007, 1-15-01]

**20.6.2.9 DOCUMENTS:** Documents referenced in the Part may be viewed at the New Mexico Environment Department, Ground Water Quality Bureau, Harold Runnels Building, 1190 St. Francis Drive, Santa Fe, New Mexico 87503.
[12-1-95; 20.6.2.9 NMAC – Rn, 20 NMAC 6.2.I.1006, 1-15-01; A, 12-1-01]

**20.6.2.10 – 20.6.2.1199: [RESERVED]**
[12-1-95; 20.6.2.10 – 20.6.2.1199 NMAC – Rn, 20 NMAC 6.2.I.1008-1100, 1102-1199, 1-15-01]

**20.6.2.1200 PROCEDURES:**
[12-1-95; 20.6.2.1200 NMAC – Rn, 20 NMAC 6.2.I.1200, 1-15-01]

**20.6.2.1201 NOTICE OF INTENT TO DISCHARGE:**

**A.** Any person intending to make a new water contaminant discharge or to alter the character or location of an existing water contaminant discharge, unless the discharge is being made or will be made into a community sewer system or subject to the Liquid Waste Disposal Regulations adopted by the New Mexico Environmental Improvement Board, shall file a notice with the Ground Water Quality Bureau of the department for discharges that may affect ground water, and/ or the Surface Water Quality Bureau of the department for discharges that may affect surface water. However, notice regarding discharges from facilities for the production, refinement, pipeline transmission of oil and gas or products thereof, the oil field service industry, oil field brine production wells, geothermal installations and carbon dioxide facilities shall be filed instead with the Oil Conservation Division.

**B.** Any person intending to inject fluids into a well, including a subsurface distribution system, unless the injection is being made subject to the Liquid Waste Disposal Regulations adopted by the New Mexico Environmental Improvement Board, shall file a notice with the Ground Water Quality Bureau of the department. However notice regarding injection to wells associated with oil and gas facilities as described in Subsection A of Section 20.6.2.1201 NMAC shall be filed instead with the Oil Conservation Division.

**C.** Notices shall state:

(1) the name of the person making the discharge;
(2) the address of the person making the discharge;
(3) the location of the discharge;
(4) an estimate of the concentration of water contaminants in the discharge; and
(5) the quantity of the discharge.

**D.** Based on information provided in the notice of intent, the department will notify the person proposing the discharge as to which of the following apply:

(1) a discharge permit is required;
(2) a discharge permit is not required;
(3) the proposed injection well will be added to the department's underground injection well inventory;
(4) the proposed injection activity or injection well is prohibited pursuant to 20.6.2.5004 NMAC.

[1-4-68, 9-5-69, 9-3-72, 2-17-74, 2-20-81, 12-1-95; 20.6.2.1201 NMAC – Rn, 20 NMAC 6.2.I.1201, 1-15-01; A, 12-1-01]

**20.6.2.1202 FILING OF PLANS AND SPECIFICATIONS--SEWERAGE SYSTEMS:**

**A.** Any person proposing to construct a sewerage system or proposing to modify any sewerage system in a manner that will change substantially the quantity or quality of the discharge from the system shall file plans and specifications of the construction or modification with Ground Water Quality Bureau of the department for discharges that may affect ground water, and/or the Surface Water Quality Bureau of the department for discharges that may affect surface water. Modifications having a minor effect on the character of the discharge from sewerage systems shall be reported as of January 1 and June 30 of each year to the Ground Water Quality Bureau of the department for discharges that may affect ground water, or the Surface Water Quality Bureau of the department for discharges that may affect surface water.

**B.** Plans, specifications and reports required by this Section, if related to facilities for the production, refinement and pipeline transmission of oil and gas, or products thereof, shall be filed instead with the Oil Conservation Division.

**C.** Plans and specifications required to be filed under this Section must be filed prior to the commencement of construction.

[1-4-68, 9-3-72, 2-20-81, 12-1-95; 20.6.2.1202 NMAC – Rn, 20 NMAC 6.2.I.1202, 1-15-01; A, 12-1-01]

**20.6.2.1203 NOTIFICATION OF DISCHARGE—REMOVAL:**

**A.** With respect to any discharge from any facility of oil or other water contaminant, in such quantity as may with reasonable probability injure or be detrimental to human health, animal or plant life, or property, or unreasonably interfere with the public welfare or the use of property, the following notifications and corrective actions are required:

(1) As soon as possible after learning of such a discharge, but in no event more than twenty-four (24) hours thereafter, any person in charge of the facility shall orally notify the Chief of the Ground Water Quality Bureau of the department, or his counterpart in any constituent agency delegated responsibility for enforcement of these rules as to any facility subject to such delegation. To the best of that person's knowledge, the following items of information shall be provided:

(a) the name, address, and telephone number of the person or persons in charge of the facility, as well as of the owner and/or operator of the facility;

(b) the name and address of the facility;

(c) the date, time, location, and duration of the discharge

(d) the source and cause of discharge;

(e) a description of the discharge, including its chemical composition;

(f) the estimated volume of the discharge; and

(g) any actions taken to mitigate immediate damage from the discharge.

(2) When in doubt as to which agency to notify, the person in charge of the facility shall notify the Chief of the Ground Water Quality Bureau of the department. If that department does not have authority pursuant to commission delegation, the department shall notify the appropriate constituent agency.

(3) Within one week after the discharger has learned of the discharge, the facility owner and/or operator shall send written notification to the same department official, verifying the prior oral notification as to each of the foregoing items and providing any appropriate additions or corrections to the information contained in the prior oral notification.

(4) The oral and written notification and reporting requirements contained in this Subsection A are not intended to be duplicative of discharge notification and reporting requirements promulgated by the Oil Conservation Commission (OCC) or by the Oil Conservation Division (OCD); therefore, any facility which is subject to OCC or OCD discharge notification and reporting requirements need not additionally comply with the notification and reporting requirements herein.

(5) As soon as possible after learning of such a discharge, the owner/operator of the facility shall take such corrective actions as are necessary or appropriate to contain and remove or mitigate the damage caused by the discharge.

(6) If it is possible to do so without unduly delaying needed corrective actions, the facility owner/operator shall endeavor to contact and consult with the Chief of the Ground Water Quality Bureau of the department or appropriate counterpart in a delegated agency, in an effort to determine the department's views as to what further corrective actions may be necessary or appropriate to the discharge in question. In any event, no later than fifteen (15) days after the discharger learns of the discharge, the facility owner/operator shall send to said Bureau Chief a written report describing any corrective actions taken and/or to be taken relative to the discharge. Upon a written request and for good cause shown, the Bureau Chief may extend the time limit beyond fifteen (15) days.

(7) The Bureau Chief shall approve or disapprove in writing the foregoing corrective action report within thirty (30) days of its receipt by the department. In the event that the report is not satisfactory to the department, the Bureau Chief shall specify in writing to the facility owner/operator any shortcomings in the report or in the corrective actions already taken or proposed to be taken relative to the discharge, and shall give the facility owner/operator a reasonable and clearly specified time within which to submit a modified corrective action report. The Bureau Chief shall approve or disapprove in writing the modified corrective action report within fifteen (15) days of its receipt by the department.

(8) In the event that the modified corrective action report also is unsatisfactory to the department, the facility owner/operator has five (5) days from the notification by the Bureau Chief that it is unsatisfactory to appeal to the department secretary. The department secretary shall approve or disapprove the modified corrective action report within five (5) days of receipt of the appeal from the Bureau Chief's decision. In the absence of either corrective action consistent with the approved corrective action report or with the decision of the secretary concerning the shortcomings of the modified corrective action report, the department may take whatever enforcement or legal action it deems necessary or appropriate.

(9) If the secretary determines that the discharge causes or may with reasonable probability cause water pollution in excess of the standards and requirements of Section 20.6.2.4103 NMAC, and the water pollution will not be abated within one hundred and eighty (180) days after notice is required to be given pursuant to Paragraph (1) of Subsection A of Section 20.6.2.1203 NMAC, the secretary may notify the facility owner/operator that he is a responsible person and that an abatement plan may be required pursuant to Section 20.6.2.4104 and Subsection A of Section 20.6.2.4106 NMAC.

**B.** Exempt from the requirements of this Section are continuous or periodic discharges which are made:

(1) in conformance with regulations of the commission and rules, regulations or orders of other state or federal agencies; or

(2) in violation of regulations of the commission, but pursuant to an assurance of discontinuance or schedule of compliance approved by the commission or one of its duly authorized constituent agencies.

**C.** As used in this Section and in Sections 20.6.2.4100 through 20.6.2.4115 NMAC, but not in other Sections of this Part:

(1) "discharge" means spilling, leaking, pumping, pouring, emitting, emptying, or dumping into water or in a location and manner where there is a reasonable probability that the discharged substance will reach surface or subsurface water;

(2) "facility" means any structure, installation, operation, storage tank, transmission line, motor vehicle, rolling stock, or activity of any kind, whether stationary or mobile;

(3) "oil" means oil of any kind or in any form including petroleum, fuel oil, sludge, oil refuse and oil mixed with wastes;

(4) "operator" means the person or persons responsible for the overall operations of a facility; and

(5) "owner" means the person or persons who own a facility, or part of a facility.

**D.** Notification of discharge received pursuant to this Part or information obtained by the exploitation of such notification shall not be used against any such person in any criminal case, except for perjury or for giving a false statement.

**E.** Any person who has any information relating to any discharge from any facility of oil or other water contaminant, in such quantity as may with reasonable probability injure or be detrimental to human health, animal or plant life, or property, or unreasonably interfere with the public welfare or the use of property, is urged to notify the Chief of the Ground Water Quality Bureau of the department. Upon such notification, the secretary may require an owner/operator or a responsible person to perform corrective actions pursuant to Paragraphs (5) and (9) of Subsection A of Section 20.6.2.1203 NMAC.

[2-17-74, 2-20-81, 12-24-87, 12-1-95; 20.6.2.1203 NMAC – Rn, 20 NMAC 6.2.I.1203, 1-15-01; A, 12-1-01]

**20.6.2.1204 – 20.6.2.1209 [RESERVED]**

[12-1-95; 20.6.2.1204 – 20.6.2.1209 NMAC – Rn, 20 NMAC 6.2.I.1204-1209, 1-15-01]

**20.6.2.1210 VARIANCE PETITIONS:**

**A.** Any person seeking a variance pursuant to Section 74-6-4 (G) NMSA 1978, shall do so by filing a written petition with the commission. The petitioner may submit with his petition any relevant documents or material which the petitioner believes would support his petition. Petitions shall:

(1) state the petitioner's name and address;

(2) state the date of the petition;
(3) describe the facility or activity for which the variance is sought;
(4) state the address or description of the property upon which the facility is located;
(5) describe the water body or watercourse affected by the discharge;
(6) identify the regulation of the commission from which the variance is sought;
(7) state in detail the extent to which the petitioner wishes to vary from the regulation;
(8) state why the petitioner believes that compliance with the regulation will impose an unreasonable burden upon his activity; and
(9) state the period of time for which the variance is desired.

**B.** The variance petition shall be reviewed in accordance with the adjudicatory procedures of 20 NMAC 1.3.

**C.** The commission may grant the requested variance, in whole or in part, may grant the variance subject to conditions, or may deny the variance. The commission shall not grant a variance for a period of time in excess of five years.

**D.** An order of the commission is final and bars the petitioner from petitioning for the same variance without special permission from the commission. The commission may consider, among other things, the development of new information and techniques to be sufficient justification for a second petition. If the petitioner, or his authorized representative, fails to appear at the public hearing on the variance petition, the commission shall proceed with the hearing on the basis of the petition. A variance may not be extended or renewed unless a new petition is filed and processed in accordance with the procedures established by this Section.
[7-19-68, 11-27-70, 9-3-72, 2-20-81, 11-15-96; 20.6.2.1210 NMAC – Rn, 20 NMAC 6.2.I.1210, 1-15-01]

**20.6.2.1211 – 20.6.2.1219: [RESERVED]**
[12-1-95; 20.6.2.1211 – 20.6.2.1219 NMAC – Rn, 20 NMAC 6.2.I.1211-1219, 1-15-01]

**20.6.2.1220 PENALTIES ENFORCEMENT, COMPLIANCE ORDERS, PENALTIES, ASSURANCE OF DISCONTINUANCE.:** Failure to comply with the Water Quality Act, or any regulation or standard promulgated pursuant to the Water Quality Act is a prohibited act. If the secretary determines that a person has violated or is violating a requirement of the Water Quality Act or any regulation promulgated thereunder or is exceeding any water quality standard or ground water standard contained in Commission regulations, or is not complying with a condition or provision of an approved or modified abatement plan, discharge plan, or permit issued pursuant to the Water Quality Act, the secretary may issue a compliance order, assess a penalty, commence a civil action in district court, or accept an assurance of discontinuance in accordance with NMSA 1978, Section 74-6-10 of the Water Quality Act.
[12-1-95; 20.6.2.1220 NMAC – Rn, 20 NMAC 6.2.I.1220, 1-15-01]

**20.6.2.1221 – 20.6.2.1999: [RESERVED]**
[12-1-95; 20.6.2.1221 – 20.6.2.1999 NMAC – Rn, 20 NMAC 6.2.I.1221-2099, 1-15-01]

**20.6.2.2000 SURFACE WATER PROTECTION:**
[12-1-95; 20.6.2.2000 NMAC – Rn, 20 NMAC 6.2.II, 1-15-01]

**20.6.2.2001 – 20.6.2.2099: [RESERVED]**
[12-1-95; 20.6.2.2001 – 20.6.2.2099 NMAC – Rn, 20 NMAC 6.2.I.1221-2099, 1-15-01]

**20.6.2.2100 APPLICABILITY:** The requirements of Section 20.6.2.2101 and 20.6.2.2102 NMAC shall not apply to any discharge which is subject to a permit under the National Pollutant Discharge Elimination System of P. L. 92-500; provided that any discharger who is given written notice of National Pollutant Discharge Elimination System permit violation from the Administrator of the Environmental Protection Agency and who has not corrected the violation within thirty days of receipt of said notice shall be subject to Section 20.6.2.2101 and 20.6.2.2102 NMAC until in compliance with the National Pollution Discharge Elimination System permit conditions; provided further that nothing in this Part shall be construed as a deterrent to action under Section 74-6-11 NMSA, 1978.
[8-13-76; 20.6.2.2100 NMAC – Rn, 20 NMAC 6.2.II.2100, 1-15-01]

**20.6.2.2101 GENERAL REQUIREMENTS:**

A. Except as otherwise provided in Sections 20.6.2.2000 through 20.6.2.2201 NMAC, no person shall cause or allow effluent to discharge to a watercourse if the effluent as indicated by:

(1) any two consecutive daily composite samples;

(2) more than one daily composite sample in any thirty-day period (in which less than ten (10) daily composite samples are examined);

(3) more than ten percent (10%) of the daily composite samples in any thirty-day period (in which ten (10) or more daily composite samples are examined); or

(4) a grab sample collected during flow from an intermittent or infrequent discharge does not conform to the following:

| | | |
|---|---|---|
| (a) | Bio-chemical Oxygen Demand (BOD) | Less than 30 mg/l |
| (b) | Chemical Oxygen Demand (COD) | Less than 125 mg/l |
| (c) | Settleable Solids | Less than 0.5 mg/l |
| (d) | Fecal Coliform Bacteria | Less than 500 organisms per 100 ml |
| (e) | pH | Between 6.6 and 8.6 |

B. Upon application, the secretary may eliminate the pH requirement for any effluent source that the secretary determines does not unreasonably degrade the water into which the effluent is discharged. C. Subsection A of this Section does not apply to the weight of constituents in the water diverted.

D. Samples shall be examined in accordance with the most current edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association or the most current edition of Methods for Chemical Analysis of Water and Wastes published by the Environmental Protection Agency, where applicable.

[4-20-68, 3-14-71, 10-8-71, 8-13-76, 2-20-81, 12-1-95; 20.6.2.2101 NMAC – Rn, 20 NMAC 6.2.II.2101, 1-15-01]

**20.6.2.2102 RIO GRANDE BASIN--COMMUNITY SEWERAGE SYSTEMS:**

A. No person shall cause or allow effluent from a community sewerage system to discharge to a watercourse in the Rio Grande Basin between the headwaters of Elephant Butte Reservoir and Angostura Diversion Dam as described in Subsection E of this Section if the effluent, as indicated by:

(1) any two consecutive daily composite samples;

(2) more than one daily composite sample in any thirty-day period (in which less than ten (10) daily composite samples are examined);

(3) more than ten percent (10%) of the daily composite samples in any thirty-day period (in which ten (10) or more daily composite samples are examined); or

(4) a grab sample collected during flow from an intermittent or infrequent discharge does not conform to the following:

| | | |
|---|---|---|
| (a) | Bio-chemical Oxygen Demand (BOD) | Less than 30 mg/l |
| (b) | Chemical Oxygen Demand (COD) | Less than 80 mg/l |
| (c) | Settleable Solids | Less than 0.1 mg/l |
| (d) | Fecal Coliform Bacteria | Less than 500 organisms per 100 ml |
| (e) | pH | Between 6.6 and 8.6 |

B. Upon application, the secretary may eliminate the pH requirement for any effluent source that the secretary determines does not unreasonably degrade the water into which the effluent is discharged.

C. Subsection A of this Section does not apply to the weight of constituents in the water diverted.

D. Samples shall be examined in accordance with the most current edition of Standard Methods for the Analysis of Water and Wastewater published by the American Public Health Association or the most current edition of Methods for Chemical Analysis of Water and Wastes published by the Environmental Protection Agency, where applicable.

E. The following is a description of the Rio Grande Basin from the headwaters of Elephant Butte Reservoir to Angostura Diversion Dam as used in this Section. Begin at San Marcial USGS gauging station, which is the headwaters of Elephant Butte Reservoir Irrigation Project, thence northwest to U.S. Highway 60, nine miles ± west of Magdalena; thence west along the northeast edge of the San Agustin Plains closed basin; thence north along the east side of the north plains closed basin to the Continental Divide; thence northly along the Continental Divide to the community of Regina on State Highway 96; thence southeasterly along the crest of the San Pedro Mountains to Cerro Toledo Peak; thence southwesterly along the Sierra de Los Valles ridge and the Borrego Mesa to Bodega Butte; thence southerly to Angostura Diversion Dam which is the upper reach of the Rio Grande in this basin; thence southeast to the crest and the crest of the Manzano Mountains and the Los Pinos Mountains; thence southerly along the divide that contributes to the Rio Grande to San Marcial gauging station to the point and place of beginning;

excluding all waters upstream of Jemez Pueblo which flow into the Jemez River drainage and the Bluewater Lake. Counties included in the basin are:

(1) north portion of Socorro County;
(2) northeast corner of Catron County;
(3) east portion of Valencia County;
(4) west portion of Bernalillo County;
(5) east portion of McKinley County; and
(6) most of Sandoval County.

[3-14-71, 9-3-72, 8-13-76, 2-20-81, 12-1-95; 20.6.2.2102 NMAC – Rn, 20 NMAC 6.2.II.2102, 1-15-01]

**20.6.2.2103 – 20.6.2.2199: [RESERVED]**
[12-1-95; 20.6.2.2103 – 20.6.2.2199 NMAC – Rn, 20 NMAC 6.2.II.2103-2199, 1-15-01]

**20.6.2.2200 WATERCOURSE PROTECTION:**
[12-1-95; 20.6.2.2200 NMAC – Rn, 20 NMAC 6.2.II.2200, 1-15-01]

**20.6.2.2201 DISPOSAL OF REFUSE:** No person shall dispose of any refuse in a natural watercourse or in a location and manner where there is a reasonable probability that the refuse will be moved into a natural watercourse by leaching or otherwise. Solids diverted from the stream and returned thereto are not subject to abatement under this Section.
[4-20-68, 9-3-72; 20.6.2.2201 NMAC – Rn, 20 NMAC 6.2.II.2201, 1-15-01]

**20.6.2.2202 – 20.6.2.2999: [RESERVED]**
[12-1-95; 20.6.2.2202 – 20.6.2.2999 NMAC – Rn, 20 NMAC 6.2.II.2202-3100, 1-15-01]

**20.6.2.3000 PERMITTING AND GROUND WATER STANDARDS:**
[12-1-95; 20.6.2.3000 NMAC – Rn, 20 NMAC 6.2.III, 1-15-01]

**20.6.2.3001 – 20.6.2.3100: [RESERVED]**
[12-1-95; 20.6.2.3001 – 20.6.2.3100 NMAC – Rn, 20 NMAC 6.2.II.2202-3100, 1-15-01]

**20.6.2.3101 PURPOSE:**

**A.** The purpose of Sections 20.6.2.3000 through 20.6.2.3114 NMAC controlling discharges onto or below the surface of the ground is to protect all ground water of the state of New Mexico which has an existing concentration of 10,000 mg/l or less TDS, for present and potential future use as domestic and agricultural water supply, and to protect those segments of surface waters which are gaining because of ground water inflow, for uses designated in the New Mexico Water Quality Standards. Sections 20.6.2.3000 through 20.6.2.3114 NMAC are written so that in general:

(1) if the existing concentration of any water contaminant in ground water is in conformance with the standard of 20.6.2.3103 NMAC, degradation of the ground water up to the limit of the standard will be allowed; and

(2) if the existing concentration of any water contaminant in ground water exceeds the standard of Section 20.6.2.3103 NMAC, no degradation of the ground water beyond the existing concentration will be allowed.

**B.** Ground water standards are numbers that represent the pH range and maximum concentrations of water contaminants in the ground water which still allow for the present and future use of ground water resources.

**C.** The standards are not intended as maximum ranges and concentrations for use, and nothing herein contained shall be construed as limiting the use of waters containing higher ranges and concentrations.
[2-18-77; 20.6.2.3101 NMAC – Rn, 20 NMAC 6.2.III.3101, 1-15-01]

**20.6.2.3102: [RESERVED]**
[12-1-95; 20.6.2.3102 NMAC – Rn, 20 NMAC 6.2.III.3102, 1-15-01]

**20.6.2.3103 STANDARDS FOR GROUND WATER OF 10,000 mg/l TDS CONCENTRATION OR LESS:** The following standards are the allowable pH range and the maximum allowable concentration in ground water for the contaminants specified unless the existing condition exceeds the standard or unless otherwise provided in Subsection D of Section 20.6.2.3109 NMAC. Regardless of whether there is one contaminant or more than one contaminant present in ground water, when an existing pH or concentration of any water contaminant exceeds the

standard specified in Subsection A, B, or C of this section, the existing pH or concentration shall be the allowable limit, provided that the discharge at such concentrations will not result in concentrations at any place of withdrawal for present or reasonably foreseeable future use in excess of the standards of this section. These standards shall apply to the dissolved portion of the contaminants specified with a definition of dissolved being that given in the publication "Methods for Chemical Analysis of Water and Waste of the U.S. Environmental Protection Agency," with the exception that standards for mercury, organic compounds and non-aqueous phase liquids shall apply to the total unfiltered concentrations of the contaminants.

**A. Human Health Standards**-Ground water shall meet the standards of Subsection A and B of this section unless otherwise provided. If more than one water contaminant affecting human health is present, the toxic pollutant criteria as set forth in the definition of toxic pollutant in Section 20.6.2.1101 NMAC for the combination of contaminants, or the Human Health Standard of Subsection A of Section 20.6.2.3103 NMAC for each contaminant shall apply, whichever is more stringent. Non-aqueous phase liquid shall not be present floating atop of or immersed within ground water, as can be reasonably measured.

(1) Arsenic (As).....0.1 mg/l
(2) Barium (Ba).....1.0 mg/l
(3) Cadmium (Cd).....0.01 mg/l
(4) Chromium (Cr).....0.05 mg/l
(5) Cyanide (CN).....0.2 mg/l
(6) Fluoride (F).....1.6 mg/l
(7) Lead (Pb).....0.05 mg/l
(8) Total Mercury (Hg).....0.002 mg/l
(9) Nitrate ($NO_3$ as N).....10.0 mg/l
(10) Selenium (Se).....0.05 mg/l
(11) Silver (Ag).....0.05 mg/l
(12) Uranium (U).....5.0 mg/l
(13) Radioactivity: Combined Radium-226 & Radium-228.....30 pCi/l
(14) Benzene.....0.01 mg/l
(15) Polychlorinated biphenyls (PCB's).....0.001 mg/l
(16) Toluene.....0.75 mg/l
(17) Carbon Tetrachloride.....0.01 mg/l
(18) 1,2-dichloroethane (EDC).....0.01 mg/l
(19) 1,1-dichloroethylene (1,1-DCE).....0.005 mg/l
(20) 1,1,2,2-tetrachloroethylene (PCE).....0.02 mg/l
(21) 1,1,2-trichloroethylene (TCE).....0.1 mg/l
(22) ethylbenzene.....0.75 mg/l
(23) total xylenes.....0.62 mg/l
(24) methylene chloride.....0.1 mg/l
(25) chloroform.....0.1 mg/l
(26) 1,1-dichloroethane.....0.025 mg/l
(27) ethylene dibromide (EDB).....0.0001 mg/l
(28) 1,1,1-trichloroethane.....0.06 mg/l
(29) 1,1,2-trichloroethane.....0.01 mg/l
(30) 1,1,2,2-tetrachloroethane.....0.01 mg/l
(31) vinyl chloride.....0.001 mg/l
(32) PAHs: total naphthalene plus monomethylnaphthalenes.....0.03 mg/l
(33) benzo-a-pyrene.....0.0007 mg/l

**B. Other Standards for Domestic Water Supply**

(1) Chloride (Cl).....250.0 mg/l
(2) Copper (Cu).....1.0 mg/l
(3) Iron (Fe).....1.0 mg/l
(4) Manganese (Mn).....0.2 mg/l
(6) Phenols.....0.005 mg/l
(7) Sulfate ($SO_4$).....600.0 mg/l
(8) Total Dissolved Solids (TDS).....1000.0 mg/l
(9) Zinc (Zn).....10.0 mg/l
(10) pH.....between 6 and 9

**C. Standards for Irrigation Use - Ground water shall meet the standards of Subsection A, B, and C of this section unless otherwise provided.**

(1) Aluminum (Al).....5.0 mg/l
(2) Boron (B).....0.75 mg/l
(3) Cobalt (Co).....0.05 mg/l
(4) Molybdenum (Mo).....1.0 mg/l
(5) Nickel (Ni).....0.2 mg/l

[2-18-77, 1-29-82, 11-17-83, 3-3-86, 12-1-95; 20.6.2.3103 NMAC – Rn, 20 NMAC 6.2.III.3103, 1-15-01]

**20.6.2.3104 DISCHARGE PERMIT REQUIRED:** Unless otherwise provided by this Part, no person shall cause or allow effluent or leachate to discharge so that it may move directly of indirectly into ground water unless he is discharging pursuant to a discharge permit issued by the secretary. When a permit has been issued, discharges must be consistent with the terms and conditions of the permit. In the event of a transfer of the ownership, control, or possession of a facility for which a discharge permit is in effect, the transferee shall have authority to discharge under such permit, provided that the transferee has complied with Section 20.6.2.3111 NMAC, regarding transfers.
[2-18-77, 12-24-87, 12-1-95; Rn & A, 20.6.2.3104 NMAC – 20 NMAC 6.2.III.3104, 1-15-01; A, 12-1-01]

**20.6.2.3105 EXEMPTIONS FROM DISCHARGE PERMIT REQUIREMENT:** Sections 20.6.2.3104 and 20.6.2.3106 NMAC do not apply to the following:

**A.** Effluent or leachate which conforms to all the listed numerical standards of Section 20.6.2.3103 NMAC and has a total nitrogen concentration of 10 mg/l or less, and does not contain any toxic pollutant. To determine conformance, samples may be taken by the agency before the effluent or leachate is discharged so that it may move directly or indirectly into ground water; provided that if the discharge is by seepage through non-natural or altered natural materials, the agency may take samples of the solution before or after seepage. If for any reason the agency does not have access to obtain the appropriate samples, this exemption shall not apply;

**B.** Effluent which is discharged from a sewerage system used only for disposal of household and other domestic waste which is designed to receive and which receives 2,000 gallons or less of liquid waste per day;

**C.** Water used for irrigated agriculture, for watering of lawns, trees, gardens or shrubs, or for irrigation for a period not to exceed five years for the revegetation of any disturbed land area, unless that water is received directly from any sewerage system;

**D.** Discharges resulting from the transport or storage of water diverted, provided that the water diverted has not had added to it after the point of diversion any effluent received from a sewerage system, that the source of the water diverted was not mine workings, and that the secretary has not determined that a hazard to public health may result;

**E.** Effluent which is discharged to a watercourse which is naturally perennial; discharges to dry arroyos and ephemeral streams are not exempt from the discharge permit requirement, except as otherwise provided in this section;

**F.** Those constituents which are subject to effective and enforceable effluent limitations in a National Pollutant Discharge Elimination System (NPDES) permit, where discharge onto or below the surface of the ground so that water contaminants may move directly or indirectly into ground water occurs downstream from the outfall where NPDES effluent limitations are imposed, unless the secretary determines that a hazard to public health may result. For purposes of this subsection, monitoring requirements alone do not constitute effluent limitations;

**G.** Discharges resulting from flood control systems;

**H.** Leachate which results from the direct natural infiltration of precipitation through disturbed materials, unless the secretary determines that a hazard to public health may result;

**I.** Leachate which results entirely from the direct natural infiltration of precipitation through undisturbed materials;

**J.** Leachate from materials disposed of in accordance with the Solid Waste Management Regulations (20 NMAC 9.1) adopted by the New Mexico Environmental Improvement Board;

**K.** Natural ground water seeping or flowing into conventional mine workings which re-enters the ground by natural gravity flow prior to pumping or transporting out of the mine and without being used in any mining process; this exemption does not apply to solution mining;

**L.** Effluent or leachate discharges resulting from activities regulated by a mining plan approved and permit issued by the New Mexico Coal Surface Mining Commission, provided that this exemption shall not be construed as limiting the application of appropriate ground water protection requirements by the New Mexico Coal Surface Mining Commission;

**M.** Effluent or leachate discharges which are regulated by the Oil Conservation Commission and the regulation of which by the Water Quality Control Commission would interfere with the exclusive authority granted under Section 70-2-12 NMSA 1978, or under other laws, to the Oil Conservation Commission.
[2-18-77, 6-26-80, 7-2-81, 12-24-87, 12-1-95; 20.6.2.3105 NMAC – Rn, 20 NMAC 6.2.III.3105, 1-15-01; A, 12-1-01]

**20.6.2.3106 APPLICATION FOR DISCHARGE PERMITS AND RENEWALS:**

**A.** Any person who, before or on June 18, 1977, is discharging any of the water contaminants listed in Section 20.6.2.3103 NMAC or any toxic pollutant so that they may move directly or indirectly into ground water shall, within 120 days of receipt of written notice from the secretary that a discharge permit is required, or such longer time as the secretary shall for good cause allow, submit a discharge plan to the secretary for approval; such person may discharge without a discharge permit until 240 days after written notification by the secretary that a discharge permit is required or such longer time as the secretary shall for good cause allow.

**B.** Any person who intends to begin, after June 18, 1977, discharging any of the water contaminants listed in Section 20.6.2.3103 NMAC or any toxic pollutant so that they may move directly or indirectly into ground water shall notify the secretary giving the information enumerated in Subsection B of Section 20.6.2.1201NMAC; the secretary shall, within 60 days, notify such person if a discharge permit is required; upon submission, the secretary shall review the discharge plan pursuant to Sections 20.6.2.3108 and 20.6.2.3109 NMAC. For good cause shown the secretary may allow such person to discharge without a discharge permit for a period not to exceed 120 days.

**C.** A proposed discharge plan shall set forth in detail the methods or techniques the discharger proposes to use or processes expected to naturally occur which will ensure compliance with this Part. At least the following information shall be included in the plan:

(1) Quantity, quality and flow characteristics of the discharge;

(2) Location of the discharge and of any bodies of water, watercourses and ground water discharge sites within one mile of the outside perimeter of the discharge site, and existing or proposed wells to be used for monitoring;

(3) Depth to and TDS concentration of the ground water most likely to be affected by the discharge;

(4) Flooding potential of the site;

(5) Location and design of site(s) and method(s) to be available for sampling, and for measurement or calculation of flow;

(6) Depth to and lithological description of rock at base of alluvium below the discharge site if such information is available;

(7) Any additional information that may be necessary to demonstrate that the discharge permit will not result in concentrations in excess of the standards of Section 20.6.2.3103 NMAC or the presence of any toxic pollutant at any place of withdrawal of water for present or reasonably foreseeable future use. Detailed information on site geologic and hydrologic conditions may be required for a technical evaluation of the applicant's proposed discharge plan; and

(8) Additional detailed information required for a technical evaluation of underground injection control wells as provided in Sections 20.6.2.5000 through 20.6.2. 5299 NMAC,

**D.** An applicant for a discharge permit shall pay fees as specified in Section 20.6.2.3114 NMAC.

**E.** An applicant for a permit to dispose of or use septage or sludge, or within a source category designated by the commission, may be required by the secretary to file a disclosure statement as specified in 74-6-5.1 of the Water Quality Act.

**F.** If the holder of a discharge permit submits an application for discharge permit renewal at least 120 days before the discharge permit expires, and the discharger is not in violation of the discharge permit on the date of its expiration, then the existing discharge permit for the same activity shall not expire until the application for renewal has been approved or disapproved. A discharge permit continued under this provision remains fully effective and enforceable. An application for discharge permit renewal must include and adequately address all of the information necessary for evaluation of a new discharge permit. Previously submitted materials may be included by reference provided they are current, readily available to the secretary and sufficiently identified to be retrieved.
[2-18-77, 6-26-80, 7-2-81, 9-20-82, 8-17-91, 12-1-95; 20.6.2.3106 NMAC – Rn, 20 NMAC 6.2.III.3106, 1-15-01; A, 12-1-01; A, 9-15-02]

**20.6.2.3107 MONITORING, REPORTING, AND OTHER REQUIREMENTS:**

**A.** Each discharge plan shall provide for the following as the secretary may require:

(1) The installation, use, and maintenance of effluent monitoring devices;

(2) The installation, use, and maintenance of monitoring devices for the ground water most likely to be affected by the discharge;

(3) Monitoring in the vadose zone;

(4) Continuation of monitoring after cessation of operations;

(5) Periodic submission to the secretary of results obtained pursuant to any monitoring requirements in the discharge permit and the methods used to obtain these results;

(6) Periodic reporting to the secretary of any other information that may be required as set forth in the discharge permit;

(7) The discharger to retain for a period of at least five years any monitoring data required in the discharge permit;

(8) A system of monitoring and reporting to verify that the permit is achieving the expected results;

(9) Procedures for detecting failure of the discharge system;

(10) Contingency plans to cope with failure of the discharge permit or system;

(11) A closure plan to prevent the exceedance of standards of Section 20.6.2.3103 NMAC or the presence of a toxic pollutant in ground water after the cessation of operation which includes: a description of closure measures, maintenance and monitoring plans, post-closure maintenance and monitoring plans, financial assurance, and other measures necessary to prevent and/or abate such contamination. The obligation to implement the closure plan as well as the requirements of the closure plan, if any is required, survives the termination or expiration of the permit. A closure plan for any underground injection control well must also incorporate the applicable requirements of Sections 20.6.2.5005 and 20.6.2.5209 NMAC.

**B.** Sampling and analytical techniques shall conform with the following references unless otherwise specified by the secretary:

(1) Standard Methods for the Examination of Water and Wastewater, latest edition, American Public Health Association; or

(2) Methods for Chemical Analysis of Water and Waste, and other publications of the Analytical Quality Laboratory, EPA; or

(3) Techniques of Water Resource Investigations of the U.S. Geological Survey; or

(4) Annual Book of ASTM Standards. Part 31. Water, latest edition, American Society For Testing and Materials; or

(5) Federal Register, latest methods published for monitoring pursuant to Resource Conservation and Recovery Act regulations; or

(6) National Handbook of Recommended Methods for Water-Data Acquisition, latest edition, prepared cooperatively by agencies of the United States Government under the sponsorship of the U.S. Geological Survey.

**C.** The discharger shall notify the secretary of any facility expansion, production increase or process modification that would result in any significant modification in the discharge of water contaminants.

**D.** Any discharger of effluent or leachate shall allow any authorized representative of the secretary to:

(1) inspect and copy records required by a discharge permit;

(2) inspect any treatment works, monitoring and analytical equipment;

(3) sample any effluent before or after discharge;

(4) use monitoring systems and wells installed pursuant to a discharge permit requirement in order to collect samples from ground water or the vadose zone.

**E.** Each discharge permit for an underground injection control well shall incorporate the applicable requirements of Sections 20.6.2.5000 through 20.6.2.5299 NMAC.

[2-18-77, 9-20-82, 11-17-83, 12-1-95; 20.6.2.3107 NMAC – Rn, 20 NMAC 6.2.III.3107, 1-15-01; A, 12-1-01]

**20.6.2.3108 PUBLIC NOTICE AND PARTICIPATION:**

**A.** Within 30 days of submission of an application for discharge permit, modification or renewal:

(1) The applicant shall provide notice, in accordance with the requirements of Section E of this Section, to the general public in the locale of the proposed discharge in a form provided by the department by each of the three methods listed below:

(a) prominently posting a synopsis of the public notice, in English and in Spanish, at a conspicuous public location, approved by the department, at or near the existing or proposed facility for 30 days; and

(b) providing written notice of the discharge by certified mail, return receipt requested, to owners of record of all adjacent properties; and

(c) providing notice by certified mail, return receipt requested, to the owner of the discharge site if the applicant is not the owner;

(2) In lieu of the public notice requirements of Subparagraph (b) of Paragraph (1) of Subsection A above, the applicant may publish a synopsis of the notice in a display ad at least two inches by three inches in a newspaper of general circulation in the location of the proposed discharge.

(3) In lieu of the public notice requirements of Subparagraph (a) and (b) of Paragraph (1) of Subsection A above, the applicant may provide notice of the discharge by certified mail, return receipt requested, to property owners of record within 1/2 mile of the discharge site on a form provided by the department.

(4) If there are no adjacent properties other than properties owned by the discharger, the applicant shall, in lieu of the requirements in Subparagraph (b) of Paragraph (1) of Subsection A above, publish a synopsis of the notice in a display ad at least two inches by three inches in a newspaper of general circulation in the location of the facility.

**B.** Within fifteen days of completion of the public notice requirements in Subsection A of this Section, the applicant shall submit to the department proof of notice, including certified mail receipts and an affidavit of posting, as appropriate. If the department determines that the notice provided pursuant to Subsection A of this Section is inadequate, the department may require additional notice in accordance with Subsection A of this Section.

**C.** Within 30 days of receipt of an application for a discharge permit, modification or renewal, the department shall review the application for administrative completeness. To be deemed administratively complete, an application must provide all of the information required by Paragraphs (1) through (5) of Subsection E of this Section. The department shall notify the applicant in writing when the application is deemed administratively complete. If the department determines that the application is not administratively complete, the department shall notify the applicant of the deficiencies in writing within 30 days of receipt of the application and state what additional information is necessary.

**D.** Within 30 days of determining an application for a discharge permit, modification or renewal is administratively complete, the department shall post a notice on its web site and shall mail notice to any affected local, state, federal, tribal or pueblo governmental agency, political subdivisions, ditch associations and Land Grants, as identified by the department. The department shall also mail or e-mail notice to those persons on a list maintained by the department who have requested notice of discharge permit applications. The notice shall include the information listed in Subsection E of this Section.

**E.** The notice provided under Subsection A and D of this Section shall include:

(1) The name and address of the proposed discharger;

(2) The location of the discharge, including a street address, if available, and sufficient information to locate the facility with respect to surrounding landmarks;

(3) A brief description of the activities that produce the discharge described in the application;

(4) A brief description of the expected quality and volume of the discharge;

(5) The depth to and total dissolved solids concentration of the ground water beneath the discharge site;

(6) The address and phone number within the department by which interested persons may obtain information, submit comments, and request to be placed on a facility-specific mailing list for future notices; and

(7) A statement that the department will accept comments and statements of interest regarding the application and will create a facility-specific mailing list for persons who wish to receive future notices.

**F.** All persons who submit comments or statements of interest to the department and who provide a mail or e-mail address shall be placed on a facility-specific mailing list and the department shall send those persons the public notice issued pursuant to Subsection G of this Section, and notice of any public meeting or hearing scheduled on the application.

**G.** Within 60 days after the department makes its administrative completeness determination and all required technical information is available, the department shall make available a proposed approval or disapproval of the application for a discharge permit, modification or renewal, including conditions for approval proposed by the department or the reasons for disapproval. The department shall mail or deliver a copy of the proposed approval or disapproval to the applicant, and shall provide notice of the proposed approval or disapproval of the application for a discharge permit, modification or renewal by:

(1) Posting on the department's website;

(2) Publishing notice in a newspaper of general circulation in this state and a newspaper of general circulation in the location of the facility;

(3) Mailing or e-mailing to those persons on a facility-specific mailing list;

(4) Mailing to any affected local, state, or federal governmental agency, as identified by the department; and

(5) Mailing to the Governor, Chairperson, or President of each Indian Tribe, Pueblo or Nation within the state of New Mexico, as identified by the department.

**H.** The public notice issued under Subsection G shall include the information in Subsection E of this Section and the following information:

(1) A brief description of the procedures to be followed by the secretary in making a final determination;

(2) A statement of the comment period and description of the procedures for a person to request a hearing on the application; and

(3) The address and telephone number at which interested persons may obtain a copy of the proposed approval or disapproval of an application for a discharge permit, modification or renewal.

**I.** In the event that the proposed approval or disapproval of an application for a discharge permit, modification or renewal is available for review within 30 days of deeming the application administratively complete, the department may combine the public notice procedures of Subsections D and G of this Section.

**J.** Following the public notice of the application and proposed approval or disapproval of an application for a discharge permit, modification or renewal, and prior to a final decision by the secretary, there shall be a period of at least 30 days during which written comments may be submitted to the department and/or a public hearing may be requested in writing. All comments will be considered by the department. Requests for a hearing shall be in writing and shall set forth the reasons why a hearing should be held. A public hearing shall be held if the secretary determines there is significant public interest. The department shall notify the applicant and any person requesting a hearing of the decision whether to hold a hearing and the reasons therefore in writing.

**K.** If a hearing is held, pursuant to Subsection J of this Section, notice of the hearing shall be given by the department at least 30 days prior to the hearing in accordance with Subsection G of this section. The notice shall include the information identified in Subsection H of this section in addition to the time and place of the hearing and a brief description of the hearing procedures. The hearing shall be held pursuant to Section 20.6.2.3110 NMAC. [2-18-77, 12-24-87, 12-1-95, 11-15-96; 20.6.2.3108 NMAC – Rn, 20 NMAC 6.2.III.3108, 1-15-01; A, 12-1-01; A, 9-15-02]

**20.6.2.3109 SECRETARY APPROVAL, DISAPPROVAL, MODIFICATION OR TERMINATION OF DISCHARGE PERMITS, AND REQUIREMENT FOR ABATEMENT PLANS:**

**A.** The department shall evaluate the application for a discharge permit, modification or renewal based on information contained in the department's administrative record. The department may request from the discharger, either before or after the issuance of any public notice, additional information necessary for the evaluation of the application. The administrative record shall consist of the application, any additional information required by the department, any information submitted by the discharger or the general public, other information considered by the department, the proposed approval or disapproval of an application for a discharge permit, modification or renewal prepared pursuant to Subsection G of Section 20.6.2.3108 NMAC, and, if a public hearing is held, all of the documents filed with the hearing clerk, all exhibits offered into evidence at the hearing, the written transcript or tape recording of the hearing, any hearing officer report, and any post hearing submissions.

**B.** The secretary shall, within 30 days after the administrative record is complete and all required information is available, approve, approve with conditions or disapprove the proposed discharge permit, modification or renewal based on the administrative record. The secretary shall give written notice of the action taken to the applicant or permittee and any other person who participated in the permitting action who requests a copy in writing.

**C.** Provided that the other requirements of this Part are met and the proposed discharge plan, modification or renewal demonstrates that neither a hazard to public health nor undue risk to property will result, the secretary shall approve the proposed discharge plan, modification or renewal if the following requirements are met:

(1) ground water that has a TDS concentration of 10,000 mg/l or less will not be affected by the discharge, or

(2) the person proposing to discharge demonstrates that approval of the proposed discharge plan, modification or renewal will not result in either concentrations in excess of the standards of Section 20.6.2.3103 NMAC or the presence of any toxic pollutant at any place of withdrawal of water for present or reasonably

foreseeable future use, except for contaminants in the water diverted as provided in Subsection D of Section 3109 NMAC, or

(3) the proposed discharge plan conforms to either Subsection a or b below and Subsection c below.

(a) Municipal, Other Domestic Discharges, and Discharges from Sewerage Systems Handling Only Animal Wastes. The effluent is entirely domestic, is entirely from a sewerage system handling only animal wastes or is from a municipality and conforms to the following:

(i) the discharge is from an impoundment or a leach field existing on February 18, 1977 which receives less than 10,000 gallons per day and the secretary has not found that the discharge may cause a hazard to public health; or

(ii) the discharger has demonstrated that the total nitrogen in effluent that enters the subsurface from a leach field or surface impoundment will not exceed 200 pounds per acre per year and that the effluent will meet the standards of Section 20.6.2.3103 NMAC except for nitrates and except for contaminants in the water diverted as provided in Subsection D of Section 20.6.2.3109 NMAC.; or

(iii) the total nitrogen in effluent that is applied to a crop which is harvested shall not exceed by more than 25 percent the maximum amount of nitrogen reasonably expected to be taken up by the crop and the effluent shall meet the standards of Section 20.6.2.3103 NMAC except for nitrates and except for contaminants in the water diverted as provided in Subsection D of Section 20.6.2.3109 NMAC.

(b) Discharges from industrial, mining or manufacturing operations.

(i) the discharger has demonstrated that the amount of effluent that enters the subsurface from a surface impoundment will not exceed 0.5 acre-feet per acre per year; or

(ii) the discharger has demonstrated that the total nitrogen in effluent that enters the subsurface from a leach field or surface impoundment shall not exceed 200 pounds per acre per year and the effluent shall meet the standards of Section 20.6.2.3103 NMAC except for nitrate and contaminants in the water diverted as provided in Subsection D of Section 20.6.2.3109 NMAC; or

(iii) the total nitrogen in effluent that is applied to a crop that is harvested shall not exceed by more than 25 percent the maximum amount of nitrogen reasonably expected to be taken up by the crop and the effluent shall meet the standards of Section 20.6.2.3103 NMAC except for nitrate and contaminants in the water diverted as provided in Subsection D of Section 20.6.2.3109 NMAC.

(c) All Discharges.

(i) the monitoring system proposed in the discharge plan includes adequate provision for sampling of effluent and adequate flow monitoring so that the amount being discharged onto or below the surface of the ground can be determined.

(ii) the monitoring data is reported to the secretary at a frequency determined by the secretary.

**D.** The secretary shall allow the following unless he determines that a hazard to public health may result:

(1) the weight of water contaminants in water diverted from any source may be discharged provided that the discharge is to the aquifer from which the water was diverted or to an aquifer containing a greater concentration of the contaminants than contained in the water diverted; and provided further that contaminants added as a result of the means of diversion shall not be considered to be part of the weight of water contaminants in the water diverted;

(2) the water contaminants leached from undisturbed natural materials may be discharged provided that:

(a) the contaminants were not leached as a product or incidentally pursuant to a solution mining operation; and

(b) the contaminants were not leached as a result of direct discharge into the vadose zone from municipal or industrial facilities used for the storage, disposal, or treatment of effluent;

(3) the water contaminants leached from undisturbed natural materials as a result of discharge into ground water from lakes used as a source of cooling water.

**E.** If data submitted pursuant to any monitoring requirements specified in the discharge permit or other information available to the secretary indicates that this Part is being or may be violated or that the standards of Section 20.6.2.3103 NMAC are being or will be exceeded, or a toxic pollutant as defined in Section 20.6.2.7 NMAC is present, in ground water at any place of withdrawal for present or reasonably foreseeable future use, or that the Water Quality Standards for Interstate and Intrastate Streams in New Mexico are being or may be violated in surface water, due to the discharge, except as provided in Subsection D of Section 20.6.2.3109 NMAC:

(1) the secretary may require a discharge permit modification within the shortest reasonable time so as to achieve compliance with this Part and to provide that any exceeding of standards in ground water at any place of withdrawal for present or reasonably foreseeable future use, or in surface water, due to the discharge except as provided in Subsection D of Section 20.6.2.3109 NMAC. will be abated or prevented. If the secretary requires a discharge permit modification to abate water pollution:

(a) the abatement shall be consistent with the requirements and provisions of Sections 20.6.2.4101, 20.6.2.4103, Subsection C and E of Section 20.6.2.4106, Section 20.6.2.4107 and Section 20.6.2.4112 NMAC; and

(b) the discharger may request of the secretary approval to carry out the abatement under Sections 20.6.2.4000 through 20.6.2.4115 NMAC, in lieu of modifying the discharge permit. The discharger shall make the request in writing and shall include the reasons for the request.

(2) the secretary may terminate a discharge permit when a discharger fails to modify the permit in accordance with Paragraph 1 of Subsection E of this section.

(3) the secretary may require modification, or may terminate a discharge permit for a Class I non-hazardous waste injection well, a Class III well or other type of well specified in Subsection A of Section 20.6.2.5101 NMAC, pursuant to the requirements of Subsection I of Section 20.6.2.5101 NMAC.

**F.** If a discharge permit expires or is terminated for any reason and the standards of Section 20.6.2.3103 NMAC are being or will be exceeded, or a toxic pollutant as defined in Section 20.6.2.7 NMAC is present in ground water, or that the Water Quality Standards for Interstate and Intrastate Streams in New Mexico are being or may be violated, the secretary may require the discharger to submit an abatement plan pursuant to Sections 20.6.2.4104 and Subsection A of Section 20.6.2.4106 NMAC.

**G.** At the request of the discharger, a discharge permit may be modified in accordance with Sections 20.6.2.3000 through 20.6.2.3114 NMAC.

**H.** The secretary shall not approve a proposed discharge plan, modification, or renewal for:

(1) any discharge for which the discharger has not provided a site and method for flow measurement and sampling;

(2) any discharge that will cause any stream standard to be violated;

(3) the discharge of any water contaminant which may result in a hazard to public health; or

(4) a period longer than five years, except that for new discharges, the term of the discharge permit approval shall commence on the date the discharge begins, but in no event shall the term of the approval exceed seven years from the date the permit was issued. For those permits expiring more than five years from the date of issuance, the discharger shall give prior written notification to the department of the date the discharge is to commence. The term of the permit shall not exceed five years from that date.

[2-18-77, 6-26-80, 9-20-82, 7-2-81, 3-3-86, 12-1-95, 11-15-96; 20.6.2.3109 NMAC – Rn, 20 NMAC 6.2.III.3109, 1-15-01; A, 12-1-01; A, 9-15-02]

[Subsection 3109.A was added and subsequent subsections renumbered 11-15-96]

**20.6.2.3110 PUBLIC HEARING PARTICIPATION:**

**A.** The secretary may appoint an impartial hearing officer to preside over the hearing. The hearing officer may be a department employee other than an employee of the bureau evaluating the application.

**B.** The hearing shall be at a place in the area affected by the facility for which the discharge permit proposal, modification or renewal is sought.

**C.** Any person who wishes to present technical evidence at the hearing shall, no later than ten (10) days prior to the hearing, file with the department, and if filed by a person who is not the applicant, serve on the applicant, a statement of intent to present evidence. A person who does not file a statement of intent to present evidence may present a general non-technical statement in support of or in opposition to the proposed discharge plan, modification or renewal. The statement of intent to present technical evidence shall include:

(1) the name of the person filing the statement;

(2) indication of whether the person filing the statement supports or opposes the proposed discharge plan proposal, modification or renewal;

(3) the name of each witness;

(4) an estimate of the length of the direct testimony of each witness;

(5) a list of exhibits, if any, to be offered into evidence at the hearing; and

(6) a summary or outline of the anticipated direct testimony of each witness.

**D.** At the hearing, the New Mexico Rules of Civil Procedure, SCRA 1986, 1-001 to 1-102 and the New Mexico Rules of Evidence, SCRA 1986, 11-101 to 11-1102 shall not apply. At the discretion of the hearing

officer, the rules may be used as guidance. Any reference to the Rules of Civil Procedure and the Rules of Evidence shall not be construed to extend or otherwise modify the authority and jurisdiction of the department under the Act.

**E.** The hearing officer shall conduct a fair and impartial proceeding, assure that the facts are fully elicited, and avoid delay. The hearing officer shall have authority to take all measures necessary for the maintenance of order and for the efficient, fair and impartial adjudication of issues arising in the proceedings.

**F.** At the hearing, all persons shall be given a reasonable chance to submit data, views or arguments orally or in writing and to examine witnesses testifying at the hearing.

**G.** Unless otherwise allowed by the hearing officer, testimony shall be presented in the following order:

(1) testimony by and examination of the applicant or permittee proving the facts relied upon to justify the proposed discharge plan, renewal or modification and meeting the requirements of the regulations;

(2) testimony by and examination of technical witnesses supporting or opposing approval, approval subject to conditions, or disapproval of the proposed discharge plan, renewal or modification, in any reasonable order;

(3) testimony by the general public; and

(4) rebuttal testimony, if appropriate.

**H.** The secretary may provide translation service at a public hearing conducted in a locale where the Department can reasonably expect to receive testimony from non-English speaking people.

**I.** If determined useful by the hearing officer, within thirty (30) days after conclusion of the hearing, or within such time as may be fixed by the hearing officer, the hearing officer may allow proposed findings of fact and conclusions of law and closing argument. All such submissions, if allowed, shall be in writing, shall be served upon the applicant or permittee, the department and all persons who request copies in advance in writing, and shall contain adequate references to the record and authorities relied on. No new evidence shall be presented unless specifically allowed by the hearing officer.

**J.** The department shall make an audio recording of the hearing. If the applicant or permittee, or a participant requests a written transcript or certified copy of the audio recording, the requestor shall pay the cost of the transcription or audio copying.

**K.** The hearing officer shall issue a report within thirty (30) days after the close of the hearing record. The report may include findings of fact, conclusions regarding all material issues of law or discretion, as well as reasons therefore. The report shall be served on the applicant or permittee, the department, and all persons who request copies in advance in writing. The report will be available for public inspection at the department's office in Santa Fe and at the field office closest to the point of the proposed discharge.

**L.** The secretary shall issue a decision in the matter no later than thirty (30) days of receipt of the hearing report. The decision shall be served and made available for inspection pursuant to Subsection K of this section.

**M.** Any person who testifies at the hearing or submits a written statement for the record will be considered a participant for purposes of Subsection 20.6.2.3113 NMAC and NMSA 1978, Section 74-6-5.N.
[2-18-77, 12-1-95, 11-15-96; 20.6.2.3110 NMAC – Rn, 20 NMAC 6.2.III.3110, 1-15-01; A, 12-1-01]

**20.6.2.3111 TRANSFER OF DISCHARGE PERMIT:** No purported transfer of any discharge permit shall be effective to create, alter or extinguish any right or responsibility of any person subject to this Part, unless the following transfer requirements are met:

**A.** Prior to any transfer of ownership, control, or possession (whether by lease, conveyance or otherwise) of a facility with a discharge permit, the transferror shall notify the transferee in writing of the existence of the discharge permit, and shall deliver or send by certified mail to the department a copy of such written notification, together with a certification or other proof that such notification has in fact been received by the transferee.

**B.** Upon receipt of such notification, the transferee shall have the duty to inquire into all of the provisions and requirements contained in such discharge permit, and the transferee shall be charged with notice of all such provisions and requirements as they appear of record in the department's file or files concerning such discharge permit.

**C.** Until both ownership and possession of the facility have been transferred to the transferee, the transferor shall continue to be responsible for any discharge from the facility.

**D.** Upon assuming either ownership or possession of the facility, the transferee shall have the same rights and responsibilities under the discharge permit as were applicable to the transferor.

**E.** Nothing in this section or in this part shall be construed to relieve any person of responsibility or liability for any act or omission which occurred while that person owned, controlled or was in possession of the facility.
[2-18-77, 12-24-87, 12-1-95, 11-15-96; 20.6.2.3111 NMAC – Rn, 20 NMAC 6.2.III.3111, 1-15-01; A, 12-1-01]

**20.6.2.3112 APPEALS OF SECRETARY'S DECISIONS:**

**A.** If the secretary approves, approves subject to conditions, or disapproves a proposed discharge plan, renewal or modification, or modifies or terminates a discharge permit, appeal therefrom shall be in accordance with the provisions of Sections 74-6-5(N), (O) and (P), NMSA 1978. The filing of an appeal does not act as a stay of any provision of the Act, the regulations, or any permit issued pursuant to the Act, unless otherwise ordered by the secretary or the commission.

**B.** If the secretary determines that a discharger is not exempt from obtaining a discharge permit, or that the material to be discharged contains any toxic pollutant as defined in Section 20.6.2.1101 NMAC, which is not included in the numerical standards of Section 20.6.2.3103 NMAC, then the discharger may appeal such determination by filing with the commission's secretary a notice of appeal to the commission within thirty days after receiving the secretary's written determination, and the appeal therefrom and any action of the commission thereon shall be in accordance with the provisions of Sections 74-6-5(N),(O) and (P), NMSA 1978.

**C.** Proceedings before the commission shall be conducted in accordance with the commission's adjudicatory procedures, 20 NMAC 1.3.
[2-18-77, 7-2-81, 12-1-95, 11-15-96; 20.6.2.3112 NMAC – Rn, 20 NMAC 6.2.III.3112, 1-15-01; A, 12-1-01]

**20.6.2.3113 APPEALS OF COMMISSION DECISIONS:** An applicant, permittee or a person who participated in a permitting action and who is adversely affected by such action may appeal the decision of the commission in accordance with the provisions of Section 74-6-7(A), NMSA 1978.
[2-18-77, 12-1-95, 11-15-96; 20.6.2.3113 NMAC – Rn, 20 NMAC 6.2.III.3113, 1-15-01; A, 12-1-01]

**20.6.2.3114 FEES:**

**A.** FEE AMOUNT AND SCHEDULE OF PAYMENT – Every facility submitting a discharge permit application for approval or renewal shall pay the permit fees specified in Table 1 of this section and shall pay a filing fee as specified in Table 2 of this section to the Water Quality Management Fund. Every facility submitting a request for temporary permission to discharge pursuant to Subsection B of Section 20.6.2.3106 NMAC, or financial assurance pursuant to Paragraph 11 of Subsection A of Section 20.6.2.3107 NMAC shall pay the fees specified in Table 2 of this section to the Water Quality Management Fund.

**B.** Facilities applying for discharge permits which are subsequently withdrawn or denied shall pay one-half of the permit fee at the time of denial or withdrawal.

**C.** Every facility submitting an application for discharge permit modification will be assessed a filing fee plus one-half of the permit fee. Applications for both renewal and modification will pay the filing fee plus the permit fee.

**D.** If the secretary requires a discharge permit modification as a component of an enforcement action, the facility shall pay the applicable discharge permit modification fee. If the secretary requires a discharge permit modification outside the context of an enforcement action, the facility shall not be assessed a fee.

**E.** The secretary may waive or reduce fees for discharge permit modifications or renewals which require little or no cost for investigation or issuance.

**F.** Facilities shall pay the filing fee at the time of discharge permit application. The filing fee is nonrefundable. The required permit fees may be paid in a single payment at the time of discharge permit approval or in equal installments over the term of the discharge permit. Installment payments shall be remitted yearly, with the first installment due on the date of discharge permit approval. Subsequent installment payments shall be remitted yearly thereafter. The discharge permit or discharge permit application review of any facility shall be suspended or terminated if the facility fails to submit an installment payment by its due date.

**G.** Every three years beginning in 2004, the department shall review the fees specified in Table 1 and 2 of this section and shall provide a report to the commission. The department shall revise the fees as necessary in accordance with Section 74-6-5(J), NMSA 1978.

| **20.6.2.3114 TABLE 1** (gpd=gallons per day) | **Permit Fee** |
|---|---|
| Agriculture <10,000 gpd | $ 1,150 |
| Agriculture 10,000 to 49,999 gpd | $ 2,300 |
| Agriculture 50,000 to 99,999 gpd | $ 3,450 |
| Agriculture 100,000 gpd or greater | $ 4,600 |
| Domestic Waste <10,000 gpd | $ 1,150 |
| Domestic Waste 10,000 to 49,999 gpd | $ 2,300 |
| Domestic Waste 50,000 to 99,999 gpd | $ 3,450 |
| Domestic Waste 100,000 to 999,999 gpd | $ 4,600 |
| Domestic Waste 1,000,000 to 9,999,999 gpd | $ 7,000 |
| Domestic Waste 10,000,000 gpd or greater | $ 9,200 |
| Food Processing <10,000 gpd | $ 1,150 |
| Food Processing 10,000 to 49,999 gpd | $ 2,300 |
| Food Processing 50,000 to 99,999 gpd | $ 3,450 |
| Food Processing 100,000 to 999,999 gpd | $ 4,600 |
| Food Processing 1,000,000 or greater | $ 7,000 |
| Grease/Septage surface disposal <10,000 gpd | $ 1,725 |
| Grease/Septage surface disposal 10,000 gpd or greater | $ 3,450 |
| Industrial <10,000 gpd; or <10,000 $yd^3$ of contaminated solids | $ 1,725 |
| Industrial 10,000 to 99,999 gpd; or 10,000 to 99,999 $yd^3$ of contaminated solids | $ 3,450 |
| Industrial 100,000 to 999,999 gpd; or 100,000 to 999,999 $yd^3$ of contaminated solids or greater | $ 6,900 |
| Industrial 1,000,000 gpd or greater; or 1,000,000 $yd^3$ of contaminated solids or greater | $10,350 |
| Discharge of remediation system effluent - remediation plan approved under separate regulatory authority | $ 1,600 |
| Mining dewatering | $ 3,250 |
| Mining leach dump | $13,000 |
| Mining tailings | $13,000 |
| Mining waste rock | $13,000 |
| Mining in-situ leach (except salt) and old stope leaching | $13,000 |
| Mining other (mines with minimal environmental impact, post closure operation and maintenance, evaporation lagoons and land application at uranium mines) | $ 4,750 |
| Gas Compressor Stations 0 to 1000 Horsepower | $ 400 |
| Gas Compressor Stations >1001 Horsepower | $ 1,700 |
| Gas Processing Plants | $ 4,000 |
| Injection Wells: Class I | $ 4,500 |
| Injection Wells: Class III and Geothermal | $ 1,700 |
| Oil and Gas Service Companies | $ 1,700 |
| Refineries | $ 8,400 |
| Crude Pump Station | $ 1,200 |
| Underground Gas Storage | $ 1,700 |
| Abatement of ground water and vadose zone contamination at oil and gas Sites | $ 2,600 |
| General permit | $ 600 |

**20.6.2.3114 Table 2**

| | Fee Amount |
|---|---|
| Filing fee | $ 100 |
| Temporary permission | $ 150 |
| Financial assurance: approval of instrument | greater of $250 or .01% |
| Financial assurance: annual review | greater of $100 or .001% |

[8-17-91, 12-1-95; 20.6.2.3114, Rn & A, 20 NMAC 6.2.III.3114, 01-01-01]

**20.6.2.3115 - 20.6.2.3999: [RESERVED]**
[12-1-95; 20.6.2.3115 – 20.6.2.3999 NMAC – Rn, 20 NMAC 6.2.III.3115-4100, 1-15-01]

**20.6.2.4000 PREVENTION AND ABATEMENT OF WATER POLLUTION:**
[12-1-95; 20.6.2.4000 NMAC – Rn, 20 NMAC 6.2.IV, 1-15-01]

**20.6.2.4001 – 20.6.2.4100: [RESERVED]**
[12-1-95; 20.6.2.4001 – 20.6.2.4100 NMAC – Rn, 20 NMAC 6.2.III.3115-4100, 1-15-01]

**20.6.2.4101 PURPOSE:**

**A.** The purposes of Sections 20.6.2.4000 through 20.6.2.4115 NMAC are to:

(1) Abate pollution of subsurface water so that all ground water of the State of New Mexico which has a background concentration of 10,000 mg/L or less TDS, is either remediated or protected for use as domestic and agricultural water supply, and to remediate or protect those segments of surface waters which are gaining because of subsurface-water inflow, for uses designated in the Water Quality Standards for Interstate and Intrastate Streams in New Mexico (20.6.4 NMAC); and

(2) Abate surface-water pollution so that all surface waters of the State of New Mexico are remediated or protected for designated or attainable uses as defined in the Water Quality Standards for Interstate and Intrastate Streams in New Mexico (20.6.4 NMAC).

**B.** If the background concentration of any water contaminant exceeds the standard or requirement of Subsections A, B and C of Section 20.6.2.4103 NMAC, pollution shall be abated by the responsible person to the background concentration.

**C.** The standards and requirements set forth in Section 20.6.2.4103 NMAC are not intended as maximum ranges and concentrations for use, and nothing herein contained shall be construed as limiting the use of waters containing higher ranges and concentrations.
[12-1-95; 20.6.2.4101 NMAC – Rn, 20 NMAC 6.2.IV.4101, 1-15-01]

**20.6.2.4102: [RESERVED]**
[12-1-95; 20.6.2.4102 NMAC – Rn, 20 NMAC 6.2.IV.4102, 1-15-01]

**20.6.2.4103 ABATEMENT STANDARDS AND REQUIREMENTS:**

**A.** The vadose zone shall be abated so that water contaminants in the vadose zone shall not be capable of contaminating ground water or surface water, in excess of the standards in Subsections B and C below, through leaching, percolation or as the water table elevation fluctuates.

**B.** Ground-water pollution at any place of withdrawal for present or reasonably foreseeable future use, where the TDS concentration is 10,000 mg/L or less, shall be abated to conform to the following standards:

(1) toxic pollutant(s) as defined in Section 20.6.2.1101 NMAC shall not be present; and

(2) the standards of Section 20.6.2.3103 NMAC shall be met.

**C.** Surface-water pollution shall be abated to conform to the Water Quality Standards for Interstate and Intrastate Streams in New Mexico (20.6.4 NMAC).

**D.** Subsurface-water and surface-water abatement shall not be considered complete until a minimum of eight (8) consecutive quarterly samples from all compliance sampling stations approved by the secretary meet the abatement standards of Subsections A, B and C of this section. Abatement of water contaminants measured in solid-matrix samples of the vadose zone shall be considered complete after one-time sampling from compliance stations approved by the secretary.

**E.** Technical Infeasibility.

(1) If any responsible person is unable to fully meet the abatement standards set forth in Subsections A and B of this section using commercially accepted abatement technology pursuant to an approved abatement plan, he may propose that abatement standards compliance is technically infeasible. Technical infeasibility proposals involving the use of experimental abatement technology shall be considered at the discretion of the secretary. Technical infeasibility may be demonstrated by a statistically valid extrapolation of the decrease in concentration(s) of any water contaminant(s) over the remainder of a twenty (20) year period, such that projected future reductions during that time would be less than 20 percent of the concentration(s) at the time technical infeasibility is proposed. A statistically valid decrease cannot be demonstrated by fewer than eight (8) consecutive quarters. The technical infeasibility proposal shall include a substitute abatement standard(s) for those contaminants that is/are technically

feasible. Abatement standards for all other water contaminants not demonstrated to be technically infeasible shall be met.

(2) In no event shall a proposed technical infeasibility demonstration be approved by the secretary for any water contaminant if its concentration is greater than 200 percent of the abatement standard for that contaminant.

(3) If the secretary cannot approve any or all portions of a proposed technical infeasibility demonstration because the water contaminant concentration(s) is/are greater than 200 percent of the abatement standard(s) for each contaminant, the responsible person may further pursue the issue of technical infeasibility by filing a petition with the commission seeking:

(a) approval of alternate abatement standard(s) pursuant to Subsection F of this section; or

(b) granting of a variance pursuant to Section 20.6.2.1210 NMAC.

**F.** Alternative Abatement Standards.

(1) At any time during or after the submission of a Stage 2 abatement plan, the responsible person may file a petition seeking approval of alternative abatement standard(s) for the standards set forth in Subsections A and B of this section. The commission may approve alternative abatement standard(s) if the petitioner demonstrates that:

(a) compliance with the abatement standard(s) is/are not feasible, by the maximum use of technology within the economic capability of the responsible person; OR there is no reasonable relationship between the economic and social costs and benefits (including attainment of the standard(s) set forth in Section 20.6.2.4103 NMAC) to be obtained;

(b) the proposed alternative abatement standard(s) is/are technically achievable and cost-benefit justifiable; and

(c) compliance with the proposed alternative abatement standard(s) will not create a present or future hazard to public health or undue damage to property.

(2) The petition shall be in writing, filed with the secretary. The petition shall specify, in addition to the information required by Subsection A of Section 20.6.2.1210 NMAC, the water contaminant(s) for which alternative standard(s) is/are proposed, the alternative standard(s) proposed, the three-dimensional body of water pollution for which approval is sought, and the extent to which the abatement standard(s) set forth in Section 20.6.2.4103 NMAC is/are now, and will in the future be, violated. The petition may include a transport, fate and risk assessment in accordance with accepted methods, and other information as the petitioner deems necessary to support the petition.

(3) The commission shall review a petition for alternative abatement standards in accordance with the procedures for review of a variance petition provided in the commission's adjudicatory procedures, 20.1.3 NMAC. [12-1-95, 11-15-96; 20.6.2.4103 NMAC – Rn, 20 NMAC 6.2.IV.4103, 1-15-01]

**20.6.2.4104 ABATEMENT PLAN REQUIRED:**

**A.** Unless otherwise provided by this Part, all responsible persons who are abating, or who are required to abate, water pollution in excess of the standards and requirements set forth in Section 20.6.2.4103 NMAC of this Part shall do so pursuant to an abatement plan approved by the secretary. When an abatement plan has been approved, all actions leading to and including abatement shall be consistent with the terms and conditions of the abatement plan.

**B.** In the event of a transfer of the ownership, control or possession of a facility for which an abatement plan is required or approved, where the transferor is a responsible person, the transferee also shall be considered a responsible person for the duration of the abatement plan, and may jointly share the responsibility to conduct the actions required by this Part with other responsible persons. The transferor shall notify the transferee in writing, at least thirty (30) days prior to the transfer, that an abatement plan has been required or approved for the facility, and shall deliver or send by certified mail to the secretary a copy of such notification together with a certificate or other proof that such notification has in fact been received by the transferee. The transferor and transferee may agree to a designated responsible person who shall assume the responsibility to conduct the actions required by this Part. The responsible persons shall notify the secretary in writing if a designated responsible person is agreed upon. If the secretary determines that the designated responsible person has failed to conduct the actions required by this Part, the secretary shall notify all responsible persons of this failure in writing and allow them thirty (30) days, or longer for good cause shown, to conduct the required actions before issuing a compliance order pursuant to Section 20.6.2.1220 NMAC.

**C.** If the source of the water pollution to be abated is a facility that operated under a discharge plan, the secretary may require the responsible person(s) to submit a financial assurance plan which covers the estimated

costs to conduct the actions required by the abatement plan. Such a financial assurance plan shall be consistent with any financial assurance requirements adopted by the commission.
[12-1-95; 20.6.2.4104 NMAC – Rn, 20 NMAC 6.2.IV.4104, 1-15-01]

**20.6.2.4105 EXEMPTIONS FROM ABATEMENT PLAN REQUIREMENTS:**

**A.** Except as provided in Subsection B of this Section, Sections 20.6.2.4104 and 20.6.2.4106 NMAC do not apply to a person who is abating water pollution:

(1) from an underground storage tank, under the authority of the Underground Storage Tank Regulations (20.5 NMAC) adopted by the New Mexico Environmental Improvement Board, or in accordance with the New Mexico Ground Water Protection Act;

(2) under the authority of the U.S. Environmental Protection Agency pursuant to either the federal Comprehensive Environmental Response, Compensation and Liability Act, and amendments, or the Resource Conservation and Recovery Act;

(3) under the authority of the secretary pursuant to the Hazardous Waste Management Regulations (20.4.1 NMAC) adopted by the New Mexico Environmental Improvement Board;

(4) under the authority of the U.S. Nuclear Regulatory Commission or the U.S. Department of Energy pursuant to the Atomic Energy Act;

(5) from a solid waste landfill, under the authority of the secretary pursuant to the Solid Waste Management Regulations (20.9.1 NMAC) adopted by the N.M. Environmental Improvement Board;

(6) under the authority of a ground-water discharge plan approved by the secretary, provided that such abatement is consistent with the requirements and provisions of Sections 20.6.2.4101, 20.6.2.4103, Subsections C and E of Section 20.6.2.4106, Sections 20.6.2.4107 and 20.6.2.4112 NMAC;

(7) under the authority of a Letter of Understanding, Settlement Agreement or Administrative Order on Consent signed by the secretary prior to December 1, 1995, provided that abatement is being performed in full compliance with the terms of the Letter of Understanding, Settlement Agreement or Administrative Order on Consent; and

(8) on an emergency basis, or while abatement plan approval is pending, or in a manner that will result in compliance with the standards and requirements set forth in Section 20.6.2.4103 NMAC within one hundred and eighty (180) days after notice is required to be given pursuant to Paragraph (1) of Subsection A of Section 20.6.2.1203 NMAC, provided that the delegated agency does not object to the abatement action pursuant to Paragraphs (6) and (7) of Subsection A of Section 20.6.2.1203 NMAC.

**B.** If the secretary determines that abatement of water pollution subject to Subsection A of this section will not meet the standards of Subsections B and C of Section 20.6.2.4103 NMAC, or that additional action is necessary to protect health, welfare, environment or property, the secretary may notify a responsible person, by certified mail, to submit an abatement plan pursuant to Section 20.6.2.4104 and Subsection A of Section 20.6.2.4106 NMAC. The notification shall state the reasons for the secretary's determination. In any appeal of the secretary's determination under this Section, the secretary shall have the burden of proof.

**C.** Sections 20.6.2.4104 and 20.6.2.4106 NMAC do not apply to the following activities:

(1) Discharges subject to an effective and enforceable National Pollutant Discharge Elimination System (NPDES) permit;

(2) Land application of ground water contaminated with nitrogen originating from human or animal waste and not otherwise exceeding the standards of Subsection A of Section 20.6.2.3103 NMAC and not containing a toxic pollutant as defined in Section 20.6.2.1101 NMAC, provided that it is done in compliance with a discharge plan approved by the secretary;

(3) Abatement of water pollution resulting from the withdrawal and decontamination or blending of polluted water for use as a public or private drinking-water supply, by any person other than a responsible person, unless the secretary determines that a hazard to public health may result; and

(4) Reasonable operation and maintenance of irrigation and flood control facilities.
[12-1-95; 20.6.2.4105 NMAC – Rn, 20 NMAC 6.2.IV.4105, 1-15-01]

**20.6.2.4106 ABATEMENT PLAN PROPOSAL:**

**A.** Except as provided for in Section 20.6.2.4105 NMAC, a responsible person shall, within sixty (60) days of receipt of written notice from the secretary that an abatement plan is required, submit an abatement plan proposal to the secretary for approval. For good cause shown, the secretary may allow for a total of one hundred and twenty (120) days to prepare and submit the abatement plan proposal.

**B. Voluntary Abatement**:

(1) Any person wishing to abate water pollution in excess of the standards and requirements set forth in Section 20.6.2.4103 NMAC may submit a Stage 1 abatement plan proposal to the secretary for approval. Following approval by the secretary of a final site investigation report prepared pursuant to Stage 1 of an abatement plan, any person may submit a Stage 2 abatement plan proposal to the secretary for approval.

(2) Following approval of a Stage 1 or Stage 2 abatement plan proposal under Paragraph (1) of Subsection B of this Section, the person submitting the approved plan shall be a responsible person under Sections 20.6.2.4000 through 20.6.2.4115 NMAC for the purpose of performing the approved Stage 1 or Stage 2 abatement plan. Nothing in this Section shall preclude the secretary from applying Paragraph (9) of Subsection A of Section 20.6.2.1203 NMAC to a responsible person if applicable.

**C. Stage 1 Abatement Plan**: The purpose of Stage 1 of the abatement plan shall be to design and conduct a site investigation that will adequately define site conditions, and provide the data necessary to select and design an effective abatement option. Stage 1 of the abatement plan may include, but not necessarily be limited to, the following information depending on the media affected, and as needed to select and implement an expeditious abatement option:

(1) Descriptions of the site, including a site map, and of site history including the nature of the discharge that caused the water pollution, and a summary of previous investigations;

(2) Site investigation workplan to define:

(a) site geology and hydrogeology, the vertical and horizontal extent and magnitude of vadose-zone and ground-water contamination, subsurface hydraulic parameters including hydraulic conductivity, transmissivity, storativity, and rate and direction of contaminant migration, inventory of water wells inside and within one (1) mile from the perimeter of the three-dimensional body where the standards set forth in Subsection B of Section 20.6.2.4103 NMAC are exceeded, and location and number of such wells actually or potentially affected by the pollution; and

(b) surface-water hydrology, seasonal stream flow characteristics, ground-water/surface-water relationships, the vertical and horizontal extent and magnitude of contamination and impacts to surface water and stream sediments. The magnitude of contamination and impacts on surface water may be, in part, defined by conducting a biological assessment of fish, benthic macroinvertebrates and other wildlife populations. Seasonal variations should be accounted for when conducting these assessments.

(3) Monitoring program, including sampling stations and frequencies, for the duration of the abatement plan that may be modified, after approval by the secretary, as additional sampling stations are created;

(4) Quality assurance plan, consistent with the sampling and analytical techniques listed in Subsection B of Section 20.6.2.3107 NMAC and with Section 20.6.4.10 NMAC of the Water Quality Standards for Interstate and Intrastate Streams in New Mexico (20.6.4 NMAC), for all work to be conducted pursuant to the abatement plan;

(5) Site health and safety plan for all work to be performed pursuant to the abatement plan;

(6) A schedule for all Stage 1 abatement plan activities, including the submission of summary quarterly progress reports, and the submission, for approval by the secretary, of a detailed final site investigation report; and

(7) Any additional information that may be required to design and perform an adequate site investigation.

**D. Stage 2 Abatement Plan**: Any responsible person shall submit a Stage 2 abatement plan proposal to the secretary for approval within sixty (60) days, or up to one hundred and twenty (120) days for good cause shown, after approval by the secretary of the final site investigation report prepared pursuant to Stage 1 of the abatement plan.

**E.** The purpose of Stage 2 of the abatement plan shall be to select and design, if necessary, an abatement option that, when implemented, will result in attainment of the abatement standards and requirements set forth in Section 20.6.2.4103 NMAC, including post-closure maintenance activities. Stage 2 of the abatement plan should include, at a minimum, the following information:

(1) Brief description of the current situation at the site;

(2) Development and assessment of abatement options;

(3) Description, justification and design, if necessary, of preferred abatement option;

(4) Modification, if necessary, of the monitoring program approved pursuant to Stage 1 of the abatement plan, including the designation of pre and post abatement-completion sampling stations and sampling frequencies to be used to demonstrate compliance with the standards and requirements set forth in Section 20.6.2.4103 NMAC;

(5) Site maintenance activities, if needed, proposed to be performed after termination of abatement activities;

(6) A schedule for the duration of abatement activities, including the submission of summary quarterly progress reports;

(7) A public notification proposal designed to satisfy the requirements of Subsections B and C of Sections 20.6.2.4108 and 20.6.2.4108 NMAC; and

(8) Any additional information that may be reasonably required to select, describe, justify and design an effective abatement option.

[12-1-95; 20.6.2.4106 NMAC – Rn, 20 NMAC 6.2.IV.4106, 1-15-01]

**20.6.2.4107 OTHER REQUIREMENTS:**

**A.** Any responsible person shall allow any authorized representative of the secretary to:

(1) upon presentation of proper credentials, enter the facility at reasonable times;

(2) inspect and copy records required by an abatement plan;

(3) inspect any treatment works, monitoring and analytical equipment;

(4) sample any wastes, ground water, surface water, stream sediment, plants, animals, or vadose-zone material including vadose-zone vapor;

(5) use monitoring systems and wells under such responsible person's control in order to collect samples of any media listed in Paragraph (4) of Subsection A of this section; and

(6) gain access to off-site property not owned or controlled by such responsible person, but accessible to such responsible person through a third-party access agreement, provided that it is allowed by the agreement.

**B.** Any responsible person shall provide the secretary, or a representative of the secretary, with at least four (4) working days advance notice of any sampling to be performed pursuant to an abatement plan, or any well plugging, abandonment or destruction at any facility where an abatement plan has been required.

**C.** Any responsible person wishing to plug, abandon or destroy a monitoring or water supply well within the perimeter of the 3-dimensional body where the standards set forth in Subsection B of Section 20.6.2.4103 NMAC are exceeded, at any facility where an abatement plan has been required, shall propose such action by certified mail to the secretary for approval, unless such approval is required from the State Engineer. The proposed action shall be designed to prevent water pollution that could result from water contaminants migrating through the well or borehole. The proposed action shall not take place without written approval from the secretary, unless written approval or disapproval is not received by the responsible person within thirty (30) days of the date of receipt of the proposal.

[12-1-95; 20.6.2.4107 NMAC – Rn, 20 NMAC 6.2.IV.4107, 1-15-01]

**20.6.2.4108 PUBLIC NOTICE AND PARTICIPATION:**

**A.** Within thirty (30) days of filing of a Stage 1 abatement plan proposal, the secretary shall issue a news release summarizing:

(1) the source, extent, magnitude and significance of water pollution, as known at that time;

(2) the proposed Stage 1 abatement plan investigation; and

(3) the name and telephone number of an agency contact who can provide additional information.

**B.** Within thirty (30) days of filing of a Stage 2 abatement plan proposal, or proposed significant modification of Stage 2 of the abatement plan, any responsible person shall provide to the secretary proof of public notice of the abatement plan to the following persons:

(1) the public, who shall be notified through publication of a notice in newspapers of general circulation in this state and in the county where the abatement will occur and, in areas with large percentages of non-English speaking people, through the mailing of the public notice in English to a bilingual radio station serving the area where the abatement will occur with a request that it be aired as a public service announcement in the predominant non-English language of the area;

(2) those persons, as identified by the secretary, who have requested notification, who shall be notified by mail;

(3) the New Mexico Trustee for Natural Resources, and any other local, state or federal governmental agency affected, as identified by the secretary, which shall be notified by certified mail;

(4) owners and residents of surface property located inside, and within one (1) mile from, the perimeter of the geographic area where the standards and requirements set forth in Section 20.6.2.4103 NMAC are exceeded who shall be notified by a means approved by the secretary; and

(5) the Governor or President of each Indian Tribe, Pueblo or Nation within the state of New Mexico, as identified by the secretary, who shall be notified by mail.

**C.** The public notice shall include, as approved in advance by the secretary:

(1) name and address of the responsible person;

(2) location of the proposed abatement;

(3) brief description of the nature of the water pollution and of the proposed abatement action;

(4) brief description of the procedures followed by the secretary in making a final determination;

(5) statement on the comment period;

(6) statement that a copy of the abatement plan can be viewed by the public at the department's main office or at the department field office for the area in which the discharge occurred;

(7) statement that written comments on the abatement plan, and requests for a public meeting or hearing that include the reasons why a meeting or hearing should be held, will be accepted for consideration if sent to the secretary within sixty (60) days after the determination of administrative completeness; and

(8) address and phone number at which interested persons may obtain further information.

**D.** A public meeting or hearing may be held if the secretary determines there is significant public interest. Notice of the time and place of the meeting or hearing shall be given at least thirty (30) days prior to the meeting or hearing pursuant to Subsections A and B above. The secretary may appoint a meeting facilitator or hearing officer. The secretary may require the responsible person to prepare for approval by the secretary a fact sheet, to be distributed at the public meeting or hearing and afterwards upon request, written in English and Spanish, describing site history, the nature and extent of water pollution, and the proposed abatement. The record of the meeting or hearing, requested under this Section, consists of a tape recorded or transcribed session, provided that the cost of a court recorder shall be paid by the person requesting the transcript. If requested by the secretary, the responsible person will provide a translator approved by the secretary at a public meeting or hearing conducted in a locale where testimony from non-English speaking people can reasonably be expected. At the meeting or hearing, all interested persons shall be given a reasonable chance to submit data, views or arguments orally or in writing, and to ask questions of the secretary or the secretary's designee and of the responsible person, or their authorized representatives.

[12-1-95; 20.6.2.4108 NMAC – Rn, 20 NMAC 6.2.IV.4108, 1-15-01]

**20.6.2.4109 SECRETARY APPROVAL OR NOTICE OF DEFICIENCY OF SUBMITTALS:**

**A.** The secretary shall, within sixty (60) days of receiving a Stage 1 abatement plan proposal, a site investigation report, a technical infeasibility demonstration, or an abatement completion report, approve the document, or notify the responsible person of the document's deficiency, based upon the information available.

**B.** The secretary shall, within thirty (30) days of receiving a fact sheet, approve or notify the responsible person of the document's deficiency, based upon the information available.

**C.** If no public meeting or hearing is held pursuant to Subsection D of Section 20.6.2.4108 NMAC, then the secretary shall, within ninety (90) days of receiving a Stage 2 abatement plan proposal, approve the plan, or notify the responsible person of the plan's deficiency, based upon the information available.

**D.** If a public meeting or hearing is held pursuant to Subsection D of Section 20.6.2.4108, then the secretary shall, within sixty (60) days of receipt of all required information, approve Stage 2 of the abatement plan proposal, or notify the responsible person of the plan's deficiency, based upon the information contained in the plan and information submitted at the meeting or hearing.

**E.** If the secretary notifies a responsible person of any deficiencies in a site investigation report, or in a Stage 1 or Stage 2 abatement plan proposal, the responsible person shall submit a modified document to cure the deficiencies specified by the secretary within thirty (30) days of receipt of the notice of deficiency. The responsible person shall be in violation of Sections 20.6.2.4000 through 20.6.2.4115 NMAC if he fails to submit a modified document within the required time, or if the modified document does not make a good faith effort to cure the deficiencies specified by the secretary.

**F.** Provided that the other requirements of this Part are met and provided further that Stage 2 of the abatement plan, if implemented, will result in the standards and requirements set forth in Section 20.6.2.4103 NMAC being met within a schedule that is reasonable given the particular circumstances of the site, the secretary shall approve the plan.

[12-1-95; 20.6.2.4109 NMAC – Rn, 20 NMAC 6.2.IV.4109, 1-15-01]

**20.6.2.4110 INVESTIGATION AND ABATEMENT:** Any responsible person who receives approval for Stage 1 and/or Stage 2 of an abatement plan shall conduct all investigation, abatement, monitoring and reporting

activity in full compliance with Sections 20.6.2.4000 through 20.6.2.4115 NMAC and according to the terms and schedules contained in the approved abatement plans.
[12-1-95; 20.6.2.4110 NMAC – Rn, 20 NMAC 6.2.IV.4110, 1-15-01]

**20.6.2.4111 ABATEMENT PLAN MODIFICATION:**

**A.** Any approved abatement plan may be modified, at the written request of the responsible person, in accordance with Sections 20.6.2.4000 through 20.6.2.4115 NMAC, and with written approval of the secretary.

**B.** If data submitted pursuant to any monitoring requirements specified in the approved abatement plan or other information available to the secretary indicates that the abatement action is ineffective, or is creating unreasonable injury to or interference with health, welfare, environment or property, the secretary may require a responsible person to modify an abatement plan within the shortest reasonable time so as to effectively abate water pollution which exceeds the standards and requirements set forth in Section 20.6.2.4103 NMAC, and to abate and prevent unreasonable injury to or interference with health, welfare, environment or property.
[12-1-95; 20.6.2.4111 NMAC – Rn, 20 NMAC 6.2.IV.4111, 1-15-01]

**20.6.2.4112 COMPLETION AND TERMINATION:**

**A.** Abatement shall be considered complete when the standards and requirements set forth in Section 20.6.2.4103 NMAC are met. At that time, the responsible person shall submit an abatement completion report, documenting compliance with the standards and requirements set forth in Section 20.6.2.4103 NMAC, to the secretary for approval. The abatement completion report also shall propose any changes to long term monitoring and site maintenance activities, if needed, to be performed after termination of the abatement plan.

**B.** Provided that the other requirements of this Part are met and provided further that the standards and requirements set forth in Section 20.6.2.4103 NMAC have been met, the secretary shall approve the abatement completion report. When the secretary approves the abatement completion report, he shall also notify the responsible person in writing that the abatement plan is terminated.
[12-1-95; 20.6.2.4112 NMAC – Rn, 20 NMAC 6.2.IV.4112, 1-15-01]

**20.6.2.4113 DISPUTE RESOLUTION:** In the event of any technical dispute regarding the requirements of Paragraph (9) of Subsection A and Subsection E of Section 20.6.2.1203, Sections 20.6.2.4103, 20.6.2.4105, 20.6.2.4106, 20.6.2.4111 or 20.6.2.4112 NMAC, including notices of deficiency, the responsible person may notify the secretary by certified mail that a dispute has arisen, and desires to invoke the dispute resolution provisions of this Section, provided that such notification must be made within thirty (30) days after receipt by the responsible person of the decision of the secretary that causes the dispute. Upon such notification, all deadlines affected by the technical dispute shall be extended for a thirty (30) day negotiation period, or for a maximum of sixty (60) days if approved by the secretary for good cause shown. During this negotiation period, the secretary or his/her designee and the responsible person shall meet at least once. Such meeting(s) may be facilitated by a mutually agreed upon third party, but the third party shall assume no power or authority granted or delegated to the secretary by the Water Quality Act or by the commission. If the dispute remains unresolved after the negotiation period, the decision of secretary shall be final.
[12-1-95; 20.6.2.4113 NMAC – Rn, 20 NMAC 6.2.IV.4113, 1-15-01]

**20.6.2.4114 APPEALS FROM SECRETARY'S DECISIONS:**

**A.** If the secretary determines that an abatement plan is required pursuant to Paragraph (9) of Subsection A of Section 20.6.2.1203, Paragraph (4) of Subsection E of Section 20.6.2.3109, or Subsection B of Section 20.6.2.4105 NMAC, approves or provides notice of deficiency of a proposed abatement plan, technical infeasibility demonstration or abatement completion report, or modifies or terminates an approved abatement plan, he shall provide written notice of such action by certified mail to the responsible person and any person who participated in the action.

**B.** Any person who participated in the action before the secretary and who is adversely affected by the action listed in Subsection A of this section may file a petition requesting a hearing before the commission.

**C.** The petition shall be made in writing to the commission and shall be filed with the commission's secretary within thirty (30) days after receiving notice of the secretary's action. The petition shall specify the portions of the action to which the petitioner objects, certify that a copy of the petition has been mailed or hand-delivered to the secretary, and to the applicant or permittee if the petitioner is not the applicant or permittee, and attach a copy of the action for which review is sought. Unless a timely petition for hearing is made, the secretary's action is final.

**D.** The proceedings before the commission shall be conducted as provided in the commission's adjudicatory procedures, 20 NMAC 1.3.

**E.** The cost of the court reporter for the hearing shall be paid by the petitioner.

**F.** The appeal provisions do not relieve the owner, operator or responsible person of their obligations to comply with any federal or state laws or regulations.

[12-1-95, 11-15-96; 20.6.2.4114 NMAC – Rn, 20 NMAC 6.2.IV.4114, 1-15-01]

**20.6.2.4115 COURT REVIEW OF COMMISSION DECISIONS:** Court review of commission decisions shall be as provided by law.

[12-1-95; 20.6.2.4115 NMAC – Rn, 20 NMAC 6.2.IV.4115, 1-15-01]

**20.6.2.4116 – 20.6.2.4999: [RESERVED]**

[12-1-95; 20.6.2.4116 – 20.6.2.4999 NMAC – Rn, 20 NMAC 6.2.IV.4116-5100, 1-15-01]

**20.6.2.5000 UNDERGROUND INJECTION CONTROL:**

[12-1-95; 20.6.2.5000 NMAC – Rn, 20 NMAC 6.2.V, 1-15-01]

**20.6.2.5001 PURPOSE:** The purpose of Sections 20.6.2.5000 through 20.6.2.5299 NMAC controlling discharges from underground injection control wells is to protect all ground water of the State of New Mexico which has an existing concentration of 10,000 mg/l or less TDS, for present and potential future use as domestic and agricultural water supply, and to protect those segments of surface waters which are gaining because of ground water inflow for uses designated in the New Mexico Water Quality Standards. Sections 20.6.2.5000 through 20.6.2.5299 NMAC include notification requirements, and requirements for discharges directly into the subsurface through underground injection control wells.

[20.6.2.5001 NMAC - N, 12-1-01]

**20.6.2.5002 UNDERGROUND INJECTION CONTROL WELL CLASSIFICATIONS:**

**A.** Underground injection control wells include the following.

(1) Any dug hole or well that is deeper than its largest surface dimension, where the principal function of the hole is emplacement of fluids.

(2) Any septic tank or cesspool used by generators of hazardous waste, or by owners or operators of hazardous waste management facilities, to dispose of fluids containing hazardous waste.

(3) Any subsurface distribution system, cesspool or other well which is used for the injection of wastes.

**B.** Underground injection control wells are classified as follows:

(1) Class I wells inject fluids beneath the lowermost formation that contains 10,000 milligrams per liter or less TDS. Class I hazardous or radioactive waste injection wells inject fluids containing any hazardous or radioactive waste as defined in 74-4-3 and 74-4A-4 NMSA 1978, including any combination of these wastes. Class I non-hazardous waste injection wells inject non-hazardous and non-radioactive fluids, and they inject naturally-occurring radioactive material (NORM) as provided by Section 20.3.1.1407 NMAC.

(2) Class II wells inject fluids associated with oil and gas recovery.

(3) Class III wells inject fluids for extraction of minerals or other natural resources, including sulfur, uranium, metals, salts or potash by in situ extraction. This classification includes only in situ production from ore bodies that have not been conventionally mined. Solution mining of conventional mines such as stopes leaching is included in Class V.

(4) Class IV wells inject fluids containing any radioactive or hazardous waste as defined in 74-4-3 and 74-4A-4 NMSA 1978, including any combination of these wastes, above or into a formation that contains 10,000 mg/l or less TDS.

(5) Class V wells inject a variety of fluids and are those wells not included in Class I, II, III or IV. Types of Class V wells include, but are not limited to, the following:

(a) Domestic liquid waste injection wells

(i) domestic liquid waste disposal wells used to inject greater than 2,000 gallons per day of treated domestic liquid waste through subsurface fluid distribution systems or vertical wells;

(ii) septic system wells used to emplace greater than 2,000 gallons per day of domestic liquid waste into the subsurface, which are comprised of a septic tank and subsurface fluid distribution system;

(iii) large capacity cesspools used to inject greater than 2,000 gallons per day of domestic liquid waste, including drywells that sometimes have an open bottom and/or perforated sides.

(b) Industrial waste injection wells

(i) air conditioning return flow wells used to return to the supply aquifer the water used for heating or cooling;

(ii) dry wells used for the injection of wastes into a subsurface formation;

(iii) geothermal energy injection wells associated with the recovery of geothermal energy for heating, aquaculture and production of electrical power;

(iv) stormwater drainage wells used to inject storm runoff from the surface into the subsurface;

(v) motor vehicle waste disposal wells that receive or have received fluids from vehicular repair or maintenance activities;

(vi) car wash waste disposal wells used to inject fluids from motor vehicle washing activities.

(c) Mining injection wells

(i) stopes leaching wells used for solution mining of conventional mines;

(ii) brine injection wells used to inject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts;

(iii) backfill wells used to inject a mixture of water and sand, mill tailings or other solids into mined out portions of subsurface mines whether water injected is a radioactive waste or not;

(iv) injection wells used for in situ recovery of lignite, coal, tar sands, and oil shale.

(d) Ground water management injection wells

(i) ground water remediation injection wells used to inject contaminated ground water that has been treated to ground water quality standards;

(ii) in situ ground water remediation wells used to inject a fluid that facilitates vadose zone or ground water remediation.

(iii) recharge wells used to replenish the water in an aquifer, including use to reclaim or improve the quality of existing ground water;

(iv) barrier wells used to inject fluids into ground water to prevent the intrusion of saline or contaminated water into ground water of better quality;

(v) subsidence control wells (not used for purposes of oil or natural gas production) used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with the overdraft of fresh water;

(vi) wells used in experimental technologies.

(e) Agricultural injection wells - drainage wells used to inject fluids into ground water to prevent the intrusion of saline or contaminated water into ground water of better quality.

[20.6.2.5002 NMAC - N, 12-1-01]

**20.6.2.5003 NOTIFICATION AND GENERAL OPERATION REQUIREMENTS FOR ALL UNDERGROUND INJECTION CONTROL WELLS:** All operators of underground injection control wells, except those wells regulated under the Oil and Gas Act, the Geothermal Resources Conservation Act, and the Surface Mining Act, shall:

**A.** For existing underground injection control wells, submit to the secretary the information enumerated in Subsection C of Section 20.6.2.1201 NMAC of this Part; provided, however, that if the information in Subsection C of Section 20.6.2.1201 NMAC has been previously submitted to the secretary and acknowledged by him, the information need not be resubmitted; and

**B.** Operate and continue to operate in conformance with Sections 20.6.2.1 through 20.6.2.5299 NMAC.

**C.** For new underground injection control wells, submit to the secretary the information enumerated in Subsection C of Section 20.6.2.1201 NMAC of this Part at least 120 days prior to well construction.

[9-20-82, 12-1-95; 20.6.2.5300 NMAC – Rn, 20 NMAC 6.2.V.5300, 1-15-01; 20.6.2.5003 NMAC – Rn, 20.6.2.5300 NMAC, 12-1-01; A, 12-1-01; A, 9-15-02]

**20.6.2.5004 PROHIBITED UNDERGROUND INJECTION CONTROL ACTIVITIES AND WELLS:**

**A.** No person shall perform the following underground injection activities nor operate the following underground injection control wells:

(1) The injection of fluids into a motor vehicle waste disposal well is prohibited. Motor vehicle waste disposal wells are prohibited. Any person operating a new motor vehicle waste disposal well (for which construction began after April 5, 2000) must close the well immediately. Any person operating an existing motor vehicle waste disposal well must cease injection immediately and must close the well by December 31, 2002, except as provided in this Subsection.

(2) The injection of fluids into a large capacity cesspool is prohibited. Large capacity cesspools are prohibited. Any person operating a new large capacity cesspool (for which construction began after April 5, 2000) must close the cesspool immediately. Any person operating an existing large capacity cesspool must cease injection immediately and must close the cesspool by December 31, 2002.

(3) The injection of any hazardous or radioactive waste into a well is prohibited, except as provided in this Subsection.

(a) Class I hazardous or radioactive waste injection wells are prohibited, except naturally-occurring radioactive material (NORM) regulated under Section 20.3.1.1407 NMAC is allowed as a Class I non-hazardous waste injection well pursuant to Subsection B (1) of Section 20.6.2.5002 NMAC;

(b) Class IV wells are prohibited, except for wells re-injecting treated ground water into the same formation from which it was drawn as part of a removal or remedial action if the injection has prior approval from the Environmental Protection Agency (EPA) or the department under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the Resource Conservation and Recovery Act (RCRA).

(4) Barrier wells, drainage wells, recharge wells, return flow wells, and motor vehicle waste disposal wells are prohibited, except when the discharger can demonstrate that the discharge will not adversely affect the health of persons, and

(a) the injection fluid does not contain a contaminant which may cause an exceedance at any place of present or reasonable foreseeable future use of any primary state drinking water maximum contaminant level as specified in the water supply regulations, "Drinking Water" (20 NMAC 7.1) [20.7.10 NMAC], adopted by the Environmental Improvement Board under the Environmental Improvement Act or the standard of Section 20.6.2.3103 NMAC, whichever is more stringent;

(b) the discharger can demonstrate that the injection will result in an overall or net improvement in water quality as determined by the secretary.

**B.** Closure of prohibited underground injection control wells shall be in accordance with Section 20.6.2.5005 NMAC and Section 20.6.2.5209 NMAC.

[20.6.2.5004 NMAC - N, 12-1-01]

**20.6.2.5005 PRE-CLOSURE NOTIFICATION AND CLOSURE REQUIREMENTS:**

**A.** Any person proposing to close a Class I, III, IV or V underground injection control well must submit pre-closure notification to the department at least 30 days prior to closure. Pre-closure notification must include the following information:

(1) Name of facility
(2) Address of facility
(3) Name of Owner/Operator
(4) Address of Owner/Operator
(5) Contact Person
(6) Phone Number
(7) Type of Well(s)
(8) Number of Well(s)
(9) Well Construction (e.g. drywell, improved sinkhole, septic tank, leachfield, cesspool, other...)
(10) Type of Discharge
(11) Average Flow (gallons per day)
(12) Year of Well Construction
(13) Proposed Well Closure Activities (e.g. sample fluids/sediment, appropriate disposal of remaining fluids/sediments, remove well and any contaminated soil, clean out well, install permanent plug, conversion to other type well, ground water and vadose zone investigation, other)
(14) Proposed Date of Well Closure
(15) Name of Preparer
(16) Date

**B.** Proposed well closure activities must be approved by the department prior to implementation.

[20.6.2.5005 NMAC - N, 12-1-01]

**20.6.2.5006 DISCHARGE PERMIT REQUIREMENTS FOR CLASS V INJECTION WELLS**
Class V injection wells must meet the requirements of Sections 20.6.2.3000 through 20.6.2.3999 NMAC and Sections 20.6.2.5000 through 20.6.2.5006 NMAC.
[20.6.2.5006 NMAC - N, 12-1-01]

**20.6.2.5007 – 20.6.2.5100: [RESERVED]**
[12-1-95; 20.6.2.5001 – 20.6.2.5100 NMAC – Rn, 20 NMAC 6.2.IV.4116-5100, 1-15-01; 20.6.2.5007 –20.6.2.5100 NMAC – Rn 20.6.2.5001 – 20.6.2.5100 NMAC, 12-1-01]

**20.6.2.5101 DISCHARGE PERMIT AND OTHER REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** Class I non-hazardous waste injection wells and Class III wells must meet the requirements of Sections 20.6.2.5000 through 20.6.2.5299 NMAC in addition to other applicable requirements of the commission regulations. The secretary may also require that some Class IV and Class V wells comply with the requirements for Class I non-hazardous waste injection wells in Sections 20.6.2.5000 through 20.6.2.5299 NMAC if the secretary determines that the additional requirements are necessary to prevent the movement of water contaminants from a specified injection zone into ground water having 10,000 mg/l or less TDS. No Class I non-hazardous waste injection well or Class III well may be approved which allows for movement of fluids into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC, or pursuant to a temporary designation as provided in Paragraph (2) of Subsection C of Section 20.6.2.5101 NMAC.

**B.** Operation of a Class I non-hazardous waste injection well or Class III well must be pursuant to a discharge permit meeting the requirements of Sections 20.6.2.3000 through 20.6.2.3999 NMAC and Sections 20.6.2.5000 through 20.6.2.5299 NMAC.

**C.** Discharge permits for Class I non-hazardous waste injection wells, or Class III wells affecting ground water of 10,000 mg/l or less TDS submitted for secretary approval shall:

(1) Receive an aquifer designation if required in Section 20.6.2.5103 NMAC prior to discharge permit issuance; or

(2) For Class III wells only, address the methods or techniques to be used to restore ground water so that upon final termination of operations including restoration efforts, ground water at any place of withdrawal for present or reasonably foreseeable future use will not contain either concentrations in excess of the standards of Section 20.6.2.3103 NMAC or any toxic pollutant. Issuance of a discharge permit or project discharge permit for Class III wells that provides for restoration of ground water in accordance with the requirements of this Subsection shall substitute for the aquifer designation provisions of Section 20.6.2.5103 NMAC. The approval shall constitute a temporary aquifer designation for a mineral bearing or producing aquifer, or portion thereof, to allow injection as provided for in the discharge permit. Such temporary designation shall expire upon final termination of operations including restoration efforts.

**D.** The exemptions from the discharge permit requirement listed in Section 20.6.2.3105 NMAC do not apply to underground injection control wells except as provided below:

(1) Wells regulated by the Oil Conservation Division under the exclusive authority granted under Section 70-2-12 NMSA 1978 or under other Sections of the "Oil and Gas Act";

(2) Wells regulated by the Oil Conservation Division under the "Geothermal Resources Act";

(3) Wells regulated by the New Mexico Coal Surface Mining Bureau under the "Surface Mining Act";

(4) Wells for the disposal of effluent from systems which receive less than 2,000 gallons per day of domestic sewage effluent and are regulated under the "Liquid Waste Disposal Regulations" (20 NMAC 7.3) [20.7.3 NMAC] adopted by the Environmental Improvement Board under the "Environmental Improvement Act".

**E.** Project permits for Class III wells.

(1) The secretary may consider a project discharge permit for Class III wells, if the wells are:

(a) Within the same well field, facility site or similar unit,

(b) Within the same aquifer and ore deposit,

(c) Of similar construction,

(d) Of the same purpose, and

(e) Operated by a single owner or operator.

(2) A project discharge permit does not allow the discharger to commence injection in any individual operational area until the secretary approves an application for injection in that operational area (operational area approval).

(3) A project discharge permit shall:

(a) Specify the approximate locations and number of wells for which operational area approvals are or will be sought with approximate time frames for operation and restoration (if restoration is required) of each area; and

(b) Provide the information required under the following Sections of this Part, except for such additional site-specific information as needed to evaluate applications for individual operational area approvals: Subsection C of Section 20.6.2.3106, Sections 20.6.2.3107, 20.6.2.5204 through 20.6.2.5209, and Subsection B of Section 20.6.2.5210 NMAC.

(4) Applications for individual operational area approval shall include the following:

(a) Site-specific information demonstrating that the requirements of this Part are met, and

(b) Information required under Sections 20.6.2.5202 through 20.6.2.5210 NMAC and not previously provided pursuant to Subparagraph (b) of Paragraph (3) of Subsection E of this Section.

(5) Applications for project discharge permits and for operational area approval shall be processed in accordance with the same procedures provided for discharge permits under Sections 20.6.2.3000 through 20.6.2.3114 NMAC, allowing for public notice on the project discharge permit and on each application for operational area approval pursuant to Section 20.6.2.3108 NMAC with opportunity for public hearing prior to approval or disapproval.

(6) The discharger shall comply with additional requirements that may be imposed by the secretary pursuant to this Part on wells in each new operational area.

**F.** If the holder of a discharge permit for a Class I non-hazardous waste injection well, or Class III well submits an application for discharge permit renewal at least 120 days before discharge permit expiration, and the discharger is in compliance with his discharge permit on the date of its expiration, then the existing discharge permit for the same activity shall not expire until the application for renewal has been approved or disapproved. An application for discharge permit renewal must include and adequately address all of the information necessary for evaluation of a new discharge permit. Previously submitted materials may be included by reference provided they are current, readily available to the secretary and sufficiently identified to be retrieved.

**G.** Discharge Permit Signatory Requirements: No discharge permit for a Class I non-hazardous waste injection well or Class III well may be issued unless:

(1) The application for a discharge permit has been signed as follows:

(a) For a corporation: by a principal executive officer of at least the level of vice-president, or a representative who performs similar policy-making functions for the corporation who has authority to sign for the corporation; or

(b) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(c) For a municipality, state, federal, or other public agency: by either a principal executive officer who has authority to sign for the agency, or a ranking elected official; and

(2) The signature is directly preceded by the following certification: "I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment."

**H.** Transfer of Class I non-hazardous waste injection well and Class III well Discharge Permits.

(1) The transfer provisions of Section 20.6.2.3111 NMAC do not apply to a discharge permit for a Class I non-hazardous waste injection well or Class III well.

(2) A Class I non-hazardous waste injection well or Class III well discharge permit may be transferred if:

(a) The secretary receives written notice 30 days prior to the transfer date; and

(b) The secretary does not object prior to the proposed transfer date. The secretary may require modification of the discharge permit as a condition of transfer, and may require demonstration of adequate financial responsibility.

(3) The written notice required by Subparagraph (b) of Paragraph (2) of Subsection I above shall:

(a) Have been signed by the discharger and the succeeding discharger, including an acknowledgement that the succeeding discharger shall be responsible for compliance with the discharge permit upon taking possession of the facility; and

(b) Set a specific date for transfer of discharge permit responsibility, coverage and liability; and

(c) Include information relating to the succeeding discharger's financial responsibility required by Paragraph (17) of Subsection B of Section 20.6.2.5210 NMAC.

I. Modification or Termination of a Discharge Permit for a Class I non-hazardous waste injection well or Class III well: If data submitted pursuant to any monitoring requirements specified in the discharge permit or other information available to the secretary indicate that this Part are being or may be violated, the secretary may require modification or, if it is determined by the secretary that the modification may not be adequate, may terminate a discharge permit for a Class I non-hazardous waste injection Well, or Class III well or well field, that was approved pursuant to the requirements of this under Sections 20.6.2.5000 through 20.6.2.5299 NMAC for the following causes:

(1) Noncompliance by the discharger with any condition of the discharge permit; or

(2) The discharger's failure in the discharge permit application or during the discharge permit review process to disclose fully all relevant facts, or the discharger's misrepresentation of any relevant facts at any time; or

(3) A determination that the permitted activity may cause a hazard to public health or undue risk to property and can only be regulated to acceptable levels by discharge permit modification or termination.

[9-20-82, 12-1-95, 11-15-96; 20.6.2.5101 NMAC – Rn, 20 NMAC 6.2.V.5101, 1-15-01; A, 12-1-01; A, 9-15-02]

**20.6.2.5102 PRE-CONSTRUCTION REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** Discharge Permit Requirement for Class I non-hazardous waste injection wells.

(1) Prior to construction of a Class I non-hazardous waste injection well or conversion of an existing well to a Class I non-hazardous waste injection well, an approved discharge permit is required that incorporates the requirements of Sections 20.6.2.5000 through 20.6.2.5299 NMAC, except Subsection C of Section 20.6.2.5210 NMAC. As a condition of discharge permit issuance, the operation of the Class I non-hazardous waste injection well under the discharge permit will not be authorized until the secretary has:

(a) Reviewed the information submitted for his consideration pursuant to Subsection C of Section 20.6.2.5210 NMAC, and

(b) Determined that the information submitted demonstrates that the operation will be in compliance with this Part and the discharge permit.

(2) If conditions encountered during construction represent a substantial change which could adversely impact ground water quality from those anticipated in the discharge permit, the secretary shall require a discharge permit modification or may terminate the discharge permit pursuant to Subsection I of Section 20.6.2.5101 NMAC, and the secretary shall publish public notice and allow for comments and hearing in accordance with Section 20.6.2.3108 NMAC.

**B.** Notification Requirement for Class III wells.

(1) The discharger shall notify the secretary in writing prior to the commencement of drilling or construction of wells which are expected to be used for in situ extraction, unless the discharger has previously received a discharge permit or project discharge permit for the Class III well operation.

(a) Any person, proposing to drill or construct a new Class III well or well field, or convert an existing well to a Class III well, shall file plans, specifications and pertinent documents regarding such construction or conversion, with the Ground Water Quality Bureau of the Environment Department.

(b) Plans, specifications, and pertinent documents required by this Section, if pertaining to geothermal installations, carbon dioxide facilities, or facilities for the exploration, production, refinement or pipeline transmission of oil and natural gas, shall be filed instead with the Oil Conservation Division.

(c) Plans, specifications and pertinent documents required to be filed under this Section must be filed 90 days prior to the planned commencement of construction or conversion.

(d) The following plans, specifications and pertinent documents shall be provided with the notification:

(i) Information required in Subsection C of Section 20.6.2.3106 NMAC;

(ii) A map showing the Class III wells which are to be constructed. The map must also show, in so far as is known or is reasonably available from the public records, the number, name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, mines (surface and

subsurface), quarries, water wells and other pertinent surface features, including residences and roads, that are within the expected area of review (Section 20.6.2.5202 NMAC) of the Class III well or well field perimeter;

(iii) Maps and cross-sections indicating the general vertical and lateral limits of all ground water having 10,000 mg/l or less TDS within one mile of the site, the position of such ground water within this area relative to the injection formation, and the direction of water movement, where known, in each zone of ground water which may be affected by the proposed injection operation;

(iv) Maps and cross-sections detailing the geology and geologic structure of the local area, including faults, if known or suspected;

(v) The proposed formation testing program to obtain an analysis or description, whichever the secretary requires, of the chemical, physical, and radiological characteristics of, and other information on, the receiving formation;

(vi) The proposed stimulation program;

(vii) The proposed injection procedure;

(viii) Schematic or other appropriate drawings of the surface and subsurface construction details of the well;

(ix) Proposed construction procedures, including a cementing and casing program, logging procedures, deviation checks, and a drilling, testing, and coring program;

(x) Information, as described in Paragraph (17) of Subsection B of Section 20.6.2.5210 NMAC, showing the ability of the discharger to undertake measures necessary to prevent groundwater contamination; and

(xi) A plugging and abandonment plan showing that the requirements of Subsections B, C and D of Section 20.6.2.5209 NMAC will be met.

(2) Prior to construction, the discharger shall have received written notice from the secretary that the information submitted under item 10 of Subparagraph (d) of Paragraph (1) of Subsection B of Section 20.6.2.5102 NMAC is acceptable. Within 30 days of submission of the above information the secretary shall notify the discharger that the information submitted is acceptable or unacceptable.

(3) Prior to construction, the secretary shall review said plans, specifications and pertinent documents and shall comment upon their adequacy of design for the intended purpose and their compliance with pertinent Sections of this Part. Review of plans, specifications and pertinent documents shall be based on the criteria contained in Section 20.6.2.5205, Subsection E of Section 20.6.2.5209, and Subparagraph (d) of Paragraph (1) of Subsection B of Section 20.6.2.5102 NMAC.

(4) Within thirty (30) days of receipt, the secretary shall issue public notice, consistent with Subsection B of Section 20.6.2.3108 NMAC, that notification was submitted pursuant to Subsection B of Section 20.6.2.5102 NMAC. The secretary shall allow a period of at least thirty (30) days during which comments may be submitted. The public notice shall include:

(a) Name and address of the proposed discharger;

(b) Location of the discharge;

(c) Brief description of the proposed activities;

(d) Statement of the public comment period; and

(e) Address and telephone number at which interested persons may obtain further information.

(5) The secretary shall comment in writing upon the plans and specifications within sixty (60) days of their receipt by the secretary.

(6) Within thirty (30) days after completion, the discharger shall submit written notice to the secretary that the construction or conversion was completed in accordance with submitted plans and specifications, or shall submit as-built plans detailing changes from the originally submitted plans and specifications.

(7) In the event a discharge permit application is not submitted or approved, all wells which may cause groundwater contamination shall be plugged and abandoned by the applicant pursuant to the plugging and abandonment plan submitted in the notification; these measures shall be consistent with any comments made by the secretary in his review. If the wells are not to be permanently abandoned and the discharger demonstrates that plugging at this time is unnecessary to prevent groundwater contamination, plugging pursuant to the notification is not required. Financial responsibility established pursuant to Sections 20.6.2.5000 through 20.6.2.5299 NMAC will remain in effect until the discharger permanently abandons and plugs the wells in accordance with the plugging and abandonment plan.

[9-20-82, 12-24-87, 12-1-95; 20.6.2.5102 NMAC – Rn, 20 NMAC 6.2.V.5102, 1-15-01; A, 12-1-01]

**20.6.2.5103 DESIGNATED AQUIFERS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** Any person may file a written petition with the secretary seeking commission consideration of certain aquifers or portions of aquifers as "designated aquifers". The purpose of aquifer designation is:

(1) For Class I non-hazardous waste injection wells, to allow as a result of injection, the addition of water contaminants into ground water, which before initiation of injection has a concentration between 5,000 and 10,000 mg/l TDS; or

(2) For Class III wells, to allow as a result of injection, the addition of water contaminants into ground water, which before initiation of injection has a concentration between 5,000 and 10,000 mg/l TDS, and not provide for restoration or complete restoration of that ground water pursuant to Paragraph (2) of Subsection C of Section 20.6.2.5101 NMAC.

**B.** The applicant shall identify (by narrative description, illustrations, maps or other means) and describe such aquifers, in geologic and/or geometric terms (such as vertical and lateral limits and gradient) which are clear and definite.

**C.** An aquifer or portion of an aquifer may be considered for aquifer designation under Subsection A. of this Section, if the applicant demonstrates that the following criteria are met:

(1) It is not currently used as a domestic or agricultural water supply; and

(2) There is no reasonable relationship between the economic and social costs of failure to designate and benefits to be obtained from its use as a domestic or agricultural water supply because:

(a) It is situated at a depth or location which makes recovery of water for drinking or agricultural purposes economically or technologically impractical at present and in the reasonably foreseeable future; or

(b) It is already so contaminated that it would be economically or technologically impractical to render that water fit for human consumption or agricultural use at present and in the reasonably foreseeable future.

**D.** The petition shall state the extent to which injection would add water contaminants to ground water and why the proposed aquifer designation should be approved. For Class III wells, the applicant shall state whether and to what extent restoration will be carried out.

**E.** The secretary shall either transmit the petition to the commission within sixty (60) days recommending that a public hearing be held, or refuse to transmit the petition and notify the applicant in writing citing reasons for such refusal.

**F.** If the secretary transmits the petition to the commission, the commission shall review the petition and determine to either grant or deny a public hearing on the petition. If the commission grants a public hearing, it shall issue a public notice, including the following information:

(1) Name and address of the applicant;

(2) Location, depth, TDS, areal extent, general description and common name or other identification of the aquifer for which designation is sought;

(3) Nature of injection and extent to which the injection will add water contaminants to ground water; and

(4) Address and telephone number at which interested persons may obtain further information.

**G.** If the secretary refuses to transmit the petition to the commission, then the applicant may appeal the secretary's disapproval of the proposed aquifer designation to the commission within thirty (30) days, and address the issue of whether the proposed aquifer designation meets the criteria of Subsections A, B, C, and D of this Section.

**H.** If the commission grants a public hearing, the hearing shall be held in accordance with the provisions of Section 74-6-6, NMSA 1978.

**I.** If the commission does not grant a public hearing on the petition, the aquifer designation shall not be approved.

**J.** After public hearing and consideration of all facts and circumstances included in Section 74-6-4(D), NMSA 1978, the commission may authorize the secretary to approve a proposed designated aquifer if the commission determines that the criteria of Subsection A, B, C, and D of this section are met.

**K.** Approval of a designated aquifer petition does not alleviate the applicant from complying with other Sections of Sections 20.6.2.5000 through 20.6.2.5299 NMAC, or of the responsibility for protection, pursuant to this part, of other nondesignated aquifers containing ground water having 10,000 mg/l or less TDS.

**L.** Persons other than the petitioner may add water contaminants as a result of injection into an aquifer designated for injection, provided the person receives a discharge permit pursuant to the requirements of

Sections 20.6.2.5000 through 20.6.2.5299 NMAC. Persons, other than the original petitioner or his designee, requesting addition of water contaminants as a result of injection into aquifers previously designated only for injection with partial restoration shall file a petition with the commission pursuant to the requirements of Subsections A, B, C, and D of this Section.
[9-20-82, 12-1-95; 20.6.2.5103 NMAC – Rn, 20 NMAC 6.2.V.5103, 1-15-01; A, 12-1-01]

**20.6.2.5104 WAIVER OF REQUIREMENT BY SECRETARY FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** Where a Class I non-hazardous waste injection well or a Class III well or well field, does not penetrate, or inject into or above, and which will not affect, ground water having 10,000 mg/l of less TDS, the secretary may:

(1) Issue a discharge permit for a well or well field with less stringent requirements for area of review, construction, mechanical integrity, operation, monitoring, and reporting than required by Sections 20.6.2.5000 through 20.6.2.5299 NMAC; or

(2) For Class III wells only, issue a discharge permit pursuant to the requirements of Sections 20.6.2.3000 through 20.6.2.3114 NMAC.

**B.** Authorization of a reduction in requirements under Subsection A of this Section shall be granted only if injection will not result in an increased risk of movement of fluids into ground water having 10,000 mg/l or less TDS, except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC.
[9-20-82, 12-1-95; 20.6.2.5104 NMAC – Rn & A, 20 NMAC 6.2.V.5104, 1-15-01; A, 12-1-01]

**20.6.2.5105 – 20.6.2.5199: [RESERVED]**
[12-1-95; 20.6.2.5105 – 20.6.2.5199 NMAC – Rn, 20 NMAC 6.2.V.5105-5199, 1-15-01]

**20.6.2.5200 TECHNICAL CRITERIA AND PERFORMANCE STANDARDS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**
[12-1-95; 20.6.2.5200 NMAC – Rn, 20 NMAC 6.2.V.5200, 1-15-01; A, 12-1-01]

**20.6.2.5201 PURPOSE:** Sections 20.6.2.5200 through 20.6.2.5210 NMAC provide the technical criteria and performance standards for Class I non-hazardous waste injection wells and Class III wells.
[9-20-82; 20.6.2.5201 NMAC – Rn, 20 NMAC 6.2.V.5201, 1-15-01; A, 12-1-01]

**20.6.2.5202 AREA OF REVIEW:**

**A.** The area of review is the area surrounding a Class I non-hazardous waste injection well or Class III well or the area within and surrounding a well field that is to be examined to identify possible fluid conduits, including the location of all known wells and fractures which may penetrate the injection zone.

**B.** The area of review for each Class I non-hazardous waste injection well, or each Class III well or well field shall be an area which extends:

(1) Two and one half (2 1/2) miles from the well, or well field; or

(2) One-quarter (1/4) mile from a well or well field where the area of review is calculated to be zero pursuant to Paragraph (3) of Subsection B below, or where the well field production at all times exceeds injection to produce a net withdrawal; or

(3) A suitable distance, not less than one-quarter (1/4) mile, proposed by the discharger and approved by the secretary, based upon a mathematical calculation to determine the area of review. Computations to determine the area of review may be based upon the parameters listed below and should be calculated for an injection time period equal to the expected life of the Class I non-hazardous waste injection well, or Class III well or well field. The following modified Theis equation illustrates one form which the mathematical model may take to compute the area of review; the discharger must demonstrate that any equation or simulation used to compute the area of review applies to the hydrogeologic conditions in the area of review.

$$r = \left( \frac{2.25 K H t}{S 10^{x}} \right)^{1/2}$$

Where:

$$x = \frac{4\square KH (H_w - H_{bo}) x \; S_p G_b}{2.3 \; Q}$$

r = Radius of the area of review for a Class I non-hazardous waste injection well or Class III well (length)

K = Hydraulic conductivity of the injection zone (length/time)

H = Thickness of the injection zone (length)

t = Time of injection (time)

S = Storage coefficient (dimensionless)

Q = Injection rate (volume/time)

$H_{bo}$ = Observed original hydrostatic head of injection zone (length) measured from the base of the lowest aquifer containing ground water of 10,000 mg/l or less TDS

$H_w$ = Hydrostatic head of underground source of drinking water (length) measured from the base of the lowest aquifer containing ground water of 10,000 mg/l or less TDS

$S_pG_b$ = Specific gravity of fluid in the injection zone (dimensionless)

$\square$ = 3.142 (dimensionless)

(4) The above equation is based on the following assumptions:

(a) The injection zone is homogenous and isotropic;

(b) The injection zone has infinite areal extent;

(c) The Class I non-hazardous waste injection well or Class III well penetrates the entire thickness of the injection zone;

(d) The well diameter is infinitesimal compared to "r" when injection time is longer than a few minutes; and

(e) The emplacement of fluid into the injection zone creates an instantaneous increase in pressure.

**C.** The secretary shall require submittal by the discharger of information regarding the area of review including the information to be considered by the secretary in Subsection B of Section 20.6.2.5210 NMAC.
[9-20-82, 12-1-95; 20.6.2.5202 NMAC – Rn, 20 NMAC 6.2.V.5202, 1-15-01; A, 12-1-01]

**20.6.2.5203 CORRECTIVE ACTION FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** Persons applying for approval of a Class I non-hazardous waste injection well, or a Class III well or well field shall identify the location of all known wells, drill holes, shafts, stopes and other conduits within the area of review which may penetrate the injection zone, in so far as is known or is reasonably available from the public records. For such wells or other conduits which are improperly sealed, completed, or abandoned, or otherwise provide a pathway for the migration of contaminants, the discharger shall address in the proposed discharge plan such steps or modifications (corrective action) as are necessary to prevent movement of fluids into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC.

**B.** Prior to operation, or continued operation of a well for which corrective action is required pursuant to Subsections A or D of Section 20.6.2.5203 NMAC, the discharger must demonstrate that:

(1) All required corrective action has been taken; or

(2) Injection pressure is to be limited so that pressure in the injection zone does not cause fluid movement through any well or other conduit within the area of review into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC. This pressure limitation may be removed after all required corrective action has been taken.

**C.** In determining the adequacy of corrective action proposed in the discharge permit application, the following factors will be considered by the secretary:

(1) Chemical nature and volume of the injected fluid;

(2) Chemical nature of native fluids and by-products of injection;

(3) Geology and hydrology;

(4) History of the injection and production operation;

(5) Completion and plugging records;

(6) Abandonment procedures in effect at the time a well, drill hole, or shaft was abandoned; and

(7) Hydraulic connections with waters having 10,000 mg/l or less TDS

**D.** In the event that, after approval for a Class I non-hazardous waste injection well or Class III well has been granted, additional information is submitted or it is discovered that a well or other conduit within the applicable area of review might allow movement of fluids into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC, the secretary may require action in accordance with Subsection I of Section 20.6.2.5101 and Subsection B Section 20.6.2.5203 NMAC.
[9-20-82, 12-1-95; 20.6.2.5203 NMAC – Rn, 20 NMAC 6.2.V.5203, 1-15-01; A, 12-1-01]

**20.6.2.5204 MECHANICAL INTEGRITY FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** A Class I non-hazardous waste injection well or Class III well has mechanical integrity if there is no detectable leak in the casing, tubing or packer which the secretary considers to be significant at maximum operating temperature and pressure; and no detectable conduit for fluid movement out of the injection zone through the well bore or vertical channels adjacent to the well bore which the secretary considers to be significant.

**B.** Prior to well injection and at least once every five years or more frequently as the secretary may require for good cause during the life of the well, the discharger must demonstrate that a Class I non-hazardous waste injection well or Class III well has mechanical integrity. The demonstration shall be made through use of the following tests:

(1) For evaluation of leaks,

(a) Monitoring of annulus pressure (after an initial pressure test with liquid or gas before operation commences), or

(b) Pressure test with liquid or gas;

(2) For determination of conduits for fluid movement,

(a) The results of a temperature or noise log, or

(b) Where the nature of the casing used for Class III wells precludes use of these logs, cementing records and an appropriate monitoring program as the secretary may require which will demonstrate the presence of adequate cement to prevent such movement;

(3) Other appropriate tests as the secretary may require.

**C.** The secretary may consider the use by the discharger of equivalent alternative test methods to determine mechanical integrity. The discharger shall submit information on the proposed test and all technical data supporting its use. The secretary may approve the request if it will reliably demonstrate the mechanical integrity of wells for which its use is proposed. For Class III wells this demonstration may be made by submission of adequate monitoring data after the initial mechanical integrity tests.

**D.** In conducting and evaluating the tests enumerated in this Section or others to be allowed by the secretary, the discharger and the secretary shall apply methods and standards generally accepted in the affected industry. When the discharger reports the results of mechanical integrity tests to the secretary, he shall include a description of the test(s), the method(s) used, and the test results. In making an evaluation, the secretary's review shall include monitoring and other test data submitted since the previous evaluation.

[9-20-82, 12-1-95; 20.6.2.5204 NMAC – Rn, 20 NMAC 6.2.V.5204, 1-15-01; A, 12-1-01]

**20.6.2.5205 CONSTRUCTION REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** General Construction Requirements Applicable to Class I non-hazardous waste injection wells and Class III wells.

(1) Construction of all Class I non-hazardous waste injection wells and all new Class III wells shall include casing and cementing. Prior to well injection, the discharger shall demonstrate that the construction and operation of:

(a) Class I non-hazardous waste injection wells will not cause or allow movement of fluids into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC;

(b) Class III wells will not cause or allow movement of fluids out of the injection zone into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC.

(2) The construction of each newly drilled well shall be designed for the proposed life expectancy of the well.

(3) In determining if the discharger has met the construction requirements of this Section and has demonstrated adequate construction, the secretary shall consider the following factors:

(a) Depth to the injection zone;

(b) Injection pressure, external pressure, annular pressure, axial loading, and other stresses that may cause well failure;

(c) Hole size;

(d) Size and grade of all casing strings, including wall thickness, diameter, nominal weight, length, joint specification, and construction material;

(e) Type and grade of cement;

(f) Rate, temperature, and volume of injected fluid;

(g) Chemical and physical characteristics of the injected fluid, including corrosiveness, density, and temperature;

(h) Chemical and physical characteristics of the formation fluids including pressure and temperature;

(i) Chemical and physical characteristics of the receiving formation and confining zones including lithology and stratigraphy, and fracture pressure; and

(j) Depth, thickness and chemical characteristics of penetrated formations which may contain ground water.

(4) To demonstrate adequate construction, appropriate logs and other tests shall be conducted during the drilling and construction of new Class I non-hazardous waste injection wells or Class III wells or during work-over of existing wells in preparation for reactivation or for change to injection use. A descriptive report interpreting the results of such logs and tests shall be prepared by a knowledgeable log analyst and submitted to the secretary for review prior to well injection. The logs and tests appropriate to each type of injection well shall be based on the intended function, depth, construction and other characteristics of the well, availability of similar data in the area of the drilling site and the need for additional information that may arise from time to time as the construction of the well progresses.

(a) The discharger shall demonstrate through use of sufficiently frequent deviation checks, or another equivalent method, that a Class I non-hazardous waste injection well or Class III well drilled using a pilot hole then enlarged by reaming or another method, does not allow a vertical avenue for fluid migration in the form of diverging holes created during drilling.

(b) The secretary may require use by the discharger of the following logs to assist in characterizing the formations penetrated and to demonstrate the integrity of the confining zones and the lack of vertical avenues for fluid migration:

(i) For casing intended to protect ground water having 10,000 mg/l or less TDS: Resistivity, spontaneous potential, and caliper logs before the casing is installed; and a cement bond, or temperature log after the casing is set and cemented.

(ii) For intermediate and long strings of casing intended to facilitate injection: Resistivity, spontaneous potential, porosity, and gamma ray logs before the casing is installed; and fracture finder or spectral logs; and a cement bond or temperature log after the casing is set and cemented.

(5) In addition to the requirements of Section 20.6.2.5102 NMAC, the discharger shall provide notice prior to commencement of drilling, cementing and casing, well logging, mechanical integrity tests, and any well work-over to allow opportunity for on-site inspection by the secretary or his representative.

**B.** Additional Construction Requirements for Class I non-hazardous waste injection wells.

(1) All Class I non-hazardous waste injection wells shall be sited in such a manner that they inject into a formation which is beneath the lowermost formation containing, within one quarter mile of the well bore, ground water having 10,000 mg/l TDS or less except as approved pursuant to Section 20.6.2.5103 NMAC.

(2) All Class I non-hazardous waste injection wells shall be cased and cemented by circulating cement to the surface.

(3) All Class I non-hazardous waste injection wells, except those municipal wells injecting noncorrosive wastes, shall inject fluids through tubing with a packer set in the annulus immediately above the injection zone, or tubing with an approved fluid seal as an alternative. The tubing, packer, and fluid seal shall be designed for the expected length of service.

(a) The use of other alternatives to a packer may be allowed with the written approval of the secretary. To obtain approval, the operator shall submit a written request to the secretary which shall set forth the proposed alternative and all technical data supporting its use. The secretary may approve the request if the alternative method will reliably provide a comparable level of protection to ground water. The secretary may approve an alternative method solely for an individual well or for general use.

(b) In determining the adequacy of the specifications proposed by the discharger for tubing and packer, or a packer alternative, the secretary shall consider the following factors:

(i) Depth of setting;

(ii) Characteristics of injection fluid (chemical nature or characteristics, corrosiveness, and density);

(iii) Injection pressure;

(iv) Annular pressure;

(v) Rate, temperature and volume of injected fluid; and

(vi) Size of casing.

**C.** Additional Construction Requirements for Class III wells.

(1) Where injection is into a formation containing ground water having 10,000 mg/l or less TDS, monitoring wells shall be completed into the injection zone and into the first formation above the injection zone containing ground water having 10,000 mg/l or less TDS which could be affected by the extraction operation. If ground water having 10,000 mg/l or less TDS below the injection zone could be affected by the extraction operation, monitoring of such ground water may be required. These wells shall be of sufficient number, located and constructed so as to detect any excursion of injection fluids, process byproducts, or formation fluids outside the extraction area or injection zone. The requirement for monitoring wells in aquifers designated pursuant to Section

20.6.2.5103 NMAC may be waived by the secretary, provided that the absence of monitoring wells does not result in an increased risk of movement of fluids into protected ground waters having 10,000 mg/l or less TDS.

(2) Where injection is into a formation which does not contain ground water having 10,000 mg/l or less TDS, no monitoring wells are necessary in the injection zone. However, monitoring wells may be necessary in adjoining zones with ground water having 10,000 mg/l or less TDS that could be affected by the extraction operation.

(3) In an area that the secretary determines is subject to subsidence or collapse, the required monitoring wells may be required to be located outside the physical influence of that area.

(4) In determining the adequacy of monitoring well location, number, construction and frequency of monitoring proposed by the discharger, the secretary shall consider the following factors:

(a) The local geology and hydrology;

(b) The operating pressures and whether a negative pressure gradient to the monitor well is being maintained;

(c) The nature and volume of injected fluid, formation water, and process by-products; and

(d) The number and spacing of Class III wells in the well field.

[9-20-82, 12-1-95; 20.6.2.5205 NMAC – Rn, 20 NMAC 6.2.V.5205, 1-15-01; A, 12-1-01]

**20.6.2.5206 OPERATING REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** General Operating Requirements Applicable to Class I non-hazardous waste injection wells and Class III wells.

(1) The maximum injection pressure at the wellhead shall not initiate new fractures or propagate existing fractures in the confining zone, or cause the movement of injection or formation fluids into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC.

(2) Injection between the outermost casing and the well bore is prohibited in a zone other than the authorized injection zone.

**B.** Additional Operating Requirements for Class I non-hazardous waste injection wells.

(1) Except during well stimulation, the maximum injection pressure shall not initiate new fractures or propagate existing fractures in the injection zone.

(2) Unless an alternative to a packer has been approved under Subparagraph (c) of Paragraph (3) of Subsection B of Section 20.6.2.5205 NMAC, the annulus between the tubing and the long string of casing shall be filled with a fluid approved by the secretary and a pressure, also approved by the secretary shall be maintained on the annulus.

**C.** Additional Operating Requirements for Class III wells: Initiation of new fractures or propagation of existing fractures in the injection zone will not be approved by the secretary as part of a discharge permit unless it is done during well stimulation and the discharger demonstrates:

(1) That such fracturing will not cause movement of fluids out of the injection zone into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC, and

(2) That the provisions of Subsection C of Section 20.6.2.3109 and Subsection C of Section 20.6.2.5101 NMAC for protection of ground water are met.

[9-20-82, 12-1-95; 20.6.2.5206 NMAC – Rn, 20 NMAC 6.2.V.5206, 1-15-01; A, 12-1-01]

**20.6.2.5207 MONITORING REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** The discharger shall demonstrate mechanical integrity for each Class I non-hazardous waste injection well or Class III well at least once every five years during the life of the well pursuant to Section 20.6.2.5204 NMAC.

**B.** Additional Monitoring Requirements for Class I non-hazardous waste injection wells.

(1) The discharger shall provide analysis of the injected fluids at least quarterly or, if necessary, more frequently to yield data representative of their characteristics.

(2) Continuous monitoring devices shall be used to provide a record of injection pressure, flow rate, flow volume, and pressure on the annulus between the tubing and the long string of casing.

(3) The discharger shall provide wells within the area of review as required by the discharge permit to be used by the discharger to monitor pressure in, and possible fluid movement into, ground water having 10,000 mg/l or less TDS except for such ground waters designated pursuant to Section 20.6.2.5103 NMAC. This Section

does not require monitoring wells for Class I non-hazardous waste injection wells unless monitoring wells are necessary due to possible flow paths within the area of review.

**C.** Additional Monitoring Requirements for Class III wells.

(1) The discharger shall provide an analysis or description, whichever the secretary requires, of the injected fluids at least quarterly or, if necessary, more frequently to yield representative data.

(2) The discharger shall perform:

(a) Appropriate monitoring of injected and produced fluid volumes by whichever of the following methods the secretary requires:

(i) Recording injection pressure and either flow rate or volume every two weeks; or

(ii) Metering and daily recording of fluid volumes;

(b) Monitoring every two weeks, or more frequently as the secretary determines, of the monitor wells, required in Subsection C of Section 20.6.2.5205 NMAC for:

(i) Water chemistry parameters used to detect any migration from the injection zone;

(ii) Fluid levels adjacent to the injection zone; and

(c) Other necessary monitoring as the secretary for good cause may require to detect movement of fluids from the injection zone into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC.

(3) With the approval of the secretary, all Class III wells may be monitored on a well field basis by manifold monitoring rather than on an individual well basis. Manifold monitoring to determine the quality, pressure, and flow rate of the injected fluid may be approved in cases of facilities consisting of more than one Class III well, operating with a common manifold, provided that the discharger demonstrates that manifold monitoring is comparable to individual well monitoring.

[9-20-82, 12-1-95; 20.6.2.5207 NMAC – Rn, 20 NMAC 6.2.V.5207, 1-15-01; A, 12-1-01]

**20.6.2.5208 REPORTING REQUIREMENTS FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** Reporting Requirements for Class I non-hazardous waste injection wells.

(1) If a Class I non-hazardous waste injection well is found to be discharging or is suspected of discharging fluids into a zone or zones other than the permitted or authorized injection zone, the discharger shall within 24 hours notify the secretary of the circumstances and action taken. The discharger shall provide subsequent written reports as required by the secretary.

(2) The discharger shall provide reports quarterly to the secretary on:

(a) The physical, chemical and other relevant characteristics of injection fluids;

(b) Monthly average, maximum and minimum values for injection pressure, flow rate and volume, and annular pressure; and

(c) The results of monitoring prescribed under Subsection B of Section 20.6.2.5207 NMAC.

(3) The discharger shall report, no later than the first quarterly report after completion, the results of:

(a) Periodic tests of mechanical integrity as required in Sections 20.6.2.5204 and 20.6.2.5207 NMAC;

(b) Any other test of the Class I non-hazardous waste injection well conducted by the discharger if required by the secretary;

(c) Any well work-over; and

(d) Any changes within the area of review which might impact subsurface conditions.

**B.** Reporting Requirements for Class III wells.

(1) The discharger shall notify the secretary within 48 hours of the detection or suspected detection of a leachate excursion, and provide subsequent reports as required by the secretary.

(2) The discharger shall provide to the secretary:

(a) Reports on required monitoring quarterly, or more frequently as required by the secretary; and

(b) Results of mechanical integrity testing as required in Sections 20.6.2.5204 and 20.6.2.5207 NMAC and any other periodic tests required by the secretary. These results are to be reported no later than the first regular report after the completion of the test.

(3) Where manifold monitoring is permitted, monitoring results may be reported on a well field basis, rather than individual well basis.

**C.** Report Signatory Requirements.

(1) All reports submitted pursuant to this Section shall be signed and certified as provided in Subsection G of Section 20.6.2.5101 NMAC, or by a duly authorized representative.

(2) For a person to be a duly authorized representative, authorization must:

(a) Be made in writing by a signatory described in Paragraph (1) of Subsection G of Section 20.6.2.5101 NMAC.;

(b) Specify either an individual or a position having responsibility for the overall operation of that regulated facility or activity, such as the position of plant manager, operator of a well or well field, superintendent, or position of equivalent responsibility; and

(c) Have been submitted to the secretary.

[9-20-82, 12-1-95; 20.6.2.5208 NMAC – Rn, 20 NMAC 6.2.V.5208, 1-15-01; A, 12-1-01]

**20.6.2.5209 PLUGGING AND ABANDONMENT FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** The discharger shall submit as part of the discharge permit application, a plan for plugging and abandonment of a Class I non-hazardous waste injection well or a Class III well that meets the requirements of Subsection C of Section 20.6.2.3109 and Subsection C of Section 20.6.2.5101 NMAC and 20.6.2.5005 NMAC for protection of ground water. If requested, a revised or updated abandonment plan shall be submitted for approval prior to closure. The obligation to implement the plugging and abandonment plan as well as the requirements of the plan survives the termination or expiration of the permit.

**B.** Prior to abandonment of a well used in a Class I non-hazardous waste injection well or Class III well operation, the well shall be plugged in a manner which will not allow the movement of fluids through the well bore out of the injection zone or between other zones of ground water. Cement plugs shall be used unless a comparable method has been approved by the secretary for the plugging of Class III wells at that site.

**C.** Prior to placement of the plugs, the well to be abandoned shall be in a state of static equilibrium with the mud weight equalized top to bottom, either by circulating the mud in the well at least once or by a comparable method approved by the secretary.

**D.** Placement of the plugs shall be accomplished by one of the following:

(1) The Balance Method; or

(2) The Dump Bailer Method; or

(3) The Two-Plug Method; or

(4) An equivalent method with the approval of the secretary.

**E.** The following shall be considered by the secretary in determining the adequacy of a plugging and abandonment plan.

(1) The type and number of plugs to be used;

(2) The placement of each plug, including the elevation of the top and bottom;

(3) The type, grade and quantity of cementing slurry to be used;

(4) The method of placement of the plugs;

(5) The procedure to be used to plug and abandon the well; and

(6) Such other factors that may affect the adequacy of the plan.

**F.** The discharger shall retain all records concerning the nature and composition of injected fluids until five years after completion of any plugging and abandonment procedures.

[9-20-82, 12-1-95; 20.6.2.5209 NMAC – Rn, 20 NMAC 6.2.V.5209, 1-15-01; A, 12-1-01]

**20.6.2.5210 INFORMATION TO BE CONSIDERED BY THE SECRETARY FOR CLASS I NON-HAZARDOUS WASTE INJECTION WELLS AND CLASS III WELLS:**

**A.** This Section sets forth the information to be considered by the secretary in authorizing construction and use of a Class I non-hazardous waste injection well or Class III well or well field. Certain maps, cross-sections, tabulations of all wells within the area of review, and other data may be included in the discharge permit application submittal by reference provided they are current, readily available to the secretary and sufficiently identified to be retrieved.

**B.** Prior to the issuance of a discharge permit or project discharge permit allowing construction of a new Class I non-hazardous waste injection well, operation of an existing Class I non-hazardous waste injection well, or operation of a new or existing Class III well or well field, or conversion of any well to injection use, the secretary shall consider the following:

(1) Information required in Subsection C of Section 20.6.2.3106 NMAC;

(2) A map showing the Class I non-hazardous waste injection well, or Class III well or well fields, for which approval is sought and the applicable area of review. Within the area of review, the map must show, in so far as is known or is reasonably available from the public records, the number, name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, mines (surface and subsurface), quarries, water wells and other pertinent surface features, including residences and roads;

(3) A tabulation of data on all wells within the area of review which may penetrate into the proposed injection zone. Such data shall include, as available, a description of each well's type, the distance and direction to the injection well or well field, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the secretary may require;

(4) For wells within the area of review which penetrate the injection zone, but are not properly completed or plugged, the corrective action proposed to be taken under Section 20.6.2.5203 NMAC;

(5) Maps and cross-sections indicating the general vertical and lateral limits of all ground water having 10,000 mg/l or less TDS within the area of review, the position of such ground water within the area of review relative to the injection formation, and the direction of water movement, where known, in each zone of ground water which may be affected by the proposed injection operation;

(6) Maps and cross-sections detailing the geology and geologic structure of the local area, including faults, if known or suspected;

(7) Generalized maps and cross-sections illustrating the regional geologic setting;

(8) Proposed operating data, including:

(a) Average and maximum daily flow rate and volume of the fluid to be injected;

(b) Average and maximum injection pressure;

(c) Source of injection fluids and an analysis or description, whichever the secretary requires, of their chemical, physical, radiological and biological characteristics;

(9) Results of the formation testing program to obtain an analysis or description, whichever the secretary requires, of the chemical, physical, and radiological characteristics of, and other information on, the receiving formation, provided that the secretary may issue a conditional approval of a discharge permit if he finds that further formation testing is necessary for final approval;

(10) Expected pressure changes, native fluid displacement, and direction of movement of the injected fluid;

(11) Proposed stimulation program;

(12) Proposed or actual injection procedure;

(13) Schematic or other appropriate drawings of the surface and subsurface construction details of the well;

(14) Construction procedures, including a cementing and casing program, logging procedures, deviation checks, and a drilling, testing, and coring program;

(15) Contingency plans to cope with all shut-ins or well failures so as to prevent movement of fluids into ground water having 10,000 mg/l or less TDS except for fluid movement approved pursuant to Section 20.6.2.5103 NMAC;

(16) Plans, including maps, for meeting the monitoring requirements of Section 20.6.2.5207 NMAC; and

(17) The ability of the discharger to undertake measures necessary to prevent contamination of ground water having 10,000 mg/l or less TDS after the cessation of operation, including the proper closing, plugging and abandonment of a well, ground water restoration if applicable, and any post-operational monitoring as may be needed. Methods by which the discharger shall demonstrate the ability to undertake these measures shall include submission of a surety bond or other adequate assurances, such as financial statements or other materials acceptable to the secretary, such as: (1) a surety bond; (2) a trust fund with a New Mexico bank in the name of the State of New Mexico, with the State as Beneficiary; (3) a non-renewable letter of credit made out to the State of New Mexico; (4) liability insurance specifically covering the contingencies listed in this paragraph; or (5) a performance bond, generally in conjunction with another type of financial assurance. Such bond or materials shall be approved and executed prior to discharge permit issuance and shall become effective upon commencement of construction. If an adequate bond is posted by the discharger to a federal or another state agency, and this bond covers all of the measures referred to above, the secretary shall consider this bond as satisfying the bonding requirements of Sections 20.6.2.5000 through 20.6.2.5299 NMAC wholly or in part, depending upon the extent to which such bond is adequate to ensure that the discharger will fully perform the measures required hereinabove.

**C.** Prior to the secretary's approval that allows the operation of a new or existing Class I non-hazardous waste injection well or Class III well or well field, the secretary shall consider the following:

(1) Update of pertinent information required under Subsection B of Section 20.6.2.5210 NMAC;
(2) All available logging and testing program data on the well;
(3) The demonstration of mechanical integrity pursuant to Section 20.6.2.5204 NMAC;
(4) The anticipated maximum pressure and flow rate at which the permittee will operate;
(5) The results of the formation testing program;
(6) The physical, chemical, and biological interactions between the injected fluids and fluids in the injection zone, and minerals in both the injection zone and the confining zone; and
(7) The status of corrective action on defective wells in the area of review.
[9-20-82, 12-24-87, 12-1-95; 20.6.2.5210 NMAC – Rn, 20 NMAC 6.2.V.5210, 1-15-01; A, 12-1-01]

**20.6.2.5211 – 20.6.2.5299: [RESERVED]**
[12-1-95; 20.6.2.5211 – 20.6.2.5299 NMAC – Rn, 20 NMAC 6.2.V.5211-5299, 1-15-01]

**HISTORY of 20.6.2. NMAC:**
**Pre-NMAC History:**
Material in this Part was derived from that previously filed with the commission of public records – state records center and archives:
WQC 67-2, Regulations Governing Water Pollution Control in New Mexico, filed 12-5-67, effective 1-4-68
WQC 72-1, Water Quality Control Commission Regulations, filed 8-4-72, effective 9-3-72
WQC 77-1, Amended Water Quality Control Commission Regulations, filed 1-18-77, effective 2-18-77
WQC 81-2, Water Quality Control Commission Regulations, filed 6-2-81, effective 7-2-81
WQC 82-1, Water Quality Control Commission Regulations, filed 8-19-82, effective 9-20-82

**History of Repealed Material: [Reserved]**

**Other History**:
20 NMAC 6.2, Water Quality – Ground and Surface Water Protection, filed 10-27-95, effective 12-1-95
20 NMAC 6.2, Water Quality – Ground and Surface Water Protection, filed 10-15-96, effective 11-15-96
20 NMAC 6.2, Water Quality – Ground and Surface Water Protection, filed 11-30-00, effective 1-15-01
20 NMAC 6.2, Water Quality – Ground and Surface Water Protection, filed 9-16-01, effective 12-1-01
20 NMAC 6.2, Water Quality – Ground and Surface Water Protection, filed 8-1-02, effective 9-15-02

**NEW MEXICO ENVIRONMENT DEPARTMENT TPH SCREENING GUIDELINES**
**June 24, 2003**

In some instances, it may be practical to assess areas of soil contamination that are the result of releases of petroleum products such as jet fuel and diesel, using total petroleum hydrocarbon (TPH) analyses. TPH results may be used to delineate the extent of petroleum-related contamination at these sites and ascertain if the residual level of petroleum products in soil represents an unacceptable risk to future users of the site. Petroleum hydrocarbons represent complex mixtures of compounds, some of which are regulated constituents and some compounds that are not regulated. In addition, the amount and types of the constituent compounds in a petroleum hydrocarbon release differ widely depending on what type of product was spilled and how the spill has weathered. This variability makes it difficult to determine the toxicity of weathered petroleum products in soil solely from TPH results; however, these results can be used to approximate risk in some cases, depending upon the nature of the petroleum product, the release scenario, how well the site has been characterized, and anticipated potential future land uses. In some cases, site clean up cannot be based solely on results of TPH sampling. NMED will make these determinations on a case by case basis, If NMED determines that additional data are necessary, then these TPH guidelines must be used in conjunction with the screening guidelines for individual petroleum-related contaminants in Table 3 and other contaminants, as applicable.

The screening levels for each petroleum carbon range from the Massachusetts Department of Environmental Protection (MADEP) Volatile Petroleum Hydrocarbons/Extractable Petroleum Hydrocarbons (VPH/EPH) approach and the percent composition table below were used to generate screening levels corresponding to total TPH. Except for waste oil, the information in the compositional assumptions table was obtained from Table 5-1 of the Massachusetts Department of Environmental Protection guidance document *Implementation of the MADEP VPH/EPH Approach Final Draft June 2001.* TPH toxicity was based only on the weighted sum of the toxicity of the hydrocarbon fractions listed in Table 1.

**Table 1: TPH Compositional Assumptions in Soil**

| Petroleum Product | C11-C22 Aromatics | C9-C18 Aliphatics | C19-C36 Aliphatics |
|---|---|---|---|
| Diesel #2/ new crankcase oil | 60% | 40% | 0% |
| #3 and #6 Fuel Oil | 70% | 30% | 0% |
| Kerosene and jet fuel | 30% | 70% | 0% |
| Mineral oil dielectric fluid | 20% | 40% | 40% |
| Unknown oil [a] | 100% | 0% | 0% |
| Waste Oil[b] | 0% | 0% | 100% |

[a] Sites with oil from unknown sources must be tested for VOCs, SVOCs, metals, and PCBs to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of

exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

[b] Compositional assumption for waste oil developed by NMED is based on review of chromatographs of several types of waste oil. Sites with waste oil must be tested for VOCs, SVOCs, metals, and PCBs to determine if other potentially toxic constituents are present. The TPH guidelines in Table 2 are not designed to be protective of exposure to these constituents therefore they must be tested for, and compared to, their individual NMED soil screening guidelines.

A TPH screening guideline was calculated for each of the types of petroleum product based on the assumed composition from the above table for petroleum products and the direct soil standards incorporating ceiling concentrations given in the MADEP VPH/EPH Excel spreadsheet for each of the carbon fractions. Ground water concentrations are based on the weighted sum of the noncarcinogenic toxicity of the petroleum fractions assuming the water is drinking water.

**Table 2: TPH Screening Guidelines**

| | TPH | | |
|---|---|---|---|
| Petroleum Product | Residential Direct Exposure (mg/kg) | Industrial Direct Exposure (mg/kg) | Concentration in Ground Water (mg/L) |
| Diesel #2/crankcase oil | 880 | 2200 | 1.8 |
| #3 and #6 Fuel Oil | 860 | 2150 | 1.4 |
| Kerosene and jet fuel | 940 | 2350 | 3.0 |
| Mineral oil dielectric fluid | 1560 | 3400 | 3.7 |
| Unknown oil [a] | 800 | 2000 | 2.3 |
| Waste Oil[b] | 2500 | 5000 | Petroleum-Related Contaminants |
| Gasoline | Not applicable | Not applicable | Petroleum-Related Contaminants |

Mineral oil based hydraulic fluids can be evaluated for petroleum fraction toxicity using the screening guidelines from Table 2 specified for waste oil, because this type of hydraulic fluid is composed of approximately the same range of carbon fractions as waste oil. However, these hydraulic fluids often contain proprietary additives that may be significantly more toxic than the oil itself; these additives must be considered on a site- and product-specific basis (see ATSDR hydraulic fluids profile reference). **Use of alternate screening guideline values requires prior written approval from the New Mexico Environment Department.** TPH screening guidelines in Table 2 must be used in conjunction with the screening levels for petroleum-related contaminants given in Table 3 because the TPH screening levels are NOT designed to be protective of exposure to these individual petroleum-related contaminants. Table 3 petroleum-related contaminants screening levels are based on the New Mexico Environment Department soil screening levels (NMED SSLs) released in December of 2000.

The list of petroleum-related contaminants does not include PAHs with individual screening levels that would exceed the total TPH screening levels (acenaphthene, anthracene, flouranthene, flourene, and pyrene). In addition, these TPH screening guidelines are based solely on human health, not ecological risk considerations, protection of surface water, or potential indoor air impacts from soil vapors. Potential soil vapor impacts to structures or utilities are not addressed by these guidelines. Site-specific investigations for potential soil vapor impacts to structures or utilities must be done to assure that screenings are consistently protective of human health, welfare or use of the property. NMED believes that use of these screening guidelines will allow more efficient screenings of petroleum release sites at sites while protecting human health and the environment. Copies of the references cited below are available on the MADEP website at http://www.state.ma.us/dep/bwsc/vph_eph.htm and the NMED website at http://www.nmenv.state.nm.us/HWB/guidance.html.

**Table 3. Petroleum-Related Contaminants Screening Guidelines**

| Petroleum-Related Contaminants | Values for Direct Exposure to Soil | | NMED DAF 20 GW protection (mg/kg in soil) | NMED DAF 1[f] GW protection (mg/kg in soil) |
|---|---|---|---|---|
| | NMED residential SSL (mg/kg) | NMED Indus. SSL (mg/kg) | | |
| Benzene | 6 | 14 | 0.06 | 0.003 |
| Toluene | 180 | 180 | 5 | 0.2 |
| Ethyl benzene | 68 | 68 | 8 | 0.4 |
| Xylene | 63 | 63 | 100 | 5 |
| Naphthalene | 53 | 180 | 0.2 | 0.01 |
| 2-methyl naphthalene | 1000[e] | 2500[e] | ---[e] | ---[e] |
| Benzo(a)anthracene | 6.2 | 26 | 40 | 2 |
| Benzo(b)fluoranthene | 6.2 | 26 | 20 | 0.8 |
| Benzo(k)fluoranthene | 62 | 260 | 200 | 8 |
| Benzo(a)pyrene | 0.62 | 2.6 | 100 | 6 |
| Chrysene | 610 | 2500 | 1000 | 50 |
| Dibenz(a,h) anthracene | 0.62 | 2.6 | 9 | 0.5 |
| Indeno(1,2,3-c,d) pyrene | 6.2 | 26 | 40 | 2 |

[e] no NMED value available, value taken from MADEP paper
[f] for contaminated soil in contact with ground water

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological Profile for Hydraulic fluids.

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards. 1994. "Background Documentation for the Development of the MCP Numerical Standards."

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup and Office of Research and Standards. 2001. "Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MADEP VPH/EPH Approach Final Draft June 2001."

New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program. 2000. "Technical Background Document for Development of Soil Screening Levels." Document # NMED-00-008.

# APPENDIX J

# EPA REGION 9 PRELIMINARY REMEDIATION GOALS

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 8.7E-03 | i | 4.0E-03 | i | 8.7E-03 | r | 4.0E-03 | r | 0 | | 30560-19-1 | | Acephate | 5.6E+01 | ca** | 2.8E+02 | ca* | 7.7E-01 | ca* | 7.7E+00 | ca* | | |
| | | | | 7.7E-03 | i | 2.6E-03 | i | 1 | | 75-07-0 | | Acetaldehyde | 1.1E+01 | ca** | 2.3E+01 | ca** | 8.7E-01 | ca* | 1.7E+00 | ca | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 34256-82-1 | | Acetochlor | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 1 | | 67-64-1 | | Acetone | 1.6E+03 | nc | 6.2E+03 | nc | 3.7E+02 | nc | 6.1E+02 | nc | 1.6E+01 | 8.0E-01 |
| | | 8.0E-04 | h | | | 8.0E-04 | r | 0 | 0.1 | 75-86-5 | | Acetone cyanohydrin | 4.9E+01 | nc | 7.0E+02 | nc | 2.9E+00 | nc | 2.9E+01 | nc | | |
| | | 6.0E-03 | x | | | 1.7E-02 | i | 1 | | 75-05-8 | | Acetonitrile | 2.7E+02 | nc | 1.7E+03 | nc | 6.2E+01 | nc | 7.9E+01 | nc | | |
| | | 1.0E-01 | i | | | 5.7E-06 | x | 1 | | 98-86-2 | | Acetophenone | 4.9E-01 | nc | 1.6E+00 | nc | 2.1E-02 | nc | 4.2E-02 | nc | | |
| 1.1E-01 | o | 1.3E-02 | i | 1.1E-01 | r | 1.3E-02 | r | 0 | 0.1 | 50594-66-6 | | Acifluorfen | 4.4E+00 | ca | 2.2E+01 | ca | 6.1E-02 | ca | 6.1E-01 | ca | | |
| | | 2.0E-02 | h | | | 5.7E-06 | i | 1 | | 107-02-8 | | Acrolein | 1.0E-01 | nc | 3.4E-01 | nc | 2.1E-02 | nc | 4.2E-02 | nc | | |
| 4.6E+00 | i | 2.0E-04 | i | 4.6E+00 | i | 2.0E-04 | r | 0 | 0.1 | 79-06-1 | | Acrylamide | 1.1E-01 | ca | 5.4E-01 | ca | 1.5E-03 | ca | 1.5E-02 | ca | | |
| | | 5.0E-01 | i | | | 2.9E-04 | i | 0 | 0.1 | 79-10-7 | | Acrylic acid | 2.9E+04 | nc | 1.0E+05 | max | 1.0E+00 | nc | 1.8E+04 | nc | | |
| 5.4E-01 | i | 1.0E-03 | h | 2.4E-01 | i | 5.7E-04 | i | 1 | | 107-13-1 | | Acrylonitrile | 2.1E-01 | ca* | 5.1E-01 | ca* | 2.8E-02 | ca* | 3.9E-02 | ca* | | |
| 8.1E-02 | h | 1.0E-02 | i | 8.0E-02 | r | 1.0E-02 | r | 0 | 0.1 | 15972-60-8 | | Alachlor | 6.0E+00 | ca | 3.1E+01 | ca | 8.4E-02 | ca | 8.4E-01 | ca | | |
| | | 1.5E-01 | i | | | 1.5E-01 | r | 0 | 0.1 | 1596-84-5 | | Alar | 9.2E+03 | nc | 1.0E+05 | max | 5.5E+02 | nc | 5.5E+03 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 116-06-3 | | Aldicarb | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 1646-88-4 | | Aldicarb sulfone | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| 1.7E+01 | i | 3.0E-05 | i | 1.7E+01 | i | 3.0E-05 | r | 0 | 0.1 | 309-00-2 | | Aldrin | 2.9E-02 | ca* | 1.5E-01 | ca | 3.9E-04 | ca | 4.0E-03 | ca | 5.0E-01 | 2.0E-02 |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 | 0.1 | 5585-64-8 | | Ally | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 107-18-6 | | Allyl alcohol | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 5.0E-02 | x | | | 2.9E-04 | i | 0 | 0.1 | 107-05-1 | | Allyl chloride | 3.0E+03 | nc | 4.3E+04 | nc | 1.0E+00 | nc | 1.8E+03 | nc | | |
| | | 1.0E+00 | n | | | 1.4E-03 | n | 0 | | 7429-90-5 | | Aluminum | 7.6E+04 | nc | 1.0E+05 | max | 5.1E+00 | nc | 3.6E+04 | nc | | |
| | | 4.0E-04 | i | | | | | 0 | | 20859-73-8 | | Aluminum phosphide | 3.1E+01 | nc | 8.2E+02 | nc | | | 1.5E+01 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | 67485-29-4 | | Amdro | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 9.0E-03 | i | | | 9.0E-03 | r | 0 | 0.1 | 834-12-8 | | Ametryn | 5.5E+02 | nc | 7.9E+03 | nc | 3.3E+01 | nc | 3.3E+02 | nc | | |
| | | 7.0E-02 | h | | | 7.0E-02 | r | 0 | 0.1 | 591-27-5 | | m-Aminophenol | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| | | 2.0E-05 | h | | | 2.0E-05 | r | 0 | 0.1 | 504-24-5 | | 4-Aminopyridine | 1.2E+00 | nc | 1.8E+01 | nc | 7.3E-02 | nc | 7.3E-01 | nc | | |
| | | 2.5E-03 | i | | | 2.5E-03 | r | 0 | 0.1 | 33089-61-1 | | Amitraz | 1.5E+02 | nc | 2.2E+03 | nc | 9.1E+00 | nc | 9.1E+01 | nc | | |
| | | | | | | 2.9E-02 | i | | | 7664-41-7 | | Ammonia | | | | | 1.0E+02 | nc | | | | |
| | | 2.0E-01 | i | | | | | 0 | 0.1 | 7773-06-0 | | Ammonium sulfamate | 1.2E+04 | nc | 1.0E+05 | max | | | 7.3E+03 | nc | | |
| 5.7E-03 | i | 7.0E-03 | n | 5.7E-03 | r | 2.9E-04 | i | 0 | 0.1 | 62-53-3 | | Aniline | 8.5E+01 | ca** | 4.3E+02 | ca* | 1.0E+00 | nc | 1.2E+01 | ca* | | |
| | | 4.0E-04 | i | | | | | 0 | | 7440-36-0 | | Antimony and compounds | 3.1E+01 | nc | 8.2E+02 | nc | | | 1.5E+01 | nc | 5.0E+00 | 3.0E-01 |
| | | 5.0E-04 | h | | | | | 0 | | 1314-60-9 | | Antimony pentoxide | 3.9E+01 | nc | 1.0E+03 | nc | | | 1.8E+01 | nc | | |
| | | 9.0E-04 | h | | | | | 0 | | 28300-74-5 | | Antimony potassium tartrate | 7.0E+01 | nc | 1.8E+03 | nc | | | 3.3E+01 | nc | | |
| | | 4.0E-04 | h | | | | | 0 | | 1332-81-6 | | Antimony tetroxide | 3.1E+01 | nc | 8.2E+02 | nc | | | 1.5E+01 | nc | | |
| | | 4.0E-04 | h | | | 5.7E-05 | i | 0 | | 1309-64-4 | | Antimony trioxide | 3.1E+01 | nc | 8.2E+02 | nc | 2.1E-01 | nc | 1.5E+01 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 74115-24-5 | | Apollo | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| 2.5E-02 | i | 5.0E-02 | h | 2.5E-02 | i | 5.0E-02 | r | 0 | 0.1 | 140-57-8 | | Aramite | 1.9E+01 | ca | 9.9E+01 | ca | 2.7E-01 | ca | 2.7E+00 | ca | | |
| | | 3.0E-04 | i | | | | | 0 | 0.03 | 7440-38-2 | | Arsenic (noncancer endpoint) | 2.2E+01 | nc | 4.4E+02 | nc | | | | | | |
| 1.5E+00 | i | 3.0E-04 | i | 1.5E+01 | i | | | 0 | 0.03 | 7440-38-2 | | Arsenic (cancer endpoint) | 3.9E-01 | ca* | 2.7E+00 | ca | 4.5E-04 | ca | 4.5E-02 | ca | 2.9E+01 | 1.0E+00 |
| | | | | | | 1.4E-05 | i | 0 | | 7784-42-1 | | Arsine (see arsenic for cancer endpoint) | | | | | 5.2E-02 | nc | | | | |
| | | 9.0E-03 | i | | | 9.0E-03 | r | | 0.1 | 76578-12-6 | | Assure | 5.5E+02 | nc | 7.9E+03 | nc | 3.3E+01 | nc | 3.3E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 3337-71-1 | | Asulam | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| 2.2E-01 | h | 3.5E-02 | h | 2.2E-01 | r | 3.5E-02 | r | 0 | 0.1 | 1912-24-9 | | Atrazine | 2.2E+00 | ca | 1.1E+01 | ca | 3.1E-02 | ca | 3.0E-01 | ca | | |
| | | 4.0E-04 | i | | | 4.0E-04 | r | 0 | 0.1 | 71751-41-2 | | Avermectin B1 | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| 1.1E-01 | i | | | 1.1E-01 | i | | | 0 | 0.1 | 103-33-3 | | Azobenzene | 4.4E+00 | ca | 2.2E+01 | ca | 6.2E-02 | ca | 6.1E-01 | ca | | |
| | | 7.0E-02 | i | | | 1.4E-04 | h | 0 | | 7440-39-3 | | Barium and compounds | 5.4E+03 | nc | 1.0E+05 | max | 5.2E-01 | nc | 2.6E+03 | nc | 1.6E+03 | 8.2E+01 |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 | 114-26-1 | | Baygon | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 43121-43-3 | | Bayleton | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 68359-37-5 | | Baythroid | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 3.0E-01 | i | | | 3.0E-01 | r | 0 | 0.1 | 1861-40-1 | | Benefin | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 17804-35-2 | | Benomyl | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 25057-89-0 | | Bentazon | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 100-52-7 | | Benzaldehyde | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| 5.5E-02 | i | 3.0E-03 | n | 2.7E-02 | i | 1.7E-03 | n | 1 | | 71-43-2 | | **Benzene** | 6.5E-01 | ca* | 1.5E+00 | ca* | 2.5E-01 | ca* | 3.5E-01 | ca* | 3.0E-02 | 2.0E-03 |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 2.3E+02 | i | 3.0E-03 | i | 2.3E+02 | i | 3.0E-03 | r | 0 | 0.1 | 92-87-5 | Benzidine | 2.1E-03 | ca | 1.1E-02 | ca | 2.9E-05 | ca | 2.9E-04 | ca | | |
| | | 4.0E+00 | i | | | 4.0E+00 | r | 0 | 0.1 | 65-85-0 | Benzoic acid | 1.0E+05 | max | 1.0E+05 | max | 1.5E+04 | nc | 1.5E+05 | nc | 4.0E+02 | 2.0E+01 |
| 1.3E+01 | i | | | 1.3E+01 | r | | | 0 | 0.1 | 98-07-7 | Benzotrichloride | 3.7E-02 | ca | 1.9E-01 | ca | 5.2E-04 | ca | 5.2E-03 | ca | | |
| | | 3.0E-01 | h | | | 3.0E-01 | r | 0 | 0.1 | 100-51-6 | Benzyl alcohol | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| 1.7E-01 | i | | | 1.7E-01 | r | | | 1 | | 100-44-7 | Benzyl chloride | 8.9E-01 | ca | 2.3E+00 | ca | 4.0E-02 | ca | 6.6E-02 | ca | | |
| | | 2.0E-03 | i | 8.4E+00 | i | 5.7E-06 | i | 0 | | 7440-41-7 | Beryllium and compounds | 1.5E+02 | nc | 2.2E+03 | ca** | 8.0E-04 | ca* | 7.3E+01 | nc | 6.3E+01 | 3.0E+00 |
| | | 1.0E-04 | i | | | 1.0E-04 | r | 0 | 0.1 | 141-66-2 | Bidrin | 6.1E+00 | nc | 8.8E+01 | nc | 3.7E-01 | nc | 3.6E+00 | nc | | |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 | 0.1 | 82657-04-3 | Biphenthrin (Talstar) | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 1 | | 92-52-4 | 1,1-Biphenyl | 3.5E+02 | sat | 3.5E+02 | sat | 1.8E+02 | nc | 3.0E+02 | nc | | |
| 1.1E+00 | i | | | 1.2E+00 | i | | | 1 | | 111-44-4 | Bis(2-chloroethyl)ether | 2.1E-01 | ca | 6.2E-01 | ca | 5.8E-03 | ca | 9.8E-03 | ca | 4.0E-04 | 2.0E-05 |
| 7.0E-02 | h | 4.0E-02 | i | 3.5E-02 | h | 4.0E-02 | r | 1 | | 108-60-1 | Bis(2-chloroisopropyl)ether | 2.9E+00 | ca | 8.1E+00 | ca | 1.9E-01 | ca | 2.7E-01 | ca | | |
| 2.2E+02 | i | | | 2.2E+02 | i | | | 1 | | 542-88-1 | Bis(chlorpmethyl)ether | 1.9E-04 | ca | 4.4E-04 | ca | 3.1E-05 | ca | 5.2E-05 | ca | | |
| 7.0E-02 | h | 4.0E-02 | i | 3.5E-02 | h | 4.0E-02 | r | 1 | | 108-60-1 | Bis(2-chloro-1-methylethyl)ether | 2.9E+00 | ca | 8.1E+00 | ca | 1.9E-01 | ca | 2.7E-01 | ca | | |
| 1.4E-02 | i | 2.0E-02 | i | 1.4E-02 | r | 2.2E-02 | r | 0 | 0.1 | 117-81-7 | Bis(2-ethylhexyl)phthalate (DEHP) | 3.5E+01 | ca* | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 80-05-7 | Bisphenol A | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 9.0E-02 | i | | | 5.7E-03 | h | 0 | 0.1 | 7440-42-8 | Boron | 5.5E+03 | nc | 7.9E+04 | nc | 2.1E+01 | nc | 3.3E+03 | nc | | |
| | | | | | | 2.0E-04 | h | 0 | 0.1 | 7637-07-2 | Boron trifluoride | | | | | 7.3E-01 | nc | | | | |
| | | 2.0E-02 | n | | | 2.9E-03 | n | 1 | | 108-86-1 | Bromobenzene | 2.8E+01 | nc | 9.2E+01 | nc | 1.0E+01 | nc | 2.0E+01 | nc | | |
| 6.2E-02 | i | 2.0E-02 | i | 6.2E-02 | r | 2.0E-02 | r | 1 | | 75-27-4 | Bromodichloromethane | 1.0E+00 | ca | 2.4E+00 | ca | 1.1E-01 | ca | 1.8E-01 | ca | 6.0E-01 | 3.0E-02 |
| 7.9E-03 | i | 2.0E-02 | i | 3.9E-03 | i | 2.0E-02 | r | 0 | 0.1 | 75-25-2 | Bromoform (tribromomethane) | 6.2E+01 | ca* | 3.1E+02 | ca* | 1.7E+00 | ca* | 8.5E+00 | ca* | 8.0E-01 | 4.0E-02 |
| | | 1.4E-03 | i | | | 1.4E-03 | i | 1 | | 74-83-9 | Bromomethane (Methyl bromide) | 3.9E+00 | nc | 1.3E+01 | nc | 5.2E+00 | nc | 8.7E+00 | nc | 2.0E-01 | 1.0E-02 |
| | | | | | | | | 0 | 0.1 | 101-55-3 | 4-Bromophenyl phenyl ether | | | | | | | | | | |
| | | 5.0E-03 | h | | | 5.0E-03 | r | 0 | 0.1 | 2104-96-3 | Bromophos | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 1689-84-5 | Bromoxynil | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 1689-99-2 | Bromoxynil octanoate | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| 1.8E+00 | r | | | 1.8E+00 | i | | | 1 | | 106-99-0 | 1,3-Butadiene | 3.5E-03 | ca | 7.6E-03 | ca | 3.7E-03 | ca | 6.2E-03 | ca | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 71-36-3 | 1-Butanol | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | 1.7E+01 | 9.0E-01 |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 2008-41-5 | Butylate | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | | 104-51-8 | n-Butylbenzene | 1.4E+02 | nc | 2.4E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | | 135-98-8 | sec-Butylbenzene | 1.1E+02 | nc | 2.2E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | | 98-06-6 | tert-Butylbenzene | 1.3E+02 | nc | 3.9E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | 85-68-7 | Butyl benzyl phthalate | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | 9.3E+02 | 8.1E+02 |
| | | 1.0E+00 | i | | | 1.0E+00 | r | 0 | 0.1 | 85-70-1 | Butylphthalyl butylglycolate | 6.1E+04 | nc | 1.0E+05 | max | 3.7E+03 | nc | 3.6E+04 | nc | | |
| | | 3.0E-03 | n | | | 3.0E-03 | r | 0 | 0.1 | 75-60-5 | Cacodylic acid | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 5.0E-04 | i | 6.3E+00 | i | | | 0 | 0.001 | 7440-43-9 | Cadmium and compounds | 3.7E+01 | nc | 8.1E+02 | nc | 1.1E-03 | ca | 1.8E+01 | nc | 8.0E+00 | 4.0E-01 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 9.0E+00 | | | | | | | | | |
| | | 5.0E-01 | i | | | 5.0E-01 | r | 0 | 0.1 | 105-60-2 | Caprolactam | 3.1E+04 | nc | 1.0E+05 | max | 1.8E+03 | nc | 1.8E+04 | nc | | |
| 8.6E-03 | h | 2.0E-03 | i | 8.6E-03 | r | 2.0E-03 | r | 0 | 0.1 | 2425-06-1 | Captafol | 5.7E+01 | ca** | 2.9E+02 | ca** | 7.8E-01 | ca** | 7.8E+00 | ca** | | |
| 3.5E-03 | h | 1.3E-01 | i | 3.5E-03 | r | 1.3E-01 | r | 0 | 0.1 | 133-06-2 | Captan | 1.4E+02 | ca* | 7.0E+02 | ca | 1.9E+00 | ca | 1.9E+01 | ca | | |
| | | 1.0E-01 | i | | | 1.1E-01 | r | 0 | 0.1 | 63-25-2 | Carbaryl | 6.1E+03 | nc | 8.8E+04 | nc | 4.0E+02 | nc | 3.6E+03 | nc | | |
| 2.0E-02 | h | | | 2.0E-02 | r | | | 0 | 0.1 | 86-74-8 | Carbazole | 2.4E+01 | ca | 1.2E+02 | ca | 3.4E-01 | ca | 3.4E+00 | ca | 6.0E-01 | 3.0E-02 |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 1563-66-2 | Carbofuran | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 1.0E-01 | i | | | 2.0E-01 | i | 1 | | 75-15-0 | Carbon disulfide | 3.6E+02 | nc | 7.2E+02 | sat | 7.3E+02 | nc | 1.0E+03 | nc | 3.2E+01 | 2.0E+00 |
| 1.3E-01 | i | 7.0E-04 | i | 5.3E-02 | i | 7.0E-04 | r | 1 | | 56-23-5 | Carbon tetrachloride | 2.4E-01 | ca** | 5.3E-01 | ca* | 1.3E-01 | ca* | 1.7E-01 | ca* | 7.0E-02 | 3.0E-03 |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 55285-14-8 | Carbosulfan | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 5234-68-4 | Carboxin | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 | 0.1 | 133-90-4 | Chloramben | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| 4.0E-01 | h | | | 4.0E-01 | r | | | 0 | 0.1 | 118-75-2 | Chloranil | 1.2E+00 | ca | 6.1E+00 | ca | 1.7E-02 | ca | 1.7E-01 | ca | | |
| 3.5E-01 | i | 5.0E-04 | i | 3.5E-01 | i | 2.0E-04 | i | 0 | 0.04 | 12789-03-6 | Chlordane | 1.6E+00 | ca* | 1.1E+01 | ca* | 1.9E-02 | ca* | 1.9E-01 | ca* | 1.0E+01 | 5.0E-01 |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 90982-32-4 | Chlorimuron-ethyl | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.0E-01 | i | | | 5.7E-05 | n | | | 7782-50-5 | **Chlorine** | | | | | 2.1E-01 | nc | | | | |
| | | | | | | 5.7E-05 | i | | | 10049-04-4 | Chlorine dioxide | | | | | 2.1E-01 | nc | | | | |
| | | | | | | | | 1 | | 107-20-0 | Chloroacetaldehyde | | | | | | | | | | |
| | | 2.0E-03 | h | | | 2.0E-03 | r | 0 | 0.1 | 79-11-8 | Chloroacetic acid | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 8.6E-06 | r | | | 8.6E-06 | i | 1 | | 532-27-4 | | 2-Chloroacetophenone | 3.3E-02 | nc | 1.1E-01 | nc | 3.1E-02 | nc | 5.2E-02 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 | 106-47-8 | | 4-Chloroaniline | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | 7.0E-01 | 3.0E-02 |
| | | 2.0E-02 | i | | | 1.7E-02 | n | 1 | | 108-90-7 | | Chlorobenzene | 1.5E+02 | nc | 5.4E+02 | nc | 6.2E+01 | nc | 1.1E+02 | nc | 1.0E+00 | 7.0E-02 |
| 2.7E-01 | h | 2.0E-02 | i | 2.7E-01 | h | 2.0E-02 | r | 0 | 0.1 | 510-15-6 | | Chlorobenzilate | 1.8E+00 | ca | 9.1E+00 | ca | 2.5E-02 | ca | 2.5E-01 | ca | | |
| | | 2.0E-01 | h | | | 2.0E-01 | r | 0 | 0.1 | 74-11-3 | | p-Chlorobenzoic acid | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 | 0.1 | 98-56-6 | | 4-Chlorobenzotrifluoride | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-03 | h | 1 | | 126-99-8 | | 2-Chloro-1,3-butadiene | 3.6E+00 | nc | 1.2E+01 | nc | 7.3E+00 | nc | 1.4E+01 | nc | | |
| | | 4.0E-01 | h | | | 4.0E-01 | r | 1 | | 109-69-3 | | 1-Chlorobutane | 4.8E+02 | sat | 4.8E+02 | sat | 1.5E+03 | nc | 2.4E+03 | nc | | |
| | | 1.4E+01 | r | | | 1.4E+01 | i | 1 | | 75-68-3 | | 1-Chloro-1,1-difluoroethane (HCFC-142b) | 3.4E+02 | sat | 3.4E+02 | sat | 5.2E+04 | nc | 8.7E+04 | nc | | |
| | | 1.4E+01 | r | | | 1.4E+01 | i | 1 | | 75-45-6 | | Chlorodifluoromethane | 3.4E+02 | sat | 3.4E+02 | sat | 5.1E+04 | nc | 8.5E+04 | nc | | |
| 2.9E-03 | n | 4.0E-01 | n | 2.9E-03 | r | 2.9E+00 | i | 1 | | 75-00-3 | | Chloroethane | 3.0E+00 | ca | 6.5E+00 | ca | 2.3E+00 | ca | 4.6E+00 | ca | | |
| | | | | | | | | 1 | | 110-75-8 | | 2-Chloroethyl vinyl ether | | | | | | | | | | |
| 6.1E-03 | i | 1.0E-02 | i | 8.1E-02 | i | 8.6E-05 | n | 1 | | 67-66-3 | | Chloroform | 2.4E-01 | ca** | 5.2E-01 | ca** | 8.4E-02 | ca** | 1.6E-01 | ca** | 6.0E-01 | 3.0E-02 |
| 1.3E-02 | h | | | 6.3E-03 | h | 8.6E-02 | n | 1 | | 74-87-3 | | Chloromethane | 1.2E+00 | ca | 2.7E+00 | ca | 1.1E+00 | ca | 1.5E+00 | ca | | |
| 5.8E-01 | h | | | 5.8E-01 | r | | | 0 | 0.1 | 95-69-2 | | 4-Chloro-2-methylaniline | 8.4E-01 | ca | 4.3E+00 | ca | 1.2E-02 | ca | 1.2E-01 | ca | | |
| 4.6E-01 | h | | | 4.6E-01 | r | | | 0 | 0.1 | 3165-93-3 | | 4-Chloro-2-methylaniline hydrochloride | 1.1E+00 | ca | 5.4E+00 | ca | 1.5E-02 | ca | 1.5E-01 | ca | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 1 | | 91-58-7 | | beta-Chloronaphthalene | 3.9E+03 | nc | 2.7E+04 | nc | 2.9E+02 | nc | 4.9E+02 | nc | | |
| 2.5E-02 | h | | | 2.5E-02 | r | | r | 1 | | 88-73-3 | | o-Chloronitrobenzene | 8.1E+00 | ca | 2.3E+01 | ca | 2.7E-01 | ca | 4.5E-01 | ca | | |
| 1.8E-02 | h | | | 1.8E-02 | r | | r | 1 | | 100-00-5 | | p-Chloronitrobenzene | 1.1E+01 | ca | 3.2E+01 | ca | 3.7E-01 | ca | 6.2E-01 | ca | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 1 | | 95-57-8 | | 2-Chlorophenol | 6.3E+01 | nc | 2.4E+02 | nc | 1.8E+01 | nc | 3.0E+01 | nc | 4.0E+00 | 2.0E-01 |
| | | 2.9E-02 | r | | | 2.9E-02 | h | 1 | | 75-29-6 | | 2-Chloropropane | 1.7E+02 | nc | 5.9E+02 | nc | 1.0E+02 | nc | 1.7E+02 | nc | | |
| 1.1E-02 | h | 1.5E-02 | i | 1.1E-02 | r | 1.5E-02 | r | 0 | 0.1 | 1897-45-6 | | Chlorothalonil | 4.4E+01 | ca* | 2.2E+02 | ca* | 6.1E-01 | ca* | 6.1E+00 | ca* | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 1 | | 95-49-8 | | o-Chlorotoluene | 1.6E+02 | nc | 5.7E+02 | nc | 7.3E+01 | nc | 1.2E+02 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | 101-21-3 | | Chlorpropham | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 2921-88-2 | | Chlorpyrifos | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 0 | 0.1 | 5598-13-0 | | Chlorpyrifos-methyl | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 64902-72-3 | | Chlorsulfuron | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 8.0E-04 | h | | | 8.0E-04 | r | 0 | 0.1 | 60238-56-4 | | Chlorthiophos | 4.9E+01 | nc | 7.0E+02 | nc | 2.9E+00 | nc | 2.9E+01 | nc | | |
| | | | | 4.2E+01 | i | | | 0 | | | | Total Chromium (1:6 ratio Cr VI:Cr III) | 2.1E+02 | ca | 4.5E+02 | ca | 1.6E-04 | ca | | | 3.8E+01 | 2.0E+00 |
| | | 1.5E+00 | i | | | | | | | 16065-83-1 | | Chromium III | 1.0E+05 | max | 1.0E+05 | max | 0.0E+00 | | 5.5E+04 | nc | | |
| | | 3.0E-03 | i | 2.9E+02 | i | | | 0 | | 18540-29-9 | | Chromium VI | 3.0E+01 | ca** | 6.4E+01 | ca | 2.3E-05 | ca | 1.1E+02 | nc | 3.8E+01 | 2.0E+00 |
| | | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 2.0E-01 | | | | | | 1.6E-01 | | | |
| | | 6.0E-02 | n | | | | | | | 7440-48-4 | | Cobalt | 4.7E+03 | nc | 1.0E+05 | max | | | 2.2E+03 | nc | | |
| | | | | 2.2E+00 | i | | | 0 | | 8007-45-2 | | Coke Oven Emissions | | | | | 3.1E-03 | ca | | | | |
| | | 3.7E-02 | h | | | | | 0 | | 7440-50-8 | | Copper and compounds | 2.9E+03 | nc | 7.6E+04 | nc | | | 1.4E+03 | nc | | |
| 1.9E+00 | h | | | 1.9E+00 | r | | | 1 | | 123-73-9 | | Crotonaldehyde | 5.3E-03 | ca | 1.1E-02 | ca | 3.5E-03 | ca | 5.9E-03 | ca | | |
| | | 1.0E-01 | i | | | 1.1E-01 | i | 1 | | 98-82-8 | | Cumene (isopropylbenzene) | 1.6E+02 | nc | 5.2E+02 | nc | 4.0E+02 | nc | 6.6E+02 | nc | | |
| 8.4E-01 | h | 2.0E-03 | h | 8.4E-01 | r | 2.0E-03 | r | 0 | 0.1 | 21725-46-2 | | Cyanazine | 5.8E-01 | ca | 2.9E+00 | ca | 8.0E-03 | ca | 8.0E-02 | ca | | |
| | | 2.0E-02 | i | | | 8.6E-04 | i | 1 | | 74-90-8 | | Cyanide and compounds | 1.1E+01 | nc | 3.5E+01 | nc | 3.1E+00 | nc | 6.2E+00 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 1 | | 460-19-5 | | Cyanogen | 1.3E+02 | nc | 4.3E+02 | nc | 1.5E+02 | nc | 2.4E+02 | nc | | |
| | | 9.0E-02 | i | | | 9.0E-02 | r | 1 | | 506-68-3 | | Cyanogen bromide | 2.9E+02 | nc | 9.7E+02 | nc | 3.3E+02 | nc | 5.5E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 1 | | 506-77-4 | | Cyanogen chloride | 1.6E+02 | nc | 5.4E+02 | nc | 1.8E+02 | nc | 3.0E+02 | nc | | |
| | | 5.7E+00 | r | | | 5.7E+00 | n | 1 | | 110-82-7 | | **Cyclohexane** | 1.4E+02 | sat | 1.4E+02 | sat | 2.1E+04 | nc | 3.5E+04 | nc | | |
| | | 5.0E+00 | i | | | 5.0E+00 | r | 0 | 0.1 | 108-94-1 | | Cyclohexanone | 1.0E+05 | max | 1.0E+05 | max | 1.8E+04 | nc | 1.8E+05 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | 108-91-8 | | Cyclohexylamine | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 68085-85-8 | | Cyhalothrin/Karate | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 52315-07-8 | | Cypermethrin | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 7.5E-03 | i | | | 7.5E-03 | r | 0 | 0.1 | 66215-27-8 | | Cyromazine | 4.6E+02 | nc | 6.6E+03 | nc | 2.7E+01 | nc | 2.7E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 1861-32-1 | | Dacthal | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 75-99-0 | | Dalapon | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 39515-41-8 | | Danitol | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| 2.4E-01 | i | | | 2.4E-01 | r | | | 0 | 0.03 | 72-54-8 | | DDD | 2.4E+00 | ca | 1.7E+01 | ca | 2.8E-02 | ca | 2.8E-01 | ca | 1.6E+01 | 8.0E-01 |
| 3.4E-01 | i | | | 3.4E-01 | r | | | 0 | 0.03 | 72-55-9 | | DDE | 1.7E+00 | ca | 1.2E+01 | ca | 2.0E-02 | ca | 2.0E-01 | ca | 5.4E+01 | 3.0E+00 |
| 3.4E-01 | i | 5.0E-04 | i | 3.4E-01 | i | 5.0E-04 | r | 0 | 0.03 | 50-29-3 | | DDT | 1.7E+00 | ca* | 1.2E+01 | ca* | 2.0E-02 | ca* | 2.0E-01 | ca* | 3.2E+01 | 2.0E+00 |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 1163-19-5 | | Decabromodiphenyl ether | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 4.0E-05 | i | | | 4.0E-05 | r | 0 | 0.1 | 8065-48-3 | | Demeton | 2.4E+00 | nc | 3.5E+01 | nc | 1.5E-01 | nc | 1.5E+00 | nc | | |
| 6.1E-02 | h | | | 6.1E-02 | r | | | 0 | 0.1 | 2303-16-4 | | Diallate | 8.0E+00 | ca | 4.0E+01 | ca | 1.1E-01 | ca | 1.1E+00 | ca | | |
| | | 9.0E-04 | h | | | 9.0E-04 | r | 0 | 0.1 | 333-41-5 | | Diazinon | 5.5E+01 | nc | 7.9E+02 | nc | 3.3E+00 | nc | 3.3E+01 | nc | | |
| | | 4.0E-03 | n | | | 4.0E-03 | r | 1 | | 132-64-9 | | Dibenzofuran | 2.9E+02 | nc | 5.1E+03 | nc | 1.5E+01 | nc | 2.4E+01 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 106-37-6 | | 1,4-Dibromobenzene | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 8.4E-02 | i | 2.0E-02 | i | 8.4E-02 | r | 2.0E-02 | r | 1 | | 124-48-1 | | Dibromochloromethane | 1.1E+00 | ca | 2.7E+00 | ca | 8.0E-02 | ca | 1.3E-01 | ca | 4.0E-01 | 2.0E-02 |
| 1.4E+00 | h | 5.7E-05 | r | 2.4E-03 | h | 5.7E-05 | i | 1 | | 96-12-8 | | 1,2-Dibromo-3-chloropropane | 4.5E-01 | ca** | 4.0E+00 | ca** | 2.1E-01 | nc | 4.8E-02 | ca** | | |
| | | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 6.0E-02 | | | | 9.6E-04 | | 4.7E-03 | | | |
| 8.5E+01 | i | 5.7E-05 | r | 7.7E-01 | i | 5.7E-05 | h | 1 | | 106-93-4 | | 1,2-Dibromoethane | 6.9E-03 | ca | 4.8E-02 | ca* | 8.7E-03 | ca* | 7.6E-04 | ca | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 84-74-2 | | Dibutyl phthalate | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | 2.3E+03 | 2.7E+02 |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 1918-00-9 | | Dicamba | | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 9.0E-02 | i | | | 5.7E-02 | h | 1 | | 95-50-1 | | 1,2-Dichlorobenzene | 3.7E+02 | sat | 3.7E+02 | sat | 2.1E+02 | nc | 3.7E+02 | nc | 1.7E+01 | 9.0E-01 |
| | | 9.0E-04 | n | | | 9.0E-04 | r | 1 | | 541-73-1 | | 1,3-Dichlorobenzene | 1.3E+01 | nc | 5.2E+01 | nc | 3.3E+00 | nc | 5.5E+00 | nc | | |
| 2.4E-02 | h | 3.0E-02 | n | 2.2E-02 | n | 2.3E-01 | i | 1 | | 106-46-7 | | 1,4-Dichlorobenzene | 3.4E+00 | ca | 8.1E+00 | ca | 3.1E-01 | ca | 5.0E-01 | ca | 2.0E+00 | 1.0E-01 |
| 4.5E-01 | i | | | 4.5E-01 | r | | | 0 | 0.1 | 91-94-1 | | 3,3-Dichlorobenzidine | 1.1E+00 | ca | 5.5E+00 | ca | 1.5E-02 | ca | 1.5E-01 | ca | 7.0E-03 | 3.0E-04 |
| | | 3.0E-02 | n | | | 3.0E-02 | r | | 0.1 | 90-98-2 | | **4,4'-Dichlorobenzophenone** | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 9.3E+00 | r | | | 9.3E+00 | h | | | 1 | | 764-41-0 | | 1,4-Dichloro-2-butene | 7.9E-03 | ca | 1.8E-02 | ca | 7.2E-04 | ca | 1.2E-03 | ca | | |
| | | 2.0E-01 | i | | | 5.7E-02 | h | 1 | | 75-71-8 | | Dichlorodifluoromethane | 9.4E+01 | nc | 3.1E+02 | nc | 2.1E+02 | nc | 3.9E+02 | nc | | |
| | | 1.0E-01 | h | | | 1.4E-01 | h | 1 | | 75-34-3 | | 1,1-Dichloroethane | 5.9E+02 | nc | 2.1E+03 | nc | 5.2E+02 | nc | 8.1E+02 | nc | 2.3E+01 | 1.0E+00 |
| 5.7E-03 | | | | 5.7E-03 | | | | 1 | | | | **"CAL-Modified PRG"** | 3.3E+00 | ca | 7.1E+00 | ca | 1.2E+00 | ca | 2.0E+00 | ca | | |
| 9.1E-02 | i | 3.0E-02 | n | 9.1E-02 | i | 1.4E-03 | n | 1 | | 107-06-2 | | 1,2-Dichloroethane (EDC) | 3.5E-01 | ca* | 7.6E-01 | ca* | 7.4E-02 | ca* | 1.2E-01 | ca* | 2.0E-02 | 1.0E-03 |
| 6.0E-01 | i | 9.0E-03 | i | 1.8E-01 | i | 9.0E-03 | r | 1 | | 75-35-4 | | 1,1-Dichloroethylene | 5.4E-02 | ca | 1.2E-01 | ca | 3.8E-02 | ca | 4.6E-02 | ca | 6.0E-02 | 3.0E-03 |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 156-59-2 | | 1,2-Dichloroethylene (cis) | 4.3E+01 | nc | 1.5E+02 | nc | 3.7E+01 | nc | 6.1E+01 | nc | 4.0E-01 | 2.0E-02 |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 1 | | 156-60-5 | | 1,2-Dichloroethylene (trans) | 6.3E+01 | nc | 2.1E+02 | nc | 7.3E+01 | nc | 1.2E+02 | nc | 7.0E-01 | 3.0E-02 |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 120-83-2 | | 2,4-Dichlorophenol | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | 1.0E+00 | 5.0E-02 |
| | | 8.0E-03 | i | | | 8.0E-03 | r | 0 | 0.1 | 94-82-6 | | 4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB) | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.05 | 94-75-7 | | 2,4-Dichlorophenoxyacetic Acid (2,4-D) | 6.9E+02 | nc | 1.2E+04 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 6.8E-02 | h | 1.1E-03 | r | 6.8E-02 | r | 1.1E-03 | i | 1 | | 78-87-5 | | 1,2-Dichloropropane | 3.5E-01 | ca* | 7.7E-01 | ca* | 9.9E-02 | ca* | 1.6E-01 | ca* | 3.0E-02 | 1.0E-03 |
| 1.0E-01 | i | 3.0E-02 | i | 1.4E-02 | i | 5.7E-03 | i | 1 | | 542-75-6 | | **1,3-Dichloropropene** | 7.0E-01 | ca | 1.6E+00 | ca | 4.8E-01 | ca | 4.0E-01 | ca | 4.0E-03 | 2.0E-04 |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 616-23-9 | | 2,3-Dichloropropanol | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| 2.9E-01 | i | 5.0E-04 | i | 2.9E-01 | r | 1.4E-04 | i | 0 | 0.1 | 62-73-7 | | Dichlorvos | 1.7E+00 | ca* | 8.5E+00 | ca* | 2.3E-02 | ca* | 2.3E-01 | ca* | | |
| 4.4E-01 | x | | | 4.4E-01 | r | | | 0 | 0.1 | 115-32-2 | | Dicofol | 1.1E+00 | ca | 5.6E+00 | ca | 1.5E-02 | ca | 1.5E-01 | ca | | |
| | | 3.0E-02 | h | | | 5.7E-05 | h | 1 | | 77-73-6 | | Dicyclopentadiene | 5.4E-01 | nc | 1.8E+00 | nc | 2.1E-01 | nc | 4.2E-01 | nc | | |
| 1.6E+01 | i | 5.0E-05 | i | 1.6E+01 | i | 5.0E-05 | r | 0 | 0.1 | 60-57-1 | | Dieldrin | 3.0E-02 | ca | 1.5E-01 | ca | 4.2E-04 | ca | 4.2E-03 | ca | 4.0E-03 | 2.0E-04 |
| | | 5.7E-03 | r | | | 5.7E-03 | h | 0 | 0.1 | 112-34-5 | | Diethylene glycol, monobutyl ether | 3.5E+02 | nc | 5.0E+03 | nc | 2.1E+01 | nc | 2.1E+02 | nc | | |
| | | 2.0E+00 | h | | | 2.0E+00 | r | 0 | 0.1 | 111-90-0 | | Diethylene glycol, monoethyl ether | 1.0E+05 | max | 1.0E+05 | max | 7.3E+03 | nc | 7.3E+04 | nc | | |
| | | 1.1E-02 | h | | | 1.1E-02 | r | 0 | 0.1 | 617-84-5 | | Diethylformamide | 6.7E+02 | nc | 9.7E+03 | nc | 4.0E+01 | nc | 4.0E+02 | nc | | |
| 1.2E-03 | i | 6.0E-01 | i | 1.2E-03 | r | 6.0E-01 | r | 0 | 0.1 | 103-23-1 | | Di(2-ethylhexyl)adipate | 4.1E+02 | ca | 2.1E+03 | ca | 5.6E+00 | ca | 5.6E+01 | ca | | |
| | | 8.0E-01 | i | | | 8.0E-01 | r | 0 | 0.1 | 84-66-2 | | Diethyl phthalate | 4.9E+04 | nc | 1.0E+05 | max | 2.9E+03 | nc | 2.9E+04 | nc | | |
| 4.7E+03 | h | | | 4.7E+03 | r | | | 0 | 0.1 | 56-53-1 | | Diethylstilbestrol | 1.0E-04 | ca | 5.2E-04 | ca | 1.4E-06 | ca | 1.4E-05 | ca | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | 43222-48-6 | | Difenzoquat (Avenge) | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 35367-38-5 | | Diflubenzuron | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.1E+01 | r | | | 1.1E+01 | i | 1 | | 75-37-6 | | 1,1-Difluoroethane | | | | | 4.2E+04 | nc | 6.9E+04 | nc | | |
| | | 2.0E-02 | n | | | 2.0E-02 | r | | 0.1 | 28553-12-0 | | **Diisononyl phthalate** | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | 1445-75-6 | | Diisopropyl methylphosphonate | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 55290-64-7 | | Dimethipin | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-04 | i | | | 2.0E-04 | r | 0 | 0.1 | 60-51-5 | | Dimethoate | 1.2E+01 | nc | 1.8E+02 | nc | 7.3E-01 | nc | 7.3E+00 | nc | | |
| 1.4E-02 | h | | | 1.4E-02 | r | | | 0 | 0.1 | 119-90-4 | | 3,3'-Dimethoxybenzidine | 3.5E+01 | ca | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 5.7E-06 | r | | | 5.7E-06 | x | 1 | | 124-40-3 | | Dimethylamine | 6.7E-02 | nc | 2.5E-01 | nc | 2.1E-02 | nc | 3.5E-02 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 121-69-7 | | N-N-Dimethylaniline | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| 7.5E-01 | h | | | 7.5E-01 | r | | | 0 | 0.1 | 95-68-1 | | 2,4-Dimethylaniline | 6.5E-01 | ca | 3.3E+00 | ca | 9.0E-03 | ca | 9.0E-02 | ca | | |
| 5.8E-01 | h | | | 5.8E-01 | r | | | 0 | 0.1 | 21436-96-4 | | 2,4-Dimethylaniline hydrochloride | 8.4E-01 | ca | 4.3E+00 | ca | 1.2E-02 | ca | 1.2E-01 | ca | | |
| 9.2E+00 | h | | | 9.2E+00 | r | | | 0 | 0.1 | 119-93-7 | | 3,3'-Dimethylbenzidine | 5.3E-02 | ca | 2.7E-01 | ca | 7.3E-04 | ca | 7.3E-03 | ca | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V C | skin O abs. C soils | CAS No. | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 2.6E+00 | x | | | 3.5E+00 | x | | | 0 | 0.1 | 57-14-7 | 1.9E-01 | ca | 9.5E-01 | ca | 1.9E-03 | ca | 2.6E-02 | ca | | |
| 3.7E+01 | x | | | 3.7E+01 | x | | | 0 | 0.1 | 540-73-8 | 1.3E-02 | ca | 6.7E-02 | ca | 1.8E-04 | ca | 1.8E-03 | ca | | |
| | | 1.0E-01 | h | | | 8.6E-03 | i | 0 | 0.1 | 68-12-2 | 6.1E+03 | nc | 8.8E+04 | nc | 3.1E+01 | nc | 3.6E+03 | nc | | |
| | | 1.0E-03 | n | | | 1.0E-03 | r | 0 | 0.1 | 122-09-8 | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 105-67-9 | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | 9.0E+00 | 4.0E-01 |
| | | 6.0E-04 | i | | | 6.0E-04 | r | 0 | 0.1 | 576-26-1 | 3.7E+01 | nc | 5.3E+02 | nc | 2.2E+00 | nc | 2.2E+01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 95-65-8 | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 1.0E+01 | x | | | 1.0E+01 | r | 0 | 0.1 | 131-11-3 | 1.0E+05 | max | 1.0E+05 | max | 3.7E+04 | nc | 3.6E+05 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 120-61-6 | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 131-89-5 | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 4.0E-04 | h | | | 4.0E-04 | r | 0 | 0.1 | 528-29-0 | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| | | 1.0E-04 | i | | | 1.0E-04 | r | 0 | 0.1 | 99-65-0 | 6.1E+00 | nc | 8.8E+01 | nc | 3.7E-01 | nc | 3.6E+00 | nc | | |
| | | 4.0E-04 | h | | | 4.0E-04 | r | 0 | 0.1 | 100-25-4 | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 51-28-5 | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | 3.0E-01 | 1.0E-02 |
| 6.8E-01 | i | | | 6.8E-01 | r | | | 0 | 0.1 | 25321-14-6 | 7.2E-01 | ca | 3.6E+00 | ca | 9.9E-03 | ca | 9.9E-02 | ca | 8.0E-04 | 4.0E-05 |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 121-14-2 | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | 8.0E-04 | 4.0E-05 |
| | | 1.0E-03 | h | | | 1.0E-03 | r | 0 | 0.1 | 606-20-2 | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | 7.0E-04 | 3.0E-05 |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 88-85-7 | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 | 0.1 | 117-84-0 | 1.2E+03 | nc | 1.0E+04 | sat | 7.3E+01 | nc | 7.3E+02 | nc | 1.0E+04 | 1.0E+04 |
| 1.1E-02 | i | | | 1.1E-02 | r | | | 0 | 0.1 | 123-91-1 | 4.4E+01 | ca | 2.2E+02 | ca | 6.1E-01 | ca | 6.1E+00 | ca | | |
| 1.5E+05 | h | | | 1.5E+05 | h | | | 0 | 0.03 | 1746-01-6 | 3.9E-06 | ca | 2.7E-05 | ca | 4.5E-08 | ca | 4.5E-07 | ca | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 957-51-7 | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 122-39-4 | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 3.0E-04 | n | | | 3.0E-04 | r | | 0.1 | 74-31-7 | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| 8.0E-01 | i | | | 7.7E-01 | i | | | 0 | 0.1 | 122-66-7 | 6.1E-01 | ca | 3.1E+00 | ca | 8.7E-03 | ca | 8.4E-02 | ca | | |
| | | 9.0E-03 | n | | | 9.0E-03 | r | 0 | 0.1 | 127-63-9 | 5.5E+02 | nc | 7.9E+03 | nc | 3.3E+01 | nc | 3.3E+02 | nc | | |
| | | 2.2E-03 | i | | | 2.2E-03 | r | 0 | 0.1 | 85-00-7 | 1.3E+02 | nc | 1.9E+03 | nc | 8.0E+00 | nc | 8.0E+01 | nc | | |
| 8.6E+00 | h | | | 8.6E+00 | r | | | 0 | 0.1 | 1937-37-7 | 5.7E-02 | ca | 2.9E-01 | ca | 7.8E-04 | ca | 7.8E-03 | ca | | |
| 8.1E+00 | h | | | 8.1E+00 | r | | | 0 | 0.1 | 2602-46-2 | 6.0E-02 | ca | 3.0E-01 | ca | 8.3E-04 | ca | 8.3E-03 | ca | | |
| 9.3E+00 | h | | | 9.3E+00 | r | | | 0 | 0.1 | 16071-86-6 | 5.2E-02 | ca | 2.7E-01 | ca | 7.2E-04 | ca | 7.2E-03 | ca | | |
| | | 4.0E-05 | i | | | 4.0E-05 | r | 0 | 0.1 | 298-04-4 | 2.4E+00 | nc | 3.5E+01 | nc | 1.5E-01 | nc | 1.5E+00 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 505-29-3 | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 330-54-1 | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 | 2439-10-3 | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 2.0E-01 | n | | | | | | | 7429-91-6 | 1.6E+04 | nc | 1.0E+05 | max | | | 7.3E+03 | nc | | |
| | | 6.0E-03 | i | | | 6.0E-03 | r | 0 | 0.1 | 115-29-7 | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | 1.8E+01 | 9.0E-01 |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 145-73-3 | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | 72-20-8 | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | 1.0E+00 | 5.0E-02 |
| 9.9E-03 | i | 2.0E-03 | h | 4.2E-03 | i | 2.9E-04 | i | 1 | | 106-89-8 | 7.6E+00 | nc | 2.6E+01 | nc | 1.0E+00 | nc | 2.0E+00 | nc | | |
| | | 5.7E-03 | r | | | 5.7E-03 | i | 0 | 0.1 | 106-88-7 | 3.5E+02 | nc | 5.0E+03 | nc | 2.1E+01 | nc | 2.1E+02 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 759-94-4 | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 16672-87-0 | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 | 0.1 | 563-12-2 | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| | | 4.0E-01 | h | | | 5.7E-02 | i | 0 | 0.1 | 110-80-5 | 2.4E+04 | nc | 1.0E+05 | max | 2.1E+02 | nc | 1.5E+04 | nc | | |
| | | 3.0E-01 | h | | | 3.0E-01 | r | 0 | 0.1 | 111-15-9 | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| | | 9.0E-01 | i | | | 9.0E-01 | r | 1 | | 141-78-6 | 1.9E+04 | nc | 3.7E+04 | sat | 3.3E+03 | nc | 5.5E+03 | nc | | |
| 4.8E-02 | h | | | 4.8E-02 | r | | | 1 | | 140-88-5 | 2.1E-01 | ca | 4.5E-01 | ca | 1.4E-01 | ca | 2.3E-01 | ca | | |
| | | 1.0E-01 | i | | | 2.9E-01 | i | 1 | | 100-41-4 | 2.3E+02 | sat | 2.3E+02 | sat | 1.1E+03 | nc | 1.3E+03 | nc | 1.3E+01 | 7.0E-01 |
| 2.9E-03 | n | 4.0E-01 | n | 2.9E-03 | r | 2.9E+00 | i | 1 | | 75-00-3 | 3.0E+00 | ca | 6.5E+00 | ca | 2.3E+00 | ca | 4.6E+00 | ca | | |
| | | 3.0E-01 | h | | | 3.0E-01 | r | 0 | 0.1 | 109-78-4 | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 | 0.1 | 107-15-3 | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E+00 | i | | | 2.0E+00 | r | 0 | 0.1 | 107-21-1 | 1.0E+05 | max | 1.0E+05 | max | 7.3E+03 | nc | 7.3E+04 | nc | | |
| | | 5.0E-01 | i | | | 3.7E+00 | i | 0 | 0.1 | 111-76-2 | 3.1E+04 | nc | 1.0E+05 | max | 1.4E+04 | nc | 1.8E+04 | nc | | |
| 1.0E+00 | h | | | 3.5E-01 | h | | | 1 | | 75-21-8 | 1.4E-01 | ca | 3.6E-01 | ca | 1.9E-02 | ca | 2.4E-02 | ca | | |

| CONTAMINANT |
|---|
| 1,1-Dimethylhydrazine |
| 1,2-Dimethylhydrazine |
| N,N-Dimethylformamide |
| Dimethylphenethylamine |
| 2,4-Dimethylphenol |
| 2,6-Dimethylphenol |
| 3,4-Dimethylphenol |
| Dimethyl phthalate |
| Dimethyl terephthalate |
| 4,6-Dinitro-o-cyclohexyl phenol |
| 1,2-Dinitrobenzene |
| 1,3-Dinitrobenzene |
| 1,4-Dinitrobenzene |
| 2,4-Dinitrophenol |
| Dinitrotoluene mixture |
| 2,4-Dinitrotoluene (see Dinitrotoluene mixture) |
| 2,6-Dinitrotoluene (see Dinitrotoluene mixture) |
| Dinoseb |
| di-n-Octyl phthalate |
| 1,4-Dioxane |
| Dioxin (2,3,7,8-TCDD) |
| Diphenamid |
| Diphenylamine |
| **N,N-Diphenyl-1,4 benzenediamine (DPPD)** |
| 1,2-Diphenylhydrazine |
| Diphenyl sulfone |
| Diquat |
| Direct black 38 |
| Direct blue 6 |
| Direct brown 95 |
| Disulfoton |
| 1,4-Dithiane |
| Diuron |
| Dodine |
| **Dysprosium** |
| Endosulfan |
| Endothall |
| Endrin |
| Epichlorohydrin |
| 1,2-Epoxybutane |
| EPTC (S-Ethyl dipropylthiocarbamate) |
| Ethephon (2-chloroethyl phosphonic acid) |
| Ethion |
| 2-Ethoxyethanol |
| 2-Ethoxyethanol acetate |
| Ethyl acetate |
| Ethyl acrylate |
| Ethylbenzene |
| Ethyl chloride |
| Ethylene cyanohydrin |
| Ethylene diamine |
| Ethylene glycol |
| **Ethylene glycol, monobutyl ether** |
| Ethylene oxide |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 1.1E-01 | h | 8.0E-05 | i | 1.1E-01 | r | 8.0E-05 | r | 0 | 0.1 | 96-45-7 | Ethylene thiourea (ETU) | 4.4E+00 | ca** | 2.2E+01 | ca** | 6.1E-02 | ca** | 6.1E-01 | ca** | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 1 | | 60-29-7 | Ethyl ether | 1.8E+03 | sat | 1.8E+03 | sat | 7.3E+02 | nc | 1.2E+03 | nc | | |
| | | 9.0E-02 | h | | | 9.0E-02 | r | 1 | | 97-63-2 | Ethyl methacrylate | 1.4E+02 | sat | 1.4E+02 | sat | 3.3E+02 | nc | 5.5E+02 | nc | | |
| | | 1.0E-05 | i | | | 1.0E-05 | r | 0 | 0.1 | 2104-64-5 | Ethyl p-nitrophenyl phenylphosphorothioate | 6.1E-01 | nc | 8.8E+00 | nc | 3.7E-02 | nc | 3.6E-01 | nc | | |
| | | 3.0E+00 | i | | | 3.0E+00 | r | 0 | 0.1 | 84-72-0 | Ethylphthalyl ethyl glycolate | 1.0E+05 | max | 1.0E+05 | max | 1.1E+04 | nc | 1.1E+05 | nc | | |
| | | 8.0E-03 | i | | | 8.0E-03 | r | 0 | 0.1 | 101200-48-0 | Express | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| | | 2.5E-04 | i | | | 2.5E-04 | r | 0 | 0.1 | 22224-92-6 | Fenamiphos | 1.5E+01 | nc | 2.2E+02 | nc | 9.1E-01 | nc | 9.1E+00 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 2164-17-2 | Fluometuron | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 6.0E-02 | i | | | | | 0 | 0.1 | 16984-48-8 | Flouride | 3.7E+03 | nc | 5.3E+04 | nc | | | 2.2E+03 | nc | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | 59756-60-4 | Fluoridone | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 56425-91-3 | Flurprimidol | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 6.0E-02 | i | | | 6.0E-02 | r | 0 | 0.1 | 66332-96-5 | Flutolanil | 3.7E+03 | nc | 5.3E+04 | nc | 2.2E+02 | nc | 2.2E+03 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 69409-94-5 | Fluvalinate | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 3.5E-03 | i | 1.0E-01 | i | 3.5E-03 | r | 1.0E-01 | r | 0 | 0.1 | 133-07-3 | Folpet | 1.4E+02 | ca* | 7.0E+02 | ca | 1.9E+00 | ca | 1.9E+01 | ca | | |
| 1.9E-01 | i | | | 1.9E-01 | r | | | 0 | 0.1 | 72178-02-0 | Fomesafen | 2.6E+00 | ca | 1.3E+01 | ca | 3.5E-02 | ca | 3.5E-01 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 944-22-9 | Fonofos | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 1.5E-01 | i | 4.6E-02 | i | | | 0 | 0.1 | 50-00-0 | Formaldehyde | 9.2E+03 | nc | 1.0E+05 | nc | 1.5E-01 | ca | 5.5E+03 | nc | | |
| | | 2.0E+00 | h | | | 2.0E+00 | r | 0 | 0.1 | 64-18-6 | Formic Acid | 1.0E+05 | max | 1.0E+05 | max | 7.3E+03 | nc | 7.3E+04 | nc | | |
| | | 3.0E+00 | i | | | 3.0E+00 | r | 0 | 0.1 | 39148-24-8 | Fosetyl-al | 1.0E+05 | max | 1.0E+05 | max | 1.1E+04 | nc | 1.1E+05 | nc | | |
| | | 3.0E+01 | i | | | 8.6E+00 | h | 1 | | 76-13-1 | Freon 113 | 5.6E+03 | sat | 5.6E+03 | sat | 3.1E+04 | nc | 5.9E+04 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 1 | | 110-00-9 | Furan | 2.5E+00 | nc | 8.5E+00 | nc | 3.7E+00 | nc | 6.1E+00 | nc | | |
| 3.8E+00 | h | | | 3.8E+00 | r | | | 0 | 0.1 | 67-45-8 | Furazolidone | 1.3E-01 | nc | 6.5E-01 | nc | 1.8E-03 | nc | 1.8E-02 | ca | | |
| | | 3.0E-03 | i | | | 1.4E-02 | h | 0 | 0.1 | 98-01-1 | Furfural | 1.8E+02 | nc | 2.6E+03 | nc | 5.2E+01 | nc | 1.1E+02 | nc | | |
| 5.0E+01 | h | | | 5.0E+01 | r | | | 0 | 0.1 | 531-82-8 | Furium | 9.7E-03 | ca | 4.9E-02 | ca | 1.3E-04 | ca | 1.3E-03 | ca | | |
| 3.0E-02 | i | | | 3.0E-02 | r | | | 0 | 0.1 | 60568-05-0 | Furmecyclox | 1.6E+01 | ca | 8.2E+01 | ca | 2.2E-01 | ca | 2.2E+00 | ca | | |
| | | 4.0E-04 | i | | | 4.0E-04 | r | 0 | 0.1 | 77182-82-2 | Glufosinate-ammonium | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| | | 4.0E-04 | i | | | 2.9E-04 | h | 0 | 0.1 | 765-34-4 | Glycidaldehyde | 2.4E+01 | nc | 3.5E+02 | nc | 1.0E+00 | nc | 1.5E+01 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 1071-83-6 | Glyphosate | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 5.0E-05 | i | | | 5.0E-05 | r | 0 | 0.1 | 69806-40-2 | Haloxyfop-methyl | 3.1E+00 | nc | 4.4E+01 | nc | 1.8E-01 | nc | 1.8E+00 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 79277-27-3 | Harmony | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| 4.5E+00 | i | 5.0E-04 | i | 4.6E+00 | i | 5.0E-04 | r | 0 | 0.1 | 76-44-8 | Heptachlor | 1.1E-01 | ca | 5.5E-01 | ca | 1.5E-03 | ca | 1.5E-02 | ca | 2.3E+01 | 1.0E+00 |
| 9.1E+00 | i | 1.3E-05 | i | 9.1E+00 | i | 1.3E-05 | r | 0 | 0.1 | 1024-57-3 | Heptachlor epoxide | 5.3E-02 | ca* | 2.7E-01 | ca* | 7.4E-04 | ca* | 7.4E-03 | ca* | 7.0E-01 | 3.0E-02 |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 87-82-1 | Hexabromobenzene | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| 1.6E+00 | i | 8.0E-04 | i | 1.6E+00 | i | 8.0E-04 | r | 0 | 0.1 | 118-74-1 | Hexachlorobenzene | 3.0E-01 | ca | 1.5E+00 | ca | 4.2E-03 | ca | 4.2E-02 | ca | 2.0E+00 | 1.0E-01 |
| 7.8E-02 | i | 3.0E-04 | n | 7.8E-02 | i | 3.0E-04 | r | 0 | 0.1 | 87-68-3 | **Hexachlorobutadiene** | 6.2E+00 | ca** | 3.2E+01 | ca** | 8.6E-02 | ca* | 8.6E-01 | ca* | 2.0E+00 | 1.0E-01 |
| 6.3E+00 | i | | | 6.3E+00 | i | | | 0 | 0.04 | 319-84-6 | HCH (alpha) | 9.0E-02 | ca | 5.9E-01 | ca | 1.1E-03 | ca | 1.1E-02 | ca | 5.0E-04 | 3.0E-05 |
| 1.8E+00 | i | | | 1.8E+00 | i | | | 0 | 0.04 | 319-85-7 | HCH (beta) | 3.2E-01 | ca | 2.1E+00 | ca | 3.7E-03 | ca | 3.7E-02 | ca | 3.0E-03 | 1.0E-04 |
| 1.3E+00 | h | 3.0E-04 | i | 1.3E+00 | r | 3.0E-04 | r | 0 | 0.04 | 58-89-9 | HCH (gamma) Lindane | 4.4E-01 | ca* | 2.9E+00 | ca | 5.2E-03 | ca | 5.2E-02 | ca | 9.0E-03 | 5.0E-04 |
| 1.8E+00 | i | | | 1.8E+00 | i | | | 0 | 0.04 | 608-73-1 | HCH-technical | 3.2E-01 | ca | 2.1E+00 | ca | 3.8E-03 | ca | 3.7E-02 | ca | 3.0E-03 | 1.0E-04 |
| | | 7.0E-03 | i | | | 2.0E-05 | h | 0 | 0.1 | 77-47-4 | Hexachlorocyclopentadiene | 4.2E+02 | nc | 5.9E+03 | nc | 7.3E-02 | nc | 2.6E+02 | nc | 4.0E+02 | 2.0E+01 |
| 6.2E+03 | i | | | 4.6E+03 | i | | | 0 | 0.1 | 19408-74-3 | Hexachlorodibenzo-p-dioxin mixture (HxCDD) | 7.8E-05 | ca | 4.0E-04 | ca | 1.5E-06 | ca | 1.1E-05 | ca | | |
| 1.4E-02 | i | 1.0E-03 | i | 1.4E-02 | i | 1.0E-03 | r | 0 | 0.1 | 67-72-1 | Hexachloroethane | 3.5E+01 | ca** | 1.8E+02 | ca** | 4.8E-01 | ca** | 4.8E+00 | ca** | 5.0E-01 | 2.0E-02 |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | 70-30-4 | Hexachlorophene | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| 1.1E-01 | i | 3.0E-03 | i | 1.1E-01 | r | 3.0E-03 | r | 0 | 0.1 | 121-82-4 | Hexahydro-1,3,5-trinitro-1,3,5-triazine | 4.4E+00 | ca* | 2.2E+01 | ca | 6.1E-02 | ca | 6.1E-01 | ca | | |
| | | 2.9E-06 | i | | | 2.9E-06 | i | 0 | 0.1 | 822-06-0 | 1,6-Hexamethylene diisocyanate | 1.7E-01 | nc | 2.5E+00 | nc | 1.0E-02 | nc | 1.0E-01 | nc | | |
| | | 6.0E-02 | h | | | 5.7E-02 | i | 1 | | 110-54-3 | n-Hexane | 1.1E+02 | sat | 1.1E+02 | sat | 2.1E+02 | nc | 3.5E+02 | nc | | |
| | | 3.3E-02 | i | | | 3.3E-02 | r | 0 | 0.1 | 51235-04-2 | Hexazinone | 2.0E+03 | nc | 2.9E+04 | nc | 1.2E+02 | nc | 1.2E+03 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 2691-41-0 | HMX | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| 3.0E+00 | i | | | 1.7E+01 | i | | | 0 | 0.1 | 302-01-2 | Hydrazine, hydrazine sulfate | 1.6E-01 | ca | 8.2E-01 | ca | 3.9E-04 | ca | 2.2E-02 | ca | | |
| 3.0E+00 | n | | | 1.7E+01 | n | | | | 0.1 | 60-34-4 | **Hydrazine, monomethyl** | 1.6E-01 | ca | 8.2E-01 | ca | 4.0E-04 | ca | 2.2E-02 | ca | | |
| 3.0E+00 | n | | | 1.7E+01 | n | | | | 0.1 | 57-14-7 | **Hydrazine, dimethyl** | 1.6E-01 | ca | 8.2E-01 | ca | 4.0E-04 | ca | 2.2E-02 | ca | | |
| | | | | | | 5.7E-03 | i | | | 7647-01-0 | Hydrogen chloride | | | | | 2.1E+01 | nc | | | | |
| | | 3.0E-03 | i | | | 2.9E-04 | i | | | 7783-06-4 | Hydrogen sulfide | | | | | 1.0E+00 | nc | 1.1E+02 | nc | | |
| | | 4.0E-02 | h | | | 4.0E-02 | r | 0 | 0.1 | 123-31-9 | p-Hydroquinone | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Migration to Ground Water | |
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | | 35554-44-0 | Imazalil | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 | 0.1 | | 81335-37-7 | Imazaquin | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 | 0.1 | | 36734-19-7 | Iprodione | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |
| | | 3.0E-01 | n | | | | | 0 | | | 7439-89-6 | Iron | 2.3E+04 | nc | 1.0E+05 | max | | | 1.1E+04 | nc | | |
| | | 3.0E-01 | i | | | 3.0E-01 | r | 1 | | | 78-83-1 | Isobutanol | 1.3E+04 | nc | 4.0E+04 | sat | 1.1E+03 | nc | 1.8E+03 | nc | | |
| 9.5E-04 | i | 2.0E-01 | i | 9.5E-04 | r | 2.0E-01 | r | 0 | 0.1 | | 78-59-1 | Isophorone | 5.1E+02 | ca* | 2.6E+03 | ca* | 7.1E+00 | ca | 7.1E+01 | ca | 5.0E-01 | 3.0E-02 |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 | 0.1 | | 33820-53-0 | Isopropalin | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.1E-01 | r | 0 | 0.1 | | 1832-54-8 | Isopropyl methyl phosphonic acid | 6.1E+03 | nc | 8.8E+04 | nc | 4.0E+02 | nc | 3.6E+03 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | | 82558-50-7 | Isoxaben | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| 1.8E+01 | n | | | 1.8E+01 | r | | | 0 | 0.1 | | 143-50-0 | Kepone | 2.7E-02 | ca | 1.4E-01 | ca | 3.7E-04 | ca | 3.7E-03 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | | 77501-63-4 | Lactofen | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| PRGs Based on EPA Models (IEUBK 1994 and TRW 1996) | | | | | | | | | | | 7439-92-1 | **Lead** | 4.0E+02 | nc | 7.5E+02 | nc | | | | | | |
| | | 1.0E-07 | i | | | | | 0 | 0.1 | | 78-00-2 | Lead (tetraethyl) | 6.1E-03 | nc | 8.8E-02 | nc | | | 3.6E-03 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | | 330-55-2 | Linuron | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 2.0E-02 | x | | | | | 0 | | | 7439-93-2 | Lithium | 1.6E+03 | nc | 4.1E+04 | nc | | | 7.3E+02 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | | 83055-99-6 | Londax | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | | 121-75-5 | Malathion | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | | 108-31-6 | Maleic anhydride | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 5.0E-01 | i | | | 5.0E-01 | r | 1 | | | 123-33-1 | Maleic hydrazide | 1.7E+03 | nc | 2.4E+03 | sat | 1.8E+03 | nc | 3.0E+03 | nc | | |
| | | 2.0E-05 | h | | | 2.0E-05 | r | 0 | 0.1 | | 109-77-3 | Malononitrile | 1.2E+00 | nc | 1.8E+01 | nc | 7.3E-02 | nc | 7.3E-01 | nc | | |
| | | 3.0E-02 | h | | | 3.0E-02 | r | 0 | 0.1 | | 8018-01-7 | Mancozeb | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 6.0E-02 | o | 5.0E-03 | i | 6.0E-02 | r | 5.0E-03 | r | 0 | 0.1 | | 12427-38-2 | Maneb | 8.1E+00 | ca* | 4.1E+01 | ca | 1.1E-01 | ca | 1.1E+00 | ca | | |
| | | 2.4E-02 | i | | | 1.4E-05 | i | 0 | | | 7439-96-5 | Manganese and compounds | 1.8E+03 | nc | 3.2E+04 | nc | 5.1E-02 | nc | 8.8E+02 | nc | | |
| | | 9.0E-05 | h | | | 9.0E-05 | r | 0 | 0.1 | | 950-10-7 | Mephosfolan | 5.5E+00 | nc | 7.9E+01 | nc | 3.3E-01 | nc | 3.3E+00 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | | 24307-26-4 | Mepiquat | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 2.9E-02 | n | 1.0E-01 | n | 2.9E-02 | r | 1.0E-01 | r | 0 | 0.1 | | 149-30-4 | 2-Mercaptobenzothiazole | 1.7E+01 | ca | 8.5E+01 | ca | 2.3E-01 | ca | 2.3E+00 | ca | | |
| | | 3.0E-04 | i | | | | | 0 | | | 7487-94-7 | Mercury and compounds | 2.3E+01 | nc | 6.1E+02 | nc | | | 1.1E+01 | nc | | |
| | | | | | | 8.6E-05 | i | | | | 7439-97-6 | Mercury (elemental) | | | | | 3.1E-01 | nc | | | | |
| | | 1.0E-04 | i | | | | | 0 | 0.1 | | 22967-92-6 | Mercury (methyl) | 6.1E+00 | nc | 8.8E+01 | nc | | | 3.6E+00 | nc | | |
| | | 3.0E-05 | i | | | 3.0E-05 | r | 0 | 0.1 | | 150-50-5 | Merphos | 1.8E+00 | nc | 2.6E+01 | nc | 1.1E-01 | nc | 1.1E+00 | nc | | |
| | | 3.0E-05 | i | | | 3.0E-05 | r | 0 | 0.1 | | 78-48-8 | Merphos oxide | 1.8E+00 | nc | 2.6E+01 | nc | 1.1E-01 | nc | 1.1E+00 | nc | | |
| | | 6.0E-02 | i | | | 6.0E-02 | r | 0 | 0.1 | | 57837-19-1 | Metalaxyl | 3.7E+03 | nc | 5.3E+04 | nc | 2.2E+02 | nc | 2.2E+03 | nc | | |
| | | 1.0E-04 | i | | | 2.0E-04 | h | 1 | | | 126-98-7 | Methacrylonitrile | 2.1E+00 | nc | 8.8E+00 | nc | 7.3E-01 | nc | 1.0E+00 | nc | | |
| | | 5.0E-05 | i | | | 5.0E-05 | r | 0 | 0.1 | | 10265-92-6 | Methamidophos | 3.1E+00 | nc | 4.4E+01 | nc | 1.8E-01 | nc | 1.8E+00 | nc | | |
| | | 5.0E-01 | i | | | 5.0E-01 | r | 0 | 0.1 | | 67-56-1 | Methanol | 3.1E+04 | nc | 1.0E+05 | max | 1.8E+03 | nc | 1.8E+04 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | | 950-37-8 | Methidathion | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 1 | | | 16752-77-5 | Methomyl | 4.4E+01 | nc | 1.5E+02 | nc | 9.1E+01 | nc | 1.5E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | | 72-43-5 | Methoxychlor | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | 1.6E+02 | 8.0E+00 |
| | | 1.0E-03 | h | | | 5.7E-03 | i | 0 | 0.1 | | 109-86-4 | 2-Methoxyethanol | 6.1E+01 | nc | 8.8E+02 | nc | 2.1E+01 | nc | 3.6E+01 | nc | | |
| | | 2.0E-03 | h | | | 2.0E-03 | r | 0 | 0.1 | | 110-49-6 | 2-Methoxyethanol acetate | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| 4.6E-02 | h | | | 4.6E-02 | r | | | 0 | 0.1 | | 99-59-2 | 2-Methoxy-5-nitroaniline | 1.1E+01 | ca | 5.4E+01 | ca | 1.5E-01 | ca | 1.5E+00 | ca | | |
| | | 1.0E+00 | h | | | 1.0E+00 | r | 1 | | | 79-20-9 | Methyl acetate | 2.2E+04 | nc | 9.6E+04 | nc | 3.7E+03 | nc | 6.1E+03 | nc | | |
| | | 3.0E-02 | h | | | 3.0E-02 | r | 1 | | | 96-33-3 | Methyl acrylate | 7.0E+01 | nc | 2.3E+02 | nc | 1.1E+02 | nc | 1.8E+02 | nc | | |
| 2.4E-01 | h | | | 2.4E-01 | r | | | 0 | 0.1 | | 95-53-4 | 2-Methylaniline (o-toluidine) | 2.0E+00 | ca | 1.0E+01 | ca | 2.8E-02 | ca | 2.8E-01 | ca | | |
| 1.8E-01 | h | | | 1.8E-01 | r | | | 0 | 0.1 | | 636-21-5 | 2-Methylaniline hydrochloride | 2.7E+00 | ca | 1.4E+01 | ca | 3.7E-02 | ca | 3.7E-01 | ca | | |
| | | 1.0E+00 | x | | | 1.0E+00 | r | 0 | 0.1 | | 79-22-1 | Methyl chlorocarbonate | 6.1E+04 | nc | 1.0E+05 | max | 3.7E+03 | nc | 3.6E+04 | nc | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 | 0.1 | | 94-74-6 | 2-Methyl-4-chlorophenoxyacetic acid | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | | 94-81-5 | 4-(2-Methyl-4-chlorophenoxy) butyric acid | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | | 93-65-2 | 2-(2-Methyl-4-chlorophenoxy) propionic acid | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | | 16484-77-8 | 2-(2-Methyl-1,4-chlorophenoxy) propionic acid | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 8.6E-01 | r | | | 8.6E-01 | h | 1 | | | 108-87-2 | Methylcyclohexane | 2.6E+03 | nc | 8.8E+03 | nc | 3.1E+03 | nc | 5.2E+03 | nc | | |
| 2.5E-01 | h | | | 2.5E-01 | r | | | 0 | 0.1 | | 101-77-9 | 4,4'-Methylenebisbenzeneamine | 1.9E+00 | ca | 9.9E+00 | ca | 2.7E-02 | ca | 2.7E-01 | ca | | |
| 1.3E-01 | h | 7.0E-04 | h | 1.3E-01 | h | 7.0E-04 | r | 0 | 0.1 | | 101-14-4 | 4,4'-Methylene bis(2-chloroaniline) | 3.7E+00 | ca* | 1.9E+01 | ca* | 5.2E-02 | ca* | 5.2E-01 | ca* | | |
| 4.6E-02 | i | | | 4.6E-02 | r | | | 0 | 0.1 | | 101-61-1 | 4,4'-Methylene bis(N,N'-dimethyl)aniline | 1.1E+01 | ca | 5.4E+01 | ca | 1.5E-01 | ca | 1.5E+00 | ca | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | Migration to Ground Water | |
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 74-95-3 | Methylene bromide | 6.7E+01 | nc | 2.4E+02 | nc | 3.7E+01 | nc | 6.1E+01 | nc | | |
| 7.5E-03 | i | 6.0E-02 | i | 1.6E-03 | i | 8.6E-01 | h | 1 | | 75-09-2 | Methylene chloride | 8.9E+00 | ca | 2.1E+01 | ca | 4.1E+00 | ca | 4.3E+00 | ca | 2.0E-02 | 1.0E-03 |
| | | 1.7E-04 | r | | | 1.7E-04 | i | 0 | 0.1 | 101-68-8 | 4,4'-Methylene diphenyl diisocyanate | 1.0E+01 | nc | 1.5E+02 | nc | 6.2E-01 | nc | 6.2E+00 | nc | | |
| | | 6.0E-01 | i | | | 2.9E-01 | i | 1 | | 78-93-3 | Methyl ethyl ketone | 7.3E+03 | nc | 2.8E+04 | nc | 1.0E+03 | nc | 1.9E+03 | nc | | |
| 1.1E+00 | h | | | 1.1E+00 | r | | | 0 | 0.1 | 60-34-4 | Methyl hydrazine | 4.4E-01 | ca | 2.2E+00 | ca | 6.1E-03 | ca | 6.1E-02 | ca | | |
| | | 8.0E-02 | h | | | 2.3E-02 | h | 1 | | 108-10-1 | Methyl isobutyl ketone | 7.9E+02 | nc | 2.9E+03 | nc | 8.3E+01 | nc | 1.6E+02 | nc | | |
| | | 5.7E-04 | r | | | 5.7E-04 | n | 0 | 0.1 | 74-93-1 | Methyl Mercaptan | 3.5E+01 | nc | 5.0E+02 | nc | 2.1E+00 | nc | 2.1E+01 | nc | | |
| | | 1.4E+00 | i | | | 2.0E-01 | i | 1 | | 80-62-6 | Methyl methacrylate | 2.2E+03 | nc | 2.7E+03 | sat | 7.3E+02 | nc | 1.4E+03 | nc | | |
| 3.3E-02 | h | | | 3.3E-02 | r | | | 0 | 0.1 | 99-55-8 | 2-Methyl-5-nitroaniline | 1.5E+01 | ca | 7.5E+01 | ca | 2.0E-01 | ca | 2.0E+00 | ca | | |
| | | 2.5E-04 | i | | | 2.5E-04 | r | 0 | 0.1 | 298-00-0 | Methyl parathion | 1.5E+01 | nc | 2.2E+02 | nc | 9.1E-01 | nc | 9.1E+00 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 95-48-7 | 2-Methylphenol | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | 1.5E+01 | 8.0E-01 |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 108-39-4 | 3-Methylphenol | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 5.0E-03 | h | | | 5.0E-03 | r | 0 | 0.1 | 106-44-5 | 4-Methylphenol | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.0E-02 | n | | | 2.0E-02 | r | 0 | 0.1 | 993-13-5 | Methyl phosphonic acid | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 6.0E-03 | h | | | 1.1E-02 | h | 1 | | 25013-15-4 | Methyl styrene (mixture) | 1.3E+02 | nc | 5.6E+02 | nc | 4.2E+01 | nc | 6.0E+01 | nc | | |
| | | 7.0E-02 | h | | | 7.0E-02 | r | 1 | | 98-83-9 | Methyl styrene (alpha) | 6.8E+02 | sat | 6.8E+02 | sat | 2.6E+02 | nc | 4.3E+02 | nc | | |
| | | | | | | 8.6E-01 | i | 1 | | 1634-04-4 | Methyl tertbutyl ether (MTBE) | | | | | 3.1E+03 | nc | 2.0E+01 | nc/ca | | |
| 1.8E-03 | | | | 1.8E-03 | | | | 1 | | | **"CAL-Modified PRG"** | 1.7E+01 | ca | 3.7E+01 | ca | 3.7E+00 | ca | 6.2E+00 | ca | | |
| | | 1.5E-01 | i | | | 1.5E-01 | r | 0 | 0.1 | 51218-45-2 | Metolaclor (Dual) | 9.2E+03 | nc | 1.0E+05 | max | 5.5E+02 | nc | 5.5E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 21087-64-9 | Metribuzin | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| 1.8E+00 | x | 2.0E-04 | i | 1.8E+00 | r | 2.0E-04 | r | 0 | 0.1 | 2385-85-5 | Mirex | 2.7E-01 | ca* | 1.4E+00 | ca | 3.7E-03 | ca | 3.7E-02 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 2212-67-1 | Molinate | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 5.0E-03 | h | | | | | 0 | | 7439-98-7 | Molybdenum | 3.9E+02 | nc | 1.0E+04 | nc | | | 1.8E+02 | nc | | |
| | | 1.0E-01 | h | | | 1.0E-01 | h | 0 | 0.1 | 10599-90-3 | Monochloramine | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 300-76-5 | Naled | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 15299-99-7 | Napropamide | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 2.0E-02 | i | | | | | 0 | | 7440-02-0 | Nickel (soluble salts) | 1.6E+03 | nc | 4.1E+04 | nc | | | 7.3E+02 | nc | 1.3E+02 | 7.0E+00 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 1.5E+02 | | | | | | | | | |
| | | | | 9.4E-01 | i | | | 0 | | | Nickel refinery dust | | | | | 8.0E-03 | ca | | | | |
| | | | | 1.7E+00 | i | | | 0 | | 12035-72-2 | Nickel subsulfide | | | 1.1E+04 | ca | 4.0E-03 | ca | | | | |
| | | 1.5E-03 | x | | | 1.5E-03 | r | 0 | 0.1 | 1929-82-4 | Nitrapyrin | 9.2E+01 | nc | 1.3E+03 | nc | 5.5E+00 | nc | 5.5E+01 | nc | | |
| Tap Water PRG Based on Infant NOAEL (see IRIS) | | | | | | | | | | 14797-55-8 | Nitrate | | | | | | | 1.0E+04 | nc | | |
| | | 1.0E-01 | x | | | | | | | 10102-43-9 | Nitric Oxide | 7.8E+03 | nc | 1.0E+05 | max | | | 3.6E+03 | nc | | |
| Tap Water PRG Based on Infant NOAEL (see IRIS) | | | | | | | | | | 14797-65-0 | Nitrite | | | | | | | 1.0E+03 | nc | | |
| | | 5.7E-05 | r | | | 5.7E-05 | h | 0 | 0.1 | 88-74-4 | 2-Nitroaniline | 3.5E+00 | nc | 5.0E+01 | nc | 2.1E-01 | nc | 2.1E+00 | nc | | |
| | | 5.0E-04 | i | | | 5.7E-04 | h | 1 | | 98-95-3 | Nitrobenzene | 2.0E+01 | nc | 1.1E+02 | nc | 2.1E+00 | nc | 3.4E+00 | nc | 1.0E-01 | 7.0E-03 |
| | | 7.0E-02 | h | | | 7.0E-02 | r | 0 | 0.1 | 67-20-9 | Nitrofurantoin | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| 1.5E+00 | h | | | 9.4E+00 | h | | | 0 | 0.1 | 59-87-0 | Nitrofurazone | 3.2E-01 | ca | 1.6E+00 | ca | 7.2E-04 | ca | 4.5E-02 | ca | | |
| 1.4E-02 | n | | | 1.4E-02 | r | | | 0 | 0.1 | 55-63-0 | Nitroglycerin | 3.5E+01 | ca | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 556-88-7 | Nitroguanidine | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 8.0E-03 | n | | | 8.0E-03 | r | 0 | 0.1 | 100-02-7 | 4-Nitrophenol | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| 9.4E+00 | r | 5.7E-03 | r | 9.4E+00 | h | 5.7E-03 | i | 1 | | 79-46-9 | 2-Nitropropane | | | | | 7.2E-04 | ca | 1.2E-03 | ca | | |
| 5.4E+00 | i | | | 5.6E+00 | i | | | 1 | | 924-16-3 | N-Nitrosodi-n-butylamine | 2.4E-02 | ca | 6.1E-02 | ca | 1.2E-03 | ca | 2.0E-03 | ca | | |
| 2.8E+00 | i | | | 2.8E+00 | r | | | 0 | 0.1 | 1116-54-7 | N-Nitrosodiethanolamine | 1.7E-01 | ca | 8.8E-01 | ca | 2.4E-03 | ca | 2.4E-02 | ca | | |
| 1.5E+02 | i | | | 1.5E+02 | i | | | 0 | 0.1 | 55-18-5 | N-Nitrosodiethylamine | 3.2E-03 | ca | 1.6E-02 | ca | 4.5E-05 | ca | 4.5E-04 | ca | | |
| 5.1E+01 | i | | | 4.9E+01 | i | | | 0 | 0.1 | 62-75-9 | N-Nitrosodimethylamine | 9.5E-03 | ca | 4.8E-02 | ca | 1.4E-04 | ca | 1.3E-03 | ca | | |
| 4.9E-03 | i | | | 4.9E-03 | r | | | 0 | 0.1 | 86-30-6 | N-Nitrosodiphenylamine | 9.9E+01 | ca | 5.0E+02 | ca | 1.4E+00 | ca | 1.4E+01 | ca | 1.0E+00 | 6.0E-02 |
| 7.0E+00 | i | | | 7.0E+00 | r | | | 0 | 0.1 | 621-64-7 | N-Nitroso di-n-propylamine | 6.9E-02 | ca | 3.5E-01 | ca | 9.6E-04 | ca | 9.6E-03 | ca | 5.0E-05 | 2.0E-06 |
| 2.2E+01 | i | | | 2.2E+01 | r | | | 0 | 0.1 | 10595-95-6 | N-Nitroso-N-methylethylamine | 2.2E-02 | ca | 1.1E-01 | ca | 3.1E-04 | ca | 3.1E-03 | ca | | |
| 2.1E+00 | i | | | 2.1E+00 | i | | | 0 | 0.1 | 930-55-2 | N-Nitrosopyrrolidine | 2.3E-01 | ca | 1.2E+00 | ca | 3.1E-03 | ca | 3.2E-02 | ca | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 99-08-1 | m-Nitrotoluene | 3.7E+02 | nc | 1.0E+03 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 88-72-2 | o-Nitrotoluene | 3.7E+02 | nc | 1.0E+03 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 99-99-0 | p-Nitrotoluene | 3.7E+02 | nc | 1.0E+03 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 | 0.1 | 27314-13-2 | Norflurazon | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 7.0E-04 | i | | | 7.0E-04 | r | 0 | 0.1 | 85509-19-9 | NuStar | 4.3E+01 | nc | 6.2E+02 | nc | 2.6E+00 | nc | 2.6E+01 | nc | | |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 32536-52-0 | Octabromodiphenyl ether | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 2.0E-03 | h | | | 2.0E-03 | r | 0 | 0.1 | 152-16-9 | Octamethylpyrophosphoramide | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 19044-88-3 | Oryzalin | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 19666-30-9 | Oxadiazon | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 23135-22-0 | Oxamyl | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 42874-03-3 | Oxyfluorfen | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 76738-62-0 | Paclobutrazol | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 4.5E-03 | i | | | 4.5E-03 | r | 0 | 0.1 | 4685-14-7 | Paraquat | 2.7E+02 | nc | 4.0E+03 | nc | 1.6E+01 | nc | 1.6E+02 | nc | | |
| | | 6.0E-03 | h | | | 6.0E-03 | r | 0 | 0.1 | 56-38-2 | Parathion | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | | |
| | | 5.0E-02 | h | | | 5.0E-02 | r | 0 | 0.1 | 1114-71-2 | Pebulate | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 | 0.1 | 40487-42-1 | Pendimethalin | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |
| 2.3E-02 | h | | | 2.3E-02 | r | | | 0 | 0.1 | 87-84-3 | Pentabromo-6-chloro cyclohexane | 2.1E+01 | ca | 1.1E+02 | ca | 2.9E-01 | ca | 2.9E+00 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 32534-81-9 | Pentabromodiphenyl ether | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 8.0E-04 | i | | | 8.0E-04 | r | 0 | 0.1 | 608-93-5 | Pentachlorobenzene | 4.9E+01 | nc | 7.0E+02 | nc | 2.9E+00 | nc | 2.9E+01 | nc | | |
| 2.6E-01 | h | 3.0E-03 | i | 2.6E-01 | r | 3.0E-03 | r | 0 | 0.1 | 82-68-8 | Pentachloronitrobenzene | 1.9E+00 | ca* | 9.5E+00 | ca | 2.6E-02 | ca | 2.6E-01 | ca | | |
| 1.2E-01 | i | 3.0E-02 | i | 1.2E-01 | r | 3.0E-02 | r | 0 | 0.25 | 87-86-5 | Pentachlorophenol | 3.0E+00 | ca | 1.1E+01 | ca | 5.6E-02 | ca | 5.6E-01 | ca | 3.0E-02 | 1.0E-03 |
| | | 5.0E-04 | x | | | | | 0 | | 7601-90-3 | Perchlorate | 3.9E+01 | nc | 1.0E+03 | nc | | | 1.8E+01 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 52645-53-1 | Permethrin | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 | 0.1 | 13684-63-4 | Phenmedipham | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 6.0E-01 | i | | | 6.0E-01 | r | 0 | 0.1 | 108-95-2 | Phenol | 3.7E+04 | nc | 1.0E+05 | max | 2.2E+03 | nc | 2.2E+04 | nc | 1.0E+02 | 5.0E+00 |
| | | 2.0E-03 | n | | | 2.0E-03 | r | 0 | 0.1 | 92-84-2 | Phenothiazine | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 6.0E-03 | i | | | 6.0E-03 | r | 0 | 0.1 | 108-45-2 | m-Phenylenediamine | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | | |
| | | 1.9E-01 | h | | | 1.9E-01 | r | 0 | 0.1 | 106-50-3 | p-Phenylenediamine | 1.2E+04 | nc | 1.0E+05 | max | 6.9E+02 | nc | 6.9E+03 | nc | | |
| | | 8.0E-05 | i | | | 8.0E-05 | r | 0 | 0.1 | 62-38-4 | Phenylmercuric acetate | 4.9E+00 | nc | 7.0E+01 | nc | 2.9E-01 | nc | 2.9E+00 | nc | | |
| 1.9E-03 | h | | | 1.9E-03 | r | | | 0 | 0.1 | 90-43-7 | 2-Phenylphenol | 2.5E+02 | ca | 1.3E+03 | ca | 3.5E+00 | ca | 3.5E+01 | ca | | |
| | | 2.0E-04 | h | | | 2.0E-04 | r | 0 | 0.1 | 298-02-2 | Phorate | 1.2E+01 | nc | 1.8E+02 | nc | 7.3E-01 | nc | 7.3E+00 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 732-11-6 | Phosmet | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 3.0E-04 | h | | | 8.6E-05 | i | 0 | 0.1 | 7803-51-2 | Phosphine | 1.8E+01 | nc | 2.6E+02 | nc | 3.1E-01 | nc | 1.1E+01 | nc | | |
| | | | | | | 2.9E-03 | i | | | 7664-38-2 | Phosphoric acid | | | | | 1.0E+01 | nc | | | | |
| | | 2.0E-05 | i | | | | | 0 | | 7723-14-0 | Phosphorus (white) | 1.6E+00 | nc | 4.1E+01 | nc | | | 7.3E-01 | nc | | |
| | | 1.0E+00 | h | | | 1.0E+00 | r | 0 | 0.1 | 100-21-0 | p-Phthalic acid | 6.1E+04 | nc | 1.0E+05 | max | 3.7E+03 | nc | 3.6E+04 | nc | | |
| | | 2.0E+00 | i | | | 3.4E-02 | h | 0 | 0.1 | 85-44-9 | Phthalic anhydride | 1.0E+05 | max | 1.0E+05 | max | 1.2E+02 | nc | 7.3E+04 | nc | | |
| | | 7.0E-02 | i | | | 7.0E-02 | r | 0 | 0.1 | 1918-02-1 | Picloram | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 23505-41-1 | Pirimiphos-methyl | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 8.9E+00 | h | 7.0E-06 | h | 8.9E+00 | r | 7.0E-06 | r | 0 | 0.1 | | Polybrominated biphenyls | 5.5E-02 | ca** | 2.8E-01 | ca* | 7.6E-04 | ca* | 7.6E-03 | ca* | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 1336-36-3 | Polychlorinated biphenyls (PCBs) | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 7.0E-02 | i | 7.0E-05 | i | 7.0E-02 | i | 7.0E-05 | r | 0 | 0.14 | 12674-11-2 | Aroclor 1016 | 3.9E+00 | nc | 2.9E+01 | ca** | 9.6E-02 | ca** | 9.6E-01 | ca** | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 11104-28-2 | Aroclor 1221 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 11141-16-5 | Aroclor 1232 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 53469-21-9 | Aroclor 1242 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 12672-29-6 | Aroclor 1248 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | 2.0E-05 | i | 2.0E+00 | i | 2.0E-05 | r | 0 | 0.14 | 11097-69-1 | Aroclor 1254 | 2.2E-01 | ca** | 1.0E+00 | ca* | 3.4E-03 | ca* | 3.4E-02 | ca* | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 11096-82-5 | Aroclor 1260 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| | | | | | | | | | 0.13 | | Polynuclear aromatic hydrocarbons (PAHs) | | | | | | | | | | |
| | | 6.0E-02 | i | | | 6.0E-02 | r | 1 | | 83-32-9 | Acenaphthene | 3.7E+03 | nc | 3.8E+04 | nc | 2.2E+02 | nc | 3.7E+02 | nc | 5.7E+02 | 2.9E+01 |
| | | 3.0E-01 | i | | | 3.0E-01 | r | 1 | | 120-12-7 | Anthracene | 2.2E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.8E+03 | nc | 1.2E+04 | 5.9E+02 |
| 7.3E-01 | n | | | 3.1E-01 | n | | | 0 | 0.13 | 56-55-3 | Benz[a]anthracene | 6.2E-01 | ca | 2.9E+00 | ca | 2.2E-02 | ca | 9.2E-02 | ca | 2.0E+00 | 8.0E-02 |
| 7.3E-01 | n | | | 3.1E-01 | n | | | 0 | 0.13 | 205-99-2 | Benzo[b]fluoranthene | 6.2E-01 | ca | 2.9E+00 | ca | 2.2E-02 | ca | 9.2E-02 | ca | 5.0E+00 | 2.0E-01 |
| 7.3E-02 | n | | | 3.1E-02 | n | | | 0 | 0.13 | 207-08-9 | Benzo[k]fluoranthene | 6.2E+00 | ca | 2.9E+01 | ca | 2.2E-01 | ca | 9.2E-01 | ca | 4.9E+01 | 2.0E+00 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 6.1E-01 | | | | | | | | | |
| 7.3E+00 | i | | | 3.1E+00 | n | | | 0 | 0.13 | 50-32-8 | Benzo[a]pyrene | 6.2E-02 | ca | 2.9E-01 | ca | 2.2E-03 | ca | 9.2E-03 | ca | 8.0E+00 | 4.0E-01 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | | | | | | | 1.5E-03 | | | |
| 7.3E-03 | n | | | 3.1E-03 | n | | | 0 | 0.13 | 218-01-9 | Chrysene | 6.2E+01 | ca | 2.9E+02 | ca | 2.2E+00 | ca | 9.2E+00 | ca | 1.6E+02 | 8.0E+00 |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS Migration to Ground Water | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V skin O abs. C soils | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 6.1E+00 | | | | | | | | | |
| 7.3E+00 | n | | | 3.1E+00 | n | | | 0 0.13 | 53-70-3 | Dibenz[ah]anthracene | 6.2E-02 | ca | 2.9E-01 | ca | 2.2E-03 | ca | 9.2E-03 | ca | 2.0E+00 | 8.0E-02 |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 0.13 | 206-44-0 | Fluoranthene | 2.3E+03 | nc | 3.0E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | 4.3E+03 | 2.1E+02 |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 1 | 86-73-7 | Fluorene | 2.6E+03 | nc | 3.3E+04 | nc | 1.5E+02 | nc | 2.4E+02 | nc | 5.6E+02 | 2.8E+01 |
| 7.3E-01 | n | | | 3.1E-01 | n | | | 0 0.13 | 193-39-5 | Indeno[1,2,3-cd]pyrene | 6.2E-01 | ca | 2.9E+00 | ca | 2.2E-02 | ca | 9.2E-02 | ca | 1.4E+01 | 7.0E-01 |
| | | 2.0E-02 | i | | | 8.6E-04 | i | 1 | 91-20-3 | Naphthalene | 5.6E+01 | nc | 1.9E+02 | nc | 3.1E+00 | nc | 6.2E+00 | nc | 8.4E+01 | 4.0E+00 |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 1 | 129-00-0 | Pyrene | 2.3E+03 | nc | 5.4E+04 | nc | 1.1E+02 | nc | 1.8E+02 | nc | 4.2E+03 | 2.1E+02 |
| 1.5E-01 | i | 9.0E-03 | i | 1.5E-01 | r | 9.0E-03 | r | 0 0.1 | 67747-09-5 | Prochloraz | 3.2E+00 | ca | 1.6E+01 | ca | 4.5E-02 | ca | 4.5E-01 | ca | | |
| | | 6.0E-03 | h | | | 6.0E-03 | r | 0 0.1 | 26399-36-0 | Profluralin | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | | |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 0.1 | 1610-18-0 | Prometon | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 0.1 | 7287-19-6 | Prometryn | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 7.5E-02 | i | | | 7.5E-02 | r | 0 0.1 | 23950-58-5 | Pronamide | 4.6E+03 | nc | 6.6E+04 | nc | 2.7E+02 | nc | 2.7E+03 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 0.1 | 1918-16-7 | Propachlor | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 0.1 | 709-98-8 | Propanil | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 0.1 | 2312-35-8 | Propargite | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 0.1 | 107-19-7 | Propargyl alcohol | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 0.1 | 139-40-2 | Propazine | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 0.1 | 122-42-9 | Propham | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 0.1 | 60207-90-1 | Propiconazole | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.1E-01 | i | 1 | 98-82-8 | Isopropylbenzene (Cumene) | 1.6E+02 | nc | 5.2E+02 | nc | 4.0E+02 | nc | 6.6E+02 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | 103-65-1 | n-Propylbenzene | 1.4E+02 | nc | 2.4E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 2.0E+01 | h | | | 2.0E+01 | r | 0 0.1 | 57-55-6 | Propylene glycol | 1.0E+05 | max | 1.0E+05 | max | 7.3E+04 | nc | 7.3E+05 | nc | | |
| | | 7.0E-01 | h | | | 7.0E-01 | r | 0 0.1 | 111-35-3 | Propylene glycol, monoethyl ether | 4.3E+04 | nc | 1.0E+05 | max | 2.6E+03 | nc | 2.6E+04 | nc | | |
| | | 7.0E-01 | h | | | 5.7E-01 | i | 0 0.1 | 107-98-2 | Propylene glycol, monomethyl ether | 4.3E+04 | nc | 1.0E+05 | max | 2.1E+03 | nc | 2.6E+04 | nc | | |
| 2.4E-01 | i | 8.6E-03 | r | 1.3E-02 | i | 8.6E-03 | i | 1 | 75-56-9 | Propylene oxide | 1.9E+00 | ca* | 9.1E+00 | ca* | 5.2E-01 | ca* | 2.2E-01 | ca | | |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 0.1 | 81335-77-5 | Pursuit | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 0.1 | 51630-58-1 | Pydrin | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 0.1 | 110-86-1 | Pyridine | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 0.1 | 13593-03-8 | Quinalphos | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| 1.2E+01 | h | | | 1.2E+01 | r | | | 0 0.1 | 91-22-5 | Quinoline | 4.1E-02 | ca | 2.1E-01 | ca | 5.6E-04 | ca | 5.6E-03 | ca | | |
| 1.1E-01 | i | 3.0E-03 | i | 1.1E-01 | r | 3.0E-03 | r | 0 0.1 | 121-82-4 | RDX (Cyclonite) | 4.4E+00 | ca* | 2.2E+01 | ca | 6.1E-02 | ca | 6.1E-01 | ca | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 0.1 | 10453-86-8 | Resmethrin | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 5.0E-02 | h | | | 5.0E-02 | r | 0 0.1 | 299-84-3 | Ronnel | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 0.1 | 83-79-4 | Rotenone | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 0.1 | 78587-05-0 | Savey | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 5.0E-03 | i | | | | | 0 0.1 | 7783-00-8 | Selenious Acid | 3.1E+02 | nc | 4.4E+03 | nc | | | 1.8E+02 | nc | | |
| | | 5.0E-03 | i | | | | | 0 | 7782-49-2 | Selenium | 3.9E+02 | nc | 1.0E+04 | nc | | | 1.8E+02 | nc | 5.0E+00 | 3.0E-01 |
| | | 5.0E-03 | h | | | | | 0 0.1 | 630-10-4 | Selenourea | 3.1E+02 | nc | 4.4E+03 | nc | | | 1.8E+02 | nc | | |
| | | 9.0E-02 | i | | | 9.0E-02 | r | 0 0.1 | 74051-80-2 | Sethoxydim | 5.5E+03 | nc | 7.9E+04 | nc | 3.3E+02 | nc | 3.3E+03 | nc | | |
| | | 5.0E-03 | i | | | | | 0 | 7440-22-4 | Silver and compounds | 3.9E+02 | nc | 1.0E+04 | nc | | | 1.8E+02 | nc | 3.4E+01 | 2.0E+00 |
| 1.2E-01 | h | 5.0E-03 | i | 1.2E-01 | r | 2.0E-03 | r | 0 0.1 | 122-34-9 | Simazine | 4.1E+00 | ca* | 2.1E+01 | ca | 5.6E-02 | ca | 5.6E-01 | ca | | |
| | | 4.0E-03 | i | | | | | | 26628-22-8 | Sodium azide | | | | | | | | | | |
| 2.7E-01 | h | 3.0E-02 | i | 2.7E-01 | r | 3.0E-02 | r | 0 0.1 | 148-18-5 | Sodium diethyldithiocarbamate | 1.8E+00 | ca | 9.1E+00 | ca | 2.5E-02 | ca | 2.5E-01 | ca | | |
| | | 2.0E-05 | i | | | 2.0E-05 | r | 0 0.1 | 62-74-8 | Sodium fluoroacetate | 1.2E+00 | nc | 1.8E+01 | nc | 7.3E-02 | nc | 7.3E-01 | nc | | |
| | | 1.0E-03 | h | | | 1.0E-03 | i | 0 0.1 | 13718-26-8 | Sodium metavanadate | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 6.0E-01 | i | | | | | 0 | 7440-24-6 | Strontium, stable | 4.7E+04 | nc | 1.0E+05 | max | | | 2.2E+04 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 0.1 | 57-24-9 | Strychnine | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 2.0E-01 | i | | | 2.9E-01 | i | 1 | 100-42-5 | Styrene | 1.7E+03 | sat | 1.7E+03 | sat | 1.1E+03 | nc | 1.6E+03 | nc | 4.0E+00 | 2.0E-01 |
| | | 1.0E-03 | n | | | 1.0E-03 | r | | 80-07-9 | **1,1'-Sulfonylbis (4-chlorobenzene)** | 7.8E+01 | nc | 2.0E+03 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 0.1 | 88671-89-0 | Systhane | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| 1.5E+05 | h | | | 1.5E+05 | h | | | 0 0.03 | 1746-01-6 | 2,3,7,8-TCDD (dioxin) | 3.9E-06 | ca | 2.7E-05 | ca | 4.5E-08 | ca | 4.5E-07 | ca | | |
| | | 7.0E-02 | i | | | 7.0E-02 | r | 0 0.1 | 34014-18-1 | Tebuthiuron | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 0.1 | 3383-96-8 | Temephos | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 0.1 | 5902-51-2 | Terbacil | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 2.5E-05 | h | | | 2.5E-05 | r | 0 | 0.1 | 13071-79-9 | Terbufos | 1.5E+00 | nc | 2.2E+01 | nc | 9.1E-02 | nc | 9.1E-01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 886-50-0 | Terbutryn | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| 2.6E-02 | i | 3.0E-02 | i | 2.6E-02 | i | 3.0E-02 | r | 1 | | 630-20-6 | 1,1,1,2-Tetrachloroethane | 3.0E+00 | ca | 7.0E+00 | ca | 2.6E-01 | ca | 4.3E-01 | ca | | |
| 2.0E-01 | i | 6.0E-02 | n | 2.0E-01 | i | 6.0E-02 | r | 1 | | 79-34-5 | 1,1,2,2-Tetrachloroethane | 3.8E-01 | ca | 9.0E-01 | ca | 3.3E-02 | ca | 5.5E-02 | ca | 3.0E-03 | 2.0E-04 |
| 5.2E-02 | n | 1.0E-02 | i | 2.0E-03 | n | 1.1E-01 | n | 1 | | 127-18-4 | Tetrachloroethylene (PCE) | 5.7E+00 | ca* | 1.9E+01 | ca* | 3.3E+00 | ca | 1.1E+00 | ca | 6.0E-02 | 3.0E-03 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | | | | | 3.2E-01 | | | | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 58-90-2 | 2,3,4,6-Tetrachlorophenol | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 2.0E+01 | h | | | 2.0E+01 | r | | | 0 | 0.1 | 5216-25-1 | p,a,a,a-Tetrachlorotoluene | 2.4E-02 | ca | 1.2E-01 | ca | 3.4E-04 | ca | 3.4E-03 | ca | | |
| 2.4E-02 | h | 3.0E-02 | i | 2.4E-02 | r | 3.0E-02 | r | 0 | 0.1 | 961-11-5 | Tetrachlorovinphos | 2.0E+01 | ca* | 1.0E+02 | ca | 2.8E-01 | ca | 2.8E+00 | ca | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 | 0.1 | 3689-24-5 | Tetraethyldithiopyrophosphate | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| 7.6E-03 | n | 2.1E-01 | n | 6.8E-03 | n | 8.6E-02 | n | 0 | 0.1 | 109-99-9 | Tetrahydrofuran | 6.4E+01 | ca | 3.2E+02 | ca | 9.9E-01 | ca | 8.8E+00 | ca | | |
| | | 6.6E-05 | i | | | | | 0 | | 7446-18-6 | **Thallium and compounds** | 5.2E+00 | nc | 1.3E+02 | nc | | | 2.4E+00 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 28249-77-6 | Thiobencarb | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 1.0E-01 | n | | | 1.0E-01 | r | 0 | 0.1 | N/A | Thiocyanate | 6.1E+03 | nc | 1.0E+05 | max | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 3.0E-04 | h | | | 3.0E-04 | r | 0 | 0.1 | 39196-18-4 | Thiofanox | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | 23564-05-8 | Thiophanate-methyl | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 137-26-8 | Thiram | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 6.0E-01 | h | | | | | 0 | | | Tin (inorganic, see tributyltin oxide for organic tin) | 4.7E+04 | nc | 1.0E+05 | max | | | 2.2E+04 | nc | | |
| | | 2.0E-01 | i | | | 1.1E-01 | h | 1 | | 108-88-3 | Toluene | 5.2E+02 | sat | 5.2E+02 | sat | 4.0E+02 | nc | 7.2E+02 | nc | 1.2E+01 | 6.0E-01 |
| 3.2E+00 | h | | | 3.2E+00 | r | | | 0 | 0.1 | 95-80-7 | Toluene-2,4-diamine | 1.5E-01 | ca | 7.7E-01 | ca | 2.1E-03 | ca | 2.1E-02 | ca | | |
| | | 6.0E-01 | h | | | 6.0E-01 | r | 0 | 0.1 | 95-70-5 | Toluene-2,5-diamine | 3.7E+04 | nc | 1.0E+05 | max | 2.2E+03 | nc | 2.2E+04 | nc | | |
| | | 2.0E-01 | h | | | 2.0E-01 | r | 0 | 0.1 | 823-40-5 | Toluene-2,6-diamine | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| 1.9E-01 | i | | | 1.9E-01 | r | | | 0 | 0.1 | 106-49-0 | p-Toluidine | 2.6E+00 | ca | 1.3E+01 | ca | 3.5E-02 | ca | 3.5E-01 | ca | | |
| 1.1E+00 | i | | | 1.1E+00 | i | | | 0 | 0.1 | 8001-35-2 | Toxaphene | 4.4E-01 | ca | 2.2E+00 | ca | 6.0E-03 | ca | 6.1E-02 | ca | 3.1E+01 | 2.0E+00 |
| | | 7.5E-03 | i | | | 7.5E-03 | r | 0 | 0.1 | 66841-25-6 | Tralomethrin | 4.6E+02 | nc | 6.6E+03 | nc | 2.7E+01 | nc | 2.7E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 2303-17-5 | Triallate | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 82097-50-5 | Triasulfuron | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 615-54-3 | 1,2,4-Tribromobenzene | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 3.0E-04 | i | | | | | 0 | 0.1 | 56-35-9 | Tributyltin oxide (TBTO) | 1.8E+01 | nc | 2.6E+02 | nc | | | 1.1E+01 | nc | | |
| 3.4E-02 | h | | | 3.4E-02 | r | | | 0 | 0.1 | 634-93-5 | 2,4,6-Trichloroaniline | 1.4E+01 | ca | 7.3E+01 | ca | 2.0E-01 | ca | 2.0E+00 | ca | | |
| 2.9E-02 | h | | | 2.9E-02 | r | | | 0 | 0.1 | 33663-50-2 | 2,4,6-Trichloroaniline hydrochloride | 1.7E+01 | ca | 8.5E+01 | ca | 2.3E-01 | ca | 2.3E+00 | ca | | |
| | | 1.0E-02 | i | | | 5.7E-02 | h | 1 | | 120-82-1 | 1,2,4-Trichlorobenzene | 6.5E+02 | nc | 3.0E+03 | sat | 2.1E+02 | nc | 1.9E+02 | nc | 5.0E+00 | 3.0E-01 |
| | | 2.0E-02 | n | | | 2.9E-01 | n | 1 | | 71-55-6 | 1,1,1-Trichloroethane | 6.3E+02 | nc | 1.4E+03 | sat | 1.0E+03 | nc | 5.4E+02 | nc | 2.0E+00 | 1.0E-01 |
| 5.7E-02 | i | 4.0E-03 | i | 5.6E-02 | i | 4.0E-03 | r | 1 | | 79-00-5 | 1,1,2-Trichloroethane | 8.4E-01 | ca* | 1.9E+00 | ca* | 1.2E-01 | ca | 2.0E-01 | ca | 2.0E-02 | 9.0E-04 |
| 1.1E-02 | n | 6.0E-03 | x | 6.0E-03 | n | 6.0E-03 | r | 1 | | 79-01-6 | Trichloroethylene (TCE) | 2.8E+00 | ca** | 6.1E+00 | ca* | 1.1E+00 | ca* | 1.6E+00 | ca* | 6.0E-02 | 3.0E-03 |
| | | 3.0E-01 | i | | | 2.0E-01 | h | 1 | | 75-69-4 | Trichlorofluoromethane | 3.9E+02 | nc | 2.0E+03 | sat | 7.3E+02 | nc | 1.3E+03 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 95-95-4 | 2,4,5-Trichlorophenol | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | 2.7E+02 | 1.4E+01 |
| 1.1E-02 | i | | | 1.1E-02 | i | | | 0 | 0.1 | 88-06-2 | 2,4,6-Trichlorophenol | 4.4E+01 | ca | 2.2E+02 | ca | 6.2E-01 | ca | 6.1E+00 | ca | 2.0E-01 | 8.0E-03 |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 93-76-5 | 2,4,5-Trichlorophenoxyacetic Acid | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 8.0E-03 | i | | | 8.0E-03 | r | 0 | 0.1 | 93-72-1 | 2-(2,4,5-Trichlorophenoxy) propionic acid | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 1 | | 598-77-6 | 1,1,2-Trichloropropane | 1.5E+01 | nc | 5.1E+01 | nc | 1.8E+01 | nc | 3.0E+01 | nc | | |
| 7.0E+00 | h | 6.0E-03 | i | 7.0E+00 | r | 5.0E-03 | r | 1 | | 96-18-4 | 1,2,3-Trichloropropane | 1.4E-03 | ca | 3.1E-03 | ca | 9.6E-04 | ca | 1.6E-03 | ca | | |
| | | 5.0E-03 | h | | | 5.0E-03 | r | 1 | | 96-19-5 | 1,2,3-Trichloropropene | 1.2E+01 | nc | 3.9E+01 | nc | 1.8E+01 | nc | 3.0E+01 | nc | | |
| | | 3.0E+01 | i | | | 8.6E+00 | h | 1 | | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | 5.6E+03 | sat | 5.6E+03 | sat | 3.1E+04 | nc | 5.9E+04 | nc | | |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 58138-08-2 | Tridiphane | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 2.0E-03 | r | | | 2.0E-03 | i | 1 | | 121-44-8 | Triethylamine | 2.3E+01 | nc | 8.8E+01 | nc | 7.3E+00 | nc | 1.2E+01 | nc | | |
| 7.7E-03 | i | 7.5E-03 | i | 7.7E-03 | r | 7.5E-03 | r | 0 | 0.1 | 1582-09-8 | Trifluralin | 6.3E+01 | ca** | 3.2E+02 | ca* | 8.7E-01 | ca* | 8.7E+00 | ca* | | |
| | | 1.4E-04 | r | | | 1.4E-04 | n | | 0.1 | 552-30-7 | **Trimellitic Anhydride (TMAN)** | 8.6E+00 | nc | 1.2E+02 | nc | 5.1E-01 | nc | 5.1E+00 | | | |
| | | 5.0E-02 | n | | | 1.7E-03 | n | 1 | | 95-63-6 | 1,2,4-Trimethylbenzene | 5.2E+01 | nc | 1.7E+02 | nc | 6.2E+00 | nc | 1.2E+01 | nc | | |
| | | 5.0E-02 | n | | | 1.7E-03 | n | 1 | | 108-67-8 | 1,3,5-Trimethylbenzene | 2.1E+01 | nc | 7.0E+01 | nc | 6.2E+00 | nc | 1.2E+01 | nc | | |
| 3.7E-02 | h | | | 3.7E-02 | r | | | 0 | 0.1 | 512-56-1 | Trimethyl phosphate | 1.3E+01 | ca | 6.7E+01 | ca | 1.8E-01 | ca | 1.8E+00 | ca | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 99-35-4 | 1,3,5-Trinitrobenzene | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 0 | 0.1 | 479-45-8 | Trinitrophenylmethylnitramine | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS Migration to Ground Water | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 3.0E-02 | i | 5.0E-04 | i | 3.0E-02 | r | 5.0E-04 | r | 0 | 0.1 | | 118-96-7 | 2,4,6-Trinitrotoluene | 1.6E+01 | ca** | 8.2E+01 | ca** | 2.2E-01 | ca** | 2.2E+00 | ca** | | |
| | | 1.0E-01 | n | | | 1.0E-01 | r | | 0.1 | | 791-28-6 | **Triphenylphosphine oxide** | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| 1.4E-02 | n | 3.0E-01 | n | 1.4E-02 | r | 3.0E-01 | r | | 0.1 | | 115-96-8 | **Tris(2-chloroethyl) phosphate** | 3.5E+01 | ca | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 2.0E-04 | n | | | | | | | | 7440-61-0 | **Uranium (chemical toxicity only)** | 1.6E+01 | nc | 4.1E+02 | nc | | | 7.3E+00 | nc | | |
| | | 7.0E-03 | h | | | | | 0 | | | 7440-62-2 | Vanadium and compounds | 5.5E+02 | nc | 1.4E+04 | nc | | | 2.6E+02 | nc | 6.0E+03 | 3.0E+02 |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | | 1929-77-7 | Vernam | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | | 50471-44-8 | Vinclozolin | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 1.0E+00 | h | | | 5.7E-02 | i | 1 | | | 108-05-4 | Vinyl acetate | 4.3E+02 | nc | 1.4E+03 | nc | 2.1E+02 | nc | 4.1E+02 | nc | 1.7E+02 | 8.0E+00 |
| 1.1E-01 | r | 8.6E-04 | r | 1.1E-01 | h | 8.6E-04 | i | 1 | | | 593-60-2 | Vinyl bromide (bromoethene) | 1.9E-01 | ca* | 4.2E-01 | ca* | 6.1E-02 | ca* | 1.0E-01 | ca* | | |
| 1.5E+00 | i | 3.0E-03 | i | 3.1E-02 | i | 2.9E-02 | i | 1 | | | 75-01-4 | **Vinyl chloride (child/adult)** | 1.5E-01 | ca | | | 2.2E-01 | ca | 4.1E-02 | ca | 1.0E-02 | 7.0E-04 |
| 7.5E-01 | i | 3.0E-03 | i | 1.6E-02 | i | 2.9E-02 | i | 1 | | | 75-01-4 | **Vinyl chloride (adult)** | | | 8.3E-01 | ca | | | | | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | | 81-81-2 | Warfarin | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 2.0E+00 | i | | | 2.0E-01 | x | 1 | 0.1 | | 1330-20-7 | Xylenes | 2.1E+02 | sat | 2.1E+02 | sat | 7.3E+02 | nc | 1.4E+03 | nc | 2.1E+02 | 1.0E+01 |
| | | 3.0E-01 | i | | | | | 0 | | | 7440-66-6 | Zinc | 2.3E+04 | nc | 1.0E+05 | max | | | 1.1E+04 | nc | 1.2E+04 | 6.2E+02 |
| | | 3.0E-04 | i | | | | | 0 | | | 1314-84-7 | Zinc phosphide | 2.3E+01 | nc | 6.1E+02 | nc | | | 1.1E+01 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | | 12122-67-7 | Zineb | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |

# NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau
and
Ground Water Quality Bureau
Voluntary Remediation Program

## TECHNICAL BACKGROUND DOCUMENT FOR DEVELOPMENT OF SOIL SCREENING LEVELS

December 18, 2000

# Volume 1

# TIER 1: SOIL SCREENING GUIDANCE TECHNICAL BACKGROUND DOCUMENT

# Table of Contents

VOLUME 1 TIER 1: SOIL SCREENING GUIDANCE TECHNICAL BACKGROUND DOCUMENT

1. Introduction ..... 1
1.1 Organization of the Document ..... 1
1.2 Scope of the Soil Screening Guidance ..... 2
1.2.1 Exposure Pathways ..... 3
1.2.2 Exposure Assumptions ..... 3
1.2.3 Target Risk and Hazard ..... 4
1.2.4 SSL Model Assumptions ..... 4
2. Development of Pathway Specific Soil Screening Levels ..... 5
2.1 Human Health Basis ..... 5
2.1.1 Additive Risk ..... 5
2.1.2 Acute Exposures ..... 6
2.1.3 Route-to-Route Extrapolation ..... 6
2.1.4 Direct Ingestion ..... 7
2.1.5 Dermal Absorption ..... 7
2.1.6 Inhalation of Volatiles and Fugitive Dusts ..... 8
2.2 Residential land uses ..... 8
2.2.1 Residential Receptors ..... 9
2.3 Non-residential land uses ..... 12
2.3.1 Commercial/Industrial Worker ..... 13
2.3.2 Construction Worker ..... 15
2.3.3 Alternative Evaluation for Lead ..... 16
2.4 Site Assessment and Characterization ..... 16
2.4.1 Development of Data Quality Objectives ..... 17
2.4.2 Identification of COPCs ..... 17
2.4.3 Development of a Preliminary Conceptual Site Model ..... 18
2.4.4 Compare COPC Maximum Concentrations With SSLs ..... 18
3. Chemical-Specific and Physical-Chemical Parameters ..... 18
3.1 Volatilization Factor ..... 19
3.2 Soil Saturation Limit ..... 20

3.3 Particulate Emission Factor ..... 21

## Table of Contents (con't)

3.4 Physical-Chemical Parameters ..... 22
3.4.1 Solubility, Henry's Law Constant, and $K_{ow}$ ..... 23
3.4.2 Soil Organic Carbon/Water Partition Coefficients ($K_{oc}$) ..... 23
3.4.3 Soil/Water Partition Coefficients ($K_d$) ..... 24
4. Migration of Contaminants to Groundwater ..... 25
4.1.1 Overview of the SSL Model Approach ..... 26
4.1.2 Model Assumptions ..... 26
4.1.3 Soil Water Partition Equation ..... 27
4.1.4 Dilution Attenuation Factor ..... 27
4.1.5 Limitations on the Use of the Dilution Attenuation Factor ..... 29
4.1.6 Generic SSLs for Protection of Groundwater ..... 30
4.1.7 Development of Site Specific SSLs for Protection of Groundwater ..... 30
4.1.8 Detailed Model Analysis for SSL Development ..... 33
4.1.9 Summary of the Migration to Groundwater Pathway SSLs ..... 34
5. Use of the SSLs ..... 34
Appendix A:
Table A-1: NMED Soil Screening Levels
Table A-2: Default Exposure factors
Appendix B
Table B-1: Physical-Chemical Properties
Appendix C
Table C-1: Human Health Benchmarks Used for calculating SSLs

## VOLUME 2 TIER 1: SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT PHASE I SCOPING ASSESSMENT

1. Introduction ..... 1
2. Scoping Assessment ..... 2
2.1 Compile and Assess Basic Site Information ..... 2
2.2 Site Visit ..... 3
2.3 Identify Contaminants of Potential Ecological Concern ..... 4
2.4 Developing the Preliminary Conceptual Site Exposure Model ..... 4

2.5 Assembling the Scoping Assessment Report ..... 6

3. Site Exclusion Criteria ..... 9

4. Technical Decision Point: Is Ecological Risk Suspected? ..... 9

Attachment A: Screening-Level Ecological Risk Assessment Scoping Assessment: Site Assessment Checklist
Table 1: Examples of Sensitive Environments

Attachment B: Ecological Site Exclusion Checklist and Decision Tree

# 1. INTRODUCTION

The New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) and the Ground Water Quality Bureau (GWQB) have developed this soil screening guidance (SSG) for internal department use for corrective action programs. The SSG discusses the methodology used to derive chemical-specific soil screening levels (SSLs). In addition, guidance is provided to assist in identifying and evaluating appropriate exposure pathways and receptors. Finally, this document provides generic SSLs for chemicals commonly found at contaminated sites based on default exposure parameters under residential and non-residential land-use scenarios.

The SSG provides site managers with a framework for developing and applying the SSLs, and is likely to be most useful for determining whether areas or entire sites are contaminated to an extent that warrants further investigation. It is intended to assist and streamline the site investigation and corrective action process by focusing resources on those sites or areas that pose the greatest risk to human health and the environment. Implementation of the methodologies outlined within this SSG may significantly reduce the time necessary to complete site investigations and cleanup actions at certain sites, as well as improve the consistency of these investigations.

Between various sites there can exist a wide spectrum of contaminant types and concentrations. The level of concern associated with those concentrations depends on several factors, including the likelihood of exposure to levels of potential concern to human health or to ecological receptors. At one end of the spectrum are levels that clearly warrant a response action; at the other end are levels that are below regulatory concern. Appropriate cleanup goals for a site may fall anywhere within this range depending on site-specific conditions. It is important to note that SSLs do not in themselves represent cleanup standards, and the SSLs alone do not trigger the need for a response action or define "unacceptable" levels of contamination in soil. Screening levels such as SSLs identify the lower end of this spectrum – levels below which there is generally no need for further concern—provided the conditions associated with the development of the SSLs are consistent.

## 1.1 ORGANIZATION OF THE DOCUMENT

The NMED SSG is organized into five major sections with supporting appendices. The remainder of Section 1 addresses the purpose of the NMED SSLs and outlines the scope of the document. Section 2 outlines the receptors, exposure pathways, and exposure assumptions used in calculating the NMED SSLs. It also discusses the risk levels on which the SSLs are predicated and presents the SSL model assumptions. Finally, Section 2 discusses site assessment/characterization activities that should be completed prior to comparing site contaminant concentrations with SSLs. These activities include development of data quality objectives, conducting site sampling, preparation of a preliminary conceptual site model (CSM), and identification of contaminants of potential concern (COPCs).

Section 3 provides a detailed description of the process used to develop pathway-specific SSLs. Included in this section is a discussion of the human health basis for the SSLs, additive risk, and acute exposures. Additional topics discussed in Section 3 include chemical specific parameters used to develop the SSLs and calculating volatilization factors, particulate emission factors and soil saturation limits. Section 4 presents methodologies for assessing the potential for migration of contaminants to groundwater from contaminated soil in concert with generic and site-specific leaching models. Finally, Section 5 addresses special use considerations for addressing contaminant concentrations in soil and notes specific problems that can arise when applying the SSLs to specific sites. Generic SSLs for contaminants that have Water Quality Control Commission (WQCC) Standards for ground water in the State of New Mexico are presented in Table A-1 of Appendix A. In addition, Table A-1 also includes additional compounds which are some of the RCRA regulated constituents. Table A-2 of Appendix A presents the default exposure factor values used in the generation of the NMED SSLs. Physical-chemical values in the calculation of the SSLs are presented in Table B-1 of Appendix B. Toxicity criteria are presented in Table C-1 of Appendix C.

## 1.2 SCOPE OF THE SOIL SCREENING GUIDANCE

The SSG incorporates readily obtainable site data and utilizes methods from various United States Environmental Protection Agency (US EPA) risk assessment guidance and derives site-specific screening levels for selected contaminants and exposure pathways. Key attributes of the SSG include default values for generic SSLs where site-specific information is unavailable, and the identification of parameters for which site-specific information is needed for the development of site-specific SSLs. The goal of the SSG is to provide a consistent approach for developing site-specific SSLs for evaluating facilities under the auspices of the corrective action process within NMED.

The NMED SSLs are generally based on a $10^{-5}$ target risk for carcinogens, or a hazard quotient of 1 for noncarcinogens. In instances where an individual contaminant has the capacity to elicit both types of responses, the SSLs preferentially report the screening value representative of the lowest (most stringent) contaminant concentration in environmental media. SSLs for migration to groundwater are based on (in order of preference): State of New Mexico Water Quality Control Commission (WQCC) standards, US EPA Region 9 Preliminary Remediation Goals (PRGs) for tap water (modified to reflect a target risk of $10^{-5}$ in instances where the PRG is based on a carcinogenic endpoint), maximum contaminant levels (MCL), and nonzero maximum contaminant level goals (MCLG). As such, the NMED SSLs serve as a generic benchmark for screening level comparisons of contaminant concentrations in soil. NMED anticipates that the SSLs will be used as a tool to facilitate prompt identification of those contaminants and areas that represent the greatest risks to human health and the environment. While concentrations above the NMED SSLs presented in this document do not automatically designate a site as "contaminated" or trigger the need for a response action, detected concentrations in site soils exceeding screening levels suggest that further evaluation is appropriate. Further evaluation may include additional sampling to further characterize the nature and extent of contamination, consideration of background levels, reevaluation of contaminants of potential concern (COPCs) or associated risk and hazard using site-specific parameters, and/or a reassessment

of the assumptions associated with the generic SSLs (e.g., appropriateness of route-to-route extrapolations, use of chronic toxicity values to evaluate childhood and construction-worker exposures).

### 1.2.1 Exposure Pathways

A complete exposure pathway consists of (1) a source, (2) a mechanism of contaminant release, (3) a receiving or contact medium, (4) a potential receptor population, and (5) an exposure route. All five elements must be present for the exposure pathway to be considered complete.

SSLs have been developed for use in evaluating three discrete exposure scenarios representing a variety of potential land uses: residential, commercial/industrial, and construction. The SSG presents lists of potential pathways for each scenario, though these lists are not intended to be exhaustive. Instead, each list represents a set of typical exposure pathways likely to account for the majority of exposure to contaminants in soil at a given site. These include:

- Direct (or incidental) ingestion of soil
- Dermal contact with soil
- Inhalation of volatiles and fugitive dusts from contaminated soil
- Migration of chemicals through soil to an underlying potable aquifer or water-bearing unit

Under some site-specific situations, additional complete exposure pathways may be identified. In these cases, a site-specific evaluation of risk is warranted in which additional exposure pathways can be considered. If other land uses and exposure scenarios are determined to be more appropriate for a site (e.g., Native American land use), the exposure pathways addressed in this document should be modified accordingly or a site-specific risk assessment should be conducted. Early identification of the need for additional information is important because it facilitates development of a defensible sampling and analysis strategy.

The exposure pathways evaluated, by land-use scenario, are presented in Table 1-1.

**Table 1-1**

| Exposure Pathways Evaluated in Soil Screening Guidance | | | |
|---|---|---|---|
| **Potential Exposure Pathway** | **Residential** | **Commercial/industrial** | **Construction** |
| Direct ingestion | ✔ | ✔ | ✔ |
| Dermal contact | ✔ | ✔ | ✔ |
| Inhalation of volatiles outdoors | ✔ | ✔ | ✔ |
| Inhalation of fugitive dusts outdoors | ✔ | ✔ | ✔ |
| Inhalation of volatiles indoors | ✔ | | |

### 1.2.2 Exposure Assumptions

SSLs represent risk-based concentrations in soil derived from equations combining exposure assumptions with toxicity criteria developed by US EPA (US EPA, 2000a and 1997a). The models and assumptions used were developed to be consistent with the Superfund concept of "reasonable maximum exposure" (US EPA, 1989). This is intended to provide an upper-

bound estimate of chronic exposure by combining both average and conservative (i.e., 90th to 95th percentile) values in the calculations. The default intake and duration assumptions presented here are intended to be protective of all potentially exposed populations for each land use consideration. Exposure point concentrations in soil should reflect either directly measured or estimated values using fate and transport models. An average concentration is typically used where the focus is on estimating long-term, chronic exposures and there are sufficient site data to allow for an accurate estimation of the mean. Where the potential for acute toxicity may be of concern, estimates based on the maximum exposure may be more appropriate.

The resulting estimate of exposure is then compared with chemical-specific toxicity criteria. To calculate the SSLs, the exposure equations and pathway models are rearranged to backcalculate an "acceptable level" of a contaminant in soil corresponding to a specific level of target risk or hazard.

### 1.2.3 Target Risk and Hazard

Target risk and hazard levels for human health are risk management-based criteria for carcinogenic and non-carcinogenic responses, respectively, to determine (1) whether site-related contamination poses an unacceptable risk to human health and requires corrective action or (2) whether implemented corrective action(s) sufficiently protects human health. If an estimated risk or hazard falls within the target range, the risk manager may conclude that a site does not pose an unacceptable risk. This decision should take into account the degree of inherent conservatism or level of uncertainty associated with the site-specific estimates of risk and hazard. An estimated risk that exceeds these targets, however, does not necessarily indicate that the current conditions are not safe or that they present an unacceptable risk. Rather, a site risk calculation that exceeds a target value may simply indicate the need for further evaluation or refinement of the exposure model.

For cumulative exposure via the ingestion, inhalation, and dermal pathways, toxicity criteria are used to calculate an acceptable level of contamination in soil. SSLs are based on a carcinogenic risk level of one-in-one-hundred-thousand ($1 \times 10^{-5}$) and a non-carcinogenic hazard quotient of 1. A carcinogenic risk level is defined as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. The non-carcinogenic hazard quotient assumes that there is a level of exposure below which it is unlikely for even sensitive populations to experience adverse health effects.

### 1.2.4 SSL Model Assumptions

The models used to calculate inhalation exposure and protection of groundwater based on potential migration of contaminants in soil are intended to be utilized at an early stage in the site investigation process when information regarding the site may be limited. For this reason, the models incorporate a number of simplifying assumptions. For instance, the models assume an infinite contaminant source, i.e. a constant concentration is maintained for the duration of the exposure period. Although this is a highly conservative assumption, finite source models require accurate data regarding source size and volume. Such data are

unlikely to be available from limited sampling efforts. The models also assume that contamination is homogeneous throughout the source and that no biological or chemical degradation occurs. Where sufficient site-specific data are available, more-detailed finite-source models may be used in place of the default assumptions presented in this SSG.

# 2. DEVELOPMENT OF PATHWAY SPECIFIC SOIL SCREENING LEVELS

The following sections present the technical basis and limitations used to calculate SSLs for residential, commercial/industrial, and construction land use scenarios. The equations used to evaluate inhalation and migration to groundwater include a number of easily obtainable site-specific input parameters. Where site-specific data are not available, conservative default values are presented. The equations used are presented in Sections 2.2 and 2.3. Generic SSLs calculated for 133 chemicals, using these default values, are presented in Table A-1 of Appendix A.

## 2.1 HUMAN HEALTH BASIS

The toxicity criteria used for calculating the SSLs are presented in Table C-1 of Appendix C. The primary sources for the human health benchmarks are US EPA's Integrated Risk Information System (IRIS) (US EPA, 2000a), the Health Effects Assessment Summary Tables (HEAST) (US EPA, 1997a), and US EPA's National Center for Environmental Assessment (NCEA). Additional sources include the minimal risk levels (MRLs) developed by the Agency for Toxic Substances and Disease Registry (ATSDR). For soil ingestion, inhalation of volatile organic compounds (VOCs) and fugitive dusts, and dermal contact, the NMED SSLs correspond to a $10^{-5}$ level for carcinogens and/or a hazard quotient of 1 for noncarcinogens, whichever is lower (i.e., more protective).

### 2.1.1 Additive Risk

It is important to note that no consideration is provided in the calculation of individual NMED SSLs for additive risk when exposures to multiple chemicals occur. The SSG addresses this issue in Section 5. Because the NMED SSLs for carcinogenic effects correspond to a $10^{-5}$ risk level individually, exposure to multiple contaminants may result in a cumulative site risk that is above the anticipated risk management range. While carcinogenic risks of multiple chemicals are simply added together, the issue of additive hazard is more complex for noncarcinogens because of the theory that a threshold exists for noncarcinogenic effects. This threshold is defined as the level below which adverse effects are not expected to occur, and represents the basis for the reference dose (RfD) and reference concentration (RfC). Since adverse effects are not expected to occur at the RfD or RfC and the SSLs are derived by setting the potential exposure dose to the RfD or RfC, the SSLs do not address the risk of exposure to multiple chemicals at levels where the individual chemicals alone would not be expected to cause any adverse effects. In such cases, the SSLs may not provide an accurate indicator for the likelihood of harmful effects. However, noncarcinogenic effects should only be considered additive for those chemicals with the same toxic endpoint and/or mechanism of action. The sources provided in Section 2.1 should be consulted to determine the endpoint and/or target organ system prior to

attempting to evaluate the additive health effects resulting from simultaneous exposure to multiple contaminants.

Additivity of the SSLs is further complicated by the fact that not all of the SSLs are based on toxicity. SSLs for certain volatile chemicals are determined based on a ceiling limit concentration termed the soil saturation limit (and denoted as $C_{sat}$) above which these chemicals may occur as nonaqueous phase liquids (NAPLs) in soil. This is discussed further in Section 3.2. Further, for certain inorganic and semivolatile organic compounds (SVOCs) that exhibit relatively low toxicity, a non risk-based maximum concentration of $10^5$ mg/kg is given when the risk-based SSL exceeds that level. These are noted as "max" in the tables.

### 2.1.2 Acute Exposures

The exposure assumptions used to develop the SSLs are based on a chronic exposure scenario and do not account for situations where high-level exposures may result in acute toxic effects. Such situations may arise when contaminant concentrations are very high, or may result from specific site-related conditions and/or behavioral patterns (i.e., pica behavior in children). Such exposures may be of concern for those contaminants that primarily exhibit acute health effects. Toxicological information regarding cyanide and phenol indicate that acute effects may be of concern for children exhibiting pica behavior. Pica is typically described as a compulsive craving to ingest non-food items (such as clay or paint). Although it can be exhibited by adults as well, it is typically of greatest concern in children because they often exhibit behavior (e.g., outdoor play activities and greater hand-to-mouth contact) that results in greater exposure to soil than for a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake.

### 2.1.3 Route-to-Route Extrapolation

As of January 1991, IRIS and NCEA databases no longer present RfDs or SFs for the inhalation route. These criteria have been replaced with RfCs for noncarcinogenic effects and unit risk factors (URFs) for carcinogenic effects. However, for the purposes of estimating risk and calculating risk-based concentrations, inhalation reference doses ($RfD_i$) and inhalation slope factors ($SF_i$) are preferred. Route-to-route extrapolations were also frequently used when there were no toxicity values available for a given route of exposure. However, route extrapolations were not performed for inorganics due to portal of entry effects and known differences in absorption efficiency between the oral and dermal routes of exposure. To calculate an $RfD_i$ from an RfC, the following equation and assumptions may be used for most chemicals:

$$RfD_i \ \frac{mg}{(kg\text{-}day)} = RfC\,(mg/m^3) \times \frac{20m^3}{day} \times \frac{1}{70kg}$$

The $SF_i$ was calculated from the URF using the following equation and assumptions:

$$SF_i \frac{(kg\text{ - }day)}{(mg)} = URF\left(m^3/mg\right) \times \frac{day}{20m^3} \times 70kg \times \frac{10^3\ ug}{mg}$$

An additional route extrapolation is the use of oral toxicity values for evaluating dermal exposures. Because no toxicity data are presently available for evaluating dermal exposure to contaminants, US EPA has developed a methodology for use in dermal assessments. Most oral RfDs and cancer slope factors are based on an administered dose while dermal equations estimate an absorbed dose. Gastrointestinal and pulmonary absorption of many chemicals is typically much greater than absorption through intact skin. Thus, for evaluating the effects of dermal exposure to contaminants in soil, the oral toxicity value should be adjusted from an administered dose to an absorbed dose by accounting for the absorption efficiency of the chemical. Assuming 100 percent absorption via the oral exposure route may result in an overestimation of the absorbed dose, resulting in an overestimation of the dose at the site of toxic injury and underestimating the actual potency of the chemical to exert an observed effect. The magnitude of the underestimation is inversely proportional to the true oral absorption of the compound. Based on the current guidance (US EPA, 2000b), the only chemical for which an adjustment is recommended is cadmium. An oral absorption efficiency of 5 percent is assumed for cadmium which leads to an estimated dermal reference dose ($RfD_d$) of 0.000025 mg/kg-day.

### 2.1.4 Direct Ingestion

Exposure to contaminants through incidental ingestion of soil can result from the inadvertent consumption of soils adhering to the hands, food items, or objects that are placed into the mouth. It can also result from swallowing dust particles that have been inhaled and deposited in the mouth and subsequently swallowed. Commercial/industrial and construction workers and residential receptors may inadvertently ingest soil that adheres to their hands while involved in work- or recreation-related activities. Calculation of SSLs for direct ingestion are based on the methodology presented in US EPA's *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim* (US EPA, 1991), *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a), and *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (US EPA, 1999a).

### 2.1.5 Dermal Absorption

Exposure to soil contaminants may result from dermal contact with contaminated soil and the subsequent absorption of contaminants through the skin. Contact with soil is most likely to occur as a result of digging, gardening, landscaping, or outdoor recreation activities. Excavation activities may also be a potential source of exposure to contaminants, particularly for construction workers. Calculation of the screening levels for ingestion of soil under the residential exposure scenario is based on the methodology presented in EPA's *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim* (1991), and *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a). The suggested default input values

used to develop the NMED SSLs are consistent with EPA's forthcoming *RAGS, Part E, Supplemental Guidance for Dermal Risk Assessment* (US EPA, 2000a).

### 2.1.6 Inhalation of Volatiles and Fugitive Dusts

EPA toxicity data indicate that risks from exposure to some chemicals via the inhalation pathway far outweigh the risk via ingestion or dermal contact; therefore, the NMED SSLs have been designed to address inhalation of volatiles and fugitive dusts. To address the soil/sediment-to-air pathways, the SSL calculations incorporate volatilization factors (VF) for volatile contaminants and particulate emission factors (PEF) for nonvolatile contaminants. The SSLs follow the procedures for evaluating inhalation of VOCs and fugitive dust particles presented in EPA's *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim* (US EPA, 1991), *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a), *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (US EPA, 1998), and *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (US EPA, 1999a).

VOCs may adhere to soil particles or be present in interstitial air spaces in soil, and may volatilize into ambient air. This pathway may be particularly significant if the VOC emissions are concentrated in indoor spaces of onsite buildings. For the purpose of calculating the NMED SSLs, VOCs are considered those chemicals having a Henry's Law constant greater than $1 \times 10^{-5}$ atm-m$^3$/mole-°K and a molecular weight less than 200 g/mole.

Inhalation of contaminants via inhalation of fugitive dusts is assessed using a PEF that relates the contaminant concentration in soil/sediment with the concentration of respirable particles in the air due to fugitive dust emissions. It is important to note that the PEF used to address residential and commercial/industrial exposures evaluates only windborne dust emissions and does not consider emissions from traffic or other forms of mechanical disturbance which could lead to a greater level of exposure. The PEF used to address construction worker exposures evaluates windborne dust emissions and emissions from vehicle traffic associated with construction activities. Therefore, the fugitive dust pathway should be considered carefully when developing the CSM at sites where receptors may be exposed to fugitive dusts by other mechanisms. The development of the PEF for both residential and non-residential land uses is discussed further in Section 3.3.

## 2.2 Residential Land Uses

Residential exposures are assessed based on child and adult receptors. As discussed below, the child forms the basis for evaluation of noncarcinogenic effects incurred under residential exposures, while carcinogenic responses are modeled based upon age-adjusted values to account for exposures averaged over a lifetime. Under most circumstances, onsite residential receptors are expected to be the most conservative receptor basis for risk assessment purposes due to the assumption that exposure occurs 24 hours a day, 350 days per year, extending over a 30 year exposure duration. Table 2-1 provides a summary of the exposure characteristics and parameters associated with a residential land use receptor.

**Table 2-1**

| **Summary of the Residential Land Use Receptors** | |
|---|---|
| **Exposure Characteristics** | • Substantial soil exposure (esp. children)<br>• High soil ingestion rate (esp. children)<br>• Significant time spent indoors<br>• Long-term exposure |
| **Default Exposure Parameters** | |
| Exposure frequency (d/yr) | 350 |
| Exposure duration (yr) | 6 (child)<br>24 (adult) |
| Soil ingestion rate (mg/day) | 200 (child)<br>100 (adult) |
| Body Weight (kg) | 15 (child)<br>70 (adult) |
| Skin surface area exposed ($cm^2$) | 2,800 (child)<br>5,700 (adult) |
| Skin-soil adherence factor | 0.2 (child)<br>0.07 (adult) |
| Air inhalation rate ($m^3/d$) | 10 (child)<br>20 (adult) |

### 2.2.1 Residential Receptors

A residential receptor is assumed to be a long-term receptor occupying a dwelling within the site boundaries and thus is exposed to contaminants 24 hours per day, and is assumed to live at the site for 30 years (representing the $90^{th}$ percentile of the length of time someone lives in a single location), remaining onsite for 350 days per year. Exposure to soil is expected to occur during home maintenance activities, yard work and landscaping, and outdoor play activities. Contaminant intake is assumed to occur via three exposure pathways – direct ingestion, dermal absorption, and inhalation of volatiles and fugitive dusts. For the residential scenario, both adult and child receptors were evaluated because children often exhibit behavior (e.g., greater hand-to-mouth contact) that can result in greater exposure to soils than those associated with a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake.

Equations 1 and 2 are used to calculate cumulative SSLs for a residential receptor exposed to non-carcinogenic and carcinogenic contaminants via all three exposure pathways. Default exposure parameters are provided for use when site-specific data are not available.

**Equation 1**
**Combined Exposures to Noncarcinogenic Contaminants in Soil**
**Residential Scenario**

$$C = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[ \left( \frac{1}{RfD_o} \times \frac{IRS_c}{10^6 \, mg/kg} \right) + \left( \frac{1}{RfD_o} \times \frac{SA_c \times AF_c \times ABS}{10^6 \, mg/kg} \right) + \left( \frac{1}{RfD_i} \times \frac{IRA_c}{VF \text{ or } PEF} \right) \right]}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| C | Contaminant concentration (mg/kg) | Chemical-specific |
| THQ | Target hazard quotient | 1 |
| $BW_c$ | Body weight, child (kg) | 15 |
| $AT_n$ | Averaging time, noncarcinogens (days) | ED x 365 |
| $EF_r$ | Exposure frequency, resident (day/yr) | 350 |
| $ED_c$ | Exposure duration, child (years) | 6 |
| $IRS_c$ | Soil ingestion rate, child (mg/day) | 200 |
| $RfD_o$ | Oral reference dose (mg/kg-day) | Chemical-specific |
| $SA_c$ | Dermal surface area, child ($cm^2$/day) | 2,800 |
| $AF_c$ | Soil adherence factor, child (mg/$cm^2$) | 0.2 |
| ABS | Skin absorption factor (unitless) | Chemical-specific |
| $IRA_c$ | Inhalation rate, child ($m^3$/day) | 10 |
| $RfD_I$ | Inhalation reference dose (mg/kg-day) | Chemical-specific |
| VF | Volatilization factor ($m^3$/kg) | See Equation 10 |
| PEF | Particulate emission factor ($m^3$/kg) | See Equation 12 |

**Equation 2**
**Combined Exposures to Carcinogenic Contaminants in Soil**
**Residential Scenario**

$$C = \frac{TR \times AT_c}{EF_r \left[ \left( \frac{IFS_{adj} \times CSF_o}{10^6 \, mg/kg} \right) + \left( \frac{SFS_{adj} \times ABS \times CSF_o}{10^6 \, mg/kg} \right) + \left( \frac{InhF_{adj} \times CSF_i}{VF \text{ or } PEF} \right) \right]}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| C | Contaminant concentration (mg/kg) | Chemical-specific |
| TR | Target cancer risk | $1 \times 10^{-5}$ |
| $AT_c$ | Averaging time, carcinogens (days) | 25,550 |
| $EF_r$ | Exposure frequency, resident (day/yr) | 350 |
| $IFS_{adj}$ | Age-adjusted soil ingestion factor ([mg-yr]/[kg-day]) | 114 |
| $CSF_o$ | Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$ | Chemical-specific |
| $SFS_{adj}$ | Age-adjusted dermal factor ([mg-yr]/[kg-day]) | 361 |
| ABS | Skin absorption factor (unitless) | Chemical-specific |
| $InhF_{adj}$ | Age-adjusted inhalation factor ([$m^3$-yr]/[kg-day]) | 11 |
| $CSF_i$ | Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$ | Chemical-specific |
| VF | Volatilization factor ($m^3$/kg) | See Equation 10 |
| PEF | Particulate emission factor ($m^3$/kg) | See Equation 12 |

Noncarcinogenic contaminants are evaluated based solely on childhood exposures using Equation 1. By combining the higher contaminant intake rates with the lower relative body weight, "childhood only" exposures lead to a lower, or more conservative, risk-based

concentration compared to an adult-only exposure. In addition, this approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria.

Unlike non-carcinogens, the duration of exposure to carcinogens is averaged over the lifetime of the receptor because of the assumption that cancer may develop even after actual exposure has ceased. As a result, the total dose received is averaged over a lifetime of 70 years. In addition, to be protective of exposures in a residential setting, the carcinogenic exposure parameter values are age-adjusted to account for exposures incurred in children (1-6 years of age) and adults (7-31 years of age). Carcinogenic exposures are age-adjusted to account for the physiological differences between children and adults as well as behavioral differences that result in markedly different relative rates of exposure. Equations 3, 4, and 5 are used to calculate age-adjusted ingestion, dermal and inhalation factors which account for the differences in soil ingestion rate, skin surface area, soil adherence factors, inhalation rate, and body weight for children versus adults. The age-adjusted factors calculated using these equations were used in Equation 2 to develop generic NMED SSLs for carcinogenic effects.

**Equation 3**
**Calculation of Age-Adjusted Ingestion Factor**

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_r - ED_c) \times IRS_a}{BW_a}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| $IFS_{adj}$ | Age-adjusted soil ingestion factor for carcinogens [(mg-yr)/(kg-day)] | 114 |
| $ED_c$ | Exposure duration, child (years) | 6 |
| $IRS_c$ | Soil ingestion rate, child (mg/day) | 200 |
| $BW_c$ | Body weight, child (kg) | 15 |
| $ED_r$ | Exposure duration, resident (years) | 30 |
| $IRS_a$ | Soil ingestion rate, adult (mg/day) | 100 |
| $BW_a$ | Body weight, adult (kg) | 70 |

**Equation 4**
**Calculation of Age-Adjusted Dermal Factor**

$$SFS_{adj} = \frac{ED_c \times AF_c \times SA_c}{BW_c} + \frac{(ED_r - ED_c) \times AF_a \times SA_a}{BW_a}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| $SFS_{adj}$ | Age-adjusted dermal factor for carcinogens [(mg-yr)/(kg-day)] | 361 |
| $ED_c$ | Exposure duration, child (years) | 6 |
| $AF_c$ | Soil adherence factor, child (mg/cm$^2$) | 0.2 |
| $SA_c$ | Dermal surface area, child (cm$^2$/day) | 2,800 |
| $BW_c$ | Body weight, child (kg) | 15 |
| $ED_r$ | Exposure duration, resident (years) | 30 |
| $AF_a$ | Soil adherence factor, adult (mg/cm$^2$) | 0.07 |
| $SA_a$ | Dermal surface area, adult (cm$^2$/day) | 5,700 |
| $BW_a$ | Body weight, adult (kg) | 70 |

**Equation 5**
**Calculation of Age-Adjusted Inhalation Factor**

$$InhF_{adj} = \frac{Ed_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| $InhF_{adj}$ | Age-adjusted inhalation factor for carcinogens [(mg-yr)/(kg-day)] | 11 |
| $ED_c$ | Exposure duration, child (years) | 6 |
| $IRA_c$ | Inhalation rate, child (m$^3$/day) | 10 |
| $BW_c$ | Body weight, child (kg) | 15 |
| $ED_r$ | Exposure duration, resident (years) | 30 |
| $IRA_a$ | Inhalation rate, adult (m$^3$/day) | 20 |
| $BW_a$ | Body weight, adult (kg) | 70 |

## 2.3 NON-RESIDENTIAL LAND USES

Non-residential land uses encompass all commercial and industrial land uses and focus on two very different receptors – a commercial/industrial worker and a construction worker. Unlike those calculated for residential land-uses, NMED SSLs for non-residential land uses are based solely on exposures to adults. Consequently, exposures to carcinogens are not age-adjusted. Due to the wide range of activities and exposure levels a non-residential receptor may be exposed to during various work-related activities, it is important to ensure that the default exposure parameters are representative of site-specific conditions. Table 2-2 provides a summary of the exposure characteristics and parameters for non-residential land use receptors.

**Table 2-2**

| Summary of Non-Residential Land Use Receptors | | |
|---|---|---|
| **Receptor** | **Commercial/Industrial Worker** | **Construction Worker** |
| **Exposure Characteristics** | • Substantial soil exposures<br>• High soil ingestion rate<br>• Long-term exposure<br>• Exposure to surface and shallow subsurface soils<br>• Adult-only exposure | • Exposed during construction activities only<br>• Short-term exposure<br>• Very high soil ingestion and dust inhalation rates<br>• Exposure to surface and subsurface soils |
| **Default Exposure Parameters** | | |
| Exposure frequency (day/yr) | 200 | 30 |
| Exposure duration (yr) | 25 | 1 |
| Soil ingestion rate (mg/day) | 100 | 480 |
| Body Weight (kg) | 70 | 70 |
| Skin surface area exposed ($cm^2$) | 3,300 | 3,300 |
| Skin-soil adherence factor (mg/ $cm^2$) | 0.2 | 0.3 |
| Air inhalation rate ($m^3$/day) | 20 | 20 |

### 2.3.1 Commercial/Industrial Worker

The commercial/industrial scenario is considered representative of on-site workers who spend all or most of their workday outdoors. A commercial/industrial worker is assumed to be a long-term receptor exposed during the course of a work day as either (1) a full time employee of a company operating on-site who spends most of the work day conducting maintenance or manual labor activities outdoors or (2) a worker who is assumed to regularly perform grounds-keeping activities as part of his/her daily responsibilities. Exposure to surface and shallow subsurface soils (i.e., at depths of zero to two feet below ground surface) is expected to occur during moderate digging associated with routine maintenance and grounds-keeping activities. A commercial/industrial receptor is expected to be the most highly exposed receptor in the outdoor environment under generic or day-to-day commercial/industrial conditions. Thus, the screening levels for this receptor are expected to be protective of other reasonably anticipated indoor and outdoor workers at a commercial/industrial facility. However, screening levels developed for the commercial/industrial worker may not be protective of a construction worker due to the latter's increased soil contact rate during construction activities. Equations 6 and 7 were used to develop generic SSLs for cumulative exposure to carcinogenic and non-carcinogenic contaminants by all exposure pathways. Default exposure parameters are provided and were used in calculating the NMED SSLs.

**Equation 6**
**Combined Exposures to Carcinogenic Contaminants in Soil**
**Commercial/Industrial Scenario**

$$C = \frac{TR \times BW_a \times AT_c}{EF_{CI} \times ED_{CI}\left[\left(\frac{IRS_{CI} \times CSF_o}{10^6 \, mg/kg}\right) + \left(\frac{SA_{CI} \times AF_{CI} \times ABS \times CSF_o}{10^6 \, mg/kg}\right) + \left(\frac{IRA_c \times CSF_i}{VF \text{ or } PEF}\right)\right]}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| C | Contaminant concentration (mg/kg) | Chemical-specific |
| TR | Target Risk | $1 \times 10^{-5}$ |
| $BW_a$ | Body weight, adult (kg) | 70 |
| $AT_c$ | Averaging time, carcinogens (days) | 25,550 |
| $EF_{CI}$ | Exposure frequency, commercial/industrial (day/yr) | 250 |
| $ED_{CI}$ | Exposure duration, commercial/industrial (years) | 25 |
| $IRS_{CI}$ | Soil ingestion rate, commercial/industrial (mg/day) | 100 |
| $CSF_o$ | Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$ | Chemical-specific |
| $SA_{CI}$ | Dermal surface area, commercial/industrial ($cm^2$/day) | 3,300 |
| $AF_{CI}$ | Soil adherence factor, commercial/industrial ($mg/cm^2$) | 0.2 |
| ABS | Skin absorption factor (unitless) | Chemical-specific |
| $IRA_{CI}$ | Inhalation rate, commercial/industrial ($m^3$/day) | 20 |
| $CSF_i$ | Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$ | Chemical-specific |
| VF | Volatilization factor ($m^3$/kg) | See Equation 10 |
| PEF | Particulate emission factor ($m^3$/kg) | See Equation 12 |

**Equation 7**
**Combined Exposures to Noncarcinogenic Contaminants in Soil**
**Commercial/Industrial Scenario**

$$C = \frac{THQ \times BW_a \times AT_n}{EF_{CI} \times ED_{CI}\left[\left(\frac{1}{RfD_o} \times \frac{IRS_{CI}}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_{CI} \times AF_{CI} \times ABS}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_{CI}}{VF \text{ or } PEF}\right)\right]}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| C | Contaminant concentration (mg/kg) | Chemical-specific |
| THQ | Target hazard quotient | 1 |
| $BW_a$ | Body weight, adult (kg) | 70 |
| $AT_n$ | Averaging time, noncarcinogens (days) | ED x 365 |
| $EF_{CI}$ | Exposure frequency, commercial/industrial (day/yr) | 250 |
| $ED_{CI}$ | Exposure duration, commercial/industrial (years) | 25 |
| $IRS_{CI}$ | Soil ingestion rate, commercial/industrial (mg/day) | 100 |
| $RfD_o$ | Oral reference dose (mg/kg-day) | Chemical-specific |
| $SA_{CI}$ | Dermal surface area, commercial/industrial ($cm^2$/day) | 3,300 |
| $AF_{CI}$ | Soil adherence factor, commercial/industrial ($mg/cm^2$) | 0.2 |
| ABS | Skin absorption factor (unitless) | Chemical-specific |
| $IRA_{CI}$ | Inhalation rate, commercial/industrial ($m^3$/day) | 20 |
| $RfD_i$ | Inhalation reference dose (mg/kg-day) | Chemical-specific |
| VF | Volatilization factor ($m^3$/kg) | See Equation 10 |
| PEF | Particulate emission factor ($m^3$/kg) | See Equation 12 |

### 2.3.2 Construction Worker

A construction worker is assumed to be a receptor who is exposed to contaminated soil during the work day for the duration of a single on-site construction project. If multiple construction projects are anticipated, it is assumed that different workers will be employed for each project. The activities for this receptor typically involve substantial exposures to surface and subsurface soils (i.e., at depths of zero to 10 feet below ground surface) during excavation, maintenance and building construction projects (intrusive operations). A construction worker is assumed to be exposed to contaminants via the following pathways: incidental soil ingestion, dermal contact with soil, and inhalation of contaminated outdoor air (volatile and particulate emissions). While a construction worker receptor is assumed to have a higher soil ingestion rate than a commercial/industrial worker due to the type of activities performed during construction projects, the exposure frequency and duration are assumed to be significantly shorter due to the short-term nature of construction projects. However, chronic toxicity information was used when developing screening levels for a construction worker receptor. This approach is significantly more conservative than using sub-chronic toxicity data because it combines the higher soil exposures for construction workers with chronic toxicity criteria. Equations 8 and 9 were used to develop generic SSLs for cumulative exposure to carcinogenic and non-carcinogenic contaminants by all exposure pathways. Default exposure parameters are provided and were used in calculating the NMED SSLs.

**Equation 8**
**Combined Exposures to Carcinogenic Contaminants in Soil**
**Construction Worker Scenarios**

$$C = \frac{THQ \times BW_a \times AT_c}{EF_{CW} \times ED_{CW}\left[\left(\frac{IRS_{CW} \times CSF_o}{10^6\,mg/kg}\right) + \left(\frac{SA_{CW} \times AF_{CW} \times ABS \times CSF_o}{10^6\,mg/kg}\right) + \left(\frac{IRA_{CW} \times CSF_i}{VF \text{ or } PEF}\right)\right]}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| C | Contaminant concentration (mg/kg) | Chemical-specific |
| TR | Target Risk | $1 \times 10^{-5}$ |
| $AT_c$ | Averaging time, carcinogens (days) | 25,550 |
| $EF_{CW}$ | Exposure frequency, construction worker (day/yr) | 250 |
| $ED_{CW}$ | Exposure duration, construction worker (years) | 1 |
| $IRS_{CW}$ | Soil ingestion rate, construction worker (mg/day) | 480 |
| $CSF_o$ | Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$ | Chemical-specific |
| $SA_{CW}$ | Dermal surface area, construction worker ($cm^2$/day) | 3,300 |
| $AF_{CW}$ | Soil adherence factor, construction worker ($mg/cm^2$) | 0.3 |
| ABS | Skin absorption factor (unitless) | Chemical-specific |
| $IRA_{CW}$ | Inhalation rate, construction worker ($m^3$/day) | 20 |
| $CSF_i$ | Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$ | Chemical-specific |
| VF | Volatilization factor ($m^3$/kg) | See Equation 10 |
| PEF | Particulate emission factor ($m^3$/kg) | See Equation 12 |

**Equation 9**
**Combined Exposures to Noncarcinogenic Contaminants in Soil**
**Construction Worker Scenario**

$$C = \frac{THQ \times BW_a \times AT_n}{EF_{CW} \times ED_{CW}\left[\left(\frac{1}{RfD_o} \times \frac{IRS_{CW}}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_{CW} \times AF_{CW} \times ABS}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_{CW}}{VF \text{ or } PEF_{CW}}\right)\right]}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| C | Contaminant concentration (mg/kg) | Chemical-specific |
| THQ | Target hazard quotient | 1 |
| $AT_n$ | Averaging time, noncarcinogens (days) | ED x 365 |
| $EF_{CW}$ | Exposure frequency, commercial/industrial (day/yr) | 250 |
| $ED_{CW}$ | Exposure duration, commercial/industrial (years) | 1 |
| $IRS_{CW}$ | Soil ingestion rate, commercial/industrial (mg/day) | 480 |
| $RfD_o$ | Oral reference dose (mg/kg-day) | Chemical-specific |
| $SA_{CW}$ | Dermal surface area, commercial/industrial ($cm^2$/day) | 3,300 |
| $AF_{CW}$ | Soil adherence factor, commercial/industrial (mg/$cm^2$) | 0.3 |
| ABS | Skin absorption factor (unitless) | Chemical-specific |
| $IRA_{CW}$ | Inhalation rate, commercial/industrial ($m^3$/day) | 20 |
| $RfD_i$ | Inhalation reference dose (mg/kg-day) | Chemical-specific |
| VF | Volatilization factor ($m^3$/kg) | See Equation 10 |
| PEF | Particulate emission factor ($m^3$/kg) | See Equation 12 |

### 2.3.3 Alternative Evaluation for Lead

Exposure to lead can result in neurotoxic and developmental effects. The primary receptors of concern are children, whose nervous systems are still undergoing development and who also exhibit behavioral tendencies that increase their likelihood of exposure (e.g., pica). These effects may occur at exposures so low that they may be considered to have no threshold, and are evaluated based on a blood lead level (rather than the external dose as reflected the RfD/RfC methodology). Therefore, US EPA views it to be inappropriate to develop noncarcinogenic "safe" exposure levels (i.e., RfDs) for lead. Instead, US EPA's lead assessment workgroup has recommended the use of the Integrated Exposure Uptake Biokinetic (IEUBK) model that relates measured lead concentrations in environmental media with an estimated blood-lead level (US EPA, 1994). The model is used to calculate a blood lead level in children when evaluating residential land use and in adults (based on a pregnant mother's capacity to contribute to fetal blood lead levels), or when evaluating occupational scenarios at sites where access by children is reliably restricted. The NMED SSLs presented in Appendix A include values for lead that were calculated by using the IEUBK to backcalculate a soil concentration for each receptor that would not result in an estimated blood-lead concentration of 10 μg/dL or greater.

## 2.4 Site Assessment and Characterization

The Site Assessment/Site Characterization phase is intended to provide additional spatial and contextual information about the site, which may be used to determine if there is any

reason to believe that receptors and/or complete exposure pathways may exist at or in the locality of the site where a release of hazardous waste/constituents has occurred. In addition, the site assessment phase serves as the initial information gathering phase to determine whether potential exposures are sufficiently similar to those upon which the NMED SSLs are predicated to support comparison. Finally, this phase can help to identify for sites in need of a more detailed assessment of potential risk. The approach outlined herein is discussed in greater detail in the NMED HRMB guidance document *Assessing Human Health Risks Posed by Chemicals: Screening-level Risk Assessment* (NMED, 2000). A conceptual site model (CSM) providing a list of the potentially exposed receptors and potentially complete exposure pathways in the scoping report is used to determine whether further assessment (i.e., a screening level assessment) and/or interim measures are required or whether the site poses minimal threat to human and ecological receptors at or near the site.

The ultimate purpose of the site assessment phase is to address the question: Are exposure pathways complete with regard to contaminant contact by receptors? A complete site assessment will consists of several steps:

- Develop data quality objectives and conduct site sampling
- Identify preliminary contaminants of potential concern (COPCs)
- Develop a preliminary site conceptual exposure model (SCEM)
- Compare maximum (or, if deemed appropriate by NMED, the 95% upper confidence limit (UCL) values ) for contaminant concentrations (or detection/quantitation limits for non-detect results) for consideration of complete exposure pathways with SSLs.

### 2.4.1 Development of Data Quality Objectives

Before any additional environmental samples are collected, data quality objectives (DQOs) should be developed. The DQOs should address the qualitative and quantitative nature of the sampling data, in terms of relative quality and intent for use, to ensure that any data collected will be appropriate for the intended objective. Development of the DQOs should consider not only precision, accuracy, representativeness, completeness, and comparability of the data, but also the sampling locations, types of laboratory analyses used, sensitivity of detection limits of the analytical techniques, the resulting data quality, and the employment of adequate quality assurance/quality control measures.

### 2.4.2 Identification of COPCs

COPCs are those substances (including transformation or breakdown compounds and companion products) likely to be present in environmental media affected by a release. Identification of COPCs should begin with existing knowledge of the process, product, or waste from which the release originated. For example, if facility operations deal primarily with pesticide manufacturing then pesticides should be considered COPCs. Contaminants identified during current or previous site investigation activities should also be evaluated as COPCs. A site-specific COPC list for soil may be generated based on maximum detected (or, if deemed appropriate by NMED, the 95% upper confidence limit (UCL) values) concentrations and a comparison of detection/quantitation limits for non-detect results to the NMED SSLs. This list may be refined through a site-specific risk assessment.

### 2.4.3 Development of a Preliminary Conceptual Site Model

A conceptual site model (CSM) is a graphical representation of three-dimensional site conditions that conveys what is known or suspected, at a discrete point in time, about the site-specific sources, releases, release mechanisms, contaminant fate and transport, exposure routes, and potential receptors. The CSM is generally documented by written descriptions and supported by maps, geological cross-sections, tables, diagrams and other illustrations to communicate site conditions. When preparing a CSM, the facility should decide the scope, quantity, and relevance of information to be included, balancing the need to present as complete a picture as possible to document current site conditions and justify risk management actions, with the need to keep the information focused and exclude extraneous data.

As a final check, the CSM should answer the following questions:

- Are there potential land uses present (now or in the foreseeable future) other than those covered by the SSLs (see US EPA, 1989).
- Are there other likely human exposure pathways that were not considered in development of the SSLs (e.g. direct exposure to groundwater, local fish consumption, raising beef, dairy, or other livestock)? (see US EPA, 1989)
- Are there potential ecological concerns? (*Guidance for Assessing Ecological Risks Posed by Chemicals: Screening Level Ecological Risk Assessment*; NMED, 2000)

If any conditions such as these exist, the SSLs may need to be adjusted to reflect this new information.

### 2.4.4 Compare COPC Maximum Concentrations With SSLs

The final step in the site assessment phase is to compare maximum detected COPC concentrations in soil (or, if deemed appropriate by NMED, the 95% upper confidence limit (UCL) values on the mean of the dataset (US EPA, 1992b)) with SSLs based on the complete exposure pathways identified by the preliminary CSM. These concentrations should also be compared against the SSL leaching values to determine which contaminants present in soil have the capacity to leach to underlying groundwater and impact these resources adversely. As stated earlier, those contaminants exhibiting concentrations in excess of the SSLs represent the initial soil COPC list for a given site. Refinement of this list may be necessary based on a host of factors, including elevated detection or quantitation limits.

## 3. Chemical-Specific and Physical-Chemical Parameters

Chemical-specific parameters required for calculating SSLs include the organic carbon normalized soil-water partition coefficient for organic compounds ($K_{oc}$), the soil-water partition coefficient ($K_d$), water solubility (S), octanol-water partition coefficient ($K_{ow}$), Henry's Law constant (H), diffusivity in air ($D_a$), and diffusivity in water ($D_w$). The following sections describe these values and present methodologies for calculating additional values necessary for calculating the NMED SSLs.

## 3.1 VOLATILIZATION FACTOR

Volatile chemicals, defined as those chemicals having a Henry's Law constant greater than $1 \times 10^{-5}$ atm-m$^3$/mole-°K and a molecular weight less than 200 g/mole, were screened for inhalation exposures using a volatilization factor for soils (VF). The soil-to-air VF is used to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to ambient air. The emission terms used in the VF are chemical-specific and were calculated from physical-chemical information obtained from several sources including: US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a), the US EPA Region 9 *Preliminary Remediation Goals* (US EPA, 1999b), EPA's *Basics of Pump and Treat Groundwater Remediation Technology* (US EPA, 1990), US EPA's *Dermal Exposure Assessment* (US EPA, 1992a), *Superfund Public Health Evaluation Manual* (US EPA, 1986), EPA's *Additional Environmental Fate Constants* (US EPA, 1995), Hazardous Substance Release/Health Effects Database (ATSDR, 2000), and the CHEMFACTS Database (US EPA, 2000c). The VF is calculated using Equation 10.

**Equation 10**
**Derivation of the Volatilization Factor for Residential and Commercial/Industrial Scenarios**

$$VF = \frac{Q/C_{vol} \times \left(3.14 \times D_A \times T\right)^{0.5} \times 10^{-4}}{\left(2 \times \rho_b \times D_A\right)}$$

Where:

$$D_A = \frac{\left[\dfrac{\left(\theta_a^{10/3} D_a H' + \theta_w^{10/3} D_w\right)}{n^2}\right]}{\rho_b K_d + \theta_w + \theta_a H'}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| VF | Volatilization factor (m$^3$/kg) | Chemical-specific |
| $D_A$ | Apparent diffusivity (cm$^2$/s) | Chemical-specific |
| $Q/C_{vol}$ | Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m$^2$-s per kg/m$^3$) | 68.18 |
| T | Exposure interval (s) | $9.5 \times 10^8$ |
| $\rho_b$ | Dry soil bulk density (g/cm$^3$) | 1.5 |
| n | Total soil porosity 1 - ($\rho_b/\rho_s$) | 0.43 |
| $\theta_a$ | Air-filled soil porosity (n - $\theta_w$) | 0.18 |
| $\theta_w$ | Water-filled soil porosity | 0.26 |
| $\rho_s$ | Soil particle density (g/cm$^3$) | 2.65 |
| $D_a$ | Diffusivity in air (cm$^2$/s) | Chemical-specific |
| H' | Dimensionless Henry's Law constant | Chemical-specific |
| $D_w$ | Diffusivity in water (cm$^2$/s) | Chemical-specific |
| $K_d$ | Soil-water partition coefficient (cm$^3$/g) = $K_{oc} \times f_{oc}$ (organics) | Chemical-specific |
| $K_{oc}$ | Soil organic carbon partition coefficient (cm$^3$/g) | Chemical-specific |
| $f_{oc}$ | Fraction organic carbon in soil (g/g) | 0.0015 |

While most of the parameters used to calculate apparent diffusivity ($D_A$) are either chemical-specific or default values, several state-specific values were used which are more representative of soil conditions found in New Mexico. The default values for $\theta_w$, $\theta_a$, and $\rho_b$ in Equation 10 are 0.26, 0.18 and 1.5 g/cm$^3$, respectively. These values represent the mean value from a National Resources Conservation Service (NRCS) soil survey database for New Mexico that includes over 1200 sample points (U.S. Department of Agriculture, 2000).

It should be noted that the basic principle of the VF model (Henry's Law) is applicable only if the soil contaminant concentration is at or below soil saturation, $C_{sat}$. Above the soil saturation limit, the model cannot predict an accurate VF-based SSL.

## 3.2 SOIL SATURATION LIMIT

$C_{sat}$ describes a chemical-physical soil condition that integrates certain chemical-specific properties with physical attributes of the soil to estimate the contaminant concentration at which the soil pore water, pore air, and surface sorption sites are saturated with contaminants. Above this concentration, the contaminants may be present in free phase within the soil matrix – as non-aqueous phase liquids (NAPLs) for substances that are liquid at ambient soil temperatures, and pure solid phases for compounds that are solids at ambient soil temperatures (EPA, 1996a). Generic $C_{sat}$ concentrations should not be interpreted as confirmation of a saturated soil condition, but as estimates of when this condition may occur. It should be noted that $C_{sat}$ concentrations are not risk-based values. Instead, they correspond to a theoretical threshold above which free phase contaminant may exist. $C_{sat}$ concentrations, therefore, serve to identify an upper limit to the applicability of generic risk-based soil criteria, because certain default assumptions and models used in the generic algorithms are not applicable when free phase contaminant is present in soil. Equation 11, given below is used to calculate $C_{sat}$ for each volatile contaminant considered within the SSLs.

**Equation 11**
**Derivation of the Soil Saturation Limit**

$$C_{sat} = \frac{S}{\rho_b}\left(K_d \rho_b + \theta_w + H'\theta_a\right)$$

| Parameter | Definition (units) | Default |
|---|---|---|
| $C_{sat}$ | Soil saturation concentration (mg/kg) | Chemical-specific |
| S | Solubility in water (mg/L-water) | Chemical-specific |
| $\rho_b$ | Dry soil bulk density (kg/L) | 1.5 |
| $K_d$ | Soil-water partition coefficient (L/kg; $K_{oc} \times f_{oc}$) | Chemical-specific |
| $K_{oc}$ | Soil organic carbon/water partition coefficient (L/kg) | Chemical-specific |
| $f_{oc}$ | Fraction organic carbon in soil (g/g) | 0.0015 |
| $\theta_w$ | Water-filled soil porosity | 0.26 |
| $H'$ | Dimensionless Henry's Law constant | Chemical-specific |
| $\theta_a$ | Air-filled soil porosity | $n - \theta_w$ |
| n | Total soil porosity | $1 - (\rho_b/\rho_s)$ |
| $\rho_s$ | Soil particle density (kg/L) | 2.65 |

Chemical-specific parameters used in Equation 11 were obtained from physical-chemical information obtained from several sources including: US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a), the US EPA Region 9 *Preliminary Remediation Goals* (US EPA, 1999b), US EPA's *Basics of Pump and Treat Groundwater remediation Technology* (US EPA, 1990), US EPA's *Dermal Exposure Assessment* (US EPA, 1992a), *Superfund Public Health Evaluation Manual* (US EPA, 1986), US EPA's *Additional Environmental Fate Constants* (US EPA, 1995), Hazardous Substance Release/Health Effects Database (ATSDR, 2000), and the CHEMFACTS Database.

## 3.3 PARTICULATE EMISSION FACTOR

Inhalation of chemicals adsorbed to suspended respirable particles is assessed using a chemical-specific PEF which relates the contaminant concentration in soil to the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. This guidance addresses dust generated from open sources, which is termed "fugitive" because it is not discharged into the atmosphere in a confined flow stream. For further details on the methodology associated with the PEF model, the reader is referred to US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a), *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (US EPA, 1999a) and *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (US EPA, 1998).

It is important to note that the PEF for use in evaluating exposures of the residential and commercial/industrial receptors addresses only windborne dust emissions and does not consider emissions from traffic or other forms of mechanical disturbance which could lead to a greater level of exposure. The PEF for use in evaluating the construction worker exposures considers windborne dust emissions and emissions from vehicle traffic associated with construction activities. Therefore, the fugitive dust pathway should be considered carefully when developing the CSM at sites where receptors may be exposed to fugitive dusts by other mechanisms. Equation 12 is used to calculate a generic PEF value used for both the residential and commercial/industrial exposure scenarios. A scenario-specific PEF value was calculated for a construction worker receptor using Equation 13.

**Equation 12**
**Derivation of the Particulate Emission Factor**
**Residential and Commercial/Industrial Scenarios**

$$PEF = Q / C_{wind} \times \frac{3{,}600 \text{ sec / hr}}{0.036 \times (1 - V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x)}$$

| Parameter | Definition (units) | Default |
|---|---|---|
| PEF | Particulate emission factor ($m^3/kg$) | $1.36 \times 10^9$ |
| $Q/C_{wind}$ | Inverse of a mean concentration at center of a 0.5-acre-square source ($g/m^2$-s per $kg/m^3$) | 93.77 |
| V | Fraction of vegetative cover (unitless) | 0.5 |
| $U_m$ | Mean annual windspeed (m/s) | 4.69 |
| $U_t$ | Equivalent threshold value of windspeed at 7 m (m/s) | 11.32 |
| F(x) | Function dependent on Um/Ut derived using Cowherd et al. (1985) (unitless) | 0.194 |

**Equation 13**
**Derivation of the Particulate Emission Factor**
**Construction Worker Scenario**

$$PEF_{CW} = Q / C_{CW} \times \frac{1}{F_D} \left[ \frac{T \times A_R}{556 \times \left(\frac{W}{3}\right)^{0.4} \times \frac{(365 \text{ days/yr} - P)}{365 \text{ days/yr}} \times \sum VKT} \right]$$

| Parameter | Definition (units) | Default |
|---|---|---|
| $PEF_{CW}$ | Particulate emission factor ($m^3/kg$) | 81.9 |
| $Q/C_{CW}$ | Inverse of a mean concentration at center of a 0.5-acre-square source ($g/m^2$-s per $kg/m^3$) | 23.02 |
| $F_D$ | Dispersion correction factor (unitless) | 0.185 |
| T | Total time over which construction occurs | 250 |
| $A_R$ | Surface area of road segment ($m^2$) | 274.2 |
| W | Mean vehicle weight (tons) | 8 |
| P | Number of days with at least 0.01 inches of precipitation (days/yr) | 80 |
| ΣVKT | sum of fleet vehicle kilometers traveled during the exposure duration (km) | 162 |

## 3.4 PHYSICAL-CHEMICAL PARAMETERS

Several chemical-specific parameters are required for calculating SSLs including the organic carbon normalized soil-organic carbon/water partition coefficients for organic compounds ($K_{oc}$), the soil-water partition coefficient for organic and inorganic constituents ($K_d$), the solubility of a compound in water (S), Henry's Law constant (H), air diffusivity ($D_a$), water diffusivity ($D_w$), and the octanol-water partition coefficient ($K_{ow}$). Prior to calculating site-specific SSLs, each relevant chemical specific parameter value presented in Appendix B

should be checked against the most recent version of its source to determine if updated data are available. Table B-1 in Appendix B provides the chemical-specific parameters used in calculating the NMED SSLs.

Chemical-specific values were obtained from EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a), the EPA Region 9 *Preliminary Remediation Goals* (US EPA, 1999b), US EPA's *Basics of Pump and Treat Groundwater remediation Technology* (US EPA, 1990), US EPA's *Dermal Exposure Assessment* (US EPA, 1992a), *Superfund Public Health Evaluation Manual* (US EPA, 1986), US EPA's *Additional Environmental Fate Constants* (US EPA, 1995), Hazardous Substance Release/Health Effects Database (ATSDR, 2000), and the CHEMFACTS Database.

### 3.4.1 Solubility, Henry's Law Constant, and $K_{ow}$

The solubility of a contaminant refers to the maximum amount that can be dissolved in a fixed volume of a solvent, usually pure water, at a specific temperature and pH. A chemical with a high solubility readily dissolves in water, while a low solubility indicates an inability to dissolve. Water solubility is generally predicted based on correlations with the octanol-water partition coefficient ($K_{ow}$). Solubility is used to calculate soil saturation limits for the NMED SSLs.

The octanol-water partition coefficient ($K_{ow}$) of a chemical is the ratio of a chemical's solubility in octanol versus its solubility in water at equilibrium. Essentially, this chemical-specific property is used as an indication of a contaminant's propensity to migrate from soil to water. It is an important parameter and is used in the assessment of environmental fate and transport for organic chemicals.

The Henry's Law constant (H) is used when evaluating air exposure pathways. For all chemicals that are capable of exchanging across the air-water interface, there is a point at which the rate of volatilization into the air and dissolution to the water or soil will be equal. The ratio of gas- and liquid-phase concentrations of the chemical at this equilibrium point is represented by H, which is used to determine the rate at which a contaminant will volatilize from soil to air. Values for H may be calculated using the following equation and the values for solubility (S), vapor pressure (VP), and molecular weight (MW).

$$H = \frac{VP \times MW}{S}$$

The dimensionless form of Henry's Law constant (H') used in calculating soil saturation limits and volatilization factors for the NMED SSLs was calculated by multiplying H by a factor of 41 to convert the Henry's Law constant to a unitless value.

### 3.4.2 Soil Organic Carbon/Water Partition Coefficients ($K_{oc}$)

The soil organic carbon-water partition coefficient ($K_{oc}$) is a measure of a chemical's tendency to adsorb to organic carbon present in soil. High $K_{oc}$ values indicate a tendency for the chemical to adsorb to soil particles rather than remain dissolved in the soil solution. Strongly adsorbed molecules will not unless the soil particle to which they are adsorbed

moves (as in erosion). $K_{oc}$ values of less than 500 indicate weak adsorption and a potential for leaching. $K_{oc}$ is calculated using the following equation:

$$K_{oc} = \frac{\text{conc. adsorbed/conc. dissolved}}{\text{\% organic carbon in soil}}$$

$K_{oc}$ can also be calculated by dividing the $K_d$ value by the fraction of organic carbon ($f_{oc}$)present in the soil or sediment. It should be noted that a strong linear relationship exists between $K_{oc}$ and $K_{ow}$ and that this relationship can be used to predict $K_{oc}$.

### 3.4.3 Soil/Water Partition Coefficients ($K_d$)

Soil-water partition coefficient ($K_d$) for organic chemicals is the ratio of a contaminant's distribution between soil and water particles. The soil-water partitioning behavior of nonionizing and ionizing organic compounds differs because the partitioning of ionizing organics can be influenced by soil pH. $K_d$ values were used in calculating soil saturation limits and volatilization factors used in developing the NMED SSLs.

For organic compounds, $K_d$ represents the tendency of a chemical to adsorb to the organic carbon fraction in soils, and is represented by

$$K_d = K_{oc} \text{ x } f_{oc}$$

where

$K_{oc}$= organic carbon partition coefficient (L/kg)
$f_{oc}$ = fraction of organic carbon in soil (mg/mg)

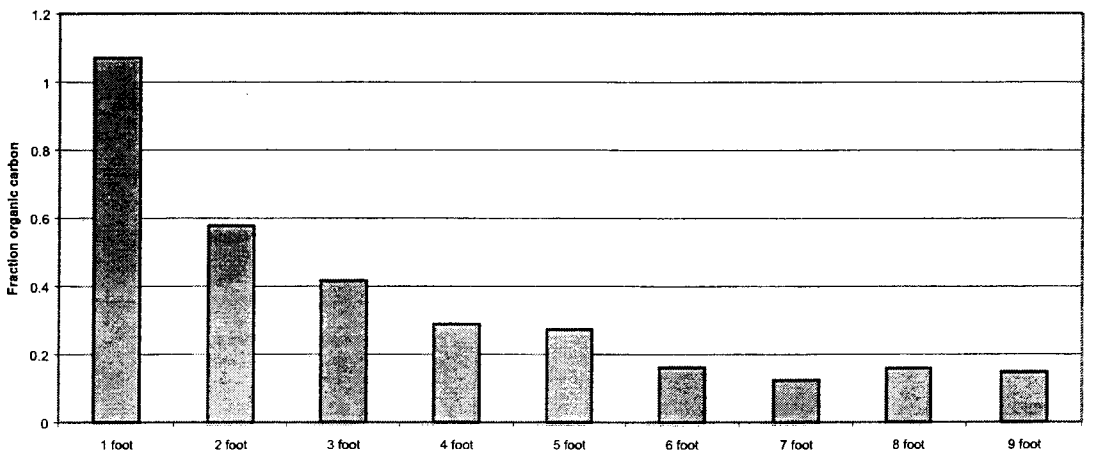
This relationship is generally valid for volatile halogenated hydrocarbons as long as the fraction of organic carbon in soil is above approximately 0.001 (0.1 percent) (Piwoni and Banaerjee, 1989; Schwarzenbach and Westall, 1981). For low organic carbon soils ($f_{oc}$ < 0.001), Piwoni and Banerjee (1989) developed the following empirical correlation for organic chemicals:

$$\log K_d = 1.01 \log K_{ow} - 0.36$$

The use of a fixed $K_{oc}$ value in the soil-water partition equation for the migration to groundwater pathway is only valid for hydrophobic non-ionizing organic chemicals. For organic chemicals that ionize in the soil environment, existing in both neutral and ionized forms within the normal soil pH range, $K_{oc}$ values must consider the relative proportions and differences in sorptive properties of these forms. For the equations and applications of developing $K_{oc}$ values for ionizing organic acids as a function of pH, the reader is referred to US EPA, 1996. The default value used for $f_{oc}$ in development of NMED SSLs is 0.0015 (0.15%). This value represents the median value of 212 data points included in the National

Resource Conservation Service (NRCS) soil survey database for New Mexico (U.S. Department of Agriculture, 2000). Only samples collected from a depth of greater than 5 feet were included in the calculation of the mean $f_{oc}$ value. Shallow soil samples tend to have higher $f_{oc}$ values as shown in Figure 2.1. There is a steady decline in $f_{oc}$ value with depth until approximately 5 feet bgs. Below 5 feet, there is little variability in the $f_{oc}$ value. Because a lower $f_{oc}$ value provides a more conservative calculation of SSL, a value representative of deeper soil conditions is used as the default value.

**Figure 2-1 Mean Value - Fraction Organic Carbon ($f_{oc}$)- All counties in New Mexico**




As with organic chemicals, development of the NMED SSLs for inorganic constituents (i.e., metals) requires a soil-water partition coefficient ($K_d$) for each contaminant. $K_d$ values for metals are affected by a variety of soil conditions, most notably pH, oxidation-reduction conditions, iron oxide content, soil organic matter content, cation exchange capacity and major ion chemistry. US EPA developed default $K_d$ values for metals using either an equilibrium geochemical speciation model (MINTEQ2) or from empirical pH-dependent adsorption relationships developed by EPA/ORD (US EPA, 1996a).

## 4. Migration of Contaminants to Groundwater

Generic SSLs were developed which address the potential for migration of contaminants from soil to groundwater. The methodology used to calculate generic SSLs addresses the potential leaching of contaminants from the vadose zone to groundwater in excess of New Mexico WQCC standards. This method does not take into account any additional attenuation associated with contaminant transport in groundwater. The SSLs developed from this analysis are based on New Mexico specific values and are protective of groundwater under a wide range of site conditions. This methodology is modeled after US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a).

### 4.1.1 Overview of the SSL Model Approach

Two approaches to developing soil leachate-based SSLs are presented, the generic model and the site-specific model. Both models use the same set of equations to calculate SSLs and are based on leaching to groundwater scenarios that NMED believes are protective of groundwater. The generic model calculates SSLs using default parameter values generally representative of conditions in New Mexico. These values are presented in Table B-1 of Appendix B. The site-specific model provides the flexibility of using site-specific meteorological, soil and hydrological data to calculate SSLs, while retaining the simplicity and ease of use associated with the generic model.

The development of soil leachate SSLs is based upon a two step process. The first step is the development of a Dilution Attenuation Factor (DAF). The DAF accounts for leachate mixing in the aquifer. A leachate concentration that is protective of ground water is back calculated by multiplying the ground water standard for a given constituent by the DAF. That leachate concentration is then used to back calculate an SSL that is protective of groundwater using a simple linear equilibrium soil/water partition equation. For the generic SSL approach, default parameter values are used for all non-chemical specific parameters. At sites that are not adequately represented by the default values and where more site-specific data are available, it may be more appropriate to use the site-specific SSL model. The site-specific model uses the same spreadsheet equations to calculate SSLs as those in the generic look-up table. However, site-specific data are used in the site-specific model.

The following sections of this document provide a general description of the leaching to groundwater pathway SSL model (generic and site-specific) including the assumptions, equations, and input parameters. Justification for the default parameters used in the generic model is also provided. Additionally, a sensitivity analysis was performed on each of the input parameters to provide guidance on when use of the site-specific model may be warranted. Applicability and limitations of the generic and site-specific models are also presented.

### 4.1.2 Model Assumptions

Assumptions regarding the release and distribution of contaminants in the subsurface that are incorporated into the SSL methodology include the following.

- The source is infinite (a constant concentration is maintained for the duration of the exposure period).
- Contamination is uniformly distributed from the surface to the water table.
- Soil/water partitioning is instantaneous and follows a linear equilibrium isotherm.
- There is no attenuation of the contaminant in soil or the aquifer (i.e., irreversible adsorption, chemical transformation or biological degradation,).
- The potentially impacted aquifer is unconfined and unconsolidated with homogenous and isotropic hydrologic properties.

- The receptor well (point of exposure) is at the downgradient edge of the source and is screened within the potentially impacted aquifer.
- Non-aqueous phase liquids (NAPLs) are not present.

### 4.1.3 Soil Water Partition Equation

US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a) developed an equation to estimate contaminant release in soil leachate based on the Freundlich adsorption isotherm. The Freundlich equation was modified to relate the sorbed concentration to the total concentration measured in a soil sample (which includes contaminants associated with solid soil, soil-water and soil-air components) (Feenstra, 1991). Equation 14, given below, is used to calculate SSLs corresponding to target soil leachate concentrations ($C_w$).

**Equation 14**
**Soil Screening Level For Leaching To Groundwater Pathway**

$$SSL = C_w \text{ x} \left[ K_d + \left( \frac{\theta_w + \theta_a H'}{\rho_b} \right) \right]$$

| Parameter | Definition (units) | Default |
|---|---|---|
| SSL | Soil Screening Level for migration to groundwater pathway (mg/kg) | Chemical-Specific |
| $C_w$ | Target soil leachate concentration (mg/L) | Chemical-Specific |
| $K_d$ | Soil /water partition coefficient (L/kg) | Chemical-Specific |
| $\theta_w$ | Water-filled soil porosity ($L_{water}/L_{soil}$) | 0.26 |
| $\theta_a$ | Air-filled soil porosity ($L_{air}/L_{soil}$) | $n - \theta_w$ |
| n | Total soil porosity ($L_{pore}/L_{soil}$) | $1 - (\rho_b/\rho_s)$ |
| $\rho_s$ | Soil particle density (g/cm$^3$) | 2.65 |
| $\rho_b$ | Dry soil bulk density (kg/L) | 1.5 |
| H′ | Dimensionless Henry's Law constant | Chemical-Specific |

Target soil leachate concentrations ($C_w$) are equivalent to the WQCC standards multiplied by a Dilution Attenuation Factor (DAF).

$$C_w = \text{WQCC x DAF}$$

The derivation of the DAF is discussed in subsequent sections of this document.

### 4.1.4 Dilution Attenuation Factor

Contaminants transported as a leachate through soil to groundwater are affected by physical, chemical and biological processes that can significantly reduce their concentration. These processes include adsorption, biological degradation, chemical transformation and dilution from mixing of the leachate with groundwater. The total reduction in concentration between the source of the contaminant (vadose zone soil) and the point of ground water withdrawal is defined as the ratio of contaminant concentration in soil leachate to the

concentration in groundwater at the point of withdrawal. This ratio is termed a dilution/attenuation factor (DAF; US EPA, 1996a and 1996b). The higher the DAF value, the greater the degree of dilution and attenuation of contaminants along the migration flowpath. A DAF of 1 implies no reduction in contaminant concentration occurs.

Development of New Mexico SSLs considers only the dilution of contaminant concentration through mixing with groundwater in the aquifer directly beneath the source. This is consistent with the conservative assumptions used in the SSL methodology including an infinite source, soil contamination extending from surface to groundwater and the point of exposure occurring at the downgradient edge of the source. The ratio of contaminant concentration in soil leachate to the concentration in groundwater at the point of withdrawal that considers only dilution processes is calculated from a simple water balance equation (Equation 15), described below.

**Equation 15**
**Dilution/Attenuation Factor (DAF)**

$$DAF = 1 + \left( \frac{K \times i \times D}{I \times L} \right)$$

Where:

$$D = \left(0.0112 \times L^2\right)^{0.5} + D_a \left( 1 - \exp\left[ \frac{-L \times I}{K \times i \times D_a} \right] \right)$$

| Parameter | Definition (units) | Default |
|---|---|---|
| DAF | Dilution/attenuation factor (unitless) | Site-Specific |
| K | Aquifer hydraulic conductivity (m/yr) | Site-Specific |
| i | Hydraulic gradient (m/m) | Site-Specific |
| D | Mixing zone depth (m) | Site-Specific |
| I | Infiltration rate (m/yr) | Site-Specific |
| L | Source length parallel to groundwater flow (m) | Site-Specific |
| $D_a$ | Aquifer thickness (m) | Site-Specific |

Most of these parameters are available from routine environmental site investigations. The mixing zone depth incorporates one additional parameter, the aquifer thickness ($D_a$).

For the calculation of SSLs, the DAF is used to back calculate the target soil leachate concentration from an appropriate groundwater concentration, such as the WQCC standard ($C_w$ in Equation 14). For example, if the WQCC standard for a constituent is 0.1 mg/L and the DAF is 20, the target soil leachate concentration would be 2 mg/L.

The US EPA conducted an extensive evaluation of the range and distribution of DAFs to select a default value to be used for developing generic SSLs that would be reasonably protective of groundwater quality (US EPA, 1996a and 1996b). The evaluation included a probabilistic modeling exercise using US EPA's Composite Model for Leachate Migration

with Transformation Products (CMTP). A cumulative frequency distribution of DAF values was developed from the model output. Results of the Monte Carlo modeling analysis indicate that for a 0.5 acre source area a DAF of approximately 170 is protective of groundwater at 90 percent of the sites. Groundwater is protected at 95 percent of the sites with a DAF of 7.

US EPA applied the simple SSL water balance dilution model (Equation 15) to 300 sites included in surveys of hydrogeologic investigations to further evaluate the range and distribution of DAF values. Results of this analysis indicated that a DAF of 10 was protective of groundwater for a 30-acre source and that a DAF of 20 was protective of groundwater for a 0.5 acre-source (US EPA, 1996a and 1996b).

An assessment was performed of US EPA's methodology to determine whether a default DAF value of 20 for a 0.5 acre source, and a DAF of 10 for a 30 acre source, would be appropriate for use as default values for sites in New Mexico. Typical New Mexico conditions may be notably different than conditions represented by areas included in the US EPA analysis of DAFs. For example, infiltration rates across much of New Mexico are substantially less than the average range of 0.15 to 0.24 m/yr reported for many of the hydrogeologic regions used in the US EPA analysis. In addition, effective porosity was assumed to be 0.35, presumably because this value is representative of the most prevalent aquifer type in the databases used (US EPA, 1996a). However, the regions included in the EPA analysis also contain extensive glacial, regolith, lacustrine, swamp and marsh deposits which have high percentages of fine-grained sediments and thus are not representative of typical New Mexico sandy soils. Sandy soils typically have higher hydraulic conductivities than more fine-grained soils and subsequently higher Darcian velocities, under equal hydraulic gradient. According to the DAF equation (Equation 15), soils with relatively greater hydraulic conductivities will tend to result in a higher calculated DAF.

An assessment was made of input parameters to the DAF equation. In order to support a DAF that is protective of the most vulnerable groundwater environments in New Mexico (i.e. areas close to perennial streams or where ground water is very shallow), environmental parameters typical of those areas in New Mexico were used to assess the DAF. This assessment indicated that the DAF is most sensitive to variations in hydraulic conductivity. This is because this value shows such large variations in the natural environment. If a hydraulic conductivity value representative of a fine grained sand is used in the DAF equation, along with an infiltration rate representative of New Mexico's arid to semi-arid environments, then the result is a DAF of approximately 20. NMED believes that a DAF of 20 for a 0.5 acre source area is protective of groundwater in New Mexico. If the default DAF is not representative of conditions at a specific site, then it is appropriate to calculate a site-specific DAF based upon available site data.

#### 4.1.5 Limitations on the Use of the Dilution Attenuation Factor

Because of assumptions used in SSL model approach, use of the DAF model may be inappropriate for certain conditions, including sites where:

- adsorption or degradation processes are expected to significantly attenuate contaminant concentrations in the soil or aquifer media;
- Saturated thickness is significantly less than 12 meters thick;
- fractured rock or karst aquifer types exist (violates the unconfined, unconsolidated, homogeneous, isotropic assumptions);
- facilitated transport is significant (colloidal transport, transport via dissolved organic matter, or transport via solvents other than water;
- NAPLs are present.

For sites that have these types of conditions, consideration should be given to application of a more detailed site-specific analysis than either the generic or site specific models described herein. A discussion of these types of models is presented in Section 4.1.9.

#### 4.1.6 Generic SSLs for Protection of Groundwater

The migration to groundwater pathway model, incorporating the assumptions, soil-water partition equation and the DAF, was used to develop NMED SSLs. Default values based on conditions predominant in New Mexico were used for the input parameters in the soil-water partition equation. The NMED SSLs were developed using default DAF values of 1 and 20.

Target soil leachate concentrations ($C_w$) are equivalent to the appropriate groundwater standards multiplied by a DAF. To maintain an approach that is protective of groundwater quality in the development of generic SSLs, a DAF of 20 is selected as reasonably protective. However SSLs are provided for two DAFs in Appendix A. The use of the SSL listed for a DAF of 20 is advised unless site-specific data on hydrologic conditions are available, and these indicate that the generic DAF is not representative of site conditions. As will be demonstrated in the sensitivity analysis section of this document, calculation of an SSL using the migration to groundwater pathway model is most sensitive to the DAF. The inclusion of the SSL for a DAF of 1 is provided for convenience to the user. If data on hydrologic conditions are readily available, a site specific DAF can be calculated and multiplied by the generic SSL for a DAF of 1 to provide a site-specific SSL.

The generic approach may be inappropriate for use at sites where conditions are substantially different from the default values used to develop the generic soil leachate SSLs.

#### 4.1.7 Development of Site Specific SSLs for Protection of Groundwater

New Mexico, as with any other state, offers a variety of geologic and hydrologic conditions that may not be readily represented by a single default parameter value.

Site specific conditions may differ considerably from the typical or average conditions represented by the default values used to calculate generic SSLs. The site-specific model can

be used to address the variability inherent in environmental conditions across and within the state.

Application of the site-specific model to develop soil leachate SSLs is the same as the generic approach except that site-specific values are used. Use of the site-specific model approach may incorporate replacement of all default values used for the generic SSLs with site-specific values, or may only include substitution of a single key parameter, such as hydraulic conductivity. The decision to use the site-specific model approach instead of the generic approach should be based on consideration of the sensitivity of the calculated SSL to specific parameters and the availability of those parameters as site-specific data. Sufficient site-specific data may be available such that each of the default values used for developing generic SSLs can be readily substituted with a more representative site-derived value. Conversely, limited site-specific data may restrict the number of default values to be replaced.

The NMED SSLs are generally more sensitive to the dilution factor than to other parameters in the soil-water partition equation. Fortunately, information needed to derive the DAF is usually available for sites that have undergone even the most basic levels of environmental investigation. Apart from the dilution factor, SSLs are most sensitive to the soil-water partition coefficient ($K_d$) as the values for this parameter can range over several orders of magnitude, particularly for metals. Although the $K_d$ term may be critical in developing protective SSLs, information required to evaluate this parameter is more difficult to obtain and less likely to be available. Porosity and bulk density are not particularly sensitive because of the relatively small range of values encountered in subsurface conditions.

Using benzene as a representative contaminant, a sensitivity analysis was performed to compare a generic soil leachate SSL to site-specific model results simulating a range of model input parameters that might be representative of different conditions in New Mexico. The generic soil leachate SSL calculated using the New Mexico default values and a DAF of 1 is 2.8 μg/kg. These results are summarized in Table 4-1. As shown, the resulting SSLs for benzene range from 1.3 to 6.1 μg/kg for the various sensitivity simulations compared to the generic SSL of 2.8 μg/kg. These results indicate that the calculation of SSLs using the site-specific approach is not overly sensitive to the reasonable range of porosity (air and water filled), bulk density and fraction of organic carbon expected for New Mexico or even for a range of values for chemical-specific properties. The generic SSL for benzene of 2.8 μg/kg is representative of values that could be calculated using a spectrum of input parameters, exclusive of the DAF term. Unless there are sufficient data to calculate a site-specific DAF, there is little benefit derived from using the site-specific model approach instead of the generic SSL.

**Table 4-1**

| Input Parameters and Resulting SSLs for the Sensitivity Analysis of the Soil-Water Partition Equation - Migration to Groundwater Pathway Model | | |
|---|---|---|
| **Input parameter (NMED default value)** | **Sensitivity Analysis Values** | **Resulting SSLs** |
| Bulk density (default value = 1.55 gm/cm) | Lower Limit = 1.20<br>Upper Limit = 1.90 | 3.4<br>2.5 |
| Air filled porosity (default value = 0.18) | Lower Limit = 0.04[a]<br>Upper Limit = 0.25[b] | 1.3<br>3.5 |
| Fraction organic carbon (default value = 0.0015) | Lower Limit = 0.0005<br>Upper Limit = 0.007 | 2.2<br>6.1 |
| Volume water content (default value = 0.26) | Lower Limit = 0.05[c]<br>Upper Limit = 0.40[c] | 1.8<br>3.5 |
| $K_{oc}$ (default value = 58.9 ml/g) | Lower Limit = 30<br>Upper Limit = 120 | 2.4<br>3.7 |
| Dimensionless Henry's Law constant (default value = 0.228) | Lower Limit = 0.1<br>Upper Limit = 0.4 | 2.7<br>3.0 |

[a] total porosity was reduced from 0.44 to 0.10 for this simulation
[b] total porosity was increased from 0.44 to 0.6 for this simulation
[c] total porosity remained at 0.44 for this simulation.

As previously stated, calculation of SSLs is most sensitive to the DAF term. The input parameter values and resulting DAFs for the sensitivity analysis are included in Table 4-2. Effects on the DAFs are, from greatest to least, the Darcian velocity (hydraulic conductivity multiplied by the hydraulic gradient), infiltration rates, size of the contaminated area, and the aquifer thickness. Corresponding effects on DAFs for each of these parameters and discussion of the relevance of the use of default values versus site-specific conditions are summarized below:

**Table 4-2**

| Input Parameters and Resulting DAFs for the Sensitivity Analysis of the Dilution Attenuation Factor-Migration to Groundwater Pathway Model | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Groundwater Velocity (m/yr)** | **Infiltration Rate (m/yr)** | **Source Length (m)** | **Aquifer thickness (m)** | **Mixing Zone Depth (m)** | **Dilution Attenuation Factor (DAF)** |
| Groundwater velocity | 2.2 | 0.13 | 45 | 12 | 7.15 | 3.7 |
| Groundwater velocity | 22 | 0.13 | 45 | 12 | 5.03 | 19.9 |
| Groundwater velocity | 220 | 0.13 | 45 | 12 | 4.79 | 181.1 |
| | | | | | | |
| Infiltration Rate | 22 | 0.065 | 45 | 12 | 4.89 | 37.8 |
| Infiltration Rate | 22 | 0.13 | 45 | 12 | 5.03 | 19.9 |
| Infiltration Rate | 22 | 0.26 | 45 | 12 | 5.28 | 10.9 |
| | | | | | | |
| Source Length | 22 | 0.13 | 22.5 | 12 | 2.51 | 19.9 |
| Source Length | 22 | 0.13 | 45 | 12 | 5.03 | 19.9 |
| Source Length | 22 | 0.13 | 348.4 | 12 | 38.76* | 6.8 |
| | | | | | | |
| Aquifer Thickness | 22 | 0.13 | 45 | 3 | 5.02* | 12.3 |
| Aquifer Thickness | 22 | 0.13 | 45 | 12 | 5.03 | 19.9 |
| Aquifer Thickness | 22 | 0.13 | 45 | 48 | 5.03 | 19.9 |

Note: If mixing zone depth calculation is greater than aquifer thickness, then aquifer thickness is used to calculate the DAF.

Higher Darcian velocity results in higher DAFs. Slower mixing of groundwater with soil leachate occurs at lower groundwater velocity. Thus, using a lower velocity will be a more conservative approach. Sandy soils typically have higher hydraulic conductivities than more fine grained soils and subsequently higher Darcian velocity (under equal hydraulic gradient).

Use of a sandy soil type will generally be less conservative (result in higher DAFs) with respect to protection of groundwater quality.

Lower infiltration rates result in higher DAFs. Therefore, using a higher infiltration rate is a more conservative approach (results in a lower DAF).

Larger source sizes result in lower DAFs. The default DAF used to develop SSLs for a 0.5 acre source may not be protective of groundwater at sites larger than 0.5 acre. However, the selection of a second source size is arbitrary. If generic SSLs are developed for a 30 acre source, then those values are considered overly conservative for a 12 acre source. Conversely, SSLs developed for a 30 acre source will be less protective of a 40 acre source. Rather than develop a separate set of generic SSLs for a second (or third or fourth) source size, the following two approaches are proposed.

- As the size of the source area increases, the assumptions underlying the generic model are less applicable. One of the conservative assumptions in the generic SSL approach is the uniform distribution of contaminants throughout the vadose zone. There are few sites that have relatively uniform soil contamination (both laterally and vertically) of a single constituent in an area of greater than 0.5 acres (22,000 $ft^2$). Soil contamination at large facilities (such as federal facilities) are usually concentrated in discrete portions of the site. Contamination at large sites is commonly the result of multiple sources. It is advisable to attempt to subdivide the facility by source and contaminant type and then apply generic SSLs to those smaller source areas.

- If this approach is not practical, calculation of site specific DAFs is recommended. Most of the parameters required for these calculations are available from routine environmental site investigations or can be reasonably estimated from general geologic and hydrologic studies.

Thin aquifers will result in lower DAFs. The nominal aquifer thickness used in the sensitivity analysis was 12 m. Reducing the aquifer thickness to 3 m results in a 40 percent reduction in the DAF. Increasing the aquifer thickness beyond the nominal value has very little impact.

The significant effects of the DAF on the calculation of SSLs, coupled with the common availability of site-specific data used to calculate the DAF, suggest that use of the site specific modeling approach should at least incorporate recalculation of the DAF term. If data are available that indicate soil properties significantly different than the default values (such as high or low $f_{oc}$ for organic contaminants, or highly acidic or basic conditions for metal contaminants) the $K_d$ term should also be evaluated and recalculated.

#### 4.1.8 Detailed Model Analysis for SSL Development

Sites that have complex or heterogeneous subsurface conditions may require more detailed evaluation for development of SSLs that are reasonably, but not overly, protective of

groundwater and surface water resources. These types of sites may require more complex models that can address a wide range of variability in environmental site conditions including soil properties, contaminant mass concentration and distribution, contaminant degradation and transformation, recharge rates and recharge concentration, and depth to the water table. Model codes suitable for these types of more detailed analysis range from simple one-dimensional analytical models to complex three-dimensional numerical models. Resource requirements (data, time and cost) increase for the more complex codes. The selection of an appropriate code needs to balance the required accuracy of the output with the level of effort necessary to develop the model.

#### 4.1.9 Summary of the Migration to Groundwater Pathway SSLs

SSLs for New Mexico have been developed for the migration to groundwater pathway, and are provided in Table A-1 of Appendix A. The NMED SSLs were developed using default parameter values representative of environmental conditions in New Mexico and utilize a DAF of 20. This approach maintains the conservative approach of the SSL methodology and is protective of groundwater quality under a wide range of site conditions. Soil contaminant concentrations can be compared directly to the generic SSLs to determine if additional investigation is necessary to evaluate potential leaching and migration of contaminants from the vadose zone to groundwater in excess of WQCC standards.

Site-specific SSLs can be developed by substituting site-related data for the default values in the leaching to groundwater pathway model. SSLs developed from this model are most sensitive to the DAF. SSLs are also provided in the lookup table for a DAF of 1. If data on hydrologic conditions are readily available, a site specific DAF can be calculated and multiplied by the generic SSL for a DAF of 1 to provide a site specific SSL.

## 5. Use of the SSLs

For screening sites with multiple contaminants, the following procedure should be followed: take the site-specific concentration (represented by the maximum reported concentration or, if deemed appropriate by NMED, the 95% upper confidence limit (UCL) value for the concentration) and divide by the SSL concentration for each analyte. For multiple contaminants, simply add the ratio for each chemical.

$$\text{Site Risk} = \left( \frac{\text{conc}_x}{\text{SSL}_x} + \frac{\text{conc}_y}{\text{SSL}_y} + \frac{\text{conc}_z}{\text{SSL}_z} + \ldots + \frac{\text{conc}_i}{\text{SSL}_i} \right)$$

If the total ratio is greater than 1, then the concentrations at the site warrant further, site-specific evaluation. A ratio less than 1 indicates that the concentrations at the site are unlikely to result in adverse health impacts, or contaminate groundwater above State of New Mexico water quality standards.

As with any risk-based tool, the potential exists for misapplication. In most cases the root cause will be a lack of understanding of the intended use of NMED SSLs. In order to prevent misuse of SSLs, the following should be avoided:

- Applying SSLs to a site without adequately developing a conceptual site model that identifies relevant exposure pathways and exposure scenarios,

- Use of SSLs as cleanup levels without verifying numbers with a toxicologist or risk assessor, and

- Not considering the effects of additivity when screening multiple chemicals.

It is important to note that the generic NMED SSLs were developed assuming distinct soil horizons for each receptor. The soils of interest differ according to the exposure pathway being addressed. For direct ingestion, dermal, and fugitive dust pathways, the primary soil horizon of concern are surface soils. For inhalation of volatiles and migration to groundwater, subsurface soils are of primary concern. Both a residential receptor and a commercial/industrial worker are typically exposed only to surface soil, which may be defined as extending to a depth of approximately two feet below ground surface, depending on site-specific conditions and the amount of intrusive activity that may occur. Construction workers will typically have much greater exposures to subsurface soils. Therefore, when generic SSLs are used for screening level evaluations at a facility, site-specific conditions must be evaluated for each receptor to determine if the assumptions associated with the generic SSLs are appropriate for comparison with the available site data.

## References

Scharwzenbach, R.P. and J.C. Westall. 1981. *Transport of non-polar organic compounds from surface water to groundwater.* Environmental Science Technology, vol. 15, no.1, pp. 1360-1367.

Enfield, C. G., R.F. Carsel, S.E. Cohen, T. Phan, and D.M. Walters. 1982. *Approximating Pollutant Transport to Ground Water.* Groundwater, vol. 20, no. 6, pp. 711-722.

United States Environmental Protection Agency. 1986. *Superfund Public Health Evaluation Manual.* Office of Emergency and Remedial Response and Office of Solid Waste and Emergency Response. Washington, D.C.

United States Environmental Protection Agency. 1988. *Superfund Exposure Assessment Manual* (EPA/540/1-88/001). Office of Emergency and Remedial Response, Washington, D.C.

Piwoni, M.D., and P. Banaerjee. 1989. *Sorption of organic solvents from aqueous solution onto subsurface solids.* Journal of Contaminant Hydrology, vol. 4, no. 2, pp 163-179.

United States Environmental Protection Agency. 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Interim Final* (EPA/540/1-89/002). Office of Emergency and Remedial Response, Washington, D.C.

United States Environmental Protection Agency. 1990. *Basics of Pump and Treat Groundwater remediation Technology* (EPA/600/8-90/003) Office of Research and Development. March.

Feenstra, S., D.M. Mackay and J.D. Cherry, 1991. *A method for assessing residual NAPL based on organic chemical concentrations in soil samples.* Groundwater Monitoring Review, vol. 11, no. 2, pp 128-136.

United States Environmental Protection Agency. 1991. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim Final* (EPA 9285.6-03). Office of Emergency and Remedial Response, Washington, D.C.

United States Environmental Protection Agency. 1992a. *Dermal Exposure Assessment: Principles and Applications* (EPA600/8-91/011B). Office of Health and Environmental Assessment, Washington, D.C.

United States Environmental Protection Agency. 1992b. *Supplemental Guidance to RAGS: Calculating the Concentration Term* (9285.7-081). Office of Solid Waste and Emergency Response, Washington, D.C.

United States Environmental Protection Agency. 1994. *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA/540/F-94/043). Office of Solid Waste and Emergency Response. Washington, D.C.

United States Environmental Protection Agency. 1995. *Additional Environmental Fate Constants*. Office of Emergency and Remedial Response, Washington D.C.

United States Environmental Protection Agency. 1996a. *Soil Screening Guidance. Technical Background Document* (EPA/540/R95/128). Office of Emergency and Remedial Response, Washington D.C.

United States Environmental Protection Agency. 1996b. *Soil Screening Guidance. Users Guide, Second Edition* (EPA 9355.4-23). Office of Emergency and Remedial Response, Washington D.C.

United States Environmental Protection Agency. 1996c. *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Associated with Adult to Lead in Soil.* December.

United States Environmental Protection Agency. 1997a. *Health Effects Assessment Summary Tables: FY 1997 Update* (HEAST). National Center for Environmental Assessment, Office of Research and Development and Office of Emergency and Remedial Response, Washington, D.C.

United States Environmental Protection Agency. 1997b. *Exposure Factors Handbook*, (EPA/600/P-95/002Fa). Office of Research and Development, Washington, D.C.

United States Environmental Protection Agency. 1998. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft* (EPA/530/D-98/001a). Office of Solid Waste and Emergency Response, Washington, D.C.

United States Environmental Protection Agency. 1999a. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Internal Draft.* Office of Emergency and Remedial Response, Washington, D.C.

United States Environmental Protection Agency, Region 9. 1999b. *EPA Region 9 Preliminary Remediation Goals*. San Francisco, California.

Center for Disease Control, Agency for Toxic Substances and Disease Registry. 2000. *Hazardous Substances Database.* http://www.atsdr.cdc.gov/hazdat.html

New Mexico Environment Department, Hazardous and Radioactive Materials Bureau. 2000. *Assessing Human Health Risks Posed by Chemicals: Screening-level Risk Assessment.* Santa Fe, New Mexico.

United States Department of Agriculture, 2000. *National Resources Conservation Service, Soil Survey Laboratory Database-New Mexico-All counties.*

United States Environmental Protection Agency. 2000a. *Integrated Risk Information System* (IRIS). http://www.epa.gov/iris/

United States Environmental Protection Agency. 2000b. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.* Office of Solid Waste and Emergency Response, Washington, D.C.

United States Environmental Protection Agency. 2000c. *CHEMFACT Database.* http://www.epa.gov/chemfact/. Office of Pollution Prevention and Toxics. Washington, D.C.

# APPENDIX A

# Appendix A

## State of New Mexico Soil Screening Levels

Table A-1 provides State of New Mexico Soil Screening Levels (SSLs), as developed by the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) and the Ground Water Quality Bureau Voluntary Remediation Program for 133 chemicals most commonly associated with environmental releases within the state. These NMED SSLs are derived using default exposure parameter values (as presented in Table A-2) and chemical- and State of New Mexico-specific physical parameters (as presented in Table B-1 of Appendix B). These default values are assumed to be appropriately conservative in the face of uncertainty and are likely to be protective for the majority of site conditions relevant to soil exposures within New Mexico.

However, the NMED SSLs are not necessarily protective of all known human exposure pathways, reasonable land uses or ecological threats. Thus, before applying NMED SSLs at a site, it is extremely important to compare the conceptual site model (CSM) with the assumptions upon which the NMED SSLs are predicated to ensure that the site conditions and exposure pathways match those used to develop the NMED SSLs. If this comparison indicates that the site at issue is more complex than the corresponding SSL scenarios, or that there are significant exposure pathways not accounted for by the NMED SSLs, then the NMED SSLs are insufficient for use in a defensible assessment of the site. A more detailed site-specific approach will be necessary to evaluate the additional pathways or site conditions.

### TABLE A-1

Column 1: The first column in Table A-1 presents the names of the 133 chemicals for which NMED has developed SSLs.

Column 2: The second column presents NMED SSLs predicated on residential soil exposures.

Column 3: The third column presents indicator categories for the NMED SSL residential basis, whether predicated on carcinogenic effects (ca), noncarcinogenic effects (nc), soil saturation limits (sat) or a non-risk based "max" determination. NMED SSLs predicated on a carcinogenic endpoint reflect age-adjusted child-to-adult exposures. NMED SSLs predicated on a noncarcinogenic endpoint reflect child-only exposures. Detected concentrations above the "sat" value may indicate the presence of nonaqueous phase liquid (NAPL). For certain inorganic and semivolatile organic compounds (SVOCs) that exhibit relatively low toxicity, a non risk-based maximum concentration of $10^5$ mg/kg is given when the risk-based SSL exceeds that level. These are noted as "max" in the tables.

Columns 4 and 6: The fourth and sixth columns present NMED SSLs analogous to Column 1, with the exception that these values correspond to Industrial/Occupational and Construction worker (adult-only) exposures, respectively.

Columns 5 and 7: The fifth and seventh columns present endpoint bases analogous to Column 3

for the Industrial/Occupational and Construction worker receptor populations, respectively. Unlike the Residential population, noncarcinogenic endpoint notes for these receptor populations are predicated on adult-only exposures.

Column 8: The eighth column notes which chemicals are considered VOCs (for inhalation considerations). Those chemicals not considered VOCs are evaluated within the SSLs relative to inhalation of particulate emissions.

Columns 9 and 10: The ninth column presents NMED SSLs for the migration to groundwater pathway developed using a default dilution attenuation factor (DAF) of 1, which assumes no effective dilution or attenuation. These values can be considered at sites where little or no dilution or attenuation of soil leachate concentrations is expected (e.g., shallow water tables, karst topography). Column 10 presents NMED SSLs for the migration to groundwater pathway developed using a DAF of 20 to account for natural processes that reduce contaminant concentrations in the subsurface.

As noted above, separate NMED SSLs are presented for use in evaluating three discrete potential receptor populations: Residential, Industrial/Occupational, and Construction. Each NMED SSL considers incidental ingestion of soil, inhalation of volatiles (limited to those chemicals noted as volatile organic compounds [VOCs] within Table A-1) or particulate emissions from impacted soil, and dermal contact with soil.

Generally, if a contaminant is detected at a level in soil exceeding the most relevant NMED SSL, and the site-specific CSM is in general agreement with the underlying assumptions upon which the NMED SSLs are predicated, this result indicates the potential for adverse human health effects to occur. Conversely, if no contaminants are detected above the most relevant NMED SSL, this tends to indicate to the user that environmental conditions may not necessitate remedial action of the surface soil or the vadose zone.

A detection above an NMED SSL does not indicate that unacceptable exposures are, in fact, occurring. The NMED SSLs are predicated on relatively conservative exposure assumptions and an exceedance only tends to indicate the potential for adverse effects. The NMED SSLs do not account for additive exposures, whether for carcinogenic or noncarcinogenic endpoints. Section 5 of Part A addresses a methodology by which an environmental manager may determine whether further site-evaluation is warranted, however, this methodology does not replace the need for defensible risk assessment where indicated.

The NMED SSLs address a basic subset of exposures fundamental to the widest array of environmentally-impacted sites within the State of New Mexico. The NMED SSLs cannot address all relevant exposure pathways associated with all sites. The utility of the NMED SSLs depends heavily upon the understanding of site conditions as accurately reflected in the CSM and nature and extent of contamination determinations. Consideration of the NMED SSLs does not preclude the need for site-specific risk assessment in all instances.

**Table A-1**

| NMED Soil Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **Residential Soil (mg/kg)** | **Endpoint** | **Industrial/Occupational Soil (mg/kg)** | **Endpoint** | **Construction Worker Soil (mg/kg)** | **Endpoint** | **VOC** | **DAF 1 (mg/kg)** | **DAF 20 (mg/kg)** |
| Acenaphthene | 2.8E+03 | nc[a] | 4.9E+03 | nc[a] | 1.1E+04 | nc[a] | X | 3.E+03 | 6.E+04 |
| Acrolein | 9.9E-02 | nc | 7.7E-02 | nc | 4.1E-01 | nc | X | 8.E-06 | 2.E-04 |
| Acrylonitrile | 1.9E+00 | ca | 4.6E+00 | ca | 2.8E+01 | nc | X | 7.E-05 | 1.E-03 |
| Aldrin | 2.9E-01 | ca | 1.2E+00 | ca | 1.6E-02 | nc | | 6.E-03 | 1.E-01 |
| Aluminum | 7.4E+04 | nc | 1.0E+05 | max | 7.5E-01 | nc | | 8.E-01 | 2.E+01 |
| Anthracene | 1.6E+04 | nc[a] | 3.4E+04 | nc[a] | 6.2E+04 | nc[a] | X | 6.E+01 | 1.E+03 |
| Antimony | 3.0E+01 | nc | 9.2E+01 | nc | 1.1E+02 | nc | | 3.E-03 | 5.E-02 |
| Arsenic | 3.9E+00 | ca | 1.7E+01 | ca | 1.9E-02 | ca | | 3.E+00 | 6.E+01 |
| Barium | 5.2E+03 | nc | 1.5E+04 | nc | 7.7E-02 | nc | | 4.E+01 | 8.E+02 |
| Benzene | 6.4E+00 | ca | 5.6E+00 | nc | 2.9E+01 | nc | X | 3.E-03 | 6.E-02 |
| Benzidine | 2.1E-02 | ca | 8.9E-02 | ca | 1.3E-03 | ca | | 5.E-07 | 1.E-05 |
| Benzo(a)anthracene | 6.2E+00 | ca | 2.6E+01 | ca | 9.4E-01 | ca | | 2.E+00 | 4.E+01 |
| Benzo(a)pyrene | 6.2E-01 | ca | 2.6E+00 | ca | 9.4E-02 | ca | | 6.E+00 | 1.E+02 |
| Benzo(b)fluoranthene | 6.2E+00 | ca | 2.6E+01 | ca | 9.4E-01 | ca | | 8.E-01 | 2.E+01 |
| Benzo(k)fluoranthene | 6.2E+01 | ca | 2.6E+02 | ca | 9.4E+00 | ca | | 8.E+00 | 2.E+02 |
| Beryllium | 1.5E+02 | nc | 4.4E+02 | nc | 3.1E-03 | nc | | 1.E-02 | 2.E-01 |
| α-BHC | 9.0E-01 | ca | 3.9E+00 | ca | 4.6E-02 | ca | | 2.E-05 | 4.E-04 |
| β-BHC | 3.2E+00 | ca | 1.4E+01 | ca | 1.6E-01 | nc | | 2.E-03 | 4.E-02 |
| γ-BHC | 4.4E+00 | ca | 1.9E+01 | ca | 1.6E-01 | nc | | 4.E-04 | 7.E-03 |
| Bis(2-chloroethyl) ether | 4.4E+00 | ca | 1.9E+01 | ca | 2.5E-01 | ca | | 2.E-05 | 3.E-04 |
| Bis(2-chloroisopropyl) ether | 6.9E+01 | ca | 2.9E+02 | ca | 8.3E+00 | ca | | 5.E-04 | 9.E-03 |
| Bis(chloromethyl) ether | 2.2E-02 | ca | 9.3E-02 | ca | 1.3E-03 | ca | | 9.E-08 | 2.E-06 |
| Boron | 5.5E+03 | nc | 1.3E+04 | nc | 3.1E+00 | nc | | 1.E-01 | 3.E+00 |
| Bromodichloromethane | 9.6E+00 | ca | 2.2E+01 | ca | 4.5E+02 | ca | X | 3.E-02 | 7.E-01 |
| Bromomethane | 3.7E+00 | nc | 3.0E+00 | nc | 1.5E+01 | nc | X | 2.E-03 | 4.E-02 |
| 2-Butanone | 3.7E+04 | nc | 8.9E+04 | nc | 1.5E+02 | nc | | 3.E-01 | 7.E+00 |
| *tert*-Butyl methyl ether | 6.1E+03 | nc | 1.5E+04 | nc | 4.5E+02 | nc | | 4.E-03 | 8.E-02 |
| Cadmium | 7.0E+01 | nc | 1.9E+02 | nc | 4.7E-02 | ca | | 8.E-01 | 2.E+01 |
| Carbon tetrachloride | 1.6E+00 | nc | 1.3E+00 | nc | 6.8E+00 | nc | X | 5.E-03 | 1.E-01 |
| Chlordane | 1.6E+01 | ca | 7.0E+01 | ca | 1.1E-01 | nc | | 4.E-01 | 8.E+00 |
| Chlorobenzene | 1.4E+02 | nc | 1.2E+02 | nc | 1.9E+02 | sat | X | 5.E-02 | 1.E+00 |
| Chloroform | 3.8E-01 | nc | 3.0E-01 | nc | 1.6E+00 | nc | X | 3.E-02 | 5.E-01 |
| Chloromethane | 1.2E+01 | ca | 2.5E+01 | ca | 6.0E+02 | ca | X | 5.E-04 | 1.E-02 |
| Chromium III | 1.0E+05 | max | 1.0E+05 | max | 1.0E+05 | max | | 9.E+00 | 2.E+02 |
| Chromium VI | 2.3E+02 | nc | 6.6E+02 | ca | 1.0E-03 | ca | | 1.E+00 | 2.E+01 |
| Chrysene | 6.1E+02 | ca[a] | 2.5E+03 | ca[a] | 6.4E+03 | nc[a] | X | 5.E+01 | 1.E+03 |
| Cobalt | 4.5E+03 | nc | 1.3E+04 | nc | 1.6E-01 | nc | | 8.E-03 | 2.E-01 |

**Table A-1**

| NMED Soil Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **Residential Soil (mg/kg)** | **Endpoint** | **Industrial/Occupational Soil (mg/kg)** | **Endpoint** | **Construction Worker Soil (mg/kg)** | **Endpoint** | **VOC** | **DAF 1 (mg/kg)** | **DAF 20 (mg/kg)** |
| Copper | 2.8E+03 | nc | 8.5E+03 | nc | 1.0E+04 | nc | | 4.E+02 | 7.E+03 |
| Cyanide | 1.2E+03 | nc | 3.0E+03 | nc | 1.1E+01 | nc | | 5.E-02 | 1.E+00 |
| DDD | 2.4E+01 | ca | 1.0E+02 | nc | 2.7E-01 | nc | | 3.E+00 | 6.E+01 |
| DDE | 1.7E+01 | ca | 7.5E+01 | ca | 2.7E-01 | nc | | 1.E+01 | 3.E+02 |
| DDT | 1.7E+01 | ca | 7.5E+01 | ca | 2.7E-01 | nc | | 7.E-01 | 1.E+01 |
| Di(2-ethylhexyl) phthalate | 3.5E+02 | ca | 1.5E+03 | ca | 1.2E+01 | nc | | 4.E-01 | 9.E+00 |
| Dibenz(a,h)anthracene | 6.2E-01 | ca | 2.6E+00 | ca | 9.4E-02 | ca | | 5.E-01 | 9.E+00 |
| 1,2-Dibromoethane | 5.3E-02 | ca | 2.1E-01 | ca | 1.4E+00 | ca | X | 2.E-05 | 4.E-04 |
| 1,2-Dichlorobenzene | 8.5E+01 | sat | 8.5E+01 | sat | 8.5E+01 | sat | X | 4.E-01 | 9.E+00 |
| 1,3-Dichlorobenzene | 1.2E+01 | nc | 1.1E+01 | nc | 5.0E+01 | nc | X | 4.E-03 | 8.E-02 |
| 1,4-Dichlorobenzene | 3.2E+01 | ca | 5.7E+01 | sat | 5.7E+01 | sat | X | 8.E-02 | 2.E+00 |
| 3,3-Dichlorobenzidine | 1.1E+01 | ca | 4.5E+01 | ca | 6.5E-01 | ca | | 3.E-04 | 5.E-03 |
| Dichlorodifluoromethane | 9.0E+01 | nc | 7.1E+01 | nc | 3.8E+02 | nc | X | 6.E+00 | 1.E+02 |
| 1,1-Dichloroethane | 5.6E+02 | nc | 4.6E+02 | nc | 1.2E+03 | sat | X | 7.E-03 | 1.E-01 |
| 1,2-Dichloroethane | 3.3E+00 | ca | 7.2E+00 | ca | 4.3E+01 | nc | X | 1.E-03 | 2.E-02 |
| *cis*-1,2-Dichloroethene | 4.1E+01 | nc | 3.3E+01 | nc | 1.7E+02 | nc | X | 2.E-02 | 3.E-01 |
| *trans*-1,2-Dichloroethene | 6.0E+01 | nc | 4.9E+01 | nc | 2.5E+02 | nc | X | 2.E-02 | 4.E-01 |
| 1,1-Dichloroethene | 8.1E+00 | ca | 3.4E+01 | ca | 1.7E+00 | ca | | 3.E-03 | 5.E-02 |
| Dichloromethane | 6.5E+02 | ca | 2.7E+03 | ca | 1.8E+02 | ca | | 2.E-02 | 4.E-01 |
| 2,4-Dichlorophenol | 1.8E+02 | nc | 4.4E+02 | nc | 1.6E+00 | nc | | 2.E-02 | 4.E-01 |
| 1,3-Dichloropropene | 7.8E-01 | ca | 1.7E+00 | ca | 3.1E+01 | nc | X | 2.E-04 | 5.E-03 |
| Dieldrin | 3.0E-01 | ca | 1.3E+00 | ca | 1.8E-02 | ca | | 1.E-04 | 2.E-03 |
| Diethyl phthalate | 4.9E+04 | nc | 1.0E+05 | max | 4.3E+02 | nc | | 8.E+00 | 2.E+02 |
| Dimethyl phthalate | 1.0E+05 | max | 1.0E+05 | max | 5.4E+03 | nc | | 6.E+01 | 1.E+03 |
| Dibutyl phthalate | 6.1E+03 | nc | 1.5E+04 | nc | 5.4E+01 | nc | | 9.E+00 | 2.E+02 |
| 2,4-Dinitro-2-methylphenol | 1.2E+02 | nc | 3.0E+02 | nc | 1.1E+00 | nc | | 1.E-02 | 2.E-01 |
| 2,4-Dinitrophenol | 1.2E+02 | nc | 3.0E+02 | nc | 1.1E+00 | nc | | 1.E-02 | 2.E-01 |
| 2,4-Dinitrotoluene | 1.2E+02 | nc | 3.0E+02 | nc | 1.1E+00 | nc | | 1.E-02 | 2.E-01 |
| 1,2-Diphenylhydrazine | 6.1E+00 | ca | 2.6E+01 | ca | 3.8E-01 | ca | | 1.E-04 | 3.E-03 |
| Endosulfan | 3.7E+02 | nc | 8.9E+02 | nc | 3.2E+00 | nc | | 3.E-01 | 6.E+00 |
| Endrin | 1.8E+01 | nc | 4.4E+01 | nc | 1.6E-01 | nc | | 3.E-04 | 7.E-03 |
| Ethylbenzene | 6.8E+01 | sat | 6.8E+01 | sat | 6.8E+01 | sat | X | 4.E-01 | 8.E+00 |
| Flouride | 3.7E+03 | nc | 8.9E+03 | nc | 1.4E+04 | nc | | 3.E-01 | 5.E+00 |
| Fluoranthene | 2.3E+03 | nc | 5.3E+03 | nc | 2.1E+01 | nc | | 9.E+01 | 2.E+03 |
| Fluorene | 2.1E+03 | nc[a] | 4.0E+03 | nc[a] | 8.0E+03 | nc[a] | X | 3.E+00 | 6.E+01 |
| Fluorotrichloromethane | 1.2E+04 | nc | 3.0E+04 | nc | 3.1E+01 | nc | | 7.E-02 | 1.E+00 |
| Heptachlor | 1.1E+00 | ca | 4.5E+00 | ca | 6.4E-02 | ca | | 4.E-03 | 8.E-02 |

**Table A-1**

| NMED Soil Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **Residential Soil (mg/kg)** | **Endpoint** | **Industrial/Occupational Soil (mg/kg)** | **Endpoint** | **Construction Worker Soil (mg/kg)** | **Endpoint** | **VOC** | **DAF 1 (mg/kg)** | **DAF 20 (mg/kg)** |
| Hexachlorobenzene | 3.0E+00 | ca | 1.3E+01 | ca | 1.8E-01 | ca | | 2.E-04 | 3.E-03 |
| Hexachlorobutadiene | 1.2E+01 | nc | 3.0E+01 | nc | 1.1E-01 | nc | | 7.E-02 | 1.E+00 |
| Hexachlorocyclopentadiene | 4.2E+02 | nc | 1.0E+03 | nc | 1.1E-02 | nc | | 1.E-02 | 3.E-01 |
| Hexachloroethane | 6.1E+01 | nc | 1.5E+02 | nc | 5.4E-01 | nc | | 9.E-03 | 2.E-01 |
| HMX | 3.1E+03 | nc | 7.4E+03 | nc | 1.1E+04 | nc | | 1.E-03 | 2.E-02 |
| Indeno(1,2,3-c,d)pyrene | 6.2E+00 | ca | 2.6E+01 | ca | 9.4E-01 | ca | | 2.E+00 | 4.E+01 |
| Iron | 2.3E+04 | nc | 6.9E+04 | nc | 8.0E+04 | nc | | 2.E-01 | 3.E+00 |
| Isophorone | 5.1E+03 | ca | 2.2E+04 | ca | 1.1E+02 | nc | | 1.E-01 | 3.E+00 |
| Lead | 4.0E+02 | NC | 1.0E+03 | nc | 1.0E+00 | nc | | 8.E-03 | 2.E-01 |
| Lead (tetraethyl-) | 6.1E-03 | nc | 1.5E-02 | nc | 2.3E-02 | nc | | 1.E-02 | 2.E-01 |
| Manganese | 7.8E+03 | nc | 1.4E+04 | nc | 7.5E-03 | nc | | 3.E-02 | 7.E-01 |
| Mercury and compounds | 2.3E+01 | nc | 6.9E+01 | nc | 8.0E+01 | nc | | 1.E-01 | 2.E+00 |
| Mercury (elemental) | 6.5E+00 | nc | 2.0E+01 | nc | 4.6E-02 | nc | | 1.E-01 | 2.E+00 |
| Mercury (methyl) | 6.1E+00 | nc | 1.5E+01 | nc | 2.3E+01 | nc | | 1.E-03 | 2.E-02 |
| Molybdenum | 3.8E+02 | nc | 1.2E+03 | nc | 1.3E+03 | nc | | 2.E-01 | 3.E+00 |
| Naphthalene | 5.3E+01 | nc[a] | 4.3E+01 | nc[a] | 2.2E+02 | nc[a] | X | 1.E-02 | 2.E-01 |
| Nickel | 1.5E+03 | nc | 4.4E+03 | nc | 3.1E-02 | nc | | 1.E+01 | 3.E+02 |
| Nitrate | 9.8E+04 | nc | 1.0E+05 | max | 8.6E+02 | nc | | 2.E+00 | 3.E+01 |
| Nitrite | 6.1E+03 | nc | 1.5E+04 | nc | 5.4E+01 | nc | | 2.E-01 | 3.E+00 |
| Nitrobenzene | 1.7E+01 | nc | 2.1E+01 | nc | 6.6E+01 | nc | X | 9.E-04 | 2.E-02 |
| Nitroglycerin | 3.5E+02 | ca | 1.5E+03 | ca | 2.1E+01 | ca | | 3.E-02 | 6.E-01 |
| *N*-Nitrosodiethylamine | 3.2E-02 | ca | 1.4E-01 | ca | 1.9E-03 | ca | | 9.E-07 | 2.E-05 |
| *N*-Nitrosodimethylamine | 9.5E-02 | ca | 4.0E-01 | ca | 6.0E-03 | ca | | 1.E-05 | 2.E-04 |
| *N*-Nitrosodi-*n*-butylamine | 2.2E-01 | ca | 5.4E-01 | ca | 9.3E+00 | ca | X | 1.E-05 | 2.E-04 |
| *N*-Nitrosodiphenylamine | 9.9E+02 | ca | 4.2E+03 | ca | 6.0E+01 | ca | | 9.E-02 | 2.E+00 |
| *N*-Nitrosopyrrolidine | 2.3E+00 | ca | 9.7E+00 | ca | 1.4E-01 | ca | | 6.E-06 | 1.E-04 |
| Aroclor 1016 | 3.9E+00 | nc | 8.9E+00 | nc | 3.8E-02 | nc | | 2.E-04 | 3.E-03 |
| Aroclor 1221 | 2.2E+00 | ca | 9.2E+00 | ca | 1.5E-01 | ca | | 2.E-04 | 3.E-03 |
| Aroclor 1232 | 2.2E+00 | ca | 9.2E+00 | ca | 1.5E-01 | ca | | 2.E-04 | 3.E-03 |
| Aroclor 1242 | 2.2E+00 | ca | 9.2E+00 | ca | 1.5E-01 | ca | | 2.E-04 | 3.E-03 |
| Aroclor 1248 | 1.1E+00 | nc | 2.5E+00 | nc | 1.1E-02 | nc | | 8.E-01 | 2.E+01 |
| Aroclor 1254 | 1.1E+00 | nc | 2.5E+00 | nc | 1.1E-02 | nc | | 8.E-01 | 2.E+01 |
| Aroclor 1260 | 1.1E+00 | nc | 2.5E+00 | nc | 1.1E-02 | nc | | 8.E-01 | 2.E+01 |
| Pentachlorobenzene | 4.9E+01 | nc | 1.2E+02 | nc | 4.3E-01 | nc | | 6.E-03 | 1.E-01 |
| Phenanthrene | 1.8E+03 | nc | 4.4E+03 | nc | 1.6E+01 | nc | | 4.E+03 | 8.E+04 |
| Phenol | 3.7E+04 | nc | 8.9E+04 | nc | 3.2E+02 | nc | | 2.E-03 | 4.E-02 |
| Pyrene | 1.8E+03 | nc[a] | 4.3E+03 | nc[a] | 6.7E+03 | nc[a] | X | 3.E-02 | 6.E-01 |

**Table A-1**

| NMED Soil Screening Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **Residential Soil (mg/kg)** | **Endpoint** | **Industrial/Occupational Soil (mg/kg)** | **Endpoint** | **Construction Worker Soil (mg/kg)** | **Endpoint** | **VOC** | **DAF 1 (mg/kg)** | **DAF 20 (mg/kg)** |
| RDX | 4.4E+01 | ca | 1.9E+02 | ca | 1.6E+00 | nc | | 2.E-03 | 4.E-02 |
| Selenium | 3.8E+02 | nc | 1.2E+03 | nc | 1.3E+03 | nc | | 3.E-01 | 5.E+00 |
| Silver | 3.8E+02 | nc | 1.2E+03 | nc | 1.3E+03 | nc | | 4.E-01 | 8.E+00 |
| Strontium | 3.7E+04 | nc | 8.9E+04 | nc | 1.0E+05 | max | | 4.E+00 | 7.E+01 |
| 1,2,4,5-Tetrachlorobenzene | 1.8E+01 | nc | 4.4E+01 | nc | 1.6E-01 | nc | | 2.E-03 | 4.E-02 |
| 1,1,2,2-Tetrachloroethane | 3.6E+00 | ca | 8.2E+00 | ca | 1.6E+02 | ca | X | 2.E-03 | 3.E-02 |
| Tetrachloroethene | 4.9E+01 | ca | 1.0E+02 | sat | 1.0E+02 | sat | X | 5.E-03 | 1.E-01 |
| Thallium | 6.1E+00 | nc | 1.8E+01 | nc | 2.1E+01 | nc | | 5.E-04 | 1.E-02 |
| Toluene | 1.8E+02 | sat | 1.8E+02 | sat | 1.8E+02 | sat | X | 2.E-01 | 5.E+00 |
| Toxaphene | 4.4E+00 | ca | 1.9E+01 | ca | 2.6E-01 | ca | | 5.E-04 | 1.E-02 |
| Tribromomethane | 6.1E+02 | ca | 2.6E+03 | ca | 1.1E+01 | nc | | 2.E-02 | 3.E-01 |
| 1,2,4-Trichlorobenzene | 5.2E+02 | nc | 5.3E+02 | sat | 5.3E+02 | sat | X | 5.E-01 | 1.E+01 |
| 1,1,1-Trichloroethane | 5.1E+02 | sat | 5.1E+02 | sat | 5.1E+02 | sat | X | 3.E-02 | 5.E-01 |
| 1,1,2-Trichloroethane | 7.9E+00 | ca | 1.8E+01 | ca | 1.6E+02 | nc | X | 3.E-03 | 6.E-02 |
| Trichloroethene | 1.6E+01 | ca | 1.8E+01 | nc | 9.2E+01 | nc | X | 4.E-02 | 7.E-01 |
| 2,4,5-Trichlorophenol | 6.1E+03 | nc | 1.5E+04 | nc | 5.4E+01 | nc | | 6.E-01 | 1.E+01 |
| 2,4,6-Trichlorophenol | 4.4E+02 | ca | 1.9E+03 | ca | 2.7E+01 | ca | | 1.E-02 | 2.E-01 |
| 2,4,6-Trinitrotoluene | 3.1E+01 | nc | 7.4E+01 | nc | 2.7E-01 | nc | | 4.E+01 | 7.E+02 |
| Vanadium | 5.3E+02 | nc | 1.6E+03 | nc | 1.9E+03 | nc | | 4.E-02 | 9.E-01 |
| Vinyl chloride | 2.1E-01 | ca | 4.5E-01 | ca | 1.0E+01 | ca | X | 3.E-04 | 6.E-03 |
| Xylenes | 6.3E+01 | sat | 6.3E+01 | sat | 6.3E+01 | sat | X | 5.E+00 | 1.E+02 |
| Zinc | 2.3E+04 | nc | 6.9E+04 | nc | 8.0E+04 | nc | | 6.E+01 | 1.E+03 |

ca – carcinogenic effect basis
nc – noncarcinogenic effect basis
sat – soil saturation limit basis
max – low toxicity maximum, health based SSL exceeds [$10^5$] mg/kg

NMED – New Mexico Environment Department
VOC – Volatile organic compound
DAF – Dilution attenuation factor
[a] compound is solid at ambient soil temperature, so risk-based level is used even though this level exceeds soil saturation (US EPA, 1996a)

**Note**: Soil Screening Levels for residential soil, industrial/occupational soil, and construction worker soil are based on the combined exposure through direct soil ingestion, inhalation of fugitive dust (and fumes for VOCs), and dermal exposure to soil.

**Table A-2**

| Default Exposure Factors | | | |
|---|---|---|---|
| **Symbol** | **Definition (units)** | **Default** | **Reference** |
| $CSF_o$ | Cancer slope factor oral $(mg/kg\text{-}day)^{-1}$ | Csv | IRIS, HEAST, or NCEA |
| $CSF_i$ | Cancer slope factor inhaled $(mg/kg\text{-}day)^{-1}$ | Csv | IRIS, HEAST, or NCEA |
| $RfD_o$ | Reference dose oral (mg/kg-day) | Csv | IRIS, HEAST, or NCEA |
| $RfD_i$ | Reference dose inhaled (mg/kg-day) | Csv | IRIS, HEAST, or NCEA |
| TR | Target cancer risk | $10^{-5}$ | NMED-specific value |
| THQ | Target hazard quotient | 1 | US EPA, 1989 |
| BW | Body weight (kg) | | |
| | -- adult | 70 | US EPA, 1989 |
| | -- child | 15 | US EPA, 1991 |
| AT | Averaging time (days) | | |
| | -- carcinogens | 25550 | US EPA, 1989 |
| | -- noncarcinogens | ED*365 | |
| SA | Exposed surface area for soil/dust ($cm^2$/day) | | US EPA, 1989 |
| | -- adult resident | 5700 | US EPA, 1996a |
| | -- adult worker | 3300 | US EPA, 1996a |
| | -- child | 2800 | US EPA, 1989 |
| AF | Adherence factor, soils ($mg/cm^2$) | | US EPA, 1989 |
| | -- adult resident | 0.07 | US EPA, 1996a |
| | -- adult worker | 0.2 | US EPA, 1996a |
| | -- child resident | 0.2 | US EPA, 1989 |
| | -- construction worker | 0.3 | NMED-specific value |
| ABS | Skin absorption defaults (unitless): | | |
| | -- semi-volatile organics | 0.1 | US EPA, 1989 |
| | -- volatile organics | na | US EPA, 2000a |
| | -- inorganics | na | US EPA, 2000s |
| IRA | Inhalation rate ($m^3$/day) | | |
| | -- adult resident | 20 | US EPA, 1991 |
| | -- adult worker | 20 | US EPA, 1999a |
| | -- child resident | 10 | Exposure Factors, (US EPA, 1997) |
| IRW | Drinking water ingestion rate (L/day) | | |
| | -- adult | 2.4 | US EPA, 1997 |
| | -- child | 1.5 | US EPA, 1997 |
| IRS | Soil ingestion (mg/day) | | |
| | -- adult residenti | 100 | US EPA, 1991 |
| | -- child resident | 200 | US EPA, 1991 |
| | -- commercial/industrial worker | 50 | US EPA, 1999a |
| | construction worker | 480 | US EPA, 1991 |
| EF | Exposure frequency (days/yr) | | |
| | -- residential | 350 | US EPA, 1991 |
| | -- commercial/industrial | 250 | US EPA, 1999a |
| | -- construction worker | 30 | NMED-specific value |
| ED | Exposure duration (years) | | |
| | -- residential | 30[a] | US EPA, 1991) |
| | -- child | 6 | (US EPA, 1991) |
| | -- commercial/industrial | 25 | (US EPA, 1999) |
| | -- construction worker | 1 | NMED-specific value |
| | Age-adjusted factors for carcinogens | | |
| IFSadj | Ingestion factor, soils ([mg-yr]/[kg-day]) | 114 | US EPA, 1996a |
| SFSadj | Dermal factor, soils ([mg-yr]/[kg-day]) | 360 | US EPA, 1999a |
| InhFadj | Inhalation factor, air ([$m^3$-yr]/[kg-day]) | 11 | By analogy to RAGS: Part B, (US EPA, 1991) |
| IFWadj | Ingestion factor, water ([L-yr]/[kg-day]) | 1.1 | By analogy to RAGS: Part B, (US EPA, 1991) |
| PEF | Particulate emission factor ($m^3$/kg) | Csv | US EPA, 1996a |
| VFs | Volatilization factor for soil ($m^3$/kg) | Csv | US EPA, 1996a |
| Csat | Soil saturation concentration (mg/kg) | Csv | US EPA, 1996a |

[a]Exposure duration for lifetime residents is assumed to be 30 years total. For carcinogens, exposures are combined for children (6 years) and adults (24 years).
Csv - Chemical-specific value
na - not applicable
RAGS – Risk Assessment Guidance for Superfund
IRIS – Integrated Risk Information System, USEPA, 2000
HEAST – Health Effects Assessment Summary Tables, USEPA, 1997
NCEA – National Center for Environmental Assessment, Office of Research and Development
NMED – New Mexico Environment Department

# APPENDIX B

**Table B-1**

| Physical-Chemical Properties | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **MW (g/mole)** | **H (atm-m³/mole)** | **H' (dimensionless)** | **$D_a$ (cm²/s)** | **$D_w$ (cm²/s)** | **$K_{oc}$ (cm³/g)** | **$K_d$ (cm³/g)** | **S (mg/L)** | **$D_A$ (cm²/s)** | **VF (m³/kg)** | **SAT (mg/kg)** | **VOC** |
| Acenaphthene | 154.21 | 1.7E-04 | 7.0E-03 | 4.2E-02 | 7.7E-06 | 4.9E+03 | 2.9E+01 | 4.2E+00 | 4.7E-07 | 1.7E+05 | 2.1E+01 | X |
| Acrolein | 56 | 1.2E-04 | 4.9E-03 | 1.1E-01 | 1.2E-05 | 2.1E+01 | 1.3E-01 | 2.1E+05 | 1.2E-04 | 1.1E+04 | 4.0E+04 | X |
| Acrylonitrile | 53 | 8.8E-05 | 3.6E-03 | 1.1E-01 | 1.3E-05 | 8.5E-01 | 5.1E-03 | 7.9E+04 | 1.9E-04 | 8.6E+03 | 1.3E+04 | X |
| Aldrin | 365 | 1.0E-04 | 4.2E-03 | | | 9.6E+04 | 2.9E+01 | | | | | |
| Aluminum | | | | | | | | | | | | |
| Anthracene | 178 | 6.5E-05 | 2.7E-03 | 3.2E-02 | 7.7E-06 | 2.4E+04 | 1.4E+02 | 4.3E-02 | 3.2E-08 | 6.7E+05 | 9.9E-01 | X |
| Antimony | | | | | | | | | | | | |
| Arsenic | | | | | | | | | | | | |
| Barium | | | | | | | | | | | | |
| Benzene | 78.1 | 5.6E-03 | 2.3E-01 | 8.8E-02 | 9.8E-06 | 6.2E+01 | 3.7E-01 | 1.8E+03 | 2.0E-03 | 2.7E+03 | 4.4E+02 | X |
| Benzidine | | | | | | | | | | | | |
| Benzo(a)anthracene | 228 | 1.2E-06 | 4.8E-05 | | | 1.4E+06 | 4.1E+02 | | | | | |
| Benzo(a)pyrene | 250 | 1.6E-06 | 6.4E-05 | | | 5.5E+06 | 1.7E+03 | | | | | |
| Benzo(b)fluoranthene | 252.3 | 1.1E-04 | 4.6E-03 | | | 5.5E+05 | 1.7E+02 | | | | | |
| Benzo(k)fluoranthene | 252.3 | 5.0E-07 | 2.1E-05 | | | 5.5E+05 | 1.7E+02 | | 3.5E+03 | | | |
| α-BHC | 290.85 | 6.8E-06 | 2.8E-04 | | | | | | | | | |
| β-BHC | 290.85 | 3.5E-07 | 1.4E-05 | | | 3.8E+03 | 1.1E+00 | | | | | |
| γ-BHC | 290.85 | 3.4E-06 | 1.4E-04 | | | 1.1E+03 | 3.2E-01 | | | | | |
| Beryllium | | | | | | | | | | | | |
| Bis(2-chloroethyl) ether | | 1.8E-05 | 7.4E-04 | | | | | | | | | |
| Bis(2-chloroisopropyl) ether | | 1.1E-04 | 4.5E-03 | | | | | | | | | |
| Bis(chloromethyl) ether | | 1.9E-05 | 7.6E-04 | | | | | | | | | |
| Boron | | | | | | | | | | | | |
| Bromodichloromethane | 164 | 1.6E-03 | 6.6E-02 | 3.0E-02 | 1.1E-05 | 1.0E+02 | 6.0E-01 | 6.7E+03 | 1.4E-04 | 1.0E+04 | 1.8E+03 | X |
| Bromomethane | 94.95 | 6.2E-03 | 2.6E-01 | 7.3E-02 | 1.2E-05 | 9.0E+00 | 5.4E-02 | 1.5E+04 | 4.8E-03 | 1.7E+03 | 3.1E+03 | X |
| 2-Butanone | 72 | 2.7E-05 | 1.1E-03 | 7.7E+03 | 8.5E-01 | 4.5E+00 | 1.4E-03 | | 7.7E-01 | | | |
| *tert*-Butyl methyl ether | 88.2 | 6.6E-04 | 2.7E-02 | 7.0E+03 | 7.5E-01 | 1.1E+01 | 3.4E-03 | | 1.2E+01 | | | |
| Cadmium | | | | | | | | | | | | |
| Carbon tetrachloride | 154 | 3.0E-02 | 1.2E+00 | 7.8E-02 | 8.8E-06 | 1.5E+02 | 9.1E-01 | 7.9E+02 | 4.1E-03 | 1.9E+03 | 3.6E+02 | X |
| Chlordane | 409.8 | 6.7E-05 | 2.7E-03 | | | 1.4E+05 | 4.2E+01 | | | | | |
| Chlorobenzene | 113 | 3.7E-03 | 1.5E-01 | 7.3E-02 | 8.7E-06 | 2.2E+02 | 1.3E+00 | 4.7E+02 | 3.9E-04 | 6.1E+03 | 1.9E+02 | X |
| Chloromethane | 51 | 2.4E-02 | 9.8E-01 | 1.1E-01 | 6.5E-06 | 3.5E+01 | 2.1E-01 | 8.2E+03 | 1.1E-02 | 1.1E+03 | 2.6E+03 | X |
| Chloroform | 119 | 3.7E-03 | 1.5E-01 | 1.0E-01 | 1.0E-05 | 5.3E+01 | 3.2E-01 | 7.9E+03 | 1.8E-03 | 2.8E+03 | 1.9E+03 | X |
| Chromium III | | | | | | | | | | | | |
| Chromium VI | | | | | | | | | | | | |
| Cobalt | | | | | | | | | | | | |
| Copper | | | | | | | | | | | | |

**Table B-1**

| Physical-Chemical Properties | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **MW (g/mole)** | **H (atm-m³/mole)** | **H' (dimensionless)** | **$D_a$ (cm²/s)** | **$D_w$ (cm²/s)** | **$K_{oc}$ (cm³/g)** | **$K_d$ (cm³/g)** | **S (mg/L)** | **$D_A$ (cm²/s)** | **VF (m³/kg)** | **SAT (mg/kg)** | **VOC** |
| Chrysene | 228.28 | 9.5E-05 | 3.9E-03 | 2.5E-02 | 6.2E-06 | 4.0E+05 | 2.4E+03 | 1.6E-03 | 2.1E-09 | 2.6E+06 | 6.2E-01 | X |
| Cyanide | | | | | | | | | | | | |
| DDD | 320 | 5.0E-06 | 2.0E-04 | | | 7.7E+05 | 2.3E+02 | | | | | |
| DDE | 318 | 1.2E-04 | 5.1E-03 | | | 4.4E+06 | 1.3E+03 | | | | | |
| DDT | 354.5 | 5.4E-05 | 2.2E-03 | | | 2.4E+05 | 7.3E+01 | | | | | |
| Dibenz(a,h)anthracene | 278.3 | 1.1E-08 | 4.6E-07 | | | 3.3E+06 | 9.9E+02 | | | | | |
| 1,2-Dibromoethane | 188 | 3.2E-04 | 1.3E-02 | 7.3E-02 | 8.1E-06 | 2.8E+01 | 1.7E-01 | 3.4E+03 | 1.8E-04 | 8.8E+03 | 6.7E+02 | X |
| Dibutyl phthalate | 278.34 | 9.4E-10 | 3.9E-08 | | | 1.6E+03 | 4.7E-01 | | | | | |
| 1,2-Dichlorobenzene | 147 | 1.9E-03 | 7.8E-02 | 6.9E-02 | 7.9E-06 | 3.8E+02 | 2.3E+00 | 1.6E+02 | 1.2E-04 | 1.1E+04 | 8.5E+01 | X |
| 1,3-Dichlorobenzene | 147 | 1.9E-03 | 7.8E-02 | 6.9E-02 | 7.9E-06 | 3.8E+02 | 2.3E+00 | 1.6E+02 | 1.2E-04 | 1.1E+04 | 8.5E+01 | X |
| 1,4-Dichlorobenzene | 147 | 2.4E-03 | 1.0E-01 | 6.9E-02 | 7.9E-06 | 6.2E+02 | 3.7E+00 | 7.4E+01 | 9.4E-05 | 1.2E+04 | 5.7E+01 | X |
| 3,3-Dichlorobenzidine | | 4.0E-09 | 1.6E-07 | | | | | | | | | |
| Dichlorodifluoromethane | 120.92 | 3.0E+00 | 1.2E+02 | 8.0E-02 | 1.1E-05 | 5.8E+01 | 3.5E-01 | 2.8E+02 | 1.4E-02 | 1.0E+03 | 4.1E+03 | X |
| 1,1-Dichloroethane | 99 | 5.6E-03 | 2.3E-01 | 7.4E-02 | 1.1E-05 | 5.3E+01 | 3.2E-01 | 5.1E+03 | 1.9E-03 | 2.7E+03 | 1.2E+03 | X |
| 1,2-Dichloroethane | 99 | 9.8E-04 | 4.0E-02 | 1.0E-01 | 9.9E-06 | 3.8E+01 | 2.3E-01 | 8.5E+03 | 6.5E-04 | 4.7E+03 | 1.8E+03 | X |
| 1,1-Dichloroethene | 97 | 2.5E-02 | 1.0E+00 | 6.8E+03 | 9.0E-01 | 6.2E+01 | 1.9E-02 | | 2.6E+02 | | | |
| *cis*-1,2-Dichloroethene | 97 | 4.1E-03 | 1.7E-01 | 7.4E-02 | 1.1E-05 | 3.6E+01 | 2.1E-01 | 3.5E+03 | 1.9E-03 | 2.8E+03 | 7.8E+02 | X |
| *trans*-1,2-Dichloroethene | 97 | 9.4E-03 | 3.8E-01 | 7.1E-02 | 1.2E-05 | 3.8E+01 | 2.3E-01 | 6.3E+03 | 3.5E-03 | 2.0E+03 | 1.6E+03 | X |
| Dichloromethane | 85 | 2.2E-03 | 9.0E-02 | 8.7E+03 | 1.0E+00 | 8.8E+00 | 2.6E-03 | | 4.9E+01 | | | |
| 2,4-Dichlorophenol | | 4.4E-07 | 1.8E-05 | | | | | | | | | |
| 1,3-Dichloropropene | 111 | 1.8E-02 | 7.3E-01 | 6.3E-02 | 1.0E-05 | 2.7E+01 | 1.6E-01 | 2.8E+03 | 5.9E-03 | 1.6E+03 | 7.8E+02 | X |
| Dieldrin | 381 | 2.7E-06 | 1.1E-04 | | | 1.7E+03 | 5.1E-01 | | | | | |
| Diethyl phthalate | 222.2 | 4.5E-07 | 1.9E-05 | | | 8.2E+01 | 2.5E-02 | | | | | |
| Di(2-ethylhexyl) phthalate | 391 | 1.0E-07 | 4.2E-06 | | | 5.9E+03 | 1.8E+00 | | | | | |
| 2,4-Dinitrophenol | | 4.4E-07 | 1.8E-05 | | | | | | | | | |
| Dimethyl phthalate | 194.19 | 4.2E-07 | 1.7E-05 | | | | | | | | | |
| 2,4-Dinitro-2-methylphenol | | 4.8E-11 | 2.0E-09 | | | | | | | | | |
| 2,4-Dinitrotoluene | 182.14 | 9.3E-08 | 3.8E-06 | | | | | | | | | |
| 1,2-Diphenylhydrazine | | 4.1E-11 | 1.7E-09 | | | | | | | | | |
| Endosulfan | 406.95 | 7.7E-05 | 3.1E-03 | | | 7.4E+02 | 2.2E-01 | | | | | |
| Endrin | 381 | 7.5E-06 | 3.1E-04 | | | | | | | | | |
| Ethylbenzene | 106.2 | 7.9E-03 | 3.2E-01 | 7.5E-02 | 7.8E-06 | 2.0E+02 | 1.2E+00 | 1.7E+02 | 9.1E-04 | 4.0E+03 | 6.8E+01 | X |
| Fluoranthene | 202.3 | 7.3E-05 | 3.0E-03 | | | 3.8E+04 | 1.1E+01 | | | | | |
| Fluorene | 166.21 | 7.7E-05 | 3.2E-03 | 6.1E-02 | 7.9E-06 | 7.9E+03 | 4.7E+01 | 1.9E+00 | 2.1E-07 | 2.6E+05 | 1.5E+01 | X |
| Flouride | | | | | | | | | | | | |
| Fluorotrichloromethane | | 6.4E-05 | 2.6E-03 | | | | | | | | | |
| Heptachlor | 373.5 | 1.1E-03 | 4.5E-02 | | | 6.8E+03 | 2.0E+00 | | | | | |
| Hexachlorobenzene | | 1.3E-03 | 5.4E-02 | | | | | | | | | |
| Hexachlorocyclopentadiene | | 2.7E-02 | 1.1E+00 | | | | | | | | | |

**Table B-1**

| Physical-Chemical Properties | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **MW (g/mole)** | **H (atm-m³/mole)** | **H' (dimensionless)** | **$D_a$ (cm²/s)** | **$D_w$ (cm²/s)** | **$K_{oc}$ (cm³/g)** | **$K_d$ (cm³/g)** | **S (mg/L)** | **$D_A$ (cm²/s)** | **VF (m³/kg)** | **SAT (mg/kg)** | **VOC** |
| Hexachloroethane | | 3.9E-03 | 1.6E-01 | | | | | | | | | |
| Hexachlorobutadiene | 260.8 | 4.6E+00 | 1.9E+02 | | | 2.9E+04 | 8.7E+00 | | | | | |
| HMX | | 1.0E-11 | 4.1E-10 | | | | | | | | | |
| Indeno(1,2,3-c,d)pyrene | 276.3 | 4.9E-09 | 2.0E-07 | | | 1.6E+06 | 4.8E+02 | | | | | |
| Isophorone | | 5.8E-06 | 2.4E-04 | | | 2.5E+01 | | 1.2E+04 | | | | |
| Iron | | | | | | | | | | | | |
| Lead | | | | | | | | | | | | |
| lead (Tetraethyl-) | | | | | | | | | | | | |
| Manganese | | | | | | | | | | | | |
| Mercury and compounds | | | | | | | | | | | | |
| Mercury (elemental) | | | | | | | | | | | | |
| Mercury (methyl) | | | | | | | | | | | | |
| Molybdenum | | | | | | | | | | | | |
| Naphthalene | 128.16 | 4.8E-04 | 2.0E-02 | 5.9E-02 | 7.5E-06 | 1.2E+03 | 7.1E+00 | 3.1E+01 | 8.4E-06 | 4.1E+04 | 4.1E+01 | X |
| Nickel | | | | | | | | | | | | |
| Nitrate | | | | | | | | | | | | |
| Nitrite | | | | | | | | | | | | |
| Nitrobenzene | 120 | 2.4E-05 | 9.8E-04 | 7.6E-02 | 8.6E-06 | 6.5E+01 | 3.9E-01 | 2.1E+03 | 8.1E-06 | 4.2E+04 | 4.8E+02 | X |
| Nitroglycerin | | 6.0E-03 | 2.5E-01 | | | 2.6E+02 | 1.5E+00 | 1.8E+03 | | | | |
| *N*-Nitrosodi-*n*-butylamine | 160 | 3.2E-04 | 1.3E-02 | 5.8E-02 | 9.7E-06 | 2.6E+02 | 1.5E+00 | 1.3E+03 | 2.4E-05 | 2.4E+04 | 5.4E+02 | X |
| *N*-Nitrosodiethylamine | | 3.6E-06 | 1.5E-04 | | | 1.2E+03 | 1.8E+00 | | | | | |
| *N*-Nitrosodimethylamine | | 1.4E-01 | 5.9E+00 | | | 4.3E+01 | 6.5E-02 | | | | | |
| *N*-Nitrosodiphenylamine | 198.23 | 1.2E-06 | 5.0E-05 | | | 3.3E+02 | 9.8E-02 | | | | | |
| *N*-Nitrosopyrrolidine | | 4.9E-08 | 2.0E-06 | | | 1.9E+01 | 2.9E-02 | | | | | |
| Phenanthrene | 178.2 | 2.3E-05 | 9.4E-04 | | | 1.4E+04 | 4.2E+00 | | 4.8E+03 | | | |
| Phenol | 94 | 6.0E-07 | 2.4E-05 | | | 1.4E+02 | 4.3E-02 | | | | | |
| **Polychlorinatedbiphenyls** | | | | | | | | | | | | |
| Aroclor 1016 | | 1.8E-08 | 7.4E-07 | | | | | | | | | |
| Aroclor 1221 | | 1.8E-08 | 7.4E-07 | | | | | | | | | |
| Aroclor 1232 | | 1.8E-08 | 7.4E-07 | | | | | | | | | |
| Aroclor 1242 | | 1.8E-08 | 7.4E-07 | | | | | | | | | |
| Aroclor 1248 | 375.7 | 1.8E-08 | 7.4E-07 | 5.7E+03 | 6.0E-01 | 5.3E+05 | 1.6E+02 | | | | | |
| Aroclor 1254 | 375.7 | 1.8E-08 | 7.4E-07 | 5.7E+03 | 6.0E-01 | 5.3E+05 | 1.6E+02 | | | | | |
| Aroclor 1260 | 375.7 | 1.8E-08 | 7.4E-07 | 5.7E+03 | 6.0E-01 | 5.3E+05 | 1.6E+02 | | | | | |
| Pentachlorobenzene | | 7.1E-03 | 2.9E-01 | | | | | | | | | |
| Pyrene | 200 | 1.1E-05 | 4.5E-04 | 2.7E-02 | 7.2E-06 | 6.8E+04 | 4.1E+02 | 1.4E-01 | 1.7E-09 | 2.9E+06 | 8.9E+00 | X |
| Selenium | | | | | | | | | | | | |
| Silver | | | | | | | | | | | | |
| Strontium | | | | | | | | | | | | |

**Table B-1**

| Physical-Chemical Properties | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **MW (g/mole)** | **H (atm-m³/mole)** | **H' (dimensionless)** | **$D_a$ (cm²/s)** | **$D_w$ (cm²/s)** | **$K_{oc}$ (cm³/g)** | **$K_d$ (cm³/g)** | **S (mg/L)** | **$D_A$ (cm²/s)** | **VF (m³/kg)** | **SAT (mg/kg)** | **VOC** |
| RDX | | 6.3E-08 | 2.6E-06 | | | 7.0E+01 | 1.1E-01 | | | | | |
| 1,2,4,5-Tetrachlorobenzene | | 1.0E-03 | 4.1E-02 | | | | | | | | | |
| 1,1,2,2-Tetrachloroethane | 168 | 3.5E-04 | 1.4E-02 | 7.1E-02 | 7.9E-06 | 7.9E+01 | 4.7E-01 | 3.0E+03 | 9.1E-05 | 1.3E+04 | 7.3E+02 | X |
| Tetrachloroethene | 165.83 | 1.8E-02 | 7.5E-01 | 7.2E-02 | 8.2E-06 | 2.7E+02 | 1.6E+00 | 2.0E+02 | 1.5E-03 | 3.1E+03 | 1.0E+02 | X |
| Thallium | | | | | | | | | | | | |
| Toluene | 92 | 6.6E-03 | 2.7E-01 | 8.7E-02 | 8.6E-06 | 1.4E+02 | 8.4E-01 | 5.3E+02 | 1.2E-03 | 3.4E+03 | 1.8E+02 | X |
| Toxaphene | | 6.0E-06 | 2.5E-04 | | | | | | | | | |
| Tribromomethane | | 6.6E-04 | 2.7E-02 | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 181 | 1.4E-03 | 5.8E-02 | 3.0E-02 | 8.2E-06 | 1.7E+03 | 1.0E+01 | 3.0E+02 | 9.0E-06 | 4.0E+04 | 5.3E+02 | X |
| 1,1,1-Trichloroethane | 133 | 1.7E-02 | 7.1E-01 | 7.8E-02 | 8.8E-06 | 1.4E+02 | 8.1E-01 | 1.3E+03 | 2.7E-03 | 2.3E+03 | 5.1E+02 | X |
| 1,1,2-Trichloroethane | 133 | 9.1E-04 | 3.7E-02 | 7.8E-02 | 8.8E-06 | 7.5E+01 | 4.5E-01 | 4.4E+03 | 2.7E-04 | 7.3E+03 | 1.1E+03 | X |
| Trichloroethene | 131 | 1.0E-02 | 4.2E-01 | 7.9E-02 | 9.1E-06 | 9.4E+01 | 5.7E-01 | 1.1E+03 | 2.3E-03 | 2.5E+03 | 3.4E+02 | X |
| 2,4,5-Trichlorophenol | 197.46 | 4.3E-06 | 1.8E-04 | | | | | | | | | |
| 2,4,6-Trichlorophenol | 197.46 | 7.8E-06 | 3.2E-04 | | | | | | | | | |
| 2,4,6-Trinitrotoluene | | 4.6E-07 | 1.9E-05 | | | 1.6E+03 | 2.4E+00 | | | | | |
| Vanadium | | | | | | | | | | | | |
| Vinyl chloride | 63 | 2.7E-02 | 1.1E+00 | 1.1E-01 | 1.2E-06 | 1.9E+01 | 1.1E-01 | 2.8E+03 | 1.5E-02 | 9.9E+02 | 8.7E+02 | X |
| Xylenes | 106 | 7.3E-03 | 3.0E-01 | 7.0E-02 | 7.8E-06 | 2.0E+02 | 1.2E+00 | 1.6E+02 | 8.2E-04 | 4.2E+03 | 6.3E+01 | X |
| Zinc | | | | | | | | | | | | |

MW – Molecular weight
H – Henry's Law Constant
H' – Dimensionless Henry's Law Constant
$D_a$ – Diffusivity in air
$D_w$ – Diffusivity in water
$K_{oc}$ – Soil organic carbon partition coefficient
$K_d$ – Soil-water partition coefficient
S - Solubility in water
$D_A$ – Apparent diffusivity
VF – Volatilization factor
SAT – Soil saturation limit
VOC – Volatile organic compound

Note: Values for properties are presented in this table only for those compounds for which the values were used in the soil screening level calculation.

# APPENDIX C

**Table C-1**

| Human Health Benchmarks Used for Calculating SSLs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **$SF_o$ (mg/kg-day$^{-1}$** | **Reference** | **$SF_i$ (mg/kg-day)$^{-1}$** | **Reference** | **$RfD_o$ (mg/kg-day)** | **Reference** | **$RfD_i$ (mg/kg-day)** | **Reference** | **ABS** |
| Acenaphthene | | | | | 6.0E-02 | IRIS | 6.0E-02 | r | 0.13 |
| Acrolein | | | | | 2.0E-02 | HEAST | 5.7E-06 | IRIS | 0.1 |
| Acrylonitrile | 5.4E-01 | IRIS | 2.4E-01 | IRIS | 1.0E-03 | HEAST | 5.7E-04 | IRIS | 0.1 |
| Aldrin | 1.7E+01 | IRIS | 1.7E+01 | IRIS | 3.0E-05 | IRIS | 3.0E-05 | r | 0.1 |
| Aluminum | | | | | 1.0E+00 | NCEA | 1.4E-03 | NCEA | 0.01 |
| Anthracene | | | | | 3.0E-01 | IRIS | 3.0E-01 | r | 0.13 |
| Antimony | | | | | 4.0E-04 | IRIS | | | 0.01 |
| Arsenic | 1.5E+00 | IRIS | 1.5E+01 | IRIS | 3.0E-04 | IRIS | | | 0.03 |
| Barium | | | | | 7.0E-02 | IRIS | 1.4E-04 | HEAST | 0.01 |
| Benzene | 2.9E-02 | IRIS | 2.7E-02 | IRIS | 3.0E-03 | NCEA | 1.7E-03 | NCEA | 0.01 |
| Benzidine | 2.3E+02 | IRIS | 2.3E+02 | IRIS | 3.0E-03 | IRIS | 3.0E-03 | r | 0.1 |
| Benz(a)anthracene | 7.3E-01 | NCEA | 3.1E-01 | NCEA | 3.0E-02 | S | 3.0E-02 | s | 0.13 |
| Benzo(a)pyrene | 7.3E+00 | IRIS | 3.1E+00 | NCEA | 3.0E-02 | S | 3.0E-02 | s | 0.13 |
| Benzo(b)fluoranthene | 7.3E-01 | NCEA | 3.1E-01 | NCEA | 3.0E-02 | S | 3.0E-02 | s | 0.13 |
| Benzo(k)fluoranthene | 7.3E-02 | NCEA | 3.1E-02 | NCEA | 3.0E-02 | S | 3.0E-02 | s | 0.13 |
| α-BHC | 6.3E+00 | IRIS | 6.3E+00 | IRIS | | | | | 0.04 |
| β-BHC | 1.8E+00 | IRIS | 1.8E+00 | IRIS | 3.0E-04 | S | 3.0E-04 | s | 0.04 |
| γ-BHC | 1.3E+00 | HEAST | 1.3E+00 | r | 3.0E-04 | IRIS | 3.0E-04 | r | 0.04 |
| Beryllium | | | 8.4E+00 | IRIS | 2.0E-03 | IRIS | 5.7E-06 | IRIS | 0.01 |
| Bis(2-chloroethyl) ether | 1.1E+00 | IRIS | 1.2E+00 | IRIS | | | | | 0.1 |
| Bis(2-chloroisopropyl) ether | 7.0E-02 | HEAST | 3.5E-02 | HEAST | 4.0E-02 | IRIS | 4.0E-02 | r | 0.1 |
| Bis(chloromethyl) ether | 2.2E+02 | IRIS | 2.2E+02 | IRIS | | | | | 0.1 |
| Boron | | | | | 9.0E-02 | IRIS | 5.7E-03 | HEAST | 0.1 |
| Bromodichloromethane | 6.2E-02 | IRIS | 6.2E-02 | r | 2.0E-02 | IRIS | 2.0E-02 | r | 0.1 |
| Bromomethane | | | | | 1.4E-03 | IRIS | 1.4E-03 | IRIS | 0.1 |
| 2-Butanone | | | | | 6.0E-01 | IRIS | 2.9E-01 | IRIS | 0.1 |
| *tert*-Butyl methyl ether | | | | | 1.0E-01 | Cal EPA | 8.6E-01 | IRIS | 0.1 |
| Cadmium | | | 6.3E+00 | IRIS | 1.0E-03 | IRIS | | | 0.001 |
| Carbon tetrachloride | 1.3E-01 | IRIS | 5.3E-02 | IRIS | 7.0E-04 | IRIS | 5.7E-04 | NCEA | 0.1 |
| Chlordane | 3.5E-01 | IRIS | 3.5E-01 | IRIS | 5.0E-04 | IRIS | 2.0E-04 | IRIS | 0.04 |
| Chlorobenzene | | | | | 2.0E-02 | IRIS | 1.7E-02 | NCEA | 0.1 |
| Chloromethane | 1.3E-02 | HEAST | 6.3E-03 | HEAST | | | 8.6E-02 | NCEA | 0.1 |
| Chloroform | 6.1E-03 | IRIS | 8.1E-02 | IRIS | 1.0E-02 | IRIS | 8.6E-05 | NCEA | 0.1 |
| Chromium III | | | | | 1.5E+00 | IRIS | | | 0.01 |
| Chromium VI | | | 2.9E+02 | IRIS | 3.0E-03 | IRIS | | | 0.01 |

**Table C-1**

| Human Health Benchmarks Used for Calculating SSLs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **$SF_o$ (mg/kg-day$^{-1}$** | **Reference** | **$SF_i$ (mg/kg-day)$^{-1}$** | **Reference** | **$RfD_o$ (mg/kg-day)** | **Reference** | **$RfD_i$ (mg/kg-day)** | **Reference** | **ABS** |
| Cobalt | | | | | 6.0E-02 | NCEA | 2.9E-04 | NCEA | 0.01 |
| Copper | | | | | 3.7E-02 | HEAST | | | 0.01 |
| Chrysene | 7.3E-03 | NCEA | 3.1E-03 | NCEA | 3.0E-02 | S | 3.0E-02 | s | 0.13 |
| Cyanide | | | | | 2.0E-02 | IRIS | 2.0E-02 | r | 0.1 |
| DDD | 2.4E-01 | IRIS | 2.4E-01 | r | 5.0E-04 | S | 5.0E-04 | s | 0.03 |
| DDE | 3.4E-01 | IRIS | 3.4E-01 | r | 5.0E-04 | S | 5.0E-04 | s | 0.03 |
| DDT | 3.4E-01 | IRIS | 3.4E-01 | IRIS | 5.0E-04 | IRIS | 5.0E-04 | r | 0.03 |
| Dibenz(a,h)anthracene | 7.3E+00 | NCEA | 3.1E+00 | NCEA | | | | | 0.13 |
| 1,2-Dibromoethane | 8.5E+01 | IRIS | 7.7E-01 | IRIS | 5.7E-05 | R | 5.7E-05 | HEAST | 0.1 |
| Dibutyl phthalate | | | | | 1.0E-01 | IRIS | 1.0E-01 | r | 0.1 |
| 1,2-Dichlorobenzene | | | | | 9.0E-02 | IRIS | 5.7E-02 | HEAST | 0.1 |
| 1,3-Dichlorobenzene | | | | | 9.0E-04 | NCEA | 9.0E-04 | r | 0.1 |
| 1,4-Dichlorobenzene | 2.4E-02 | HEAST | 2.2E-02 | NCEA | 3.0E-02 | NCEA | 3.0E-02 | IRIS | 0.1 |
| 3,3-Dichlorobenzidine | 4.5E-01 | IRIS | 4.5E-01 | r | | | | | 0.1 |
| Dichlorodifluoromethane | | | | | 2.0E-01 | IRIS | 5.7E-02 | HEAST | 0.1 |
| 1,1-Dichloroethane | | | | | 1.0E-01 | HEAST | 1.4E-01 | HEAST | 0.1 |
| 1,2-Dichloroethane | 9.1E-02 | IRIS | 9.1E-02 | IRIS | 3.0E-02 | NCEA | 1.4E-03 | NCEA | 0.1 |
| 1,1-Dichloroethene | 6.0E-01 | IRIS | 1.8E-01 | IRIS | 9.0E-03 | IRIS | 9.0E-03 | r | 0.1 |
| *cis*-1,2-Dichloroethene | | | | | 1.0E-02 | HEAST | 1.0E-02 | r | 0.1 |
| *trans*-1,2-Dichloroethene | | | | | 2.0E-02 | IRIS | 2.0E-02 | r | 0.1 |
| Dichloromethane | 7.5E-03 | IRIS | 1.6E-03 | IRIS | 6.0E-02 | IRIS | 8.6E-01 | HEAST | 0.1 |
| 2,4-Dichlorophenol | | | | | 3.0E-03 | IRIS | 3.0E-03 | r | 0.1 |
| 1,3-Dichloropropene | 1.8E-01 | HEAST | 1.3E-01 | HEAST | 3.0E-04 | IRIS | 5.7E-03 | IRIS | 0.1 |
| Dieldrin | 1.6E+01 | IRIS | 1.6E+01 | IRIS | 5.0E-05 | IRIS | 5.0E-05 | r | 0.1 |
| Diethyl phthalate | | | | | 8.0E-01 | IRIS | 8.0E-01 | r | 0.1 |
| Di(2-ethylhexyl) phthalate | 1.4E-02 | IRIS | 1.4E-02 | r | 2.0E-02 | IRIS | 2.2E-02 | r | 0.1 |
| 2,4-Dinitrophenol | | | | | 2.0E-03 | IRIS | 2.0E-03 | r | 0.1 |
| Dimethyl phthalate | | | | | 1.0E+01 | HEAST | 1.0E+01 | r | 0.1 |
| 2,4-Dinitro-2-methylphenol | | | | | 2.0E-03 | S | 2.0E-03 | s | 0.1 |
| 2,4-Dinitrotoluene | | | | | 2.0E-03 | IRIS | 2.0E-03 | r | 0.1 |
| 1,2-Diphenylhydrazine | 8.0E-01 | IRIS | 7.7E-01 | IRIS | | | | | 0.1 |
| Endosulfan | | | | | 6.0E-03 | IRIS | 6.0E-03 | r | 0.1 |
| Endrin | | | | | 3.0E-04 | IRIS | 3.0E-04 | r | 0.1 |
| Ethylbenzene | | | | | 1.0E-01 | IRIS | 2.9E-01 | IRIS | 0.1 |
| Fluoranthene | | | | | 4.0E-02 | IRIS | 4.0E-02 | r | 0.13 |

**Table C-1**

| Human Health Benchmarks Used for Calculating SSLs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **$SF_o$ (mg/kg-day$^{-1}$** | **Reference** | **$SF_i$ (mg/kg-day)$^{-1}$** | **Reference** | **$RfD_o$ (mg/kg-day)** | **Reference** | **$RfD_i$ (mg/kg-day)** | **Reference** | **ABS** |
| Fluorene | | | | | 4.0E-02 | IRIS | 4.0E-02 | r | 0.1 |
| Flouride | | | | | 6.0E-02 | IRIS | | | 0.1 |
| Fluorotrichloromethane | | | | | | | | | 0.1 |
| Heptachlor | 4.5E+00 | IRIS | 4.6E+00 | IRIS | 5.0E-04 | IRIS | 5.0E-04 | r | 0.1 |
| Hexachlorobenzene | 1.6E+00 | IRIS | 1.6E+00 | IRIS | 8.0E-04 | IRIS | 8.0E-04 | r | 0.1 |
| Hexachlorocyclopentadiene | | | | | 7.0E-03 | IRIS | 2.0E-05 | HEAST | 0.1 |
| Hexachloroethane | 1.4E-02 | IRIS | 1.4E-02 | IRIS | 1.0E-03 | IRIS | 1.0E-03 | r | 0.1 |
| Hexachlorobutadiene | 7.8E-02 | IRIS | 7.8E-02 | IRIS | 2.0E-04 | HEAST | 2.0E-04 | r | 0.1 |
| HMX | | | | | 5.0E-02 | IRIS | | | 0.1 |
| Indeno(1,2,3-c,d)pyrene | 7.3E-01 | NCEA | 3.1E-01 | NCEA | 3.0E-02 | S | 3.0E-02 | s | 0.13 |
| Iron | | | | | 3.0E-01 | NCEA | | | 0.01 |
| Isophorone | 9.5E-04 | IRIS | 9.5E-04 | r | 2.0E-01 | IRIS | 2.0E-01 | r | 0.1 |
| Lead | The effects of lead are evaluated using US EPA's IEUBK model | | | | | | | | |
| Lead (tetraethyl-) | | | | | 1.0E-07 | IRIS | | | 0.1 |
| Manganese | | | | | 1.4E-01 | IRIS | 1.4E-05 | IRIS | 0.01 |
| Mercury and compounds | | | | | 3.0E-04 | IRIS | | | 0.01 |
| Mercury (elemental) | | | | | | | 8.6E-05 | IRIS | 0.01 |
| Mercury (methyl) | | | | | 1.0E-04 | IRIS | | | 0.1 |
| Molybdenum | | | | | 5.0E-03 | HEAST | | | 0.01 |
| Naphthalene | | | | | 2.0E-02 | IRIS | 8.6E-04 | IRIS | 0.1 |
| Nickel | | | | | 2.0E-02 | IRIS | 5.7E-05 | ATSDR | 0.01 |
| Nitrate | | | | | 1.6E+00 | IRIS | 1.6E+00 | r | 0.1 |
| Nitrite | | | | | 1.0E-01 | IRIS | 1.0E-01 | r | 0.1 |
| Nitrobenzene | | | | | 5.0E-04 | IRIS | 5.7E-04 | HEAST | 0.1 |
| Nitroglycerin | 1.4E-02 | NCEA | 1.4E-02 | r | | | | | 0.1 |
| *N*-Nitrosodi-*n*-butylamine | 5.4E+00 | IRIS | 5.6E+00 | IRIS | | | | | 0.1 |
| *N*-Nitrosodiethylamine | 1.5E+02 | IRIS | 1.5E+02 | IRIS | | | | | 0.1 |
| *N*-Nitrosodimethylamine | 5.1E+01 | IRIS | 4.9E+01 | IRIS | | | | | 0.1 |
| *N*-Nitrosodiphenylamine | 4.9E-03 | IRIS | 4.9E-03 | r | | | | | 0.1 |
| *N*-Nitrosopyrrolidine | 2.1E+00 | IRIS | 2.1E+00 | IRIS | | | | | 0.1 |
| Phenanthrene | | | | | 3.0E-02 | X | 3.0E-02 | x | 0.1 |
| Phenol | | | | | 6.0E-01 | IRIS | 6.0E-01 | r | 0.1 |
| Phenol | 1.6E+00 | IRIS | 1.6E+00 | IRIS | 8.0E-04 | IRIS | 8.0E-04 | r | 0.1 |
| **Polychlorinatedbiphenyls** | | | | | | | | | |
| Aroclor 1016 | 7.0E-02 | IRIS | 7.0E-02 | IRIS | 7.0E-05 | IRIS | 7.0E-05 | r | 0.14 |

**Table C-1**

| Human Health Benchmarks Used for Calculating SSLs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **$SF_o$ (mg/kg-day$^{-1}$** | **Reference** | **$SF_i$ (mg/kg-day)$^{-1}$** | **Reference** | **$RfD_o$ (mg/kg-day)** | **Reference** | **$RfD_i$ (mg/kg-day)** | **Reference** | **ABS** |
| Aroclor 1221 | 2.0E+00 | IRIS | 2.0E+00 | IRIS | | | | | 0.14 |
| Aroclor 1232 | 2.0E+00 | IRIS | 2.0E+00 | IRIS | | | | | 0.14 |
| Aroclor 1242 | 2.0E+00 | IRIS | 2.0E+00 | IRIS | | | | | 0.14 |
| Aroclor 1248 | 2.0E+00 | IRIS | 2.0E+00 | IRIS | 2.0E-05 | S | 2.0E-05 | s | 0.14 |
| Aroclor 1254 | 2.0E+00 | IRIS | 2.0E+00 | IRIS | 2.0E-05 | IRIS | 2.0E-05 | r | 0.14 |
| Aroclor 1260 | 2.0E+00 | IRIS | 2.0E+00 | IRIS | 2.0E-05 | S | 2.0E-05 | s | 0.14 |
| Pentachlorobenzene | | | | | 8.0E-04 | IRIS | 8.0E-04 | r | 0.1 |
| Pyrene | | | | | 3.0E-02 | IRIS | 3.0E-02 | r | 0.1 |
| Selenium | | | | | 5.0E-03 | IRIS | | | 0.01 |
| Silver | | | | | 5.0E-03 | IRIS | | | 0.01 |
| Strontium | | | | | 6.0E-01 | IRIS | | | 0.1 |
| RDX | 1.1E-01 | IRIS | 1.1E-01 | r | 3.0E-03 | IRIS | 3.0E-03 | r | 0.1 |
| 1,2,4,5-Tetrachlorobenzene | | | | | 3.0E-04 | IRIS | 3.0E-04 | r | 0.1 |
| 1,1,2,2-Tetrachloroethane | 2.0E-01 | IRIS | 2.0E-01 | IRIS | 6.0E-02 | NCEA | 6.0E-02 | r | 0.1 |
| Tetrachloroethene | 5.2E-02 | NCEA | 2.0E-03 | NCEA | 1.0E-02 | IRIS | 1.1E-01 | NCEA | 0.1 |
| Thallium | | | | | 8.0E-05 | IRIS | | | 0.01 |
| Toluene | | | | | 2.0E-01 | IRIS | 1.1E-01 | HEAST | 0.1 |
| Toxaphene | 1.1E+00 | IRIS | 1.1E+00 | IRIS | | | | | 0.1 |
| Tribromomethane | 7.9E-03 | IRIS | 3.9E-03 | IRIS | 2.0E-02 | IRIS | 2.0E-02 | r | 0.1 |
| 1,2,4-Trichlorobenzene | | | | | 1.0E-02 | IRIS | 5.7E-02 | HEAST | 0.1 |
| 1,1,1-Trichloroethane | | | | | 3.5E-02 | NCEA | 2.9E-01 | NCEA | 0.1 |
| 1,1,2-Trichloroethane | 5.7E-02 | IRIS | 5.6E-02 | IRIS | 4.0E-03 | IRIS | 4.0E-03 | r | 0.1 |
| Trichloroethene | 1.5E-02 | NCEA | 1.0E-02 | NCEA | 6.0E-03 | NCEA | 6.0E-03 | r | 0.1 |
| 2,4,5-Trichlorophenol | | | | | 1.0E-01 | IRIS | 1.0E-01 | r | 0.1 |
| 2,4,6-Trichlorophenol | 1.1E-02 | IRIS | 1.1E-02 | IRIS | | | | | 0.1 |
| 2,4,6-Trinitrotoluene | 3.0E-02 | IRIS | 3.0E-02 | r | 5.0E-04 | IRIS | 5.0E-04 | r | 0.1 |
| Vanadium | | | | | 7.0E-03 | HEAST | | | 0.01 |
| Vinyl chloride | 1.9E+00 | HEAST | 3.0E-01 | HEAST | | | | | 0.1 |
| Xylenes | | | | | 2.0E+00 | IRIS | 2.0E+00 | r | 0.1 |
| Zinc | | | | | 3.0E-01 | IRIS | | | 0.01 |

$SF_o$ – Oral cancer slope factor
$SF_i$ – Inhalation cancer slope factor
$RfD_o$ – Oral Reference Dose
$RfD_i$ – Inhalation Reference Dose
ABS – Gastrointestinal absorption coefficient

IRIS – Integrated Risk Information System, USEPA, 2000
HEAST – Health Effects Assessment Summary Tables, USEPA, 1997
NCEA – National Center for Environmental Assessment, Office of Research and Development
r – Route-to-route extrapolation
S – Surrogate value selected on basis of structure-activity relationship

OSWER 9240.1-05A-P
PB99-963506
EPA540/R-99/008
October 1999

# USEPA CONTRACT LABORATORY PROGRAM NATIONAL FUNCTIONAL GUIDELINES FOR ORGANIC DATA REVIEW

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

# NOTICE

The polices and procedures set forth here are intended as guidance to the Agency and other governmental employees. They do not constitute rule making by the agency, and may not be relied on to create a substantive or procedural right enforceable by any other person. The Government may take action that is at variance with the policies and procedures in this manual.

Additional copies of this document can be obtained from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650
Document Number PB 99-963506

This document can also be obtained from the EPA's Contract Laboratory Program Web site at:

http://www.epa.gov/superfund/programs/clp/guidance.htm

## TABLE OF CONTENTS

**INTRODUCTION** . . . . . 1

**PRELIMINARY REVIEW** . . . . . 2

**DATA QUALIFIER DEFINITIONS** . . . . . 4

**VOLATILE DATA REVIEW** . . . . . 5

I. Holding Times . . . . . 6

II. GC/MS Instrument Performance Check . . . . . 9

III. Initial Calibration . . . . . 12

IV. Continuing Calibration . . . . . 17

V. Blanks . . . . . 20

VI. System Monitoring Compounds . . . . . 24

VII. Matrix Spikes/Matrix Spike Duplicates . . . . . 27

VIII. Laboratory Control Samples . . . . . 29

IX. Regional Quality Assurance and Quality Control . . . . . 31

X. Internal Standards . . . . . 32

XI. Target Compound Identification . . . . . 34

XII. Compound Quantitation and Reported CRQLs . . . . . 36

XIII. Tentatively Identified Compounds . . . . . 38

XIV. System Performance . . . . . 42

XV. Overall Assessment of Data . . . . . 44

**SEMIVOLATILE DATA REVIEW** . . . . . 45

I. Holding Times . . . . . 46

II. GC/MS Instrument Performance Check . . . . . 48

III. Initial Calibration . . . . . 51

IV. Continuing Calibration . . . . . 55

V. Blanks . . . . . 58

VI. Surrogate Spikes . . . . . 61

VII. Matrix Spikes/Matrix Spike Duplicates . . . . . 64

VIII. Laboratory Control Samples . . . . . 66

IX. Regional Quality Assurance and Quality Control . . . . . 68

X. Internal Standards . . . . . 69

XI. Target Compound Identification . . . . . 71

XII. Compound Quantitation and Reported CRQLS . . . . . 73

XIII. Tentatively Identified Compounds . . . . . 75

XIV. System Performance . . . . . 80

XV. Overall Assessment of Data . . . . . 82

**PESTICIDE/AROCLOR DATA REVIEW** . . . . . 83

I. Holding Times . . . . . 84

II. GC/ECD Instrument Performance Check . . . . . 86

III. Initial Calibration . . . . . 92

IV. Calibration Verification . . . . . 96

V. Blanks . . . . . 99

VI. Surrogate Spikes . . . . . 103

**PESTICIDE/AROCLOR DATA REVIEW (cont.)**


VII. Matrix Spikes/Matrix Spike Duplicates ..... 106

VIII. Laboratory Control Samples ..... 108

IX. Regional Quality Assurance and Quality Control ..... 110

X. Pesticide Cleanup Checks ..... 111

XI. Target Compound Identification ..... 113

XII. Compound Quantitation and Reported CRQLS ..... 116

XIII. Overall Assessment of Data ..... 118

# INTRODUCTION

This document is designed to offer guidance on EPA Contract Laboratory Program (CLP) organic analytical data evaluation and review. In some applications it may be used as a Standard Operating Procedure (SOP). In other, more subjective areas, only general guidance is offered due to the complexities and uniqueness of data relative to specific samples. For example, areas where the application of specific SOPs are possible are primarily those in which definitive performance criteria are established. These criteria are concerned with specifications that are not sample dependent; they specify performance requirements that should fully be under a laboratory's control. These specific areas include blanks, calibration standards, performance evaluation standard materials, and instrument performance checks (tuning).

These guidelines include the requirements for the Organic Analysis Multi-Media, Multi-Concentration method, and for the Low Concentration Water Organic Analysis method. *To ensure that the data review guidelines that are unique to the Low Concentration Water Samples are easily identified, these requirements and procedures are presented in italics and contained within brackets* ([ ]) *throughout the document.*

This document is intended to assist in the technical review of analytical data generated through the CLP. Determining contract compliance is not the intended objective of these guidelines. The data review process provides information on analytical limitations of data based on specific quality control (QC) criteria. In order to provide more specific usability statements, the reviewer must have a complete understanding of the intended use of the data. For this reason, it is recommended that whenever possible the reviewer obtain usability issues from the user prior to reviewing the data. When this is not possible, the user should be encouraged to communicate any questions of the reviewer.

At times, there may be a need to use data which does not meet all contract requirements and technical criteria. Use of these data does not constitute either a new requirement standard or full acceptance of the data. Any decision to utilize data for which performance criteria have not been met is strictly to facilitate the progress of projects requiring the availability of the data. A contract laboratory submitting data which are out of specification may be required to rerun samples or resubmit data, even if the previously submitted data have been utilized due to program needs. Data which do not meet specified requirements are never fully acceptable. The only exception to this condition is in the area of the requirements for individual sample analysis; if the nature of the sample itself inhibits the attainment of specifications, appropriate allowances must be made.

## PRELIMINARY REVIEW

In order to use this document effectively, the reviewer should have a general overview of the Sample Delivery Group (SDG) or sample Case at hand. The exact number of samples, their assigned numbers, their matrix and the number of laboratories involved in their analysis are essential information. Background information on the site is helpful but often this information may be difficult to locate. The site manager is the best source for answers to questions or further direction.

Sample cases (SDGs) routinely have unique samples which require special attention by the reviewer. These include field blanks, field duplicates, and performance audit samples which need to be identified. The sampling records should identify:

1. The Project Officer for site.

2. The Complete list of samples with information on:

   a. sample matrix,
   b. field blanks,
   c. field duplicates,
   d. field spikes,
   e. QC audit samples,
   f. shipping dates,
   g. preservatives, and
   h. laboratories involved.

The chain-of-custody record includes sample descriptions and date(s) of sampling. The reviewer must take into account lag times between sampling and start of analysis when assessing technical sample holding times.

The laboratory's SDG Narrative is another source of general information. Notable problems with matrices, insufficient sample volume for analysis or re-analysis, samples received in broken containers, preservation, and unusual events should be found in the SDG Narrative.

The SDG Narrative for the sample data package must include a Laboratory Certification Statement (exactly as written in the method), signed by the laboratory manager or his designee. This statement authorizes the validation and release of the sample data results. In addition, the laboratory must also provide comments in the SDG Narrative describing in detail any problems encountered in processing the samples in the data package.

For every data package, the reviewer must verify that the laboratory certification statement is present, exactly stated as in the method (i.e., verbatim to the statement in the method), and signed by the laboratory manager or designee. The reviewer must further verify that the data package is consistent with the laboratory's certified narrative. Also, the reviewer should check the comments provided in the narrative to determine if they are sufficient to describe and explain any associated problem(s).

The data review should include comments that clearly identify the problems associated with a Case or Sample Delivery Group and to state the limitations of the data. Documentation should include the sample number, analytical method, extent of the problem, and assigned qualifiers.

A data review narrative generally accompanies the laboratory data forwarded to the intended data recipient (client) or user to promote communications. A copy of the data review narrative should be submitted to the EPA Project Officer assigned oversight responsibility for the laboratory producing the data.

It is a responsibility to notify the appropriate EPA Project Officer concerning problems and deficiencies with regard to laboratory data. If there is an urgent requirement, the EPA Project Officer may be contacted by telephone to expedite corrective action. It is recommended that all items for EPA Project Officer action be presented at one time.

## DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If the Regions choose to use additional qualifiers, a complete explanation of those qualifiers should accompany the data review.

**U** - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

**J** - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

**N** - The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".

**NJ** - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

**UJ** - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

**R** - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

## VOLATILE DATA REVIEW

** * *Data review guidelines that are unique to data generated through the Low Concentration Water Method are contained within brackets ([]) and written in italics. * * **

The volatile data requirements to be checked are listed below:

I. Holding Times

II. GC/MS Instrument Performance Check

III. Initial Calibration

IV. Continuing Calibration

V. Blanks

VI. System Monitoring Compounds

VII. Matrix Spikes/Matrix Spike Duplicates

*[VIII. Laboratory Control Samples]*

IX. Regional Quality Assurance and Quality Control

X. Internal Standards

XI. Target Compound Identification

XII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs)

XIII. Tentatively Identified Compounds

XIV. System Performance

XV. Overall Assessment of Data

## I. Holding Times

**A. Review Items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, EPA Sample Traffic Report and/or chain-of-custody, raw data, and SDG Narrative.

**B. Objective:**

The objective is to ascertain the validity of the analytical results based on the holding time of the sample from the time of collection to the time of analysis.

**C. Criteria:**

Technical requirements for sample holding times have only been established for water matrices.

The technical holding time criteria for water samples are as follows:

For non-aromatic volatile compounds in cooled (@4°C) water samples, the maximum holding time is 14 days from sample collection.

Maximum holding times for purgeable aromatic hydrocarbons in cooled (@4°C±2°C), acid-preserved (with HCl to pH 2 or below) water samples is 14 days from sample collection.

Water samples that have not been maintained at 4°C (±2°C) and preserved to a pH of 2 or below should be analyzed within 7 days from sample collection. If insufficient ice is used to ship samples, the laboratory may receive samples with no ice left in the cooler. Under these circumstances, the temperature of the samples may exceed 4°C.

**NOTE:** It is further recommended that volatile compounds in properly preserved (4°C±2°C) nonaqueous samples be analyzed within 14 days of sample collection.

The method maximum holding times, which differ from the technical maximum holding times, state that water and soil samples are to be analyzed within 10 days from the validated time of sample receipt (VTSR) at the laboratory.

**D. Evaluation:**

Technical holding times are established by comparing the sampling dates on the EPA Sample Traffic Report with dates of analysis on Form I VOA-1 and Form I VOA-2 *[Form I LCV]* and the raw data. Information contained in the Complete SDG File should also be considered in the determination of holding times. Verify that the analysis dates on the Form Is and the raw data/SDG file are identical. Review the SDG Narrative to determine if samples were preserved. If there is no indication in the SDG Narrative or the sample records that there was a problem with the samples (e.g., samples not maintained @ 4°C or containing headspace in the samples), then the integrity of samples can be assumed to be good. If it is indicated that there were problems with the samples, then the integrity of the sample may have been compromised and professional

judgement should be used to evaluate the effect of the problem on the sample results.

**E. Action:**

1. If technical holding times are exceeded, document in the data review narrative that holding times were exceeded and qualify the sample results as follows (also see Table 1):

   a. If there is no evidence that the samples were properly preserved and the technical holding times exceeded 7 days, qualify positive results for aromatic compounds with "J" and sample quantitation limits with "UJ". Use professional judgement to determine if and how non-aromatic volatile compounds should also be qualified.

   b. If the samples were properly preserved but the technical holding times exceeded 14 days, qualify positive results with "J" and sample quantitation limits with "UJ".

   Table 1. Qualification of Volatile Analytes Based on Technical Holding Times

| MATRIX | PRESERVED | > 7 DAYS | > 14 DAYS |
|---|---|---|---|
| Water | No | All Aromatics* | All Compounds |
| | Yes | None | All Compounds |
| Non-Aqueous | No/Yes | Professional Judgement | Professional Judgement |

   * Reviewer should use professional judgement to determine if data for additional compounds require qualification.

2. If technical holding times are grossly exceeded (e.g., by greater than two times the required time for volatiles) either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effects of additional storage on the sample results. Should the reviewer determine that qualification is necessary, non-detected volatile target compounds may be qualified unusable (R). Positive results are considered approximates and are qualified with "J".

3. Due to limited information concerning holding times for non-aqueous samples, it is left to the discretion of the data reviewer to apply water holding times or other information that is available.

4. Whenever possible, the reviewer should comment on the effect of the holding time exceedance on the resulting data in the data review narrative.

**VOA**

5. When method and/or technical holding times are grossly exceeded, this should be noted for EPA Project Officer action.

6. The reviewer should also be aware of the scenario in which the laboratory has exceeded the technical holding times, but met method holding times. In this case, the data reviewer should notify the EPA Project Officer (where samples were collected) and/or RSCC that shipment delays have occurred so that the field problem can be corrected. The reviewer may pass this information on to the laboratory's EPA Project Officer, but should explain that the laboratory met the requirements in the method.

## II. GC/MS Instrument Performance Check

**A. Review Items:** Form V VOA *[Form V LCV]*, BFB mass spectra and mass listing.

**B. Objective:**

Gas chromatograph/mass spectrometer (GC/MS) instrument performance checks are performed to ensure mass resolution, identification, and to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials, therefore, these criteria should be met in all circumstances.

**C. Criteria:**

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples or standards are analyzed. The instrument performance check, bromofluorobenzene (BFB) for volatile analysis, must meet the ion abundance criteria given below:

Bromofluorobenzene (BFB)

| m/z | ION ABUNDANCE CRITERIA |
|---|---|
| 50 | 8.0 - 40.0% of m/z 95 |
| 75 | 30.0 - 66.0% of m/z 95 |
| 95 | Base peak, 100% relative abundance |
| 96 | 5.0 - 9.0% of m/z 95 |
| 173 | Less than 2.0% of m/z 174 |
| 174 | 50.0 - 120.0% of m/z 95 |
| 175 | 4.0-9.0% of mass 174 |
| 176 | 93.0 - 101.0% of m/z 174 |
| 177 | 5.0 - 9.0% of m/z 176 |

**NOTE:** All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.

**VOA**

**D. Evaluation:**

1. Compare the data presented for each Instrument Performance Check (Form V VOA *[Form V LCV])* with each mass listing submitted to ensure the following:

   a. Form V VOA *[Form V LCV]* is present and completed for each 12-hour period during which samples were analyzed.

   b. The laboratory has not made transcription errors between the data and the form. If there are major differences between the mass listing and the Form Vs, a more in depth review of the data is required. This may include obtaining and reviewing additional information from the laboratory.

   c. The appropriate number of significant figures has been reported (number of significant figures given for each ion in the ion abundance criteria column) and that rounding is correct.

   d. The laboratory has not made calculation errors.

2. Verify from the raw data (mass spectral listing) that the mass assignment is correct and that the mass listing is normalized to m/z 95.

3. Verify that the ion abundance criteria was met. The criteria for m/z 173, 175, 176, and 177 are calculated by normalizing to the specified m/z.

4. If possible, verify that spectra were generated using appropriate background subtraction techniques. Since the BFB spectrum is obtained from chromatographic peaks that should be free from coelution problems, background subtraction should be done in accordance with the following procedure. Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan no more than 20 scans prior to the elution of BFB. Do not subtract as part of the background the BFB peak.

**NOTE:** All instrument conditions must be identical to those used during the sample analysis. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting the method specifications are contrary to the quality assurance objectives and are therefore unacceptable.

**E. Action:**

1. If the laboratory has made minor transcription errors which do not significantly affect the data, the data reviewer should make the necessary corrections on a copy of the form.

2. If the laboratory has failed to provide the correct forms or has made significant transcription or calculation errors, the Region's designated representative should contact the laboratory and request corrected data. If the information is not available, then the reviewer must use professional judgement to assess the data. The laboratory's EPA Project Officer should be notified.

3. If mass assignment is in error (such as m/z 96 is indicated as the base peak rather than m/z 95), classify all associated data as unusable (R).

4. If ion abundance criteria are not met, professional judgement may be applied to determine to what extent the data may be utilized. Guidelines to aid in the application of professional judgement to this topic are discussed as follows:

   The most important factors to consider are the empirical results that are relatively insensitive to location on the chromatographic profile and the type of instrumentation. Therefore, the critical ion abundance criteria for BFB are the m/z 95/96, 174/175, 74/176, and 176/177 ratios. The relative abundances of m/z 50 and 75 are of lower importance.

5. Decisions to use analytical data associated with BFB instrument performance checks not meeting contract requirements should be clearly noted on the data review narrative.

6. If the reviewer has reason to believe that instrument performance check criteria were achieved using techniques other than those described in II.D.4, then additional information on the instrument performance checks should be obtained. If the techniques employed are found to be at variance with the contract requirements, the performance and procedures of the laboratory may merit evaluation. Concerns or questions regarding laboratory performance should be noted for EPA Project Officer action. For example, if the reviewer has reason to believe that an inappropriate technique was used to obtain background subtraction (such as background subtracting from the solvent front or from another region of the chromatogram rather than the BFB peak), then this should be noted for EPA Project Officer action.

## III. Initial Calibration

**A. Review Items:** Form VI VOA-1 and Form VI VOA-2 *[Form VI LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the volatile target compound list (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve.

**C. Criteria:**

1. Initial calibration standards containing both volatile target compounds and system monitoring compounds are analyzed at concentrations of 10, 20, 50, 100, and 200 ug/L at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met. The initial calibration (and any associated samples and blanks) must be analyzed within 12 hours of the associated instrument performance check.

   *[For data generated through the Low Concentration Water Method: Initial calibration standards containing both volatile target compounds and system monitoring compounds are analyzed at concentrations of 1, 2, 5, 10, and 25 ug/L for non-ketones and 5, 10, 25, 50, and 125 ug/L for ketones at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met.]*

2. Separate initial calibrations must be performed for water samples (or medium level soil samples) and for low level soil samples. The calibration for water samples and medium level soil samples is performed with an unheated purge and the calibration for low level soil samples is performed with a heated purge.

3. Initial calibration standard Relative Response Factors (RRFs) for all volatile target compounds and system monitoring compounds must be greater than or equal to 0.05. (Contractual initial calibration RRF criteria are listed in the appropriate method.)

4. The Percent Relative Standard Deviation (%RSD) from the initial calibration must be less than or equal to 30.0 percent for all compounds.

**D. Evaluation:**

1. Verify that the correct concentration of standards were used for the initial calibration (i.e., 10, 20, 50, 100, and 200 ug/L for water).

   *[Verify that the correct concentration of standards were used for the initial calibration (i.e., 1, 2, 5, 10, and 25 ug/L for non-ketones and 5, 10, 25, 50, and 125 ug/L for ketones).]*

2. Verify that the correct initial calibration was used for water and medium level soil samples (i.e., unheated purge) and for low level soil samples (i.e., heated purge).

3. If any sample results were calculated using an initial calibration, verify that the correct standard (i.e., the 50 ug/L standard) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated instrument performance check.

   *[If any sample results were calculated using an initial calibration, verify that the correct standard (i.e., the 5 ug/L for non-ketones and 25 ug/L for ketones) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated instrument performance check.]*

4. Evaluate the initial calibration RRFs and $\overline{RRF}$ for all volatile target compounds and system monitoring compounds:

   a. Check and recalculate the RRFs and $\overline{RRF}$ for at least one volatile target compound associated with each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that for all volatile target compounds and system monitoring compounds, the initial calibration RRFs are greater than or equal to 0.05.

**NOTE:** The criteria employed for technical data review purposes are different from those used in the method. The laboratory must meet a minimum RRF criterion of 0.0 1, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all volatile compounds.**

Table 2. Volatile Target Compounds Exhibiting Poor Response

| | |
|---|---|
| Acetone | 1,2-Dichloropropane |
| 2-Butanone | 2-Hexanone |
| Carbon Disulfide | Methylene Chloride |
| Chloroethane | 4-Methyl-2-pentanone |
| Chloromethane | **Toluene-d8 †** |
| trans-1,2-Dichloroethene | **1,2-Dichloroethane-d4 †** |
| cis-1,2-Dichloroethene | 1,2-Dibromo-3-chloropropane |

**† Multi-Media, Multi-Concentration only**

5. Evaluate the %RSD for all volatile target compounds and system monitoring compounds:

   a. Check and recalculate the %RSD for one or more volatile target compound(s); verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all volatile target compounds have a %RSD of less than or equal to 30.0 percent. The method criteria for an acceptable initial calibration specifies that up to any 2 volatile target compounds may fail to meet minimum RRF or maximum %RSD as long as they have RRFs that are greater than or equal to 0.010, and %RSD of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %RSD exceeds the ±30.0 percent criterion.

   c. If the %RSD is greater than 30.0 percent, then the reviewer should use professional judgement to determine the need to check the points on the curve for the cause of the non-linearity. This is checked by eliminating either the high point or the low point and recalculating the %RSD.

6. If errors are detected in the calculations of either the RRFs or the %RSD, perform a more comprehensive recalculation.

**E. Action:**

1. All volatile target compounds, including the 14 "poor performers" (See Table 2) will be qualified using the following criteria:

   a. If the %RSD is greater than 30.0 percent and all initial calibration RRFs greater than or equal to 0.05, qualify positive results with "J", and non-detected volatile target compounds using professional judgement.

   b. If any initial calibration RRF is less than 0.05, qualify positive results that have acceptable mass spectral identification with "J", using professional judgement, and non-detected analytes as unusable (R).

2. At the reviewer's discretion, a more in-depth review to minimize the qualification of data can be accomplished by considering the following:

   a. If any of the required volatile compounds have a %RSD greater than 30.0 percent, and if eliminating either the high or the low point of the curve does not restore the %RSD to less than or equal to 30.0 percent.

      i. Qualify positive results for that compound(s) with "J".

      ii. Qualify non-detected volatile target compounds based on professional judgement.

   b. If the high point of the curve is outside of the linearity criteria (e.g., due to saturation):

      i. No qualifiers are required for positive results in the linear portion of the curve.

      ii. Qualify positive results outside of the linear portion of the curve with a "J".

      iii. No qualifiers are needed for volatile target compounds that were not detected.

   c. If the low end of the curve is outside of the linearity criteria:

      i. No qualifiers are required for positive results in the linear portion of the curve.

      ii. Qualify low level positive results in the area of non-linearity with "J".

      iii. Qualify non-detected volatile target compounds based on professional judgement.

**VOA**

3. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

4. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

5. If calibration criteria are grossly exceeded, this should be noted for EPA Project Officer action.

## IV. Continuing Calibration

**A. Review Items:** Form VII VOA-1 and Form VII VOA-2 *[Form VII LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

**C. Criteria:**

1. Continuing calibration standards containing both target compounds and system monitoring compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of the method blank and samples.

2. The continuing calibration RRF for volatile target compounds and system monitoring compounds must be greater than or equal to 0.05.

3. The percent difference (%D) between the initial calibration $\overline{RRF}$ and the continuing calibration RRF must be within ±25.0 percent.

   *[For data generated through the Low Concentration Water Method: The percent difference (%D) between the initial calibration $\overline{RRF}$ and the continuing calibration RRF must be within ±30.0 percent.]*

**D. Evaluation:**

1. Verify that the continuing calibration was run at the required frequency and that the continuing calibration was compared to the correct initial calibration.

2. Evaluate the continuing calibration RRF for all volatile target compounds and system monitoring compounds:

   a. Check and recalculate the continuing calibration RRF for at least one volatile target compound associated with each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all volatile target compounds and system monitoring compounds meet the RRF specifications.

**NOTE:** The criteria employed for data review purposes are different from those defined in the method. The compounds listed in Table 2 (VOA Section III.D.4) have no method maximum %D criteria. The laboratory must meet a minimum RRF criterion of 0.01, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all volatile compounds.**

3. Evaluate the %D between initial calibration RRF and continuing calibration RRF for one or more compound(s).

   a. Check and recalculate the %D for one or more volatile target compound(s) associated with each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that the %D is within ±25.0 percent for all volatile target compounds and system monitoring compounds. Note those compounds which have a %D outside the ±25.0 percent criterion. The method criteria for an acceptable continuing calibration specifies that up to any 2 volatile target compounds may fail to meet minimum RRF or maximum %D as long as they have RRFs that are greater than or equal to 0.010, and %D of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %D exceeds the ±25.0 percent criterion.

4. If errors are detected in the calculations of either the continuing calibration RRF or the %D, perform a more comprehensive recalculation.

**E. Action:**

1. The reviewer should use professional judgement to determine if it is necessary to qualify the data for any volatile target compound. If qualification of data is required, it should be performed using the following guidelines:

   a. If the %D is outside the ±25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify positive results with "J".

   b. If the %D is outside the ±25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify non-detected volatile target compounds with "UJ".

   c. If the continuing calibration RRF is less than 0.05, qualify positive results that have acceptable mass spectral identifications with "J" or use professional judgement.

   d. If the continuing calibration RRF is less than 0.05, qualify non-detected volatile target compounds as unusable (R).

2. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

3. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

4. If calibration criteria are grossly exceeded, this should be noted for EPA Project Officer action.

## V. Blanks

**A. Review Items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, Form IV VOA *[Form IV LCV]*, chromatograms, and quantitation reports.

**B. Objective:**

The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

**C. Criteria:**

1. No contaminants should be found in the blanks.

2. A method blank analysis must be performed after the calibration standards and once for every 12-hour time period beginning with the injection of BFB.

3. The method blank must be analyzed on each GC/MS system used to analyze samples for each type of analysis (i.e., unheated purge (water and medium level soil) and heated purge (low level soil)).

4. A storage blank must be prepared upon receipt of the first samples from an SDG, and stored with samples until analysis. The storage blank must be analyzed once per SDG.

5. An instrument blank must be analyzed after any sample that has saturated ions from a given compound to check that the blank is free of interference and the system is not contaminated.

**D. Evaluation:**

1. Review the results of all associated blanks on the forms and raw data (chromatograms and quantitation reports) to evaluate the presence of target and non-target compounds in the blanks.

2. Verify that a method blank analysis has been reported per matrix, per concentration level, for each 12-hour time period on each GC/MS system used to analyze volatile samples. The reviewer can use the Method Blank Summary (Form IV VOA *[Form IV LCV])* to identify the samples associated with each method blank.

3. Verify that a storage blank has been analyzed and included with each SDG and that the storage blanks are free of contamination.

4. Verify that the instrument blank analysis has been performed following any sample analysis where a target analyte(s) is/are reported at high concentration(s).

**E. Action:**

If the appropriate blanks were not analyzed with the frequency described in Criteria 2, 3, and 4, and 5 then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be noted for EPA Project Officer action.

Action regarding unsuitable blank results depends on the circumstances and origin of the blank. Positive sample results should be reported unless the concentration of the compound in the sample is less than or equal to 10 times (10x) the amount in any blank for the common volatile laboratory contaminants **(methylene chloride, acetone, 2-butanone, and cyclohexane)**, or 5 times (5x) the amount for other volatile target compounds. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must <u>not</u> be corrected by subtracting any blank value.

Specific actions are as follows:

1. If a volatile compound is found in a blank but not found in the sample, no action is taken. If the contaminants found are volatile target compounds (or interfering non-target compounds) at significant concentrations above the CRQL, then this should be noted for EPA Project Officer action.

2. Any volatile compound detected in the sample (other than the common volatile laboratory contaminants), that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required. <u>For the common volatile laboratory contaminants, the results are qualified by elevating the quantitation limit to the concentration found in the sample when the sample concentration is less than 10 times (10x) the blank concentration</u>.

   The reviewer should note that blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" and "10x" criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample is deemed necessary. If the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be

detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. In this case, the "5x" or "10x" rules may not apply; the target compound should be reported as not detected, and an explanation of the data qualification should be provided in the data review narrative.

3. If gross contamination exists (i.e., saturated peaks by GC/MS), all affected compounds in the associated samples should be qualified as unusable (R) due to interference. This should be noted for EPA Project Officer action if the contamination is suspected of having an effect on the sample results.

4. If inordinate numbers of other target compounds are found at low levels in the blank(s), it may be indicative of a problem and should be noted for EPA Project Officer action.

5. The same consideration given to the target compounds should also be given to Tentatively Identified Compounds (TICs), which are found in both the sample and associated blank(s). (See VOA Section XII for TIC guidance.)

6. If contaminants are found in the storage blanks, the following action is recommended:

   a. The associated method blank data should be reviewed to determine if the contaminant(s) was also present in the method blank. If the analyte was present at a comparable level in the method blank, then the source of the contamination may be in the analytical system and the action recommended for the method blank would apply.

      If the analyte was not present in the method blank, then the source of contamination may be in the storage and all associated samples should be considered for possible cross-contamination.

   b. If the storage blank contains a volatile TCL compound(s) at a concentration greater than the CRQL, then all positive results for that compounds(s) should be qualified with "J". If the concentration level in the blank is significantly high, then positive sample results may require rejection and be qualified with "R". Non-detected volatile target compounds should not require qualification unless the contamination is so high that it interferes with the analysis of the non-detect compounds.

7. If an instrument blank was not analyzed following a sample analysis which contained an analyte(s) at high concentration(s), sample analysis results after the high concentration sample must be evaluated for carryover. Professional judgement should be used to determine if instrument cross-contamination has affected any positive compound identification(s). If instrument cross-contamination is suggested, then this should be noted for EPA Project Officer action if the cross-contamination is suspected of having an effect on the sample results.

The following are examples of applying the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Example 1: Sample result is greater than the Contract Required Quantitation Limit (CRQL), but is less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 7 | 7 |
| CRQL | 5 | 5 |
| Sample Result | 60 | 30 |
| Final Sample Result | 60U | 30U |

In the example for the "10x" rule, sample results less than 70 (or 10x7) would be qualified as not detected. In the case of the "5x" rule, sample results less than 35 (or 5x7) would be qualified as not detected.

Example 2: Sample result is less than the CRQL, and is also less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 6 | 6 |
| CRQL | 5 | 5 |
| Sample Result | 4J | 4J |
| Final Sample Result | 5U | 5U |

Note that data are not reported as 4U, as this would be reported as a detection limit below the CRQL.

Example 3: Sample result is greater than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 10 | 10 |
| CRQL | 5 | 5 |
| Sample Result | 120 | 60 |
| Final Sample Result | 120 | 60 |

For both the "10x" and "5x" rules, sample results exceeded the adjusted blank results of 100 (or 10x10) and 50 (or 5x10), respectively, and therefore are not qualified.

## VI. System Monitoring Compounds

**A. Review Items:** Form II VOA-1 and Form II VOA-2 *[Form II LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with system monitoring compounds, SMC, (formerly referred to as surrogates) just prior to sample purging. The evaluation of the results of these system monitoring compounds is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the evaluation and review of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

**C. Criteria:**

1. Three system monitoring compounds (1,2-Dichloroethane-d4, bromofluorobenzene, and toluene-d8) are added to all samples and blanks to measure their recovery in environmental samples in sample and blank matrices.

   *[For data generated through the Low Concentration Water Method: A single system monitoring compound, bromofluorobenzene, is added to all samples and blanks to measure the recovery in sample and blank matrices.]*

2. Recoveries for system monitoring compounds in volatile samples and blanks must be within the limits specified in the method.

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation reports) to verify the recoveries on the System Monitoring Compound Recovery Form - Form II VOA-1 and Form II VOA-2 *[Form II LCV]*. Check for any calculation or transcription errors.

2. Check that the system monitoring compound recoveries were calculated correctly. The equation can be found in the method.

3. The following should be determined from the System Monitoring Compound Recovery form(s):

   a. If any system monitoring compound(s) in the volatile fraction is out of specification, there should be a re-analysis to confirm that the non-compliance is due to sample matrix effects rather than laboratory deficiencies.

**NOTE:** When there are unacceptable system monitoring compound recoveries followed by acceptable re-analyses, the laboratories are required to report only the successful run.

   b. The laboratory failed to perform acceptably if system monitoring compounds are outside criteria with no evidence of re-analysis. Medium soils must first be re-extracted prior to re-analysis when this occurs.

   c. Verify that no blanks have system monitoring compounds outside the criteria.

4. Any time there are two or more analyses for a particular sample, the reviewer must determine which are the best data to report. Considerations should include but are not limited to:

   a. System monitoring compound recovery (marginal versus gross deviation).

   b. Technical holding times.

   c. Comparison of the values of the target compounds reported in each sample analysis.

   d. Other QC information, such as performance of internal standards.

**E. Action:**

Data are qualified based on system monitoring compounds results if the recovery of any volatile system monitoring compound is out of specification. For system monitoring compound recoveries out of specification, the following approaches are suggested based on a review of all data from the package, especially considering the apparent complexity of the sample matrix.

1. If a system monitoring compound in the volatile sample has a recovery greater than the upper acceptance limit (UL):

   a. Detected volatile target compounds are qualified "J".

   b. Results for non-detected volatile target compounds should not be qualified.

**VOA**

2. If a system monitoring compound in the volatile sample has a recovery greater than or equal to 10 percent but less than the lower acceptance limit (LL):

   a. Detected volatile target compounds are qualified "J".

   b. For non-detected volatile target compounds, the sample quantitation limit is qualified as approximated (UJ).

3. If a system monitoring compound in a volatile sample shows less than 10 percent recovery:

   a. Detected volatile target compounds are qualified "J".

   b. Non-detected volatile target compounds may be qualified as unusable (R).

Table 3. Qualification of Volatile Analytes Based on System Monitoring Compound Recoveries

| | SMC Recovery | | |
|---|---|---|---|
| | >UL | 10% to LL | <10% |
| Detected analytes | J | J | J |
| Non-detected analytes | No Qualification | UJ | R |

4. In the special case of a blank analysis with system monitoring compounds out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable system monitoring compound recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems should be noted for EPA Project Officer action. Also note if there are potential contractual problems associated with the lack of re-analysis of samples that were out of specification.

5. Whenever possible, potential effects of the data resulting from system monitoring recoveries not meeting the advisory limits should be noted in the data review narrative.

## VII. Matrix Spikes/Matrix Spike Duplicates (Not Required for Low Concentration Water Data)

**A. Review Items:** Form III VOA- 1, Form III VOA-2, chromatograms, and quantitation reports.

**B. Objective:**

Data for matrix spike/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. These data alone cannot be used to evaluate the precision and accuracy of individual samples. However, when exercising professional judgement, this data should be used in conjunction with other available QC information.

**C. Criteria:**

1. Matrix spikes (MS) and matrix spike duplicate (MSD) samples are analyzed at a frequency of one MS and MSD per 20 samples of similar matrix, unless MS/MSD analyses are not required.

2. Spike recoveries should be within the advisory limits provided on Form III VOA-1 and Form III VOA-2.

3. Relative percent difference (RPD) between MS and MSD recoveries must be within the advisory limits provided on Form III VOA- 1 and Form III VOA-2.

**D. Evaluation:**

1. Verify that MS and MSD samples were analyzed at the required frequency and that results are provided for each sample matrix.

2. Inspect results for the MS/MSD Recovery on Form III VOA- 1 and Form III VOA-2 and verify that the results for recovery and RPD are within the advisory limits.

3. Verify transcriptions from raw data and verify calculations.

4. Check that the matrix spike recoveries and RPD were calculated correctly.

5. Compare %RSD results of non-spiked compounds between the original result, MS, and MSD.

**E. Action:**

1. No action is taken on MS/MSD data alone. However, using informed professional judgment the data reviewer may use the MS and MSD results in conjunction with other QC criteria and determine the need for some qualification of the data.

**VOA**

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of non-spiked compounds.

**NOTE:** If a field blank was used for the MS/MSD, the EPA Project Officer must be notified.

## VIII. Laboratory Control Samples
## (Low Concentration Water)

*[A.* ***Review Items:*** *Form III LCV- 1, LCS chromatograms, and quantitation reports.*

***B. Objective:***

*Data for laboratory control samples (LCS) are generated to provide information on the accuracy of the analytical method and on the laboratory performance.*

***C. Criteria:***

1. *A laboratory control sample (LCS) must be analyzed once per SDG and concurrently with the samples in the SDG.*

2. *The LCS contains the following volatile compounds, in addition to the required SMC (Bromofluorobenzene):*

| | |
|---|---|
| *Vinyl chloride* | *Benzene* |
| *1,2-Dichloroethane* | *cis-1,3-Dichloropropene* |
| *Carbon tetrachloride* | *Bromoform* |
| *1,2-Dichloropropane* | *Tetrachloroethene* |
| *Trichloroethene* | *1,2-Dibromoethane* |
| *1, 1, 2-Trichloroethane* | *1,4-Dichlorobenzene* |

3. *The percent recoveries for the LCS compounds must be within the QC limits. The LCS must meet this recovery criteria for the sample data to be accepted.*

4. *The criteria for system monitoring compound recovery and internal standard performance also apply.*

***D. Evaluation:***

1. *Verify that LCS samples were analyzed at the required frequency and that results are provided for each SDG.*

2. *Inspect results for the LCS Recovery on Form III LCV-1 and verify that the results for recovery are within the QC limits.*

3. *Verify transcriptions from raw data and verify calculations.*

4. *Check that the LCS recovery was calculated correctly by using the correct equation.*

**VOA**

***E. Action:***

*If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.*

1. *Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.*

2. *If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.*

3. *If the LCS recovery is greater than the upper control limit, then positive sample results for the affected compound(s) should be qualified with a "J".*

4. *If the mass spectral criteria are met but the LCS recovery is less than the lower control limit, then the associated detected target compounds should be qualified "J" and the associated non-detected target compounds should be qualified "R".*

5. *If more than half of the compounds in the LCS are not within the required recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated nondetected target compounds should be qualified "R".*

6. *Action on non-compliant system monitoring compound recovery and internal standard performance should follow the procedures provided in VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that non-compliance for system monitoring compound recovery and internal standard performance in the LCS has on the associated sample data.*

7. *It should be noted for EPA Project Officer action if a laboratory fails to analyze an LCS with each SDG, or if a laboratory consistently fails to generate acceptable LCS recoveries.]*

## IX. Regional Quality Assurance and Quality Control

**A. Review items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, chromatograms, and quantitation reports.

**B. Objective:**

Regional Quality Assurance and Quality Control (QA/QC) refer to any QA and/or QC samples initiated by the Region, including field duplicates, Performance Evaluation (PE) samples, blind spikes, and blind blanks. (It is highly recommended that Regions adopt the use of these QA/QC samples.)

**C. Criteria:**

Criteria are determined by each Region.

1. Performance Evaluation sample frequency may vary.

   *[For data generated through the Low Concentration Water Method: A PE sample can be included as frequently as once per SDG].*

2. The analytes present in the PE sample must be correctly identified and quantified.

**D. Evaluation:**

Evaluation procedures must follow the Region's SOP for data review. Each Region will handle the evaluation of PE samples on an individual basis. Results for PE samples should be compared to the acceptance criteria for the specific PE samples, if available.

**E. Action:**

Any action must be in accordance with Regional specifications and the criteria for acceptable PE sample results. Unacceptable results for PE samples should be noted for EPA Project Officer action.

## X. Internal Standards

**A. Review Items:** Form VIII VOA *[Form VIII LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Internal Standards (IS) performance criteria ensures that GC/MS sensitivity and response are stable during each analysis.

**C. Criteria:**

1. Internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated 12hr calibration standard.

   *[For data generated through the Low Concentration Water Method: Internal standard area counts must not vary by more than a factor of ±40.0 percent from the associated calibration standard.]*

2. The retention time of the internal standard must not vary more than ±30 seconds from the retention time of the associated 12hr calibration standard.

   *[For data generated through the Low Concentration Water Method: The retention time of the internal standard must not vary more than ±20.0 seconds from the retention time of the associated 12hr calibration standard.]*

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation lists) to verify the internal standard retention times and areas reported on the Internal Standard Area Summary (Form VIII VOA *[Form VIII LCV]*).

2. Verify that all retention times and IS areas are within criteria.

3. If there are two analyses for a particular fraction, the reviewer must determine which are the best data to report. Considerations should include:

   a. Magnitude and direction of the IS area shift.

   b. Magnitude and direction of the IS retention time shift.

   c. Technical holding times.

   d. Comparison of the values of the target compounds reported in each fraction.

   e. Other QC.

**E. Action:**

1. If an IS area count for a sample or blank is outside -50 percent or +100 percent of the area for associated standard:

   a. Positive results for compounds quantitated using that IS should be qualified with "J".

   b. Non-detected compounds quantitated using an IS area count greater than 100 percent should not be qualified.

   c. Non-detected compounds quantitated using an IS area count less than 50 percent are reported as the associated sample quantitation limit and qualified with "UJ".

   d. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detected target compounds should then be qualified as unusable (R).

   *[If an IS area count for a sample or blank is outside ± 40.0 percent of the area for associated standard:*

   *a. Positive results for compounds quantitated using that IS should be qualified with "J".*

   *b. Non-detected compounds quantitated using an IS area count greater than 40 percent should not be qualified.*

   *c. Non-detected compounds quantitated using an IS area count less than 40 percent are reported as the associated sample quantitation limit and qualified with "UJ".*

   *d. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detected target compounds should then be qualified as unusable (R).]*

2. If an IS retention time varies by more than 30 seconds:

   *[If an IS retention time varies by more than 20.0 seconds:]*

   The chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection of the data for that sample fraction. Positive results should not need to be qualified as "R" if the mass spectral criteria are met.

3. If the internal standards performance criteria are grossly exceeded, then this should be noted for EPA Project Officer action. Potential effects on the data resulting from unacceptable internal standard performance should be noted in the data review narrative.

## XI. Target Compound Identification

**A. Review Items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, quantitation reports, mass spectra, and chromatograms.

**B. Objective:**

The objective of the criteria for GC/MS qualitative analysis is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied more easily in detecting false positives than false negatives. More information is available for false positives due to the requirement for submittal of data supporting positive identifications. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, more difficult to assess. One example of detecting false negatives is the not reporting of a target compound that is reported as a TIC.

**C. Criteria:**

1. The relative retention times (RRTs) must be within ±0.06 RRT units of the standard RRT.

2. Mass spectra of the sample compound and a current laboratory-generated standard (i.e., the mass spectrum from the associated calibration standard) must match according to the following criteria:

   a. All ions present in the standard mass spectrum at a relative intensity greater than 10 percent <u>must</u> be present in the sample spectrum.

      *[For data generated through the Low Concentration Water Method: All ions present in the standard mass spectrum at a relative intensity greater than 25 percent <u>must</u> be present in the sample spectrum.]*

   b. The relative intensities of these ions must agree within ±20 percent between the standard and sample spectra. (Example: For an ion with an abundance of 50 percent in the standard spectrum, the corresponding sample ion abundance must be between 30 percent and 70 percent.)

   c. Ions present at greater than 10 percent in the <u>sample</u> mass spectrum but not present in the <u>standard</u> spectrum must be considered and accounted for.

      *[For data generated through the Low Concentration Water Method: Ions present at greater than 25 percent in the <u>sample</u> mass spectrum but not present in the <u>standard</u> spectrum must be considered and accounted for.]*

**D. Evaluation:**

1. Check that the RRT of reported compounds is within ±0.06 RRT units of the standard RRT.

2. Check the sample compound spectra against the laboratory standard spectra to see that it meets the specified criteria.

3. The reviewer should be aware of situations (e.g., high concentration samples preceding low concentration samples) when sample carryover is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification. The method specifies that an instrument blank must be run after samples in which a target analyte ion(s) saturates the detector.

   *[The reviewer should be aware of situations when sample carryover is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification. The method specifies that an instrument blank must be run after samples which contain target compounds at levels exceeding the initial calibration range (25 ug/L for non-ketones, 125 ug/L for ketones) or non-target compounds at concentrations greater than 100 ug/L or saturated ions from a compound (excluding the compound peaks in the solvent front).]*

4. Check the chromatogram to verify that peaks are accounted for (i.e., major peaks are either identified as target compounds, TICs, system monitoring compounds, or internal standards).

**E. Action:**

1. The application of qualitative criteria for GC/MS analysis of target compounds requires professional judgement. It is up to the reviewer's discretion to obtain additional information from the laboratory. If it is determined that incorrect identifications were made, all such data should be qualified as not detected (U) or unusable (R).

2. Professional judgement must be used to qualify the data if it is determined that cross-contamination has occurred.

3. Any changes made to the reported compounds or concerns regarding target compound identifications should be clearly indicated in the data review narrative. The necessity for numerous or significant changes should be noted for EPA Project Officer action.

## XII. Compound Quantitation and Reported CRQLs

**A. Review Items:** Forms I VOA-1 and Form I VOA-2 *[Form I LCV]*, sample preparation sheets, SDG Narrative, quantitation reports, and chromatograms.

**B. Objective:**

The objective is to ensure that the reported quantitation results and Contract Required Quantitation Limits (CRQLs) are accurate.

**C. Criteria:**

1. Compound quantitation, as well as the adjustment of the CRQLs, must be calculated according to the correct equation.

2. Compound RRFs must be calculated based on the internal standard (IS) associated with that compound, as listed in the method. Quantitation must be based on the quantitation ion (m/z) specified in the method for both the IS and target analytes. The compound quantitation must be based on the RRF from the appropriate daily standard.

**D. Evaluation:**

1. For all fractions, raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Quantitation lists and chromatograms should be compared to the reported positive sample results and quantitation limits. Check the reported values.

2. Verify that the correct internal standard, quantitation ion, and RRF were used to quantitate the compound. Verify that the same internal standard, quantitation ion, and RRF are used consistently throughout, in both the calibration as well as the quantitation process.

3. Verify that the CRQLs have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.

**E. Action:**

1. If any discrepancies are found, the laboratory may be contacted by the Region's designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must use professional judgement to decide which value is the best value. Under these circumstances, the reviewer may determine qualification of data is warranted. A description of the reasons for data qualification and the qualification that is applied to the data should be documented in the data review narrative.

2. Numerous or significant failures to accurately quantify the target compound or to properly evaluate and adjust CRQLs should be noted for EPA Project Officer action.

## XIII. Tentatively Identified Compounds

**A. Review Items:** Form I VOA-TIC *[Form I LCV- TIC]*, chromatograms, and library search printouts and spectra for the TIC candidates.

**B. Objective:**

Chromatographic peaks in volatile fraction analyses that are not target analytes, system monitoring compounds, or internal standards are potential tentatively identified compounds (TICs). TICs must be qualitatively identified via a forward search of the NIST/EPA/NIH and/or Wiley Mass Spectral Library, and the identifications assessed by the data reviewer.

**C. Criteria:**

For each sample, the laboratory must conduct a mass spectral search of the NIST library and report the possible identity for the appropriate number of the largest volatile fraction peaks which are not system monitoring compounds, internal standards, or target compounds, but which have area or height greater than 10 percent of the area or height of the nearest internal standard. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I VOA-TIC).

*[For data generated through the Low Concentration Water Method: For each sample, the laboratory must conduct a mass spectral search of the NIST/EPA/NIH and/or Wiley mass spectral library and report the possible identity for the appropriate number of the largest volatile fraction peaks which are not system monitoring compounds, internal standards, or TCL compounds, but which have area greater than or equal to 40 percent of the area of the nearest internal standard. Estimated concentrations for TICs are calculated similarly to the TCL compounds, using total ion areas for the TIC and the internal standard, and assuming a relative response factor of 1.0. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I LCV-TIC).]*

**NOTE:** Since the method revision of October 1986, the CLP does not allow the laboratory to report as tentatively identified compounds any target compound which is properly reported in another fraction. For example, late eluting volatile target compounds should not be reported as semivolatile TICs.

**D. Evaluation:**

1. Guidelines for tentative identification are as follows:

   a. Major ions (greater than 10 percent relative intensity) in the reference spectrum should be present in the sample spectrum.

      *[Major ions (greater than 25 percent relative intensity) in the reference spectrum should be present in the sample spectrum.]*

   b. The relative intensities of the major ions should agree within ±20 percent

between the sample and the reference spectra.

c. Molecular ions present in the reference spectrum should be present in the sample spectrum.

d. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or coelution of additional TIC or target compounds.

e. When the above criteria are not met, but in the technical judgement of the data reviewer or mass spectral interpretation specialist the identification is correct, the data reviewer may report the identification.

f. If, after careful review and in the technical judgement of the mass spectral interpretation specialist, no valid identification can be made, the compound should be reported as follows:

- If the library search produces a match at or above 85%, report that compound.
- If the library search produces more than one compound at or above 85%, report the first compound (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown. The mass spectral specialist should give additional classification of the unknown compound, if possible (i.e., unknown hydrocarbon, unknown acid type, unknown chlorinated coumpound). If probable molecular weights can be distinguished, include them.

2. Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms for samples and blanks.

3. Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-target compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which are less than 10 percent of the internal standard height, but present in the blank chromatogram at similar relative retention time.

*[Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-TCL compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank*

*chromatograms may require looking for peaks which are less than 40 percent of the internal standard area but present in the blank chromatogram at similar relative retention time.]*

4. All mass spectra for every sample and blank must be examined.

5. Since TIC library searches often yield several candidate compounds having a close matching score, all reasonable choices must be considered.

6. The reviewer should be aware of common laboratory artifacts/contaminants and their sources (e.g., aldol condensation products, solvent preservatives, and reagent contaminants). These may be present in blanks and not reported as sample TICs.

   Examples:

   a. Common laboratory contaminants: $C0_2$ (m/z 44), siloxanes (m/z 73), diethyl ether, hexane, certain freons, and phthalates at levels less than 100 ug/L or 4000 ug/Kg.

   b. Solvent preservatives such as cyclohexene which is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, and chlorocyclohexanol.

   c. Aldol condensation reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone.

7. Occasionally, a target compound may be identified in the proper analytical fraction by non-target library search procedures, even though it was not found on the quantitation list. If the total area quantitation method was used, the reviewer should request that the laboratory recalculate the result using the proper quantitation ion. In addition, the reviewer should evaluate other sample chromatograms and check library reference retention times on quantitation lists to determine whether the false negative result is an isolated occurrence or whether additional data may be affected.

8. Target compounds could be identified in more than one fraction. Verify that quantitation is made from the proper fraction.

9. Library searches should not be performed on internal standards or system monitoring compounds.

10. TIC concentration should be estimated assuming a RRF of 1.0.

**E. Action:**

1. All TIC results should be qualified "NJ", tentatively identified, with approximated concentrations.

2. General actions related to the review of TIC results are as follows:

   a. If it is determined that a tentative identification of a non-target compound is not acceptable, the tentative identification should be changed to "unknown" or an appropriate identification.

   b. If all contractually required peaks were not library searched and quantitated, the Region's designated representative could request these data from the laboratory.

3. TIC results which are not sufficiently above 10x the level in the blank should not be reported. (Dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples.)

4. When a compound is not found in any blanks, but is a suspected artifact of common laboratory contaminant, the result may be qualified as unusable (R).

5. In deciding whether a library search result for a TIC represents a reasonable identification, professional judgment must be exercised. If there is more than one possible match, the result may be reported as "either compound X or compound Y". If there is a lack of isomer specificity, the TIC result may be changed to a non-specific isomer result (e.g., 1,3,5-trimethyl benzene to trimethyl benzene isomer) or to a compound class (e.g., 2-methyl, 3-ethyl benzene to substituted aromatic compound).

6. The reviewer may elect to report all similar compounds as a total. (e.g., All alkanes may be summarized and reported as total hydrocarbons.)

7. Other case factors may influence TIC judgements. If a sample TIC match is poor but other samples have a TIC with a good library match, similar relative retention time, and the same ions, identification information may be inferred from the other sample TIC results.

8. Physical constants, such as boiling point, may be factored into professional judgement of TIC results.

9. Any changes made to the reported data or any concerns regarding TIC identifications should be indicated in the data review narrative.

10. Failure to properly evaluate and report TICs should be noted for EPA Project Officer action.

## XIV. System Performance

**A. Review Items:** Form VIII VOA *[Form VIII LCV]*, Form III VOA-1 and Form III VOA-2 *[Form III LCV-1]*, and chromatograms.

**B. Objective:**

During the period following Instrument Performance QC checks (e.g., blanks, tuning, calibration), changes may occur in the system that degrade the quality of the data. While this degradation would not be directly shown by QC checks until the next required series of analytical QC runs, a thorough review of the ongoing data acquisition can yield indicators of instrument performance.

**C. Criteria:**

There are no specific criteria for system performance. Professional judgement should be applied to assess the system performance.

**D. Evaluation:**

1. Abrupt discrete shifts in the reconstructed ion chromatogram (RIC) baseline may indicate a change in the instrument's sensitivity or the zero setting. A baseline "shift" could indicate a decrease in sensitivity in the instrument or an increase in the instrument zero, possibly causing target compounds, at or near the detection limit, to miss detection. A baseline "rise" could indicate problems such as a change in the instrument zero, a leak, or degradation of the column.

2. Poor chromatographic performance affects both qualitative and quantitative results. Indications of substandard performance include:

   a. High RIC background levels or shifts in absolute retention times of internal standards.

   b. Excessive baseline rise at elevated temperature.

   c. Extraneous peaks.

   d. Loss of resolution.

   e. Peak tailing or peak splitting that may result in inaccurate quantitation.

*[3. A drift in instrument sensitivity may occur during the 12-hour time period. This could be discerned by examination of the IS area on Form VIII LCV for trends such as a continuous or near continuous increase or decrease in the IS area over time.*

4. *The results of the LCS analysis (Form III LCV) may also be used to assess instrument performance.]*

**E. Action:**

Professional judgement must be used to qualify the data if it is determined that system performance has degraded during sample analyses. Any degradation of system performance which significantly affected the data should be documented for EPA Project Officer action.

## XV. Overall Assessment of Data

A. **Review Items:** Entire data package, data review results, and (if available) Quality Assurance Project Plan (QAPjP), and Sampling and Analysis Plan (SAP).

B. **Objective:**

The overall assessment of a data package is a brief narrative in which the data reviewer expresses concerns and comments on the quality and, if possible, the useability of the data.

C. **Criteria:**

Assess the overall quality of the data.

Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

D. **Evaluation:**

1. Evaluate any technical problems which have not been previously addressed.

2. If appropriate information is available, the reviewer may assess the useability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the QAPjP (specifically the Data Quality Objectives), SAP, and communication with data user that concerns the intended use and desired quality of these data.

E. **Action:**

1. Use professional judgement to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief narrative to give the user an indication of the analytical limitations of the data. Any inconsistency of the data with the SDG Narrative should be noted for EPA Project Officer action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include his/her assessment of the useability of the data within the given context.

## SEMIVOLATILE DATA REVIEW

****Data review guidelines that are unique to data generated through the Low Concentration Water Method are contained within brackets ([]) and written in italics.****

The semivolatile data requirements to be checked are listed below:

I. Holding Times

II. GC/MS Instrument Performance Check

III. Initial Calibration

IV. Continuing Calibration

V. Blanks

VI. Surrogate Spikes

VII. Matrix Spikes/Matrix Spike Duplicates

*[VIII. Laboratory Control Samples]*

IX. Regional Quality Assurance and Quality Control

X. Internal Standards

XI. Target Compound Identification

XII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs)

XIII. Tentatively Identified Compounds

XIV. System Performance

XV. Overall Assessment of Data

## I. Holding Times

**A. Review Items:** Form I SV-1*[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, EPA Sample Traffic Report and/or chain of-custody, raw data, and sample extraction sheets.

**B. Objective:**

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis.

**C. Criteria:**

Technical requirements for sample holding times have only been established for water matrices.

The technical holding time criteria for water samples, are as follows:

> For semivolatile compounds in cooled (@ 4°C) water samples, the maximum holding time is 7 days from sample collection to extraction and 40 days from sample extraction to analysis.

It is recommended that semivolatile compounds in soil samples be extracted within 14 days of sample collection.

The method holding times, which differ from the technical holding times, state that water samples are to be extracted within 5 days from the validated time of sample receipt (VTSR) at the laboratory, and soil samples are to be extracted within 10 days from the VTSR. Also, contractually both water and soil sample extracts must be analyzed within 40 days of sample extraction.

*[For data generated through the Low Concentration Method: The method holding times requirements are that the extraction of all samples must be started within 5 days of the VTSR, and the extracts must be analyzed within 40 days of VTSR.]*

**D. Evaluation:**

Technical holding times for sample extraction are established by comparing the sampling date on the EPA Sample Traffic Report with the dates of extraction on Form I SV-1 *[Form I LCSV-1]* and Form I SV-2 *[Form I LCSV-2]* and the sample extraction sheets. To determine if the samples were analyzed within the holding time after extraction, compare the dates of extraction on the sample extraction sheets with the dates of analysis on Form I SV-1 *[Form I LCSV-1]* and Form I SV-2 *[Form I LCSV-2]*.

Verify that the Traffic Report indicates that the samples were received intact and iced. If the samples were not iced or there were any problems with the samples upon receipt, then discrepancies in the sample condition could affect the data.

**E. Action:**

1. If technical holding times are exceeded, flag all positive results as estimated "J", and sample quantitation limits as estimated "UJ" and document that holding times were exceeded.

2. If technical holding times are grossly exceeded, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effect of additional storage on the sample results. The reviewer may determine that positive results or the associated quantitation limits are approximates and should be qualified with "J" or "UJ", respectively. The reviewer may determine that non-detect data are unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer to apply water holding time criteria to soil samples. Professional judgement is required to evaluate holding times for soil samples.

4. Whenever possible, the reviewer should comment on the effect of the holding time exceedance on the resulting data in the data review narrative.

5. When method and/or technical holding times are exceeded, this should be noted as an action item for the EPA Project Officer.

6. The reviewer should also be aware of the scenario in which the laboratory has exceeded the technical holding times, but met method holding times. In this case, the data reviewer should notify the EPA Project Officer (where samples were collected) and/or RSCC that shipment delays have occurred so that the field problem can be corrected. The reviewer may pass this information on to the laboratory's EPA Project Officer, but should explain that the laboratory met the requirements in the method.

## II. GC/MS Instrument Performance Check

**A. Review Items:** Form V SV *[Form V LCSV]*, and DFTPP mass spectra and mass listing.

**B. Objective:**

Gas chromatograph/mass spectrometer (GC/MS) instrument performance checks (formerly referred to as tuning) are performed to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials, therefore, these criteria should be met in all circumstances.

**C. Criteria:**

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples or standards are analyzed. The instrument performance check, decafluorotriphenylphosphine (DFTPP) for semivolatile analysis, must meet the ion abundance criteria given below.

Decafluorotriphenylphosphine (DFTPP)

| m/z | ION ABUNDANCE CRITERIA |
|---|---|
| 51 | 30.0 - 80.0% of m/z 198 |
| 68 | Less than 2.0% of m/z 69 |
| 69 | Present |
| 70 | Less than 2.0% of m/z 69 |
| 127 | 25.0 - 75.0% of m/z 198 |
| 197 | Less than 1.0% of m/z 198 |
| 198 | Base peak, 100% relative abundance |
| 199 | 5.0 - 9.0% of m/z 198 |
| 275 | 10.0 - 30.0% of m/z 198 |
| 365 | Greater than 0.75% of m/z 198 Present, |
| 441 | but less than m/z 443 |
| 442 | 40.0 - 110.0% of m/z 198 |
| 443 | 15.0 - 24.0% of m/z 442 |

**NOTE:** All ion abundances must be normalized to m/z 198, the nominal base peak, even though the ion abundances of m/z 442 may be up to 110 percent that of m/z 198.

**D. Evaluation:**

1. Compare the data presented on each GC/MS Instrument Performance Check (Form V SV *[Form V LCSV]*) with each mass listing submitted and ensure the following:

a. Form V SV *[Form V LCSV]* is present and completed for each 12-hour period during which samples were analyzed.

b. The laboratory has not made any transcription errors between the data and the form. If there are major differences between the mass listing and the Form Vs, a more in-depth review of the data is required. This may include obtaining and reviewing additional information from the laboratory.

c. The appropriate number of significant figures has been reported (number of significant figures given for each ion in the ion abundance criteria column) and that rounding is correct.

d. The laboratory has not made any calculation errors.

2. Verify from the raw data (mass spectral listing) that the mass assignment is correct and that the mass is normalized to m/z 198.

3. Verify that the ion abundance criteria was met. The criteria for m/z 68, 70, 441, and 443 are calculated by normalizing to the specified m/z.

4. If possible, verify that spectra were generated using appropriate background subtraction techniques. Since the DFTPP spectrum is obtained from chromatographic peaks that should be free from coelution problems, background subtraction should be done in accordance with the following procedure. Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. Do not subtract as part of the background the DFTPP peak.

**NOTE:** All instrument conditions must be identical to those used during the sample analysis. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting the contract specifications are contrary to the quality assurance objectives and are therefore unacceptable.

**E. Action:**

1. If the laboratory has made minor transcription errors which do not significantly affect the data, the data reviewer should make the necessary corrections on a copy of the form.

2. If the laboratory has failed to provide the correct forms or has made significant transcription or calculation errors, the Region's designated representative should contact the laboratory and request corrected data. If the information is not available, then the reviewer must use professional judgement to assess the data. The laboratory's EPA Project Officer should be notified.

3. If mass assignment is in error (such as m/z 199 is indicated as the base peak rather than m/z 198), classify all associated data as unusable (R).

4. If ion abundance criteria are not met, professional judgement may be applied to determine to what extent the data may be utilized. Guidelines to aid in the application of professional judgement in evaluating ion abundance criteria are discussed as follows:

   a. Some of the most critical factors in the DFTPP criteria are the non-instrument specific requirements that are also not unduly affected by the location of the spectrum on the chromatographic profile. The m/z ratios for 198/199 and 442/443 are critical. These ratios are based on the natural abundances of carbon 12 and carbon 13 and should always be met. Similarly, the relative abundances for m/z 68, 70, 197, and 441 indicate the condition of the instrument and the suitability of the resolution adjustment and are very important. Note that all of the foregoing abundances relate to adjacent ions; they are relatively insensitive to differences in instrument design and position of the spectrum on the chromatographic profile.

   b. For the ions at m/z 51, 127, and 275, the actual relative abundance is not as critical. For instance, if m/z 275 has 40 percent relative abundance (criteria: 10.0-30.0 percent) and other criteria are met, then the deficiency is minor.

   c. The relative abundance of m/z 365 is an indicator of suitable instrument zero adjustment. If relative abundance for m/z 365 is zero, minimum detection limits may be affected. On the other hand, if m/z 365 is present, but less than the 0.75 percent minimum abundance criteria, the deficiency is not as serious.

5. Decisions to use analytical data associated with DFTPP instrument performance checks not meeting method requirements should be clearly noted in the data review narrative.

6. If the reviewer has reason to believe that instrument performance check criteria were achieved using techniques other than those specified in the method and Section II.D.4 above, additional information on the DFTPP instrument performance checks should be obtained. If the techniques employed are found to be at variance with contract requirements, the procedures of the laboratory may merit evaluation. Concerns or questions regarding laboratory performance should be noted for EPA Project Officer action. For example, if the reviewer has reason to believe that an inappropriate technique was used to obtain background subtraction (such as background subtracting from the solvent front or from another region of the chromatogram rather than the DFTPP peak), then this should be noted for EPA Project Officer action.

## III. Initial Calibration

**A. Review Items:** Form VI SV-1 *[Form VI LCSV-1]*, Form VI SV-2 *[Form VI LCSV-2]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile Target Compound List (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve.

**C. Criteria:**

1. Initial calibration standards containing both semivolatile target compounds and surrogates are analyzed at concentrations of 20, 50, 80, 120, and 160 ng/2uL at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met. The initial calibration (and any associated samples and blanks) must be analyzed within 12 hours of the associated instrument performance check.

   *[For data generated through the Low Concentration Method: Initial calibration standards containing both semivolatile TCL compounds and surrogates are analyzed at concentrations of 5, 10, 20, 50, and 80 ng/2uL at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met. The initial calibration (and any associated samples and blanks) must be analyzed within 12 hours of the associated instrument performance check. The following nine compounds require initial calibration at 20, 50, 80, 100, and 120 ng/2uL: 2,4-dinitrophenol, 2,4,5-trichlorophenol, 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, 4-nitrophenol, 4,6-dinitro-2-methylphenol, pentachlorophenol, and 2,4,6-tribromophenol (surrogate).]*

2. Minimum Relative Response Factor (RRF) criteria must be greater than or equal to 0.05. (Initial RRF criteria are listed in the appropriate method.)

3. The Percent Relative Standard Deviations (%RSD) for the RRFs in the initial calibration must be less than or equal to 30 percent.

**D. Evaluation:**

1. Verify that the correct concentration of standards were used for the initial calibration (i.e., 20, 50, 80, 120, and 160 ng/2uL). For the eight compounds with higher CRQLs, only a four-point initial calibration is required (i.e., 50, 80, 120, and 160 ng/2uL).

*[Verify that the correct concentration of standards were used for the initial calibration (i.e., 5, 10, 20, 50, and 80 ng). For the nine compounds listed in SV Section III.C.1. with higher CRQLs, verify that a five point initial calibration at 20, 50, 80, 100, and 120 ng was performed.]*

2. If any sample results were calculated using an initial calibration, verify that the correct standard (i.e., the 50 ng standard) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated instrument performance check.

   *[If any sample results were calculated using an initial calibration, verify that the correct standard (i. e., the 20 ng standard or 80 ng for the compounds listed in III.C.1) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated DFTPP tuning/instrument performance check.]*

3. Evaluate the RRFs for all semivolatile target compounds and surrogates:

   a. Check and recalculate the RRF and $\overline{RRF}$ for at least one semivolatile target compound associated with each internal standard. Verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all semivolatile target compounds and surrogates have RRFs that are greater than or equal to 0.05.

**NOTE:** The criteria used for data review purposes are different from those used for contractual purposes. The laboratory must meet a minimum RRF criteria of 0.01, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all semivolatile compounds.**

Table 4. Semivolatile Target Compounds Exhibiting Poor Response

| | |
|---|---|
| 2,2'-oxybis(1-Chloropropane) | Diethylphthalate |
| 4-Chloroaniline | 4-Nitroaniline |
| Hexachlorobutadiene | 4,6-Dinitro-2-methylphenol |
| Hexachlorocyclopentadiene | N-Nitrosodiphenylamine |
| 2-Nitroaniline | Di-n-butylphthalate |
| Dimethylphthalate | Butylbenzylphthalate |
| 3-Nitroaniline | 3-3'-Dichlorobenzidine |
| 2,4-Dinitrophenol | bis(2-Ethylhexyl)phthalate |
| 4-Nitrophenol | Di-n-octylphthalate |
| **Carbazole†** | 2,4,6-Tribromophenol (surr) |
| Nitrobenzene-$d_5$ (surr) | |

**† Multi-Media, Multi-Concentration only**

4. Evaluate the %RSD for all semivolatile target compounds and surrogates:

   a. Check and recalculate the %RSD for one or more semivolatile target compound(s); verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all semivolatile target compounds have a %RSD of less than 30 percent. The method criteria for an acceptable initial calibration specifies that up to any 4 semivolatile target compounds may fail to meet minimum RRF or maximum %RSD as long as they have RRFs that are greater than or equal to 0.010, and %RSD of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %RSD exceeds the ≤30.0 percent criterion.

   c. If the %RSD is greater than 30.0 percent, then the reviewer should use professional judgement to determine the need to check the points on the curve for the cause of the non-linearity. This is checked by eliminating either the high point or the low point and recalculating the %RSD.

5. If errors are detected in the calculations of either the $\overline{RRF}$ or the %RSD, perform a more comprehensive recalculation.

**E. Action:**

1. All semivolatile target compounds, including the 19 "poor performers" will be qualified using the following criteria:

   a. If the %RSD is greater than 30.0 percent and the RRF is greater than 0.05, qualify positive results with "J", and non-detected semivolatile target compounds using professional judgement.

   b. If the RRF is less than 0.05, qualify positive results that have acceptable mass spectral identification with "J" using professional judgement, and non-detects as unusable (R).

2. At the reviewer's discretion, a more in-depth review to minimize the qualification of data can be accomplished by considering the following:

   a. If any of the required semivolatile compounds have a %RSD greater than 30.0 percent, and if eliminating either the high or the low point of the curve does not restore the %RSD to less than or equal to 30.0 percent:

      i. Qualify positive results for that compound(s) with "J".

      ii. Qualify non-detected semivolatile target compounds based on professional judgement.

b. If the high point of the curve is outside of the linearity criteria (e.g., due to saturation):

   i. No qualifiers are required for positive results in the linear portion of the curve.

   ii. Qualify positive results outside of the linear portion of the curve with "J".

   iii. No qualifiers are needed for non-detected target compounds.

c. If the low end of the curve is outside of the linearity criteria:

   i. No qualifiers are required for positive results in the linear portion of the curve.

   ii. Qualify low level positive results in the area of non-linearity with "J".

   iii. Qualify non-detected semivolatile target compounds using professional judgement.

3. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

4. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

5. If calibration criteria are exceeded, this should be noted for EPA Project Officer action.

## IV. Continuing Calibration

**A. Review Items:** Form VII SV-1 *[Form VII LCSV-1]*, Form VII SV-2 *[Form VII LCSV-2]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for semivolatile target compounds. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

**C. Criteria:**

1. Continuing calibration standards containing both target compounds and surrogates are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples.

2. The minimum Relative Response Factors (RRF) for semivolatile target compounds and surrogates must be greater than or equal to 0.05.

1. 3. The percent difference (%D) between the initial calibration $\overline{RRF}$ and the continuing calibration RRF must be within ± 25.0 percent for all target compounds.

**D. Evaluation:**

1. Verify that the continuing calibration was run at the required frequency and that the continuing calibration was compared to the correct initial calibration.

2. Evaluate the continuing calibration RRF for all semivolatile target compounds and surrogates.

   a. Check and recalculate the continuing calibration RRF for at least one semivolatile target compound for each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all semivolatile target compounds and surrogates have RRFs within specifications.

**NOTE:** The criteria employed for the data review purposes are different from those used for contractual purposes. The laboratory must meet a minimum RRF criterion of 0.01, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all semivolatile compounds.**

3. Evaluate the %D between initial calibration $\overline{RRF}$ and continuing calibration RRF for one or more semivolatile compounds.

   a. Check and recalculate the %D for at least one semivolatile target compound for each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that the %D is within the ±25.0 percent criterion, for all semivolatile target compounds and surrogates. Note those compounds which have a %D outside the ±25.0 percent criterion. The method criteria for an acceptable continuing calibration specifies that up to any 4 semivolatile target compounds may fail to meet minimum RRF or maximum %D as long as they have RRFs that are greater than or equal to 0.010, and %D of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %D exceeds the ±25.0 percent criterion.

4. If errors are detected in the calculations of either the continuing calibration RRF or the %D, perform a more comprehensive recalculation.

**E. Action:**

1. The reviewer should use professional judgement to determine if it is necessary to qualify the data for any semivolatile target compound. If qualification of data is required, it should be performed using the following guidelines:

   a. If the %D is outside the ± 25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify positive results "J".

   b. If the %D is outside the ± 25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify non-detected semivolatile target compounds "UJ".

   c. If the continuing calibration RRF is less than 0.05, qualify positive results that have acceptable mass spectral identification with "J" or use professional judgement.

   d. If the continuing calibration RRF is less than 0.05, qualify non-detected semivolatile target compounds as unusable (R).

2. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

3. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

4. If calibration criteria are grossly exceeded, this should be noted for EPA Project Officer action.

## V. Blanks

A. **Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, Form IV SV *[Form IV LCSV]*, chromatograms, and quantitation reports.

B. **Objective:**

The purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination problems resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

C. **Criteria:**

1. No contaminants should be found in the blanks.

2. The method blank must be analyzed on each GC/MS system used to analyze that specific group or set of samples.

D. **Evaluation:**

1. Review the results of all associated blank, Form I SV-1, Form I SV-2, and raw data (chromatograms and quantitation reports) to evaluate the presence of target and non-target compounds in the blanks.

2. Verify that a method blank analysis has been reported per matrix, per concentration level, for each extraction batch and for each GC/MS system used to analyze semivolatile samples. The reviewer can use the method blank summary (Form IV SV) to assist in identifying samples associated with each method blank.

E. **Action:**

If the appropriate blanks were not analyzed with the frequency described above, then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be noted for EPA Project Officer action.

Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. Positive sample results should be reported unless the concentration of the compound in the sample is less than or equal to 10 times (10x) the amount in any blank for the **common phthalate contaminants**, or 5 times the amount for other compounds. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting any blank value.

Specific actions are as follows:

If a semivolatile compound is found in a blank but not found in the sample, no action is taken. If the contaminants found are volatile target compounds (or interfering non-target compounds) at significant concentrations above the CRQL, then this should be noted for EPA Project Officer action.

2. Any semivolatile compound detected in the sample (other than the common phthalate contaminants), that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required. For phthalate contaminants, the results are qualified "U" by elevating the sample quantitation limit to the sample concentration when the sample result is less than 10x the blank concentration.

   The reviewer should note that blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" and "10x" criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. In this case, the "5x" or "10x" rules may not apply; the sample value should be reported as a non-detect. An explanation of the rationale used for this determination should be provided in the narrative accompanying the Regional Data Assessment Summary.

3. If gross contamination exists (i.e., saturated peaks by GC/MS), all affected compounds in the associated samples should be qualified as unusable (R), due to interference. This should be noted for EPA Project Officer action if the contamination is suspected of having an effect on the sample results.

4. If inordinate amounts of other target compounds are found at low levels in the blank(s), it may be indicative of a problem and should be noted for EPA Project Officer action.

5. The same consideration given to the target compounds should also be given to Tentatively Identified Compounds (TICs) which are found in both the sample and associated blank(s). (See SV Section XIII for TIC guidance.)

The following are examples of applying the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Example 1: Sample result is greater than the Contract Required Quantitation Limit (CRQL), but is less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 12 | 12 |
| CRQL | 10 | 10 |
| Sample Result | 50 | 40 |
| Qualified Sample Result | 50U | 40U |

In the example for the "10x" rule, sample results less than 120 (or 10 x 12) would be qualified as non-detects. In the case of the "5x" rule, sample results less than 60 (or 5 x 12) would be qualified as non-detects.

Example 2: Sample result is less than CRQL, and is also less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 12 | 12 |
| CRQL | 10 | 10 |
| Sample Result | 8J | 8J |
| Qualified Sample Result | 10U | 10U |

Note that data are not reported as 8U, as this would be reported as a detection limit below the CRQL.

Example 3: Sample result is greater than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 15 | 15 |
| CRQL | 10 | 10 |
| Sample Result | 160 | 80 |
| Qualified Sample Result | 160 | 80 |

For both the "10x" and "5x" rules, sample results exceeded the adjusted blank results of 150 (or 10x15) and 75 (or 5x15), respectively, and therefore are not qualified.

## VI. Surrogate Spikes

**A. Review Items:** Form II SV-1 and Form II SV-2 *[Form II LCSV]*, chromatograms, and quantitation reports.

**B. Objective:**

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the evaluation and review of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

**C. Criteria:**

1. Surrogate spikes, 4 acid compounds (3 required and 1 advisory) and 4 base/neutral compounds (3 required and 1 advisory) are added to all samples and blanks to measure their recovery in sample and blank matrices.

   *[For data generated through the Low Concentration Method: Surrogate spikes, 3 acid compounds and 3 base/neutral compounds, are added to all samples and blanks to measure their recovery in sample and blank matrices.]*

2. Surrogate spike recoveries for semivolatile samples and blanks must be within the limits specified on in the method and on Form II SV- 1 and Form II SV-2.

   *[For data generated through the Low Concentration Method: Surrogate spike recoveries for semivolatile samples and blanks must be within the limits specified in the method and on Form II LCSV.]*

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation reports) to verify the surrogate spike recoveries on the Surrogate Recovery Form II SV-1 and Form II SV-2 *[Form II LCSV]*. Check for any transcription or calculation errors.

2. Check that the surrogate spike recoveries were calculated correctly. The equation can be found in the method.

3. The following should be determined from the Surrogate Recovery form(s):

   a. If any two base/neutral or acid surrogates are out of specification, or if any one base/neutral or acid extractable surrogate has a recovery of less than 10 percent, then there should be a re-analysis to confirm that the non-compliance is due to sample matrix effects rather than laboratory deficiencies.

**NOTE:** When there are unacceptable surrogate recoveries followed by successful re-analyses, the laboratories are required to report only the acceptable run.

   b. The laboratory has failed to perform satisfactorily if surrogate recoveries are out of specification and there is no evidence of reinjection of the extract, or reextraction and re-analysis (if reinjection fails to resolve the problem).

   c. Verify that no blanks have surrogate recoveries outside the criteria.

4. Any time there are two or more analyses for a particular fraction the reviewer must determine which are the best data to report. Considerations should include but are not limited to:

   a. Surrogate recovery (marginal versus gross deviation).

   b. Technical holding times.

   c. Comparison of the values of the target compounds reported in each fraction.

   d. Other QC information, such as performance of internal standards.

**E. Action:**

Data are not qualified with respect to surrogate recovery unless two or more semivolatile surrogates, within the same fraction (base/neutral or acid fraction), are out of specification. For surrogate spike recoveries out of specification, the following approaches are suggested based on a review of all data from the Case, especially considering the apparent complexity of the sample matrix.

1. If two or more surrogates in either semivolatile fraction (base/neutral or acid fraction) have a recovery greater than the upper acceptance limit (UL):

   a. Specify the fraction that is being qualified (i.e. acid, base/neutral, or both).

   b. Detected semivolatile target compounds are qualified "J."

   c. Results for non-detected semivolatile target compounds should not be qualified.

2. If two or more surrogates in either semivolatile fraction have a recovery greater than or equal to 10 percent but less than the lower acceptance limit (LL):

   a. Specify the fraction that is being qualified (i.e. acid, base/neutral, or both).

   b. Detected semivolatile target compounds are qualified "J".

   c. For non-detected semivolatile target compounds, the sample quantitation limit is qualified as approximated (UJ).

3. In the case where two or more surrogates are out in either semivolatile fraction; one with a recovery greater than the upper acceptance limit and one with a recovery greater than or equal to 10 percent but less than the lower acceptance limit, qualify as described in SV Section VI.E.2 a, b, and c above.

4. If any surrogate in either semivolatile fraction show less than 10 percent recovery:

   a. Specify the fraction that is being qualified (i.e. acid, base/neutral, or both).

   b. Detected semivolatile target compounds are qualified "J".

   c. Non-detected semivolatile target compounds may be qualified as unusable (R).

5. In the special case of a blank analysis with surrogates out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable surrogate recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence.

6. Whenever possible, the potential effects of the data resulting from surrogate recoveries not meeting the advisory limits should be noted in the data review narrative. Additionally, the lack of re-analysis of samples that were out of specification should be noted for EPA Project Officer action.

## VII. Matrix Spikes/Matrix Spike Duplicates
## (Not Required for Low Concentration Water Data)

**A. Review Items:** Form III SV-1, Form III SV-2, chromatograms, and quantitation reports.

**B. Objective:**

Data for matrix spikes/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. These data alone cannot be used to evaluate the precision and accuracy of individual samples. However, when exercising professional judgement, this data should be used in conjunction with other available QC information.

**C. Criteria:**

1. A matrix spike and matrix spike duplicate are extracted and analyzed for every 20 field samples of similar matrix in an SDG, whenever samples are extracted by the same procedure, unless MS/MSD analyses are not required.

2. Matrix spike and matrix spike duplicate recoveries should be within the advisory limits established on Form III SV- 1 and Form III SV-2.

3. The Relative Percent Differences (RPDs) between matrix spike and matrix spike duplicate recoveries should be within the advisory limits listed on Form III SV-1 and Form III SV-2.

**D. Evaluation:**

1. Verify that MS and MSD samples were analyzed at the required frequency and that results are provided for each sample matrix.

2. Inspect results for the MS/MSD Recovery on Form III SV-1 and Form III SV-2 and verify that the results for recovery and RPD are within the advisory limits.

3. Verify transcriptions from raw data and verify calculations.

4. Check that the recoveries and RPD were calculated correctly.

5. Compare results (%RSD) of non-spiked compounds between the original result, MS, and MSD.

**E. Action:**

1. No action is taken on MS/MSD data alone. However, using informed professional judgment the data reviewer may use the matrix spike and matrix spike duplicate results in conjunction with other QC criteria and determine the need for some qualification of the data.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD effect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD effect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of non-spiked compounds.

**NOTE:** If a field blank was used for the MS/MSD, the EPA Project Officer must be notified.

## VIII. Laboratory Control Samples
## (Low Concentration Water)

*[A.* ***Review Items:*** *Form III LCSV, LCS chromatograms, and quantitation reports.*

***B. Objective:***

*Data for Laboratory Control Samples (LCS) are generated to provide information on the accuracy of the analytical method and the laboratory performance.*

***C. Criteria:***

1. *Laboratory control samples are prepared, extracted, analyzed, and reported once per SDG. The LCS must be extracted and analyzed concurrently with the samples in the SDG, using the same instrumentation as the samples in the SDG.*

2. *LCS percent recoveries must he within the QC limits provided on Form III LCSV. The LCS must meet the recovery criteria for the sample data to be accepted.*

3. *The LCS contains the following semivolatile target compounds, in addition to the required surrogates:*

| | |
|---|---|
| *Phenol* | *Naphthalene* |
| *2-Chlorophenol* | *2,4-Dinitrotoluene* |
| *4-Chloroaniline* | *Diethylphthalate* |
| *2,4,6-Trichlorophenol* | *N-Nitrosodiphenylamine* |
| *bis(2-Chloroethyl)ether* | *Hexachlorobenzene* |
| *N-Nitroso-di-n-propylamine* | *Benzo(a)pyrene* |
| *Hexachloroethane* | |
| *Isophorone* | |

4. *The criteria for surrogate recovery and internal standard performance also apply.*

***D. Evaluation:***

1. *Verify that LCS samples were analyzed at the required frequency.*

2. *Inspect the results for LCS Recovery on Form III LCSV and verify that the results for recovery are within the QC limits.*

3. *Verify transcriptions from raw data and verify calculations.*

4. *Check that the recoveries were calculated correctly.*

***E. Action:***

*If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.*

1. *Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.*

2. *If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.*

3. *If the LCS recovery is greater than the upper acceptance limit, then positive sample results for the affected compound(s) should be qualified with a "J".*

4. *If the mass spectral criteria are met but the LCS recovery is less than the lower acceptance limit, then the associated detected target compounds should be qualified "J" and the associated non-detected target compounds should be qualified "R".*

5. *If more than half of the compounds in the LCS are not within the recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated non-detected target compounds should be qualified "R".*

6. *Action on non-compliant surrogate recovery and internal standard performance should follow the procedures provided in SV Section VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that non-compliance for surrogate recovery and internal standard performance in the LCS has on the associated sample data.*

7. *It should be noted for EPA Project Officer action if a laboratory fails to analyze an LCS with each SDG, or if a laboratory consistently fails to generate acceptable LCS recoveries.]*

## IX. Regional Quality Assurance and Quality Control

**A. Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, chromatograms, quantitation report, Traffic Report, and raw data for Regional QC samples.

**B. Objective:**

Regional Quality Assurance and Quality Control (QA/QC) refer to any QA and/or QC initiated by the Region, including field duplicates, Regional Performance Evaluation (PE) samples, blind spikes, and blind blanks. (It is highly recommended that Regions adopt the use of these QA/QC samples.)

**C. Criteria:**

Criteria are determined by each Region.

1. Performance Evaluation sample frequency may vary.

   *[For data generated through the Low Concentration Method: A PE sample can be included as frequently as once per SDG.]*

2. The analytes present in the PE sample must be correctly identified and quantified.

**D. Evaluation:**

Evaluation procedures must follow the Region's SOP for data review. Each Region will handle the evaluation of PE samples on an individual basis. Results for PE samples should be compared to the acceptance criteria for the specific PE samples, if available.

**E. Action:**

Any action must be in accordance with Regional specifications and the criteria for acceptable PE sample results. Unacceptable results for PE samples should be noted for EPA Project Officer action.

## X. Internal Standards

**A. Review Items:** Form VIII SV-1 *[Form VIII LCSV-1]*, Form VIII SV-2 *[Form VIII LCSV-2]*, quantitation reports, and chromatograms.

**B. Objective:**

Internal Standards (IS) performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run.

**C. Criteria:**

1. Internal standard area counts for samples and blanks must not vary by more than a factor of two (-50 percent to + 100 percent) from the associated 12hr calibration standard.

2. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated 12hr calibration standard.

   *[For data generated through the Low Concentration Method: The retention time of the internal standards in samples and blanks must not vary by more than ±20.0 seconds from the retention time of the associated calibration standard.]*

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation lists) for samples and blanks to verify the internal standard retention times and areas reported on the Internal Standard Area Summary (Form VIII SV-1 *[Form VIII LCSV-1]* and Form VIII SV-2 *[Form VIII LCSV-2]).*

2. Verify that all retention times and IS areas are within the required criteria.

3. If there are two analyses for a particular fraction, the reviewer must determine which are the best data to report. Considerations should include:

   a. Magnitude and direction of the IS area shift.

   b. Magnitude and direction of the IS retention time shift.

   c. Technical holding times.

   d. Comparison of the values of the target compounds reported in each fraction.

SV

**E. Action:**

1. If an IS area count for a sample or blank is outside -50 percent or +100 percent of the area for the associated standard:

   a. Positive results for compounds quantitated using that IS should be qualified with "J".

   b. Non-detected compounds quantitated using an IS area count greater than 100 percent should not be qualified.

   c. Non-detected compounds quantitated using an IS area count less than 50 percent are reported as the associated sample quantitation limit and qualified with "UJ".

   d. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detected target compounds should then be qualified as unusable (R).

2. If an IS retention time varies by more than 30 seconds:

   *[If an IS retention time varies by more than 20.0 seconds:]*

   The chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection (R) of the data for that sample fraction. Positive results should not need to be qualified with "R" if the mass spectral criteria are met.

3. If the internal standards performance criteria are grossly exceeded, then this should be noted for EPA Project Officer action. Potential effects on the data resulting from unacceptable internal standard performance should be noted in the data review narrative.

## XI. Target Compound Identification

**A. Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, quantitation reports, mass spectra, and chromatograms.

**B. Objective:**

Qualitative criteria for compound identification have been established to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied much more easily in detecting false positives than false negatives. More information is available due to the requirement for submittal of data supporting positive identifications. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, much more difficult to assess. One example of detecting false negatives is the reporting of a Target Compound as a TIC.

**C. Criteria:**

1. Compound must be within ±0.06 relative retention time (RRT) units of the standard RRT.

2. Mass spectra of the sample compound and a current laboratory-generated standard must match according to the following criteria:

   a. All ions present in the standard mass spectrum at a relative intensity greater than 10 percent <u>must</u> be present in the sample spectrum.

      *[For data generated through the Low Concentration Method: All ions present in the standard mass spectrum at a relative intensity greater than 25 percent <u>must</u> be present in the sample spectrum.]*

   b. The relative intensities of these ions must agree within ±20 percent between the standard and sample spectra. (Example: For an ion with an abundance of 50 percent in the standard spectrum, the corresponding sample ion abundance must be between 30 percent and 70 percent.)

   c. Ions present at greater than 10 percent in the <u>sample</u> mass spectrum but not present in the <u>standard</u> spectrum must be considered and accounted for.

      *[For data generated through the Low Concentration Method: Ions present at greater than 25 percent in the <u>sample</u> mass spectrum but not present in the <u>standard</u> mass spectrum must be considered and accounted for.]*

SV

**D. Evaluation:**

1. Check that the RRT of reported compounds is within ±0.06 RRT units of the standard relative retention time.

2. Check the sample compound spectra against the laboratory standard spectra to verify that it meets the specified criteria.

3. The reviewer should be aware of situations (e.g., high concentration samples preceding low concentration samples) when sample carryover is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification.

4. Check the chromatogram to verify that peaks are accounted for (i.e., major peaks are either identified as target compounds, TICs, surrogates, or internal standards).

**E. Action:**

1. The application of qualitative criteria for GC/MS analysis of target compounds requires professional judgement. It is up to the reviewer's discretion to obtain additional information from the laboratory. If it is determined that incorrect identifications were made, all such data should be qualified as not detected (U) or unusable (R).

2. Professional judgement must be used to qualify the data if it is determined that cross-contamination has occurred.

3. Any changes made to the reported compounds or concerns regarding target compound identifications should be clearly indicated in the data review narrative. The necessity for numerous or significant changes should be noted for EPA Project Officer action.

## XII. Compound Quantitation and Reported CRQLS

**A. Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, sample preparation sheets, SDG Narrative, sample clean-up sheets, quantitation reports, and chromatograms.

**B. Objective:**

The objective is to ensure that the reported quantitation results and Contract Required Quantitation Limits (CRQLs) for semivolatile target compounds are accurate.

**C. Criteria:**

1. Compound quantitation, as well as the adjustment of the CRQL, must be calculated according to the correct equation.

2. Compound area responses must be calculated based on the internal standard (IS) associated with that compound, as listed in the method. Quantitation must be based on the quantitation ion (m/z) specified in the method for both the IS and target analytes. The compound quantitation must be based on the RRF from the appropriate daily calibration standard.

**D. Evaluation:**

1. For all fractions, raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Quantitation lists, chromatograms, and sample preparation log sheets should be compared to the reported positive sample results and quantitation limits. Check the reported values.

2. Verify that the correct internal standard, quantitation ion, and RRF were used to quantitate the compound. Verify that the same internal standard, quantitation ion, and RRF are used consistently throughout the calibration and quantitation processes.

3. Verify that the CRQLs have been adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

**E. Action:**

1. If there are any discrepancies found, the laboratory may be contacted by the Region's designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must use professional judgement to decide which value is the best value. Under these circumstances, the reviewer may determine qualification of data is warranted. Decisions made on data

quality should be included in the data review narrative. A description of the reasons for data qualification and the qualification that is applied to the data should be documented in the data review narrative.

2. Numerous or significant failures to accurately quantify the target compound or to properly evaluate and adjust CRQLs should be noted for EPA Project Officer action.

## XIII. Tentatively Identified Compounds

**A. Review Items:** Form I SV-TIC *[Form I LCSV-TIC],* chromatograms, and library search printouts with spectra for the TIC candidates.

**B. Objective:**

Chromatographic peaks in semivolatile fraction analyses that are not target analytes, surrogates, or internal standards are potential tentatively identified compounds (TICs). TICs must be qualitatively identified by a National Institute of Standards and Technology (NIST) mass spectral library search and the identifications assessed by the data reviewer.

**C. Criteria:**

For each sample, the laboratory must conduct a mass spectral search of the NIST library and report the possible identity for the appropriate number of the largest semivolatile fraction peaks which are not surrogate, internal standard, or target compounds, but which have area or height greater than 10 percent of the area or height of the nearest internal standard. Peaks that are suspected to be part of an alkane series shall be library searched and reported, as the alkane series (e.g., $C_5$-$C_9$), as a single entry along with the estimate for the total concentration of the series. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I SV-TIC).

*[For data generated through the Low Concentration Method: For each sample, the laboratory must conduct a mass spectral search of the NIST library and report the possible identity for the appropriate number of the largest semivolatile fraction peaks which are not surrogates, internal standards, or target compounds, but which have an area greater than 50 percent of the area of the nearest internal standard. Estimated concentrations for TICs are calculated similarly to the target compounds, using total ion areas for the TIC and the internal standard, and assuming a relative response factor of 1.0. Peaks that are suspected to be part of an alkane series shall be library searched and reported, as the alkane series (e.g., $C_5$-$C_9$), as a single entry along with the estimate for the total concentration of the series. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I LCSV- TIC).]*

**NOTE:** Since the method revision of October 1986, the CLP does not allow the laboratory to report as tentatively identified compounds any target compound which is properly reported in another fraction. For example, late eluting volatile target compounds should not be reported as semivolatile TICs.

**D. Evaluation:**

1. Guidelines for tentative identification are as follows:

   a. Major ions (greater than 10 percent relative intensity) in the reference spectrum should be present in the sample spectrum.

      *[Major ions (greater than 25 percent relative intensity) in the reference spectrum should be present in the sample spectrum.]*

   b. The relative intensities of the major ions should agree within ±20 percent between the sample and the reference spectra.

   c. Molecular ions present in the reference spectrum should be present in the sample spectrum.

   d. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or coelution of additional TIC or target compounds.

   e. When the above criteria are not met, but in the technical judgment of the data reviewer or mass spectral interpretation specialist the identification is correct, the data reviewer may report the identification.

   f. If, after careful review and in the technical judgement of the mass spectral interpretation specialist, no valid identification can be made, the compound should be reported as follows:

      - If the library search produces a match at or above 85%, report that compound.

      - If the library search produces more than one compound at or above 85%, report the first compound (highest).

      - If the library search produces no matches at or above 85%, the compound should be reported as unknown. The mass spectral specialist should give additional classification of the unknown compound, if possible (i.e., unknown hydrocarbon, unknown acid type, unknown chlorinated coumpound). If probable molecular weights can be distinguished, include them.

2. Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms for samples and blanks.

   *[Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms for samples and blanks with areas greater than or equal to 50 percent of the area of the nearest internal standard.]*

3. Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-target compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which are less than 10 percent of the internal standard height, but present in the blank chromatogram at a similar relative retention time.

   *[Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-TCL compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which have areas less than 50 percent of the internal standard area, but present in the blank chromatogram at a similar relative retention time.]*

4. All mass spectra for each sample and blank must be examined.

5. Since TIC library searches often yield several candidate compounds having a close matching score, all reasonable choices should be considered.

6. Check the raw data to verify that the laboratory has properly identified and assigned peaks to the alkane series.

7. The reviewer should be aware of common laboratory artifacts/contaminants and their sources (e.g., aldol condensation products, solvent preservatives, and reagent contaminants). These may be present in blanks and not reported as sample TICs.

   Examples:

   a. Common laboratory contaminants: $CO_2$ (m/z 44), siloxanes (m/z 73), diethyl ether, hexane, certain freons, and phthalates at levels less than 100 ug/L or 4000 ug/Kg.

   b. Solvent preservatives, such as cyclohexene which is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, and chlorocyclohexanol.

   c. Aldol reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanon, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone.

8. Occasionally, a target compound may be identified as a TIC in the proper analytical fraction by non-target library search procedures, even though it was not found on the quantitation list. If the total area quantitation method was used, the reviewer should request that the laboratory recalculate the result using the proper quantitation ion. In addition, the reviewer should evaluate other sample chromatograms and check library reference retention time quantitation lists to determine whether the false negative result is an isolated occurrence whether additional data may be affected.

9. Target compounds may be identified in more than one fraction. Verify that quantitation is made from the proper fraction.

10. Library searches should not be performed on internal standards or surrogates.

11. TIC concentration should be estimated assuming a RRF of 1.0.

**E. Action:**

1. All TIC results should be qualified "NJ", tentatively identified, with approximated concentrations.

2. General actions related to the review of TIC results are as follows:

   a. If it is determined that a tentative identification of a non-target compound is not acceptable, the tentative identification should be changed to "unknown" or an appropriate identification.

   b. If all contractually required peaks were not library searched and quantitated, the Region's designated representative could request these data from the laboratory.

3. TIC results which are not sufficiently above the level in the blank should not be reported. (Dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples.)

4. When a compound is not found in any blanks, but is a suspected artifact of common laboratory contamination, the result may be qualified as unusable (R).

5. In deciding whether a library search result for a TIC represents a reasonable identification, professional judgment must be exercised. If there is more than one possible match, the result may be reported as "either compound X or compound Y". If there is a lack of isomer specificity, the TIC result may be changed to a non-specific isomer result (e.g., 1,3,5-trimethyl benzene to trimethyl benzene isomer) or to a compound class (e.g., 2-methyl, 3-ethyl benzene to substituted aromatic compound).

6. The reviewer may elect to report all similar isomers as a total. All alkanes may be summarized and reported as total hydrocarbons (e.g., alkane series $C_5$-$C_9$). Reporting an alkane series counts only as one of the 30 most intense non-target semi-volatile compounds.

7. Other case factors may influence TIC judgments. If a sample TIC match is poor but other samples have a TIC with a good library match, similar relative retention time, and the same ions, identification information may be inferred from the other sample TIC results.

8. Physical constants, such as boiling point, may be factored into professional judgment of TIC results.

9. Any changes made to the reported data or any concerns regarding TIC identifications should be indicated in the data review narrative.

10. Failure to properly evaluate and report TICs should be noted for EPA Project Officer action.

## XIV. System Performance

**A. Review Items:** Form III SV-1 and Form III SV-2 *[Form III LCSV]*, Form VIII SV-1 *[Form* VIII *LCSV-1]*, Form VIII SV-2 *[Form VIII LCSV-2]*, and chromatograms.

**B. Objective:**

During the period following Instrument Performance QC checks (e.g., blanks, tuning, calibration), changes may occur in the system that degrade the quality of the data. While this degradation would not be directly shown by QC checks until the next required series of analytical QC runs, a through review of the ongoing data acquisition can yield indicators of instrument performance.

**C. Criteria:**

There are no specific criteria for system performance. Professional judgement should be used to assess the system performance.

**D. Evaluation:**

1. Abrupt, discrete shifts in the reconstructed ion chromatogram (RIC) baseline may indicate a change in the instrument's sensitivity or the zero setting. A baseline shift could indicate a decrease in sensitivity in the instrument or an increase in the instrument zero, possibly causing target compounds at or near the detection limit to be non-detects. A baseline "rise" could indicate problems such as a change in the instrument zero, a leak, or degradation of the column.

2. Poor chromatographic performance affects both qualitative and quantitative results. Indications of substandard performance include:

   a. High RIC background levels or shifts in absolute retention times of internal standards.

   b. Excessive baseline rise at elevated temperature.

   c. Extraneous peaks.

   d. Loss of resolution as suggested between by factors such as non-resolution of 2,4- and 2,5- dinitrotoluene.

   e. Peak tailing or peak splitting that may result in inaccurate quantitation.

*[3. A drift in instrument sensitivity may occur during the 12-hour time period. This could be discerned by examination of the IS area on Form VIII LCSV-1 and Form VIII LCSV-2 for trends such as a continuous or near-continuous increase or decrease in the IS area over time.*

4. *The results of the LCS analysis (Form III LCSV) may also be used to assess instrument performance.]*

**E. Action:**

Professional judgement must be used to qualify the data if it is determined that system performance has degraded during sample analyses. Any degradation of system performance which significantly affected the data should be documented for EPA Project Officer action.

## XV. Overall Assessment of Data

**A. Review Items:** Entire data package, data review results, and (if available) Quality Assurance Project Plan (QAPjP), and Sampling and Analysis Plan (SAP).

**B. Objective:**

The overall assessment of a data package is a brief narrative in which the data reviewer expresses concerns and comments on the quality and, if possible, the useability of the data.

**C. Criteria:**

Assess the overall quality of the data.

**D. Evaluation:**

1. Evaluate any technical problems which have not been previously addressed.

2. Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

3. If appropriate information is available, the reviewer may assess the useability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the QAPjP (specifically the Data Quality Objectives), SAP, and communication with data user that concerns the intended use and desired quality of the data.

**E. Action:**

1. Use professional judgement to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief narrative to give the user an indication of the analytical limitations of the data. Any inconsistency of that data with the SDG Narrative should be noted for EPA Project Officer action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include his/her assessment of the useability of the data within the given context.

## PESTICIDE/AROCLOR DATA REVIEW

****Data review guidelines that are unique to data generated through the Low Concentration Water Method are contained within brackets ([ ]) and written in italics.****

The pesticide/Aroclor data requirements to be checked are listed below.

I. Holding Times

II. GC/ECD Instrument Performance Check

III. Initial Calibration

IV. Calibration Verification

V. Blanks

VI. Surrogate Spikes

VII. Matrix Spikes/Matrix Spike Duplicates

*[VIII. Laboratory Control Samples]*

IX. Regional Quality Assurance and Quality Control

X. Pesticide Cleanup Checks

XI. Target Compound Identification

XII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs)

XIII. Overall Assessment of Data

## I. Holding Times

A. **Review Items:** Form I PEST *[Form I LCP],* EPA Sample Traffic Report and/or chain-of-custody, raw data, sample extraction sheets, and SDG Narrative.

B. **Objective:**

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis.

C. **Criteria:**

Technical requirements for sample holding times have only been established for water matrices.

The technical holding time criteria for water samples are as follows:

> For pesticides and Aroclors in cooled (@ 4°C) water samples, 7 days from sample collection to time of extraction and then 40 days from sample extraction to analysis.

It is recommended that pesticides and Aroclors in soil samples be extracted within 14 days of sample collection.

The method holding times, which differ from the technical holding times, state that extraction of water samples by separatory funnel must be completed within 5 days of validated time of sample receipt (VTSR), extraction of water samples by continuous liquid-liquid extraction procedures must be started within 5 days of VTSR, and soil/sediment samples are to be extracted within 10 days of VTSR. Also, contractually both water and soil sample extracts must be analyzed within 40 days of sample extraction.

*[For data generated through the Low Concentration Method: The holding times requirements are that the extraction of all samples must be started within 5 days of the VTSR, and the extracts must be analyzed within 40 days of VTSR.]*

D. **Evaluation:**

Technical holding times for sample extraction are established by comparing the sample collection date on the EPA Sample Traffic Report with the dates of extraction on Form I PEST *[Form I LCP]* and the sample extraction sheets. To determine if the samples were analyzed within the holding time after extraction, compare the dates of extraction on the sample extraction sheets with the dates of analysis on Form I PEST *[Form I LCP].*

Verify that the Traffic Report indicates that the samples were received intact and iced. If the samples were not iced or there were any problems with the samples upon receipt, then discrepancies in the sample condition could effect the data.

**E. Action:**

1. If technical holding times are exceeded, qualify all detected compound results as estimated "J" and sample quantitation limits as estimated "UJ", and document in the data review narrative that holding times were exceeded.

2. If technical holding times are grossly exceeded, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effect of additional storage on the sample results. The reviewer may determine that detected compound results or the associated quantitation limits are approximates and should be qualified with "J" or "UJ", respectively. The reviewer may determine that non-detected target compound data are unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer to apply water holding time criteria to soil samples. Professional judgement is required to evaluate holding times for soil samples.

4. Whenever possible, the reviewer should comment on the effect of exceeding the holding time on the resulting data in the data review narrative.

5. When method and/or technical holding times are exceeded, this should be noted as an action item for the EPA Project Officer.

6. The reviewer should also be aware of the scenario in which the laboratory has exceeded the technical holding times, but met contractual holding times. In this case, the data reviewer should notify the EPA Project Officer (where samples were collected) and/or RSCC that shipment delays have occurred so that the field problem can be corrected. The reviewer may pass this information on to the laboratory's EPA Project Officer, but should explain that contractually the laboratory met the method requirements.

## II. GC/ECD Instrument Performance Check

**A. Review Items:** Forms VI PEST-4 *[Form VI LCP-4]*, Form VI PEST-5*[Form VI LCP-5]*, Form VII PEST-1 *[Form VII LCP*-1], FormVIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

**B. Objective:**

Performance checks on the gas chromatograph with electron capture detector (GC/ECD) system are performed to ensure adequate resolution and instrument sensitivity. These criteria are not sample specific. Conformance is determined using standard materials, therefore, these criteria should be met in all circumstances.

**C. Criteria:**

1. Resolution Check Mixture

   a. The Resolution Check Mixture must be analyzed at the beginning of every initial calibration sequence, on each GC column and instrument used for analysis. The Resolution Check Mixture contains the following pesticides and surrogates:

| | |
|---|---|
| gamma-Chlordane | Endrin ketone |
| Endosulfan I | Methoxychlor |
| 4,4'-DDE | Tetrachloro-m-xylene |
| Dieldrin | Decachlorobiphenyl |
| Endosulfan sulfate | |

   b. The depth of the valley between two adjacent peaks in the Resolution Check Mixture must be greater than or equal to 60.0 percent of the height of the shorter peak.

2. Performance Evaluation Mixture

   a. The Performance Evaluation Mixture (PEM) must be analyzed at the beginning (following the resolution check mixture) and at the end of the initial calibration sequence. The PEM must also be analyzed at the beginning of every other 12-hour analytical period. The PEM contains the following pesticides and surrogates:

| | |
|---|---|
| gamma-BHC | Endrin |
| alpha-BHC | Methoxychlor |
| 4,4'-DDT | Tetrachloro-m-xylene |
| beta-BHC | Decachlorobiphenyl |

b. All peaks in the Performance Evaluation Mixture injections must be greater than or equal to 90 percent resolved on each GC column. This applies to both initial and continuing calibrations.

c. The absolute retention times of each of the single component pesticides and surrogates in all PEM analyses must be within the specific retention time windows centered around the mean retention times determined from the three-point initial calibration using the Individual Standard Mixtures.

For example, for a given pesticide the mean retention time is first determined from the initial calibration and found to be 12.69 minutes. The retention time window for this pesticide is ±0.05 minutes. Therefore, the calculated retention time window would range from 12.64 to 12.74 minutes.

d. The percent difference between the calculated amount (amount found) and the nominal amount (amount added) for each of the single component pesticides and surrogates in both of the PEM analyses on each GC column must be greater than or equal to -25.0 percent, AND less than or equal to 25.0 percent using the equation as specified in the method.

e. The percent breakdown is the amount of decomposition that 4,4'-DDT and Endrin undergo when analyzed on the GC column. For Endrin, the percent breakdown is determined by the presence of Endrin aldehyde and/or Endrin ketone in the GC chromatogram. For 4,4-DDT, the percent breakdown is determined from the presence of 4,4'-DDD and/or 4,4'-DDE in the GC chromatogram.

i. The percent breakdown for both 4,4'-DDT and Endrin in each PEM must be less than or equal to 20.0 percent for both GC columns.

ii. The combined percent breakdown for 4,4'-DDT and Endrin in each PEM must be less than or equal to 30.0 percent for both GC columns.

**D. Evaluation:**

1. Resolution Check Mixture

   a. Verify from the Form VIII PEST *[Form VIII LCP]* that the resolution check mixture was analyzed at the beginning of the initial calibration sequence on each GC column and instrument used for analysis.

   b. Check the resolution check mixture data and Form VI PEST-4 *[Form VI LCP-4]* to verify that the resolution criterion between two adjacent peaks for the required compounds is greater than or equal to 60 percent.

2. Performance Evaluation Mixture

   a. Verify from the Form VIII PEST *[Form VIII LCP]* that the Performance Evaluation Mixture (PEM) was analyzed at the proper frequency and position sequence.

   b. Check the PEM data from Form VI PEST-5, and the initial and continuing calibrations to verify that the resolution between adjacent peaks is greater than or equal to 90 percent on both GC columns.

   c. Check the PEM data from the initial and continuing calibrations and Form VII PEST-1 to verify that the absolute retention times for the pesticides in each analysis are within the calculated retention time windows based on the mean retention time from the three-point initial calibration.

   d. Verify that the percent difference between the calculated amount (amount found) and the nominal amount (amount added) for each of the single component pesticides and surrogates in both of the PEM analyses on each GC column must be greater than or equal to -25.0 percent, AND less than or equal to 25.0 percent.

   e. Verify that the individual breakdowns for 4,4'-DDT and Endrin are less than or equal to 20.0 percent, and that the combined breakdown is less than or equal to 30.0 percent.

**E. Action:**

1. Resolution Check Mixture

   a. If the Resolution Check Mixture was not analyzed with the frequency described in PEST Section II.C.1, then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. This situation should be brought to the attention of the EPA Project Officer.

b. If resolution criteria are not met, the quantitative results may not be accurate due to inadequate resolution. Detected target compounds that were not adequately resolved should be qualified with "J". Qualitative identifications may also be questionable if coelution exists. Non-detects with retention times in the region of coelution may not be valid, depending on the extent of the problem. Professional judgement should be used to determine the need to qualify data as unusable (R).

2. Performance Evaluation Mixture Frequency

If the Performance Evaluation Mixture was not analyzed with the frequency described in PEST Section II.C.2, then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. This situation should be brought to the attention of the EPA Project Officer.

3. Performance Evaluation Mixture Resolution

If PEM resolution criteria are not met, then the quantitative results may not be accurate due to inadequate resolution. Positive sample results for compounds that were not adequately resolved should be qualified with "J". Qualitative identifications may be questionable if coelution exists. Non-detected target compounds that elute in the region of coelution may not be valid depending on the extent of the coelution problem. Professional judgement should be used to qualify data as unusable (R).

4. Performance Evaluation Mixture Retention Times

Retention time windows are used in qualitative identification. If the retention times of the pesticides in the PEM do not fall within the retention time windows, the associated sample results should be carefully evaluated. All samples injected after the last in-control standard are potentially affected. It should be noted for EPA Project Officer action if the PEM retention time criteria are grossly exceeded.

a. For the affected samples, check to see if the sample chromatograms contain any peaks that are close to the expected retention time window of the pesticide of interest. If no peaks are present either within or close to the retention time window of the deviant target pesticide compound, then there is usually no effect on the data (i.e., non-detected values can be considered valid). Sample data that are potentially affected by standards not meeting the retention time windows should be noted in the data review narrative.

b. If the affected sample chromatograms contain peaks which may be of concern (i.e., above the CRQL and either close to or within the expected retention time window of the analyte of interest), then the reviewer should determine the extent of the effect on the data and may choose to qualify detected target compounds "NJ" and non-detected target compounds "UJ". In some cases, additional effort by the reviewer may be necessary to determine if sample peaks represent the compounds of interest, for example:

i. The reviewer can examine the data package for the presence of three or more standards containing the pesticide of interest that were run within a 72-hour period during which the sample was analyzed.

ii. If three or more such standards are present, the mean and standard deviation of the retention time window can be re-evaluated by using the mean retention times of the standards.

iii. If all standards and matrix spikes fall within the revised window, the valid positive or negative sample results can be determined using this window.

iv. The data review narrative should identify the additional efforts taken by the reviewer and the resultant impact on data usability. In addition, the support documentation should contain all calculations and comparisons generated by the reviewer.

c. If the reviewer cannot do anything with the data to resolve the problem of concern, all positive results and quantitation limits should be qualified "R".

5. If percent difference criteria are not met, qualify all associated positive results generated during the analytical sequence with "J" and the sample quantitation limits for non-detected target compounds with "UJ".

6. 4,4'-DDT/Endrin Breakdown:

a. If 4,4'-DDT breakdown is greater than 20.0 percent:

i. Qualify all positive results for DDT with "J". If DDT was not detected, but DDD and DDE are detected, then qualify the quantitation limit for DDT as unusable (R).

ii. Qualify positive results for DDD and/or DDE as presumptively present at an approximated quantity (NJ).

b. If Endrin breakdown is greater than 20.0 percent:

i. Qualify all positive results for Endrin with "J". If Endrin was not detected, but Endrin aldehyde and Endrin ketone are detected, then qualify the quantitation limit for Endrin as unusable (R).

ii. Qualify positive results for Endrin Aldehyde and Endrin ketone as presumptively present at an approximated quantity (NJ).

c. If the combined 4,4'-DDT and Endrin breakdown is greater than 30.0 percent:

i. The reviewer should consider the degree of individual breakdown of DDT and Endrin and apply qualifiers as described above.

7. Potential effects on the sample data resulting from the instrument performance check criteria should be noted in the data review narrative. If the data reviewer has knowledge that the laboratory has repeatedly failed to comply with the requirements for frequency, linearity, retention time, resolution, or DDT/Endrin breakdown, the data reviewer should notify the EPA Project Officer.

## III. Initial Calibration

A. **Review Items:** Forms VI PEST-1 *[Form VI LCP-1]*, Form VI PEST-2 *[Form VI LCP-2]*, Form VI PEST-3 *[Form VI LCP-3]*, Form VI PEST-4 *[Form VI LCP-4]*, Form VII PEST-1 *[Form VII LCP-1]*, Form VIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

B. **Objective:**

Compliance requirements for satisfactory initial calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for pesticide and Aroclor compounds on the Target Compound List (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical sequence and of producing a linear calibration curve.

C. **Criteria:**

1. Individual Standard Mixtures

a. Individual Standard Mixtures A and B (containing all of the single component pesticides and surrogates) must be analyzed at low, midpoint, and high levels during the initial calibration, on each GC column and instrument used for analysis.

b. The resolution between any two adjacent peaks in the midpoint concentration of Individual Standard Mixtures A and B in the initial calibration must be greater than or equal to 90.0 percent on each column.

c. The absolute retention times of each of the single component pesticides and surrogates are determined from three-point initial calibration using the Individual Standard Mixtures. The retention time window for each single component compound can be found in the appropriate method. An example for determining retention time windows is given in PEST Section II.C.2.c above.

d. At least one chromatogram from each of the Individual Standard Mixtures A and B must yield peaks that give recorder deflections between 50 to 100 percent of full scale.

e. The concentrations of the low, medium, and high level standards containing all of the single component pesticides and surrogates (Individual Standard Mixtures A and B) are as follows:

The low point corresponds to the CRQL for each analyte. The midpoint concentration must be 4 times the low point. The high point must be at least 16 times the low point, but a higher concentration may be chosen.

f. The Percent Relative Standard Deviation (%RSD) of the calibration factors for each of the single component pesticides and surrogates in the initial calibration on both columns for Individual Standard Mixtures A and B must be less than or equal to 20.0 percent, except as stated below. For the two surrogates, the %RSD must be less than or equal to 30.0 percent. Up to two single component target pesticides (other than the surrogates) per column may exceed the 20.0 percent limit but the %RSD must be less than or equal to 30.0 percent.

**Note:** Either peak area or peak height may be used to calculate the calibration factors that are, in turn, used to calculate %RSD. However, the type of peak measurement used to calculate each calibration factor for a given compound must be consistent. For example, if peak area is used to calculate the low point calibration factor for endrin, then the mid and high point calibration factors for endrin must also be calculated using peak area.

2. Multi-component Target Compounds

a. The multi-component target compounds (the 7 Aroclors and Toxaphene) must each be analyzed separately at a single concentration level during the initial calibration sequence. The analysis of the multi-component target compounds must also contain the pesticide surrogates.

b. For each multi-component analyte, the retention times are determined for three to five peaks. A retention time window of ±0.07 minutes is used to determine retention time windows for all multi-component analyte peaks, as stated in the appropriate method.

c. Calibration factor data must be determined for each peak selected from the multi-component analytes.

**D. Evaluation:**

1. Individual Standard Mixtures

a. Verify from the Form VIII PEST *[Form VIII LCP]* that the Individual Standard Mixtures A and B were analyzed at the proper frequency on each GC column and instrument used for analysis. Check the raw data (chromatograms and data system printouts) for each standard to verify that each of the standards was analyzed at the required concentration levels.

b. Check Form VII PEST-2 with the raw data, and determine that the midpoint standard concentration is 4 times the concentration of the low point standard concentration and verify that resolution is greater than 90 percent.

c. Check the Individual Standard Mixtures A and B data and Form VI PEST-1 *[Form VI LCP-1]* and review the calculated retention time windows for calculation and transcription errors.

d. Check the chromatograms and verify that at least one chromatogram from each of the Individual Standard Mixtures A and B yields peaks registering recorder/printer deflections between 50 and 100 percent of full scale.

e. Verify that the concentrations of the low, medium and high level standards of Individual Standard Mixtures A and B meet the criteria in PEST Section III. C.1. above.

f. Check the Individual Standard Mixtures A and B data and Form VI PEST-2 *[Form VI LCP-2]* to verify that the %RSD for the calibration factors in each of the single component pesticides and surrogates in the initial calibration analyses on both columns are in compliance with the criteria in PEST Section III.C above. Check and recalculate the calibration factors and %RSD for one or more pesticides; verify that the recalculated values agree with the reported values. If errors are detected, more comprehensive recalculation and review should be performed.

2. Multi-component Target Compounds

a. Verify from the Form VIII PEST *[Form VIII LCP]* that each of the multi-component target compounds were analyzed at the required frequency. Check the raw data for the standards to verify that the multi-component analytes were analyzed at the required concentration.

b. Check the data for the multi-component target compounds and Form PEST VI-3 *[Form VI LCP-3]* to verify that at least three peaks were used for calibration and that retention time windows were calculated as required.

c. Check the data to verify that calibration factors have been determined for each selected peak.

**E. Action:**

1. If the initial calibration sequence was not followed as required, then professional judgement must be used to evaluate the effect of the non-compliance on the sample data. If the requirements for the initial calibration sequence were not met, then this should be noted for EPA Project Officer action. If the non-compliance has a potential effect on the data, then the data should be qualified according to the professional judgement of the reviewer and this should be noted in the data review narrative.

2. If resolution criteria are not met, then the quantitative results may not be accurate due to peak overlap and lack of adequate resolution. Positive sample results for compounds

that were not adequately resolved should be qualified with "J". Qualitative identifications may be questionable if coelution exists. Non-detected target compounds that elute in the region of coelution may not be valid, depending on the extent of the coelution problem. Professional judgement should be used to qualify data as unusable (R).

3. If retention time windows are not calculated correctly, recalculate the windows and use the corrected values for all evaluations.

4. If the chromatogram display (recorder deflection) criteria are not met, use professional judgement to evaluate the effect on the data. If the data reviewer has knowledge that the laboratory has repeatedly failed to comply with this requirement, the data reviewer should notify the EPA Project Officer.

5. If the sample concentration exceeds the linearity of the calibration curve, and the sample is not properly diluted and re-analyzed, flag the positive results "J".

6. If the standard concentration criteria are not met, use professional judgement to evaluate the affect on the data and notify the EPA Project Officer. This is especially critical for the low level standards and non-detects.

7. If the %RSD linearity criteria are not met for the compound(s) being quantified, qualify all associated positive quantitative results with "J" and the sample quantitation limits for non-detected target compounds with "UJ".

8. Potential effects on the sample data due to problems with calibration should be noted in the data review narrative. If the data reviewer has knowledge that the laboratory has repeatedly failed to comply with the requirements for frequency, linearity, retention time, or resolution, the data reviewer should notify the EPA Project Officer.

## IV. Calibration Verification

A **Review Items:** Form VI PEST-6 *[Form VI LCP-6]*, Form VI PEST-7 *[Form VI LCP-7]*, Form VII PEST-1 *[Form VII LCP-1]*, Form VII PEST-2 *[Form VII LCP-2]*, Form VIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

B. **Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Calibration verification checks and documents satisfactory performance of the instrument over specific time periods during sample analysis. To confirm the calibration and evaluate instrument performance, calibration verification is performed, consisting of the analyses of instrument blanks, the PEM, and the midpoint concentration of Individual Standard Mixtures A and B.

C. **Criteria:**

1. An instrument blank and the PEM must bracket one end of a 12-hour period during which samples are analyzed, and a second instrument blank and the midpoint concentration of Individual Standard Mixtures A and B must bracket the other end of the 12-hour period.

2. The resolution between any two adjacent peaks in the midpoint concentration of Individual Standard Mixtures A and B must be greater than or equal to 90.0 percent.

3. The absolute retention time for each single component pesticide and surrogate in the midpoint concentration of Individual Standard Mixtures A and B must be within the retention time windows determined from the initial calibration.

4. The percent difference between the calculated amount and the true amount for each of the pesticides and surrogates in the midpoint concentration of the Individual Standard Mixtures A and B must not exceed ±25.0 percent.

D. **Evaluation:**

1. Check the Form VIII PEST *[Form VIII LCP]* to verify that the instrument blanks, PEMs, and Individual Standard Mixtures were analyzed at the proper frequency and that no more than 12 hours was elapsed between continuing calibration brackets in an ongoing analytical sequence.

2. Check Form VI PEST-6 *[Form VI LCP-6]* and Form VI PEST-7 *[Form VI LCP-7]*, and the data for the midpoint concentration of Individual Standard Mixtures A and B to verify that the resolution between any two adjacent peaks is greater than or equal to 90.0 percent.

3. Check the data for each of the single component pesticides and surrogates in the midpoint concentration of Individual Standard Mixtures A and B and Form VII PEST-2 *[Form VII LCP-2]* to verify that the absolute retention times are within the appropriate retention time windows.

4. Check the data from the midpoint concentration of Individual Standard Mixtures A and B and Form VII PEST-2 *[Form VII LCP-2]* to verify that the percent difference between the calculated amount and the true amount for each of the pesticides and surrogates (must be within ±25).

**E. Action:**

1. If the continuing calibration sequence was not followed as required, then professional judgement must be used to evaluate the effect of the non-compliance on the sample data. If the requirements for the continuing calibration sequence were not met, then this should be noted for EPA Project Officer action. If the non-compliance has a potential effect on the data, then the data should be qualified according to the professional judgement of the reviewer and this should be noted in the data review narrative.

2. If resolution criteria are not met, then the quantitative results may not be accurate due to inadequate resolution. Positive sample results for compounds that were not adequately resolved should be qualified with "J". Qualitative identifications may be questionable if coelution exists. Non-detected target compounds that elute in the region of coelution may not be valid depending on the extent of the coelution problem. Professional judgement should be used to qualify data as unusable (R).

3. Retention time windows are used in qualitative identification. If the standards do not fall within the retention time windows, the associated sample results should be carefully evaluated. All samples injected after the last <u>in-control</u> standard are potentially affected.

   a. For the affected samples, check to see if the sample chromatograms contain any peaks that are close to the expected retention time window of the pesticide of interest. If no peaks are present either within or close to the retention time window of the deviant target pesticide compound, then non-detected values can be considered valid. Sample data that is potentially affected by the standards not meeting the retention time windows should be noted in the data review narrative. If the retention time window criteria are grossly exceeded, then this should be noted for EPA Project Officer action.

   b. If the affected sample chromatograms contain peaks which may be of concern (i.e., above the CRQL and either close to or within the expected retention time window of the pesticide of interest), then the reviewer should follow the guidelines provided in Pesticide Section III.E.3 to determine the extent of the effect on the data.

**PEST**

4. If the percent difference is greater than 25 percent for the compound(s) being quantified, qualify all associated positive quantitative results with "J" and the sample quantitation limits for non-detects with "UJ".

5. Potential effects on the sample data due to problems with calibration should be noted in the data review narrative.

## V. Blanks

**A. Review Items:** Form I PEST *[Form I LCP]*, Form IV PEST *[Form IV LCP]*, chromatograms, and data system printouts.

**B. Objective:**

The purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination problems resulting from laboratory (or field) activities. The criteria for evaluation of laboratory blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, and sulfur cleanup blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

**C. Criteria:**

1. No contaminants should be present in the blanks.

2. Method Blanks

   a. A method blank analysis must be performed for each 20 samples of similar matrix in each Sample Delivery Group (SDG) or whenever a sample extraction procedure is performed. The method blank should be analyzed on each GC system used to analyze that set of associated samples.

3. Instrument Blanks

   a. An acceptable instrument blank must be run at least once every 12 hours and immediately prior to the analysis of either the performance evaluation mixture or Individual Standard Mixtures A and B, depending on the position in the analytical sequence.

4. Sulfur Cleanup Blanks

   a. A sulfur cleanup blank must be analyzed whenever part of a set of samples extracted together requires sulfur cleanup. If the entire set of samples associated with a method blank requires sulfur cleanup, then the method blank also serves the purpose of a sulfur blank and no separate sulfur blank is required. The sulfur cleanup blank should be analyzed on each GC system used to analyze the associated samples.

**D. Evaluation:**

1. Review the results of all associated blanks, Form I PEST *[Form I LCP]* and Form IV PEST *[Form IV LCP]*, and raw data (chromatograms and data system printouts) to evaluate presence of target or non-target analytes in the blanks.

2. Verify that method blank analysis has been reported per SDG, per matrix, per concentration level, for each GC system used to analyze samples, and for each extraction batch. The reviewer can use Form IV PEST *[Form IV LCP]* to assist in identifying samples associated with each blank.

3. Verify that the method blank analysis(es) contains less than the Contract Required Quantitation Limit (CRQL) of any target pesticide or Aroclor/Toxaphene or any interfering peak.

4. Verify that the instrument blank analysis has been performed every 12 hours as the first analysis of the continuing calibration sequence. All acceptable sample analyses are to be bracketed by acceptable instrument blanks. Additionally, the instrument blank must follow sample analyses which contain an analyte at high concentration. Evaluate the results from the various instrument blanks to verify that they do not contain any target analytes above one-half the CRQL values for water samples (assuming a 1-L extraction of a water sample).

5. Verify that the sulfur cleanup blanks were analyzed at the required frequency and that (assuming a 1-L extraction of a water sample) the sulfur blanks do not contain any target compounds above the CRQL. If a separate sulfur cleanup blank was prepared, one version of Form IV PEST *[Form IV LCP]* should be completed associating all the samples with the method blank, and a second version of Form IV PEST *[Form IV LCP]* should be completed listing only those samples associated with the separate sulfur cleanup blank.

**E. Action:**

If the appropriate blanks were not analyzed with the frequency described in the previous PEST Section V.C., then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be brought to the attention of the EPA Project Officer.

Action in the case of unsuitable blank results depends on the circumstances and the origin of the blank. Detected compounds should be reported unless the concentration of the compound in the sample is less than or equal to 5 times (5x) the amount in any blank. In instances where more than one blank is associated with a given sample, <u>qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant</u>. The results <u>must not</u> be corrected by subtracting the blank value.

Specific actions are as follows:

1. If a target pesticide or Aroclor/Toxaphene is found in the blank but <u>not</u> found in the sample(s), no qualification is required. If the contaminants found are at levels significantly greater than the CRQL, then this should be noted for EPA Project Officer action.

2. Any pesticide or Aroclor/Toxaphene detected in the sample, that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required.

   The reviewer should note that analyte concentrations calculated for method, sulfur, or instrument blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances when little or no contamination was present in the associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. In this case, the "5x" rule does not apply; the sample value should be reported as a non-detected target compound ("U"). An explanation of the rationale for this determination should be provided in the data review narrative.

3. If gross contamination exists (e.g., saturated peaks, "hump-o-grams", "junk" peaks), all affected compounds in the associated samples should be qualified as unusable (R), due to interference. This should be noted in the data review narrative and as a EPA Project Officer action item if the contamination is suspected of having an effect on the sample results.

4. If inordinate amounts of target pesticides, Aroclors/Toxaphene, or other interfering non-target compounds are found at low levels in the blank(s), it may be indicative of a problem at the laboratory and should be noted for EPA Project Officer action.

5. If an instrument blank was not analyzed following a sample analysis which contained an analyte(s) at high concentration(s), sample analysis results after the high concentration sample must be evaluated for carryover. Professional judgement should be used to determine if instrument cross-contamination has affected any positive compound identification(s), and if so, detected compound results should be qualified. If instrument cross-contamination is suggested, then this should be noted in the data review narrative, and for EPA Project Officer action, if the cross-contamination is suspected of having an affect on the sample results.

**PEST**

The following are examples of applying the blank qualification guidelines.

Example 1: Sample result is greater than the CRQL, but is less than the 5x multiple of the blank result.

| | 5x |
|---|---|
| Blank Result | 1.0 |
| CRQL | 0.5 |
| Sample Result | 4.0 |
| Qualified Sample Result | 4.0U |

Example 2: Sample result is less than the CRQL, and is also less than the 5x multiple of the blank result.

| | 5x |
|---|---|
| Blank Result | 1.0 |
| CRQL | 0.5 |
| Sample Result | 0.4J |
| Qualified Sample Result | 0.5U |

Example 3: Sample result is greater than the 5x multiple of the blank result.

| | 5x |
|---|---|
| Blank Result | 1.0 |
| CRQL | 0.5 |
| Sample Result | 10.0 |
| Qualified Sample Result | 10.0 |

In this case, the sample result exceeded the adjusted blank result (5 x 1.0) and the sample result is not qualified.

## VI. Surrogate Spikes

A. **Review Items:** Form II PEST-1 and Form II PEST-2 *[Form II LCP]*, Form VIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

B. **Objective:**

Laboratory performance on individual samples is established by means of spiking samples prior to extraction and analysis to determine surrogate spike recoveries. All samples are spiked with surrogate compounds prior to sample extraction. The evaluation of the recovery results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of target and/or non-target analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the evaluation and review of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

C. **Criteria:**

1. Two surrogate spikes, tetrachloro-m-xylene and decachlorobiphenyl, are added to all samples, Individual Standard Mixtures, PEMs, blanks, and matrix spikes to measure their recovery in sample and blank matrices.

2. The limits for recovery of the surrogates tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB) are 30-150 percent for both water and soil samples.

3. The retention times of both of the surrogates in the PEM, Individual Standard Mixtures, and samples must be within the calculated retention time windows. TCX must be within ±0.05 minutes, and DCB must be within ±0.10 minutes of the mean retention time determined from the initial calibration.

D. **Evaluation:**

1. Check the raw data (e.g., chromatograms and data system printouts) to verify that the recoveries on the Surrogate Recovery Form II PEST-1 and Form II PEST-2 *[Form II LCP]* are calculated and transcribed correctly.

2. If recoveries are not within limits, check the raw data for possible interferences which may have affected surrogate recoveries. If low surrogate recoveries are observed, the reviewer should investigate whether the low recoveries were a result of sample dilution.

3. Check the raw data (e.g., chromatograms and data system printouts) to verify that the retention times on Form VIII PEST *[Form VIII LCP]* are accurate and within retention time windows.

4. If retention times were not met, check the raw data for possible mis-identification of GC peaks. Non-recovery of surrogates may also be due to shifts in retention times.

**E. Action:**

1. If either surrogate spike recovery is outside of advisory limits, the following guidance is suggested. **Professional judgement must be used in applying these criteria, as surrogate recovery problems may not directly apply to target analytes.**

   a. If low recoveries (i.e., between 10 and 30 percent) are obtained, associated detected compounds should be qualified "J" and quantitation limits "UJ".

   b. If high recoveries (i.e., greater than 150 percent) are obtained, this may be an indication of a high bias due to co-eluting interferences. Using professional judgement, qualify associated detected compound data with "J". Non-detected analytes do not require qualification.

   c. If either pesticide surrogate recovery is reported as between 0 percent and 10 percent, the reviewer should examine the sample chromatogram to assess the qualitative validity of the analysis. If low surrogate recoveries are found to be due to sample dilution, then professional judgement should be used to determine if the resulting data should be qualified. If sample dilution is not a factor, then detected target compounds may be qualified "J" and non-detected target compound results should be qualified unusable (R).

   d. If zero pesticide surrogate recovery is reported, the reviewer should examine the sample chromatogram to determine if the surrogate may be present, but slightly outside its retention time window. If this is the case, in addition to assessing surrogate recovery for quantitative bias, the overriding consideration is to investigate the qualitative validity of the analysis. If the surrogate is not present, qualify all nondetected target compounds as unusable (R).

2. If surrogate retention times in PEMs, Individual Standard Mixtures, samples, and blanks are outside of the retention time limits, qualification of the data is left up to the professional judgement of the reviewer. Refer to Pesticide Section II.E.2 for more guidance.

3. In the special case of a blank analysis with surrogates out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable surrogate recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence. Data is qualified on the professional judgement of the reviewer.

4. Extreme or repeated analytical problems with surrogate recoveries should be noted for EPA Project Officer action.

5. If possible, the impact on the data resulting from surrogate recoveries not meeting the advisory limits, should be noted in the data review narrative.

## VII. Matrix Spikes/Matrix Spike Duplicates (Not Required for Low Concentration Water Data)

A. **Review Items:** Form III PEST-1, Form III PEST-2, chromatograms, and data system printouts.

B. **Objective:**

Data for matrix spikes (MS) and matrix spike duplicates (MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices. These data alone cannot be used to evaluate the precision and accuracy of individual samples. However, when exercising professional judgement, MS/MSD data should be used in conjunction with information on other deficiencies.

C. **Criteria:**

1. Matrix spikes (MS) and matrix spike duplicate (MSD) samples are analyzed at a frequency of at least one MS and MSD per 20 samples of each matrix, unless MS/MSD analyses are not required.

2. Matrix spike recoveries should be within the advisory limits provided on Form III PEST-1 and Form III PEST-2.

3. Relative percent difference (RPD) between MS and MSD recoveries should be within the advisory limits provided on Form III PEST-1 and Form III PEST-2.

D. **Evaluation:**

1. Verify that MS and MSD samples were analyzed at the required frequency and that results are provided for each sample matrix.

2. Check the raw data and Form III PEST-1 and Form III PEST-2 to verify that the results for matrix spike recoveries were calculated and transcribed correctly.

3. Check the raw data and Form III PEST-1 and Form III PEST-2 to verify that the matrix spike Relative Percent Difference (RPD) was calculated and transcribed correctly.

4. Compare %RSD results of non-spiked compounds between the original result, MS, and MSD.

E. **Action:**

1. No action is taken on MS/MSD data alone. However, using informed professional judgment, the data reviewer may use the MS and MSD results in conjunction with other QC criteria and determine the need for some qualification of the data.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated sample data. This determination should be made with regard to the MS/MSD sample itself, as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples. For example, if the recoveries for MS and MSD are consistently low for both water and soil samples, this could be indicative of a systematic problem in the laboratory and recoveries should be examined in all associated samples.

4 The reviewer must use professional judgement to determine the need for qualification of positive results of non-spiked compounds.

**NOTE:** If a field blank was used for the MS/MSD, unless designated as such by the Region, the EPA Project Officer must be notified.

## VIII. Laboratory Control Samples
## (Low Concentration Water)

*[A.* ***Review Items:*** *Form I LCP, Form III LCP, LCS chromatograms, and data system printouts.*

***B. Objective:***

*Data for laboratory control samples (LCSs) are generated to provide information on the accuracy of the analytical method and laboratory performance.*

***C. Criteria:***

1. *Laboratory control samples are analyzed at a frequency of once per SDG.*

2. *The LCS contains the following pesticides: gamma-BHC, heptachlor epoxide, dieldrin, 4,4-DDE, endrin, endosulfan sulfate, and gamma-chlordane, in addition to the two required surrogates.*

3. *The percent recoveries for the LCS compounds must be within the QC limits provided on Form III LCP. The LCS must meet the recovery criteria for the sample data to be accepted.*

4. *The criteria for surrogate recovery and target compound identification also apply.*

***D. Evaluation:***

1. *Verify that LCS samples were analyzed at the required frequency.*

2. *Verify that the LCS recoveries reported on Form III LCP are within the QC limits.*

3. *Check that the LCS recoveries were calculated correctly.*

4. *Verify transcriptions from raw data to Forms I and III LCP.*

***E. Action:***

*If the LCS criteria are not met, then laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.*

1. *Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the noncompliance.*

2. *If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. If the LCS recovery exceeds the upper acceptance limit, detected target compounds may be qualified "J". If the LCS recovery exceeds the lower acceptance limit, detected target compounds may be qualified "J" and non-detects may be qualified unusable (R). Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in the performance of the LCS compound to the non-LCS compound.*

3. *If more than half of the compounds in the LCS are not within the recovery criteria, then all of the associated detected target compounds may be qualified "J" and all associated non-detected target compounds may be qualified unusable (R).*

4. *It should be noted for EPA Project Officer action if a laboratory fails to analyze an LCS with each SDG, or if the reviewer has knowledge that a laboratory consistently fails to generate acceptable LCS recoveries.]*

## IX. Regional Quality Assurance and Quality Control

**A. Review Items:** Form I PEST *[Form I LCP]*, chromatograms, data system printouts, Traffic Reports and raw data for Regional QC samples.

**B. Objective:**

Regional Quality Assurance and Quality Control (QA/QC) refers to any QA and/or QC initiated by the Region, including field duplicates, Regional Performance Evaluation (PE) samples, blind spikes, and blind blanks. (It is highly recommended that Regions adopt the use of these QA/QC samples.)

**C. Criteria:**

Criteria are determined by each Region.

1. Performance Evaluation sample frequency may vary.

   *[For data generated through the Low Concentration Method: A PE sample can be included as frequently as once per SDG.]*

2. The analytes present in the PE sample must be correctly identified and quantified.

**D. Evaluation:**

Evaluation procedures must follow the Region's SOP for data review. Each Region will handle the evaluation of PE samples on an individual basis. Results for PE samples should be compared to the acceptance criteria for the specific PE samples, if available.

**E. Action:**

Any action must be in accordance with Regional specifications and the criteria for acceptable PE sample results. Unacceptable results for PE samples should be noted for EPA Project Officer action.

## X. Pesticide Cleanup Checks

**A. Review Items:** Forms IX PEST-1 *[Form IX LCP]*, Form IX PEST-2, GPC/Florisil raw data, chromatograms, and data system printouts.

**B. Objective:**

Pesticide cleanup procedures are utilized to remove matrix interferences from sample extracts prior to analysis. The use of the Florisil cartridge cleanup procedure significantly reduces matrix interferences caused by polar compounds. Gel permeation chromatography (GPC) is used to remove high molecular weight contaminants that can interfere with the analysis of target analytes. Pesticide cleanup procedures are checked by spiking the cleanup columns and cartridges, and verifying the recovery of pesticides through the cleanup procedure.

**C. Criteria:**

1. Florisil Cartridge Cleanup

   a. Florisil cartridges must be used for the cleanup of all sample extracts.

   b. Every lot number of Florisil cartridges used for sample cleanup must be checked by spiking with 2,4,5-trichlorophenol and the midpoint concentration of Individual Standard Mixture A at least once, or every six months, whichever is most frequent.

   c. The lot of Florisil cartridges is acceptable if the recoveries for all of the pesticides and surrogates in Individual Standard Mixture A are within 80 to 120 percent, the recovery of 2,4,5-trichlorophenol is less than 5 percent, and no peaks interfering with the target analytes are detected.

2. Gel Permeation Chromatography (GPC)

   a. GPC is used for the cleanup of all soil sample extracts and for water sample extracts that contain high molecular weight components that interfere with the analysis of the target analytes.

   b. At least once every 7 days, the calibration of the GPC unit must be checked by spiking with two check mixtures: the matrix spiking solution and a mixture of Aroclors 1016 and 1260.

   c. The GPC calibration is acceptable if the recovery of the pesticides in the matrix spiking solution are within 80 to 110 percent, and the Aroclor patterns should match those generated for previously run standards.

   d. A GPC blank must be analyzed after each GPC calibration and is acceptable if the blank does not exceed one-half the CRQL for any target analytes.

**D. Evaluation:**

1. Florisil Cartridge Check

   Check the data from the Florisil cartridge solution analyses and the Form IX PEST-1 *[Form IX LCP]*. Recalculate some of the percent recoveries to verify that the percent recoveries of the pesticides and surrogates in Individual Standard Mixture A are within 80 to 120 percent, the recovery of 2,4,5-trichlorophenol is less than 5 percent, and no interfering peaks are present. Compare the raw data to the reported results and verify that no calculation or transcription errors have occurred.

2. Gel Permeation Chromatography (GPC)

   Check the data from the GPC calibration check analyses and the Form IX PEST-2, and recalculate some of the percent recoveries to verify that the percent recoveries of the pesticides in the matrix spike solution are within 80 to 110 percent and that the Aroclor patterns are similar to those of previous standards. Aroclor pattern comparison within a laboratory can be checked if more than one GPC calibration was performed for that SDG. The Region may devise other means to compare this information. Check to make sure that no transcription errors have occurred.

**E. Action:**

1. If Florisil Cartridge Check criteria are not met, the raw data should be examined for the presence of polar interferences and professional judgement should be used in qualifying the data. If a laboratory analyzes samples under an unacceptable Florisil Cartridge Check, then the EPA Project Officer should be notified.

2. If Gel Permeation Criteria are not met, the raw data should be examined for the presence of high molecular weight contaminants, subsequent sample data should be examined for unusual peaks, and professional judgement should be used in qualifying the data. If a laboratory chooses to analyze samples under unacceptable Gel Permeation Criteria, then the EPA Project Officer should be notified.

3. If zero recovery was obtained for the pesticide compounds and surrogates during either check, then the non-detected target compounds may be suspect and the data may be qualified unusable (R).

4. If high recoveries (i.e., greater than 120 percent) were obtained for the pesticides and surrogates during either check, use professional judgement to qualify detected target compounds. Non detected target compounds do not require qualification.

5. Potential effects on the sample data resulting from the pesticide cleanup analyses not yielding acceptable results should be noted in the data review narrative.

## XI. Target Compound Identification

A. **Review Items:** Form I PEST *[Form I LCP]*, Form X PEST-1 *[Form X LCP-1]*, Form X PEST-2 *[Form X LCP-2]*, chromatograms, and data system printouts.

B. **Objective:**

Qualitative criteria for compound identification have been established to minimize the number of false positives (reporting a compound present when it is not) and false negatives (not reporting a compound that is present).

C. **Criteria:**

1. The retention times of both of the surrogates, matrix spikes, and reported compounds in each sample must be within the calculated retention time windows on both columns. TCX must be within ±0.05 minutes of the mean retention time determined from the initial calibration and DCB must be within ±0.10 minutes of the mean retention time determined from the initial calibration.

2. GC/MS confirmation is required if the concentration of a compound exceeds 10 ng/uL in the final sample extract. Pesticides that are confirmed by GC/MS should be identified with a "C" in the Q column on Form I PEST *[Form I LCP]*.

3. When no analytes are identified in a sample, the chromatograms from the analyses of the sample extract must use the same scaling factor as was used for the low point standard of the initial calibration associated with those analyses.

4. Chromatograms must display single component pesticides detected in the sample and the largest peak of any multicomponent analyte detected in the sample at less than full scale.

5. If an extract must be diluted, chromatograms must display single component pesticides between 10 and 100 percent of full scale, and multicomponent analytes between 25 and 100 percent of full scale.

6. For any sample, the baseline of the chromatogram must return to below 50 percent of full scale before the elution time of alpha-BHC, and also return to below 25 percent of full scale after the elution time of alpha-BHC and before the elution time of decachloro-biphenyl.

7. If a chromatogram is replotted electronically to meet these requirements, the scaling factor used must be displayed on the chromatogram, and both the initial chromatogram and the replotted chromatogram must be submitted in the data package.

**PEST**

**D. Evaluation:**

1. Review Form I PEST *[Form I LCP]*, the associated raw data (chromatograms and data system printouts) and Form X PEST- 1 *[Form X LCP-1]* and Form X PEST-2 *[Form X LCP-2]*. Confirm reported detected analytes by comparing the sample chromatograms to the tabulated results and verifying peak measurements and retention times. Confirm reported non-detected analytes by a review of the sample chromatograms. Check the associated blank data for potential interferences (to evaluate sample data for false positives) and check the calibration data for adequate retention time windows (to evaluate sample data for false positives and false negatives).

2. For multi-component target compounds (Toxaphene and Aroclors), the retention times and relative peak height ratios of major component peaks should be compared against the appropriate standard chromatograms.

3. Verify that GC/MS confirmation was performed for pesticide concentrations in the final sample extract which exceeded 10 ng/uL.

**E. Action:**

1. If the qualitative criteria for both columns were <u>not</u> met, all target compounds that are reported detected should be considered non-detected. The reviewer may need to use the qualifiers that are specific to pesticides. The reviewer should use professional judgement to assign an appropriate quantitation limit using the following guidance:

   a. If the misidentified peak was sufficiently outside the target pesticide retention time window, then the reported values may be a false positive and should be replaced with the sample CRQL value.

   b. If the misidentified peak poses an interference with potential detection of a target peak, then the reported value should be considered and qualified as unusable (R).

2. If the data reviewer identifies a peak in both GC column analyses that falls within the appropriate retention time windows, but was reported as a non-detect, then the compound may be a false negative. Professional judgement should be used to decide if the compound should be included. All conclusions made regarding target compound identification should be included in the data review narrative.

3. If multi-component target compounds exhibit marginal pattern-matching quality, professional judgement should be used to establish whether the differences are due to environmental "weathering" (i.e., degradation of the earlier eluting peaks relative to the later eluting peaks). If the presence of a multi-component pesticide is strongly suggested, results should be reported as presumptively present (N).

If an observed pattern closely matches more than one Aroclor, professional judgement should be used to decide whether the neighboring Aroclor is a better match, or if multiple Aroclors are present.

4. If GC/MS confirmation was required but not performed, the reviewer should report this for EPA Project Officer action.

## XII. Compound Quantitation and Reported CRQLS

**A. Review Items:** Form I PEST *[Form I LCP]*, Form X PEST-1 *[Form X LCP-1]*, Form X PEST-2 *[Form X LCP-2]*, sample preparation log sheets, chromatograms, SDG Narrative, and data system printouts.

**B. Objective:**

The objective is to ensure that the reported quantitative results and contract required quantitation limits (CRQLs) are accurate.

**C. Criteria:**

Compound quantitation, as well as the adjustment of the CRQL, must be calculated according to the equations provided in the method.

**D. Evaluation:**

1. Raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Data system printouts, chromatograms, and sample preparation log sheets should be compared to the reported positive sample results and quantitation limits. Verify that the sample values are reported correctly.

2. Verify that the CRQLs have been adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

**E. Action:**

1. Quantitation limits affected by large, off-scale peaks should be qualified as unusable (R). If the interference is on-scale, the reviewer can provide an approximated quantitation limit (UJ) for each affected compound.

**NOTE:** Single-peak pesticide results are checked for rough agreement between quantitative results obtained on the two GC columns. The potential for coelution should be considered and the reviewer should use professional judgment to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interfering compound is indicated, professional judgement must be used to determine how best to report, and if necessary, qualify the data. Contractually the lower of the two values is reported.

2. If there are any discrepancies found, the laboratory may be contacted by the Region's designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must decide which value is the best value. Under these circumstances, the reviewer may determine if qualification of the data is warranted. A description of the reasons for data qualification and the qualification that is applied to the data should be documented in the data review narrative.

## XIII. Overall Assessment of Data

A. **Review Items:** Entire data package, data review results, and (if available) Quality Assurance Project Plan (QAPjP), and Sampling and Analysis Plan (SAP).

B. **Objective:**

The overall assessment of a data package is a brief narrative in which the data reviewer expresses concerns and comments on the quality and, if possible, the useability of the data.

C. **Criteria:**

Assess the overall quality of the data.

Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

D. **Evaluation:**

1. Evaluate any technical problems which have not been previously addressed.

2. If appropriate information is available, the reviewer may assess the useability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the QAPjP (specifically the Data Quality Objectives), SAP, and communication with data user that concerns the intended use and desired quality of the data.

E. **Action:**

1. Use professional judgement to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief narrative to give the user an indication of the analytical limitations of the data. Any inconsistency of that data with the SDG Narrative should be noted for EPA Project Officer action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include his/her assessment of the useability of the data within the given context.

# APPENDIX J

# EPA REGION 9 PRELIMINARY REMEDIATION GOALS

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo (mg/kg-d) | | RfDo (mg/kg-d) | | SFi (mg/kg-d) | | RfDi (mg/kg-d) | | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m3) | | Tap Water (ug/l) | | Ingestion (mg/kg) | Inhalation (mg/kg) |
| 8.7E-03 | i | 4.0E-03 | i | 8.7E-03 | r | 4.0E-03 | r | 0 | 30560-19-1 | Acephate | 5.6E+01 | ca** | 2.8E+02 | ca* | 7.7E-01 | ca* | 7.7E+00 | ca* | | |
| | | | | 7.7E-03 | i | 2.6E-03 | i | 1 | 75-07-0 | Acetaldehyde | 1.1E+01 | ca** | 2.3E+01 | ca** | 8.7E-01 | ca* | 1.7E+00 | ca | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 34256-82-1 | Acetochlor | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 1 | 67-64-1 | Acetone | 1.6E+03 | nc | 6.2E+03 | nc | 3.7E+02 | nc | 6.1E+02 | nc | 1.6E+01 | 8.0E-01 |
| | | 8.0E-04 | h | | | 8.0E-04 | r | 0 | 0.1 75-86-5 | Acetone cyanohydrin | 4.9E+01 | nc | 7.0E+02 | nc | 2.9E+00 | nc | 2.9E+01 | nc | | |
| | | 6.0E-03 | x | | | 1.7E-02 | i | 1 | 75-05-8 | Acetonitrile | 2.7E+02 | nc | 1.7E+03 | nc | 6.2E+01 | nc | 7.9E+01 | nc | | |
| | | 1.0E-01 | i | | | 5.7E-06 | x | 1 | 98-86-2 | Acetophenone | 4.9E-01 | nc | 1.6E+00 | nc | 2.1E-02 | nc | 4.2E-02 | nc | | |
| 1.1E-01 | o | 1.3E-02 | i | 1.1E-01 | r | 1.3E-02 | r | 0 | 0.1 50594-66-6 | Acifluorfen | 4.4E+00 | ca | 2.2E+01 | ca | 6.1E-02 | ca | 6.1E-01 | ca | | |
| | | 2.0E-02 | h | | | 5.7E-06 | i | 1 | 107-02-8 | Acrolein | 1.0E-01 | nc | 3.4E-01 | nc | 2.1E-02 | nc | 4.2E-02 | nc | | |
| 4.6E+00 | i | 2.0E-04 | i | 4.6E+00 | i | 2.0E-04 | r | 0 | 0.1 79-06-1 | Acrylamide | 1.1E-01 | ca | 5.4E-01 | ca | 1.5E-03 | ca | 1.5E-02 | ca | | |
| | | 5.0E-01 | i | | | 2.9E-04 | i | 0 | 0.1 79-10-7 | Acrylic acid | 2.9E+04 | nc | 1.0E+05 | max | 1.0E+00 | nc | 1.8E+04 | nc | | |
| 5.4E-01 | i | 1.0E-03 | h | 2.4E-01 | i | 5.7E-04 | i | 1 | 107-13-1 | Acrylonitrile | 2.1E-01 | ca* | 5.1E-01 | ca* | 2.8E-02 | ca* | 3.9E-02 | ca* | | |
| 8.1E-02 | h | 1.0E-02 | i | 8.0E-02 | r | 1.0E-02 | r | 0 | 0.1 15972-60-8 | Alachlor | 6.0E+00 | ca | 3.1E+01 | ca | 8.4E-02 | ca | 8.4E-01 | ca | | |
| | | 1.5E-01 | i | | | 1.5E-01 | r | 0 | 0.1 1596-84-5 | Alar | 9.2E+03 | nc | 1.0E+05 | max | 5.5E+02 | nc | 5.5E+03 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 116-06-3 | Aldicarb | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 1646-88-4 | Aldicarb sulfone | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| 1.7E+01 | i | 3.0E-05 | i | 1.7E+01 | i | 3.0E-05 | r | 0 | 0.1 309-00-2 | Aldrin | 2.9E-02 | ca* | 1.5E-01 | ca | 3.9E-04 | ca | 4.0E-03 | ca | 5.0E-01 | 2.0E-02 |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 | 0.1 5585-64-8 | Ally | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 107-18-6 | Allyl alcohol | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 5.0E-02 | x | | | 2.9E-04 | i | 0 | 0.1 107-05-1 | Allyl chloride | 3.0E+03 | nc | 4.3E+04 | nc | 1.0E+00 | nc | 1.8E+03 | nc | | |
| | | 1.0E+00 | n | | | 1.4E-03 | n | 0 | 7429-90-5 | Aluminum | 7.6E+04 | nc | 1.0E+05 | max | 5.1E+00 | nc | 3.6E+04 | nc | | |
| | | 4.0E-04 | i | | | | | 0 | 20859-73-8 | Aluminum phosphide | 3.1E+01 | nc | 8.2E+02 | nc | | | 1.5E+01 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 67485-29-4 | Amdro | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 9.0E-03 | i | | | 9.0E-03 | r | 0 | 0.1 834-12-8 | Ametryn | 5.5E+02 | nc | 7.9E+03 | nc | 3.3E+01 | nc | 3.3E+02 | nc | | |
| | | 7.0E-02 | h | | | 7.0E-02 | r | 0 | 0.1 591-27-5 | m-Aminophenol | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| | | 2.0E-05 | h | | | 2.0E-05 | r | 0 | 0.1 504-24-5 | 4-Aminopyridine | 1.2E+00 | nc | 1.8E+01 | nc | 7.3E-02 | nc | 7.3E-01 | nc | | |
| | | 2.5E-03 | i | | | 2.5E-03 | r | 0 | 0.1 33089-61-1 | Amitraz | 1.5E+02 | nc | 2.2E+03 | nc | 9.1E+00 | nc | 9.1E+01 | nc | | |
| | | | | | | 2.9E-02 | i | | 7664-41-7 | Ammonia | | | | | 1.0E+02 | nc | | | | |
| | | 2.0E-01 | i | | | | | 0 | 0.1 7773-06-0 | Ammonium sulfamate | 1.2E+04 | nc | 1.0E+05 | max | | | 7.3E+03 | nc | | |
| 5.7E-03 | i | 7.0E-03 | n | 5.7E-03 | r | 2.9E-04 | i | 0 | 0.1 62-53-3 | Aniline | 8.5E+01 | ca** | 4.3E+02 | ca* | 1.0E+00 | nc | 1.2E+01 | ca* | | |
| | | 4.0E-04 | i | | | | | 0 | 7440-36-0 | Antimony and compounds | 3.1E+01 | nc | 8.2E+02 | nc | | | 1.5E+01 | nc | 5.0E+00 | 3.0E-01 |
| | | 5.0E-04 | h | | | | | 0 | 1314-60-9 | Antimony pentoxide | 3.9E+01 | nc | 1.0E+03 | nc | | | 1.8E+01 | nc | | |
| | | 9.0E-04 | h | | | | | 0 | 28300-74-5 | Antimony potassium tartrate | 7.0E+01 | nc | 1.8E+03 | nc | | | 3.3E+01 | nc | | |
| | | 4.0E-04 | h | | | | | 0 | 1332-81-6 | Antimony tetroxide | 3.1E+01 | nc | 8.2E+02 | nc | | | 1.5E+01 | nc | | |
| | | 4.0E-04 | h | | | 5.7E-05 | i | 0 | 1309-64-4 | Antimony trioxide | 3.1E+01 | nc | 8.2E+02 | nc | 2.1E-01 | nc | 1.5E+01 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 74115-24-5 | Apollo | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| 2.5E-02 | i | 5.0E-02 | h | 2.5E-02 | i | 5.0E-02 | r | 0 | 0.1 140-57-8 | Aramite | 1.9E+01 | ca | 9.9E+01 | ca | 2.7E-01 | ca | 2.7E+00 | ca | | |
| | | 3.0E-04 | i | | | | | 0 | 0.03 7440-38-2 | Arsenic (noncancer endpoint) | 2.2E+01 | nc | 4.4E+02 | nc | | | | | | |
| 1.5E+00 | i | 3.0E-04 | i | 1.5E+01 | i | | | 0 | 0.03 7440-38-2 | Arsenic (cancer endpoint) | 3.9E-01 | ca* | 2.7E+00 | ca | 4.5E-04 | ca | 4.5E-02 | ca | 2.9E+01 | 1.0E+00 |
| | | | | | | 1.4E-05 | i | 0 | 7784-42-1 | Arsine (see arsenic for cancer endpoint) | | | | | 5.2E-02 | nc | | | | |
| | | 9.0E-03 | i | | | 9.0E-03 | r | | 0.1 76578-12-6 | Assure | 5.5E+02 | nc | 7.9E+03 | nc | 3.3E+01 | nc | 3.3E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 3337-71-1 | Asulam | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| 2.2E-01 | h | 3.5E-02 | h | 2.2E-01 | r | 3.5E-02 | r | 0 | 0.1 1912-24-9 | Atrazine | 2.2E+00 | ca | 1.1E+01 | ca | 3.1E-02 | ca | 3.0E-01 | ca | | |
| | | 4.0E-04 | i | | | 4.0E-04 | r | 0 | 0.1 71751-41-2 | Avermectin B1 | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| 1.1E-01 | i | | | 1.1E-01 | i | | | 0 | 0.1 103-33-3 | Azobenzene | 4.4E+00 | ca | 2.2E+01 | ca | 6.2E-02 | ca | 6.1E-01 | ca | | |
| | | 7.0E-02 | i | | | 1.4E-04 | h | 0 | 7440-39-3 | Barium and compounds | 5.4E+03 | nc | 1.0E+05 | max | 5.2E-01 | nc | 2.6E+03 | nc | 1.6E+03 | 8.2E+01 |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 114-26-1 | Baygon | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 43121-43-3 | Bayleton | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 68359-37-5 | Baythroid | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 3.0E-01 | i | | | 3.0E-01 | r | 0 | 0.1 1861-40-1 | Benefin | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 17804-35-2 | Benomyl | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 25057-89-0 | Bentazon | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 100-52-7 | Benzaldehyde | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| 5.5E-02 | i | 3.0E-03 | n | 2.7E-02 | i | 1.7E-03 | n | 1 | 71-43-2 | **Benzene** | 6.5E-01 | ca* | 1.5E+00 | ca* | 2.5E-01 | ca* | 3.5E-01 | ca* | 3.0E-02 | 2.0E-03 |

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RfD (mg/kg-d) | | RfDo (mg/kg-d) | | RfC (mg/kg-d) | | RfDi (mg/kg-d) | | Y - yes, O - no, E - extra | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Tap Water (ug/l) | | Tap Water Soil (mg/kg) | | Soil to Groundwater (mg/kg) | Soil to Groundwater (mg/kg) |
| 2.3E+02 | i | 3.0E-03 | i | 2.3E+02 | i | 3.0E-03 | r | 0 0.1 | 92-87-5 | Benzidine | 2.1E-03 | ca | 1.1E-02 | ca | 2.9E-05 | ca | 2.9E-04 | ca | | |
| | | 4.0E+00 | i | | | 4.0E+00 | r | 0 0.1 | 65-85-0 | Benzoic acid | 1.0E+05 | max | 1.0E+05 | max | 1.5E+04 | nc | 1.5E+05 | nc | 4.0E+02 | 2.0E+01 |
| 1.3E+01 | i | | | 1.3E+01 | r | | | 0 0.1 | 98-07-7 | Benzotrichloride | 3.7E-02 | ca | 1.9E-01 | ca | 5.2E-04 | ca | 5.2E-03 | ca | | |
| | | 3.0E-01 | h | | | 3.0E-01 | r | 0 0.1 | 100-51-6 | Benzyl alcohol | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| 1.7E-01 | i | | | 1.7E-01 | r | | | 1 | 100-44-7 | Benzyl chloride | 8.9E-01 | ca | 2.3E+00 | ca | 4.0E-02 | ca | 6.6E-02 | ca | | |
| | | 2.0E-03 | i | 8.4E+00 | i | 5.7E-06 | i | 0 | 7440-41-7 | Beryllium and compounds | 1.5E+02 | nc | 2.2E+03 | ca** | 8.0E-04 | ca* | 7.3E+01 | nc | 6.3E+01 | 3.0E+00 |
| | | 1.0E-04 | i | | | 1.0E-04 | r | 0 0.1 | 141-66-2 | Bidrin | 6.1E+00 | nc | 8.8E+01 | nc | 3.7E-01 | nc | 3.6E+00 | nc | | |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 0.1 | 82657-04-3 | Biphenthrin (Talstar) | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 1 | 92-52-4 | 1,1-Biphenyl | 3.5E+02 | sat | 3.5E+02 | sat | 1.8E+02 | nc | 3.0E+02 | nc | | |
| 1.1E+00 | i | | | 1.2E+00 | i | | | 1 | 111-44-4 | Bis(2-chloroethyl)ether | 2.1E-01 | ca | 6.2E-01 | ca | 5.8E-03 | ca | 9.8E-03 | ca | 4.0E-04 | 2.0E-05 |
| 7.0E-02 | h | 4.0E-02 | i | 3.5E-02 | h | 4.0E-02 | r | 1 | 108-60-1 | Bis(2-chloroisopropyl)ether | 2.9E+00 | ca | 8.1E+00 | ca | 1.9E-01 | ca | 2.7E-01 | ca | | |
| 2.2E+02 | i | | | 2.2E+02 | i | | | 1 | 542-88-1 | Bis(chloromethyl)ether | 1.9E-04 | ca | 4.4E-04 | ca | 3.1E-05 | ca | 5.2E-05 | ca | | |
| 7.0E-02 | h | 4.0E-02 | i | 3.5E-02 | h | 4.0E-02 | r | 1 | 108-60-1 | Bis(2-chloro-1-methylethyl)ether | 2.9E+00 | ca | 8.1E+00 | ca | 1.9E-01 | ca | 2.7E-01 | ca | | |
| 1.4E-02 | i | 2.0E-02 | i | 1.4E-02 | r | 2.2E-02 | r | 0 0.1 | 117-81-7 | Bis(2-ethylhexyl)phthalate (DEHP) | 3.5E+01 | ca* | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 0.1 | 80-05-7 | Bisphenol A | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 9.0E-02 | i | | | 5.7E-03 | h | 0 0.1 | 7440-42-8 | Boron | 5.5E+03 | nc | 7.9E+04 | nc | 2.1E+01 | nc | 3.3E+03 | nc | | |
| | | | | | | 2.0E-04 | h | 0 0.1 | 7637-07-2 | Boron trifluoride | | | | | 7.3E-01 | nc | | | | |
| | | 2.0E-02 | n | | | 2.9E-03 | n | 1 | 108-86-1 | Bromobenzene | 2.8E+01 | nc | 9.2E+01 | nc | 1.0E+01 | nc | 2.0E+01 | nc | | |
| 6.2E-02 | i | 2.0E-02 | i | 6.2E-02 | r | 2.0E-02 | r | 1 | 75-27-4 | Bromodichloromethane | 1.0E+00 | ca | 2.4E+00 | ca | 1.1E-01 | ca | 1.8E-01 | ca | 6.0E-01 | 3.0E-02 |
| 7.9E-03 | i | 2.0E-02 | i | 3.9E-03 | i | 2.0E-02 | r | 0 0.1 | 75-25-2 | Bromoform (tribromomethane) | 6.2E+01 | ca* | 3.1E+02 | ca* | 1.7E+00 | ca* | 8.5E+00 | ca* | 8.0E-01 | 4.0E-02 |
| | | 1.4E-03 | i | | | 1.4E-03 | i | 1 | 74-83-9 | Bromomethane (Methyl bromide) | 3.9E+00 | nc | 1.3E+01 | nc | 5.2E+00 | nc | 8.7E+00 | nc | 2.0E-01 | 1.0E-02 |
| | | | | | | | | 0 0.1 | 101-55-3 | 4-Bromophenyl phenyl ether | | | | | | | | | | |
| | | 5.0E-03 | h | | | 5.0E-03 | r | 0 0.1 | 2104-96-3 | Bromophos | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 0.1 | 1689-84-5 | Bromoxynil | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 0.1 | 1689-99-2 | Bromoxynil octanoate | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| 1.8E+00 | r | | | 1.8E+00 | i | | | 1 | 106-99-0 | 1,3-Butadiene | 3.5E-03 | ca | 7.6E-03 | ca | 3.7E-03 | ca | 6.2E-03 | ca | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 0.1 | 71-36-3 | 1-Butanol | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | 1.7E+01 | 9.0E-01 |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 0.1 | 2008-41-5 | Butylate | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | 104-51-8 | n-Butylbenzene | 1.4E+02 | nc | 2.4E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | 135-98-8 | sec-Butylbenzene | 1.1E+02 | nc | 2.2E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | 98-06-6 | tert-Butylbenzene | 1.3E+02 | nc | 3.9E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 0.1 | 85-68-7 | Butyl benzyl phthalate | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | 9.3E+02 | 8.1E+02 |
| | | 1.0E+00 | i | | | 1.0E+00 | r | 0 0.1 | 85-70-1 | Butylphthalyl butylglycolate | 6.1E+04 | nc | 1.0E+05 | max | 3.7E+03 | nc | 3.6E+04 | nc | | |
| | | 3.0E-03 | h | | | 3.0E-03 | r | 0 0.1 | 75-60-5 | Cacodylic acid | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 5.0E-04 | i | 6.3E+00 | i | | | 0 0.001 | 7440-43-9 | Cadmium and compounds | 3.7E+01 | nc | 8.1E+02 | nc | 1.1E-03 | ca | 1.8E+01 | nc | 8.0E+00 | 4.0E-01 |
| | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 9.0E+00 | | | | | | | | | |
| | | 5.0E-01 | i | | | 5.0E-01 | r | 0 0.1 | 105-60-2 | Caprolactam | 3.1E+04 | nc | 1.0E+05 | max | 1.8E+03 | nc | 1.8E+04 | nc | | |
| 8.6E-03 | h | 2.0E-03 | i | 8.6E-03 | r | 2.0E-03 | r | 0 0.1 | 2425-06-1 | Captafol | 5.7E+01 | ca** | 2.9E+02 | ca** | 7.8E-01 | ca** | 7.8E+00 | ca** | | |
| 3.5E-03 | h | 1.3E-01 | i | 3.5E-03 | r | 1.3E-01 | r | 0 0.1 | 133-06-2 | Captan | 1.4E+02 | ca* | 7.0E+02 | ca | 1.9E+00 | ca | 1.9E+01 | ca | | |
| | | 1.0E-01 | i | | | 1.1E-01 | r | 0 0.1 | 63-25-2 | Carbaryl | 6.1E+03 | nc | 8.8E+04 | nc | 4.0E+02 | nc | 3.6E+03 | nc | | |
| 2.0E-02 | h | | | 2.0E-02 | r | | | 0 0.1 | 86-74-8 | Carbazole | 2.4E+01 | ca | 1.2E+02 | ca | 3.4E-01 | ca | 3.4E+00 | ca | 6.0E-01 | 3.0E-02 |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 0.1 | 1563-66-2 | Carbofuran | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 1.0E-01 | i | | | 2.0E-01 | i | 1 | 75-15-0 | Carbon disulfide | 3.6E+02 | nc | 7.2E+02 | sat | 7.3E+02 | nc | 1.0E+03 | nc | 3.2E+01 | 2.0E+00 |
| 1.3E-01 | i | 7.0E-04 | i | 5.3E-02 | i | 7.0E-04 | r | 1 | 56-23-5 | Carbon tetrachloride | 2.4E-01 | ca** | 5.3E-01 | ca* | 1.3E-01 | ca* | 1.7E-01 | ca* | 7.0E-02 | 3.0E-03 |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 0.1 | 55285-14-8 | Carbosulfan | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 0.1 | 5234-68-4 | Carboxin | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 0.1 | 133-90-4 | Chloramben | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| 4.0E-01 | h | | | 4.0E-01 | r | | | 0 0.1 | 118-75-2 | Chloranil | 1.2E+00 | ca | 6.1E+00 | ca | 1.7E-02 | ca | 1.7E-01 | ca | | |
| 3.5E-01 | i | 5.0E-04 | i | 3.5E-01 | i | 2.0E-04 | i | 0 0.04 | 12789-03-6 | Chlordane | 1.6E+00 | ca* | 1.1E+01 | ca* | 1.9E-02 | ca* | 1.9E-01 | ca* | 1.0E+01 | 5.0E-01 |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 0.1 | 90982-32-4 | Chlorimuron-ethyl | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.0E-01 | i | | | 5.7E-05 | n | | 7782-50-5 | **Chlorine** | | | | | 2.1E-01 | nc | | | | |
| | | | | | | 5.7E-05 | i | | 10049-04-4 | Chlorine dioxide | | | | | 2.1E-01 | nc | | | | |
| | | | | | | | | 1 | 107-20-0 | Chloroacetaldehyde | | | | | | | | | | |
| | | 2.0E-03 | h | | | 2.0E-03 | r | 0 0.1 | 79-11-8 | Chloroacetic acid | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |

# FOR PLANNING PURPOSES

| RfD (mg/kg-d) | | RfC (mg/kg-d) | | RfD (mg/kg-d) | | Cancer Slope Factor (mg/kg-d)-1 | | | CAS No. | CONTAMINANT | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Tap Water (ug/L) | | Top Water (ug/L) | | Soil to Groundwater (mg/kg) | Soil to Groundwater (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 8.6E-06 | r | | | 8.6E-06 | i | 1 | | 532-27-4 | 2-Chloroacetophenone | 3.3E-02 | nc | 1.1E-01 | nc | 3.1E-02 | nc | 5.2E-02 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 | 106-47-8 | 4-Chloroaniline | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | 7.0E-01 | 3.0E-02 |
| | | 2.0E-02 | i | | | 1.7E-02 | n | 1 | | 108-90-7 | Chlorobenzene | 1.5E+02 | nc | 5.4E+02 | nc | 6.2E+01 | nc | 1.1E+02 | nc | 1.0E+00 | 7.0E-02 |
| 2.7E-01 | h | 2.0E-02 | i | 2.7E-01 | h | 2.0E-02 | r | 0 | 0.1 | 510-15-6 | Chlorobenzilate | 1.8E+00 | ca | 9.1E+00 | ca | 2.5E-02 | ca | 2.5E-01 | ca | | |
| | | 2.0E-01 | h | | | 2.0E-01 | r | 0 | 0.1 | 74-11-3 | p-Chlorobenzoic acid | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 | 0.1 | 98-56-6 | 4-Chlorobenzotrifluoride | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-03 | h | 1 | | 126-99-8 | 2-Chloro-1,3-butadiene | 3.6E+00 | nc | 1.2E+01 | nc | 7.3E+00 | nc | 1.4E+01 | nc | | |
| | | 4.0E-01 | h | | | 4.0E-01 | r | 1 | | 109-69-3 | 1-Chlorobutane | 4.8E+02 | sat | 4.8E+02 | sat | 1.5E+03 | nc | 2.4E+03 | nc | | |
| | | 1.4E+01 | r | | | 1.4E+01 | i | 1 | | 75-68-3 | 1-Chloro-1,1-difluoroethane (HCFC-142b) | 3.4E+02 | sat | 3.4E+02 | sat | 5.2E+04 | nc | 8.7E+04 | nc | | |
| | | 1.4E+01 | r | | | 1.4E+01 | i | 1 | | 75-45-6 | Chlorodifluoromethane | 3.4E+02 | sat | 3.4E+02 | sat | 5.1E+04 | nc | 8.5E+04 | nc | | |
| 2.9E-03 | n | 4.0E-01 | n | 2.9E-03 | r | 2.9E+00 | i | 1 | | 75-00-3 | Chloroethane | 3.0E+00 | ca | 6.5E+00 | ca | 2.3E+00 | ca | 4.6E+00 | ca | | |
| | | | | | | | | 1 | | 110-75-8 | 2-Chloroethyl vinyl ether | | | | | | | | | | |
| 6.1E-03 | i | 1.0E-02 | i | 8.1E-02 | i | 8.6E-05 | n | 1 | | 67-66-3 | Chloroform | 2.4E-01 | ca** | 5.2E-01 | ca** | 8.4E-02 | ca** | 1.6E-01 | ca** | 6.0E-01 | 3.0E-02 |
| 1.3E-02 | h | | | 6.3E-03 | h | 8.6E-02 | n | 1 | | 74-87-3 | Chloromethane | 1.2E+00 | ca | 2.7E+00 | ca | 1.1E+00 | ca | 1.5E+00 | ca | | |
| 5.8E-01 | h | | | 5.8E-01 | r | | | 0 | 0.1 | 95-69-2 | 4-Chloro-2-methylaniline | 8.4E-01 | ca | 4.3E+00 | ca | 1.2E-02 | ca | 1.2E-01 | ca | | |
| 4.6E-01 | h | | | 4.6E-01 | r | | | 0 | 0.1 | 3165-93-3 | 4-Chloro-2-methylaniline hydrochloride | 1.1E+00 | ca | 5.4E+00 | ca | 1.5E-02 | ca | 1.5E-01 | ca | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 1 | | 91-58-7 | beta-Chloronaphthalene | 3.9E+03 | nc | 2.7E+04 | nc | 2.9E+02 | nc | 4.9E+02 | nc | | |
| 2.5E-02 | h | | | 2.5E-02 | r | | r | 1 | | 88-73-3 | o-Chloronitrobenzene | 8.1E+00 | ca | 2.3E+01 | ca | 2.7E-01 | ca | 4.5E-01 | ca | | |
| 1.8E-02 | h | | | 1.8E-02 | r | | r | 1 | | 100-00-5 | p-Chloronitrobenzene | 1.1E+01 | ca | 3.2E+01 | ca | 3.7E-01 | ca | 6.2E-01 | ca | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 1 | | 95-57-8 | 2-Chlorophenol | 6.3E+01 | nc | 2.4E+02 | nc | 1.8E+01 | nc | 3.0E+01 | nc | 4.0E+00 | 2.0E-01 |
| | | 2.9E-02 | r | | | 2.9E-02 | h | 1 | | 75-29-6 | 2-Chloropropane | 1.7E+02 | nc | 5.9E+02 | nc | 1.0E+02 | nc | 1.7E+02 | nc | | |
| 1.1E-02 | h | 1.5E-02 | i | 1.1E-02 | r | 1.5E-02 | r | 0 | 0.1 | 1897-45-6 | Chlorothalonil | 4.4E+01 | ca* | 2.2E+02 | ca* | 6.1E-01 | ca* | 6.1E+00 | ca* | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 1 | | 95-49-8 | o-Chlorotoluene | 1.6E+02 | nc | 5.7E+02 | nc | 7.3E+01 | nc | 1.2E+02 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | 101-21-3 | Chlorpropham | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | 2921-88-2 | Chlorpyrifos | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 0 | 0.1 | 5598-13-0 | Chlorpyrifos-methyl | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 64902-72-3 | Chlorsulfuron | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 8.0E-04 | h | | | 8.0E-04 | r | 0 | 0.1 | 60238-56-4 | Chlorthiophos | 4.9E+01 | nc | 7.0E+02 | nc | 2.9E+00 | nc | 2.9E+01 | nc | | |
| | | | | 4.2E+01 | i | | | 0 | | | Total Chromium (1:6 ratio Cr VI:Cr III) | 2.1E+02 | ca | 4.5E+02 | ca | 1.6E-04 | ca | | | 3.8E+01 | 2.0E+00 |
| | | 1.5E+00 | i | | | | | | | 16065-83-1 | Chromium III | 1.0E+05 | max | 1.0E+05 | max | 0.0E+00 | | 5.5E+04 | nc | | |
| | | 3.0E-03 | i | 2.9E+02 | i | | | 0 | | 18540-29-9 | Chromium VI | 3.0E+01 | ca** | 6.4E+01 | ca | 2.3E-05 | ca | 1.1E+02 | nc | 3.8E+01 | 2.0E+00 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 2.0E-01 | | | | | | 1.6E-01 | | | |
| | | 6.0E-02 | n | | | | | | | 7440-48-4 | Cobalt | 4.7E+03 | nc | 1.0E+05 | max | | | 2.2E+03 | nc | | |
| | | | | 2.2E+00 | i | | | 0 | | 8007-45-2 | Coke Oven Emissions | | | | | 3.1E-03 | ca | | | | |
| | | 3.7E-02 | h | | | | | 0 | | 7440-50-8 | Copper and compounds | 2.9E+03 | nc | 7.6E+04 | nc | | | 1.4E+03 | nc | | |
| 1.9E+00 | h | | | 1.9E+00 | r | | | 1 | | 123-73-9 | Crotonaldehyde | 5.3E-03 | ca | 1.1E-02 | ca | 3.5E-03 | ca | 5.9E-03 | ca | | |
| | | 1.0E-01 | i | | | 1.1E-01 | i | 1 | | 98-82-8 | Cumene (isopropylbenzene) | 1.6E+02 | nc | 5.2E+02 | nc | 4.0E+02 | nc | 6.6E+02 | nc | | |
| 8.4E-01 | h | 2.0E-03 | h | 8.4E-01 | r | 2.0E-03 | r | 0 | 0.1 | 21725-46-2 | Cyanazine | 5.8E-01 | ca | 2.9E+00 | ca | 8.0E-03 | ca | 8.0E-02 | ca | | |
| | | 2.0E-02 | i | | | 8.6E-04 | i | 1 | | 74-90-8 | Cyanide and compounds | 1.1E+01 | nc | 3.5E+01 | nc | 3.1E+00 | nc | 6.2E+00 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 1 | | 460-19-5 | Cyanogen | 1.3E+02 | nc | 4.3E+02 | nc | 1.5E+02 | nc | 2.4E+02 | nc | | |
| | | 9.0E-02 | i | | | 9.0E-02 | r | 1 | | 506-68-3 | Cyanogen bromide | 2.9E+02 | nc | 9.7E+02 | nc | 3.3E+02 | nc | 5.5E+02 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 1 | | 506-77-4 | Cyanogen chloride | 1.6E+02 | nc | 5.4E+02 | nc | 1.8E+02 | nc | 3.0E+02 | nc | | |
| | | 5.7E+00 | r | | | 5.7E+00 | n | 1 | | 110-82-7 | **Cyclohexane** | 1.4E+02 | sat | 1.4E+02 | sat | 2.1E+04 | nc | 3.5E+04 | nc | | |
| | | 5.0E+00 | i | | | 5.0E+00 | r | 0 | 0.1 | 108-94-1 | Cyclohexanone | 1.0E+05 | max | 1.0E+05 | max | 1.8E+04 | nc | 1.8E+05 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | 108-91-8 | Cyclohexylamine | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 68085-85-8 | Cyhalothrin/Karate | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 52315-07-8 | Cypermethrin | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 7.5E-03 | i | | | 7.5E-03 | r | 0 | 0.1 | 66215-27-8 | Cyromazine | 4.6E+02 | nc | 6.6E+03 | nc | 2.7E+01 | nc | 2.7E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 1861-32-1 | Dacthal | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 75-99-0 | Dalapon | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 39515-41-8 | Danitol | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| 2.4E-01 | i | | | 2.4E-01 | r | | | 0 | 0.03 | 72-54-8 | DDD | 2.4E+00 | ca | 1.7E+01 | ca | 2.8E-02 | ca | 2.8E-01 | ca | 1.6E+01 | 8.0E-01 |
| 3.4E-01 | i | | | 3.4E-01 | r | | | 0 | 0.03 | 72-55-9 | DDE | 1.7E+00 | ca | 1.2E+01 | ca | 2.0E-02 | ca | 2.0E-01 | ca | 5.4E+01 | 3.0E+00 |
| 3.4E-01 | i | 5.0E-04 | i | 3.4E-01 | i | 5.0E-04 | r | 0 | 0.03 | 50-29-3 | DDT | 1.7E+00 | ca* | 1.2E+01 | ca* | 2.0E-02 | ca* | 2.0E-01 | ca* | 3.2E+01 | 2.0E+00 |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | | 1163-19-5 | Decabromodiphenyl ether | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 4.0E-05 | i | | | 4.0E-05 | r | 0 | 0.1 | | 8065-48-3 | Demeton | 2.4E+00 | nc | 3.5E+01 | nc | 1.5E-01 | nc | 1.5E+00 | nc | | |
| 6.1E-02 | h | | | 6.1E-02 | r | | | 0 | 0.1 | | 2303-16-4 | Diallate | 8.0E+00 | ca | 4.0E+01 | ca | 1.1E-01 | ca | 1.1E+00 | ca | | |
| | | 9.0E-04 | h | | | 9.0E-04 | r | 0 | 0.1 | | 333-41-5 | Diazinon | 5.5E+01 | nc | 7.9E+02 | nc | 3.3E+00 | nc | 3.3E+01 | nc | | |
| | | 4.0E-03 | n | | | 4.0E-03 | r | 1 | | | 132-64-9 | Dibenzofuran | 2.9E+02 | nc | 5.1E+03 | nc | 1.5E+01 | nc | 2.4E+01 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | | 106-37-6 | 1,4-Dibromobenzene | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 8.4E-02 | i | 2.0E-02 | i | 8.4E-02 | r | 2.0E-02 | r | 1 | | | 124-48-1 | Dibromochloromethane | 1.1E+00 | ca | 2.7E+00 | ca | 8.0E-02 | ca | 1.3E-01 | ca | 4.0E-01 | 2.0E-02 |
| 1.4E+00 | h | 5.7E-05 | r | 2.4E-03 | h | 5.7E-05 | i | 1 | | | 96-12-8 | 1,2-Dibromo-3-chloropropane | 4.5E-01 | ca** | 4.0E+00 | ca** | 2.1E-01 | nc | 4.8E-02 | ca** | | |
| | | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 6.0E-02 | | | | 9.6E-04 | | 4.7E-03 | | | |
| 8.5E+01 | i | 5.7E-05 | r | 7.7E-01 | i | 5.7E-05 | h | 1 | | | 106-93-4 | 1,2-Dibromoethane | 6.9E-03 | ca | 4.8E-02 | ca* | 8.7E-03 | ca* | 7.6E-04 | ca | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | | 84-74-2 | Dibutyl phthalate | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | 2.3E+03 | 2.7E+02 |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | | 1918-00-9 | Dicamba | | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 9.0E-02 | i | | | 5.7E-02 | h | 1 | | | 95-50-1 | 1,2-Dichlorobenzene | 3.7E+02 | sat | 3.7E+02 | sat | 2.1E+02 | nc | 3.7E+02 | nc | 1.7E+01 | 9.0E-01 |
| | | 9.0E-04 | n | | | 9.0E-04 | r | 1 | | | 541-73-1 | 1,3-Dichlorobenzene | 1.3E+01 | nc | 5.2E+01 | nc | 3.3E+00 | nc | 5.5E+00 | nc | | |
| 2.4E-02 | h | 3.0E-02 | n | 2.2E-02 | n | 2.3E-01 | i | 1 | | | 106-46-7 | 1,4-Dichlorobenzene | 3.4E+00 | ca | 8.1E+00 | ca | 3.1E-01 | ca | 5.0E-01 | ca | 2.0E+00 | 1.0E-01 |
| 4.5E-01 | i | | | 4.5E-01 | r | | | 0 | 0.1 | | 91-94-1 | 3,3-Dichlorobenzidine | 1.1E+00 | ca | 5.5E+00 | ca | 1.5E-02 | ca | 1.5E-01 | ca | 7.0E-03 | 3.0E-04 |
| | | 3.0E-02 | n | | | 3.0E-02 | r | | 0.1 | | 90-98-2 | **4,4'-Dichlorobenzophenone** | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 9.3E+00 | r | | | 9.3E+00 | h | | | 1 | | | 764-41-0 | 1,4-Dichloro-2-butene | 7.9E-03 | ca | 1.8E-02 | ca | 7.2E-04 | ca | 1.2E-03 | ca | | |
| | | 2.0E-01 | i | | | 5.7E-02 | h | 1 | | | 75-71-8 | Dichlorodifluoromethane | 9.4E+01 | nc | 3.1E+02 | nc | 2.1E+02 | nc | 3.9E+02 | nc | | |
| | | 1.0E-01 | h | | | 1.4E-01 | h | 1 | | | 75-34-3 | 1,1-Dichloroethane | 5.9E+02 | nc | 2.1E+03 | nc | 5.2E+02 | nc | 8.1E+02 | nc | 2.3E+01 | 1.0E+00 |
| 5.7E-03 | | | | 5.7E-03 | | | | 1 | | | | **"CAL-Modified PRG"** | 3.3E+00 | ca | 7.1E+00 | ca | 1.2E+00 | ca | 2.0E+00 | ca | | |
| 9.1E-02 | i | 3.0E-02 | n | 9.1E-02 | i | 1.4E-03 | n | 1 | | | 107-06-2 | 1,2-Dichloroethane (EDC) | 3.5E-01 | ca* | 7.6E-01 | ca* | 7.4E-02 | ca* | 1.2E-01 | ca* | 2.0E-02 | 1.0E-03 |
| 6.0E-01 | i | 9.0E-03 | i | 1.8E-01 | i | 9.0E-03 | r | 1 | | | 75-35-4 | 1,1-Dichloroethylene | 5.4E-02 | ca | 1.2E-01 | ca | 3.8E-02 | ca | 4.6E-02 | ca | 6.0E-02 | 3.0E-03 |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | | 156-59-2 | 1,2-Dichloroethylene (cis) | 4.3E+01 | nc | 1.5E+02 | nc | 3.7E+01 | nc | 6.1E+01 | nc | 4.0E-01 | 2.0E-02 |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 1 | | | 156-60-5 | 1,2-Dichloroethylene (trans) | 6.3E+01 | nc | 2.1E+02 | nc | 7.3E+01 | nc | 1.2E+02 | nc | 7.0E-01 | 3.0E-02 |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | | 120-83-2 | 2,4-Dichlorophenol | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | 1.0E+00 | 5.0E-02 |
| | | 8.0E-03 | i | | | 8.0E-03 | r | 0 | 0.1 | | 94-82-6 | 4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB) | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.05 | | 94-75-7 | 2,4-Dichlorophenoxyacetic Acid (2,4-D) | 6.9E+02 | nc | 1.2E+04 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 6.8E-02 | h | 1.1E-03 | r | 6.8E-02 | r | 1.1E-03 | i | 1 | | | 78-87-5 | 1,2-Dichloropropane | 3.5E-01 | ca* | 7.7E-01 | ca* | 9.9E-02 | ca* | 1.6E-01 | ca* | 3.0E-02 | 1.0E-03 |
| 1.0E-01 | i | 3.0E-02 | i | 1.4E-02 | i | 5.7E-03 | i | 1 | | | 542-75-6 | **1,3-Dichloropropene** | 7.0E-01 | ca | 1.6E+00 | ca | 4.8E-01 | ca | 4.0E-01 | ca | 4.0E-03 | 2.0E-04 |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | | 616-23-9 | 2,3-Dichloropropanol | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| 2.9E-01 | i | 5.0E-04 | i | 2.9E-01 | r | 1.4E-04 | i | 0 | 0.1 | | 62-73-7 | Dichlorvos | 1.7E+00 | ca* | 8.5E+00 | ca* | 2.3E-02 | ca* | 2.3E-01 | ca* | | |
| 4.4E-01 | x | | | 4.4E-01 | r | | | 0 | 0.1 | | 115-32-2 | Dicofol | 1.1E+00 | ca | 5.6E+00 | ca | 1.5E-02 | ca | 1.5E-01 | ca | | |
| | | 3.0E-02 | h | | | 5.7E-05 | h | 1 | | | 77-73-6 | Dicyclopentadiene | 5.4E-01 | nc | 1.8E+00 | nc | 2.1E-01 | nc | 4.2E-01 | nc | | |
| 1.6E+01 | i | 5.0E-05 | i | 1.6E+01 | i | 5.0E-05 | r | 0 | 0.1 | | 60-57-1 | Dieldrin | 3.0E-02 | ca | 1.5E-01 | ca | 4.2E-04 | ca | 4.2E-03 | ca | 4.0E-03 | 2.0E-04 |
| | | 5.7E-03 | r | | | 5.7E-03 | h | 0 | 0.1 | | 112-34-5 | Diethylene glycol, monobutyl ether | 3.5E+02 | nc | 5.0E+03 | nc | 2.1E+01 | nc | 2.1E+02 | nc | | |
| | | 2.0E+00 | h | | | 2.0E+00 | r | 0 | 0.1 | | 111-90-0 | Diethylene glycol, monoethyl ether | 1.0E+05 | max | 1.0E+05 | max | 7.3E+03 | nc | 7.3E+04 | nc | | |
| | | 1.1E-02 | h | | | 1.1E-02 | r | 0 | 0.1 | | 617-84-5 | Diethylformamide | 6.7E+02 | nc | 9.7E+03 | nc | 4.0E+01 | nc | 4.0E+02 | nc | | |
| 1.2E-03 | i | 6.0E-01 | i | 1.2E-03 | r | 6.0E-01 | r | 0 | 0.1 | | 103-23-1 | Di(2-ethylhexyl)adipate | 4.1E+02 | ca | 2.1E+03 | ca | 5.6E+00 | ca | 5.6E+01 | ca | | |
| | | 8.0E-01 | i | | | 8.0E-01 | r | 0 | 0.1 | | 84-66-2 | Diethyl phthalate | 4.9E+04 | nc | 1.0E+05 | max | 2.9E+03 | nc | 2.9E+04 | nc | | |
| 4.7E+03 | h | | | 4.7E+03 | r | | | 0 | 0.1 | | 56-53-1 | Diethylstilbestrol | 1.0E-04 | ca | 5.2E-04 | ca | 1.4E-06 | ca | 1.4E-05 | ca | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | | 43222-48-6 | Difenzoquat (Avenge) | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | | 35367-38-5 | Diflubenzuron | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.1E+01 | r | | | 1.1E+01 | i | 1 | | | 75-37-6 | 1,1-Difluoroethane | | | | | 4.2E+04 | nc | 6.9E+04 | nc | | |
| | | 2.0E-02 | n | | | 2.0E-02 | r | | 0.1 | | 28553-12-0 | **Diisononyl phthalate** | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | | 1445-75-6 | Diisopropyl methylphosphonate | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | | 55290-64-7 | Dimethipin | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-04 | i | | | 2.0E-04 | r | 0 | 0.1 | | 60-51-5 | Dimethoate | 1.2E+01 | nc | 1.8E+02 | nc | 7.3E-01 | nc | 7.3E+00 | nc | | |
| 1.4E-02 | h | | | 1.4E-02 | r | | | 0 | 0.1 | | 119-90-4 | 3,3'-Dimethoxybenzidine | 3.5E+01 | ca | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 5.7E-06 | r | | | 5.7E-06 | x | 1 | | | 124-40-3 | Dimethylamine | 6.7E-02 | nc | 2.5E-01 | nc | 2.1E-02 | nc | 3.5E-02 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | | 121-69-7 | N-N-Dimethylaniline | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| 7.5E-01 | h | | | 7.5E-01 | r | | | 0 | 0.1 | | 95-68-1 | 2,4-Dimethylaniline | 6.5E-01 | ca | 3.3E+00 | ca | 9.0E-03 | ca | 9.0E-02 | ca | | |
| 5.8E-01 | h | | | 5.8E-01 | r | | | 0 | 0.1 | | 21436-96-4 | 2,4-Dimethylaniline hydrochloride | 8.4E-01 | ca | 4.3E+00 | ca | 1.2E-02 | ca | 1.2E-01 | ca | | |
| 9.2E+00 | h | | | 9.2E+00 | r | | | 0 | 0.1 | | 119-93-7 | 3,3'-Dimethylbenzidine | 5.3E-02 | ca | 2.7E-01 | ca | 7.3E-04 | ca | 7.3E-03 | ca | | |

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | |
| 2.6E+00 | x | | 3.5E+00 | x | | | 0 | 0.1 | | 57-14-7 | | 1,1-Dimethylhydrazine | 1.9E-01 | ca | 9.5E-01 | ca | 1.9E-03 | ca | 2.6E-02 | ca | | |
| 3.7E+01 | x | | 3.7E+01 | x | | | 0 | 0.1 | | 540-73-8 | | 1,2-Dimethylhydrazine | 1.3E-02 | ca | 6.7E-02 | ca | 1.8E-04 | ca | 1.8E-03 | ca | | |
| | | 1.0E-01 | h | | 8.6E-03 | i | 0 | 0.1 | | 68-12-2 | | N,N-Dimethylformamide | 6.1E+03 | nc | 8.8E+04 | nc | 3.1E+01 | nc | 3.6E+03 | nc | | |
| | | 1.0E-03 | n | | 1.0E-03 | r | 0 | 0.1 | | 122-09-8 | | Dimethylphenethylamine | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.0E-02 | i | | 2.0E-02 | r | 0 | 0.1 | | 105-67-9 | | 2,4-Dimethylphenol | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | 9.0E+00 | 4.0E-01 |
| | | 6.0E-04 | i | | 6.0E-04 | r | 0 | 0.1 | | 576-26-1 | | 2,6-Dimethylphenol | 3.7E+01 | nc | 5.3E+02 | nc | 2.2E+00 | nc | 2.2E+01 | nc | | |
| | | 1.0E-03 | i | | 1.0E-03 | r | 0 | 0.1 | | 95-65-8 | | 3,4-Dimethylphenol | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 1.0E+01 | x | | 1.0E+01 | r | 0 | 0.1 | | 131-11-3 | | Dimethyl phthalate | 1.0E+05 | max | 1.0E+05 | max | 3.7E+04 | nc | 3.6E+05 | nc | | |
| | | 1.0E-01 | i | | 1.0E-01 | r | 0 | 0.1 | | 120-61-6 | | Dimethyl terephthalate | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 2.0E-03 | i | | 2.0E-03 | r | 0 | 0.1 | | 131-89-5 | | 4,6-Dinitro-o-cyclohexyl phenol | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 4.0E-04 | h | | 4.0E-04 | r | 0 | 0.1 | | 528-29-0 | | 1,2-Dinitrobenzene | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| | | 1.0E-04 | i | | 1.0E-04 | r | 0 | 0.1 | | 99-65-0 | | 1,3-Dinitrobenzene | 6.1E+00 | nc | 8.8E+01 | nc | 3.7E-01 | nc | 3.6E+00 | nc | | |
| | | 4.0E-04 | h | | 4.0E-04 | r | 0 | 0.1 | | 100-25-4 | | 1,4-Dinitrobenzene | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| | | 2.0E-03 | i | | 2.0E-03 | r | 0 | 0.1 | | 51-28-5 | | 2,4-Dinitrophenol | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | 3.0E-01 | 1.0E-02 |
| 6.8E-01 | i | | 6.8E-01 | r | | | 0 | 0.1 | | 25321-14-6 | | Dinitrotoluene mixture | 7.2E-01 | ca | 3.6E+00 | ca | 9.9E-03 | ca | 9.9E-02 | ca | 8.0E-04 | 4.0E-05 |
| | | 2.0E-03 | i | | 2.0E-03 | r | 0 | 0.1 | | 121-14-2 | | 2,4-Dinitrotoluene (see Dinitrotoluene mixture) | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | 8.0E-04 | 4.0E-05 |
| | | 1.0E-03 | h | | 1.0E-03 | r | 0 | 0.1 | | 606-20-2 | | 2,6-Dinitrotoluene (see Dinitrotoluene mixture) | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | 7.0E-04 | 3.0E-05 |
| | | 1.0E-03 | i | | 1.0E-03 | r | 0 | 0.1 | | 88-85-7 | | Dinoseb | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.0E-02 | h | | 2.0E-02 | r | 0 | 0.1 | | 117-84-0 | | di-n-Octyl phthalate | 1.2E+03 | nc | 1.0E+04 | sat | 7.3E+01 | nc | 7.3E+02 | nc | 1.0E+04 | 1.0E+04 |
| 1.1E-02 | i | | 1.1E-02 | r | | | 0 | 0.1 | | 123-91-1 | | 1,4-Dioxane | 4.4E+01 | ca | 2.2E+02 | ca | 6.1E-01 | ca | 6.1E+00 | ca | | |
| 1.5E+05 | h | | 1.5E+05 | h | | | 0 | 0.03 | | 1746-01-6 | | Dioxin (2,3,7,8-TCDD) | 3.9E-06 | ca | 2.7E-05 | ca | 4.5E-08 | ca | 4.5E-07 | ca | | |
| | | 3.0E-02 | i | | 3.0E-02 | r | 0 | 0.1 | | 957-51-7 | | Diphenamid | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 2.5E-02 | i | | 2.5E-02 | r | 0 | 0.1 | | 122-39-4 | | Diphenylamine | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 3.0E-04 | n | | 3.0E-04 | r | | 0.1 | | 74-31-7 | | **N,N-Diphenyl-1,4 benzenediamine (DPPD)** | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| 8.0E-01 | i | | 7.7E-01 | i | | | 0 | 0.1 | | 122-66-7 | | 1,2-Diphenylhydrazine | 6.1E-01 | ca | 3.1E+00 | ca | 8.7E-03 | ca | 8.4E-02 | ca | | |
| | | 9.0E-03 | n | | 9.0E-03 | r | 0 | 0.1 | | 127-63-9 | | Diphenyl sulfone | 5.5E+02 | nc | 7.9E+03 | nc | 3.3E+01 | nc | 3.3E+02 | nc | | |
| | | 2.2E-03 | i | | 2.2E-03 | r | 0 | 0.1 | | 85-00-7 | | Diquat | 1.3E+02 | nc | 1.9E+03 | nc | 8.0E+00 | nc | 8.0E+01 | nc | | |
| 8.6E+00 | h | | 8.6E+00 | r | | | 0 | 0.1 | | 1937-37-7 | | Direct black 38 | 5.7E-02 | ca | 2.9E-01 | ca | 7.8E-04 | ca | 7.8E-03 | ca | | |
| 8.1E+00 | h | | 8.1E+00 | r | | | 0 | 0.1 | | 2602-46-2 | | Direct blue 6 | 6.0E-02 | ca | 3.0E-01 | ca | 8.3E-04 | ca | 8.3E-03 | ca | | |
| 9.3E+00 | h | | 9.3E+00 | r | | | 0 | 0.1 | | 16071-86-6 | | Direct brown 95 | 5.2E-02 | ca | 2.7E-01 | ca | 7.2E-04 | ca | 7.2E-03 | ca | | |
| | | 4.0E-05 | i | | 4.0E-05 | r | 0 | 0.1 | | 298-04-4 | | Disulfoton | 2.4E+00 | nc | 3.5E+01 | nc | 1.5E-01 | nc | 1.5E+00 | nc | | |
| | | 1.0E-02 | i | | 1.0E-02 | r | 0 | 0.1 | | 505-29-3 | | 1,4-Dithiane | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 2.0E-03 | i | | 2.0E-03 | r | 0 | 0.1 | | 330-54-1 | | Diuron | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 4.0E-03 | i | | 4.0E-03 | r | 0 | 0.1 | | 2439-10-3 | | Dodine | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 2.0E-01 | n | | | | | | | 7429-91-6 | | **Dysprosium** | 1.6E+04 | nc | 1.0E+05 | max | | | 7.3E+03 | nc | | |
| | | 6.0E-03 | i | | 6.0E-03 | r | 0 | 0.1 | | 115-29-7 | | Endosulfan | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | 1.8E+01 | 9.0E-01 |
| | | 2.0E-02 | i | | 2.0E-02 | r | 0 | 0.1 | | 145-73-3 | | Endothall | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 3.0E-04 | i | | 3.0E-04 | r | 0 | 0.1 | | 72-20-8 | | Endrin | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | 1.0E+00 | 5.0E-02 |
| 9.9E-03 | i | 2.0E-03 | h | 4.2E-03 | i | 2.9E-04 | i | 1 | | 106-89-8 | | Epichlorohydrin | 7.6E+00 | nc | 2.6E+01 | nc | 1.0E+00 | nc | 2.0E+00 | nc | | |
| | | 5.7E-03 | r | | 5.7E-03 | i | 0 | 0.1 | | 106-88-7 | | 1,2-Epoxybutane | 3.5E+02 | nc | 5.0E+03 | nc | 2.1E+01 | nc | 2.1E+02 | nc | | |
| | | 2.5E-02 | i | | 2.5E-02 | r | 0 | 0.1 | | 759-94-4 | | EPTC (S-Ethyl dipropylthiocarbamate) | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 5.0E-03 | i | | 5.0E-03 | r | 0 | 0.1 | | 16672-87-0 | | Ethephon (2-chloroethyl phosphonic acid) | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 5.0E-04 | i | | 5.0E-04 | r | 0 | 0.1 | | 563-12-2 | | Ethion | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| | | 4.0E-01 | h | | 5.7E-02 | i | 0 | 0.1 | | 110-80-5 | | 2-Ethoxyethanol | 2.4E+04 | nc | 1.0E+05 | max | 2.1E+02 | nc | 1.5E+04 | nc | | |
| | | 3.0E-01 | h | | 3.0E-01 | r | 0 | 0.1 | | 111-15-9 | | 2-Ethoxyethanol acetate | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| | | 9.0E-01 | i | | 9.0E-01 | r | 1 | | | 141-78-6 | | Ethyl acetate | 1.9E+04 | nc | 3.7E+04 | sat | 3.3E+03 | nc | 5.5E+03 | nc | | |
| 4.8E-02 | h | | 4.8E-02 | r | | | 1 | | | 140-88-5 | | Ethyl acrylate | 2.1E-01 | ca | 4.5E-01 | ca | 1.4E-01 | ca | 2.3E-01 | ca | | |
| | | 1.0E-01 | i | | 2.9E-01 | i | 1 | | | 100-41-4 | | Ethylbenzene | 2.3E+02 | sat | 2.3E+02 | sat | 1.1E+03 | nc | 1.3E+03 | nc | 1.3E+01 | 7.0E-01 |
| 2.9E-03 | n | 4.0E-01 | n | 2.9E-03 | r | 2.9E+00 | i | 1 | | 75-00-3 | | Ethyl chloride | 3.0E+00 | ca | 6.5E+00 | ca | 2.3E+00 | ca | 4.6E+00 | ca | | |
| | | 3.0E-01 | h | | | 3.0E-01 | r | 0 | 0.1 | 109-78-4 | | Ethylene cyanohydrin | 1.8E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.1E+04 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 | 0.1 | 107-15-3 | | Ethylene diamine | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E+00 | i | | | 2.0E+00 | r | 0 | 0.1 | 107-21-1 | | Ethylene glycol | 1.0E+05 | max | 1.0E+05 | max | 7.3E+03 | nc | 7.3E+04 | nc | | |
| | | 5.0E-01 | i | | | 3.7E+00 | i | 0 | 0.1 | 111-76-2 | | **Ethylene glycol, monobutyl ether** | 3.1E+04 | nc | 1.0E+05 | max | 1.4E+04 | nc | 1.8E+04 | nc | | |
| 1.0E+00 | h | | 3.5E-01 | h | | | 1 | | | 75-21-8 | | Ethylene oxide | 1.4E-01 | ca | 3.6E-01 | ca | 1.9E-02 | ca | 2.4E-02 | ca | | |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | CAS No. | | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 1.1E-01 | h | 8.0E-05 | i | 1.1E-01 | r | 8.0E-05 | r | 0 | 0.1 | 96-45-7 | | Ethylene thiourea (ETU) | 4.4E+00 | ca** | 2.2E+01 | ca** | 6.1E-02 | ca** | 6.1E-01 | ca** | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 1 | | 60-29-7 | | Ethyl ether | 1.8E+03 | sat | 1.8E+03 | sat | 7.3E+02 | nc | 1.2E+03 | nc | | |
| | | 9.0E-02 | h | | | 9.0E-02 | r | 1 | | 97-63-2 | | Ethyl methacrylate | 1.4E+02 | sat | 1.4E+02 | sat | 3.3E+02 | nc | 5.5E+02 | nc | | |
| | | 1.0E-05 | i | | | 1.0E-05 | r | 0 | 0.1 | 2104-64-5 | | Ethyl p-nitrophenyl phenylphosphorothioate | 6.1E-01 | nc | 8.8E+00 | nc | 3.7E-02 | nc | 3.6E-01 | nc | | |
| | | 3.0E+00 | i | | | 3.0E+00 | r | 0 | 0.1 | 84-72-0 | | Ethylphthalyl ethyl glycolate | 1.0E+05 | max | 1.0E+05 | max | 1.1E+04 | nc | 1.1E+05 | nc | | |
| | | 8.0E-03 | i | | | 8.0E-03 | r | 0 | 0.1 | 101200-48-0 | | Express | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| | | 2.5E-04 | i | | | 2.5E-04 | r | 0 | 0.1 | 22224-92-6 | | Fenamiphos | 1.5E+01 | nc | 2.2E+02 | nc | 9.1E-01 | nc | 9.1E+00 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 2164-17-2 | | Fluometuron | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 6.0E-02 | i | | | | | 0 | 0.1 | 16984-48-8 | | Flouride | 3.7E+03 | nc | 5.3E+04 | nc | | | 2.2E+03 | nc | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | 59756-60-4 | | Fluoridone | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 56425-91-3 | | Flurprimidol | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 6.0E-02 | i | | | 6.0E-02 | r | 0 | 0.1 | 66332-96-5 | | Flutolanil | 3.7E+03 | nc | 5.3E+04 | nc | 2.2E+02 | nc | 2.2E+03 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 69409-94-5 | | Fluvalinate | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 3.5E-03 | i | 1.0E-01 | i | 3.5E-03 | r | 1.0E-01 | r | 0 | 0.1 | 133-07-3 | | Folpet | 1.4E+02 | ca* | 7.0E+02 | ca | 1.9E+00 | ca | 1.9E+01 | ca | | |
| 1.9E-01 | i | | | 1.9E-01 | r | | | 0 | 0.1 | 72178-02-0 | | Fomesafen | 2.6E+00 | ca | 1.3E+01 | ca | 3.5E-02 | ca | 3.5E-01 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 944-22-9 | | Fonofos | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 1.5E-01 | i | 4.6E-02 | i | | | 0 | 0.1 | 50-00-0 | | Formaldehyde | 9.2E+03 | nc | 1.0E+05 | nc | 1.5E-01 | ca | 5.5E+03 | nc | | |
| | | 2.0E+00 | h | | | 2.0E+00 | r | 0 | 0.1 | 64-18-6 | | Formic Acid | 1.0E+05 | max | 1.0E+05 | max | 7.3E+03 | nc | 7.3E+04 | nc | | |
| | | 3.0E+00 | i | | | 3.0E+00 | r | 0 | 0.1 | 39148-24-8 | | Fosetyl-al | 1.0E+05 | max | 1.0E+05 | max | 1.1E+04 | nc | 1.1E+05 | nc | | |
| | | 3.0E+01 | i | | | 8.6E+00 | h | 1 | | 76-13-1 | | Freon 113 | 5.6E+03 | sat | 5.6E+03 | sat | 3.1E+04 | nc | 5.9E+04 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 1 | | 110-00-9 | | Furan | 2.5E+00 | nc | 8.5E+00 | nc | 3.7E+00 | nc | 6.1E+00 | nc | | |
| 3.8E+00 | h | | | 3.8E+00 | r | | | 0 | 0.1 | 67-45-8 | | Furazolidone | 1.3E-01 | nc | 6.5E-01 | nc | 1.8E-03 | nc | 1.8E-02 | ca | | |
| | | 3.0E-03 | i | | | 1.4E-02 | h | 0 | 0.1 | 98-01-1 | | Furfural | 1.8E+02 | nc | 2.6E+03 | nc | 5.2E+01 | nc | 1.1E+02 | nc | | |
| 5.0E+01 | h | | | 5.0E+01 | r | | | 0 | 0.1 | 531-82-8 | | Furium | 9.7E-03 | ca | 4.9E-02 | ca | 1.3E-04 | ca | 1.3E-03 | ca | | |
| 3.0E-02 | i | | | 3.0E-02 | r | | | 0 | 0.1 | 60568-05-0 | | Furmecyclox | 1.6E+01 | ca | 8.2E+01 | ca | 2.2E-01 | ca | 2.2E+00 | ca | | |
| | | 4.0E-04 | i | | | 4.0E-04 | r | 0 | 0.1 | 77182-82-2 | | Glufosinate-ammonium | 2.4E+01 | nc | 3.5E+02 | nc | 1.5E+00 | nc | 1.5E+01 | nc | | |
| | | 4.0E-04 | i | | | 2.9E-04 | h | 0 | 0.1 | 765-34-4 | | Glycidaldehyde | 2.4E+01 | nc | 3.5E+02 | nc | 1.0E+00 | nc | 1.5E+01 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 1071-83-6 | | Glyphosate | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 5.0E-05 | i | | | 5.0E-05 | r | 0 | 0.1 | 69806-40-2 | | Haloxyfop-methyl | 3.1E+00 | nc | 4.4E+01 | nc | 1.8E-01 | nc | 1.8E+00 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 79277-27-3 | | Harmony | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| 4.5E+00 | i | 5.0E-04 | i | 4.6E+00 | i | 5.0E-04 | r | 0 | 0.1 | 76-44-8 | | Heptachlor | 1.1E-01 | ca | 5.5E-01 | ca | 1.5E-03 | ca | 1.5E-02 | ca | 2.3E+01 | 1.0E+00 |
| 9.1E+00 | i | 1.3E-05 | i | 9.1E+00 | i | 1.3E-05 | r | 0 | 0.1 | 1024-57-3 | | Heptachlor epoxide | 5.3E-02 | ca* | 2.7E-01 | ca* | 7.4E-04 | ca* | 7.4E-03 | ca* | 7.0E-01 | 3.0E-02 |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 87-82-1 | | Hexabromobenzene | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| 1.6E+00 | i | 8.0E-04 | i | 1.6E+00 | i | 8.0E-04 | r | 0 | 0.1 | 118-74-1 | | Hexachlorobenzene | 3.0E-01 | ca | 1.5E+00 | ca | 4.2E-03 | ca | 4.2E-02 | ca | 2.0E+00 | 1.0E-01 |
| 7.8E-02 | i | 3.0E-04 | n | 7.8E-02 | i | 3.0E-04 | r | 0 | 0.1 | 87-68-3 | | **Hexachlorobutadiene** | 6.2E+00 | ca** | 3.2E+01 | ca** | 8.6E-02 | ca* | 8.6E-01 | ca* | 2.0E+00 | 1.0E-01 |
| 6.3E+00 | i | | | 6.3E+00 | i | | | 0 | 0.04 | 319-84-6 | | HCH (alpha) | 9.0E-02 | ca | 5.9E-01 | ca | 1.1E-03 | ca | 1.1E-02 | ca | 5.0E-04 | 3.0E-05 |
| 1.8E+00 | i | | | 1.8E+00 | i | | | 0 | 0.04 | 319-85-7 | | HCH (beta) | 3.2E-01 | ca | 2.1E+00 | ca | 3.7E-03 | ca | 3.7E-02 | ca | 3.0E-03 | 1.0E-04 |
| 1.3E+00 | h | 3.0E-04 | i | 1.3E+00 | r | 3.0E-04 | r | 0 | 0.04 | 58-89-9 | | HCH (gamma) Lindane | 4.4E-01 | ca* | 2.9E+00 | ca | 5.2E-03 | ca | 5.2E-02 | ca | 9.0E-03 | 5.0E-04 |
| 1.8E+00 | i | | | 1.8E+00 | i | | | 0 | 0.04 | 608-73-1 | | HCH-technical | 3.2E-01 | ca | 2.1E+00 | ca | 3.8E-03 | ca | 3.7E-02 | ca | 3.0E-03 | 1.0E-04 |
| | | 7.0E-03 | i | | | 2.0E-05 | h | 0 | 0.1 | 77-47-4 | | Hexachlorocyclopentadiene | 4.2E+02 | nc | 5.9E+03 | nc | 7.3E-02 | nc | 2.6E+02 | nc | 4.0E+02 | 2.0E+01 |
| 6.2E+03 | i | | | 4.6E+03 | i | | | 0 | 0.1 | 19408-74-3 | | Hexachlorodibenzo-p-dioxin mixture (HxCDD) | 7.8E-05 | ca | 4.0E-04 | ca | 1.5E-06 | ca | 1.1E-05 | ca | | |
| 1.4E-02 | i | 1.0E-03 | i | 1.4E-02 | i | 1.0E-03 | r | 0 | 0.1 | 67-72-1 | | Hexachloroethane | 3.5E+01 | ca** | 1.8E+02 | ca** | 4.8E-01 | ca** | 4.8E+00 | ca** | 5.0E-01 | 2.0E-02 |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | 70-30-4 | | Hexachlorophene | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| 1.1E-01 | i | 3.0E-03 | i | 1.1E-01 | r | 3.0E-03 | r | 0 | 0.1 | 121-82-4 | | Hexahydro-1,3,5-trinitro-1,3,5-triazine | 4.4E+00 | ca* | 2.2E+01 | ca | 6.1E-02 | ca | 6.1E-01 | ca | | |
| | | 2.9E-06 | r | | | 2.9E-06 | i | 0 | 0.1 | 822-06-0 | | 1,6-Hexamethylene diisocyanate | 1.7E-01 | nc | 2.5E+00 | nc | 1.0E-02 | nc | 1.0E-01 | nc | | |
| | | 6.0E-02 | h | | | 5.7E-02 | i | 1 | | 110-54-3 | | n-Hexane | 1.1E+02 | sat | 1.1E+02 | sat | 2.1E+02 | nc | 3.5E+02 | nc | | |
| | | 3.3E-02 | i | | | 3.3E-02 | r | 0 | 0.1 | 51235-04-2 | | Hexazinone | 2.0E+03 | nc | 2.9E+04 | nc | 1.2E+02 | nc | 1.2E+03 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 2691-41-0 | | HMX | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| 3.0E+00 | i | | | 1.7E+01 | i | | | 0 | 0.1 | 302-01-2 | | Hydrazine, hydrazine sulfate | 1.6E-01 | ca | 8.2E-01 | ca | 3.9E-04 | ca | 2.2E-02 | ca | | |
| 3.0E+00 | n | | | 1.7E+01 | n | | | | 0.1 | 60-34-4 | | **Hydrazine, monomethyl** | 1.6E-01 | ca | 8.2E-01 | ca | 4.0E-04 | ca | 2.2E-02 | ca | | |
| 3.0E+00 | n | | | 1.7E+01 | n | | | | 0.1 | 57-14-7 | | **Hydrazine, dimethyl** | 1.6E-01 | ca | 8.2E-01 | ca | 4.0E-04 | ca | 2.2E-02 | ca | | |
| | | | | | | 5.7E-03 | i | | | 7647-01-0 | | Hydrogen chloride | | | | | 2.1E+01 | nc | | | | |
| | | 3.0E-03 | i | | | 2.9E-04 | i | | | 7783-06-4 | | Hydrogen sulfide | | | | | 1.0E+00 | nc | 1.1E+02 | nc | | |
| | | 4.0E-02 | h | | | 4.0E-02 | r | 0 | 0.1 | 123-31-9 | | p-Hydroquinone | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. solls | CAS No. | | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | 35554-44-0 | | Imazalil | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 | 0.1 | 81335-37-7 | | Imazaquin | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 | 0.1 | 36734-19-7 | | Iprodione | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |
| | | 3.0E-01 | n | | | | | 0 | | 7439-89-6 | | Iron | 2.3E+04 | nc | 1.0E+05 | max | | | 1.1E+04 | nc | | |
| | | 3.0E-01 | i | | | 3.0E-01 | r | 1 | | 78-83-1 | | Isobutanol | 1.3E+04 | nc | 4.0E+04 | sat | 1.1E+03 | nc | 1.8E+03 | nc | | |
| 9.5E-04 | i | 2.0E-01 | i | 9.5E-04 | r | 2.0E-01 | r | 0 | 0.1 | 78-59-1 | | Isophorone | 5.1E+02 | ca* | 2.6E+03 | ca* | 7.1E+00 | ca | 7.1E+01 | ca | 5.0E-01 | 3.0E-02 |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 | 0.1 | 33820-53-0 | | Isopropalin | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.1E-01 | r | 0 | 0.1 | 1832-54-8 | | Isopropyl methyl phosphonic acid | 6.1E+03 | nc | 8.8E+04 | nc | 4.0E+02 | nc | 3.6E+03 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 82558-50-7 | | Isoxaben | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| 1.8E+01 | n | | | 1.8E+01 | r | | | 0 | 0.1 | 143-50-0 | | Kepone | 2.7E-02 | ca | 1.4E-01 | ca | 3.7E-04 | ca | 3.7E-03 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 77501-63-4 | | Lactofen | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| PRGs Based on EPA Models (IEUBK 1994 and TRW 1996) | | | | | | | | | | 7439-92-1 | | **Lead** | 4.0E+02 | nc | 7.5E+02 | nc | | | | | | |
| | | 1.0E-07 | i | | | | | 0 | 0.1 | 78-00-2 | | Lead (tetraethyl) | 6.1E-03 | nc | 8.8E-02 | nc | | | 3.6E-03 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 330-55-2 | | Linuron | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 2.0E-02 | x | | | | | 0 | | 7439-93-2 | | Lithium | 1.6E+03 | nc | 4.1E+04 | nc | | | 7.3E+02 | nc | | |
| | | 2.0E-01 | i | | | 2.0E-01 | r | 0 | 0.1 | 83055-99-6 | | Londax | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | 121-75-5 | | Malathion | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 108-31-6 | | Maleic anhydride | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 5.0E-01 | i | | | 5.0E-01 | r | 1 | | 123-33-1 | | Maleic hydrazide | 1.7E+03 | nc | 2.4E+03 | sat | 1.8E+03 | nc | 3.0E+03 | nc | | |
| | | 2.0E-05 | h | | | 2.0E-05 | r | 0 | 0.1 | 109-77-3 | | Malononitrile | 1.2E+00 | nc | 1.8E+01 | nc | 7.3E-02 | nc | 7.3E-01 | nc | | |
| | | 3.0E-02 | h | | | 3.0E-02 | r | 0 | 0.1 | 8018-01-7 | | Mancozeb | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 6.0E-02 | o | 5.0E-03 | i | 6.0E-02 | r | 5.0E-03 | r | 0 | 0.1 | 12427-38-2 | | Maneb | 8.1E+00 | ca* | 4.1E+01 | ca | 1.1E-01 | ca | 1.1E+00 | ca | | |
| | | 2.4E-02 | i | | | 1.4E-05 | i | 0 | | 7439-96-5 | | Manganese and compounds | 1.8E+03 | nc | 3.2E+04 | nc | 5.1E-02 | nc | 8.8E+02 | nc | | |
| | | 9.0E-05 | h | | | 9.0E-05 | r | 0 | 0.1 | 950-10-7 | | Mephosfolan | 5.5E+00 | nc | 7.9E+01 | nc | 3.3E-01 | nc | 3.3E+00 | nc | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | 24307-26-4 | | Mepiquat | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 2.9E-02 | n | 1.0E-01 | n | 2.9E-02 | r | 1.0E-01 | r | 0 | 0.1 | 149-30-4 | | 2-Mercaptobenzothiazole | 1.7E+01 | ca | 8.5E+01 | ca | 2.3E-01 | ca | 2.3E+00 | ca | | |
| | | 3.0E-04 | i | | | | | 0 | | 7487-94-7 | | Mercury and compounds | 2.3E+01 | nc | 6.1E+02 | nc | | | 1.1E+01 | nc | | |
| | | | | | | 8.6E-05 | i | | | 7439-97-6 | | Mercury (elemental) | | | | | 3.1E-01 | nc | | | | |
| | | 1.0E-04 | i | | | | | 0 | 0.1 | 22967-92-6 | | Mercury (methyl) | 6.1E+00 | nc | 8.8E+01 | nc | | | 3.6E+00 | nc | | |
| | | 3.0E-05 | i | | | 3.0E-05 | r | 0 | 0.1 | 150-50-5 | | Merphos | 1.8E+00 | nc | 2.6E+01 | nc | 1.1E-01 | nc | 1.1E+00 | nc | | |
| | | 3.0E-05 | i | | | 3.0E-05 | r | 0 | 0.1 | 78-48-8 | | Merphos oxide | 1.8E+00 | nc | 2.6E+01 | nc | 1.1E-01 | nc | 1.1E+00 | nc | | |
| | | 6.0E-02 | i | | | 6.0E-02 | r | 0 | 0.1 | 57837-19-1 | | Metalaxyl | 3.7E+03 | nc | 5.3E+04 | nc | 2.2E+02 | nc | 2.2E+03 | nc | | |
| | | 1.0E-04 | i | | | 2.0E-04 | h | 1 | | 126-98-7 | | Methacrylonitrile | 2.1E+00 | nc | 8.8E+00 | nc | 7.3E-01 | nc | 1.0E+00 | nc | | |
| | | 5.0E-05 | i | | | 5.0E-05 | r | 0 | 0.1 | 10265-92-6 | | Methamidophos | 3.1E+00 | nc | 4.4E+01 | nc | 1.8E-01 | nc | 1.8E+00 | nc | | |
| | | 5.0E-01 | i | | | 5.0E-01 | r | 0 | 0.1 | 67-56-1 | | Methanol | 3.1E+04 | nc | 1.0E+05 | max | 1.8E+03 | nc | 1.8E+04 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 950-37-8 | | Methidathion | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 1 | | 16752-77-5 | | Methomyl | 4.4E+01 | nc | 1.5E+02 | nc | 9.1E+01 | nc | 1.5E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | 72-43-5 | | Methoxychlor | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | 1.6E+02 | 8.0E+00 |
| | | 1.0E-03 | h | | | 5.7E-03 | i | 0 | 0.1 | 109-86-4 | | 2-Methoxyethanol | 6.1E+01 | nc | 8.8E+02 | nc | 2.1E+01 | nc | 3.6E+01 | nc | | |
| | | 2.0E-03 | h | | | 2.0E-03 | r | 0 | 0.1 | 110-49-6 | | 2-Methoxyethanol acetate | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| 4.6E-02 | h | | | 4.6E-02 | r | | | 0 | 0.1 | 99-59-2 | | 2-Methoxy-5-nitroaniline | 1.1E+01 | ca | 5.4E+01 | ca | 1.5E-01 | ca | 1.5E+00 | ca | | |
| | | 1.0E+00 | h | | | 1.0E+00 | r | 1 | | 79-20-9 | | Methyl acetate | 2.2E+04 | nc | 9.6E+04 | nc | 3.7E+03 | nc | 6.1E+03 | nc | | |
| | | 3.0E-02 | h | | | 3.0E-02 | r | 1 | | 96-33-3 | | Methyl acrylate | 7.0E+01 | nc | 2.3E+02 | nc | 1.1E+02 | nc | 1.8E+02 | nc | | |
| 2.4E-01 | h | | | 2.4E-01 | r | | | 0 | 0.1 | 95-53-4 | | 2-Methylaniline (o-toluidine) | 2.0E+00 | ca | 1.0E+01 | ca | 2.8E-02 | ca | 2.8E-01 | ca | | |
| 1.8E-01 | h | | | 1.8E-01 | r | | | 0 | 0.1 | 636-21-5 | | 2-Methylaniline hydrochloride | 2.7E+00 | ca | 1.4E+01 | ca | 3.7E-02 | ca | 3.7E-01 | ca | | |
| | | 1.0E+00 | x | | | 1.0E+00 | r | 0 | 0.1 | 79-22-1 | | Methyl chlorocarbonate | 6.1E+04 | nc | 1.0E+05 | max | 3.7E+03 | nc | 3.6E+04 | nc | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 | 0.1 | 94-74-6 | | 2-Methyl-4-chlorophenoxyacetic acid | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | 94-81-5 | | 4-(2-Methyl-4-chlorophenoxy) butyric acid | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 93-65-2 | | 2-(2-Methyl-4-chlorophenoxy) propionic acid | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 16484-77-8 | | 2-(2-Methyl-1,4-chlorophenoxy) propionic acid | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 8.6E-01 | r | | | 8.6E-01 | h | 1 | | 108-87-2 | | Methylcyclohexane | 2.6E+03 | nc | 8.8E+03 | nc | 3.1E+03 | nc | 5.2E+03 | nc | | |
| 2.5E-01 | h | | | 2.5E-01 | r | | | 0 | 0.1 | 101-77-9 | | 4,4'-Methylenebisbenzeneamine | 1.9E+00 | ca | 9.9E+00 | ca | 2.7E-02 | ca | 2.7E-01 | ca | | |
| 1.3E-01 | h | 7.0E-04 | h | 1.3E-01 | h | 7.0E-04 | r | 0 | 0.1 | 101-14-4 | | 4,4'-Methylene bis(2-chloroaniline) | 3.7E+00 | ca* | 1.9E+01 | ca* | 5.2E-02 | ca* | 5.2E-01 | ca* | | |
| 4.6E-02 | i | | | 4.6E-02 | r | | | 0 | 0.1 | 101-61-1 | | 4,4'-Methylene bis(N,N'-dimethyl)aniline | 1.1E+01 | ca | 5.4E+01 | ca | 1.5E-01 | ca | 1.5E+00 | ca | | |

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 74-95-3 | Methylene bromide | 6.7E+01 | nc | 2.4E+02 | nc | 3.7E+01 | nc | 6.1E+01 | nc | | |
| 7.5E-03 | i | 6.0E-02 | i | 1.6E-03 | i | 8.6E-01 | h | 1 | | 75-09-2 | Methylene chloride | 8.9E+00 | ca | 2.1E+01 | ca | 4.1E+00 | ca | 4.3E+00 | ca | 2.0E-02 | 1.0E-03 |
| | | 1.7E-04 | r | | | 1.7E-04 | i | 0 | 0.1 | 101-68-8 | 4,4'-Methylene diphenyl diisocyanate | 1.0E+01 | nc | 1.5E+02 | nc | 6.2E-01 | nc | 6.2E+00 | nc | | |
| | | 6.0E-01 | i | | | 2.9E-01 | i | 1 | | 78-93-3 | Methyl ethyl ketone | 7.3E+03 | nc | 2.8E+04 | nc | 1.0E+03 | nc | 1.9E+03 | nc | | |
| 1.1E+00 | h | | | 1.1E+00 | r | | | 0 | 0.1 | 60-34-4 | Methyl hydrazine | 4.4E-01 | ca | 2.2E+00 | ca | 6.1E-03 | ca | 6.1E-02 | ca | | |
| | | 8.0E-02 | h | | | 2.3E-02 | h | 1 | | 108-10-1 | Methyl isobutyl ketone | 7.9E+02 | nc | 2.9E+03 | nc | 8.3E+01 | nc | 1.6E+02 | nc | | |
| | | 5.7E-04 | r | | | 5.7E-04 | n | 0 | 0.1 | 74-93-1 | Methyl Mercaptan | 3.5E+01 | nc | 5.0E+02 | nc | 2.1E+00 | nc | 2.1E+01 | nc | | |
| | | 1.4E+00 | i | | | 2.0E-01 | i | 1 | | 80-62-6 | Methyl methacrylate | 2.2E+03 | nc | 2.7E+03 | sat | 7.3E+02 | nc | 1.4E+03 | nc | | |
| 3.3E-02 | h | | | 3.3E-02 | r | | | 0 | 0.1 | 99-55-8 | 2-Methyl-5-nitroaniline | 1.5E+01 | ca | 7.5E+01 | ca | 2.0E-01 | ca | 2.0E+00 | ca | | |
| | | 2.5E-04 | i | | | 2.5E-04 | r | 0 | 0.1 | 298-00-0 | Methyl parathion | 1.5E+01 | nc | 2.2E+02 | nc | 9.1E-01 | nc | 9.1E+00 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 95-48-7 | 2-Methylphenol | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | 1.5E+01 | 8.0E-01 |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 108-39-4 | 3-Methylphenol | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 5.0E-03 | h | | | 5.0E-03 | r | 0 | 0.1 | 106-44-5 | 4-Methylphenol | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.0E-02 | n | | | 2.0E-02 | r | 0 | 0.1 | 993-13-5 | Methyl phosphonic acid | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 6.0E-03 | h | | | 1.1E-02 | h | 1 | | 25013-15-4 | Methyl styrene (mixture) | 1.3E+02 | nc | 5.6E+02 | nc | 4.2E+01 | nc | 6.0E+01 | nc | | |
| | | 7.0E-02 | h | | | 7.0E-02 | r | 1 | | 98-83-9 | Methyl styrene (alpha) | 6.8E+02 | sat | 6.8E+02 | sat | 2.6E+02 | nc | 4.3E+02 | nc | | |
| | | | | | | 8.6E-01 | i | 1 | | 1634-04-4 | Methyl tertbutyl ether (MTBE) | | | | | 3.1E+03 | nc | 2.0E+01 | nc/ca | | |
| 1.8E-03 | | | | 1.8E-03 | | | | 1 | | | **"CAL-Modified PRG"** | 1.7E+01 | ca | 3.7E+01 | ca | 3.7E+00 | ca | 6.2E+00 | ca | | |
| | | 1.5E-01 | i | | | 1.5E-01 | r | 0 | 0.1 | 51218-45-2 | Metolaclor (Dual) | 9.2E+03 | nc | 1.0E+05 | max | 5.5E+02 | nc | 5.5E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 21087-64-9 | Metribuzin | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| 1.8E+00 | x | 2.0E-04 | i | 1.8E+00 | r | 2.0E-04 | r | 0 | 0.1 | 2385-85-5 | Mirex | 2.7E-01 | ca* | 1.4E+00 | ca | 3.7E-03 | ca | 3.7E-02 | ca | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 2212-67-1 | Molinate | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 5.0E-03 | h | | | | | 0 | | 7439-98-7 | Molybdenum | 3.9E+02 | nc | 1.0E+04 | nc | | | 1.8E+02 | nc | | |
| | | 1.0E-01 | h | | | 1.0E-01 | h | 0 | 0.1 | 10599-90-3 | Monochloramine | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | 300-76-5 | Naled | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 15299-99-7 | Napropamide | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 2.0E-02 | i | | | | | 0 | | 7440-02-0 | Nickel (soluble salts) | 1.6E+03 | nc | 4.1E+04 | nc | | | 7.3E+02 | nc | 1.3E+02 | 7.0E+00 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 1.5E+02 | | | | | | | | | |
| | | | | 8.4E-01 | i | | | 0 | | | Nickel refinery dust | | | | | 8.0E-03 | ca | | | | |
| | | | | 1.7E+00 | i | | | 0 | | 12035-72-2 | Nickel subsulfide | | | 1.1E+04 | ca | 4.0E-03 | ca | | | | |
| | | 1.5E-03 | x | | | 1.5E-03 | r | 0 | 0.1 | 1929-82-4 | Nitrapyrin | 9.2E+01 | nc | 1.3E+03 | nc | 5.5E+00 | nc | 5.5E+01 | nc | | |
| Tap Water PRG Based on Infant NOAEL (see IRIS) | | | | | | | | | | 14797-55-8 | Nitrate | | | | | | | 1.0E+04 | nc | | |
| | | 1.0E-01 | x | | | | | | | 10102-43-9 | Nitric Oxide | 7.8E+03 | nc | 1.0E+05 | max | | | 3.6E+03 | nc | | |
| Tap Water PRG Based on infant NOAEL (see IRIS) | | | | | | | | | | 14797-65-0 | Nitrite | | | | | | | 1.0E+03 | nc | | |
| | | 5.7E-05 | r | | | 5.7E-05 | h | 0 | 0.1 | 88-74-4 | 2-Nitroaniline | 3.5E+00 | nc | 5.0E+01 | nc | 2.1E-01 | nc | 2.1E+00 | nc | | |
| | | 5.0E-04 | i | | | 5.7E-04 | h | 1 | | 98-95-3 | Nitrobenzene | 2.0E+01 | nc | 1.1E+02 | nc | 2.1E+00 | nc | 3.4E+00 | nc | 1.0E-01 | 7.0E-03 |
| | | 7.0E-02 | h | | | 7.0E-02 | r | 0 | 0.1 | 67-20-9 | Nitrofurantoin | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| 1.5E+00 | h | | | 9.4E+00 | h | | | 0 | 0.1 | 59-87-0 | Nitrofurazone | 3.2E-01 | ca | 1.6E+00 | ca | 7.2E-04 | ca | 4.5E-02 | ca | | |
| 1.4E-02 | n | | | 1.4E-02 | r | | | 0 | 0.1 | 55-63-0 | Nitroglycerin | 3.5E+01 | ca | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | 556-88-7 | Nitroguanidine | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 8.0E-03 | n | | | 8.0E-03 | r | 0 | 0.1 | 100-02-7 | 4-Nitrophenol | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| 9.4E+00 | r | 5.7E-03 | r | 9.4E+00 | h | 5.7E-03 | i | 1 | | 79-46-9 | 2-Nitropropane | | | | | 7.2E-04 | ca | 1.2E-03 | ca | | |
| 5.4E+00 | i | | | 5.6E+00 | i | | | 1 | | 924-16-3 | N-Nitrosodi-n-butylamine | 2.4E-02 | ca | 6.1E-02 | ca | 1.2E-03 | ca | 2.0E-03 | ca | | |
| 2.8E+00 | i | | | 2.8E+00 | r | | | 0 | 0.1 | 1116-54-7 | N-Nitrosodiethanolamine | 1.7E-01 | ca | 8.8E-01 | ca | 2.4E-03 | ca | 2.4E-02 | ca | | |
| 1.5E+02 | i | | | 1.5E+02 | i | | | 0 | 0.1 | 55-18-5 | N-Nitrosodiethylamine | 3.2E-03 | ca | 1.6E-02 | ca | 4.5E-05 | ca | 4.5E-04 | ca | | |
| 5.1E+01 | i | | | 4.9E+01 | i | | | 0 | 0.1 | 62-75-9 | N-Nitrosodimethylamine | 9.5E-03 | ca | 4.8E-02 | ca | 1.4E-04 | ca | 1.3E-03 | ca | | |
| 4.9E-03 | i | | | 4.9E-03 | r | | | 0 | 0.1 | 86-30-6 | N-Nitrosodiphenylamine | 9.9E+01 | ca | 5.0E+02 | ca | 1.4E+00 | ca | 1.4E+01 | ca | 1.0E+00 | 6.0E-02 |
| 7.0E+00 | i | | | 7.0E+00 | r | | | 0 | 0.1 | 621-64-7 | N-Nitroso di-n-propylamine | 6.9E-02 | ca | 3.5E-01 | ca | 9.6E-04 | ca | 9.6E-03 | ca | 5.0E-05 | 2.0E-06 |
| 2.2E+01 | i | | | 2.2E+01 | r | | | 0 | 0.1 | 10595-95-6 | N-Nitroso-N-methylethylamine | 2.2E-02 | ca | 1.1E-01 | ca | 3.1E-04 | ca | 3.1E-03 | ca | | |
| 2.1E+00 | i | | | 2.1E+00 | i | | | 0 | 0.1 | 930-55-2 | N-Nitrosopyrrolidine | 2.3E-01 | ca | 1.2E+00 | ca | 3.1E-03 | ca | 3.2E-02 | ca | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 99-08-1 | m-Nitrotoluene | 3.7E+02 | nc | 1.0E+03 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 88-72-2 | o-Nitrotoluene | 3.7E+02 | nc | 1.0E+03 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 1 | | 99-99-0 | p-Nitrotoluene | 3.7E+02 | nc | 1.0E+03 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 | 0.1 | 27314-13-2 | Norflurazon | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | 7.0E-04 | i | | 7.0E-04 | r | 0 | 0.1 | 85509-19-9 | NuStar | 4.3E+01 | nc | 6.2E+02 | nc | 2.6E+00 | nc | 2.6E+01 | nc | | |
| | 3.0E-03 | i | | 3.0E-03 | r | 0 | 0.1 | 32536-52-0 | Octabromodiphenyl ether | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | 2.0E-03 | h | | 2.0E-03 | r | 0 | 0.1 | 152-16-9 | Octamethylpyrophosphoramide | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | 5.0E-02 | i | | 5.0E-02 | r | 0 | 0.1 | 19044-88-3 | Oryzalin | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | 5.0E-03 | i | | 5.0E-03 | r | 0 | 0.1 | 19666-30-9 | Oxadiazon | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | 2.5E-02 | i | | 2.5E-02 | r | 0 | 0.1 | 23135-22-0 | Oxamyl | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | 3.0E-03 | i | | 3.0E-03 | r | 0 | 0.1 | 42874-03-3 | Oxyfluorfen | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | 1.3E-02 | i | | 1.3E-02 | r | 0 | 0.1 | 76738-62-0 | Paclobutrazol | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | 4.5E-03 | i | | 4.5E-03 | r | 0 | 0.1 | 4685-14-7 | Paraquat | 2.7E+02 | nc | 4.0E+03 | nc | 1.6E+01 | nc | 1.6E+02 | nc | | |
| | 6.0E-03 | h | | 6.0E-03 | r | 0 | 0.1 | 56-38-2 | Parathion | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | | |
| | 5.0E-02 | h | | 5.0E-02 | r | 0 | 0.1 | 1114-71-2 | Pebulate | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | 4.0E-02 | i | | 4.0E-02 | r | 0 | 0.1 | 40487-42-1 | Pendimethalin | 2.4E+03 | nc | 3.5E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | | |
| 2.3E-02 | h | | 2.3E-02 | r | | 0 | 0.1 | 87-84-3 | Pentabromo-6-chloro cyclohexane | 2.1E+01 | ca | 1.1E+02 | ca | 2.9E-01 | ca | 2.9E+00 | ca | | |
| | 2.0E-03 | i | | 2.0E-03 | r | 0 | 0.1 | 32534-81-9 | Pentabromodiphenyl ether | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | 8.0E-04 | i | | 8.0E-04 | r | 0 | 0.1 | 608-93-5 | Pentachlorobenzene | 4.9E+01 | nc | 7.0E+02 | nc | 2.9E+00 | nc | 2.9E+01 | nc | | |
| 2.6E-01 | h | 3.0E-03 | i | 2.6E-01 | r | 3.0E-03 | r | 0 | 0.1 | 82-68-8 | Pentachloronitrobenzene | 1.9E+00 | ca* | 9.5E+00 | ca | 2.6E-02 | ca | 2.6E-01 | ca | | |
| 1.2E-01 | i | 3.0E-02 | i | 1.2E-01 | r | 3.0E-02 | r | 0 | 0.25 | 87-86-5 | Pentachlorophenol | 3.0E+00 | ca | 1.1E+01 | ca | 5.6E-02 | ca | 5.6E-01 | ca | 3.0E-02 | 1.0E-03 |
| | 5.0E-04 | x | | | | | | 0 | | 7601-90-3 | Perchlorate | 3.9E+01 | nc | 1.0E+03 | nc | | | 1.8E+01 | nc | | |
| | 5.0E-02 | i | | 5.0E-02 | r | 0 | 0.1 | 52645-53-1 | Permethrin | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | 2.5E-01 | i | | 2.5E-01 | r | 0 | 0.1 | 13684-63-4 | Phenmedipham | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | 6.0E-01 | i | | 6.0E-01 | r | 0 | 0.1 | 108-95-2 | Phenol | 3.7E+04 | nc | 1.0E+05 | max | 2.2E+03 | nc | 2.2E+04 | nc | 1.0E+02 | 5.0E+00 |
| | 2.0E-03 | n | | 2.0E-03 | r | 0 | 0.1 | 92-84-2 | Phenothiazine | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | 6.0E-03 | i | | 6.0E-03 | r | 0 | 0.1 | 108-45-2 | m-Phenylenediamine | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | | |
| | 1.9E-01 | h | | 1.9E-01 | r | 0 | 0.1 | 106-50-3 | p-Phenylenediamine | 1.2E+04 | nc | 1.0E+05 | max | 6.9E+02 | nc | 6.9E+03 | nc | | |
| | 8.0E-05 | i | | 8.0E-05 | r | 0 | 0.1 | 62-38-4 | Phenylmercuric acetate | 4.9E+00 | nc | 7.0E+01 | nc | 2.9E-01 | nc | 2.9E+00 | nc | | |
| 1.9E-03 | h | | 1.9E-03 | r | | 0 | 0.1 | 90-43-7 | 2-Phenylphenol | 2.5E+02 | ca | 1.3E+03 | ca | 3.5E+00 | ca | 3.5E+01 | ca | | |
| | 2.0E-04 | h | | 2.0E-04 | r | 0 | 0.1 | 298-02-2 | Phorate | 1.2E+01 | nc | 1.8E+02 | nc | 7.3E-01 | nc | 7.3E+00 | nc | | |
| | 2.0E-02 | i | | 2.0E-02 | r | 0 | 0.1 | 732-11-6 | Phosmet | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | 3.0E-04 | h | | 8.6E-05 | i | 0 | 0.1 | 7803-51-2 | Phosphine | 1.8E+01 | nc | 2.6E+02 | nc | 3.1E-01 | nc | 1.1E+01 | nc | | |
| | | | | 2.9E-03 | i | | | 7664-38-2 | Phosphoric acid | | | | | 1.0E+01 | nc | | | | |
| | 2.0E-05 | i | | | | 0 | | 7723-14-0 | Phosphorus (white) | 1.6E+00 | nc | 4.1E+01 | nc | | | 7.3E-01 | nc | | |
| | 1.0E+00 | h | | 1.0E+00 | r | 0 | 0.1 | 100-21-0 | p-Phthalic acid | 6.1E+04 | nc | 1.0E+05 | max | 3.7E+03 | nc | 3.6E+04 | nc | | |
| | 2.0E+00 | i | | 3.4E-02 | h | 0 | 0.1 | 85-44-9 | Phthalic anhydride | 1.0E+05 | max | 1.0E+05 | max | 1.2E+02 | nc | 7.3E+04 | nc | | |
| | 7.0E-02 | i | | 7.0E-02 | r | 0 | 0.1 | 1918-02-1 | Picloram | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| | 1.0E-02 | i | | 1.0E-02 | r | 0 | 0.1 | 23505-41-1 | Pirimiphos-methyl | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| 8.9E+00 | h | 7.0E-06 | h | 8.9E+00 | r | 7.0E-06 | r | 0 | 0.1 | | Polybrominated biphenyls | 5.5E-02 | ca** | 2.8E-01 | ca* | 7.6E-04 | ca* | 7.6E-03 | ca* | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 1336-36-3 | Polychlorinated biphenyls (PCBs) | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 7.0E-02 | i | 7.0E-05 | i | 7.0E-02 | i | 7.0E-05 | r | 0 | 0.14 | 12674-11-2 | Aroclor 1016 | 3.9E+00 | nc | 2.9E+01 | ca** | 9.6E-02 | ca** | 9.6E-01 | ca** | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 11104-28-2 | Aroclor 1221 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 11141-16-5 | Aroclor 1232 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 53469-21-9 | Aroclor 1242 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 12672-29-6 | Aroclor 1248 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| 2.0E+00 | i | 2.0E-05 | i | 2.0E+00 | i | 2.0E-05 | r | 0 | 0.14 | 11097-69-1 | Aroclor 1254 | 2.2E-01 | ca** | 1.0E+00 | ca* | 3.4E-03 | ca* | 3.4E-02 | ca* | | |
| 2.0E+00 | i | | | 2.0E+00 | i | | | 0 | 0.14 | 11096-82-5 | Aroclor 1260 | 2.2E-01 | ca | 1.0E+00 | ca | 3.4E-03 | ca | 3.4E-02 | ca | | |
| | | | | | | | | | 0.13 | | Polynuclear aromatic hydrocarbons (PAHs) | | | | | | | | | | |
| | 6.0E-02 | i | | 6.0E-02 | r | 1 | | | | 83-32-9 | Acenaphthene | 3.7E+03 | nc | 3.8E+04 | nc | 2.2E+02 | nc | 3.7E+02 | nc | 5.7E+02 | 2.9E+01 |
| | 3.0E-01 | i | | 3.0E-01 | r | 1 | | | | 120-12-7 | Anthracene | 2.2E+04 | nc | 1.0E+05 | max | 1.1E+03 | nc | 1.8E+03 | nc | 1.2E+04 | 5.9E+02 |
| 7.3E-01 | n | | 3.1E-01 | n | | | | 0 | 0.13 | 56-55-3 | Benz[a]anthracene | 6.2E-01 | ca | 2.9E+00 | ca | 2.2E-02 | ca | 9.2E-02 | ca | 2.0E+00 | 8.0E-02 |
| 7.3E-01 | n | | 3.1E-01 | n | | | | 0 | 0.13 | 205-99-2 | Benzo[b]fluoranthene | 6.2E-01 | ca | 2.9E+00 | ca | 2.2E-02 | ca | 9.2E-02 | ca | 5.0E+00 | 2.0E-01 |
| 7.3E-02 | n | | 3.1E-02 | n | | | | 0 | 0.13 | 207-08-9 | Benzo[k]fluoranthene | 6.2E+00 | ca | 2.9E+01 | ca | 2.2E-01 | ca | 9.2E-01 | ca | 4.9E+01 | 2.0E+00 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 6.1E-01 | | | | | | | | | |
| 7.3E+00 | i | | 3.1E+00 | n | | | | 0 | 0.13 | 50-32-8 | Benzo[a]pyrene | 6.2E-02 | ca | 2.9E-01 | ca | 2.2E-03 | ca | 9.2E-03 | ca | 8.0E+00 | 4.0E-01 |
| | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | | | | | | | 1.5E-03 | | | |
| 7.3E-03 | n | | 3.1E-03 | n | | | | 0 | 0.13 | 218-01-9 | Chrysene | 6.2E+01 | ca | 2.9E+02 | ca | 2.2E+00 | ca | 9.2E+00 | ca | 1.6E+02 | 8.0E+00 |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS Migration to Ground Water | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| | | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | 6.1E+00 | | | | | | | | | |
| 7.3E+00 | n | | | 3.1E+00 | n | | | 0 | 0.13 | | 53-70-3 | Dibenz[ah]anthracene | 6.2E-02 | ca | 2.9E-01 | ca | 2.2E-03 | ca | 9.2E-03 | ca | 2.0E+00 | 8.0E-02 |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 0 | 0.13 | | 206-44-0 | Fluoranthene | 2.3E+03 | nc | 3.0E+04 | nc | 1.5E+02 | nc | 1.5E+03 | nc | 4.3E+03 | 2.1E+02 |
| | | 4.0E-02 | i | | | 4.0E-02 | r | 1 | | | 86-73-7 | Fluorene | 2.6E+03 | nc | 3.3E+04 | nc | 1.5E+02 | nc | 2.4E+02 | nc | 5.6E+02 | 2.8E+01 |
| 7.3E-01 | n | | | 3.1E-01 | n | | | 0 | 0.13 | | 193-39-5 | Indeno[1,2,3-cd]pyrene | 6.2E-01 | ca | 2.9E+00 | ca | 2.2E-02 | ca | 9.2E-02 | ca | 1.4E+01 | 7.0E-01 |
| | | 2.0E-02 | i | | | 8.6E-04 | i | 1 | | | 91-20-3 | Naphthalene | 5.6E+01 | nc | 1.9E+02 | nc | 3.1E+00 | nc | 6.2E+00 | nc | 8.4E+01 | 4.0E+00 |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 1 | | | 129-00-0 | Pyrene | 2.3E+03 | nc | 5.4E+04 | nc | 1.1E+02 | nc | 1.8E+02 | nc | 4.2E+03 | 2.1E+02 |
| 1.5E-01 | i | 9.0E-03 | i | 1.5E-01 | r | 9.0E-03 | r | 0 | 0.1 | | 67747-09-5 | Prochloraz | 3.2E+00 | ca | 1.6E+01 | ca | 4.5E-02 | ca | 4.5E-01 | ca | | |
| | | 6.0E-03 | h | | | 6.0E-03 | r | 0 | 0.1 | | 26399-36-0 | Profluralin | 3.7E+02 | nc | 5.3E+03 | nc | 2.2E+01 | nc | 2.2E+02 | nc | | |
| | | 1.5E-02 | i | | | 1.5E-02 | r | 0 | 0.1 | | 1610-18-0 | Prometon | 9.2E+02 | nc | 1.3E+04 | nc | 5.5E+01 | nc | 5.5E+02 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 | | 7287-19-6 | Prometryn | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 7.5E-02 | i | | | 7.5E-02 | r | 0 | 0.1 | | 23950-58-5 | Pronamide | 4.6E+03 | nc | 6.6E+04 | nc | 2.7E+02 | nc | 2.7E+03 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | | 1918-16-7 | Propachlor | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | | 709-98-8 | Propanil | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | | 2312-35-8 | Propargite | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-03 | i | | | 2.0E-03 | r | 0 | 0.1 | | 107-19-7 | Propargyl alcohol | 1.2E+02 | nc | 1.8E+03 | nc | 7.3E+00 | nc | 7.3E+01 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | | 139-40-2 | Propazine | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 2.0E-02 | i | | | 2.0E-02 | r | 0 | 0.1 | | 122-42-9 | Propham | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | | 60207-90-1 | Propiconazole | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 1.0E-01 | i | | | 1.1E-01 | i | 1 | | | 98-82-8 | Isopropylbenzene (Cumene) | 1.6E+02 | nc | 5.2E+02 | nc | 4.0E+02 | nc | 6.6E+02 | nc | | |
| | | 1.0E-02 | n | | | 1.0E-02 | r | 1 | | | 103-65-1 | n-Propylbenzene | 1.4E+02 | nc | 2.4E+02 | sat | 3.7E+01 | nc | 6.1E+01 | nc | | |
| | | 2.0E+01 | h | | | 2.0E+01 | r | 0 | 0.1 | | 57-55-6 | Propylene glycol | 1.0E+05 | max | 1.0E+05 | max | 7.3E+04 | nc | 7.3E+05 | nc | | |
| | | 7.0E-01 | h | | | 7.0E-01 | r | 0 | 0.1 | | 111-35-3 | Propylene glycol, monoethyl ether | 4.3E+04 | nc | 1.0E+05 | max | 2.6E+03 | nc | 2.6E+04 | nc | | |
| | | 7.0E-01 | h | | | 5.7E-01 | i | 0 | 0.1 | | 107-98-2 | Propylene glycol, monomethyl ether | 4.3E+04 | nc | 1.0E+05 | max | 2.1E+03 | nc | 2.6E+04 | nc | | |
| 2.4E-01 | i | 8.6E-03 | r | 1.3E-02 | i | 8.6E-03 | i | 1 | | | 75-56-9 | Propylene oxide | 1.9E+00 | ca* | 9.1E+00 | ca* | 5.2E-01 | ca* | 2.2E-01 | ca | | |
| | | 2.5E-01 | i | | | 2.5E-01 | r | 0 | 0.1 | | 81335-77-5 | Pursuit | 1.5E+04 | nc | 1.0E+05 | max | 9.1E+02 | nc | 9.1E+03 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | | 51630-58-1 | Pydrin | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | | 110-86-1 | Pyridine | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 | 0.1 | | 13593-03-8 | Quinalphos | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| 1.2E+01 | h | | | 1.2E+01 | r | | | 0 | 0.1 | | 91-22-5 | Quinoline | 4.1E-02 | ca | 2.1E-01 | ca | 5.6E-04 | ca | 5.6E-03 | ca | | |
| 1.1E-01 | i | 3.0E-03 | i | 1.1E-01 | r | 3.0E-03 | r | 0 | 0.1 | | 121-82-4 | RDX (Cyclonite) | 4.4E+00 | ca* | 2.2E+01 | ca | 6.1E-02 | ca | 6.1E-01 | ca | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | | 10453-86-8 | Resmethrin | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 5.0E-02 | h | | | 5.0E-02 | r | 0 | 0.1 | | 299-84-3 | Ronnel | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |
| | | 4.0E-03 | i | | | 4.0E-03 | r | 0 | 0.1 | | 83-79-4 | Rotenone | 2.4E+02 | nc | 3.5E+03 | nc | 1.5E+01 | nc | 1.5E+02 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | | 78587-05-0 | Savey | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 5.0E-03 | i | | | | | 0 | 0.1 | | 7783-00-8 | Selenious Acid | 3.1E+02 | nc | 4.4E+03 | nc | | | 1.8E+02 | nc | | |
| | | 5.0E-03 | i | | | | | 0 | | | 7782-49-2 | Selenium | 3.9E+02 | nc | 1.0E+04 | nc | | | 1.8E+02 | nc | 5.0E+00 | 3.0E-01 |
| | | 5.0E-03 | h | | | | | 0 | 0.1 | | 630-10-4 | Selenourea | 3.1E+02 | nc | 4.4E+03 | nc | | | 1.8E+02 | nc | | |
| | | 9.0E-02 | i | | | 9.0E-02 | r | 0 | 0.1 | | 74051-80-2 | Sethoxydim | 5.5E+03 | nc | 7.9E+04 | nc | 3.3E+02 | nc | 3.3E+03 | nc | | |
| | | 5.0E-03 | i | | | | | 0 | | | 7440-22-4 | Silver and compounds | 3.9E+02 | nc | 1.0E+04 | nc | | | 1.8E+02 | nc | 3.4E+01 | 2.0E+00 |
| 1.2E-01 | h | 5.0E-03 | i | 1.2E-01 | r | 2.0E-03 | r | 0 | 0.1 | | 122-34-9 | Simazine | 4.1E+00 | ca* | 2.1E+01 | ca | 5.6E-02 | ca | 5.6E-01 | ca | | |
| | | 4.0E-03 | i | | | | | | | | 26628-22-8 | Sodium azide | | | | | | | | | | |
| 2.7E-01 | h | 3.0E-02 | i | 2.7E-01 | r | 3.0E-02 | r | 0 | 0.1 | | 148-18-5 | Sodium diethyldithiocarbamate | 1.8E+00 | ca | 9.1E+00 | ca | 2.5E-02 | ca | 2.5E-01 | ca | | |
| | | 2.0E-05 | i | | | 2.0E-05 | r | 0 | 0.1 | | 62-74-8 | Sodium fluoroacetate | 1.2E+00 | nc | 1.8E+01 | nc | 7.3E-02 | nc | 7.3E-01 | nc | | |
| | | 1.0E-03 | h | | | 1.0E-03 | r | 0 | 0.1 | | 13718-26-8 | Sodium metavanadate | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 6.0E-01 | i | | | | | 0 | | | 7440-24-6 | Strontium, stable | 4.7E+04 | nc | 1.0E+05 | max | | | 2.2E+04 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | | 57-24-9 | Strychnine | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 2.0E-01 | i | | | 2.9E-01 | i | 1 | | | 100-42-5 | Styrene | 1.7E+03 | sat | 1.7E+03 | sat | 1.1E+03 | nc | 1.6E+03 | nc | 4.0E+00 | 2.0E-01 |
| | | 1.0E-03 | n | | | 1.0E-03 | r | | | | 80-07-9 | **1,1'-Sulfonylbis (4-chlorobenzene)** | 7.8E+01 | nc | 2.0E+03 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | | 88671-89-0 | Systhane | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| 1.5E+05 | h | | | 1.5E+05 | h | | | 0 | 0.03 | | 1746-01-6 | 2,3,7,8-TCDD (dioxin) | 3.9E-06 | ca | 2.7E-05 | ca | 4.5E-08 | ca | 4.5E-07 | ca | | |
| | | 7.0E-02 | i | | | 7.0E-02 | r | 0 | 0.1 | | 34014-18-1 | Tebuthiuron | 4.3E+03 | nc | 6.2E+04 | nc | 2.6E+02 | nc | 2.6E+03 | nc | | |
| | | 2.0E-02 | h | | | 2.0E-02 | r | 0 | 0.1 | | 3383-96-8 | Temephos | 1.2E+03 | nc | 1.8E+04 | nc | 7.3E+01 | nc | 7.3E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | | 5902-51-2 | Terbacil | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2.5E-05 | h | | | 2.5E-05 | r | 0 | 0.1 | | | | 13071-79-9 | Terbufos | 1.5E+00 | nc | 2.2E+01 | nc | 9.1E-02 | nc | 9.1E-01 | nc | | |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | | | | 886-50-0 | Terbutryn | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | | | | 95-94-3 | 1,2,4,5-Tetrachlorobenzene | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| 2.6E-02 | i | 3.0E-02 | i | 2.6E-02 | i | 3.0E-02 | r | 1 | | | | | 630-20-6 | 1,1,1,2-Tetrachloroethane | 3.0E+00 | ca | 7.0E+00 | ca | 2.6E-01 | ca | 4.3E-01 | ca | | |
| 2.0E-01 | i | 6.0E-02 | n | 2.0E-01 | i | 6.0E-02 | r | 1 | | | | | 79-34-5 | 1,1,2,2-Tetrachloroethane | 3.8E-01 | ca | 9.0E-01 | ca | 3.3E-02 | ca | 5.5E-02 | ca | 3.0E-03 | 2.0E-04 |
| 5.2E-02 | n | 1.0E-02 | i | 2.0E-03 | n | 1.1E-01 | n | 1 | | | | | 127-18-4 | Tetrachloroethylene (PCE) | 5.7E+00 | ca* | 1.9E+01 | ca* | 3.3E+00 | ca | 1.1E+00 | ca | 6.0E-02 | 3.0E-03 |
| | | | | | | | | | | | | | | "CAL-Modified PRG" (PEA, 1994) | | | | | 3.2E-01 | | | | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | | | | 58-90-2 | 2,3,4,6-Tetrachlorophenol | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| 2.0E+01 | h | | | 2.0E+01 | r | | | 0 | 0.1 | | | | 5216-25-1 | p,a,a,a-Tetrachlorotoluene | 2.4E-02 | ca | 1.2E-01 | ca | 3.4E-04 | ca | 3.4E-03 | ca | | |
| 2.4E-02 | h | 3.0E-02 | i | 2.4E-02 | r | 3.0E-02 | r | 0 | 0.1 | | | | 961-11-5 | Tetrachlorovinphos | 2.0E+01 | ca* | 1.0E+02 | ca | 2.8E-01 | ca | 2.8E+00 | ca | | |
| | | 5.0E-04 | i | | | 5.0E-04 | r | 0 | 0.1 | | | | 3689-24-5 | Tetraethyldithiopyrophosphate | 3.1E+01 | nc | 4.4E+02 | nc | 1.8E+00 | nc | 1.8E+01 | nc | | |
| 7.6E-03 | n | 2.1E-01 | n | 6.8E-03 | n | 8.6E-02 | n | 0 | 0.1 | | | | 109-99-9 | Tetrahydrofuran | 6.4E+01 | ca | 3.2E+02 | ca | 9.9E-01 | ca | 8.8E+00 | ca | | |
| | | 6.6E-05 | i | | | | | 0 | | | | | 7446-18-6 | **Thallium and compounds** | 5.2E+00 | nc | 1.3E+02 | nc | | | 2.4E+00 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | | | | 28249-77-6 | Thiobencarb | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 1.0E-01 | n | | | 1.0E-01 | r | 0 | 0.1 | | | | N/A | Thiocyanate | 6.1E+03 | nc | 1.0E+05 | max | 3.7E+02 | nc | 3.6E+03 | nc | | |
| | | 3.0E-04 | h | | | 3.0E-04 | r | 0 | 0.1 | | | | 39196-18-4 | Thiofanox | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 8.0E-02 | i | | | 8.0E-02 | r | 0 | 0.1 | | | | 23564-05-8 | Thiophanate-methyl | 4.9E+03 | nc | 7.0E+04 | nc | 2.9E+02 | nc | 2.9E+03 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | | | | 137-26-8 | Thiram | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 6.0E-01 | h | | | | | 0 | | | | | | Tin (inorganic, see tributyltin oxide for organic tin) | 4.7E+04 | nc | 1.0E+05 | max | | | 2.2E+04 | nc | | |
| | | 2.0E-01 | i | | | 1.1E-01 | h | 1 | | | | | 108-88-3 | Toluene | 5.2E+02 | sat | 5.2E+02 | sat | 4.0E+02 | nc | 7.2E+02 | nc | 1.2E+01 | 6.0E-01 |
| 3.2E+00 | h | | | 3.2E+00 | r | | | 0 | 0.1 | | | | 95-80-7 | Toluene-2,4-diamine | 1.5E-01 | ca | 7.7E-01 | ca | 2.1E-03 | ca | 2.1E-02 | ca | | |
| | | 6.0E-01 | h | | | 6.0E-01 | r | 0 | 0.1 | | | | 95-70-5 | Toluene-2,5-diamine | 3.7E+04 | nc | 1.0E+05 | max | 2.2E+03 | nc | 2.2E+04 | nc | | |
| | | 2.0E-01 | h | | | 2.0E-01 | r | 0 | 0.1 | | | | 823-40-5 | Toluene-2,6-diamine | 1.2E+04 | nc | 1.0E+05 | max | 7.3E+02 | nc | 7.3E+03 | nc | | |
| 1.9E-01 | i | | | 1.9E-01 | r | | | 0 | 0.1 | | | | 106-49-0 | p-Toluidine | 2.6E+00 | ca | 1.3E+01 | ca | 3.5E-02 | ca | 3.5E-01 | ca | | |
| 1.1E+00 | i | | | 1.1E+00 | i | | | 0 | 0.1 | | | | 8001-35-2 | Toxaphene | 4.4E-01 | ca | 2.2E+00 | ca | 6.0E-03 | ca | 6.1E-02 | ca | 3.1E+01 | 2.0E+00 |
| | | 7.5E-03 | i | | | 7.5E-03 | r | 0 | 0.1 | | | | 66841-25-6 | Tralomethrin | 4.6E+02 | nc | 6.6E+03 | nc | 2.7E+01 | nc | 2.7E+02 | nc | | |
| | | 1.3E-02 | i | | | 1.3E-02 | r | 0 | 0.1 | | | | 2303-17-5 | Triallate | 7.9E+02 | nc | 1.1E+04 | nc | 4.7E+01 | nc | 4.7E+02 | nc | | |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | | | | 82097-50-5 | Triasulfuron | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 0 | 0.1 | | | | 615-54-3 | 1,2,4-Tribromobenzene | 3.1E+02 | nc | 4.4E+03 | nc | 1.8E+01 | nc | 1.8E+02 | nc | | |
| | | 3.0E-04 | i | | | | | 0 | 0.1 | | | | 56-35-9 | Tributyltin oxide (TBTO) | 1.8E+01 | nc | 2.6E+02 | nc | | | 1.1E+01 | nc | | |
| 3.4E-02 | h | | | 3.4E-02 | r | | | 0 | 0.1 | | | | 634-93-5 | 2,4,6-Trichloroaniline | 1.4E+01 | ca | 7.3E+01 | ca | 2.0E-01 | ca | 2.0E+00 | ca | | |
| 2.9E-02 | h | | | 2.9E-02 | r | | | 0 | 0.1 | | | | 33663-50-2 | 2,4,6-Trichloroaniline hydrochloride | 1.7E+01 | ca | 8.5E+01 | ca | 2.3E-01 | ca | 2.3E+00 | ca | | |
| | | 1.0E-02 | i | | | 5.7E-02 | h | 1 | | | | | 120-82-1 | 1,2,4-Trichlorobenzene | 6.5E+02 | nc | 3.0E+03 | sat | 2.1E+02 | nc | 1.9E+02 | nc | 5.0E+00 | 3.0E-01 |
| | | 2.0E-02 | n | | | 2.9E-01 | n | 1 | | | | | 71-55-6 | 1,1,1-Trichloroethane | 6.3E+02 | nc | 1.4E+03 | sat | 1.0E+03 | nc | 5.4E+02 | nc | 2.0E+00 | 1.0E-01 |
| 5.7E-02 | i | 4.0E-03 | i | 5.6E-02 | i | 4.0E-03 | r | 1 | | | | | 79-00-5 | 1,1,2-Trichloroethane | 8.4E-01 | ca* | 1.9E+00 | ca* | 1.2E-01 | ca | 2.0E-01 | ca | 2.0E-02 | 9.0E-04 |
| 1.1E-02 | n | 6.0E-03 | x | 6.0E-03 | n | 6.0E-03 | r | 1 | | | | | 79-01-6 | Trichloroethylene (TCE) | 2.8E+00 | ca** | 6.1E+00 | ca* | 1.1E+00 | ca* | 1.6E+00 | ca* | 6.0E-02 | 3.0E-03 |
| | | 3.0E-01 | i | | | 2.0E-01 | h | 1 | | | | | 75-69-4 | Trichlorofluoromethane | 3.9E+02 | nc | 2.0E+03 | sat | 7.3E+02 | nc | 1.3E+03 | nc | | |
| | | 1.0E-01 | i | | | 1.0E-01 | r | 0 | 0.1 | | | | 95-95-4 | 2,4,5-Trichlorophenol | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | 2.7E+02 | 1.4E+01 |
| 1.1E-02 | i | | | 1.1E-02 | i | | | 0 | 0.1 | | | | 88-06-2 | 2,4,6-Trichlorophenol | 4.4E+01 | ca | 2.2E+02 | ca | 6.2E-01 | ca | 6.1E+00 | ca | 2.0E-01 | 8.0E-03 |
| | | 1.0E-02 | i | | | 1.0E-02 | r | 0 | 0.1 | | | | 93-76-5 | 2,4,5-Trichlorophenoxyacetic Acid | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |
| | | 8.0E-03 | i | | | 8.0E-03 | r | 0 | 0.1 | | | | 93-72-1 | 2-(2,4,5-Trichlorophenoxy) propionic acid | 4.9E+02 | nc | 7.0E+03 | nc | 2.9E+01 | nc | 2.9E+02 | nc | | |
| | | 5.0E-03 | i | | | 5.0E-03 | r | 1 | | | | | 598-77-6 | 1,1,2-Trichloropropane | 1.5E+01 | nc | 5.1E+01 | nc | 1.8E+01 | nc | 3.0E+01 | nc | | |
| 7.0E+00 | h | 6.0E-03 | i | 7.0E+00 | r | 5.0E-03 | r | 1 | | | | | 96-18-4 | 1,2,3-Trichloropropane | 1.4E-03 | ca | 3.1E-03 | ca | 9.6E-04 | ca | 1.6E-03 | ca | | |
| | | 5.0E-03 | h | | | 5.0E-03 | r | 1 | | | | | 96-19-5 | 1,2,3-Trichloropropene | 1.2E+01 | nc | 3.9E+01 | nc | 1.8E+01 | nc | 3.0E+01 | nc | | |
| | | 3.0E+01 | i | | | 8.6E+00 | h | 1 | | | | | 76-13-1 | 1,1,2-Trichloro-1,2,2-trifluoroethane | 5.6E+03 | sat | 5.6E+03 | sat | 3.1E+04 | nc | 5.9E+04 | nc | | |
| | | 3.0E-03 | i | | | 3.0E-03 | r | 0 | 0.1 | | | | 58138-08-2 | Tridiphane | 1.8E+02 | nc | 2.6E+03 | nc | 1.1E+01 | nc | 1.1E+02 | nc | | |
| | | 2.0E-03 | r | | | 2.0E-03 | i | 1 | | | | | 121-44-8 | Triethylamine | 2.3E+01 | nc | 8.8E+01 | nc | 7.3E+00 | nc | 1.2E+01 | nc | | |
| 7.7E-03 | i | 7.5E-03 | i | 7.7E-03 | r | 7.5E-03 | r | 0 | 0.1 | | | | 1582-09-8 | Trifluralin | 6.3E+01 | ca** | 3.2E+02 | ca* | 8.7E-01 | ca* | 8.7E+00 | ca* | | |
| | | 1.4E-04 | r | | | 1.4E-04 | n | | 0.1 | | | | 552-30-7 | **Trimellitic Anhydride (TMAN)** | 8.6E+00 | nc | 1.2E+02 | nc | 5.1E-01 | nc | 5.1E+00 | | | |
| | | 5.0E-02 | n | | | 1.7E-03 | n | 1 | | | | | 95-63-6 | 1,2,4-Trimethylbenzene | 5.2E+01 | nc | 1.7E+02 | nc | 6.2E+00 | nc | 1.2E+01 | nc | | |
| | | 5.0E-02 | n | | | 1.7E-03 | n | 1 | | | | | 108-67-8 | 1,3,5-Trimethylbenzene | 2.1E+01 | nc | 7.0E+01 | nc | 6.2E+00 | nc | 1.2E+01 | nc | | |
| 3.7E-02 | h | | | 3.7E-02 | r | | | 0 | 0.1 | | | | 512-56-1 | Trimethyl phosphate | 1.3E+01 | ca | 6.7E+01 | ca | 1.8E-01 | ca | 1.8E+00 | ca | | |
| | | 3.0E-02 | i | | | 3.0E-02 | r | 0 | 0.1 | | | | 99-35-4 | 1,3,5-Trinitrobenzene | 1.8E+03 | nc | 2.6E+04 | nc | 1.1E+02 | nc | 1.1E+03 | nc | | |
| | | 1.0E-02 | h | | | 1.0E-02 | r | 0 | 0.1 | | | | 479-45-8 | Trinitrophenylmethylnitramine | 6.1E+02 | nc | 8.8E+03 | nc | 3.7E+01 | nc | 3.6E+02 | nc | | |

Key: i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

# FOR PLANNING PURPOSES

| TOXICITY INFORMATION | | | | | | | | | | | | CONTAMINANT | PRELIMINARY REMEDIATION GOALS (PRGs) | | | | | | | | SOIL SCREENING LEVELS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SFo 1/(mg/kg-d) | | RfDo (mg/kg-d) | | SFi 1/(mg/kg-d) | | RfDi (mg/kg-d) | | V O C | skin abs. soils | | CAS No. | | Residential Soil (mg/kg) | | Industrial Soil (mg/kg) | | Ambient Air (ug/m^3) | | Tap Water (ug/l) | | Migration to Ground Water DAF 20 (mg/kg) | DAF 1 (mg/kg) |
| 3.0E-02 | i | 5.0E-04 | i | 3.0E-02 | r | 5.0E-04 | r | 0 | 0.1 | 118-96-7 | 2,4,6-Trinitrotoluene | 1.6E+01 | ca** | 8.2E+01 | ca** | 2.2E-01 | ca** | 2.2E+00 | ca** | | |
| | | 1.0E-01 | n | | | 1.0E-01 | r | | 0.1 | 791-28-6 | **Triphenylphosphine oxide** | 6.1E+03 | nc | 8.8E+04 | nc | 3.7E+02 | nc | 3.6E+03 | nc | | |
| 1.4E-02 | n | 3.0E-01 | n | 1.4E-02 | r | 3.0E-01 | r | | 0.1 | 115-96-8 | **Tris(2-chloroethyl) phosphate** | 3.5E+01 | ca | 1.8E+02 | ca | 4.8E-01 | ca | 4.8E+00 | ca | | |
| | | 2.0E-04 | n | | | | | | | 7440-61-0 | **Uranium (chemical toxicity only)** | 1.6E+01 | nc | 4.1E+02 | nc | | | 7.3E+00 | nc | | |
| | | 7.0E-03 | h | | | | | 0 | | 7440-62-2 | Vanadium and compounds | 5.5E+02 | nc | 1.4E+04 | nc | | | 2.6E+02 | nc | 6.0E+03 | 3.0E+02 |
| | | 1.0E-03 | i | | | 1.0E-03 | r | 0 | 0.1 | 1929-77-7 | Vernam | 6.1E+01 | nc | 8.8E+02 | nc | 3.7E+00 | nc | 3.6E+01 | nc | | |
| | | 2.5E-02 | i | | | 2.5E-02 | r | 0 | 0.1 | 50471-44-8 | Vinclozolin | 1.5E+03 | nc | 2.2E+04 | nc | 9.1E+01 | nc | 9.1E+02 | nc | | |
| | | 1.0E+00 | h | | | 5.7E-02 | i | 1 | | 108-05-4 | Vinyl acetate | 4.3E+02 | nc | 1.4E+03 | nc | 2.1E+02 | nc | 4.1E+02 | nc | 1.7E+02 | 8.0E+00 |
| 1.1E-01 | r | 8.6E-04 | r | 1.1E-01 | h | 8.6E-04 | i | 1 | | 593-60-2 | Vinyl bromide (bromoethene) | 1.9E-01 | ca* | 4.2E-01 | ca* | 6.1E-02 | ca* | 1.0E-01 | ca* | | |
| 1.5E+00 | i | 3.0E-03 | i | 3.1E-02 | i | 2.9E-02 | i | 1 | | 75-01-4 | **Vinyl chloride (child/adult)** | 1.5E-01 | ca | | | 2.2E-01 | ca | 4.1E-02 | ca | 1.0E-02 | 7.0E-04 |
| 7.5E-01 | i | 3.0E-03 | i | 1.6E-02 | i | 2.9E-02 | i | 1 | | 75-01-4 | **Vinyl chloride (adult)** | | | 8.3E-01 | ca | | | | | | |
| | | 3.0E-04 | i | | | 3.0E-04 | r | 0 | 0.1 | 81-81-2 | Warfarin | 1.8E+01 | nc | 2.6E+02 | nc | 1.1E+00 | nc | 1.1E+01 | nc | | |
| | | 2.0E+00 | i | | | 2.0E-01 | x | 1 | 0.1 | 1330-20-7 | Xylenes | 2.1E+02 | sat | 2.1E+02 | sat | 7.3E+02 | nc | 1.4E+03 | nc | 2.1E+02 | 1.0E+01 |
| | | 3.0E-01 | i | | | | | 0 | | 7440-66-6 | Zinc | 2.3E+04 | nc | 1.0E+05 | max | | | 1.1E+04 | nc | 1.2E+04 | 6.2E+02 |
| | | 3.0E-04 | i | | | | | 0 | | 1314-84-7 | Zinc phosphide | 2.3E+01 | nc | 6.1E+02 | nc | | | 1.1E+01 | nc | | |
| | | 5.0E-02 | i | | | 5.0E-02 | r | 0 | 0.1 | 12122-67-7 | Zineb | 3.1E+03 | nc | 4.4E+04 | nc | 1.8E+02 | nc | 1.8E+03 | nc | | |

# VOLUME 2

# TIER 1: SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

## PHASE I
## Scoping Assessment

## Table Of Contents

1. Introduction ..... 1
2. Scoping Assessment ..... 2
   2.1 Compile and Assess Basic Site Information ..... 2
   2.2 Site Visit ..... 3
   2.3 Identify Contaminants of Potential Ecological Concern ..... 4
   2.4 Developing the Preliminary Conceptual Site Exposure Model ..... 4
   2.5 Assembling the Scoping Assessment Report ..... 6
3. Site Exclusion Criteria ..... 9
4. Technical Decision Point: Is Ecological Risk Suspected? ..... 9

# 1. INTRODUCTION

The purpose of an ecological risk assessment is to evaluate the potential adverse effects that chemical contamination has on the plants and animals that make up ecosystems. The risk assessment process provides a way to develop, organize and present scientific information so that it is relevant to environmental decisions.

The New Mexico Environment Department Hazardous and Radioactive Materials Bureau (NMED) has developed a tiered procedure for the evaluation of ecological risk. This procedure is outlined in the *Guidance for Assessing Ecological Risks Posed by Chemicals: Screening-Level Ecological Risk Assessment* (GAERPC) (NMED, 2000). Briefly, the tiers of the procedure are organized as follows:

PHASE I: QUALITATIVE ASSESSMENT

- Tier I: Screening-Level Ecological Risk Assessment
- Scoping Assessment
- Screening Assessment

PHASE II: QUANTITATIVE ASSESSMENT

- Tier II: Site-Specific Ecological Risk Assessment

As discussed above and illustrated in Figure 1, the Scoping Assessment is the first phase of the Tier I Screening-Level Ecological Risk Assessment process as defined by the NMED GAERPC. This document provides specific procedures to assist the facility in conducting the first step (Scoping Assessment) of the Tier I, Screening-Level Ecological Risk Assessment process outlined in the GAERPC. The purpose of the Scoping Assessment is to gather information which will be used to determine if there is "any reason to believe that ecological receptors and/or complete exposure pathways exist at or in the locality of the site" (NMED, 2000). The scoping assessment step also serves as the initial information gathering phase for sites clearly in need of a more detailed assessment of potential ecological risk. This document outlines the methodology for conducting a Scoping Assessment, and includes a Site Assessment Checklist (Attachment A) which serves as tool for gathering information about the facility property and surrounding areas. Although the GAERPC provides a copy of the US EPA Checklist for Ecological Assessment/Sampling (US EPA, 1997), the attached Site Assessment Checklist provides an expanded, user-friendly template which both guides the user as to what information to collect and furnishes an organized structure in which to enter the information.

After the Site Assessment Checklist has been completed, the assessor must use the collected information to generate a Scoping Assessment Report and Preliminary Conceptual Site Exposure Model (PCSEM). Guidance for performing these tasks is provided in this document, and in the GAERPC. The Scoping Assessment Report and PCSEM are subsequently used to address the first in a series of Technical Decision Points of the tiered

GAERPC process. Technical Decision Points are questions which must be answered by the assessor after the completion of certain phases in the process. The resulting answer to the question determines the next step to be undertaken by the facility. The first Technical Decision Point, as illustrated in Figure 1, is to decide: *Is Ecological Risk Suspected?*

If the answer to the first Technical Decision Point is "no" (that is, ecological risk is not suspected), the assessor may use the Exclusion Criteria Checklist and Decision Tree (Attachment B) to help confirm or deny that possibility. However, it is unlikely that any site containing potential ecological habitat or receptors will meet the Site Exclusion Criteria.

If ecological risk is suspected, the facility will usually be directed to proceed to the next phase of Tier I, which is a Screening Level Ecological Risk Assessment (SLERA). A SLERA is a simplified risk assessment that can be conducted with limited site-specific data by defining assumptions for parameters that lack site-specific data (US EPA, 1997). Values used for screening are consistently biased in the direction of overestimating risk to ensure that sites that might pose an ecological risk are properly identified. The completed Site Assessment Checklist is a valuable source of information needed for the completion of the SLERA. Instructions for performing a SLERA can be found in the GAERPC and in a number of EPA guidance documents (e.g., US EPA, 1997; US EPA, 1998).

# 2. Scoping Assessment

The Scoping Assessment serves as the initial information gathering and evaluation phase of the Tier I process. A Scoping Assessment consists of the following steps:

- Compile and Assess Basic Site Information (using Site Assessment Checklist)
- Conduct Site Visit
- Identify Preliminary Contaminants of Potential Ecological Concern
- Develop a Preliminary Conceptual Site Exposure Model
- Prepare a Scoping Assessment Report

The following subsections provide guidance for completing each step of the Scoping Assessment. For additional guidance, readers should refer to the GAERPC (NMED, 2000).

## 2.1 Compile and Assess Basic Site Information

The first step of the Scoping Assessment process is to compile and assess basic site information. Since the purpose of the Scoping Assessment is to determine if ecological habitats, receptors, and complete exposure pathways are likely to exist at the site, those items are the focus of the information gathering. The Site Assessment Checklist (Attachment A) should be used to complete this step. The questions in the Site Assessment Checklist should be addressed as completely as possible with the information available before conducting a site visit.

In many cases, a large portion of the Site Assessment Checklist can be completed using reference materials and general knowledge of the site. A thorough file search should be conducted to compile all potential reference materials. Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) and Facility Investigation (RFI) reports, inspection reports, RCRA Part B Permit Applications, and facility maps can all be good sources of the information needed for the Site Assessment Checklist.

Habitats and receptors which may be present at the site can be identified by contacting local and regional natural resource agencies. Habitat types may be determined by reviewing land use and land cover maps (LULC), which are available via the Internet at http://www.nationalatlas.gov/scripts. Additional sources of general information for the identification of ecological receptors and habitats are listed in the introduction section of the Site Assessment Checklist (Attachment A).

After all available information has been compiled and entered into the Site Assessment Checklist, the assessor should review the checklist and identify data gaps. Plans should then be made to obtain the missing information by performing additional research and/or by observation and investigation during the site visit.

## 2.2 Site Visit

When performing a Scoping Assessment, at least one site visit should be conducted to directly assess ecological features and conditions. As discussed in the previous section, completion of the Site Assessment Checklist should have begun during the compilation of basic site information. The site visit allows for verification of the information obtained from the review of references and other information sources. The current land and surface water usage and characteristics at the site can be observed, as well as direct and indirect evidence of receptors. In addition to the site, areas adjacent to the site and all areas where ecological receptors are likely to contact site-related chemicals (i.e., all areas which may have been impacted by the release or migration of chemicals from the site) should be observed or visited and addressed in the Site Assessment Checklist. The focus of the habitat and receptor observations should be on a community level. That is, dominant plant and animal species and habitats (e.g., wetlands, wooded areas) should be identified during the site visit. Photographs should be taken during the site visit and attached to the Scoping Assessment Report. Photographs are particularly useful for documenting the nature, quality, and distribution of vegetation, other ecological features, potential exposure pathways, and any evidence of contamination or impact. While the focus of the survey is on the community level, the U.S. Fish and Wildlife Service and the New Mexico Natural Heritage Program should be contacted prior to the site visit. The intent is to determine if state listed and/or federal listed Threatened & Endangered (T&E) species or sensitive habitats may be present at the site, or if any other fish or wildlife species could occur in the area (as indicated in the Site Assessment Checklist, Section IIID). A trained biologist or ecologist should conduct the biota surveys to appropriately characterize major habitats and to determine whether T&E species are present or may potentially use the site. The site assessment should also include a general survey for T&E species and any sensitive habitats (e.g. wetlands, perennial waters, breeding areas), due to the fact that federal and state databases might not be complete.

Site visits should be conducted at times of the year when ecological features are most apparent (i.e., spring, summer, early fall). Visits during winter might not provide as much evidence of the presence or absence of receptors and potential exposure pathways.

In addition to observations of ecological features, the assessor should note any evidence of chemical releases (including visual and olfactory clues), drainage patterns, areas with apparent erosion, signs of groundwater discharge at the surface (such as seeps or springs), and any natural or anthropogenic site disturbances.

## 2.3 Identify Contaminants of Potential Ecological Concern

Contaminants of Potential Ecological Concern (COPECs) are chemicals which may pose a threat to individual species or biological communities. For the purposes of the Scoping Assessment, all chemicals known or suspected of being released at the site are considered COPECs. The identification of COPECs is usually accomplished by the review of historical information in which previous site activities and releases are identified, or by sampling data which confirm the presence of contaminants in environmental media at the site. If any non-chemical stressors such as mechanical disturbances or extreme temperature conditions are known to be present at the site, they too are to be considered in the assessment.

After the COPECs have been identified, they should be summarized and organized (such as in table or chart form) for presentation in the Scoping Assessment Report.

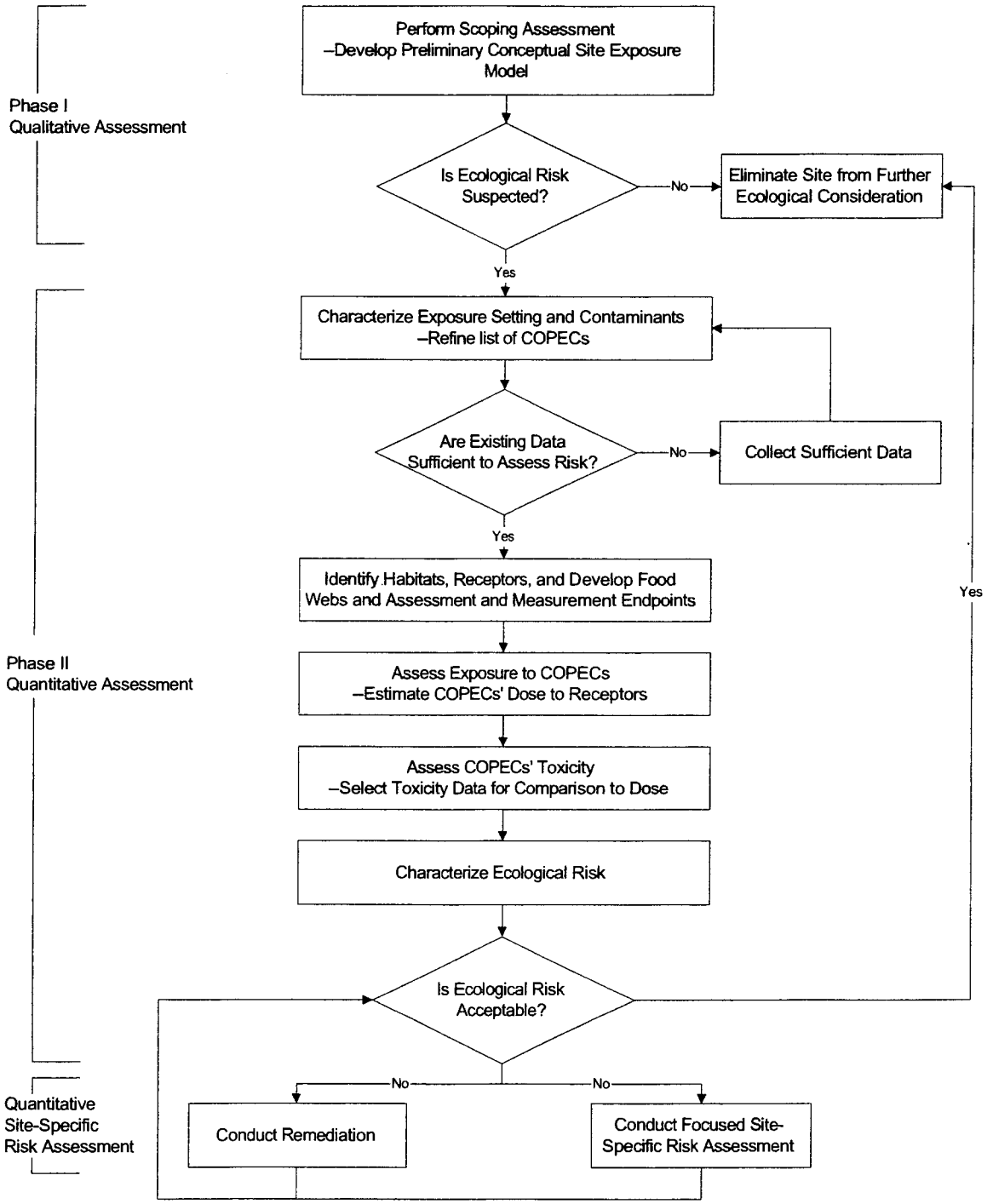
## 2.4 Developing the Preliminary Conceptual Site Exposure Model

A PCSEM provides a summary of potentially complete exposure pathways, along with potentially exposed receptor types. The PCSEM, in conjunction with the scoping report, is used to determine whether further ecological assessment (i.e., Screening-Level Assessment, Site-Specific Assessment) and/or interim measures are required.

A complete exposure pathway is defined as a pathway having all of the following attributes (US EPA, 1998; NMED, 2000):

- A source and mechanism for hazardous waste/constituent release to the environment
- An environmental transport medium or mechanism by which a receptor can come into contact with the hazardous waste/constituent
- A point of receptor contact with the contaminated media or via the food web, and
- An exposure route to the receptor.

If any of the above components are missing from the exposure pathway, it is not a complete pathway for the site. A discussion regarding all possible exposure pathways and the rationale/justification for eliminating any pathways should be included in the PCSEM narrative and in the Scoping Assessment Report.




Adapted from GAERPC (NMED 2000).

**Figure 1. NMED Ecological Risk Assessment Process**

The PCSEM is presented as both a narrative discussion and a diagram illustrating potential contaminant migration and exposure pathways to ecological receptors. A sample PCSEM diagram is presented in Figure 2. On the PCSEM diagram, the components of a complete exposure pathway are grouped into three main categories: sources, release mechanisms, and potential receptors. As a contaminant migrates and/or is transformed in the environment, sources and release mechanisms can be defined as primary, secondary, and tertiary.

For example, Figure 2 depicts releases from a landfill that migrate into soils, and reach nearby surface water and sediment via storm water runoff. In this situation, the release from the landfill is considered the primary release, with infiltration as the primary release mechanism. Soil becomes the secondary source, and storm water runoff is the secondary release mechanism to surface water and sediments, the tertiary source.

Subsequent ecological exposures to terrestrial and aquatic receptors will result from this release. The primary exposure routes to ecological receptors are direct contact, ingestion, and possibly inhalation. For example, plant roots will be in direct contact with contaminated sediments, and burrowing mammals will be exposed via dermal contact with soil and incidental ingestion of contaminated soil. In addition, exposures for birds and mammals will occur as they ingest prey items through the food web.

Although completing the Site Assessment Checklist will not provide the user with a ready made PCSEM, a majority of the components of the PCSEM can be found in the information provided by the Site Assessment Checklist. The information gathered for the completion of Section II of the Site Assessment Checklist, can be used to identify sources of releases. The results of Section III, Habitat Evaluation, can be used to both identify secondary and tertiary sources and to identify the types of receptors which may be exposed. The information gathered for completion of Section IV, Exposure Pathway Evaluation, will assist users in tracing the migration pathways of releases in the environment, thus helping to identify release mechanisms and sources.

Once all of the components of the conceptual model have been identified, complete exposure pathways and receptors that have the potential for exposure to site releases can be identified.

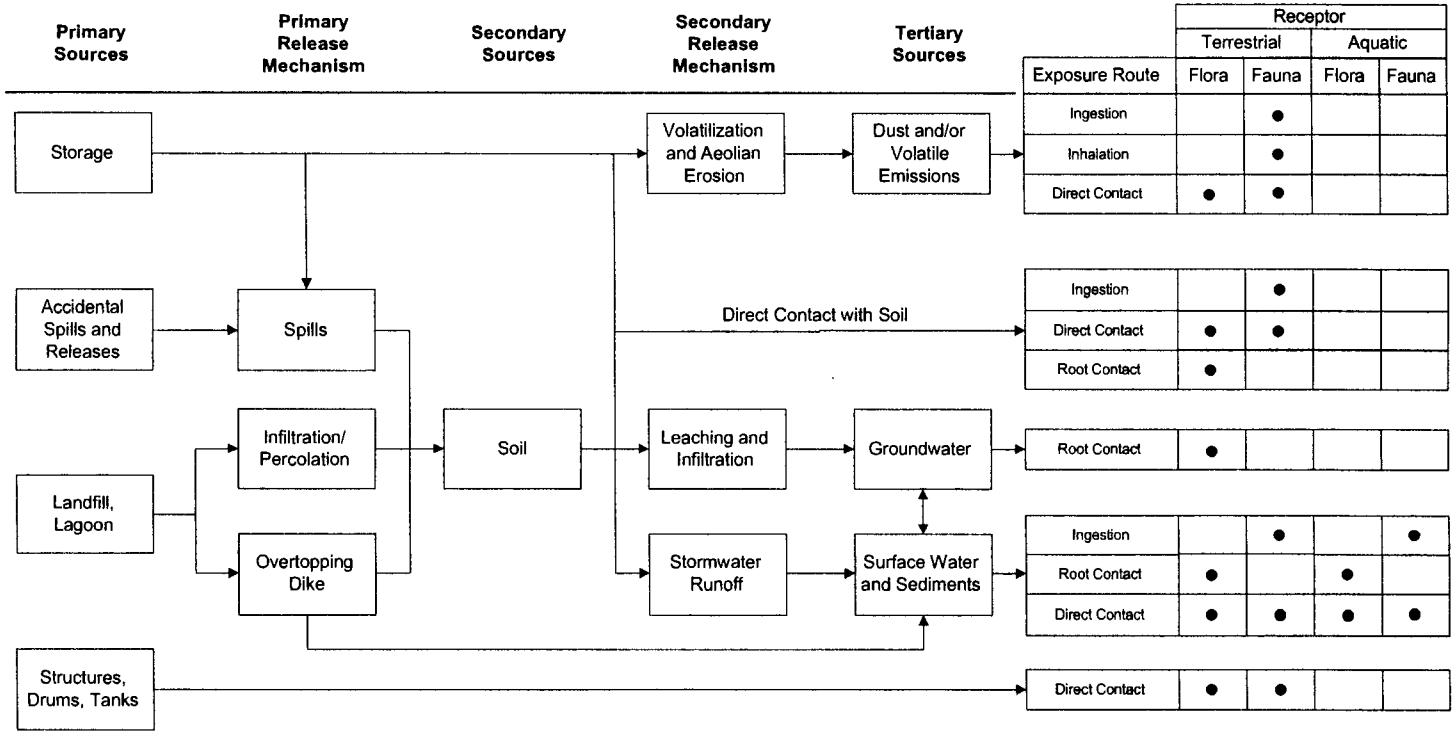
For further guidance on constructing a PCSEM, consult the GAERPC (NMED, 2000), and EPA's Office of Solid Waste and Emergency Response's *Soil Screening Guidance: User's Guide* (1996).

## 2.5 Assembling the Scoping Assessment Report

After completion of the previously described activities of the scoping assessment, the Scoping Assessment Report should be assembled to summarize the site information and present an evaluation of receptors and pathways at the site. The Scoping Assessment Report should be designed to support the decision made regarding the first Technical Decision Point (Is Ecological Risk Suspected?). The Scoping Assessment Report should, at a minimum, contain the following information:

- Existing Data Summary
- Site Visit Summary (including a completed Site Assessment Checklist)
- Evaluation of Receptors and Pathways
- Recommendations
- Attachments (e.g. photographs, field notes, telephone conversation logs with natural resource agencies)
- References/Data Sources

After completion, the Scoping Assessment Report and PCSEM should be submitted to NMED for review and approval. These documents will serve as a basis for decisions regarding future actions at the site.




Adapted from GAERPC (NMED 2000).

**Figure 2. Example Preliminary Conceptual Site Exposure Model Diagram for a Hypothetical Site**

# 3. SITE EXCLUSION CRITERIA

If the assessor believes that the answer to the first Technical Decision Point (Is Ecological Risk Suspected?) is "no" based on the results of the PCSEM and Scoping Assessment Report, it should be determined whether the facility meets the NMED Site Exclusion Criteria.

Exclusion criteria are defined as those conditions at an affected property which eliminate the need for a SLERA. The three criteria are as follows:

- Affected property does not include viable ecological habitat.
- Affected property is not utilized by potential receptors.
- Complete or potentially complete exposure pathways do not exist due to affected property setting or conditions of affected property media.

The Exclusion Criteria Checklist and associated Decision Tree (Attachment B) can be used as a tool to help the user determine if an affected site meets the exclusion criteria. The checklist assists in making a conservative, qualitative determination of whether viable habitats, ecological receptors, and/or complete exposure pathways exist at or in the locality of the site where a release of hazardous waste/constituents has occurred. Thus, meeting the exclusion criteria means that the facility can answer "no" to the first Technical Decision Point.

If the affected property meets the Site Exclusion Criteria, based on the results of the checklist and decision tree, the facility must still submit a Scoping Assessment Report to NMED which documents the site conditions and justification for how the criteria have been met. Upon review and approval of the exclusion by the appropriate NMED Bureau, the facility will not be required to conduct any further evaluation of ecological risk. However, the exclusion is not permanent; a future change in circumstances may result in the affected property no longer meeting the exclusion criteria.

# 4. TECHNICAL DECISION POINT: IS ECOLOGICAL RISK SUSPECTED?

As discussed in the beginning of this document, the Scoping Assessment is the first phase of the GAERPC ecological risk assessment process (Figure 1). Following the submission of the Scoping Assessment Report and PCSEM, NMED will decide upon one of the following three recommendations for the site:

- No further ecological investigation at the site, or
- Continue the risk assessment process, and/or
- Undertake a removal or remedial action.

If the information presented in the Scoping Assessment Report supports the answer of "no" to the first Technical Decision Point, and the site meets the exclusion criteria, the site will likely be excused from further consideration of ecological risk. However, this is only true if it can be documented that a complete exposure pathway does not exist and will not exist in the future at the site based on current conditions. For those sites where valid pathways for potential exposure exist or are likely to exist in the future, further ecological risk assessment (usually in the form of a SLERA) will be required. However, if the Scoping Assessment indicates that a detailed assessment is warranted, the facility would not be required to conduct a SLERA. Instead the facility would move directly to Tier II–Site-Specific Ecological Risk Assessment.

## References

Los Alamos National Laboratory (LANL), 1997. *Administrative Procedure 4.5*, Draft

New Mexico Environment Department (NMED), 2000. *Guidance for Assessing Ecological Risks Posed by Chemicals: Screening-Level Ecological Risk Assessment*, Hazardous and Radioactive Materials Bureau, Final, March.

U.S. Environmental Protection Agency (US EPA), 1996. *Soil Screening Guidance: User's Guide.* Office of Solid Waste and Emergency Response. Washington, DC. EPA-540-R-96/018. July.

US EPA, 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Environmental Response Team, Interim Final, June 5.

US EPA, 1998. *Guidelines for Ecological Risk Assessment*, Risk Assessment Forum, Final, April. EPA/630/R-95/002F; http://www.epa.gov/ncea/ecorisk.htm.

OSWER 9240.1-05A-P
PB99-963506
EPA540/R-99/008
October 1999

# USEPA CONTRACT LABORATORY PROGRAM NATIONAL FUNCTIONAL GUIDELINES FOR ORGANIC DATA REVIEW

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

# NOTICE

The polices and procedures set forth here are intended as guidance to the Agency and other governmental employees. They do not constitute rule making by the agency, and may not be relied on to create a substantive or procedural right enforceable by any other person. The Government may take action that is at variance with the policies and procedures in this manual.

Additional copies of this document can be obtained from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650
Document Number PB 99-963506

This document can also be obtained from the EPA's Contract Laboratory Program Web site at:

http://www.epa.gov/superfund/programs/clp/guidance.htm

## TABLE OF CONTENTS

**INTRODUCTION** . . . . . 1

**PRELIMINARY REVIEW** . . . . . 2

**DATA QUALIFIER DEFINITIONS** . . . . . 4

**VOLATILE DATA REVIEW** . . . . . 5

I. Holding Times . . . . . 6

II. GC/MS Instrument Performance Check . . . . . 9

III. Initial Calibration . . . . . 12

IV. Continuing Calibration . . . . . 17

V. Blanks . . . . . 20

VI. System Monitoring Compounds . . . . . 24

VII. Matrix Spikes/Matrix Spike Duplicates . . . . . 27

VIII. Laboratory Control Samples . . . . . 29

IX. Regional Quality Assurance and Quality Control . . . . . 31

X. Internal Standards . . . . . 32

XI. Target Compound Identification . . . . . 34

XII. Compound Quantitation and Reported CRQLs . . . . . 36

XIII. Tentatively Identified Compounds . . . . . 38

XIV. System Performance . . . . . 42

XV. Overall Assessment of Data . . . . . 44

**SEMIVOLATILE DATA REVIEW** . . . . . 45

I. Holding Times . . . . . 46

II. GC/MS Instrument Performance Check . . . . . 48

III. Initial Calibration . . . . . 51

IV. Continuing Calibration . . . . . 55

V. Blanks . . . . . 58

VI. Surrogate Spikes . . . . . 61

VII. Matrix Spikes/Matrix Spike Duplicates . . . . . 64

VIII. Laboratory Control Samples . . . . . 66

IX. Regional Quality Assurance and Quality Control . . . . . 68

X. Internal Standards . . . . . 69

XI. Target Compound Identification . . . . . 71

XII. Compound Quantitation and Reported CRQLS . . . . . 73

XIII. Tentatively Identified Compounds . . . . . 75

XIV. System Performance . . . . . 80

XV. Overall Assessment of Data . . . . . 82

**PESTICIDE/AROCLOR DATA REVIEW** . . . . . 83

I. Holding Times . . . . . 84

II. GC/ECD Instrument Performance Check . . . . . 86

III. Initial Calibration . . . . . 92

IV. Calibration Verification . . . . . 96

V. Blanks . . . . . 99

VI. Surrogate Spikes . . . . . 103

**PESTICIDE/AROCLOR DATA REVIEW (cont.)**


VII. Matrix Spikes/Matrix Spike Duplicates . . . . . 106

VIII. Laboratory Control Samples . . . . . 108

IX. Regional Quality Assurance and Quality Control . . . . . 110

X. Pesticide Cleanup Checks . . . . . 111

XI. Target Compound Identification . . . . . 113

XII. Compound Quantitation and Reported CRQLS . . . . . 116

XIII. Overall Assessment of Data . . . . . 118

# INTRODUCTION

This document is designed to offer guidance on EPA Contract Laboratory Program (CLP) organic analytical data evaluation and review. In some applications it may be used as a Standard Operating Procedure (SOP). In other, more subjective areas, only general guidance is offered due to the complexities and uniqueness of data relative to specific samples. For example, areas where the application of specific SOPs are possible are primarily those in which definitive performance criteria are established. These criteria are concerned with specifications that are not sample dependent; they specify performance requirements that should fully be under a laboratory's control. These specific areas include blanks, calibration standards, performance evaluation standard materials, and instrument performance checks (tuning).

These guidelines include the requirements for the Organic Analysis Multi-Media, Multi-Concentration method, and for the Low Concentration Water Organic Analysis method. *To ensure that the data review guidelines that are unique to the Low Concentration Water Samples are easily identified, these requirements and procedures are presented in italics and contained within brackets* ([ ]) *throughout the document.*

This document is intended to assist in the technical review of analytical data generated through the CLP. Determining contract compliance is not the intended objective of these guidelines. The data review process provides information on analytical limitations of data based on specific quality control (QC) criteria. In order to provide more specific usability statements, the reviewer must have a complete understanding of the intended use of the data. For this reason, it is recommended that whenever possible the reviewer obtain usability issues from the user prior to reviewing the data. When this is not possible, the user should be encouraged to communicate any questions of the reviewer.

At times, there may be a need to use data which does not meet all contract requirements and technical criteria. Use of these data does not constitute either a new requirement standard or full acceptance of the data. Any decision to utilize data for which performance criteria have not been met is strictly to facilitate the progress of projects requiring the availability of the data. A contract laboratory submitting data which are out of specification may be required to rerun samples or resubmit data, even if the previously submitted data have been utilized due to program needs. Data which do not meet specified requirements are never fully acceptable. The only exception to this condition is in the area of the requirements for individual sample analysis; if the nature of the sample itself inhibits the attainment of specifications, appropriate allowances must be made.

## PRELIMINARY REVIEW

In order to use this document effectively, the reviewer should have a general overview of the Sample Delivery Group (SDG) or sample Case at hand. The exact number of samples, their assigned numbers, their matrix and the number of laboratories involved in their analysis are essential information. Background information on the site is helpful but often this information may be difficult to locate. The site manager is the best source for answers to questions or further direction.

Sample cases (SDGs) routinely have unique samples which require special attention by the reviewer. These include field blanks, field duplicates, and performance audit samples which need to be identified. The sampling records should identify:

1. The Project Officer for site.

2. The Complete list of samples with information on:

   a. sample matrix,
   b. field blanks,
   c. field duplicates,
   d. field spikes,
   e. QC audit samples,
   f. shipping dates,
   g. preservatives, and
   h. laboratories involved.

The chain-of-custody record includes sample descriptions and date(s) of sampling. The reviewer must take into account lag times between sampling and start of analysis when assessing technical sample holding times.

The laboratory's SDG Narrative is another source of general information. Notable problems with matrices, insufficient sample volume for analysis or re-analysis, samples received in broken containers, preservation, and unusual events should be found in the SDG Narrative.

The SDG Narrative for the sample data package must include a Laboratory Certification Statement (exactly as written in the method), signed by the laboratory manager or his designee. This statement authorizes the validation and release of the sample data results. In addition, the laboratory must also provide comments in the SDG Narrative describing in detail any problems encountered in processing the samples in the data package.

For every data package, the reviewer must verify that the laboratory certification statement is present, exactly stated as in the method (i.e., verbatim to the statement in the method), and signed by the laboratory manager or designee. The reviewer must further verify that the data package is consistent with the laboratory's certified narrative. Also, the reviewer should check the comments provided in the narrative to determine if they are sufficient to describe and explain any associated problem(s).

The data review should include comments that clearly identify the problems associated with a Case or Sample Delivery Group and to state the limitations of the data. Documentation should include the sample number, analytical method, extent of the problem, and assigned qualifiers.

A data review narrative generally accompanies the laboratory data forwarded to the intended data recipient (client) or user to promote communications. A copy of the data review narrative should be submitted to the EPA Project Officer assigned oversight responsibility for the laboratory producing the data.

It is a responsibility to notify the appropriate EPA Project Officer concerning problems and deficiencies with regard to laboratory data. If there is an urgent requirement, the EPA Project Officer may be contacted by telephone to expedite corrective action. It is recommended that all items for EPA Project Officer action be presented at one time.

## DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the national qualifiers assigned to results in the data review process. If the Regions choose to use additional qualifiers, a complete explanation of those qualifiers should accompany the data review.

**U** - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

**J** - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

**N** - The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".

**NJ** - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

**UJ** - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

**R** - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

## VOLATILE DATA REVIEW

** * *Data review guidelines that are unique to data generated through the Low Concentration Water Method are contained within brackets ([]) and written in italics. * * **

The volatile data requirements to be checked are listed below:

I. Holding Times

II. GC/MS Instrument Performance Check

III. Initial Calibration

IV. Continuing Calibration

V. Blanks

VI. System Monitoring Compounds

VII. Matrix Spikes/Matrix Spike Duplicates

*[VIII. Laboratory Control Samples]*

IX. Regional Quality Assurance and Quality Control

X. Internal Standards

XI. Target Compound Identification

XII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs)

XIII. Tentatively Identified Compounds

XIV. System Performance

XV. Overall Assessment of Data

## I. Holding Times

**A. Review Items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, EPA Sample Traffic Report and/or chain-of-custody, raw data, and SDG Narrative.

**B. Objective:**

The objective is to ascertain the validity of the analytical results based on the holding time of the sample from the time of collection to the time of analysis.

**C. Criteria:**

Technical requirements for sample holding times have only been established for water matrices.

The technical holding time criteria for water samples are as follows:

For non-aromatic volatile compounds in cooled (@4°C) water samples, the maximum holding time is 14 days from sample collection.

Maximum holding times for purgeable aromatic hydrocarbons in cooled (@4°C±2°C), acid-preserved (with HCl to pH 2 or below) water samples is 14 days from sample collection.

Water samples that have not been maintained at 4°C (±2°C) and preserved to a pH of 2 or below should be analyzed within 7 days from sample collection. If insufficient ice is used to ship samples, the laboratory may receive samples with no ice left in the cooler. Under these circumstances, the temperature of the samples may exceed 4°C.

**NOTE:** It is further recommended that volatile compounds in properly preserved (4°C±2°C) nonaqueous samples be analyzed within 14 days of sample collection.

The method maximum holding times, which differ from the technical maximum holding times, state that water and soil samples are to be analyzed within 10 days from the validated time of sample receipt (VTSR) at the laboratory.

**D. Evaluation:**

Technical holding times are established by comparing the sampling dates on the EPA Sample Traffic Report with dates of analysis on Form I VOA-1 and Form I VOA-2 *[Form I LCV]* and the raw data. Information contained in the Complete SDG File should also be considered in the determination of holding times. Verify that the analysis dates on the Form Is and the raw data/SDG file are identical. Review the SDG Narrative to determine if samples were preserved. If there is no indication in the SDG Narrative or the sample records that there was a problem with the samples (e.g., samples not maintained @ 4°C or containing headspace in the samples), then the integrity of samples can be assumed to be good. If it is indicated that there were problems with the samples, then the integrity of the sample may have been compromised and professional

judgement should be used to evaluate the effect of the problem on the sample results.

**E. Action:**

1. If technical holding times are exceeded, document in the data review narrative that holding times were exceeded and qualify the sample results as follows (also see Table 1):

   a. If there is no evidence that the samples were properly preserved and the technical holding times exceeded 7 days, qualify positive results for aromatic compounds with "J" and sample quantitation limits with "UJ". Use professional judgement to determine if and how non-aromatic volatile compounds should also be qualified.

   b. If the samples were properly preserved but the technical holding times exceeded 14 days, qualify positive results with "J" and sample quantitation limits with "UJ".

   Table 1. Qualification of Volatile Analytes Based on Technical Holding Times

| MATRIX | PRESERVED | > 7 DAYS | > 14 DAYS |
|---|---|---|---|
| Water | No | All Aromatics* | All Compounds |
| | Yes | None | All Compounds |
| Non-Aqueous | No/Yes | Professional Judgement | Professional Judgement |

   * Reviewer should use professional judgement to determine if data for additional compounds require qualification.

2. If technical holding times are grossly exceeded (e.g., by greater than two times the required time for volatiles) either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effects of additional storage on the sample results. Should the reviewer determine that qualification is necessary, non-detected volatile target compounds may be qualified unusable (R). Positive results are considered approximates and are qualified with "J".

3. Due to limited information concerning holding times for non-aqueous samples, it is left to the discretion of the data reviewer to apply water holding times or other information that is available.

4. Whenever possible, the reviewer should comment on the effect of the holding time exceedance on the resulting data in the data review narrative.

**VOA**

5. When method and/or technical holding times are grossly exceeded, this should be noted for EPA Project Officer action.

6. The reviewer should also be aware of the scenario in which the laboratory has exceeded the technical holding times, but met method holding times. In this case, the data reviewer should notify the EPA Project Officer (where samples were collected) and/or RSCC that shipment delays have occurred so that the field problem can be corrected. The reviewer may pass this information on to the laboratory's EPA Project Officer, but should explain that the laboratory met the requirements in the method.

## II. GC/MS Instrument Performance Check

**A. Review Items:** Form V VOA *[Form V LCV],* BFB mass spectra and mass listing.

**B. Objective:**

Gas chromatograph/mass spectrometer (GC/MS) instrument performance checks are performed to ensure mass resolution, identification, and to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials, therefore, these criteria should be met in all circumstances.

**C. Criteria:**

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples or standards are analyzed. The instrument performance check, bromofluorobenzene (BFB) for volatile analysis, must meet the ion abundance criteria given below:

Bromofluorobenzene (BFB)

| m/z | ION ABUNDANCE CRITERIA |
|---|---|
| 50 | 8.0 - 40.0% of m/z 95 |
| 75 | 30.0 - 66.0% of m/z 95 |
| 95 | Base peak, 100% relative abundance |
| 96 | 5.0 - 9.0% of m/z 95 |
| 173 | Less than 2.0% of m/z 174 |
| 174 | 50.0 - 120.0% of m/z 95 |
| 175 | 4.0-9.0% of mass 174 |
| 176 | 93.0 - 101.0% of m/z 174 |
| 177 | 5.0 - 9.0% of m/z 176 |

**NOTE:** All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.

**D. Evaluation:**

1. Compare the data presented for each Instrument Performance Check (Form V VOA *[Form V LCV])* with each mass listing submitted to ensure the following:

   a. Form V VOA *[Form V LCV]* is present and completed for each 12-hour period during which samples were analyzed.

   b. The laboratory has not made transcription errors between the data and the form. If there are major differences between the mass listing and the Form Vs, a more in depth review of the data is required. This may include obtaining and reviewing additional information from the laboratory.

   c. The appropriate number of significant figures has been reported (number of significant figures given for each ion in the ion abundance criteria column) and that rounding is correct.

   d. The laboratory has not made calculation errors.

2. Verify from the raw data (mass spectral listing) that the mass assignment is correct and that the mass listing is normalized to m/z 95.

3. Verify that the ion abundance criteria was met. The criteria for m/z 173, 175, 176, and 177 are calculated by normalizing to the specified m/z.

4. If possible, verify that spectra were generated using appropriate background subtraction techniques. Since the BFB spectrum is obtained from chromatographic peaks that should be free from coelution problems, background subtraction should be done in accordance with the following procedure. Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan no more than 20 scans prior to the elution of BFB. Do not subtract as part of the background the BFB peak.

**NOTE:** All instrument conditions must be identical to those used during the sample analysis. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting the method specifications are contrary to the quality assurance objectives and are therefore unacceptable.

**E. Action:**

1. If the laboratory has made minor transcription errors which do not significantly affect the data, the data reviewer should make the necessary corrections on a copy of the form.

2. If the laboratory has failed to provide the correct forms or has made significant transcription or calculation errors, the Region's designated representative should contact the laboratory and request corrected data. If the information is not available, then the reviewer must use professional judgement to assess the data. The laboratory's EPA Project Officer should be notified.

3. If mass assignment is in error (such as m/z 96 is indicated as the base peak rather than m/z 95), classify all associated data as unusable (R).

4. If ion abundance criteria are not met, professional judgement may be applied to determine to what extent the data may be utilized. Guidelines to aid in the application of professional judgement to this topic are discussed as follows:

   The most important factors to consider are the empirical results that are relatively insensitive to location on the chromatographic profile and the type of instrumentation. Therefore, the critical ion abundance criteria for BFB are the m/z 95/96, 174/175, 74/176, and 176/177 ratios. The relative abundances of m/z 50 and 75 are of lower importance.

5. Decisions to use analytical data associated with BFB instrument performance checks not meeting contract requirements should be clearly noted on the data review narrative.

6. If the reviewer has reason to believe that instrument performance check criteria were achieved using techniques other than those described in II.D.4, then additional information on the instrument performance checks should be obtained. If the techniques employed are found to be at variance with the contract requirements, the performance and procedures of the laboratory may merit evaluation. Concerns or questions regarding laboratory performance should be noted for EPA Project Officer action. For example, if the reviewer has reason to believe that an inappropriate technique was used to obtain background subtraction (such as background subtracting from the solvent front or from another region of the chromatogram rather than the BFB peak), then this should be noted for EPA Project Officer action.

## III. Initial Calibration

**A. Review Items:** Form VI VOA-1 and Form VI VOA-2 *[Form VI LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the volatile target compound list (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve.

**C. Criteria:**

1. Initial calibration standards containing both volatile target compounds and system monitoring compounds are analyzed at concentrations of 10, 20, 50, 100, and 200 ug/L at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met. The initial calibration (and any associated samples and blanks) must be analyzed within 12 hours of the associated instrument performance check.

   *[For data generated through the Low Concentration Water Method: Initial calibration standards containing both volatile target compounds and system monitoring compounds are analyzed at concentrations of 1, 2, 5, 10, and 25 ug/L for non-ketones and 5, 10, 25, 50, and 125 ug/L for ketones at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met.]*

2. Separate initial calibrations must be performed for water samples (or medium level soil samples) and for low level soil samples. The calibration for water samples and medium level soil samples is performed with an unheated purge and the calibration for low level soil samples is performed with a heated purge.

3. Initial calibration standard Relative Response Factors (RRFs) for all volatile target compounds and system monitoring compounds must be greater than or equal to 0.05. (Contractual initial calibration RRF criteria are listed in the appropriate method.)

4. The Percent Relative Standard Deviation (%RSD) from the initial calibration must be less than or equal to 30.0 percent for all compounds.

**D. Evaluation:**

1. Verify that the correct concentration of standards were used for the initial calibration (i.e., 10, 20, 50, 100, and 200 ug/L for water).

   *[Verify that the correct concentration of standards were used for the initial calibration (i.e., 1, 2, 5, 10, and 25 ug/L for non-ketones and 5, 10, 25, 50, and 125 ug/L for ketones).]*

2. Verify that the correct initial calibration was used for water and medium level soil samples (i.e., unheated purge) and for low level soil samples (i.e., heated purge).

3. If any sample results were calculated using an initial calibration, verify that the correct standard (i.e., the 50 ug/L standard) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated instrument performance check.

   *[If any sample results were calculated using an initial calibration, verify that the correct standard (i.e., the 5 ug/L for non-ketones and 25 ug/L for ketones) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated instrument performance check.]*

4. Evaluate the initial calibration RRFs and $\overline{RRF}$ for all volatile target compounds and system monitoring compounds:

   a. Check and recalculate the RRFs and $\overline{RRF}$ for at least one volatile target compound associated with each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that for all volatile target compounds and system monitoring compounds, the initial calibration RRFs are greater than or equal to 0.05.

**NOTE:** The criteria employed for technical data review purposes are different from those used in the method. The laboratory must meet a minimum RRF criterion of 0.0 1, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all volatile compounds.**

Table 2. Volatile Target Compounds Exhibiting Poor Response

| | |
|---|---|
| Acetone | 1,2-Dichloropropane |
| 2-Butanone | 2-Hexanone |
| Carbon Disulfide | Methylene Chloride |
| Chloroethane | 4-Methyl-2-pentanone |
| Chloromethane | **Toluene-d8 †** |
| trans-1,2-Dichloroethene | **1,2-Dichloroethane-d4 †** |
| cis-1,2-Dichloroethene | 1,2-Dibromo-3-chloropropane |

**† Multi-Media, Multi-Concentration only**

5. Evaluate the %RSD for all volatile target compounds and system monitoring compounds:

   a. Check and recalculate the %RSD for one or more volatile target compound(s); verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all volatile target compounds have a %RSD of less than or equal to 30.0 percent. The method criteria for an acceptable initial calibration specifies that up to any 2 volatile target compounds may fail to meet minimum RRF or maximum %RSD as long as they have RRFs that are greater than or equal to 0.010, and %RSD of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %RSD exceeds the ±30.0 percent criterion.

   c. If the %RSD is greater than 30.0 percent, then the reviewer should use professional judgement to determine the need to check the points on the curve for the cause of the non-linearity. This is checked by eliminating either the high point or the low point and recalculating the %RSD.

6. If errors are detected in the calculations of either the RRFs or the %RSD, perform a more comprehensive recalculation.

**E. Action:**

1. All volatile target compounds, including the 14 "poor performers" (See Table 2) will be qualified using the following criteria:

   a. If the %RSD is greater than 30.0 percent and all initial calibration RRFs greater than or equal to 0.05, qualify positive results with "J", and non-detected volatile target compounds using professional judgement.

   b. If any initial calibration RRF is less than 0.05, qualify positive results that have acceptable mass spectral identification with "J", using professional judgement, and non-detected analytes as unusable (R).

2. At the reviewer's discretion, a more in-depth review to minimize the qualification of data can be accomplished by considering the following:

   a. If any of the required volatile compounds have a %RSD greater than 30.0 percent, and if eliminating either the high or the low point of the curve does not restore the %RSD to less than or equal to 30.0 percent.

      i. Qualify positive results for that compound(s) with "J".

      ii. Qualify non-detected volatile target compounds based on professional judgement.

   b. If the high point of the curve is outside of the linearity criteria (e.g., due to saturation):

      i. No qualifiers are required for positive results in the linear portion of the curve.

      ii. Qualify positive results outside of the linear portion of the curve with a "J".

      iii. No qualifiers are needed for volatile target compounds that were not detected.

   c. If the low end of the curve is outside of the linearity criteria:

      i. No qualifiers are required for positive results in the linear portion of the curve.

      ii. Qualify low level positive results in the area of non-linearity with "J".

      iii. Qualify non-detected volatile target compounds based on professional judgement.

**VOA**

3. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

4. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

5. If calibration criteria are grossly exceeded, this should be noted for EPA Project Officer action.

## IV. Continuing Calibration

**A. Review Items:** Form VII VOA-1 and Form VII VOA-2 *[Form VII LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

**C. Criteria:**

1. Continuing calibration standards containing both target compounds and system monitoring compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of the method blank and samples.

2. The continuing calibration RRF for volatile target compounds and system monitoring compounds must be greater than or equal to 0.05.

3. The percent difference (%D) between the initial calibration $\overline{RRF}$ and the continuing calibration RRF must be within ±25.0 percent.

   *[For data generated through the Low Concentration Water Method: The percent difference (%D) between the initial calibration $\overline{RRF}$ and the continuing calibration RRF must be within ±30.0 percent.]*

**D. Evaluation:**

1. Verify that the continuing calibration was run at the required frequency and that the continuing calibration was compared to the correct initial calibration.

2. Evaluate the continuing calibration RRF for all volatile target compounds and system monitoring compounds:

   a. Check and recalculate the continuing calibration RRF for at least one volatile target compound associated with each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all volatile target compounds and system monitoring compounds meet the RRF specifications.

**NOTE:** The criteria employed for data review purposes are different from those defined in the method. The compounds listed in Table 2 (VOA Section III.D.4) have no method maximum %D criteria. The laboratory must meet a minimum RRF criterion of 0.01, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all volatile compounds.**

3. Evaluate the %D between initial calibration RRF and continuing calibration RRF for one or more compound(s).

   a. Check and recalculate the %D for one or more volatile target compound(s) associated with each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that the %D is within ±25.0 percent for all volatile target compounds and system monitoring compounds. Note those compounds which have a %D outside the ±25.0 percent criterion. The method criteria for an acceptable continuing calibration specifies that up to any 2 volatile target compounds may fail to meet minimum RRF or maximum %D as long as they have RRFs that are greater than or equal to 0.010, and %D of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %D exceeds the ±25.0 percent criterion.

4. If errors are detected in the calculations of either the continuing calibration RRF or the %D, perform a more comprehensive recalculation.

**E. Action:**

1. The reviewer should use professional judgement to determine if it is necessary to qualify the data for any volatile target compound. If qualification of data is required, it should be performed using the following guidelines:

   a. If the %D is outside the ±25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify positive results with "J".

   b. If the %D is outside the ±25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify non-detected volatile target compounds with "UJ".

   c. If the continuing calibration RRF is less than 0.05, qualify positive results that have acceptable mass spectral identifications with "J" or use professional judgement.

   d. If the continuing calibration RRF is less than 0.05, qualify non-detected volatile target compounds as unusable (R).

2. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

3. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

4. If calibration criteria are grossly exceeded, this should be noted for EPA Project Officer action.

## V. Blanks

**A. Review Items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, Form IV VOA *[Form IV LCV]*, chromatograms, and quantitation reports.

**B. Objective:**

The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

**C. Criteria:**

1. No contaminants should be found in the blanks.

2. A method blank analysis must be performed after the calibration standards and once for every 12-hour time period beginning with the injection of BFB.

3. The method blank must be analyzed on each GC/MS system used to analyze samples for each type of analysis (i.e., unheated purge (water and medium level soil) and heated purge (low level soil)).

4. A storage blank must be prepared upon receipt of the first samples from an SDG, and stored with samples until analysis. The storage blank must be analyzed once per SDG.

5. An instrument blank must be analyzed after any sample that has saturated ions from a given compound to check that the blank is free of interference and the system is not contaminated.

**D. Evaluation:**

1. Review the results of all associated blanks on the forms and raw data (chromatograms and quantitation reports) to evaluate the presence of target and non-target compounds in the blanks.

2. Verify that a method blank analysis has been reported per matrix, per concentration level, for each 12-hour time period on each GC/MS system used to analyze volatile samples. The reviewer can use the Method Blank Summary (Form IV VOA *[Form IV LCV])* to identify the samples associated with each method blank.

3. Verify that a storage blank has been analyzed and included with each SDG and that the storage blanks are free of contamination.

4. Verify that the instrument blank analysis has been performed following any sample analysis where a target analyte(s) is/are reported at high concentration(s).

**E. Action:**

If the appropriate blanks were not analyzed with the frequency described in Criteria 2, 3, and 4, and 5 then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be noted for EPA Project Officer action.

Action regarding unsuitable blank results depends on the circumstances and origin of the blank. Positive sample results should be reported unless the concentration of the compound in the sample is less than or equal to 10 times (10x) the amount in any blank for the common volatile laboratory contaminants (**methylene chloride, acetone, 2-butanone, and cyclohexane**), or 5 times (5x) the amount for other volatile target compounds. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must <u>not</u> be corrected by subtracting any blank value.

Specific actions are as follows:

1. If a volatile compound is found in a blank but not found in the sample, no action is taken. If the contaminants found are volatile target compounds (or interfering non-target compounds) at significant concentrations above the CRQL, then this should be noted for EPA Project Officer action.

2. Any volatile compound detected in the sample (other than the common volatile laboratory contaminants), that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required. <u>For the common volatile laboratory contaminants, the results are qualified by elevating the quantitation limit to the concentration found in the sample when the sample concentration is less than 10 times (10x) the blank concentration</u>.

   The reviewer should note that blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" and "10x" criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample is deemed necessary. If the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be

detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. In this case, the "5x" or "10x" rules may not apply; the target compound should be reported as not detected, and an explanation of the data qualification should be provided in the data review narrative.

3. If gross contamination exists (i.e., saturated peaks by GC/MS), all affected compounds in the associated samples should be qualified as unusable (R) due to interference. This should be noted for EPA Project Officer action if the contamination is suspected of having an effect on the sample results.

4. If inordinate numbers of other target compounds are found at low levels in the blank(s), it may be indicative of a problem and should be noted for EPA Project Officer action.

5. The same consideration given to the target compounds should also be given to Tentatively Identified Compounds (TICs), which are found in both the sample and associated blank(s). (See VOA Section XII for TIC guidance.)

6. If contaminants are found in the storage blanks, the following action is recommended:

   a. The associated method blank data should be reviewed to determine if the contaminant(s) was also present in the method blank. If the analyte was present at a comparable level in the method blank, then the source of the contamination may be in the analytical system and the action recommended for the method blank would apply.

      If the analyte was not present in the method blank, then the source of contamination may be in the storage and all associated samples should be considered for possible cross-contamination.

   b. If the storage blank contains a volatile TCL compound(s) at a concentration greater than the CRQL, then all positive results for that compounds(s) should be qualified with "J". If the concentration level in the blank is significantly high, then positive sample results may require rejection and be qualified with "R". Non-detected volatile target compounds should not require qualification unless the contamination is so high that it interferes with the analysis of the non-detect compounds.

7. If an instrument blank was not analyzed following a sample analysis which contained an analyte(s) at high concentration(s), sample analysis results after the high concentration sample must be evaluated for carryover. Professional judgement should be used to determine if instrument cross-contamination has affected any positive compound identification(s). If instrument cross-contamination is suggested, then this should be noted for EPA Project Officer action if the cross-contamination is suspected of having an effect on the sample results.

The following are examples of applying the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Example 1: Sample result is greater than the Contract Required Quantitation Limit (CRQL), but is less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 7 | 7 |
| CRQL | 5 | 5 |
| Sample Result | 60 | 30 |
| Final Sample Result | 60U | 30U |

In the example for the "10x" rule, sample results less than 70 (or 10x7) would be qualified as not detected. In the case of the "5x" rule, sample results less than 35 (or 5x7) would be qualified as not detected.

Example 2: Sample result is less than the CRQL, and is also less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 6 | 6 |
| CRQL | 5 | 5 |
| Sample Result | 4J | 4J |
| Final Sample Result | 5U | 5U |

Note that data are not reported as 4U, as this would be reported as a detection limit below the CRQL.

Example 3: Sample result is greater than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 10 | 10 |
| CRQL | 5 | 5 |
| Sample Result | 120 | 60 |
| Final Sample Result | 120 | 60 |

For both the "10x" and "5x" rules, sample results exceeded the adjusted blank results of 100 (or 10x10) and 50 (or 5x10), respectively, and therefore are not qualified.

## VI. System Monitoring Compounds

**A. Review Items:** Form II VOA-1 and Form II VOA-2 *[Form II LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with system monitoring compounds, SMC, (formerly referred to as surrogates) just prior to sample purging. The evaluation of the results of these system monitoring compounds is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the evaluation and review of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

**C. Criteria:**

1. Three system monitoring compounds (1,2-Dichloroethane-d4, bromofluorobenzene, and toluene-d8) are added to all samples and blanks to measure their recovery in environmental samples in sample and blank matrices.

   *[For data generated through the Low Concentration Water Method: A single system monitoring compound, bromofluorobenzene, is added to all samples and blanks to measure the recovery in sample and blank matrices.]*

2. Recoveries for system monitoring compounds in volatile samples and blanks must be within the limits specified in the method.

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation reports) to verify the recoveries on the System Monitoring Compound Recovery Form - Form II VOA-1 and Form II VOA-2 *[Form II LCV]*. Check for any calculation or transcription errors.

2. Check that the system monitoring compound recoveries were calculated correctly. The equation can be found in the method.

3. The following should be determined from the System Monitoring Compound Recovery form(s):

   a. If any system monitoring compound(s) in the volatile fraction is out of specification, there should be a re-analysis to confirm that the non-compliance is due to sample matrix effects rather than laboratory deficiencies.

**NOTE:** When there are unacceptable system monitoring compound recoveries followed by acceptable re-analyses, the laboratories are required to report only the successful run.

   b. The laboratory failed to perform acceptably if system monitoring compounds are outside criteria with no evidence of re-analysis. Medium soils must first be re-extracted prior to re-analysis when this occurs.

   c. Verify that no blanks have system monitoring compounds outside the criteria.

4. Any time there are two or more analyses for a particular sample, the reviewer must determine which are the best data to report. Considerations should include but are not limited to:

   a. System monitoring compound recovery (marginal versus gross deviation).

   b. Technical holding times.

   c. Comparison of the values of the target compounds reported in each sample analysis.

   d. Other QC information, such as performance of internal standards.

**E. Action:**

Data are qualified based on system monitoring compounds results if the recovery of any volatile system monitoring compound is out of specification. For system monitoring compound recoveries out of specification, the following approaches are suggested based on a review of all data from the package, especially considering the apparent complexity of the sample matrix.

1. If a system monitoring compound in the volatile sample has a recovery greater than the upper acceptance limit (UL):

   a. Detected volatile target compounds are qualified "J".

   b. Results for non-detected volatile target compounds should not be qualified.

2. If a system monitoring compound in the volatile sample has a recovery greater than or equal to 10 percent but less than the lower acceptance limit (LL):

   a. Detected volatile target compounds are qualified "J".

   b. For non-detected volatile target compounds, the sample quantitation limit is qualified as approximated (UJ).

3. If a system monitoring compound in a volatile sample shows less than 10 percent recovery:

   a. Detected volatile target compounds are qualified "J".

   b. Non-detected volatile target compounds may be qualified as unusable (R).

Table 3. Qualification of Volatile Analytes Based on System Monitoring Compound Recoveries

| | SMC Recovery | | |
|---|---|---|---|
| | >UL | 10% to LL | <10% |
| Detected analytes | J | J | J |
| Non-detected analytes | No Qualification | UJ | R |

4. In the special case of a blank analysis with system monitoring compounds out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable system monitoring compound recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence. However, even if this judgment allows some use of the affected data, analytical problems should be noted for EPA Project Officer action. Also note if there are potential contractual problems associated with the lack of re-analysis of samples that were out of specification.

5. Whenever possible, potential effects of the data resulting from system monitoring recoveries not meeting the advisory limits should be noted in the data review narrative.

## VII. Matrix Spikes/Matrix Spike Duplicates (Not Required for Low Concentration Water Data)

**A. Review Items:** Form III VOA- 1, Form III VOA-2, chromatograms, and quantitation reports.

**B. Objective:**

Data for matrix spike/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. These data alone cannot be used to evaluate the precision and accuracy of individual samples. However, when exercising professional judgement, this data should be used in conjunction with other available QC information.

**C. Criteria:**

1. Matrix spikes (MS) and matrix spike duplicate (MSD) samples are analyzed at a frequency of one MS and MSD per 20 samples of similar matrix, unless MS/MSD analyses are not required.

2. Spike recoveries should be within the advisory limits provided on Form III VOA-1 and Form III VOA-2.

3. Relative percent difference (RPD) between MS and MSD recoveries must be within the advisory limits provided on Form III VOA- 1 and Form III VOA-2.

**D. Evaluation:**

1. Verify that MS and MSD samples were analyzed at the required frequency and that results are provided for each sample matrix.

2. Inspect results for the MS/MSD Recovery on Form III VOA- 1 and Form III VOA-2 and verify that the results for recovery and RPD are within the advisory limits.

3. Verify transcriptions from raw data and verify calculations.

4. Check that the matrix spike recoveries and RPD were calculated correctly.

5. Compare %RSD results of non-spiked compounds between the original result, MS, and MSD.

**E. Action:**

1. No action is taken on MS/MSD data alone. However, using informed professional judgment the data reviewer may use the MS and MSD results in conjunction with other QC criteria and determine the need for some qualification of the data.

**VOA**

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of non-spiked compounds.

**NOTE:** If a field blank was used for the MS/MSD, the EPA Project Officer must be notified.

## VIII. Laboratory Control Samples
## (Low Concentration Water)

*[A.* ***Review Items:*** *Form III LCV- 1, LCS chromatograms, and quantitation reports.*

***B. Objective:***

*Data for laboratory control samples (LCS) are generated to provide information on the accuracy of the analytical method and on the laboratory performance.*

***C. Criteria:***

1. *A laboratory control sample (LCS) must be analyzed once per SDG and concurrently with the samples in the SDG.*

2. *The LCS contains the following volatile compounds, in addition to the required SMC (Bromofluorobenzene):*

| | |
|---|---|
| *Vinyl chloride* | *Benzene* |
| *1,2-Dichloroethane* | *cis-1,3-Dichloropropene* |
| *Carbon tetrachloride* | *Bromoform* |
| *1,2-Dichloropropane* | *Tetrachloroethene* |
| *Trichloroethene* | *1,2-Dibromoethane* |
| *1, 1, 2-Trichloroethane* | *1,4-Dichlorobenzene* |

3. *The percent recoveries for the LCS compounds must be within the QC limits. The LCS must meet this recovery criteria for the sample data to be accepted.*

4. *The criteria for system monitoring compound recovery and internal standard performance also apply.*

***D. Evaluation:***

1. *Verify that LCS samples were analyzed at the required frequency and that results are provided for each SDG.*

2. *Inspect results for the LCS Recovery on Form III LCV-1 and verify that the results for recovery are within the QC limits.*

3. *Verify transcriptions from raw data and verify calculations.*

4. *Check that the LCS recovery was calculated correctly by using the correct equation.*

**VOA**

***E. Action:***

*If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.*

1. *Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.*

2. *If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.*

3. *If the LCS recovery is greater than the upper control limit, then positive sample results for the affected compound(s) should be qualified with a "J".*

4. *If the mass spectral criteria are met but the LCS recovery is less than the lower control limit, then the associated detected target compounds should be qualified "J" and the associated non-detected target compounds should be qualified "R".*

5. *If more than half of the compounds in the LCS are not within the required recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated nondetected target compounds should be qualified "R".*

6. *Action on non-compliant system monitoring compound recovery and internal standard performance should follow the procedures provided in VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that non-compliance for system monitoring compound recovery and internal standard performance in the LCS has on the associated sample data.*

7. *It should be noted for EPA Project Officer action if a laboratory fails to analyze an LCS with each SDG, or if a laboratory consistently fails to generate acceptable LCS recoveries.]*

## IX. Regional Quality Assurance and Quality Control

**A. Review items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV]*, chromatograms, and quantitation reports.

**B. Objective:**

Regional Quality Assurance and Quality Control (QA/QC) refer to any QA and/or QC samples initiated by the Region, including field duplicates, Performance Evaluation (PE) samples, blind spikes, and blind blanks. (It is highly recommended that Regions adopt the use of these QA/QC samples.)

**C. Criteria:**

Criteria are determined by each Region.

1. Performance Evaluation sample frequency may vary.

   *[For data generated through the Low Concentration Water Method: A PE sample can be included as frequently as once per SDG].*

2. The analytes present in the PE sample must be correctly identified and quantified.

**D. Evaluation:**

Evaluation procedures must follow the Region's SOP for data review. Each Region will handle the evaluation of PE samples on an individual basis. Results for PE samples should be compared to the acceptance criteria for the specific PE samples, if available.

**E. Action:**

Any action must be in accordance with Regional specifications and the criteria for acceptable PE sample results. Unacceptable results for PE samples should be noted for EPA Project Officer action.

## X. Internal Standards

**A. Review Items:** Form VIII VOA *[Form VIII LCV]*, quantitation reports, and chromatograms.

**B. Objective:**

Internal Standards (IS) performance criteria ensures that GC/MS sensitivity and response are stable during each analysis.

**C. Criteria:**

1. Internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated 12hr calibration standard.

   *[For data generated through the Low Concentration Water Method: Internal standard area counts must not vary by more than a factor of ±40.0 percent from the associated calibration standard.]*

2. The retention time of the internal standard must not vary more than ±30 seconds from the retention time of the associated 12hr calibration standard.

   *[For data generated through the Low Concentration Water Method: The retention time of the internal standard must not vary more than ±20.0 seconds from the retention time of the associated 12hr calibration standard.]*

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation lists) to verify the internal standard retention times and areas reported on the Internal Standard Area Summary (Form VIII VOA *[Form VIII LCV]*).

2. Verify that all retention times and IS areas are within criteria.

3. If there are two analyses for a particular fraction, the reviewer must determine which are the best data to report. Considerations should include:

   a. Magnitude and direction of the IS area shift.

   b. Magnitude and direction of the IS retention time shift.

   c. Technical holding times.

   d. Comparison of the values of the target compounds reported in each fraction.

   e. Other QC.

**E. Action:**

1. If an IS area count for a sample or blank is outside -50 percent or +100 percent of the area for associated standard:

   a. Positive results for compounds quantitated using that IS should be qualified with "J".

   b. Non-detected compounds quantitated using an IS area count greater than 100 percent should not be qualified.

   c. Non-detected compounds quantitated using an IS area count less than 50 percent are reported as the associated sample quantitation limit and qualified with "UJ".

   d. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detected target compounds should then be qualified as unusable (R).

   *[If an IS area count for a sample or blank is outside ± 40.0 percent of the area for associated standard:*

   *a. Positive results for compounds quantitated using that IS should be qualified with "J".*

   *b. Non-detected compounds quantitated using an IS area count greater than 40 percent should not be qualified.*

   *c. Non-detected compounds quantitated using an IS area count less than 40 percent are reported as the associated sample quantitation limit and qualified with "UJ".*

   *d. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detected target compounds should then be qualified as unusable (R).]*

2. If an IS retention time varies by more than 30 seconds:

   *[If an IS retention time varies by more than 20.0 seconds:]*

   The chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection of the data for that sample fraction. Positive results should not need to be qualified as "R" if the mass spectral criteria are met.

3. If the internal standards performance criteria are grossly exceeded, then this should be noted for EPA Project Officer action. Potential effects on the data resulting from unacceptable internal standard performance should be noted in the data review narrative.

## XI. Target Compound Identification

**A. Review Items:** Form I VOA-1 and Form I VOA-2 *[Form I LCV],* quantitation reports, mass spectra, and chromatograms.

**B. Objective:**

The objective of the criteria for GC/MS qualitative analysis is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied more easily in detecting false positives than false negatives. More information is available for false positives due to the requirement for submittal of data supporting positive identifications. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, more difficult to assess. One example of detecting false negatives is the not reporting of a target compound that is reported as a TIC.

**C. Criteria:**

1. The relative retention times (RRTs) must be within ±0.06 RRT units of the standard RRT.

2. Mass spectra of the sample compound and a current laboratory-generated standard (i.e., the mass spectrum from the associated calibration standard) must match according to the following criteria:

   a. All ions present in the standard mass spectrum at a relative intensity greater than 10 percent must be present in the sample spectrum.

      *[For data generated through the Low Concentration Water Method: All ions present in the standard mass spectrum at a relative intensity greater than 25 percent must be present in the sample spectrum.]*

   b. The relative intensities of these ions must agree within ±20 percent between the standard and sample spectra. (Example: For an ion with an abundance of 50 percent in the standard spectrum, the corresponding sample ion abundance must be between 30 percent and 70 percent.)

   c. Ions present at greater than 10 percent in the sample mass spectrum but not present in the standard spectrum must be considered and accounted for.

      *[For data generated through the Low Concentration Water Method: Ions present at greater than 25 percent in the sample mass spectrum but not present in the standard spectrum must be considered and accounted for.]*

**D. Evaluation:**

1. Check that the RRT of reported compounds is within ±0.06 RRT units of the standard RRT.

2. Check the sample compound spectra against the laboratory standard spectra to see that it meets the specified criteria.

3. The reviewer should be aware of situations (e.g., high concentration samples preceding low concentration samples) when sample carryover is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification. The method specifies that an instrument blank must be run after samples in which a target analyte ion(s) saturates the detector.

   *[The reviewer should be aware of situations when sample carryover is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification. The method specifies that an instrument blank must be run after samples which contain target compounds at levels exceeding the initial calibration range (25 ug/L for non-ketones, 125 ug/L for ketones) or non-target compounds at concentrations greater than 100 ug/L or saturated ions from a compound (excluding the compound peaks in the solvent front).]*

4. Check the chromatogram to verify that peaks are accounted for (i.e., major peaks are either identified as target compounds, TICs, system monitoring compounds, or internal standards).

**E. Action:**

1. The application of qualitative criteria for GC/MS analysis of target compounds requires professional judgement. It is up to the reviewer's discretion to obtain additional information from the laboratory. If it is determined that incorrect identifications were made, all such data should be qualified as not detected (U) or unusable (R).

2. Professional judgement must be used to qualify the data if it is determined that cross-contamination has occurred.

3. Any changes made to the reported compounds or concerns regarding target compound identifications should be clearly indicated in the data review narrative. The necessity for numerous or significant changes should be noted for EPA Project Officer action.

## XII. Compound Quantitation and Reported CRQLs

**A. Review Items:** Forms I VOA-1 and Form I VOA-2 *[Form I LCV]*, sample preparation sheets, SDG Narrative, quantitation reports, and chromatograms.

**B. Objective:**

The objective is to ensure that the reported quantitation results and Contract Required Quantitation Limits (CRQLs) are accurate.

**C. Criteria:**

1. Compound quantitation, as well as the adjustment of the CRQLs, must be calculated according to the correct equation.

2. Compound RRFs must be calculated based on the internal standard (IS) associated with that compound, as listed in the method. Quantitation must be based on the quantitation ion (m/z) specified in the method for both the IS and target analytes. The compound quantitation must be based on the RRF from the appropriate daily standard.

**D. Evaluation:**

1. For all fractions, raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Quantitation lists and chromatograms should be compared to the reported positive sample results and quantitation limits. Check the reported values.

2. Verify that the correct internal standard, quantitation ion, and RRF were used to quantitate the compound. Verify that the same internal standard, quantitation ion, and RRF are used consistently throughout, in both the calibration as well as the quantitation process.

3. Verify that the CRQLs have been adjusted to reflect all sample dilutions and dry weight factors that are not accounted for by the method.

**E. Action:**

1. If any discrepancies are found, the laboratory may be contacted by the Region's designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must use professional judgement to decide which value is the best value. Under these circumstances, the reviewer may determine qualification of data is warranted. A description of the reasons for data qualification and the qualification that is applied to the data should be documented in the data review narrative.

2. Numerous or significant failures to accurately quantify the target compound or to properly evaluate and adjust CRQLs should be noted for EPA Project Officer action.

## XIII. Tentatively Identified Compounds

**A. Review Items:** Form I VOA-TIC *[Form I LCV- TIC],* chromatograms, and library search printouts and spectra for the TIC candidates.

**B. Objective:**

Chromatographic peaks in volatile fraction analyses that are not target analytes, system monitoring compounds, or internal standards are potential tentatively identified compounds (TICs). TICs must be qualitatively identified via a forward search of the NIST/EPA/NIH and/or Wiley Mass Spectral Library, and the identifications assessed by the data reviewer.

**C. Criteria:**

For each sample, the laboratory must conduct a mass spectral search of the NIST library and report the possible identity for the appropriate number of the largest volatile fraction peaks which are not system monitoring compounds, internal standards, or target compounds, but which have area or height greater than 10 percent of the area or height of the nearest internal standard. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I VOA-TIC).

*[For data generated through the Low Concentration Water Method: For each sample, the laboratory must conduct a mass spectral search of the NIST/EPA/NIH and/or Wiley mass spectral library and report the possible identity for the appropriate number of the largest volatile fraction peaks which are not system monitoring compounds, internal standards, or TCL compounds, but which have area greater than or equal to 40 percent of the area of the nearest internal standard. Estimated concentrations for TICs are calculated similarly to the TCL compounds, using total ion areas for the TIC and the internal standard, and assuming a relative response factor of 1.0. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I LCV-TIC).]*

**NOTE:** Since the method revision of October 1986, the CLP does not allow the laboratory to report as tentatively identified compounds any target compound which is properly reported in another fraction. For example, late eluting volatile target compounds should not be reported as semivolatile TICs.

**D. Evaluation:**

1. Guidelines for tentative identification are as follows:

   a. Major ions (greater than 10 percent relative intensity) in the reference spectrum should be present in the sample spectrum.

      *[Major ions (greater than 25 percent relative intensity) in the reference spectrum should be present in the sample spectrum.]*

   b. The relative intensities of the major ions should agree within ±20 percent

between the sample and the reference spectra.

c. Molecular ions present in the reference spectrum should be present in the sample spectrum.

d. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or coelution of additional TIC or target compounds.

e. When the above criteria are not met, but in the technical judgement of the data reviewer or mass spectral interpretation specialist the identification is correct, the data reviewer may report the identification.

f. If, after careful review and in the technical judgement of the mass spectral interpretation specialist, no valid identification can be made, the compound should be reported as follows:

- If the library search produces a match at or above 85%, report that compound.
- If the library search produces more than one compound at or above 85%, report the first compound (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown. The mass spectral specialist should give additional classification of the unknown compound, if possible (i.e., unknown hydrocarbon, unknown acid type, unknown chlorinated coumpound). If probable molecular weights can be distinguished, include them.

2. Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms for samples and blanks.

3. Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-target compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which are less than 10 percent of the internal standard height, but present in the blank chromatogram at similar relative retention time.

*[Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-TCL compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank*

*chromatograms may require looking for peaks which are less than 40 percent of the internal standard area but present in the blank chromatogram at similar relative retention time.]*

4. All mass spectra for every sample and blank must be examined.

5. Since TIC library searches often yield several candidate compounds having a close matching score, all reasonable choices must be considered.

6. The reviewer should be aware of common laboratory artifacts/contaminants and their sources (e.g., aldol condensation products, solvent preservatives, and reagent contaminants). These may be present in blanks and not reported as sample TICs.

   Examples:

   a. Common laboratory contaminants: $C0_2$ (m/z 44), siloxanes (m/z 73), diethyl ether, hexane, certain freons, and phthalates at levels less than 100 ug/L or 4000 ug/Kg.

   b. Solvent preservatives such as cyclohexene which is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, and chlorocyclohexanol.

   c. Aldol condensation reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone.

7. Occasionally, a target compound may be identified in the proper analytical fraction by non-target library search procedures, even though it was not found on the quantitation list. If the total area quantitation method was used, the reviewer should request that the laboratory recalculate the result using the proper quantitation ion. In addition, the reviewer should evaluate other sample chromatograms and check library reference retention times on quantitation lists to determine whether the false negative result is an isolated occurrence or whether additional data may be affected.

8. Target compounds could be identified in more than one fraction. Verify that quantitation is made from the proper fraction.

9. Library searches should not be performed on internal standards or system monitoring compounds.

10. TIC concentration should be estimated assuming a RRF of 1.0.

**E. Action:**

1. All TIC results should be qualified "NJ", tentatively identified, with approximated concentrations.

2. General actions related to the review of TIC results are as follows:

   a. If it is determined that a tentative identification of a non-target compound is not acceptable, the tentative identification should be changed to "unknown" or an appropriate identification.

   b. If all contractually required peaks were not library searched and quantitated, the Region's designated representative could request these data from the laboratory.

3. TIC results which are not sufficiently above 10x the level in the blank should not be reported. (Dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples.)

4. When a compound is not found in any blanks, but is a suspected artifact of common laboratory contaminant, the result may be qualified as unusable (R).

5. In deciding whether a library search result for a TIC represents a reasonable identification, professional judgment must be exercised. If there is more than one possible match, the result may be reported as "either compound X or compound Y". If there is a lack of isomer specificity, the TIC result may be changed to a non-specific isomer result (e.g., 1,3,5-trimethyl benzene to trimethyl benzene isomer) or to a compound class (e.g., 2-methyl, 3-ethyl benzene to substituted aromatic compound).

6. The reviewer may elect to report all similar compounds as a total. (e.g., All alkanes may be summarized and reported as total hydrocarbons.)

7. Other case factors may influence TIC judgements. If a sample TIC match is poor but other samples have a TIC with a good library match, similar relative retention time, and the same ions, identification information may be inferred from the other sample TIC results.

8. Physical constants, such as boiling point, may be factored into professional judgement of TIC results.

9. Any changes made to the reported data or any concerns regarding TIC identifications should be indicated in the data review narrative.

10. Failure to properly evaluate and report TICs should be noted for EPA Project Officer action.

## XIV. System Performance

**A. Review Items:** Form VIII VOA *[Form VIII LCV]*, Form III VOA-1 and Form III VOA-2 *[Form III LCV-1]*, and chromatograms.

**B. Objective:**

During the period following Instrument Performance QC checks (e.g., blanks, tuning, calibration), changes may occur in the system that degrade the quality of the data. While this degradation would not be directly shown by QC checks until the next required series of analytical QC runs, a thorough review of the ongoing data acquisition can yield indicators of instrument performance.

**C. Criteria:**

There are no specific criteria for system performance. Professional judgement should be applied to assess the system performance.

**D. Evaluation:**

1. Abrupt discrete shifts in the reconstructed ion chromatogram (RIC) baseline may indicate a change in the instrument's sensitivity or the zero setting. A baseline "shift" could indicate a decrease in sensitivity in the instrument or an increase in the instrument zero, possibly causing target compounds, at or near the detection limit, to miss detection. A baseline "rise" could indicate problems such as a change in the instrument zero, a leak, or degradation of the column.

2. Poor chromatographic performance affects both qualitative and quantitative results. Indications of substandard performance include:

   a. High RIC background levels or shifts in absolute retention times of internal standards.

   b. Excessive baseline rise at elevated temperature.

   c. Extraneous peaks.

   d. Loss of resolution.

   e. Peak tailing or peak splitting that may result in inaccurate quantitation.

*[3. A drift in instrument sensitivity may occur during the 12-hour time period. This could be discerned by examination of the IS area on Form VIII LCV for trends such as a continuous or near continuous increase or decrease in the IS area over time.*

4. *The results of the LCS analysis (Form III LCV) may also be used to assess instrument performance.]*

**E. Action:**

Professional judgement must be used to qualify the data if it is determined that system performance has degraded during sample analyses. Any degradation of system performance which significantly affected the data should be documented for EPA Project Officer action.

## XV. Overall Assessment of Data

**A. Review Items:** Entire data package, data review results, and (if available) Quality Assurance Project Plan (QAPjP), and Sampling and Analysis Plan (SAP).

**B. Objective:**

The overall assessment of a data package is a brief narrative in which the data reviewer expresses concerns and comments on the quality and, if possible, the useability of the data.

**C. Criteria:**

Assess the overall quality of the data.

Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

**D. Evaluation:**

1. Evaluate any technical problems which have not been previously addressed.

2. If appropriate information is available, the reviewer may assess the useability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the QAPjP (specifically the Data Quality Objectives), SAP, and communication with data user that concerns the intended use and desired quality of these data.

**E. Action:**

1. Use professional judgement to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief narrative to give the user an indication of the analytical limitations of the data. Any inconsistency of the data with the SDG Narrative should be noted for EPA Project Officer action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include his/her assessment of the useability of the data within the given context.

## SEMIVOLATILE DATA REVIEW

****Data review guidelines that are unique to data generated through the Low Concentration Water Method are contained within brackets ([]) and written in italics.****

The semivolatile data requirements to be checked are listed below:

I. Holding Times

II. GC/MS Instrument Performance Check

III. Initial Calibration

IV. Continuing Calibration

V. Blanks

VI. Surrogate Spikes

VII. Matrix Spikes/Matrix Spike Duplicates

*[VIII. Laboratory Control Samples]*

IX. Regional Quality Assurance and Quality Control

X. Internal Standards

XI. Target Compound Identification

XII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs)

XIII. Tentatively Identified Compounds

XIV. System Performance

XV. Overall Assessment of Data

## I. Holding Times

**A. Review Items:** Form I SV-1*[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, EPA Sample Traffic Report and/or chain of-custody, raw data, and sample extraction sheets.

**B. Objective:**

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis.

**C. Criteria:**

Technical requirements for sample holding times have only been established for water matrices.

The technical holding time criteria for water samples, are as follows:

> For semivolatile compounds in cooled (@ 4°C) water samples, the maximum holding time is 7 days from sample collection to extraction and 40 days from sample extraction to analysis.

It is recommended that semivolatile compounds in soil samples be extracted within 14 days of sample collection.

The method holding times, which differ from the technical holding times, state that water samples are to be extracted within 5 days from the validated time of sample receipt (VTSR) at the laboratory, and soil samples are to be extracted within 10 days from the VTSR. Also, contractually both water and soil sample extracts must be analyzed within 40 days of sample extraction.

*[For data generated through the Low Concentration Method: The method holding times requirements are that the extraction of all samples must be started within 5 days of the VTSR, and the extracts must be analyzed within 40 days of VTSR.]*

**D. Evaluation:**

Technical holding times for sample extraction are established by comparing the sampling date on the EPA Sample Traffic Report with the dates of extraction on Form I SV-1 *[Form I LCSV-1]* and Form I SV-2 *[Form I LCSV-2]* and the sample extraction sheets. To determine if the samples were analyzed within the holding time after extraction, compare the dates of extraction on the sample extraction sheets with the dates of analysis on Form I SV-1 *[Form I LCSV-1]* and Form I SV-2 *[Form I LCSV-2]*.

Verify that the Traffic Report indicates that the samples were received intact and iced. If the samples were not iced or there were any problems with the samples upon receipt, then discrepancies in the sample condition could affect the data.

**E. Action:**

1. If technical holding times are exceeded, flag all positive results as estimated "J", and sample quantitation limits as estimated "UJ" and document that holding times were exceeded.

2. If technical holding times are grossly exceeded, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effect of additional storage on the sample results. The reviewer may determine that positive results or the associated quantitation limits are approximates and should be qualified with "J" or "UJ", respectively. The reviewer may determine that non-detect data are unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer to apply water holding time criteria to soil samples. Professional judgement is required to evaluate holding times for soil samples.

4. Whenever possible, the reviewer should comment on the effect of the holding time exceedance on the resulting data in the data review narrative.

5. When method and/or technical holding times are exceeded, this should be noted as an action item for the EPA Project Officer.

6. The reviewer should also be aware of the scenario in which the laboratory has exceeded the technical holding times, but met method holding times. In this case, the data reviewer should notify the EPA Project Officer (where samples were collected) and/or RSCC that shipment delays have occurred so that the field problem can be corrected. The reviewer may pass this information on to the laboratory's EPA Project Officer, but should explain that the laboratory met the requirements in the method.

## II. GC/MS Instrument Performance Check

**A. Review Items:** Form V SV *[Form V LCSV]*, and DFTPP mass spectra and mass listing.

**B. Objective:**

Gas chromatograph/mass spectrometer (GC/MS) instrument performance checks (formerly referred to as tuning) are performed to ensure mass resolution, identification and, to some degree, sensitivity. These criteria are not sample specific. Conformance is determined using standard materials, therefore, these criteria should be met in all circumstances.

**C. Criteria:**

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples or standards are analyzed. The instrument performance check, decafluorotriphenylphosphine (DFTPP) for semivolatile analysis, must meet the ion abundance criteria given below.

Decafluorotriphenylphosphine (DFTPP)

| m/z | ION ABUNDANCE CRITERIA |
|---|---|
| 51 | 30.0 - 80.0% of m/z 198 |
| 68 | Less than 2.0% of m/z 69 |
| 69 | Present |
| 70 | Less than 2.0% of m/z 69 |
| 127 | 25.0 - 75.0% of m/z 198 |
| 197 | Less than 1.0% of m/z 198 |
| 198 | Base peak, 100% relative abundance |
| 199 | 5.0 - 9.0% of m/z 198 |
| 275 | 10.0 - 30.0% of m/z 198 |
| 365 | Greater than 0.75% of m/z 198 Present, |
| 441 | but less than m/z 443 |
| 442 | 40.0 - 110.0% of m/z 198 |
| 443 | 15.0 - 24.0% of m/z 442 |

**NOTE:** All ion abundances must be normalized to m/z 198, the nominal base peak, even though the ion abundances of m/z 442 may be up to 110 percent that of m/z 198.

**D. Evaluation:**

1. Compare the data presented on each GC/MS Instrument Performance Check (Form V SV *[Form V LCSV]*) with each mass listing submitted and ensure the following:

a. Form V SV *[Form V LCSV]* is present and completed for each 12-hour period during which samples were analyzed.

b. The laboratory has not made any transcription errors between the data and the form. If there are major differences between the mass listing and the Form Vs, a more in-depth review of the data is required. This may include obtaining and reviewing additional information from the laboratory.

c. The appropriate number of significant figures has been reported (number of significant figures given for each ion in the ion abundance criteria column) and that rounding is correct.

d. The laboratory has not made any calculation errors.

2. Verify from the raw data (mass spectral listing) that the mass assignment is correct and that the mass is normalized to m/z 198.

3. Verify that the ion abundance criteria was met. The criteria for m/z 68, 70, 441, and 443 are calculated by normalizing to the specified m/z.

4. If possible, verify that spectra were generated using appropriate background subtraction techniques. Since the DFTPP spectrum is obtained from chromatographic peaks that should be free from coelution problems, background subtraction should be done in accordance with the following procedure. Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. Do not subtract as part of the background the DFTPP peak.

<u>NOTE:</u> All instrument conditions must be identical to those used during the sample analysis. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting the contract specifications are contrary to the quality assurance objectives and are therefore unacceptable.

**E. Action:**

1. If the laboratory has made minor transcription errors which do not significantly affect the data, the data reviewer should make the necessary corrections on a copy of the form.

2. If the laboratory has failed to provide the correct forms or has made significant transcription or calculation errors, the Region's designated representative should contact the laboratory and request corrected data. If the information is not available, then the reviewer must use professional judgement to assess the data. The laboratory's EPA Project Officer should be notified.

3. If mass assignment is in error (such as m/z 199 is indicated as the base peak rather than m/z 198), classify all associated data as unusable (R).

4. If ion abundance criteria are not met, professional judgement may be applied to determine to what extent the data may be utilized. Guidelines to aid in the application of professional judgement in evaluating ion abundance criteria are discussed as follows:

   a. Some of the most critical factors in the DFTPP criteria are the non-instrument specific requirements that are also not unduly affected by the location of the spectrum on the chromatographic profile. The m/z ratios for 198/199 and 442/443 are critical. These ratios are based on the natural abundances of carbon 12 and carbon 13 and should always be met. Similarly, the relative abundances for m/z 68, 70, 197, and 441 indicate the condition of the instrument and the suitability of the resolution adjustment and are very important. Note that all of the foregoing abundances relate to adjacent ions; they are relatively insensitive to differences in instrument design and position of the spectrum on the chromatographic profile.

   b. For the ions at m/z 51, 127, and 275, the actual relative abundance is not as critical. For instance, if m/z 275 has 40 percent relative abundance (criteria: 10.0-30.0 percent) and other criteria are met, then the deficiency is minor.

   c. The relative abundance of m/z 365 is an indicator of suitable instrument zero adjustment. If relative abundance for m/z 365 is zero, minimum detection limits may be affected. On the other hand, if m/z 365 is present, but less than the 0.75 percent minimum abundance criteria, the deficiency is not as serious.

5. Decisions to use analytical data associated with DFTPP instrument performance checks not meeting method requirements should be clearly noted in the data review narrative.

6. If the reviewer has reason to believe that instrument performance check criteria were achieved using techniques other than those specified in the method and Section II.D.4 above, additional information on the DFTPP instrument performance checks should be obtained. If the techniques employed are found to be at variance with contract requirements, the procedures of the laboratory may merit evaluation. Concerns or questions regarding laboratory performance should be noted for EPA Project Officer action. For example, if the reviewer has reason to believe that an inappropriate technique was used to obtain background subtraction (such as background subtracting from the solvent front or from another region of the chromatogram rather than the DFTPP peak), then this should be noted for EPA Project Officer action.

## III. Initial Calibration

**A. Review Items:** Form VI SV-1 *[Form VI LCSV-1]*, Form VI SV-2 *[Form VI LCSV-2]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile Target Compound List (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve.

**C. Criteria:**

1. Initial calibration standards containing both semivolatile target compounds and surrogates are analyzed at concentrations of 20, 50, 80, 120, and 160 ng/2uL at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met. The initial calibration (and any associated samples and blanks) must be analyzed within 12 hours of the associated instrument performance check.

   *[For data generated through the Low Concentration Method: Initial calibration standards containing both semivolatile TCL compounds and surrogates are analyzed at concentrations of 5, 10, 20, 50, and 80 ng/2uL at the beginning of each analytical sequence or as necessary if the continuing calibration acceptance criteria are not met. The initial calibration (and any associated samples and blanks) must be analyzed within 12 hours of the associated instrument performance check. The following nine compounds require initial calibration at 20, 50, 80, 100, and 120 ng/2uL: 2,4-dinitrophenol, 2,4,5-trichlorophenol, 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, 4-nitrophenol, 4,6-dinitro-2-methylphenol, pentachlorophenol, and 2,4,6-tribromophenol (surrogate).]*

2. Minimum Relative Response Factor (RRF) criteria must be greater than or equal to 0.05. (Initial RRF criteria are listed in the appropriate method.)

3. The Percent Relative Standard Deviations (%RSD) for the RRFs in the initial calibration must be less than or equal to 30 percent.

**D. Evaluation:**

1. Verify that the correct concentration of standards were used for the initial calibration (i.e., 20, 50, 80, 120, and 160 ng/2uL). For the eight compounds with higher CRQLs, only a four-point initial calibration is required (i.e., 50, 80, 120, and 160 ng/2uL).

*[Verify that the correct concentration of standards were used for the initial calibration (i.e., 5, 10, 20, 50, and 80 ng). For the nine compounds listed in SV Section III.C.1. with higher CRQLs, verify that a five point initial calibration at 20, 50, 80, 100, and 120 ng was performed.]*

2. If any sample results were calculated using an initial calibration, verify that the correct standard (i.e., the 50 ng standard) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated instrument performance check.

   *[If any sample results were calculated using an initial calibration, verify that the correct standard (i. e., the 20 ng standard or 80 ng for the compounds listed in III.C.1) was used for calculating sample results and that the samples were analyzed within 12 hours of the associated DFTPP tuning/instrument performance check.]*

3. Evaluate the RRFs for all semivolatile target compounds and surrogates:

   a. Check and recalculate the RRF and $\overline{RRF}$ for at least one semivolatile target compound associated with each internal standard. Verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all semivolatile target compounds and surrogates have RRFs that are greater than or equal to 0.05.

**NOTE:** The criteria used for data review purposes are different from those used for contractual purposes. The laboratory must meet a minimum RRF criteria of 0.01, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all semivolatile compounds.**

Table 4. Semivolatile Target Compounds Exhibiting Poor Response

| | |
|---|---|
| 2,2'-oxybis(1-Chloropropane) | Diethylphthalate |
| 4-Chloroaniline | 4-Nitroaniline |
| Hexachlorobutadiene | 4,6-Dinitro-2-methylphenol |
| Hexachlorocyclopentadiene | N-Nitrosodiphenylamine |
| 2-Nitroaniline | Di-n-butylphthalate |
| Dimethylphthalate | Butylbenzylphthalate |
| 3-Nitroaniline | 3-3'-Dichlorobenzidine |
| 2,4-Dinitrophenol | bis(2-Ethylhexyl)phthalate |
| 4-Nitrophenol | Di-n-octylphthalate |
| **Carbazole†** | 2,4,6-Tribromophenol (surr) |
| Nitrobenzene-$d_5$ (surr) | |

**† Multi-Media, Multi-Concentration only**

4. Evaluate the %RSD for all semivolatile target compounds and surrogates:

   a. Check and recalculate the %RSD for one or more semivolatile target compound(s); verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all semivolatile target compounds have a %RSD of less than 30 percent. The method criteria for an acceptable initial calibration specifies that up to any 4 semivolatile target compounds may fail to meet minimum RRF or maximum %RSD as long as they have RRFs that are greater than or equal to 0.010, and %RSD of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %RSD exceeds the $\leq$30.0 percent criterion.

   c. If the %RSD is greater than 30.0 percent, then the reviewer should use professional judgement to determine the need to check the points on the curve for the cause of the non-linearity. This is checked by eliminating either the high point or the low point and recalculating the %RSD.

5. If errors are detected in the calculations of either the $\overline{RRF}$ or the %RSD, perform a more comprehensive recalculation.

**E. Action:**

1. All semivolatile target compounds, including the 19 "poor performers" will be qualified using the following criteria:

   a. If the %RSD is greater than 30.0 percent and the RRF is greater than 0.05, qualify positive results with "J", and non-detected semivolatile target compounds using professional judgement.

   b. If the RRF is less than 0.05, qualify positive results that have acceptable mass spectral identification with "J" using professional judgement, and non-detects as unusable (R).

2. At the reviewer's discretion, a more in-depth review to minimize the qualification of data can be accomplished by considering the following:

   a. If any of the required semivolatile compounds have a %RSD greater than 30.0 percent, and if eliminating either the high or the low point of the curve does not restore the %RSD to less than or equal to 30.0 percent:

      i. Qualify positive results for that compound(s) with "J".

      ii. Qualify non-detected semivolatile target compounds based on professional judgement.

b. If the high point of the curve is outside of the linearity criteria (e.g., due to saturation):

   i. No qualifiers are required for positive results in the linear portion of the curve.

   ii. Qualify positive results outside of the linear portion of the curve with "J".

   iii. No qualifiers are needed for non-detected target compounds.

c. If the low end of the curve is outside of the linearity criteria:

   i. No qualifiers are required for positive results in the linear portion of the curve.

   ii. Qualify low level positive results in the area of non-linearity with "J".

   iii. Qualify non-detected semivolatile target compounds using professional judgement.

3. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

4. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

5. If calibration criteria are exceeded, this should be noted for EPA Project Officer action.

## IV. Continuing Calibration

**A. Review Items:** Form VII SV-1 *[Form VII LCSV-1]*, Form VII SV-2 *[Form VII LCSV-2]*, quantitation reports, and chromatograms.

**B. Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for semivolatile target compounds. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis.

**C. Criteria:**

1. Continuing calibration standards containing both target compounds and surrogates are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples.

2. The minimum Relative Response Factors (RRF) for semivolatile target compounds and surrogates must be greater than or equal to 0.05.

1. 3. The percent difference (%D) between the initial calibration $\overline{RRF}$ and the continuing calibration RRF must be within ± 25.0 percent for all target compounds.

**D. Evaluation:**

1. Verify that the continuing calibration was run at the required frequency and that the continuing calibration was compared to the correct initial calibration.

2. Evaluate the continuing calibration RRF for all semivolatile target compounds and surrogates.

   a. Check and recalculate the continuing calibration RRF for at least one semivolatile target compound for each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that all semivolatile target compounds and surrogates have RRFs within specifications.

**NOTE:** The criteria employed for the data review purposes are different from those used for contractual purposes. The laboratory must meet a minimum RRF criterion of 0.01, however, **for data review purposes, the "greater than or equal to 0.05" criterion is applied to all semivolatile compounds.**

3. Evaluate the %D between initial calibration $\overline{RRF}$ and continuing calibration RRF for one or more semivolatile compounds.

   a. Check and recalculate the %D for at least one semivolatile target compound for each internal standard; verify that the recalculated value(s) agrees with the laboratory reported value(s).

   b. Verify that the %D is within the ±25.0 percent criterion, for all semivolatile target compounds and surrogates. Note those compounds which have a %D outside the ±25.0 percent criterion. The method criteria for an acceptable continuing calibration specifies that up to any 4 semivolatile target compounds may fail to meet minimum RRF or maximum %D as long as they have RRFs that are greater than or equal to 0.010, and %D of less than or equal to 40.0 percent. For data review purposes, however, all compounds must be considered for qualification when the %D exceeds the ±25.0 percent criterion.

4. If errors are detected in the calculations of either the continuing calibration RRF or the %D, perform a more comprehensive recalculation.

**E. Action:**

1. The reviewer should use professional judgement to determine if it is necessary to qualify the data for any semivolatile target compound. If qualification of data is required, it should be performed using the following guidelines:

   a. If the %D is outside the ± 25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify positive results "J".

   b. If the %D is outside the ± 25.0 percent criterion and the continuing calibration RRF is greater than or equal to 0.05, qualify non-detected semivolatile target compounds "UJ".

   c. If the continuing calibration RRF is less than 0.05, qualify positive results that have acceptable mass spectral identification with "J" or use professional judgement.

   d. If the continuing calibration RRF is less than 0.05, qualify non-detected semivolatile target compounds as unusable (R).

2. If the laboratory has failed to provide adequate calibration information, the Region's designated representative should contact the laboratory and request the necessary information. If the information is not available, the reviewer must use professional judgement to assess the data.

3. Whenever possible, the potential effects on the data due to calibration criteria exceedance should be noted in the data review narrative.

4. If calibration criteria are grossly exceeded, this should be noted for EPA Project Officer action.

## V. Blanks

A. **Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, Form IV SV *[Form IV LCSV]*, chromatograms, and quantitation reports.

B. **Objective:**

The purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination problems resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

C. **Criteria:**

1. No contaminants should be found in the blanks.

2. The method blank must be analyzed on each GC/MS system used to analyze that specific group or set of samples.

D. **Evaluation:**

1. Review the results of all associated blank, Form I SV-1, Form I SV-2, and raw data (chromatograms and quantitation reports) to evaluate the presence of target and non-target compounds in the blanks.

2. Verify that a method blank analysis has been reported per matrix, per concentration level, for each extraction batch and for each GC/MS system used to analyze semivolatile samples. The reviewer can use the method blank summary (Form IV SV) to assist in identifying samples associated with each method blank.

E. **Action:**

If the appropriate blanks were not analyzed with the frequency described above, then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be noted for EPA Project Officer action.

Action in the case of unsuitable blank results depends on the circumstances and origin of the blank. Positive sample results should be reported unless the concentration of the compound in the sample is less than or equal to 10 times (10x) the amount in any blank for the **common phthalate contaminants**, or 5 times the amount for other compounds. In instances where more than one blank is associated with a given sample, qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant. The results must not be corrected by subtracting any blank value.

Specific actions are as follows:

If a semivolatile compound is found in a blank but not found in the sample, no action is taken. If the contaminants found are volatile target compounds (or interfering non-target compounds) at significant concentrations above the CRQL, then this should be noted for EPA Project Officer action.

2. Any semivolatile compound detected in the sample (other than the common phthalate contaminants), that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required. For phthalate contaminants, the results are qualified "U" by elevating the sample quantitation limit to the sample concentration when the sample result is less than 10x the blank concentration.

   The reviewer should note that blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" and "10x" criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances where little or no contamination was present in the associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. In this case, the "5x" or "10x" rules may not apply; the sample value should be reported as a non-detect. An explanation of the rationale used for this determination should be provided in the narrative accompanying the Regional Data Assessment Summary.

3. If gross contamination exists (i.e., saturated peaks by GC/MS), all affected compounds in the associated samples should be qualified as unusable (R), due to interference. This should be noted for EPA Project Officer action if the contamination is suspected of having an effect on the sample results.

4. If inordinate amounts of other target compounds are found at low levels in the blank(s), it may be indicative of a problem and should be noted for EPA Project Officer action.

5. The same consideration given to the target compounds should also be given to Tentatively Identified Compounds (TICs) which are found in both the sample and associated blank(s). (See SV Section XIII for TIC guidance.)

The following are examples of applying the blank qualification guidelines. Certain circumstances may warrant deviations from these guidelines.

Example 1: Sample result is greater than the Contract Required Quantitation Limit (CRQL), but is less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 12 | 12 |
| CRQL | 10 | 10 |
| Sample Result | 50 | 40 |
| Qualified Sample Result | 50U | 40U |

In the example for the "10x" rule, sample results less than 120 (or 10 x 12) would be qualified as non-detects. In the case of the "5x" rule, sample results less than 60 (or 5 x 12) would be qualified as non-detects.

Example 2: Sample result is less than CRQL, and is also less than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 12 | 12 |
| CRQL | 10 | 10 |
| Sample Result | 8J | 8J |
| Qualified Sample Result | 10U | 10U |

Note that data are not reported as 8U, as this would be reported as a detection limit below the CRQL.

Example 3: Sample result is greater than the 5x or 10x multiple of the blank result.

| | Rule | |
|---|---|---|
| | 10x | 5x |
| Blank Result | 15 | 15 |
| CRQL | 10 | 10 |
| Sample Result | 160 | 80 |
| Qualified Sample Result | 160 | 80 |

For both the "10x" and "5x" rules, sample results exceeded the adjusted blank results of 150 (or 10x15) and 75 (or 5x15), respectively, and therefore are not qualified.

## VI. Surrogate Spikes

A. **Review Items:** Form II SV-1 and Form II SV-2 *[Form II LCSV]*, chromatograms, and quantitation reports.

B. **Objective:**

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the evaluation and review of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

C. **Criteria:**

1. Surrogate spikes, 4 acid compounds (3 required and 1 advisory) and 4 base/neutral compounds (3 required and 1 advisory) are added to all samples and blanks to measure their recovery in sample and blank matrices.

   *[For data generated through the Low Concentration Method: Surrogate spikes, 3 acid compounds and 3 base/neutral compounds, are added to all samples and blanks to measure their recovery in sample and blank matrices.]*

2. Surrogate spike recoveries for semivolatile samples and blanks must be within the limits specified on in the method and on Form II SV- 1 and Form II SV-2.

   *[For data generated through the Low Concentration Method: Surrogate spike recoveries for semivolatile samples and blanks must be within the limits specified in the method and on Form II LCSV.]*

D. **Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation reports) to verify the surrogate spike recoveries on the Surrogate Recovery Form II SV-1 and Form II SV-2 *[Form II LCSV]*. Check for any transcription or calculation errors.

2. Check that the surrogate spike recoveries were calculated correctly. The equation can be found in the method.

3. The following should be determined from the Surrogate Recovery form(s):

   a. If any two base/neutral <u>or</u> acid surrogates are out of specification, or if any one base/neutral or acid extractable surrogate has a recovery of less than 10 percent, then there should be a re-analysis to confirm that the non-compliance is due to sample matrix effects rather than laboratory deficiencies.

**<u>NOTE:</u>** When there are unacceptable surrogate recoveries followed by successful re-analyses, the laboratories are required to report only the acceptable run.

   b. The laboratory has failed to perform satisfactorily if surrogate recoveries are out of specification and there is no evidence of reinjection of the extract, or reextraction and re-analysis (if reinjection fails to resolve the problem).

   c. Verify that no blanks have surrogate recoveries outside the criteria.

4. Any time there are two or more analyses for a particular fraction the reviewer must determine which are the best data to report. Considerations should include but are not limited to:

   a. Surrogate recovery (marginal versus gross deviation).

   b. Technical holding times.

   c. Comparison of the values of the target compounds reported in each fraction.

   d. Other QC information, such as performance of internal standards.

**E. Action:**

Data are not qualified with respect to surrogate recovery unless two or more semivolatile surrogates, within the same fraction (base/neutral or acid fraction), are out of specification. For surrogate spike recoveries out of specification, the following approaches are suggested based on a review of all data from the Case, especially considering the apparent complexity of the sample matrix.

1. If two or more surrogates in either semivolatile fraction (base/neutral or acid fraction) have a recovery greater than the upper acceptance limit (UL):

   a. Specify the fraction that is being qualified (i.e. acid, base/neutral, or both).

   b. Detected semivolatile target compounds are qualified "J."

   c. Results for non-detected semivolatile target compounds should not be qualified.

2. If two or more surrogates in either semivolatile fraction have a recovery greater than or equal to 10 percent but less than the lower acceptance limit (LL):

   a. Specify the fraction that is being qualified (i.e. acid, base/neutral, or both).

   b. Detected semivolatile target compounds are qualified "J".

   c. For non-detected semivolatile target compounds, the sample quantitation limit is qualified as approximated (UJ).

3. In the case where two or more surrogates are out in either semivolatile fraction; one with a recovery greater than the upper acceptance limit and one with a recovery greater than or equal to 10 percent but less than the lower acceptance limit, qualify as described in SV Section VI.E.2 a, b, and c above.

4. If any surrogate in either semivolatile fraction show less than 10 percent recovery:

   a. Specify the fraction that is being qualified (i.e. acid, base/neutral, or both).

   b. Detected semivolatile target compounds are qualified "J".

   c. Non-detected semivolatile target compounds may be qualified as unusable (R).

5. In the special case of a blank analysis with surrogates out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable surrogate recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence.

6. Whenever possible, the potential effects of the data resulting from surrogate recoveries not meeting the advisory limits should be noted in the data review narrative. Additionally, the lack of re-analysis of samples that were out of specification should be noted for EPA Project Officer action.

## VII. Matrix Spikes/Matrix Spike Duplicates
## (Not Required for Low Concentration Water Data)

**A. Review Items:** Form III SV-1, Form III SV-2, chromatograms, and quantitation reports.

**B. Objective:**

Data for matrix spikes/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. These data alone cannot be used to evaluate the precision and accuracy of individual samples. However, when exercising professional judgement, this data should be used in conjunction with other available QC information.

**C. Criteria:**

1. A matrix spike and matrix spike duplicate are extracted and analyzed for every 20 field samples of similar matrix in an SDG, whenever samples are extracted by the same procedure, unless MS/MSD analyses are not required.

2. Matrix spike and matrix spike duplicate recoveries should be within the advisory limits established on Form III SV- 1 and Form III SV-2.

3. The Relative Percent Differences (RPDs) between matrix spike and matrix spike duplicate recoveries should be within the advisory limits listed on Form III SV-1 and Form III SV-2.

**D. Evaluation:**

1. Verify that MS and MSD samples were analyzed at the required frequency and that results are provided for each sample matrix.

2. Inspect results for the MS/MSD Recovery on Form III SV-1 and Form III SV-2 and verify that the results for recovery and RPD are within the advisory limits.

3. Verify transcriptions from raw data and verify calculations.

4. Check that the recoveries and RPD were calculated correctly.

5. Compare results (%RSD) of non-spiked compounds between the original result, MS, and MSD.

**E. Action:**

1. No action is taken on MS/MSD data alone. However, using informed professional judgment the data reviewer may use the matrix spike and matrix spike duplicate results in conjunction with other QC criteria and determine the need for some qualification of the data.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD effect the associated data. This determination should be made with regard to the MS/MSD sample itself as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD effect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples.

4. The reviewer must use professional judgement to determine the need for qualification of positive results of non-spiked compounds.

**NOTE:** If a field blank was used for the MS/MSD, the EPA Project Officer must be notified.

## VIII. Laboratory Control Samples
## (Low Concentration Water)

*[A.* ***Review Items:*** *Form III LCSV, LCS chromatograms, and quantitation reports.*

***B. Objective:***

*Data for Laboratory Control Samples (LCS) are generated to provide information on the accuracy of the analytical method and the laboratory performance.*

***C. Criteria:***

1. *Laboratory control samples are prepared, extracted, analyzed, and reported once per SDG. The LCS must be extracted and analyzed concurrently with the samples in the SDG, using the same instrumentation as the samples in the SDG.*

2. *LCS percent recoveries must he within the QC limits provided on Form III LCSV. The LCS must meet the recovery criteria for the sample data to be accepted.*

3. *The LCS contains the following semivolatile target compounds, in addition to the required surrogates:*

| | |
|---|---|
| *Phenol* | *Naphthalene* |
| *2-Chlorophenol* | *2,4-Dinitrotoluene* |
| *4-Chloroaniline* | *Diethylphthalate* |
| *2,4,6-Trichlorophenol* | *N-Nitrosodiphenylamine* |
| *bis(2-Chloroethyl)ether* | *Hexachlorobenzene* |
| *N-Nitroso-di-n-propylamine* | *Benzo(a)pyrene* |
| *Hexachloroethane* | |
| *Isophorone* | |

4. *The criteria for surrogate recovery and internal standard performance also apply.*

***D. Evaluation:***

1. *Verify that LCS samples were analyzed at the required frequency.*

2. *Inspect the results for LCS Recovery on Form III LCSV and verify that the results for recovery are within the QC limits.*

3. *Verify transcriptions from raw data and verify calculations.*

4. *Check that the recoveries were calculated correctly.*

***E. Action:***

*If the LCS criteria are not met, then the laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.*

1. *Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the exceedance of the criteria.*

2. *If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in performance of the LCS compound to the non-LCS compound.*

3. *If the LCS recovery is greater than the upper acceptance limit, then positive sample results for the affected compound(s) should be qualified with a "J".*

4. *If the mass spectral criteria are met but the LCS recovery is less than the lower acceptance limit, then the associated detected target compounds should be qualified "J" and the associated non-detected target compounds should be qualified "R".*

5. *If more than half of the compounds in the LCS are not within the recovery criteria, then all of the associated detected target compounds should be qualified "J" and all associated non-detected target compounds should be qualified "R".*

6. *Action on non-compliant surrogate recovery and internal standard performance should follow the procedures provided in SV Section VI.E and X.E, respectively. Professional judgement should be used to evaluate the impact that non-compliance for surrogate recovery and internal standard performance in the LCS has on the associated sample data.*

7. *It should be noted for EPA Project Officer action if a laboratory fails to analyze an LCS with each SDG, or if a laboratory consistently fails to generate acceptable LCS recoveries.]*

## IX. Regional Quality Assurance and Quality Control

**A. Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, chromatograms, quantitation report, Traffic Report, and raw data for Regional QC samples.

**B. Objective:**

Regional Quality Assurance and Quality Control (QA/QC) refer to any QA and/or QC initiated by the Region, including field duplicates, Regional Performance Evaluation (PE) samples, blind spikes, and blind blanks. (It is highly recommended that Regions adopt the use of these QA/QC samples.)

**C. Criteria:**

Criteria are determined by each Region.

1. Performance Evaluation sample frequency may vary.

   *[For data generated through the Low Concentration Method: A PE sample can be included as frequently as once per SDG.]*

2. The analytes present in the PE sample must be correctly identified and quantified.

**D. Evaluation:**

Evaluation procedures must follow the Region's SOP for data review. Each Region will handle the evaluation of PE samples on an individual basis. Results for PE samples should be compared to the acceptance criteria for the specific PE samples, if available.

**E. Action:**

Any action must be in accordance with Regional specifications and the criteria for acceptable PE sample results. Unacceptable results for PE samples should be noted for EPA Project Officer action.

## X. Internal Standards

**A. Review Items:** Form VIII SV-1 *[Form VIII LCSV-1]*, Form VIII SV-2 *[Form VIII LCSV-2]*, quantitation reports, and chromatograms.

**B. Objective:**

Internal Standards (IS) performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run.

**C. Criteria:**

1. Internal standard area counts for samples and blanks must not vary by more than a factor of two (-50 percent to + 100 percent) from the associated 12hr calibration standard.

2. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated 12hr calibration standard.

   *[For data generated through the Low Concentration Method: The retention time of the internal standards in samples and blanks must not vary by more than ±20.0 seconds from the retention time of the associated calibration standard.]*

**D. Evaluation:**

1. Check raw data (e.g., chromatograms and quantitation lists) for samples and blanks to verify the internal standard retention times and areas reported on the Internal Standard Area Summary (Form VIII SV-1 *[Form VIII LCSV-1]* and Form VIII SV-2 *[Form VIII LCSV-2]).*

2. Verify that all retention times and IS areas are within the required criteria.

3. If there are two analyses for a particular fraction, the reviewer must determine which are the best data to report. Considerations should include:

   a. Magnitude and direction of the IS area shift.

   b. Magnitude and direction of the IS retention time shift.

   c. Technical holding times.

   d. Comparison of the values of the target compounds reported in each fraction.

SV

**E. Action:**

1. If an IS area count for a sample or blank is outside -50 percent or +100 percent of the area for the associated standard:

   a. Positive results for compounds quantitated using that IS should be qualified with "J".

   b. Non-detected compounds quantitated using an IS area count greater than 100 percent should not be qualified.

   c. Non-detected compounds quantitated using an IS area count less than 50 percent are reported as the associated sample quantitation limit and qualified with "UJ".

   d. If extremely low area counts are reported, or if performance exhibits a major abrupt drop-off, then a severe loss of sensitivity is indicated. Non-detected target compounds should then be qualified as unusable (R).

2. If an IS retention time varies by more than 30 seconds:

   *[If an IS retention time varies by more than 20.0 seconds:]*

   The chromatographic profile for that sample must be examined to determine if any false positives or negatives exist. For shifts of a large magnitude, the reviewer may consider partial or total rejection (R) of the data for that sample fraction. Positive results should not need to be qualified with "R" if the mass spectral criteria are met.

3. If the internal standards performance criteria are grossly exceeded, then this should be noted for EPA Project Officer action. Potential effects on the data resulting from unacceptable internal standard performance should be noted in the data review narrative.

## XI. Target Compound Identification

**A. Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, quantitation reports, mass spectra, and chromatograms.

**B. Objective:**

Qualitative criteria for compound identification have been established to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied much more easily in detecting false positives than false negatives. More information is available due to the requirement for submittal of data supporting positive identifications. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, much more difficult to assess. One example of detecting false negatives is the reporting of a Target Compound as a TIC.

**C. Criteria:**

1. Compound must be within ±0.06 relative retention time (RRT) units of the standard RRT.

2. Mass spectra of the sample compound and a current laboratory-generated standard must match according to the following criteria:

   a. All ions present in the standard mass spectrum at a relative intensity greater than 10 percent <u>must</u> be present in the sample spectrum.

      *[For data generated through the Low Concentration Method: All ions present in the standard mass spectrum at a relative intensity greater than 25 percent <u>must</u> be present in the sample spectrum.]*

   b. The relative intensities of these ions must agree within ±20 percent between the standard and sample spectra. (Example: For an ion with an abundance of 50 percent in the standard spectrum, the corresponding sample ion abundance must be between 30 percent and 70 percent.)

   c. Ions present at greater than 10 percent in the <u>sample</u> mass spectrum but not present in the <u>standard</u> spectrum must be considered and accounted for.

      *[For data generated through the Low Concentration Method: Ions present at greater than 25 percent in the <u>sample</u> mass spectrum but not present in the <u>standard</u> mass spectrum must be considered and accounted for.]*

**D. Evaluation:**

1. Check that the RRT of reported compounds is within ±0.06 RRT units of the standard relative retention time.

2. Check the sample compound spectra against the laboratory standard spectra to verify that it meets the specified criteria.

3. The reviewer should be aware of situations (e.g., high concentration samples preceding low concentration samples) when sample carryover is a possibility and should use judgment to determine if instrument cross-contamination has affected any positive compound identification.

4. Check the chromatogram to verify that peaks are accounted for (i.e., major peaks are either identified as target compounds, TICs, surrogates, or internal standards).

**E. Action:**

1. The application of qualitative criteria for GC/MS analysis of target compounds requires professional judgement. It is up to the reviewer's discretion to obtain additional information from the laboratory. If it is determined that incorrect identifications were made, all such data should be qualified as not detected (U) or unusable (R).

2. Professional judgement must be used to qualify the data if it is determined that cross-contamination has occurred.

3. Any changes made to the reported compounds or concerns regarding target compound identifications should be clearly indicated in the data review narrative. The necessity for numerous or significant changes should be noted for EPA Project Officer action.

## XII. Compound Quantitation and Reported CRQLS

**A. Review Items:** Form I SV-1 *[Form I LCSV-1]*, Form I SV-2 *[Form I LCSV-2]*, sample preparation sheets, SDG Narrative, sample clean-up sheets, quantitation reports, and chromatograms.

**B. Objective:**

The objective is to ensure that the reported quantitation results and Contract Required Quantitation Limits (CRQLs) for semivolatile target compounds are accurate.

**C. Criteria:**

1. Compound quantitation, as well as the adjustment of the CRQL, must be calculated according to the correct equation.

2. Compound area responses must be calculated based on the internal standard (IS) associated with that compound, as listed in the method. Quantitation must be based on the quantitation ion (m/z) specified in the method for both the IS and target analytes. The compound quantitation must be based on the RRF from the appropriate daily calibration standard.

**D. Evaluation:**

1. For all fractions, raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Quantitation lists, chromatograms, and sample preparation log sheets should be compared to the reported positive sample results and quantitation limits. Check the reported values.

2. Verify that the correct internal standard, quantitation ion, and RRF were used to quantitate the compound. Verify that the same internal standard, quantitation ion, and RRF are used consistently throughout the calibration and quantitation processes.

3. Verify that the CRQLs have been adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

**E. Action:**

1. If there are any discrepancies found, the laboratory may be contacted by the Region's designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must use professional judgement to decide which value is the best value. Under these circumstances, the reviewer may determine qualification of data is warranted. Decisions made on data

quality should be included in the data review narrative. A description of the reasons for data qualification and the qualification that is applied to the data should be documented in the data review narrative.

2. Numerous or significant failures to accurately quantify the target compound or to properly evaluate and adjust CRQLs should be noted for EPA Project Officer action.

## XIII. Tentatively Identified Compounds

**A. Review Items:** Form I SV-TIC *[Form I LCSV-TIC]*, chromatograms, and library search printouts with spectra for the TIC candidates.

**B. Objective:**

Chromatographic peaks in semivolatile fraction analyses that are not target analytes, surrogates, or internal standards are potential tentatively identified compounds (TICs). TICs must be qualitatively identified by a National Institute of Standards and Technology (NIST) mass spectral library search and the identifications assessed by the data reviewer.

**C. Criteria:**

For each sample, the laboratory must conduct a mass spectral search of the NIST library and report the possible identity for the appropriate number of the largest semivolatile fraction peaks which are not surrogate, internal standard, or target compounds, but which have area or height greater than 10 percent of the area or height of the nearest internal standard. Peaks that are suspected to be part of an alkane series shall be library searched and reported, as the alkane series (e.g., $C_5$-$C_9$), as a single entry along with the estimate for the total concentration of the series. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I SV-TIC).

*[For data generated through the Low Concentration Method: For each sample, the laboratory must conduct a mass spectral search of the NIST library and report the possible identity for the appropriate number of the largest semivolatile fraction peaks which are not surrogates, internal standards, or target compounds, but which have an area greater than 50 percent of the area of the nearest internal standard. Estimated concentrations for TICs are calculated similarly to the target compounds, using total ion areas for the TIC and the internal standard, and assuming a relative response factor of 1.0. Peaks that are suspected to be part of an alkane series shall be library searched and reported, as the alkane series (e.g., $C_5$-$C_9$), as a single entry along with the estimate for the total concentration of the series. TIC results are reported for each sample on the Organic Analyses Data Sheet (Form I LCSV- TIC).]*

**NOTE:** Since the method revision of October 1986, the CLP does not allow the laboratory to report as tentatively identified compounds any target compound which is properly reported in another fraction. For example, late eluting volatile target compounds should not be reported as semivolatile TICs.

**D. Evaluation:**

1. Guidelines for tentative identification are as follows:

   a. Major ions (greater than 10 percent relative intensity) in the reference spectrum should be present in the sample spectrum.

      *[Major ions (greater than 25 percent relative intensity) in the reference spectrum should be present in the sample spectrum.]*

   b. The relative intensities of the major ions should agree within ±20 percent between the sample and the reference spectra.

   c. Molecular ions present in the reference spectrum should be present in the sample spectrum.

   d. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination, interference, or coelution of additional TIC or target compounds.

   e. When the above criteria are not met, but in the technical judgment of the data reviewer or mass spectral interpretation specialist the identification is correct, the data reviewer may report the identification.

   f. If, after careful review and in the technical judgement of the mass spectral interpretation specialist, no valid identification can be made, the compound should be reported as follows:

      - If the library search produces a match at or above 85%, report that compound.

      - If the library search produces more than one compound at or above 85%, report the first compound (highest).

      - If the library search produces no matches at or above 85%, the compound should be reported as unknown. The mass spectral specialist should give additional classification of the unknown compound, if possible (i.e., unknown hydrocarbon, unknown acid type, unknown chlorinated coumpound). If probable molecular weights can be distinguished, include them.

2. Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms for samples and blanks.

   *[Check the raw data to verify that the laboratory has generated a library search for all required peaks in the chromatograms for samples and blanks with areas greater than or equal to 50 percent of the area of the nearest internal standard.]*

3. Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-target compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which are less than 10 percent of the internal standard height, but present in the blank chromatogram at a similar relative retention time.

   *[Blank chromatograms should be examined to verify that TIC peaks present in samples are not found in blanks. When a low-level non-TCL compound that is a common artifact or laboratory contaminant is detected in a sample, a thorough check of blank chromatograms may require looking for peaks which have areas less than 50 percent of the internal standard area, but present in the blank chromatogram at a similar relative retention time.]*

4. All mass spectra for each sample and blank must be examined.

5. Since TIC library searches often yield several candidate compounds having a close matching score, all reasonable choices should be considered.

6. Check the raw data to verify that the laboratory has properly identified and assigned peaks to the alkane series.

7. The reviewer should be aware of common laboratory artifacts/contaminants and their sources (e.g., aldol condensation products, solvent preservatives, and reagent contaminants). These may be present in blanks and not reported as sample TICs.

   Examples:

   a. Common laboratory contaminants: $CO_2$ (m/z 44), siloxanes (m/z 73), diethyl ether, hexane, certain freons, and phthalates at levels less than 100 ug/L or 4000 ug/Kg.

   b. Solvent preservatives, such as cyclohexene which is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, and chlorocyclohexanol.

   c. Aldol reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanon, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone.

8. Occasionally, a target compound may be identified as a TIC in the proper analytical fraction by non-target library search procedures, even though it was not found on the quantitation list. If the total area quantitation method was used, the reviewer should request that the laboratory recalculate the result using the proper quantitation ion. In addition, the reviewer should evaluate other sample chromatograms and check library reference retention time quantitation lists to determine whether the false negative result is an isolated occurrence whether additional data may be affected.

9. Target compounds may be identified in more than one fraction. Verify that quantitation is made from the proper fraction.

10. Library searches should not be performed on internal standards or surrogates.

11. TIC concentration should be estimated assuming a RRF of 1.0.

**E. Action:**

1. All TIC results should be qualified "NJ", tentatively identified, with approximated concentrations.

2. General actions related to the review of TIC results are as follows:

   a. If it is determined that a tentative identification of a non-target compound is not acceptable, the tentative identification should be changed to "unknown" or an appropriate identification.

   b. If all contractually required peaks were not library searched and quantitated, the Region's designated representative could request these data from the laboratory.

3. TIC results which are not sufficiently above the level in the blank should not be reported. (Dilutions and sample size must be taken into account when comparing the amounts present in blanks and samples.)

4. When a compound is not found in any blanks, but is a suspected artifact of common laboratory contamination, the result may be qualified as unusable (R).

5. In deciding whether a library search result for a TIC represents a reasonable identification, professional judgment must be exercised. If there is more than one possible match, the result may be reported as "either compound X or compound Y". If there is a lack of isomer specificity, the TIC result may be changed to a non-specific isomer result (e.g., 1,3,5-trimethyl benzene to trimethyl benzene isomer) or to a compound class (e.g., 2-methyl, 3-ethyl benzene to substituted aromatic compound).

6. The reviewer may elect to report all similar isomers as a total. All alkanes may be summarized and reported as total hydrocarbons (e.g., alkane series $C_5$-$C_9$). Reporting an alkane series counts only as one of the 30 most intense non-target semi-volatile compounds.

7. Other case factors may influence TIC judgments. If a sample TIC match is poor but other samples have a TIC with a good library match, similar relative retention time, and the same ions, identification information may be inferred from the other sample TIC results.

8. Physical constants, such as boiling point, may be factored into professional judgment of TIC results.

9. Any changes made to the reported data or any concerns regarding TIC identifications should be indicated in the data review narrative.

10. Failure to properly evaluate and report TICs should be noted for EPA Project Officer action.

## XIV. System Performance

**A. Review Items:** Form III SV-1 and Form III SV-2 *[Form III LCSV]*, Form VIII SV-1 *[Form* VIII *LCSV-1]*, Form VIII SV-2 *[Form VIII LCSV-2]*, and chromatograms.

**B. Objective:**

During the period following Instrument Performance QC checks (e.g., blanks, tuning, calibration), changes may occur in the system that degrade the quality of the data. While this degradation would not be directly shown by QC checks until the next required series of analytical QC runs, a through review of the ongoing data acquisition can yield indicators of instrument performance.

**C. Criteria:**

There are no specific criteria for system performance. Professional judgement should be used to assess the system performance.

**D. Evaluation:**

1. Abrupt, discrete shifts in the reconstructed ion chromatogram (RIC) baseline may indicate a change in the instrument's sensitivity or the zero setting. A baseline shift could indicate a decrease in sensitivity in the instrument or an increase in the instrument zero, possibly causing target compounds at or near the detection limit to be non-detects. A baseline "rise" could indicate problems such as a change in the instrument zero, a leak, or degradation of the column.

2. Poor chromatographic performance affects both qualitative and quantitative results. Indications of substandard performance include:

   a. High RIC background levels or shifts in absolute retention times of internal standards.

   b. Excessive baseline rise at elevated temperature.

   c. Extraneous peaks.

   d. Loss of resolution as suggested between by factors such as non-resolution of 2,4- and 2,5- dinitrotoluene.

   e. Peak tailing or peak splitting that may result in inaccurate quantitation.

*[3. A drift in instrument sensitivity may occur during the 12-hour time period. This could be discerned by examination of the IS area on Form VIII LCSV-1 and Form VIII LCSV-2 for trends such as a continuous or near-continuous increase or decrease in the IS area over time.*

4. *The results of the LCS analysis (Form III LCSV) may also be used to assess instrument performance.]*

**E. Action:**

Professional judgement must be used to qualify the data if it is determined that system performance has degraded during sample analyses. Any degradation of system performance which significantly affected the data should be documented for EPA Project Officer action.

## XV. Overall Assessment of Data

**A. Review Items:** Entire data package, data review results, and (if available) Quality Assurance Project Plan (QAPjP), and Sampling and Analysis Plan (SAP).

**B. Objective:**

The overall assessment of a data package is a brief narrative in which the data reviewer expresses concerns and comments on the quality and, if possible, the useability of the data.

**C. Criteria:**

Assess the overall quality of the data.

**D. Evaluation:**

1. Evaluate any technical problems which have not been previously addressed.

2. Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

3. If appropriate information is available, the reviewer may assess the useability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the QAPjP (specifically the Data Quality Objectives), SAP, and communication with data user that concerns the intended use and desired quality of the data.

**E. Action:**

1. Use professional judgement to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief narrative to give the user an indication of the analytical limitations of the data. Any inconsistency of that data with the SDG Narrative should be noted for EPA Project Officer action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include his/her assessment of the useability of the data within the given context.

## PESTICIDE/AROCLOR DATA REVIEW

****Data review guidelines that are unique to data generated through the Low Concentration Water Method are contained within brackets ([ ]) and written in italics.****

The pesticide/Aroclor data requirements to be checked are listed below.

I. Holding Times

II. GC/ECD Instrument Performance Check

III. Initial Calibration

IV. Calibration Verification

V. Blanks

VI. Surrogate Spikes

VII. Matrix Spikes/Matrix Spike Duplicates

*[VIII. Laboratory Control Samples]*

IX. Regional Quality Assurance and Quality Control

X. Pesticide Cleanup Checks

XI. Target Compound Identification

XII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs)

XIII. Overall Assessment of Data

## I. Holding Times

**A. Review Items:** Form I PEST *[Form I LCP]*, EPA Sample Traffic Report and/or chain-of-custody, raw data, sample extraction sheets, and SDG Narrative.

**B. Objective:**

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis.

**C. Criteria:**

Technical requirements for sample holding times have only been established for water matrices.

The technical holding time criteria for water samples are as follows:

> For pesticides and Aroclors in cooled (@ 4°C) water samples, 7 days from sample collection to time of extraction and then 40 days from sample extraction to analysis.

It is recommended that pesticides and Aroclors in soil samples be extracted within 14 days of sample collection.

The method holding times, which differ from the technical holding times, state that extraction of water samples by separatory funnel must be completed within 5 days of validated time of sample receipt (VTSR), extraction of water samples by continuous liquid-liquid extraction procedures must be started within 5 days of VTSR, and soil/sediment samples are to be extracted within 10 days of VTSR. Also, contractually both water and soil sample extracts must be analyzed within 40 days of sample extraction.

*[For data generated through the Low Concentration Method: The holding times requirements are that the extraction of all samples must be started within 5 days of the VTSR, and the extracts must be analyzed within 40 days of VTSR.]*

**D. Evaluation:**

Technical holding times for sample extraction are established by comparing the sample collection date on the EPA Sample Traffic Report with the dates of extraction on Form I PEST *[Form I LCP]* and the sample extraction sheets. To determine if the samples were analyzed within the holding time after extraction, compare the dates of extraction on the sample extraction sheets with the dates of analysis on Form I PEST *[Form I LCP]*.

Verify that the Traffic Report indicates that the samples were received intact and iced. If the samples were not iced or there were any problems with the samples upon receipt, then discrepancies in the sample condition could effect the data.

**E. Action:**

1. If technical holding times are exceeded, qualify all detected compound results as estimated "J" and sample quantitation limits as estimated "UJ", and document in the data review narrative that holding times were exceeded.

2. If technical holding times are grossly exceeded, either on the first analysis or upon re-analysis, the reviewer must use professional judgement to determine the reliability of the data and the effect of additional storage on the sample results. The reviewer may determine that detected compound results or the associated quantitation limits are approximates and should be qualified with "J" or "UJ", respectively. The reviewer may determine that non-detected target compound data are unusable (R).

3. Due to limited information concerning holding times for soil samples, it is left to the discretion of the data reviewer to apply water holding time criteria to soil samples. Professional judgement is required to evaluate holding times for soil samples.

4. Whenever possible, the reviewer should comment on the effect of exceeding the holding time on the resulting data in the data review narrative.

5. When method and/or technical holding times are exceeded, this should be noted as an action item for the EPA Project Officer.

6. The reviewer should also be aware of the scenario in which the laboratory has exceeded the technical holding times, but met contractual holding times. In this case, the data reviewer should notify the EPA Project Officer (where samples were collected) and/or RSCC that shipment delays have occurred so that the field problem can be corrected. The reviewer may pass this information on to the laboratory's EPA Project Officer, but should explain that contractually the laboratory met the method requirements.

## II. GC/ECD Instrument Performance Check

**A. Review Items:** Forms VI PEST-4 *[Form VI LCP-4]*, Form VI PEST-5*[Form VI LCP-5]*, Form VII PEST-1 *[Form VII LCP*-1], FormVIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

**B. Objective:**

Performance checks on the gas chromatograph with electron capture detector (GC/ECD) system are performed to ensure adequate resolution and instrument sensitivity. These criteria are not sample specific. Conformance is determined using standard materials, therefore, these criteria should be met in all circumstances.

**C. Criteria:**

1. Resolution Check Mixture

   a. The Resolution Check Mixture must be analyzed at the beginning of every initial calibration sequence, on each GC column and instrument used for analysis. The Resolution Check Mixture contains the following pesticides and surrogates:

| | |
|---|---|
| gamma-Chlordane | Endrin ketone |
| Endosulfan I | Methoxychlor |
| 4,4'-DDE | Tetrachloro-m-xylene |
| Dieldrin | Decachlorobiphenyl |
| Endosulfan sulfate | |

   b. The depth of the valley between two adjacent peaks in the Resolution Check Mixture must be greater than or equal to 60.0 percent of the height of the shorter peak.

2. Performance Evaluation Mixture

   a. The Performance Evaluation Mixture (PEM) must be analyzed at the beginning (following the resolution check mixture) and at the end of the initial calibration sequence. The PEM must also be analyzed at the beginning of every other 12-hour analytical period. The PEM contains the following pesticides and surrogates:

| | |
|---|---|
| gamma-BHC | Endrin |
| alpha-BHC | Methoxychlor |
| 4,4'-DDT | Tetrachloro-m-xylene |
| beta-BHC | Decachlorobiphenyl |

b. All peaks in the Performance Evaluation Mixture injections must be greater than or equal to 90 percent resolved on each GC column. This applies to both initial and continuing calibrations.

c. The absolute retention times of each of the single component pesticides and surrogates in all PEM analyses must be within the specific retention time windows centered around the mean retention times determined from the three-point initial calibration using the Individual Standard Mixtures.

For example, for a given pesticide the mean retention time is first determined from the initial calibration and found to be 12.69 minutes. The retention time window for this pesticide is ±0.05 minutes. Therefore, the calculated retention time window would range from 12.64 to 12.74 minutes.

d. The percent difference between the calculated amount (amount found) and the nominal amount (amount added) for each of the single component pesticides and surrogates in both of the PEM analyses on each GC column must be greater than or equal to -25.0 percent, AND less than or equal to 25.0 percent using the equation as specified in the method.

e. The percent breakdown is the amount of decomposition that 4,4'-DDT and Endrin undergo when analyzed on the GC column. For Endrin, the percent breakdown is determined by the presence of Endrin aldehyde and/or Endrin ketone in the GC chromatogram. For 4,4-DDT, the percent breakdown is determined from the presence of 4,4'-DDD and/or 4,4'-DDE in the GC chromatogram.

i. The percent breakdown for both 4,4'-DDT and Endrin in each PEM must be less than or equal to 20.0 percent for both GC columns.

ii. The combined percent breakdown for 4,4'-DDT and Endrin in each PEM must be less than or equal to 30.0 percent for both GC columns.

**D. Evaluation:**

1. Resolution Check Mixture

   a. Verify from the Form VIII PEST *[Form VIII LCP]* that the resolution check mixture was analyzed at the beginning of the initial calibration sequence on each GC column and instrument used for analysis.

   b. Check the resolution check mixture data and Form VI PEST-4 *[Form VI LCP-4]* to verify that the resolution criterion between two adjacent peaks for the required compounds is greater than or equal to 60 percent.

2. Performance Evaluation Mixture

   a. Verify from the Form VIII PEST *[Form VIII LCP]* that the Performance Evaluation Mixture (PEM) was analyzed at the proper frequency and position sequence.

   b. Check the PEM data from Form VI PEST-5, and the initial and continuing calibrations to verify that the resolution between adjacent peaks is greater than or equal to 90 percent on both GC columns.

   c. Check the PEM data from the initial and continuing calibrations and Form VII PEST-1 to verify that the absolute retention times for the pesticides in each analysis are within the calculated retention time windows based on the mean retention time from the three-point initial calibration.

   d. Verify that the percent difference between the calculated amount (amount found) and the nominal amount (amount added) for each of the single component pesticides and surrogates in both of the PEM analyses on each GC column must be greater than or equal to -25.0 percent, AND less than or equal to 25.0 percent.

   e. Verify that the individual breakdowns for 4,4'-DDT and Endrin are less than or equal to 20.0 percent, and that the combined breakdown is less than or equal to 30.0 percent.

**E. Action:**

1. Resolution Check Mixture

   a. If the Resolution Check Mixture was not analyzed with the frequency described in PEST Section II.C.1, then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. This situation should be brought to the attention of the EPA Project Officer.

b. If resolution criteria are not met, the quantitative results may not be accurate due to inadequate resolution. Detected target compounds that were not adequately resolved should be qualified with "J". Qualitative identifications may also be questionable if coelution exists. Non-detects with retention times in the region of coelution may not be valid, depending on the extent of the problem. Professional judgement should be used to determine the need to qualify data as unusable (R).

2. Performance Evaluation Mixture Frequency

If the Performance Evaluation Mixture was not analyzed with the frequency described in PEST Section II.C.2, then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. This situation should be brought to the attention of the EPA Project Officer.

3. Performance Evaluation Mixture Resolution

If PEM resolution criteria are not met, then the quantitative results may not be accurate due to inadequate resolution. Positive sample results for compounds that were not adequately resolved should be qualified with "J". Qualitative identifications may be questionable if coelution exists. Non-detected target compounds that elute in the region of coelution may not be valid depending on the extent of the coelution problem. Professional judgement should be used to qualify data as unusable (R).

4. Performance Evaluation Mixture Retention Times

Retention time windows are used in qualitative identification. If the retention times of the pesticides in the PEM do not fall within the retention time windows, the associated sample results should be carefully evaluated. All samples injected after the last in-control standard are potentially affected. It should be noted for EPA Project Officer action if the PEM retention time criteria are grossly exceeded.

a. For the affected samples, check to see if the sample chromatograms contain any peaks that are close to the expected retention time window of the pesticide of interest. If no peaks are present either within or close to the retention time window of the deviant target pesticide compound, then there is usually no effect on the data (i.e., non-detected values can be considered valid). Sample data that are potentially affected by standards not meeting the retention time windows should be noted in the data review narrative.

b. If the affected sample chromatograms contain peaks which may be of concern (i.e., above the CRQL and either close to or within the expected retention time window of the analyte of interest), then the reviewer should determine the extent of the effect on the data and may choose to qualify detected target compounds "NJ" and non-detected target compounds "UJ". In some cases, additional effort by the reviewer may be necessary to determine if sample peaks represent the compounds of interest, for example:

i. The reviewer can examine the data package for the presence of three or more standards containing the pesticide of interest that were run within a 72-hour period during which the sample was analyzed.

ii. If three or more such standards are present, the mean and standard deviation of the retention time window can be re-evaluated by using the mean retention times of the standards.

iii. If all standards and matrix spikes fall within the revised window, the valid positive or negative sample results can be determined using this window.

iv. The data review narrative should identify the additional efforts taken by the reviewer and the resultant impact on data usability. In addition, the support documentation should contain all calculations and comparisons generated by the reviewer.

c. If the reviewer cannot do anything with the data to resolve the problem of concern, all positive results and quantitation limits should be qualified "R".

5. If percent difference criteria are not met, qualify all associated positive results generated during the analytical sequence with "J" and the sample quantitation limits for non-detected target compounds with "UJ".

6. 4,4'-DDT/Endrin Breakdown:

a. If 4,4'-DDT breakdown is greater than 20.0 percent:

i. Qualify all positive results for DDT with "J". If DDT was not detected, but DDD and DDE are detected, then qualify the quantitation limit for DDT as unusable (R).

ii. Qualify positive results for DDD and/or DDE as presumptively present at an approximated quantity (NJ).

b. If Endrin breakdown is greater than 20.0 percent:

i. Qualify all positive results for Endrin with "J". If Endrin was not detected, but Endrin aldehyde and Endrin ketone are detected, then qualify the quantitation limit for Endrin as unusable (R).

ii. Qualify positive results for Endrin Aldehyde and Endrin ketone as presumptively present at an approximated quantity (NJ).

c. If the combined 4,4'-DDT and Endrin breakdown is greater than 30.0 percent:

i. The reviewer should consider the degree of individual breakdown of DDT and Endrin and apply qualifiers as described above.

7. Potential effects on the sample data resulting from the instrument performance check criteria should be noted in the data review narrative. If the data reviewer has knowledge that the laboratory has repeatedly failed to comply with the requirements for frequency, linearity, retention time, resolution, or DDT/Endrin breakdown, the data reviewer should notify the EPA Project Officer.

## III. Initial Calibration

A. **Review Items:** Forms VI PEST-1 *[Form VI LCP-1]*, Form VI PEST-2 *[Form VI LCP-2]*, Form VI PEST-3 *[Form VI LCP-3]*, Form VI PEST-4 *[Form VI LCP-4]*, Form VII PEST-1 *[Form VII LCP-1]*, Form VIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

B. **Objective:**

Compliance requirements for satisfactory initial calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for pesticide and Aroclor compounds on the Target Compound List (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical sequence and of producing a linear calibration curve.

C. **Criteria:**

1. Individual Standard Mixtures

a. Individual Standard Mixtures A and B (containing all of the single component pesticides and surrogates) must be analyzed at low, midpoint, and high levels during the initial calibration, on each GC column and instrument used for analysis.

b. The resolution between any two adjacent peaks in the midpoint concentration of Individual Standard Mixtures A and B in the initial calibration must be greater than or equal to 90.0 percent on each column.

c. The absolute retention times of each of the single component pesticides and surrogates are determined from three-point initial calibration using the Individual Standard Mixtures. The retention time window for each single component compound can be found in the appropriate method. An example for determining retention time windows is given in PEST Section II.C.2.c above.

d. At least one chromatogram from each of the Individual Standard Mixtures A and B must yield peaks that give recorder deflections between 50 to 100 percent of full scale.

e. The concentrations of the low, medium, and high level standards containing all of the single component pesticides and surrogates (Individual Standard Mixtures A and B) are as follows:

The low point corresponds to the CRQL for each analyte. The midpoint concentration must be 4 times the low point. The high point must be at least 16 times the low point, but a higher concentration may be chosen.

f. The Percent Relative Standard Deviation (%RSD) of the calibration factors for each of the single component pesticides and surrogates in the initial calibration on both columns for Individual Standard Mixtures A and B must be less than or equal to 20.0 percent, except as stated below. For the two surrogates, the %RSD must be less than or equal to 30.0 percent. Up to two single component target pesticides (other than the surrogates) per column may exceed the 20.0 percent limit but the %RSD must be less than or equal to 30.0 percent.

**Note:** Either peak area or peak height may be used to calculate the calibration factors that are, in turn, used to calculate %RSD. However, the type of peak measurement used to calculate each calibration factor for a given compound must be consistent. For example, if peak area is used to calculate the low point calibration factor for endrin, then the mid and high point calibration factors for endrin must also be calculated using peak area.

2. Multi-component Target Compounds

a. The multi-component target compounds (the 7 Aroclors and Toxaphene) must each be analyzed separately at a single concentration level during the initial calibration sequence. The analysis of the multi-component target compounds must also contain the pesticide surrogates.

b. For each multi-component analyte, the retention times are determined for three to five peaks. A retention time window of ±0.07 minutes is used to determine retention time windows for all multi-component analyte peaks, as stated in the appropriate method.

c. Calibration factor data must be determined for each peak selected from the multi-component analytes.

**D. Evaluation:**

1. Individual Standard Mixtures

a. Verify from the Form VIII PEST *[Form VIII LCP]* that the Individual Standard Mixtures A and B were analyzed at the proper frequency on each GC column and instrument used for analysis. Check the raw data (chromatograms and data system printouts) for each standard to verify that each of the standards was analyzed at the required concentration levels.

b. Check Form VII PEST-2 with the raw data, and determine that the midpoint standard concentration is 4 times the concentration of the low point standard concentration and verify that resolution is greater than 90 percent.

c. Check the Individual Standard Mixtures A and B data and Form VI PEST-1 *[Form VI LCP-1]* and review the calculated retention time windows for calculation and transcription errors.

d. Check the chromatograms and verify that at least one chromatogram from each of the Individual Standard Mixtures A and B yields peaks registering recorder/printer deflections between 50 and 100 percent of full scale.

e. Verify that the concentrations of the low, medium and high level standards of Individual Standard Mixtures A and B meet the criteria in PEST Section III. C.1. above.

f. Check the Individual Standard Mixtures A and B data and Form VI PEST-2 *[Form VI LCP-2]* to verify that the %RSD for the calibration factors in each of the single component pesticides and surrogates in the initial calibration analyses on both columns are in compliance with the criteria in PEST Section III.C above. Check and recalculate the calibration factors and %RSD for one or more pesticides; verify that the recalculated values agree with the reported values. If errors are detected, more comprehensive recalculation and review should be performed.

2. Multi-component Target Compounds

a. Verify from the Form VIII PEST *[Form VIII LCP]* that each of the multi-component target compounds were analyzed at the required frequency. Check the raw data for the standards to verify that the multi-component analytes were analyzed at the required concentration.

b. Check the data for the multi-component target compounds and Form PEST VI-3 *[Form VI LCP-3]* to verify that at least three peaks were used for calibration and that retention time windows were calculated as required.

c. Check the data to verify that calibration factors have been determined for each selected peak.

**E. Action:**

1. If the initial calibration sequence was not followed as required, then professional judgement must be used to evaluate the effect of the non-compliance on the sample data. If the requirements for the initial calibration sequence were not met, then this should be noted for EPA Project Officer action. If the non-compliance has a potential effect on the data, then the data should be qualified according to the professional judgement of the reviewer and this should be noted in the data review narrative.

2. If resolution criteria are not met, then the quantitative results may not be accurate due to peak overlap and lack of adequate resolution. Positive sample results for compounds

that were not adequately resolved should be qualified with "J". Qualitative identifications may be questionable if coelution exists. Non-detected target compounds that elute in the region of coelution may not be valid, depending on the extent of the coelution problem. Professional judgement should be used to qualify data as unusable (R).

3. If retention time windows are not calculated correctly, recalculate the windows and use the corrected values for all evaluations.

4. If the chromatogram display (recorder deflection) criteria are not met, use professional judgement to evaluate the effect on the data. If the data reviewer has knowledge that the laboratory has repeatedly failed to comply with this requirement, the data reviewer should notify the EPA Project Officer.

5. If the sample concentration exceeds the linearity of the calibration curve, and the sample is not properly diluted and re-analyzed, flag the positive results "J".

6. If the standard concentration criteria are not met, use professional judgement to evaluate the affect on the data and notify the EPA Project Officer. This is especially critical for the low level standards and non-detects.

7. If the %RSD linearity criteria are not met for the compound(s) being quantified, qualify all associated positive quantitative results with "J" and the sample quantitation limits for non-detected target compounds with "UJ".

8. Potential effects on the sample data due to problems with calibration should be noted in the data review narrative. If the data reviewer has knowledge that the laboratory has repeatedly failed to comply with the requirements for frequency, linearity, retention time, or resolution, the data reviewer should notify the EPA Project Officer.

## IV. Calibration Verification

A **Review Items:** Form VI PEST-6 *[Form VI LCP-6]*, Form VI PEST-7 *[Form VI LCP-7]*, Form VII PEST-1 *[Form VII LCP-1]*, Form VII PEST-2 *[Form VII LCP-2]*, Form VIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

B. **Objective:**

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Calibration verification checks and documents satisfactory performance of the instrument over specific time periods during sample analysis. To confirm the calibration and evaluate instrument performance, calibration verification is performed, consisting of the analyses of instrument blanks, the PEM, and the midpoint concentration of Individual Standard Mixtures A and B.

C. **Criteria:**

1. An instrument blank and the PEM must bracket one end of a 12-hour period during which samples are analyzed, and a second instrument blank and the midpoint concentration of Individual Standard Mixtures A and B must bracket the other end of the 12-hour period.

2. The resolution between any two adjacent peaks in the midpoint concentration of Individual Standard Mixtures A and B must be greater than or equal to 90.0 percent.

3. The absolute retention time for each single component pesticide and surrogate in the midpoint concentration of Individual Standard Mixtures A and B must be within the retention time windows determined from the initial calibration.

4. The percent difference between the calculated amount and the true amount for each of the pesticides and surrogates in the midpoint concentration of the Individual Standard Mixtures A and B must not exceed ±25.0 percent.

D. **Evaluation:**

1. Check the Form VIII PEST *[Form VIII LCP]* to verify that the instrument blanks, PEMs, and Individual Standard Mixtures were analyzed at the proper frequency and that no more than 12 hours was elapsed between continuing calibration brackets in an ongoing analytical sequence.

2. Check Form VI PEST-6 *[Form VI LCP-6]* and Form VI PEST-7 *[Form VI LCP-7]*, and the data for the midpoint concentration of Individual Standard Mixtures A and B to verify that the resolution between any two adjacent peaks is greater than or equal to 90.0 percent.

3. Check the data for each of the single component pesticides and surrogates in the midpoint concentration of Individual Standard Mixtures A and B and Form VII PEST-2 *[Form VII LCP-2]* to verify that the absolute retention times are within the appropriate retention time windows.

4. Check the data from the midpoint concentration of Individual Standard Mixtures A and B and Form VII PEST-2 *[Form VII LCP-2]* to verify that the percent difference between the calculated amount and the true amount for each of the pesticides and surrogates (must be within ±25).

**E. Action:**

1. If the continuing calibration sequence was not followed as required, then professional judgement must be used to evaluate the effect of the non-compliance on the sample data. If the requirements for the continuing calibration sequence were not met, then this should be noted for EPA Project Officer action. If the non-compliance has a potential effect on the data, then the data should be qualified according to the professional judgement of the reviewer and this should be noted in the data review narrative.

2. If resolution criteria are not met, then the quantitative results may not be accurate due to inadequate resolution. Positive sample results for compounds that were not adequately resolved should be qualified with "J". Qualitative identifications may be questionable if coelution exists. Non-detected target compounds that elute in the region of coelution may not be valid depending on the extent of the coelution problem. Professional judgement should be used to qualify data as unusable (R).

3. Retention time windows are used in qualitative identification. If the standards do not fall within the retention time windows, the associated sample results should be carefully evaluated. All samples injected after the last <u>in-control</u> standard are potentially affected.

    a. For the affected samples, check to see if the sample chromatograms contain any peaks that are close to the expected retention time window of the pesticide of interest. If no peaks are present either within or close to the retention time window of the deviant target pesticide compound, then non-detected values can be considered valid. Sample data that is potentially affected by the standards not meeting the retention time windows should be noted in the data review narrative. If the retention time window criteria are grossly exceeded, then this should be noted for EPA Project Officer action.

    b. If the affected sample chromatograms contain peaks which may be of concern (i.e., above the CRQL and either close to or within the expected retention time window of the pesticide of interest), then the reviewer should follow the guidelines provided in Pesticide Section III.E.3 to determine the extent of the effect on the data.

**PEST**

4. If the percent difference is greater than 25 percent for the compound(s) being quantified, qualify all associated positive quantitative results with "J" and the sample quantitation limits for non-detects with "UJ".

5. Potential effects on the sample data due to problems with calibration should be noted in the data review narrative.

## V. Blanks

**A. Review Items:** Form I PEST *[Form I LCP]*, Form IV PEST *[Form IV LCP]*, chromatograms, and data system printouts.

**B. Objective:**

The purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination problems resulting from laboratory (or field) activities. The criteria for evaluation of laboratory blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, and sulfur cleanup blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data.

**C. Criteria:**

1. No contaminants should be present in the blanks.

2. Method Blanks

   a. A method blank analysis must be performed for each 20 samples of similar matrix in each Sample Delivery Group (SDG) or whenever a sample extraction procedure is performed. The method blank should be analyzed on each GC system used to analyze that set of associated samples.

3. Instrument Blanks

   a. An acceptable instrument blank must be run at least once every 12 hours and immediately prior to the analysis of either the performance evaluation mixture or Individual Standard Mixtures A and B, depending on the position in the analytical sequence.

4. Sulfur Cleanup Blanks

   a. A sulfur cleanup blank must be analyzed whenever part of a set of samples extracted together requires sulfur cleanup. If the entire set of samples associated with a method blank requires sulfur cleanup, then the method blank also serves the purpose of a sulfur blank and no separate sulfur blank is required. The sulfur cleanup blank should be analyzed on each GC system used to analyze the associated samples.

**D. Evaluation:**

1. Review the results of all associated blanks, Form I PEST *[Form I LCP]* and Form IV PEST *[Form IV LCP]*, and raw data (chromatograms and data system printouts) to evaluate presence of target or non-target analytes in the blanks.

2. Verify that method blank analysis has been reported per SDG, per matrix, per concentration level, for each GC system used to analyze samples, and for each extraction batch. The reviewer can use Form IV PEST *[Form IV LCP]* to assist in identifying samples associated with each blank.

3. Verify that the method blank analysis(es) contains less than the Contract Required Quantitation Limit (CRQL) of any target pesticide or Aroclor/Toxaphene or any interfering peak.

4. Verify that the instrument blank analysis has been performed every 12 hours as the first analysis of the continuing calibration sequence. All acceptable sample analyses are to be bracketed by acceptable instrument blanks. Additionally, the instrument blank must follow sample analyses which contain an analyte at high concentration. Evaluate the results from the various instrument blanks to verify that they do not contain any target analytes above one-half the CRQL values for water samples (assuming a 1-L extraction of a water sample).

5. Verify that the sulfur cleanup blanks were analyzed at the required frequency and that (assuming a 1-L extraction of a water sample) the sulfur blanks do not contain any target compounds above the CRQL. If a separate sulfur cleanup blank was prepared, one version of Form IV PEST *[Form IV LCP]* should be completed associating all the samples with the method blank, and a second version of Form IV PEST *[Form IV LCP]* should be completed listing only those samples associated with the separate sulfur cleanup blank.

**E. Action:**

If the appropriate blanks were not analyzed with the frequency described in the previous PEST Section V.C., then the data reviewer should use professional judgement to determine if the associated sample data should be qualified. The reviewer may need to obtain additional information from the laboratory. The situation should be brought to the attention of the EPA Project Officer.

Action in the case of unsuitable blank results depends on the circumstances and the origin of the blank. Detected compounds should be reported unless the concentration of the compound in the sample is less than or equal to 5 times (5x) the amount in any blank. In instances where more than one blank is associated with a given sample, <u>qualification should be based upon a comparison with the associated blank having the highest concentration of a contaminant</u>. The results <u>must not</u> be corrected by subtracting the blank value.

Specific actions are as follows:

1. If a target pesticide or Aroclor/Toxaphene is found in the blank but <u>not</u> found in the sample(s), no qualification is required. If the contaminants found are at levels significantly greater than the CRQL, then this should be noted for EPA Project Officer action.

2. Any pesticide or Aroclor/Toxaphene detected in the sample, that was also detected in any associated blank, is qualified if the sample concentration is less than five times (5x) the blank concentration. The quantitation limit may also be elevated. Typically, the sample CRQL is elevated to the concentration found in the sample. The reviewer should use professional judgement to determine if further elevation of the CRQL is required.

   The reviewer should note that analyte concentrations calculated for method, sulfur, or instrument blanks may not involve the same weights, volumes, or dilution factors as the associated samples. These factors must be taken into consideration when applying the "5x" criteria, such that a comparison of the total amount of contamination is actually made.

   Additionally, there may be instances when little or no contamination was present in the associated blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but absent in the undiluted sample result. Since both results are not routinely reported, it may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, he/she should qualify the data. In this case, the "5x" rule does not apply; the sample value should be reported as a non-detected target compound ("U"). An explanation of the rationale for this determination should be provided in the data review narrative.

3. If gross contamination exists (e.g., saturated peaks, "hump-o-grams", "junk" peaks), all affected compounds in the associated samples should be qualified as unusable (R), due to interference. This should be noted in the data review narrative and as a EPA Project Officer action item if the contamination is suspected of having an effect on the sample results.

4. If inordinate amounts of target pesticides, Aroclors/Toxaphene, or other interfering non-target compounds are found at low levels in the blank(s), it may be indicative of a problem at the laboratory and should be noted for EPA Project Officer action.

5. If an instrument blank was not analyzed following a sample analysis which contained an analyte(s) at high concentration(s), sample analysis results after the high concentration sample must be evaluated for carryover. Professional judgement should be used to determine if instrument cross-contamination has affected any positive compound identification(s), and if so, detected compound results should be qualified. If instrument cross-contamination is suggested, then this should be noted in the data review narrative, and for EPA Project Officer action, if the cross-contamination is suspected of having an affect on the sample results.

**PEST**

The following are examples of applying the blank qualification guidelines.

Example 1: Sample result is greater than the CRQL, but is less than the 5x multiple of the blank result.

| | 5x |
|---|---|
| Blank Result | 1.0 |
| CRQL | 0.5 |
| Sample Result | 4.0 |
| Qualified Sample Result | 4.0U |

Example 2: Sample result is less than the CRQL, and is also less than the 5x multiple of the blank result.

| | 5x |
|---|---|
| Blank Result | 1.0 |
| CRQL | 0.5 |
| Sample Result | 0.4J |
| Qualified Sample Result | 0.5U |

Example 3: Sample result is greater than the 5x multiple of the blank result.

| | 5x |
|---|---|
| Blank Result | 1.0 |
| CRQL | 0.5 |
| Sample Result | 10.0 |
| Qualified Sample Result | 10.0 |

In this case, the sample result exceeded the adjusted blank result (5 x 1.0) and the sample result is not qualified.

## VI. Surrogate Spikes

A. **Review Items:** Form II PEST-1 and Form II PEST-2 *[Form II LCP]*, Form VIII PEST *[Form VIII LCP]*, chromatograms, and data system printouts.

B. **Objective:**

Laboratory performance on individual samples is established by means of spiking samples prior to extraction and analysis to determine surrogate spike recoveries. All samples are spiked with surrogate compounds prior to sample extraction. The evaluation of the recovery results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of target and/or non-target analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the evaluation and review of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement. Accordingly, this section consists primarily of guidelines, in some cases with several optional approaches suggested.

C. **Criteria:**

1. Two surrogate spikes, tetrachloro-m-xylene and decachlorobiphenyl, are added to all samples, Individual Standard Mixtures, PEMs, blanks, and matrix spikes to measure their recovery in sample and blank matrices.

2. The limits for recovery of the surrogates tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB) are 30-150 percent for both water and soil samples.

3. The retention times of both of the surrogates in the PEM, Individual Standard Mixtures, and samples must be within the calculated retention time windows. TCX must be within ±0.05 minutes, and DCB must be within ±0.10 minutes of the mean retention time determined from the initial calibration.

D. **Evaluation:**

1. Check the raw data (e.g., chromatograms and data system printouts) to verify that the recoveries on the Surrogate Recovery Form II PEST-1 and Form II PEST-2 *[Form II LCP]* are calculated and transcribed correctly.

2. If recoveries are not within limits, check the raw data for possible interferences which may have affected surrogate recoveries. If low surrogate recoveries are observed, the reviewer should investigate whether the low recoveries were a result of sample dilution.

3. Check the raw data (e.g., chromatograms and data system printouts) to verify that the retention times on Form VIII PEST *[Form VIII LCP]* are accurate and within retention time windows.

4. If retention times were not met, check the raw data for possible mis-identification of GC peaks. Non-recovery of surrogates may also be due to shifts in retention times.

**E. Action:**

1. If either surrogate spike recovery is outside of advisory limits, the following guidance is suggested. **Professional judgement must be used in applying these criteria, as surrogate recovery problems may not directly apply to target analytes.**

   a. If low recoveries (i.e., between 10 and 30 percent) are obtained, associated detected compounds should be qualified "J" and quantitation limits "UJ".

   b. If high recoveries (i.e., greater than 150 percent) are obtained, this may be an indication of a high bias due to co-eluting interferences. Using professional judgement, qualify associated detected compound data with "J". Non-detected analytes do not require qualification.

   c. If either pesticide surrogate recovery is reported as between 0 percent and 10 percent, the reviewer should examine the sample chromatogram to assess the qualitative validity of the analysis. If low surrogate recoveries are found to be due to sample dilution, then professional judgement should be used to determine if the resulting data should be qualified. If sample dilution is not a factor, then detected target compounds may be qualified "J" and non-detected target compound results should be qualified unusable (R).

   d. If zero pesticide surrogate recovery is reported, the reviewer should examine the sample chromatogram to determine if the surrogate may be present, but slightly outside its retention time window. If this is the case, in addition to assessing surrogate recovery for quantitative bias, the overriding consideration is to investigate the qualitative validity of the analysis. If the surrogate is not present, qualify all nondetected target compounds as unusable (R).

2. If surrogate retention times in PEMs, Individual Standard Mixtures, samples, and blanks are outside of the retention time limits, qualification of the data is left up to the professional judgement of the reviewer. Refer to Pesticide Section II.E.2 for more guidance.

3. In the special case of a blank analysis with surrogates out of specification, the reviewer must give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if one or more samples in the batch show acceptable surrogate recoveries, the reviewer may choose to consider the blank problem to be an isolated occurrence. Data is qualified on the professional judgement of the reviewer.

4. Extreme or repeated analytical problems with surrogate recoveries should be noted for EPA Project Officer action.

5. If possible, the impact on the data resulting from surrogate recoveries not meeting the advisory limits, should be noted in the data review narrative.

## VII. Matrix Spikes/Matrix Spike Duplicates (Not Required for Low Concentration Water Data)

A. **Review Items:** Form III PEST-1, Form III PEST-2, chromatograms, and data system printouts.

B. **Objective:**

Data for matrix spikes (MS) and matrix spike duplicates (MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices. These data alone cannot be used to evaluate the precision and accuracy of individual samples. However, when exercising professional judgement, MS/MSD data should be used in conjunction with information on other deficiencies.

C. **Criteria:**

1. Matrix spikes (MS) and matrix spike duplicate (MSD) samples are analyzed at a frequency of at least one MS and MSD per 20 samples of each matrix, unless MS/MSD analyses are not required.

2. Matrix spike recoveries should be within the advisory limits provided on Form III PEST-1 and Form III PEST-2.

3. Relative percent difference (RPD) between MS and MSD recoveries should be within the advisory limits provided on Form III PEST-1 and Form III PEST-2.

D. **Evaluation:**

1. Verify that MS and MSD samples were analyzed at the required frequency and that results are provided for each sample matrix.

2. Check the raw data and Form III PEST-1 and Form III PEST-2 to verify that the results for matrix spike recoveries were calculated and transcribed correctly.

3. Check the raw data and Form III PEST-1 and Form III PEST-2 to verify that the matrix spike Relative Percent Difference (RPD) was calculated and transcribed correctly.

4. Compare %RSD results of non-spiked compounds between the original result, MS, and MSD.

E. **Action:**

1. No action is taken on MS/MSD data alone. However, using informed professional judgment, the data reviewer may use the MS and MSD results in conjunction with other QC criteria and determine the need for some qualification of the data.

2. The data reviewer should first try to determine to what extent the results of the MS/MSD affect the associated sample data. This determination should be made with regard to the MS/MSD sample itself, as well as specific analytes for all samples associated with the MS/MSD.

3. In those instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to this sample alone. However, it may be determined through the MS/MSD results that a laboratory is having a systematic problem in the analysis of one or more analytes, which affects all associated samples. For example, if the recoveries for MS and MSD are consistently low for both water and soil samples, this could be indicative of a systematic problem in the laboratory and recoveries should be examined in all associated samples.

4 The reviewer must use professional judgement to determine the need for qualification of positive results of non-spiked compounds.

**NOTE:** If a field blank was used for the MS/MSD, unless designated as such by the Region, the EPA Project Officer must be notified.

## VIII. Laboratory Control Samples
## (Low Concentration Water)

*[A.* ***Review Items:*** *Form I LCP, Form III LCP, LCS chromatograms, and data system printouts.*

***B. Objective:***

*Data for laboratory control samples (LCSs) are generated to provide information on the accuracy of the analytical method and laboratory performance.*

***C. Criteria:***

1. *Laboratory control samples are analyzed at a frequency of once per SDG.*

2. *The LCS contains the following pesticides: gamma-BHC, heptachlor epoxide, dieldrin, 4,4-DDE, endrin, endosulfan sulfate, and gamma-chlordane, in addition to the two required surrogates.*

3. *The percent recoveries for the LCS compounds must be within the QC limits provided on Form III LCP. The LCS must meet the recovery criteria for the sample data to be accepted.*

4. *The criteria for surrogate recovery and target compound identification also apply.*

***D. Evaluation:***

1. *Verify that LCS samples were analyzed at the required frequency.*

2. *Verify that the LCS recoveries reported on Form III LCP are within the QC limits.*

3. *Check that the LCS recoveries were calculated correctly.*

4. *Verify transcriptions from raw data to Forms I and III LCP.*

***E. Action:***

*If the LCS criteria are not met, then laboratory performance and method accuracy are in question. Professional judgement should be used to determine if the data should be qualified or rejected. The following guidance is suggested for qualifying sample data for which the associated LCS does not meet the required criteria.*

1. *Action on the LCS recovery should be based on both the number of compounds that are outside of the recovery criteria and the magnitude of the noncompliance.*

2. *If the LCS recovery criteria are not met, then the LCS results should be used to qualify sample data for the specific compounds that are included in the LCS solution. If the LCS recovery exceeds the upper acceptance limit, detected target compounds may be qualified "J". If the LCS recovery exceeds the lower acceptance limit, detected target compounds may be qualified "J" and non-detects may be qualified unusable (R). Professional judgement should be used to qualify data for compounds other than those compounds that are included in the LCS. Professional judgement to qualify non-LCS compounds should take into account the compound class, compound recovery efficiency, analytical problems associated with each compound, and comparability in the performance of the LCS compound to the non-LCS compound.*

3. *If more than half of the compounds in the LCS are not within the recovery criteria, then all of the associated detected target compounds may be qualified "J" and all associated non-detected target compounds may be qualified unusable (R).*

4. *It should be noted for EPA Project Officer action if a laboratory fails to analyze an LCS with each SDG, or if the reviewer has knowledge that a laboratory consistently fails to generate acceptable LCS recoveries.]*

## IX. Regional Quality Assurance and Quality Control

**A. Review Items:** Form I PEST *[Form I LCP]*, chromatograms, data system printouts, Traffic Reports and raw data for Regional QC samples.

**B. Objective:**

Regional Quality Assurance and Quality Control (QA/QC) refers to any QA and/or QC initiated by the Region, including field duplicates, Regional Performance Evaluation (PE) samples, blind spikes, and blind blanks. (It is highly recommended that Regions adopt the use of these QA/QC samples.)

**C. Criteria:**

Criteria are determined by each Region.

1. Performance Evaluation sample frequency may vary.

   *[For data generated through the Low Concentration Method: A PE sample can be included as frequently as once per SDG.]*

2. The analytes present in the PE sample must be correctly identified and quantified.

**D. Evaluation:**

Evaluation procedures must follow the Region's SOP for data review. Each Region will handle the evaluation of PE samples on an individual basis. Results for PE samples should be compared to the acceptance criteria for the specific PE samples, if available.

**E. Action:**

Any action must be in accordance with Regional specifications and the criteria for acceptable PE sample results. Unacceptable results for PE samples should be noted for EPA Project Officer action.

## X. Pesticide Cleanup Checks

**A. Review Items:** Forms IX PEST-1 *[Form IX LCP]*, Form IX PEST-2, GPC/Florisil raw data, chromatograms, and data system printouts.

**B. Objective:**

Pesticide cleanup procedures are utilized to remove matrix interferences from sample extracts prior to analysis. The use of the Florisil cartridge cleanup procedure significantly reduces matrix interferences caused by polar compounds. Gel permeation chromatography (GPC) is used to remove high molecular weight contaminants that can interfere with the analysis of target analytes. Pesticide cleanup procedures are checked by spiking the cleanup columns and cartridges, and verifying the recovery of pesticides through the cleanup procedure.

**C. Criteria:**

1. Florisil Cartridge Cleanup

   a. Florisil cartridges must be used for the cleanup of all sample extracts.

   b. Every lot number of Florisil cartridges used for sample cleanup must be checked by spiking with 2,4,5-trichlorophenol and the midpoint concentration of Individual Standard Mixture A at least once, or every six months, whichever is most frequent.

   c. The lot of Florisil cartridges is acceptable if the recoveries for all of the pesticides and surrogates in Individual Standard Mixture A are within 80 to 120 percent, the recovery of 2,4,5-trichlorophenol is less than 5 percent, and no peaks interfering with the target analytes are detected.

2. Gel Permeation Chromatography (GPC)

   a. GPC is used for the cleanup of all soil sample extracts and for water sample extracts that contain high molecular weight components that interfere with the analysis of the target analytes.

   b. At least once every 7 days, the calibration of the GPC unit must be checked by spiking with two check mixtures: the matrix spiking solution and a mixture of Aroclors 1016 and 1260.

   c. The GPC calibration is acceptable if the recovery of the pesticides in the matrix spiking solution are within 80 to 110 percent, and the Aroclor patterns should match those generated for previously run standards.

   d. A GPC blank must be analyzed after each GPC calibration and is acceptable if the blank does not exceed one-half the CRQL for any target analytes.

**D. Evaluation:**

1. Florisil Cartridge Check

   Check the data from the Florisil cartridge solution analyses and the Form IX PEST-1 *[Form IX LCP]*. Recalculate some of the percent recoveries to verify that the percent recoveries of the pesticides and surrogates in Individual Standard Mixture A are within 80 to 120 percent, the recovery of 2,4,5-trichlorophenol is less than 5 percent, and no interfering peaks are present. Compare the raw data to the reported results and verify that no calculation or transcription errors have occurred.

2. Gel Permeation Chromatography (GPC)

   Check the data from the GPC calibration check analyses and the Form IX PEST-2, and recalculate some of the percent recoveries to verify that the percent recoveries of the pesticides in the matrix spike solution are within 80 to 110 percent and that the Aroclor patterns are similar to those of previous standards. Aroclor pattern comparison within a laboratory can be checked if more than one GPC calibration was performed for that SDG. The Region may devise other means to compare this information. Check to make sure that no transcription errors have occurred.

**E. Action:**

1. If Florisil Cartridge Check criteria are not met, the raw data should be examined for the presence of polar interferences and professional judgement should be used in qualifying the data. If a laboratory analyzes samples under an unacceptable Florisil Cartridge Check, then the EPA Project Officer should be notified.

2. If Gel Permeation Criteria are not met, the raw data should be examined for the presence of high molecular weight contaminants, subsequent sample data should be examined for unusual peaks, and professional judgement should be used in qualifying the data. If a laboratory chooses to analyze samples under unacceptable Gel Permeation Criteria, then the EPA Project Officer should be notified.

3. If zero recovery was obtained for the pesticide compounds and surrogates during either check, then the non-detected target compounds may be suspect and the data may be qualified unusable (R).

4. If high recoveries (i.e., greater than 120 percent) were obtained for the pesticides and surrogates during either check, use professional judgement to qualify detected target compounds. Non detected target compounds do not require qualification.

5. Potential effects on the sample data resulting from the pesticide cleanup analyses not yielding acceptable results should be noted in the data review narrative.

## XI. Target Compound Identification

**A. Review Items:** Form I PEST *[Form I LCP]*, Form X PEST-1 *[Form X LCP-1]*, Form X PEST-2 *[Form X LCP-2]*, chromatograms, and data system printouts.

**B. Objective:**

Qualitative criteria for compound identification have been established to minimize the number of false positives (reporting a compound present when it is not) and false negatives (not reporting a compound that is present).

**C. Criteria:**

1. The retention times of both of the surrogates, matrix spikes, and reported compounds in each sample must be within the calculated retention time windows on both columns. TCX must be within ±0.05 minutes of the mean retention time determined from the initial calibration and DCB must be within ±0.10 minutes of the mean retention time determined from the initial calibration.

2. GC/MS confirmation is required if the concentration of a compound exceeds 10 ng/uL in the final sample extract. Pesticides that are confirmed by GC/MS should be identified with a "C" in the Q column on Form I PEST *[Form I LCP]*.

3. When no analytes are identified in a sample, the chromatograms from the analyses of the sample extract must use the same scaling factor as was used for the low point standard of the initial calibration associated with those analyses.

4. Chromatograms must display single component pesticides detected in the sample and the largest peak of any multicomponent analyte detected in the sample at less than full scale.

5. If an extract must be diluted, chromatograms must display single component pesticides between 10 and 100 percent of full scale, and multicomponent analytes between 25 and 100 percent of full scale.

6. For any sample, the baseline of the chromatogram must return to below 50 percent of full scale before the elution time of alpha-BHC, and also return to below 25 percent of full scale after the elution time of alpha-BHC and before the elution time of decachloro-biphenyl.

7. If a chromatogram is replotted electronically to meet these requirements, the scaling factor used must be displayed on the chromatogram, and both the initial chromatogram and the replotted chromatogram must be submitted in the data package.

**D. Evaluation:**

1. Review Form I PEST *[Form I LCP]*, the associated raw data (chromatograms and data system printouts) and Form X PEST- 1 *[Form X LCP-1]* and Form X PEST-2 *[Form X LCP-2]*. Confirm reported detected analytes by comparing the sample chromatograms to the tabulated results and verifying peak measurements and retention times. Confirm reported non-detected analytes by a review of the sample chromatograms. Check the associated blank data for potential interferences (to evaluate sample data for false positives) and check the calibration data for adequate retention time windows (to evaluate sample data for false positives and false negatives).

2. For multi-component target compounds (Toxaphene and Aroclors), the retention times and relative peak height ratios of major component peaks should be compared against the appropriate standard chromatograms.

3. Verify that GC/MS confirmation was performed for pesticide concentrations in the final sample extract which exceeded 10 ng/uL.

**E. Action:**

1. If the qualitative criteria for both columns were <u>not</u> met, all target compounds that are reported detected should be considered non-detected. The reviewer may need to use the qualifiers that are specific to pesticides. The reviewer should use professional judgement to assign an appropriate quantitation limit using the following guidance:

   a. If the misidentified peak was sufficiently outside the target pesticide retention time window, then the reported values may be a false positive and should be replaced with the sample CRQL value.

   b. If the misidentified peak poses an interference with potential detection of a target peak, then the reported value should be considered and qualified as unusable (R).

2. If the data reviewer identifies a peak in both GC column analyses that falls within the appropriate retention time windows, but was reported as a non-detect, then the compound may be a false negative. Professional judgement should be used to decide if the compound should be included. All conclusions made regarding target compound identification should be included in the data review narrative.

3. If multi-component target compounds exhibit marginal pattern-matching quality, professional judgement should be used to establish whether the differences are due to environmental "weathering" (i.e., degradation of the earlier eluting peaks relative to the later eluting peaks). If the presence of a multi-component pesticide is strongly suggested, results should be reported as presumptively present (N).

If an observed pattern closely matches more than one Aroclor, professional judgement should be used to decide whether the neighboring Aroclor is a better match, or if multiple Aroclors are present.

4. If GC/MS confirmation was required but not performed, the reviewer should report this for EPA Project Officer action.

## XII. Compound Quantitation and Reported CRQLS

**A. Review Items:** Form I PEST *[Form I LCP]*, Form X PEST-1 *[Form X LCP-1]*, Form X PEST-2 *[Form X LCP-2]*, sample preparation log sheets, chromatograms, SDG Narrative, and data system printouts.

**B. Objective:**

The objective is to ensure that the reported quantitative results and contract required quantitation limits (CRQLs) are accurate.

**C. Criteria:**

Compound quantitation, as well as the adjustment of the CRQL, must be calculated according to the equations provided in the method.

**D. Evaluation:**

1. Raw data should be examined to verify the correct calculation of all sample results reported by the laboratory. Data system printouts, chromatograms, and sample preparation log sheets should be compared to the reported positive sample results and quantitation limits. Verify that the sample values are reported correctly.

2. Verify that the CRQLs have been adjusted to reflect all sample dilutions, concentrations, splits, clean-up activities, and dry weight factors that are not accounted for by the method.

**E. Action:**

1. Quantitation limits affected by large, off-scale peaks should be qualified as unusable (R). If the interference is on-scale, the reviewer can provide an approximated quantitation limit (UJ) for each affected compound.

**NOTE:** Single-peak pesticide results are checked for rough agreement between quantitative results obtained on the two GC columns. The potential for coelution should be considered and the reviewer should use professional judgment to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interfering compound is indicated, professional judgement must be used to determine how best to report, and if necessary, qualify the data. Contractually the lower of the two values is reported.

2. If there are any discrepancies found, the laboratory may be contacted by the Region's designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer must decide which value is the best value. Under these circumstances, the reviewer may determine if qualification of the data is warranted. A description of the reasons for data qualification and the qualification that is applied to the data should be documented in the data review narrative.

## XIII. Overall Assessment of Data

A. **Review Items:** Entire data package, data review results, and (if available) Quality Assurance Project Plan (QAPjP), and Sampling and Analysis Plan (SAP).

B. **Objective:**

The overall assessment of a data package is a brief narrative in which the data reviewer expresses concerns and comments on the quality and, if possible, the useability of the data.

C. **Criteria:**

Assess the overall quality of the data.

Review all available materials to assess the overall quality of the data, keeping in mind the additive nature of analytical problems.

D. **Evaluation:**

1. Evaluate any technical problems which have not been previously addressed.

2. If appropriate information is available, the reviewer may assess the useability of the data to assist the data user in avoiding inappropriate use of the data. Review all available information, including the QAPjP (specifically the Data Quality Objectives), SAP, and communication with data user that concerns the intended use and desired quality of the data.

E. **Action:**

1. Use professional judgement to determine if there is any need to qualify data which were not qualified based on the QC criteria previously discussed.

2. Write a brief narrative to give the user an indication of the analytical limitations of the data. Any inconsistency of that data with the SDG Narrative should be noted for EPA Project Officer action. If sufficient information on the intended use and required quality of the data are available, the reviewer should include his/her assessment of the useability of the data within the given context.

# APPENDIX C

## A – REPORTING REQUIREMENTS

The reporting requirements outlined below are for hard-copy data reports from the laboratory. They are divided into mandatory requirements for all printed data reports, and optional requirements. Optional reporting requirements are those that may be required by a specific project, depending upon the needs of the project. The following elements are required in every report: cover sheet, table of contents, case narrative, analytical results, sample management records, and QA/QC information. Information for third-party review and a performance-based data package may be required depending on project-specific requirements or the method being used.

1. Cover Sheet. The cover sheet shall specify the following information:

- title of report (i.e., Test Report, Test Certificate)
- name and location of laboratory (to include a point of contact, phone and facsimile numbers)
- name and location of any subcontractor laboratories, and appropriate test method performed
- contract number
- client name and address
- project name and site location
- statement of data authenticity and official signature and title of person authorizing report release
- amendments to previously released reports that clearly identify the serial number for the previous report and state the reason(s) for reissuance of the report.

2. Table of Contents. Laboratory data packages should be organized in a format that allows for easy identification and retrieval of information. An index or table of contents shall be included for this purpose.

3. Case Narrative. A case narrative shall be included in each report. The purpose of the case narrative is to:

- describe any abnormalities and deviations that may affect the analytical results, and
- summarize any issues in the data package that need to be highlighted for the data user to help them assess the usability of the data.

The case narrative shall provide:

- a table(s) summarizing samples received, providing a correlation between field sample numbers and laboratory sample numbers, and identifying which analytical test methods were performed and by which laboratories
- a list of samples that were received but not analyzed
- a description of extractions or analyses that are performed out of holding times
- a definition of all data qualifiers or flags used
- identification of deviations of any calibration standards or QC sample results from appropriate acceptance limits and a discussion of the associated corrective actions taken by the laboratory
- appropriate notation of any other factors that could affect the sample results (e.g., air bubbles in VOC sample vials, excess headspace in soil VOC containers, the presence of multiple phases, sample temperature and sample pH excursions, container type or volume, etc.).

4. Analytical Results. The results for each sample shall contain the following information at a minimum: (Information need not be repeated if noted elsewhere in the data package.)

- project name and site location
- field sample ID number as written on custody form
- laboratory sample ID number

- matrix (soil, water, oil, etc.)
- date sample extracted or prepared
- date sample analyzed
- method numbers for all preparation, cleanup, and analysis procedures employed
- analyte or parameter
- method reporting limits and method quantitation limits (at or above the low-level standard concentration) adjusted for sample-specific factors (e.g., aliquot size, dilution/concentration factors, moisture content)
- method detection limits
- analytical results with correct number of significant figures
- any data qualifiers assigned
- concentration units
- dilution factors
- any dilutions or concentrations for all reported data, and if neat or less diluted results are available, recorded and reported data from both runs
- percent moisture or percent solids (all soils are to be reported on a dry weight basis).

The following information is optional but may be required site specifically:

- laboratory name and location (city and state)
- sample description
- sample preservation or condition at receipt
- date sample collected
- date sample received
- sample aliquot analyzed
- final extract volume
- CAS numbers.

5. Sample Management Records. These types of records include the documentation accompanying the samples:

- chain-of-custody records
- shipping documents
- records generated by the laboratory which detail the condition of the samples upon receipt at the laboratory (e.g., sample cooler receipt forms)
- telephone conversation records associated with actions taken or quality issues
- laboratory internal sample custody records through sample analysis, transfer, and disposal.

6. QA/QC Information. The minimum internal QC data package must include:

- matrix spikes percent recovery
- relative percent difference (RPD) of required duplicates
- LCS percent recoveries
- surrogate percent recoveries (organics)
- tracer recoveries (radiochemical)
- method blank results
- preparation, analysis, and other batch numbers.

7. Information for Third-Party Review. The information listed below is required if third-party (from outside the laboratory) data validation or verification is to be performed. This information is therefore optional and is provided only when the project-specific requirements specify that a third-party review will occur:

- calibration data from the initial calibration curve
- initial calibration verification (ICV)

- continuing calibration verification(s) (CCV)
- performance standards analyzed in conjunction with the test method (e.g., tuning standards, degradation check standards, etc.)
- preparation, analysis, and other batch numbers[1]
- raw data (e.g., chromatograms, mass spectrum results)
- matrix spike (MS), if applicable (includes spike target concentration levels, measured spike concentration, and calculated recoveries)[1]
- RPD of required duplicates (e.g., MS, LCS, field duplicates)[1]
- method blank results[1]
- LCS recoveries[1]
- surrogate recoveries (organics)[1]
- serial dilutions (SD) percent difference (inorganics)
- post-digestion spikes recovery (inorganics).

In addition, the data package for third party review may include:

- method detection limit studies and
- supporting documentation (e.g., run logs, sample preparation logs, standard preparation logs).

The data validation guidelines for performance-based methods established in other DoD guidance on data review and data validation, EPA national functional guidelines, EPA regional functional guidelines, and project-specific guidelines for validation may all have distinct reporting formats. The appropriate validation guidelines should be consulted to determine what type of data package is required.

8. Performance Based Data Package. The requirements for the ***performance based data package are the same as those defined within the definitive data package with the addition of the following items: (1) all appropriate project action level(s) and DQOs, and (2) appropriate preparatory and analysis logs.*** Refer to other DoD guidance on the data review of performance based methods for further details on this data package.

[1] Required for other purposes identified in number 6, QA/QC Information.

## B – QUALITY CONTROL REQUIREMENTS

The quality control (QC) protocols specified by the method shall be followed. In some cases the method may be ambiguous or provide insufficient detail. The specific manner in which methods commonly used should be implemented is detailed in the following tables. Modifications to the following requirements need project-specific approval by Bhate.

The tables describe specific quality assurance and quality control requirements for analytical methods (SW-846) commonly used when investigating HAFB sites. The tables specify the method requirements, when available, as well as additional clarification and/or requirements. If possible, the actual requirement from the method is listed, although in some cases the description in the method is so lengthy that only a reference to the appropriate section is made. The methods should always be referenced, however, for clarification purposes. Bhate has done its best to interpret the methods, providing clarification where there are inconsistencies between existing guidance documents, and stating preferences when multiple options are acceptable. If there is a contradiction between the method and the following tables, the requirements specified in the tables shall be followed.

**SW-846 Methods**

This Section refers to the method versions current at the time of publication. As methods are updated subsequent versions of this manual will incorporate the changes. If the tables in this Section do not yet correspond with the most recent version of the SW-846 method, or a new method that analyzes for the same group of analytes becomes available, the requirements in the tables shall be followed where appropriate. Otherwise, follow the requirements in the method.

Table B-1 below presents a summary of the definition, purpose, and evaluation of the major QC checks required in the subsequent QA/QC tables (B-2 through B-10) for the various methods. The *definition* column describes generally what the QC check is and/or how it is performed. The *purpose* column describes why the check is important for assessing and measuring the quality of the data being generated. The *evaluation* column describes how to interpret the results of the QC check, particularly in the context of the results of other QC checks. This table should be used in conjunction with the instrument- and method-specific requirement tables to properly implement the methods for HAFB projects. In addition, a supplementary list of acronyms and a glossary relevant to this Section follows Table B-10.

### TABLE B-1. SUMMARY OF QUALITY CONTROL CHECK DEFINITIONS, PURPOSE, AND EVALUATION

| QC Check | Definition | Purpose | Evaluation |
|---|---|---|---|
| **Breakdown check (Endrin - Method 8081A only, DDT - Methods 8081A and 8270C)** | Analysis of a standard solution containing Endrin and DDT. Area counts of these compounds and their breakdown products are evaluated to assess instrument conditions. | To verify the inertness of the injection port because DDT and Endrin are easily degraded in the injection port. | If degradation of either DDT or Endrin exceeds method-specified criteria, corrective action must be taken before proceeding with calibration. |
| **Calibration blank (metals only)** | Reagent water containing no analytes of interest, but acidified to the same pH as all samples. | To determine the zero point of the calibration curve for all initial and continuing calibrations. | |
| **Confirmation of positive results (organics only)** | Use of alternative analytical techniques (another method, dissimilar column, or different detector) to validate the presence of target analytes identified. | To verify the identification of an analyte. | This is a required QC procedure. All positive results must be confirmed. |

## TABLE B-1. SUMMARY OF QUALITY CONTROL CHECK DEFINITIONS, PURPOSE, AND EVALUATION (Continued)

| QC Check | Definition | Purpose | Evaluation |
|---|---|---|---|
| **Continuing calibration verification (CCV)** | The verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. (IDQTF) | To verify that instrument response is reliable, and has not changed significantly from the current initial calibration curve. | If the values for the analytes are outside the acceptance criteria, the initial calibration may not be stable. Results associated with out-of-control CCV results require reanalysis or flagging. |
| **Demonstrate acceptable analyst capability** | Analyst runs QC samples in series to establish his ability to produce data of acceptable accuracy and precision. | To establish the analysts' ability to produce data of acceptable accuracy and precision. | The average recovery and standard deviation of the replicates must be within designated acceptance criteria.<br><br>Analysis of field samples cannot be conducted until this check is successful. |
| **Dilution test (metals only)** | Analysis of a positive sample, which has been diluted to a concentration five times the original, to confirm that there is no interference at lower concentrations. (Modified COE) | To assess matrix interference. | Agreement within 10% between the concentration for the undiluted sample and five times the concentration for the diluted sample indicates the absence of interferences, and such samples may be analyzed without using the method of standard additions. Results outside acceptance limits indicate a possible matrix effect. For ICP, a post-digestion spike must be run; for GFAA, a recovery test must be run. |
| **Distilled standards (one high and one low) (cyanide only)** | Standards are run through the distillation procedure and then compared to the undistilled standards' reported values. (Method) | To check the efficiency of the distillation process. | Results must agree to within ±10% of the undistilled value before analysis can proceed. |
| **Duplicate sample** | Two identical portions of material collected for chemical analysis, and identified by unique alphanumeric codes. The duplicate may be portioned from the same sample, or may be two identical samples taken from the same site. The two portions are prepared and analyzed identically. (Modified QAPP) | To provide information on the heterogeneity of the sample matrix or to determine the precision of the intralaboratory analytical process for a specific sample matrix. | A duplicate sample will provide information on the heterogeneity of the sample matrix. The greater the heterogeneity of the matrix, the greater the relative percent difference between the sample and the sample duplicate.<br><br>If the sample matrix is homogeneous (such as with drinking water) and the relative percent difference is high, this could indicate a problem in the analytical system. |
| **GC column performance check (Methods 8280A and 8290 only)** | Analysis of method-specified compounds to verify chromatographic separation of dioxin isomers. (Method) | To evaluate the performance of the analytical system and establish retention time window markers for dioxin isomers. | Sample analysis cannot begin until method-specified criteria are met. |
| **Initial calibration for all analytes (ICAL)** | Analysis of analytical standards at different concentrations that are used to define the linearity and dynamic range of the response of the analytical detector or method. (Guide to Environmental Analytical Methods, 2nd Edition) | To establish a calibration curve for the quantification of the analytes of interest. | Statistical procedures are used to determine the relationship between the signal response and the known concentration of analytes of interest. The initial calibration must be successful before any samples or other QC check samples can be analyzed. |
| **Instrument detection limit (IDL) study (ICP/MS Method 6020 only)** | The process to determine the minimum concentration of a substance (analyte) that an instrument can differentiate from noise. The procedure for calculating varies by method. | To provide a quarterly evaluation of instrument sensitivity. | IDLs must be established quarterly for Method 6020. |

## TABLE B-1. SUMMARY OF QUALITY CONTROL CHECK DEFINITIONS, PURPOSE, AND EVALUATION (Continued)

| QC Check | Definition | Purpose | Evaluation |
|---|---|---|---|
| **Interference check solutions (ICP Only)** | A pair of solutions containing interfering elements that are used to verify the correction factors of analytes of concern. | To verify the established correction factors by analyzing the interference check solution at the beginning of the analytical sequence. | No samples can be run if this check does not pass acceptance criteria. |
| **Internal standards** | A known amount of standard added to all standards and samples as a reference for evaluating and controlling the precision and bias of the applied analytical method. (QAPP) | To verify that the analytical system is in control. | Any samples associated with out-of-control results must be reanalyzed. |
| **Laboratory control sample (LCS) containing all reported analytes** | A QC standard of known composition prepared using reagent free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is analyzed using the same sample preparation, reagents, and analytical methods employed for regular samples. (Guide to Environmental Analytical Methods, 2nd Edition) | To evaluate method performance by assessing the ability of the laboratory/analyst to successfully recover the target analytes from a control (clean) matrix.<br><br>Control limits for LCS recovery, typically expressed as percent recovery, are used for the development of statistical control limits and serve as acceptance criteria for determining whether an analytical run is in control (batch acceptance). | This is a required QC check. The inability to achieve acceptable recoveries in the LCS indicates problems with the accuracy/bias of the measurement system.<br><br>Failure to achieve acceptable recoveries in a "clean" matrix is an indicator of possible problems achieving acceptable recoveries in field samples. |
| **Linear range or high-level calibration check standard (ICP only)** | High-level calibration check standard periodically analyzed to verify the linearity of the calibration curve at the upper end. | To verify quantitative accuracy of data up to the high-level concentration. | This QC check establishes the upper linear range of the calibration. |
| **Low-level calibration check standard (ICP only)** | A reference standard that contains a small quantity of analyte (less than or equal to the quantitation limit). | To confirm the accuracy of measurements at or near the quantitation limit. It establishes the lower quantitation limit of the calibration curve for those ICP methods that rely on single point calibration. It also may be used to validate a client's reporting limit. | This QC check must be within acceptance criteria before any samples are analyzed. |
| **Matrix spike** | A sample prepared by adding a known concentration of a target analyte to an aliquot of a specific environmental sample for which an independent estimate of the target analyte concentration is available. (Modified G-5) | To assess the performance of the method as applied to a particular project matrix.<br><br>Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.<br><br>The recovery of target analytes from the matrix spike sample is used to determine the bias of the method in the specific sample matrix. | The lack of acceptable recoveries in the matrix spike often points to problems with the sample matrix. One test of this is a comparison to the LCS recoveries. If the corresponding LCS recoveries are within acceptable limits, a matrix effect is likely. The laboratory should not correct for recovery; only report the results of the analyses and the associated matrix spike results and indicate that the results from these analyses have increased uncertainty. |
| **Matrix spike duplicate (MSD)** | A second replicate matrix spike prepared in the laboratory, spiked with identical, known concentrations of targeted analyte(s), and analyzed to obtain a measure of the precision of the recovery for each analyte. (Modified QAPP) | To assess the performance of the method as applied to a particular project matrix and provide information on the homogeneity of the matrix.<br><br>Used to determine the precision of the intralaboratory analytical process for a specific sample matrix. | When compared to the MS, the MSD will provide information on the heterogeneity of the sample matrix. The greater the heterogeneity of the matrix, the greater the RPD between the matrix spike and the matrix spike duplicate.<br><br>Also, if the sample matrix is more homogeneous, such as with drinking water, and the RPD is high, this could indicate a problem in the analytical system. |

## TABLE B-1. SUMMARY OF QUALITY CONTROL CHECK DEFINITIONS, PURPOSE, AND EVALUATION (Continued)

| QC Check | Definition | Purpose | Evaluation |
|---|---|---|---|
| **Matrix verification sample (hexavalent chromium only)** | A pH-adjusted filtrate that has been spiked with hexavalent chromium to ensure that the sample matrix does not have a reducing condition or other interferents that could affect color development. (Modified Method) | To ensure that the sample matrix does not have a reducing condition or other interferents that affect color development. | To verify the absence of an interference, the spike recovery must be between 85% and 115%. If the result of verification indicates a suppressive interference, the sample should be diluted and reanalyzed. If the interference persists after sample dilution, an alternative method (Method 7195, Coprecipitation, or Method 7197, Chelation/Extraction) should be used. |
| **Method detection limit (MDL) verification check** | A low-level spike taken through the preparatory and analytical steps at two times the MDL used to verify that the lab can detect analytes at the calculated MDL. | To validate the MDL on an ongoing basis. | If the MDL verification check fails, the MDL verification check shall be reprepped and reanalyzed at a higher level to set a higher MDL or the MDL study must be repeated. |
| **Method blank** | A sample of a matrix similar to the batch of associated samples (when available) in which no target analytes or interferences are present at concentrations that impact the analytical results. It is processed simultaneously with samples of similar matrix and under the same conditions as the samples. (Modified QAPP) | To assess background interference or contamination that exists in the analytical system that might lead to the reporting of elevated concentration levels or false positive data. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the preparation and analytical procedure. | This is one of the QC samples used to measure laboratory accuracy/bias. This sample could indicate whether contamination is occurring during sample preparation and analysis. If analytes are detected ≥ ½ RL, reanalyze or qualify (B-flag) all results for the specific analyte(s) in all samples in the associated preparatory batch, as appropriate. |
| **MDL study**<br><br>**o known as an IDL ddy in SW-846 Method 6020, ICP/MS)** | The process to determine the minimum concentration of a substance (analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40CFR part 136 Appendix B) | To determine the lowest concentration of an analyte that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero. | MDLs must be established prior to sample analysis. The reporting or quantitation limit is at least three times the MDL.<br><br>Used in combination with the MDL verification check to validate the MDL on an ongoing basis. |
| **Method of standard additions (ICP/GFAA only)** | Adding known amounts of standard to one or more aliquots of the processed sample solution. (Method) | To compensate for a sample constituent that enhances or depresses the analyte signal, thus producing a different slope from that of the calibration standards. It will not correct for additive interferences that cause a baseline shift. | This is the method used when matrix interferences are present and do not allow determination of accurate sample results. |
| **Post digestion spike addition (ICP only)** | An analyte spike added to a portion of prepared sample to verify absence or presence of matrix effects. | To confirm the presence of a matrix interference. Assess matrix effects based on, (1) the occurrence of new and unusual matrices included within the batch, or (2) contingency analysis based on serial dilution or matrix spike failures. | To verify the absence of an interference, the spike recovery must be between 85% and 115%. Results outside the acceptance limits require a method of standard additions (MSA) for all samples within the batch. |
| **Recovery test (GFAA only)** | An analyte spike added to a portion of prepared sample to verify absence or presence of matrix effects. | To confirm the presence of a matrix interference. Assess matrix effects based on, (1) the occurrence of new and unusual matrices included within the batch, or (2) contingency analysis based on serial dilution or matrix spike failures. | To verify the absence of an interference, the spike recovery must be between 85% and 115%. Results outside the acceptance limits require a MSA for all samples within the batch. |

**TABLE B-1. SUMMARY OF QUALITY CONTROL CHECK DEFINITIONS, PURPOSE, AND EVALUATION (Continued)**

| QC Check | Definition | Purpose | Evaluation |
|---|---|---|---|
| **Retention time window position establishment for each analyte (and surrogate) (all chromatographic methods only)** | Determination of the placement of the retention time window (i.e., start/stop time) of each analyte or group of analytes as it elutes through the chromatographic column so that analyte identification can be made during sample analysis. This is done during the initial calibration. | To identify analytes of interest. | Incorrect window position may result in false negatives, require additional manual integrations, and/or cause unnecessary reanalysis of samples when surrogates or spiked compounds are erroneously not identified. |
| **Retention time window verification for each analyte (and surrogate) (all chromatographic methods only)** | A standard is used to verify that the width and position of the retention time windows are valid so that accurate analyte identification can be made during sample analysis. | To minimize the occurrence of both false positive and false negative results at each calibration verification. | The peaks from the standard used are compared to the retention time window established during the initial calibration (ICAL) to verify that the analytes of interest still fall within the window. |
| **Retention time window width calculated for each analyte (and surrogate) (non-MS chromatographic methods only)** | Determination of the length of time between sample injection and the appearance of a peak at the detector. The total length of time (window) is established for each analyte or groups of analytes and is set for complete elution of analyte peaks. It is based upon a series of analyses and statistical calculations that establish the measured band on the chromatogram that can be associated with a specific analyte or group of analytes. | To ensure that the chromatographic system is operating reliably and that the system conditions have been optimized for the target analytes and surrogates in the standards and sample matrix to be analyzed. It is done to minimize the occurrence of both false positive and false negative results. | Used to evaluate continued system performance. Tight retention time windows may result in false negatives and/or may cause unnecessary reanalysis of samples when surrogates or spiked compounds are erroneously not identified. Overly wide retention time windows may result in false positive results that cannot be confirmed upon further analysis. |
| **Second source calibration verification** | A standard obtained or prepared from a source independent of the source of standards for the initial calibration. Its concentration should be at or near the middle of the calibration range. It is done after the initial calibration. (QAPP) | To verify the accuracy of the initial calibration. | The concentration of the second-source calibration verification, determined from the analysis, is compared to the known value of the standard to determine the accuracy of the ICAL. This independent verification of the ICAL must be acceptable before sample analysis can begin. |
| **Surrogate spike (organic analysis only)**<br><br>**Similar to recovery standards (Method 8280A only)** | A pure substance with properties that mimic the analyte of interest. Surrogates are compounds unlikely to be found in environmental samples and are added to samples to evaluate analytical efficiency by measuring their percent recovery. (Modified G-5 and CLP) | To assess the ability of the method to successfully recover specific non-target analytes from an actual matrix.<br><br>Because surrogates are generally added to each sample in a batch, they can be used to monitor recovery on a sample-specific, rather than batch-specific basis. | Whereas the matrix spike is normally done on a batch-specific basis, the surrogate spike is done on a sample-specific basis. Taken with the information derived from other spikes (LCS, matrix spike), the bias in the analytical system can be determined. |
| **Tuning (mass spectrometer methods only)** | The analysis of a standard compound to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to sample analysis. (COE) | To verify the proper working of the mass spectrometer. | Proper tuning of the mass spectrometer must be verified prior to sample analysis. |

As always, project-specific requirements identified by the client supersede any requirements listed in the following tables. The requirements are meant to be the default, to be used when project-specific direction based on DQOs is not included.

Tables B-2 through B-10 are organized in most cases by instrument type. The applicable methods are specified in the table title. When there are exceptions (i.e., the QC check does not apply to all methods or instrument types in the table), they are noted in the first column of the table ("QC Check"). Each table contains the following fields (or columns):

- QC Check: The name of the QC measure that is required. If the check is only applicable to certain methods from the table, they will be noted in parentheses in this field.
- Minimum Frequency: Describes how often the QC check must be performed and, if relevant, at what point in the process (for example, prior to sample analysis). Some QC checks are only performed when another QC check fails. This will be noted in the minimum frequency field.
- Acceptance Criteria: The standard that the QC check must satisfy in order to proceed without performing corrective action. In some cases there are multiple options, all equivalently acceptable, for acceptance of a single QC check. These options will be listed and the appropriate option should be applied. There may be references to acceptance criteria published by DoD. The LCS control limits for certain methods can be found in Section D of this Appendix.
- Corrective Action: If a QC check does not meet the acceptance criteria specified in the preceding field, the corrective action field identifies what steps must be taken to ensure that the results will be valid. Requirements usually include finding the cause of failure of the acceptance criteria and rerunning the QC check. The corrective action field will also specify which other QC checks must be rerun to ensure valid data.
- Flagging Criteria: Where flagging is appropriate, the qualifier flag is listed in this field along with the criteria for using the flag. **Flagging should only be used as a last resort.** Data should only be flagged once corrective action has been performed. In many cases the field states "Flagging criteria is not appropriate." This means that corrective action must continue until the problem is solved and the QC check satisfies its acceptance criteria. Samples will not be accepted without successful completion of this QC check. This field will also specify when additional information should be detailed in the case narrative.
- Comments: This field contains further clarification of any of the previous five fields.

The following tables detail HAFB-specific QC requirements for SW-846 methods, organized by instrument type:

Table B-2: Organic Analysis by Gas Chromatography and High-Performance Liquid Chromatography (methods 8011, 8015B, 8021B, 8070A, 8081A, 8082, 8141A, 8151A, 8310 and 8330
Table B-3: Organic Analysis by Gas Chromatography/Mass Spectroscopy (methods 8260B and 8270C)
Table B-4: Inorganic Analysis by Inductively Coupled Plasma (ICP) and Graphite Furnace Atomic Absorption Spectroscopy (GFAA) (methods 6010B and 7000A series)
Table B-5: Trace Metals Analysis by Inductively Coupled Plasma Mass Spectrometry (method 6020)
Table B-6: Inorganic Analysis by Colorimetric Hexavalent Chromium (method 7196A)
Table B-7: Dioxin/Furan Analysis by High-Resolution Gas Chromatography/Low-Resolution Mass Spectroscopy (method 8280A)
Table B-8: Dioxin/Furan Analysis by High-Resolution Gas Chromatography/High-Resolution Mass Spectroscopy (method 8290)
Table B-9: Cyanide Analysis (methods 9010B/9012A)
Table B-10: Common Anions Analysis (method 9056)

## TABLE B-2. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY (METHODS 8011, 8015B, 8021B, 8070A, 8081A, 8082, 8141A, 8151A, 8310, AND 8330)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C) | QC acceptance criteria published by DoD, if available; otherwise method-specified criteria. | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f) | Not applicable (NA) | This is a demonstration of ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete. |
| **Method detection limit (MDL) study** | At initial set-up and subsequently once per 12 month period; otherwise quarterly MDL verification checks shall be performed (see box D-12) | See 40 CFR 136B. MDL verification checks must produce a response at least 3 times greater than instrument's noise level. | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12) | NA | Samples cannot be analyzed without a valid MDL |
| **Retention time window width calculated for each analyte and surrogate** | At method set-up and after major maintenance (e.g., column change) | Width is ± 3 times standard deviation for each analyte retention time from 72-hour study | NA | NA | |
| **Breakdown check (Endrin/ DDT Method 8081A only** | Daily prior to analysis of samples | Degradation <15% for both Endrin and DDT | Correct problem then repeat breakdown check | Flagging criteria is not appropriate. | No samples shall be run until degradation <15% |

**TABLE B-2. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY (METHODS 8011, 8015B, 8021B, 8070A, 8081A, 8082, 8141A, 8151A, 8310, AND 8330) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Minimum five-point initial calibration for all analytes (ICAL)** | Initial calibration prior to sample analysis | One of the options below (except for Method 8082, which may only use Option 1 or 3):<br><br>Option 1: RSD for each analyte ≤20%<br><br>Option 2: Grand mean[2] RSD ≤20%, with no individual analyte RSD >30%<br><br>Option 3: linear – least squares regression: r > 0.995<br><br>Option 4: non-linear regression: coefficient of determination (COD) $r^2 \geq$ 0.990 (6 points shall be used for second order, 7 points shall be used for third order) | Correct problem then repeat initial calibration | Apply J to all analytes with RSD >20% and ≤30%. Identify in case narrative analytes with RSD >20%, provide to client the actual RSD for those analytes, and document the grand mean. | Problem must be corrected. No samples may be run until ICAL has passed.<br><br>For PCB analysis, a mixture of Aroclors 1016 and 1260 is normally used to establish detector calibration linearity, unless project-specific data suggest the presence of another Aroclor (e.g., 1268, 1262). In addition, a mid level standard for each of the remaining Aroclors is analyzed for pattern recognition and response factor. |
| **Second source calibration verification** | Once after each initial calibration | Value of second source for all analytes within ±20% of expected value (initial source) | Correct problem and verify second source standard. If that fails then repeat initial calibration. | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |
| **Retention time window position establishment for each analyte and surrogate** | At the beginning of the analytical shift | The center of the retention time window shall be set at midpoint of initial calibration curve | NA | NA | |
| **Retention time window verification for each analyte and surrogate** | Each calibration verification standard | Analyte within established window | Correct problem, then reanalyze all samples analyzed since the last acceptable retention time check. If they fail, redo ICAL and reset retention time window. | Flagging criteria is not appropriate for initial verification. For CCV, apply a Q-flag to all results for analytes outside the established window. | No samples shall be run without a verified retention time window at the initial verification. For method 8015B, check state methods for use of modified retention time markers with gasoline range organics (GRO) or diesel range organics (DRO). |

[2] Grand mean is the average of the mean RSDs for all analytes.

**TABLE B-2. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY (METHODS 8011, 8015B, 8021B, 8070A, 8081A, 8082, 8141A, 8151A, 8310, AND 8330) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Calibration verification (initial [ICV] and continuing [CCV])** | ICV: Daily, before sample analysis.<br>CCV: After every 10 field samples and at the end of the analysis sequence. | All analytes within ±15% of expected value (%D), or grand mean ≤15%D with no %drift/difference for any individual analyte >20%D | ICV: Correct problem, rerun ICV. If that fails, repeat initial calibration. See section 9.4.2.2.e and box 41.<br><br>CCV: Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification. | Identify in case narrative analytes with %D>15%, provide to client the actual %D for those analytes, and document the grand mean.<br>ICV: Apply J to all results for analyte(s) >15% and <20% of expected range.<br>CCV: Apply Q to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. | If an individual analyte is >20% or the grand mean is >15%, no samples may be analyzed until the problem has been corrected.<br>In Method 8021B, bromomethane, chloroethane, chloromethane, dichlorodifluoromethane, trichlorofluoromethane, and vinyl chloride shall be within ±20%D. |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem, then see criteria in box D-4; if required, reprep then reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch | |
| **Laboratory control sample (LCS) containing all reported analytes** | One LCS per preparatory batch | QC acceptance criteria specified by DoD, if available; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated preparatory batch, if sufficient sample material is available (see full explanation in this Appendix) | If corrective action fails apply Q to specific analyte(s) in all samples in the associated preparatory batch | |
| **Matrix spike (MS)** | One MS per every 20 project samples per matrix (see box D-6) | For matrix evaluation, use QC acceptance criteria specified by DoD for LCS. | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. |
| **Matrix spike duplicate (MSD) or sample duplicate** | One per every 20 project samples per matrix | RPD ≤30% (between MS and MSD or sample and sample duplicate) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | The data shall be evaluated to determine the source of difference. |

**TABLE B-2. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY (METHODS 8011, 8015B, 8021B, 8070A, 8081A, 8082, 8141A, 8151A, 8310, AND 8330) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Surrogate spike (analytes identified in this Appendix)** | All field and QC samples | QC acceptance criteria for LCS specified by DoD, if available; otherwise method-specified criteria or laboratory's own in-house criteria. | For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. | For the specific analyte(s) in all field samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. For QC samples, apply Q to specific analyte(s) in all samples in the associated preparatory batch. | |
| **Confirmation of positive results (second column or second detector)** | All positive results must be confirmed (in Method 8081A, exclude toxaphene and chlordane) | Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%. | NA | Apply J if RPD >40% from primary column result or Q-flag if sample is not confirmed. Discuss in the case narrative. | Report the higher of two confirmed results unless overlapping peaks are causing erroneously high results, then report the non-effected result and document in the case narrative. |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-3. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (METHODS 8260B AND 8270C)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C). | QC acceptance criteria published by DoD, if available; otherwise method-specific criteria. | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete. |
| **MDL study** | At initial set-up and subsequently once per 12 - month period; otherwise quarterly MDL verification checks shall be performed (see box D-12) | See 40 CFR 136B. MDL verification checks must produce a response at least 3 times greater than instrument's noise level. | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12) | NA | Samples cannot be analyzed without a valid MDL |
| **Tuning (MS methods only)** | Prior to calibration and every 12 hours during sample analysis | Refer to method for specific ion criteria | Retune instrument and verify. Rerun affected samples. | Flagging criteria is not appropriate | Problem must be corrected. No samples may be accepted without a valid tune. |
| **Breakdown check (DDT Method 8270C only)** | Daily prior to analysis of samples | Degradation <20% for DDT | Correct problem then repeat breakdown check | Flagging criteria is not appropriate | No samples shall be run until degradation <20%. Benzidine and pentachlorophenol should be present at their normal responses and no peak tailing should be visible. |

## TABLE B-3. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (METHODS 8260B AND 8270C) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Minimum five-point initial calibration for all analytes (ICAL)** | Initial calibration prior to sample analysis | 1. Average response factor (RF) for SPCCs:<br>VOCs - ≥ 0.30 for Chlorobenzene and 1,1,2,2-tetrachlorolethane, ≥0.1 for chloromethane, bromoform, and 1,1-dichloroethane.<br>SVOCs - ≥ 0.050.<br>2. <u>%RSD for RFs for CCCs:</u><br>VOCs and SVOCs - ≤30% and one option below;<br>Option 1: RSD for each analyte ≤15%<br>Option 2: Grand mean ≤15%, with no individual analyte RSD >30%<br>Option 3: linear – least squares regression r > 0.995<br>Option 4: non-linear regression - coefficient of determination (COD) $r^2 \geq 0.990$ (6 points shall be used for second order, 7 points shall be used for third order) | Correct problem then repeat initial calibration | Apply J to all analytes with RSD >15% and ≤30%. Identify in case narrative analytes with RSD >15%, provide to client the actual RSD for those analytes, and document the grand mean. | Problem must be corrected. No samples may be run until ICAL has passed. |
| **Second source calibration verification** | Once after each initial calibration | Value of second source for all analytes within ±25% of expected value<br>(Initial source) | Correct problem and verify second source standard. If that fails, then repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |
| **Evaluation of relative retention times (RRT)** | Once per ICAL | RRT of each target analyte in each calibration standard within +/- 0.06 RRT units. | Correct problem, then rerun ICAL | Flagging criteria is not appropriate. | |
| **Retention time window position establishment for each analyte and surrogate** | Once per ICAL | Position shall be set using the midpoint standard of the initial calibration curve. | NA | NA | |

## TABLE B-3. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (METHODS 8260B AND 8270C) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Calibration verification (CV)** | Daily, before sample analysis and every 12 hours of analysis time | 1. Average RF for SPCCs: VOCs - ≥ 0.30 for Chlorobenzene and 1,1,2,2-tetrachlorolethane, ≥0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050.<br>2. %Difference/Drift for CCCs: VOCs and SVOCs - ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration)<br>In addition, it is required that all calibration analytes within ±20%D of expected value from ICAL when using grand mean, with no individual analytes (except CCCs) >25%. | Correct problem, rerun CV. If that fails, then repeat initial calibration. See section 9.4.2.2.e and box #41. | Apply J to all results for all analytes >20%D and ≤25%D. Identify in case narrative analytes with %D > 20%, provide to client the actual %D for those analytes, and document the grand mean. Apply Q-flag if no sample material remains and analyte exceeds criteria. | |
| **Calibration verification internal standards (CV-IS)** | With every calibration verification | Retention time ±30 seconds from retention time of the midpoint standard in the ICAL<br>EICP area within -50% to +100% of ICAL midpoint standard | Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. See corrective action for CV. | Flagging criteria is not appropriate. | Sample results are not acceptable without a valid CV-IS. |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem, then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch. | |
| **LCS containing all reported analytes** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate, if available; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient sample material is available. (see full explanation in this Appendix) | If corrective action fails, apply Q to specific analyte(s) in all samples in the associated preparatory batch | |

## TABLE B-3. ORGANIC ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (METHODS 8260B AND 8270C) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **MS** | One MS per every 20 project samples per matrix (see box D-6) | For matrix evaluation, use QC acceptance criteria specified by Bhate for LCS. | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. |
| **MSD or sample duplicate** | One per every 20 project samples per matrix | RPD ≤30% (between MS and MSD or sample and sample duplicate) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | The data shall be evaluated to determine the source of difference. |
| **Surrogate spike (analytes identified in this Appendix)** | All field and QC samples | QC acceptance criteria for LCS published by Bhate, if available; otherwise method-specified criteria or laboratory's own in-house criteria. | For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. | For the specific analyte(s) in all field samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. For QC samples, apply Q to specific analyte(s) in all samples in the associated preparatory batch. | |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-4. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) AND GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROSCOPY (GFAA) (METHODS 6010B AND 7000A SERIES)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C). | QC acceptance criteria published by DoD, if available; otherwise method-specified criteria | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete |
| **MDL study** | At initial set-up and subsequently once per 12 months; otherwise quarterly MDL verification checks shall be performed (see box D-12). | See 40 CFR 136B. MDL verification checks must produce a response at least 3 times greater than instrument noise level | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12). | NA | Samples cannot be analyzed without a valid MDL |
| **Linear range or high-level calibration check standard (ICP only)** | Every 6 months | Within ±10% of expected value | NA | NA | |
| **Initial calibration for all analytes (ICAL)**<br><br>**(ICP: minimum one high standard and a blank; GFAA: minimum three standards and a blank)** | Daily initial calibration prior to sample analysis | ICP: No acceptance criteria unless more than one standard is used, in which case r≥0.995.<br><br>GFAA: r≥ 0.995 | Correct problem and repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until ICAL has passed. |
| **Second source calibration verification** | Once after each initial calibration, prior to sample analysis | All analyte(s) within ±10% of expected value | Correct problem and verify second source standard. If that fails, then repeat initial calibration. | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |

**TABLE B-4. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) AND GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROSCOPY (GFAA) (METHODS 6010B AND 7000A SERIES) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Continuing calibration verification (CCV)** | After every 10 samples and at the end of the analysis sequence | GFAA: within ±20% of expected value<br><br>ICP: within ±10% of expected value | Correct problem, rerun calibration verification. If that fails, then repeat initial calibration. Reanalyze all samples since the last successful calibration. | Flagging criteria is not appropriate. | Problem must be corrected. Results may not be reported without a valid CCV. |
| **Low level calibration check standard (ICP only)** | Daily, after one-point initial calibration | Within ±30% of expected value | Correct problem, then reanalyze | Flagging criteria is not appropriate. | No samples may be analyzed without a valid low-level calibration check standard. Low-level calibration check standard should be less than or equal to the reporting limit. |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem, then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch | |
| **Calibration blank** | Before beginning a sample run, after every 10 samples, and at end of the analysis sequence | No analytes detected ≥ ½ RL | Correct problem, then reprep and reanalyze calibration blank and previous 10 samples | Apply B to all results for specific analyte(s) in all samples associated with the blank | |
| **Interference check solutions (ICS) (ICP only)** | At the beginning of an analytical run | Within ±20% of expected value | Terminate analysis; locate and correct problem; reanalyze ICS. | Flagging criteria is not appropriate. | No samples may be analyzed without a valid ICS |
| **LCS containing all reported analytes** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate, if available; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated preparatory batch (see full explanation in this Appendix). | If corrective action fails, apply Q to specific analyte(s) in all samples in the associated preparatory batch. | |
| **Dilution test** | Each preparatory batch or when a new or unusual matrix is encountered | Five-fold dilution must agree within ±10% of the original determination | ICP: Perform post-digestion spike (PDS) addition<br><br>GFAA: Perform recovery test | Flagging criteria is not appropriate. | Only applicable for samples with concentrations >50 x MDL (ICP) or >25 x MDL (GFAA) |
| **Post-digestion spike (PDS) addition (ICP only)** | When dilution test fails or analyte concentration in all samples <50 x MDL | Recovery within 75-125% of expected results. | Run samples by method of standard addition (MSA) or see flagging criteria | Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post-digestion spike addition | |

**TABLE B-4. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) AND GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROSCOPY (GFAA) (METHODS 6010B AND 7000A SERIES) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Recovery test (GFAA only)** | When dilution test fails or analyte concentration in all samples <25 x MDL | Recovery within 85-115% of expected results. | Run samples by method of standard addition (MSA) or see flagging criteria | Apply J to all sample results (for same matrix) in which MSA was not run when recovery is outside of 85-115% range | |
| **Method of standard addition (MSA)** | When matrix interference is suspected | NA | NA | NA | Document use in the case narrative. |
| **MS** | One MS per every 20 project samples per matrix (see box D-6) | For matrix evaluation, use QC acceptance criteria specified by Bhate for LCS. | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. | For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. |
| **MSD or sample duplicate** | One per every 20 project samples per matrix | RPD ≤20% (between MS and MSD or sample and sample duplicate) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | The data shall be evaluated to determine the source of difference. |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-5. TRACE METALS ANALYSIS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (METHOD 6020)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel or test method (see Section C). | QC acceptance criteria published by DoD, if available; otherwise method-specified criteria | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete. |
| **MDL study** | At initial set-up and once per 12 months; otherwise quarterly MDL verification checks shall be performed (see box D-12) | See 40 CFR 136B. MDL verification checks must produce a response at least 3 times greater than instrument noise level | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12). | NA | Samples cannot be analyzed without a valid MDL |
| **Instrument detection limit (IDL) study** | Every 3 months | Detection limits established shall be ≤ the RLs | NA | NA | Samples cannot be analyzed without a valid IDL |
| **Tuning (MS methods only)** | Prior to initial calibration | Per 6020 (5.8) | Retune instrument then reanalyze tuning solutions | Flagging criteria is not appropriate. | No analysis shall be performed without a valid MS tune. |
| **Initial calibration (ICAL)**<br><br>**(minimum one high standard and a blank)** | Daily initial calibration prior to sample analysis | If more than one calibration standard is used, r≥ 0.995 | Correct problem, then repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until ICAL has passed. |
| **Second source calibration verification** | Once after each ICAL, prior to beginning a sample run. | Value of second source for all analytes within ±10% of expected value (initial source) | Correct problem and verify second source standard. If that fails, then repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |
| **Continuing calibration verification (CCV)** | After every 10 samples and at the end of the analysis sequence | All analytes within ±10% of expected value | Correct problem, rerun calibration verification. If that fails, then repeat initial calibration. Reanalyze all samples since the last successful calibration. | Flagging criteria is not appropriate. | Problem must be corrected. Results may not be reported without a valid CCV. |
| **Low-level calibration check standard** | Daily, after one-point initial calibration | Within ±30% of expected value | Correct problem, then reanalyze | Flagging criteria is not appropriate. | No samples may be analyzed without a valid low-level calibration check standard. Low-level calibration check standard should be less than or equal to the reporting limit. |

## TABLE B-5. TRACE METALS ANALYSIS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (METHOD 6020) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Linear range or high-level calibration check standard** | Every 6 months | Within ±10% of expected value | NA | NA | |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem, then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch | |
| **Calibration blank** | Before beginning a sample run, after every 10 samples, and at end of the analysis sequence | No analytes detected ≥ ½ RL | Correct problem, then reprep and reanalyze calibration blank and previous 10 samples | Apply B to all results for specific analyte(s) in all samples associated with the blank | |
| **Interference check solutions (ICS-A and ICS-AB)** | At the beginning and end of an analytical run or twice during a 12-hour period, whichever is more frequent | ICS-A:<br>All non-spiked analytes < RL (unless they are a verified trace impurity from one of the spiked analytes)<br><br>ICS-AB:<br>Within ±20% of true value | Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all affected samples | If corrective action fails, apply Q to all results for specific analyte(s) in all samples associated with the ICS | |
| **LCS containing all reported analytes** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate, if available; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated preparatory batch, if sufficient sample material is available (see full explanation in this Appendix) | If corrective action fails, apply Q to specific analyte(s) in all samples in the associated preparatory batch. | |
| **Dilution test** | Each preparatory batch | Five-fold dilution must agree within ±10% of the original measurement | Perform post-digestion spike addition | Flagging criteria is not appropriate. | Only applicable for samples with concentrations >100 x MDL |
| **Post digestion spike addition** | When dilution test fails or analyte concentration for all samples <100 x MDL | Recovery within 75-125% of expected results | Run samples by method of standard addition (MSA) or see flagging criteria | Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post - digestion spike addition | |
| **Method of standard additions (MSA)** | When matrix interference is suspected | NA | NA | NA | Document use in the case narrative |

## TABLE B-5. TRACE METALS ANALYSIS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (METHOD 6020) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **MS** | One MS per every 20 project | For matrix evaluation, use | Examine the project-specific | For the specific analyte(s) in | For matrix evaluation only. If |

| | | | | | |
|---|---|---|---|---|---|
| | samples per matrix (see box D-6) | QC acceptance criteria specified by Bhate for LCS. | DQOs. Contact the client as to additional measures to be taken. | all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. | MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. |
| **MSD or sample duplicate** | One per every 20 project samples per matrix | RPD < 20% (between MS and MSD or sample and sample duplicate) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | The data shall be evaluated to determine the source of difference. |
| **Internal standards (IS)** | Every sample | IS intensity within 80-120% of intensity of the IS in the initial calibration | Perform corrective action as described in method 6020 (8.3) | Flagging criteria is not appropriate | |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-6. INORGANIC ANALYSIS BY COLORIMETRIC HEXAVALENT CHROMIUM (METHOD 7196A)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel or test method (see Appendix C). | QC acceptance criteria published in method; otherwise QC acceptance criteria established in-house by laboratory. | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete |
| **MDL study** | At initial set-up and subsequently once per 12-month period | See 40 CFR 136B. MDL verification checks must produce a response at least 3 times greater than instrument noise level | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12). | NA | Samples cannot be analyzed without a valid MDL |
| **Reference blank (reagent water)** | Before beginning standards or sample analysis | NA | NA | NA | Used for blank subtraction of standards, field and QC samples.<br>For turbid field samples, a turbidity blank must be used instead of the reference blank (using a sample aliquot prepped in accordance with 7196A (7.1)) |
| **Initial calibration (ICAL)**<br><br>**(minimum three standards and a blank)** | Daily initial calibration prior to sample analysis | r∃0.995 | Correct problem and repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until ICAL has passed |
| **Second source calibration verification**<br><br>**(also known as independently prepared check standard)** | Before beginning a sample run and after every 15 samples. | Value of second source for all analytes within ±10% of expected value (initial source) | Correct problem and verify second source standard. If that fails, then repeat calibration and reanalyze all samples since last successful calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |

## TABLE B-6. INORGANIC ANALYSIS BY COLORIMETRIC HEXAVALENT CHROMIUM (METHOD 7196A) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Sample matrix verification**<br><br>**(also known as matrix spike)** | Once for every sample matrix analyzed | Spike recovery within 85-115% | If check indicates interference, dilute and reanalyze sample; persistent interference indicates the need to use alternative method or analytical conditions, or to use method of standard additions. | Flagging criteria is not appropriate. | Verification check ensures lack of reducing condition or interference from matrix. Additional corrective actions are identified in method 7196A (7.4 and 7.5). |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch | |
| **LCS** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated preparatory batch, if sufficient sample material is available (see full explanation in this Appendix). | If corrective action fails, apply Q to specific analyte(s) in all samples in the associated preparatory batch. | |
| **MSD or sample duplicate** | One per every 10 project samples per matrix | RPD ≤ 30% (between MS and MSD or sample and sample duplicate) | Examine project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria not met | Refer to sample matrix verification sample for MS data evaluation |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-7. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/LOW-RESOLUTION MASS SPECTROSCOPY (METHOD 8280A)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C). | QC acceptance criteria established in-house by laboratory. | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete. |
| **MDL study** | At initial set-up and quarterly MDL verification checks shall be performed (see box D-12). | See 40 CFR 136B. MDL verification check must produce a response at least 3 times greater than instrument's noise level. | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12) | NA | Samples cannot be analyzed without a valid MDL. Refer to Sample Estimated Detection Limit. |
| **Tuning (MS methods only)** | Prior to calibration standards | Verify MS calibration per 8280A (7.13.1). | Retune instrument; verify. | Flagging criteria is not appropriate. | |
| **Retention time window defining mix** | At method set-up and prior to calibration standards | Verify descriptor switching times per 8280A (7.13.2). | Correct problem then repeat retention time window defining mix | Flagging criteria is not appropriate. | |
| **GC column performance check** | Prior to initial calibration or calibration verification standards for each 12-hour period of sample analysis. | Peak separation between 2,3,7,8-TCDD and other TCDD isomers result in a valley of #25%, per 8280A (7.12.2) | Correct problem, then repeat column performance check | Flagging criteria is not appropriate. | Needed only if using a column other than DB-5. |
| **Column performance check for DB-5 columns** | Included with the ICAL standard (CC3) and the calibration verification standard analyses | Peak separation of standard CC3: Peak between the 2,3,7,8-TCDD and 1,2,3,4-TCDD must be resolved with a valley of #25%, per 8280A (7.12.1).<br><br>For calibration verification standard only: Peak separation between 1,2,3,4,7,8-HxCDD and 1,2,3,6,7,8-HxCDD must be resolved with a valley of #50%, per 8280A (7.13.3.6.1) | Correct problem, then repeat column performance check | Flagging criteria is not appropriate. | |

## TABLE B-7. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/LOW-RESOLUTION MASS SPECTROSCOPY (METHOD 8280A) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Initial calibration for all analytes identified in Table 1 of Method 8280A (ICAL)** | Initial calibration prior to sample analysis and as needed by the failure of calibration verification standard. | Ion abundance ratios in accordance with 8280A Table 9 (7.13.3.1.1)<br>and<br>%RSD ≤15% for labeled IS and unlabeled PCDD/PCDF RRFs per 8280A (7.13.3.4) | Correct problem, then repeat initial calibration | Apply Q to all analytes with RSD >15%. | Problem must be corrected. No samples may be run until ICAL has passed. |
| **Calibration verification**<br><br>**(Table 4 of Method 8280A – final concentrations of Standard CC3 of Table 1)** | At the beginning of each 12-hour period of sample analysis, after successful GC and MS resolution checks. | Ion abundance in Table 9 of 8280A must be met for all PCDD/PCDF peaks, including labeled IS and recovery standards,<br>and<br>Sensitivity criteria of an S/N ratio >2.5 for unlabeled PCDD/PCDF ions and >10 for labeled IS and recovery standards per 8280A (7.13.3.6.3)<br>and<br>RF within 30% (% difference) of mean RF from initial calibration | Correct problem, rerun calibration verification. If that fails, then repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification. | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration verification has passed. |
| **Sensitivity check**<br><br>**(Standard CC1 of Table 1 of Method 8280A)** | End of 12-hour sample analysis period<br><br>(Injection must be done within the 12-hour period.) | See criteria for retention time check, ion abundances, and S/N ratios noted above for calibration verification standard per 8280A (7.13.3.7) | Correct problem, then repeat calibration and reanalyze samples indicating a presence of PCDD/PCDF less than quantitation limit or when maximum possible concentration is reported | Flagging criteria is not appropriate. | Nondetects and samples with positive results above the method quantitation limit do not need to be reanalyzed. |
| **Method blank** | One per preparatory batch | No analytes detected ≥ MDL for the analyte or ≥5% of the associated regulatory limit for the analyte or ≥5% of the sample result for the analyte, whichever is greater, per 8280A (8.4.3) | Correct problem, then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to the result for specific analyte(s) in all samples in the associated preparatory batch | |
| **LCS containing analytes identified in Table 5 of Method 8280A** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for the failed analytes in all samples in the associated preparatory batch | If corrective action fails or if insufficient sample is available for reanalysis, apply Q to specific analytes in all samples in the associated preparatory batch. | LCS compounds are the same as the MS compounds identified in Table 5 of Method 8280A (8.4.2) |

**TABLE B-7. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/LOW-RESOLUTION MASS SPECTROSCOPY (METHOD 8280A) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| | | | (see full explanation in this Appendix) | | |
| **MS containing analytes identified in Table 5 of Method 8280A** | One MS per every 20 project samples per matrix (see box D-6) | For evaluation of MS, use QC acceptance criteria specified by Bhate for LCS | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | Check other QC measures to verify matrix interference. For instance, verify that the LCS shows control of the batch analysis. Also verify sample recoveries for the internal standards, recovery, and cleanup standards for an indication of potential impact. |
| **MSD or sample duplicate** | One per every 20 project samples per matrix | RPD ≤ 20% (between MS and MSD or sample and sample duplicate) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if criteria are not met. | MSD spike includes the MS compounds identified in Table 5 of Method 8280A. |
| **Internal standards identified in Table 3 of Method 8280A** | Every sample, standard, and QC sample | % recovery for each IS in the original sample (prior to any dilutions) must be within 25-150% per 8280A (7.15.5.2) | Correct problem, then reprep and reanalyze the sample(s) with failed IS | Apply Q to results of all affected samples | |

## TABLE B-7. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/LOW-RESOLUTION MASS SPECTROSCOPY (METHOD 8280A) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Sample PCDD/PCDF identification** | Verify all positive sample detections per 8280A (7.14.5) | Verify that absolute RT at maximum height is within -1 to +3 secs. of corresponding labeled standard, or the RRT of analytes is within 0.05 RT units of the calibration verification standard, or is within the RT window established with the RT window defining mix for the corresponding homologue per 8280A (7.14.5.1)<br>and<br>Absolute RTs of the two recovery standards must be ∀10 sec. of the calibration verification standard (7.14.5.1)<br>and<br>All ions listed in Table 8 of Method 8280A must be present in the SICP (7.14.5.2)<br>and<br>S/N ratio of ISs ∃10 times background noise and must have not saturated the detector. Remaining ions on Table 8 must have an S/N ratio ∃2.5 times the background noise (7.14.5.3)<br>and<br>Ion abundance in Table 9 of 8280A must be met for all ISs, recovery, and cleanup standards (7.14.5.4)<br>and<br>No signal is present having an S/N ratio > 2.5 times background for the corresponding ether (PCDPE) detected at the same RT (∀ 2 sec.) (7.14.5.5) | Correct problem, then reprep and reanalyze the sample(s) with failed criteria for any of the internal, recovery, or cleanup standards.<br><br>If PCDPE is detected or if sample peaks present do not meet all identification criteria, calculate the EMPC (estimated maximum possible concentration) according to 8280A (7.15.7). | Flagging criteria is not appropriate. | |
| **Sample estimated detection limit (EDL)** | Every sample that indicates nondetects or detections that are less than 2.5 times background noise | Per 8280A (7.15.6) | NA | NA | |
| **Sample** | Every sample that indicates a | Identification criteria in 7.4.5 | NA | NA | |

**TABLE B-7. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/LOW-RESOLUTION MASS SPECTROSCOPY (METHOD 8280A) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **estimated maximum possible concentration (EMPC)** | detection ≥ 2.5 times S/N ratio. | of 8280A must be met, and response for both quantitation ions must be ≥ 2.5 times S/N ratio of background (7.15.7) | | | |
| **Sample 2,3,7,8-TCDD toxicity equivalents (TE) concentration** | All positive detections | Per 8280A (7.15.8) | NA | NA | Recommended reporting convention by the EPA and CDC for positive detections in terms of toxicity of 2,3,7,8-TCDD. |
| **Results reported between MDL and RL** | Positive detections calculated per 8280A (7.15.1) | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-8. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROSCOPY (METHOD 8290)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C). | QC acceptance criteria established in-house by laboratory. | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete |
| **MDL study** | At initial set-up and quarterly MDL verification checks shall be performed (see box D-12). | See 40 CFR 136B. MDL verification check must produce a response at least 3 times greater than instrument's noise level. | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12) | NA | Samples cannot be analyzed without a valid MDL. Refer to Sample EDL. |
| **Tuning (MS methods only)** | At the beginning and the end of each 12-hour period of analysis | Static resolving power ≥ 10,000 (10% valley) for identified masses per 8290 (7.6.2.2 and 8.2.2.1/8.2.2.3), <u>and</u> Monitor mass drift of lock-mass ion per 8290 (8.2.2.2) | Retune instrument; verify. Rerun affected samples. | Flagging criteria is not appropriate. | Recommend that a check of static resolution also be documented before and after each analysis. |
| **GC column performance check** | Prior to initial calibration or calibration verification standards for each 12-hour period of sample analysis. | Peak separation between 2,3,7,8-TCDD and other TCDD isomers result in a valley of #25% per 8290 (8.2.1.2) <u>and</u> Identification of all first and last eluters of the eight homologue retention time windows and documentation by labeling (F/L) on the chromatogram (8.2.1.2) <u>and</u> Absolute retention times for switching times for all components <10 sec. (8.2.1.3) | Correct problem then repeat column performance check | Flagging criteria is not appropriate. | |

**TABLE B-8. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROSCOPY (METHOD 8290) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Initial calibration for all analytes identified in Table 5 of Method 8290 (ICAL)** | Initial calibration prior to sample analysis, as needed by the failure of calibration verification standard, and when a new lot is used for standard source of CCV, sample fortification solution (IS), and recovery standards. | Ion abundance ratios in accordance with criteria in Table 8 of Method 8290 (7.7.1.4.1/7.7.2.3)<br>and<br>S/N ratio ≥ 10 for all ions (7.7.2.2)<br>and<br>%RSD ≤20% for 17 unlabeled standards and %RSD ≤ 30% for the 9 labeled IS mean RFs (7.7.2.1) | Correct problem, then repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until ICAL has passed. |
| **Routine (continuing) calibration check**<br><br>**(Table 5 of 8290 - final concentrations of HRCC3)** | At the beginning of each 12-hour period after successful GC resolution and mass resolution checks, and at the end of 12-hour shift. | Ion abundance ratios in accordance with criteria in Table 8 of Method 8290 (7.7.4.3)<br>and<br>RF within 20% D for unlabeled standards from mean RF from initial calibration (7.7.4.1)<br>and<br>RF within 30% D for labeled standards from mean RF from initial calibration (7.7.4.2)<br><br>End-of-run CCV only: RF within 25% D for unlabeled standards from mean RF from initial calibration and RF within 35% D for labeled standards from mean RF from initial calibration (8.4.2.4) requires the use of the mean RF from the two daily CCVs instead of the ICAL mean RF value. | Correct problem, repeat calibration verification standard one more time. If that fails, then repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification.<br><br>Evaluation of corresponding labeled/unlabeled standards may impact the corrective action required (see 8290 section 7.7.4.4)<br><br>If ending CCV RF > 25% and 35% for unlabeled and labeled standards, respectively, a new ICAL must be run immediately (within 2 hr.). Reanalyze samples with positive detections, if necessary. | Flagging criteria is not appropriate for routine calibration check.<br>Q-flag (noncompliances) for end-of-run continuing calibration check. | Problem must be corrected. No samples may be run until routine (beginning of 12-hour period) calibration verification has passed. |
| **Method blank** | One per preparatory batch, run after calibration standards and before | No analytes detected ≥ ½ RL | Correct problem then see criteria in box D-4. If required, reprep and reanalyze method | Apply B to the result for specific analyte(s) in all samples in the associated | |

**TABLE B-8. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROSCOPY (METHOD 8290) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| | samples | | blank and all samples processed with the contaminated blank. | preparatory batch | |
| **Field blanks and/or rinsates** | Per project requirements (see 8290 section 8.3.4) | Per project requirements | Per project requirements | Per project requirements | |
| **Performance evaluation (PE) sample** | Per project requirements (see 8290 section 8.3.1) | Per project requirements | Correct problem, then reprep and reanalyze the PE and all samples in the associated batch for failed analytes in all samples in the associated batch, if sufficient sample material is available. | If corrective action fails, apply Q to specific analyte(s) in all samples in the associated preparatory batch. | |
| **MS** | One MS per every 20 project samples per matrix (see box D-6) | QC acceptance criteria for lab's in-house control limits. | Check other QC measures to verify matrix interference. For instance, verify that the PE sample shows control of the batch analysis. Also verify sample recoveries for the internal, recovery and cleanup standards for an indication of potential impact. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | MS spike includes all compounds identified in Table 5 of Method 8290 at the concentration corresponding to HRCC3 standard. |
| **MSD or sample duplicate** | One per every 20 project samples per matrix | RPD ≤ 25% for laboratory duplicates per 8290 (8.3.5.1.1); RPD ≤ 20% for MS/MSD (8.3.6.4) | Refer to MS. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met | MSD spike includes all compounds identified in Table 5 of Method 8290 at the concentration corresponding to HRCC3 standard. |
| **Internal standards identified in Table 2 of Method 8290** | Every sample, standard, and QC sample | %Recovery for each IS in the original sample (prior to dilutions) must be within 40-135% per 8290 (8.4) | Correct problem, then reprep and reanalyze the sample(s) with failed IS. | Apply Q to results of all affected samples. | |
| **Sample PCDD/PCDF identification**<br><br>**Sample PCDD/PCDF identification (continued)** | Verify all sample positive detections per 8290 (7.8.4) | Retention time of sample components in accordance with stated criteria in 8290 (7.8.4.1)<br>and<br>Ion abundance ratios in accordance with criteria on Table 8 of 8290 (7.8.4.2),<br>and<br>S/N Ratio of all ions ∃2.5 times background noise (7.8.4.3)<br>and<br>No signal present having a S/N ratio > 2.5 for the | Correct problem, then reprep and reanalyze the sample(s) with failed criteria for any of the internal, recovery, or cleanup standards.<br><br>If PCDPE is detected or if sample peaks present do not meet all identification criteria, calculate the EMPC (estimated maximum possible concentration) according to 8290 (7.9.5.2.1) | Flagging criteria is not appropriate. | Positive identification of 2,3,7,8-TCDF on the DB-5 or equivalent column must be reanalyzed on a column capable of isomer specificity (DB-225) (see 8290 section 3.4) |

**TABLE B-8. DIOXIN/FURAN ANALYSIS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROSCOPY (METHOD 8290) (Continued)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| | | corresponding ether (PCDPE) detected at the same retention time (∀2 sec) (7.8.4.4) | | | |
| **Sample estimated detection limit (EDL)** | Every sample that indicates nondetects or detections that are < 2.5 times background noise | Per 8290 (7.9.5) | NA | NA | |
| **Sample estimated maximum possible concentration (EMPC)** | Every sample that indicates a detection ≥ 2.5 times S/N response | Identification criteria in 8290 (7.4.5) must be met, and response for both quantitation ions must be ≥ 2.5 times S/N ratio for background (7.9.5.2.1) | NA | NA | |
| **Sample 2,3,7,8-TCDD toxicity equivalents (TE) concentration** | All positive detections | Per 8290 (7.9.7) | NA | NA | Recommended reporting convention by the EPA and CDC for positive detections in terms of toxicity of 2,3,7,8-TCDD |
| **Results reported between MDL and RL** | Positive detections calculated per 8290 (7.9.1) | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-9. CYANIDE ANALYSIS (METHODS 9010B/9012A)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C). | QC acceptance criteria published by DoD, if available; otherwise use method-specified criteria | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete |
| **MDL study** | At initial set-up and subsequently once per 12-month period; otherwise quarterly MDL verification checks shall be performed (see box D-12). | See 40 CFR 136B. MDL verification check must produce a response at least 3 times greater than instrument's noise level. | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12) | NA | Samples cannot be analyzed without a valid MDL |
| **Multipoint calibration curve**<br><br>**(six standards and a calibration blank)** | Initial daily calibration prior to sample analysis | Correlation coefficient ≥0.995 for linear regression | Correct problem, then repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has passed. |
| **Distilled standards**<br><br>**(one high and one low)** | Once per multipoint calibration | Within ±10% of true value | Correct problem, then repeat distilled standards | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until distilled standards have passed. |
| **Second source calibration verification check standard** | Once per stock standard preparation | Value of second source within ±15% of expected value (initial source). | Correct problem and verify second source standard. If that fails, then repeat initial calibration. | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem, then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch. | |
| **LCS containing all reported analytes** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate, if available; see box D-5 and this Appendix. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated preparatory batch, if sufficient sample material is available (see full explanation in this Appendix). | If corrective action fails apply Q to the specific analyte in all samples in the associated preparatory batch. | |

## TABLE B-9. CYANIDE ANALYSIS (METHODS 9010B/9012A) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **MS** | One per every 20 project samples per matrix (see box D-6) | For matrix evaluation, use QC acceptance criteria specified by Bhate for LCS | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. | For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. |
| **MSD** | One per every 20 project samples per matrix | RPD ≤20% (between MS or MSD) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. | The data shall be evaluated to determine the source of difference. |
| **Sample duplicate** | Once per every 20 project samples | %D of duplicate within ± 20% of sample | Correct problem and reanalyze sample and duplicate | Apply Q if sample cannot be rerun or reanalysis does not correct problem. | |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## TABLE B-10. COMMON ANIONS ANALYSIS (METHOD 9056)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Demonstrate acceptable analyst capability** | Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Section C). | QC acceptance criteria published by DoD, if available; otherwise use method-specified criteria | Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f). | NA | This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is completed. |
| **MDL study** | At initial set-up and subsequently once per 12-month period; otherwise quarterly MDL verification checks shall be performed (see box D-12). | See 40 CFR 136B. MDL verification checks must produce a response at least 3 times greater than instrument's noise level. | Run MDL verification check at higher level and higher MDL set or reconduct MDL study (see box D-12). | NA | Samples cannot be analyzed without a valid MDL |
| **Retention time window width calculated for each analyte** | After method set-up and after major maintenance (e.g., column change) | Width is ± 3 times standard deviation for each analyte retention time over 8-hour period | NA | NA | |
| **Multipoint calibration for all analytes**<br><br>**(minimum three standards and one calibration blank)** | Initial calibration prior to sample analysis | Correlation coefficient ≥0.995 for linear regression | Correct problem, then repeat initial calibration | Flagging criteria is not appropriate. | Problem must be corrected. No sample may be run until calibration has passed. |
| **Second source calibration verification** | Once after each multipoint calibration | Value of second source for all analytes within ±10% of expected value (initial source). | Correct problem and verify second source standard. If that fails, then repeat initial calibration. | Flagging criteria is not appropriate. | Problem must be corrected. No samples may be run until calibration has been verified. |
| **Retention time window position establishment for each analyte** | Once per multipoint calibration | Position shall be at midpoint of calibration curve | NA | NA | |
| **Retention time window verification for each analyte** | Each calibration verification | Analyte within established window | Correct problem, then reanalyze all samples analyzed since the last retention time check. If they fail, redo ICAL and reset retention time window. | Flagging criteria is not appropriate. | No samples shall be run without a verified retention time window. |

## TABLE B-10. COMMON ANIONS ANALYSIS (METHOD 9056) (Continued)

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **Initial calibration verification (ICV)** | Daily before sample analysis; and when eluent is changed, and with every batch of samples | All analytes within ±10% of expected value and retention times within appropriate windows | Correct problem, rerun ICV. If that fails, then repeat initial calibration (see section 9.4.2.2.e and box #41). | Flagging criteria is not appropriate. | No samples may be run without verifying initial calibration |
| **Midrange continuing calibration verification (CCV)** | After every 10 field samples and at the end of the analysis sequence | Instrument response within ±5% of expected response | Correct problem, then repeat continuing calibration verification and reanalyze all samples since last successful calibration verification | Apply Q to all results for the specific analyte(s) in all samples since the last acceptable calibration verification | |
| **Method blank** | One per preparatory batch | No analytes detected ≥ ½ RL | Correct problem, then see criteria in box D-4. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | Apply B to all results for the specific analyte(s) in all samples in the associated preparatory batch | |
| **LCS containing all reported analytes** | One LCS per preparatory batch | QC acceptance criteria specified by Bhate, if available; see box D-5 and this Appendix | Correct problem then reprep and reanalyze the LCS and all samples in the associated batch for failed analytes in all samples in the associated prepatory batch, if sufficient sample material is available. | If corrective action fails apply Q to specific analyte(s) in all samples in the associated preparatory batch | |
| **MS** | One MS per every 20 project samples per matrix (see box D-6) | For matrix evaluation, use QC acceptance criteria specified by Bhate for LCS. | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. | For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. |
| **MSD** | One per every 20 project samples per matrix | RPD ≤20% (between MS and MSD) | Examine the project-specific DQOs. Contact the client as to additional measures to be taken. | For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J if acceptance criteria are not met. | The data shall be evaluated to determine the source of difference. |
| **Sample duplicate** | One per every 10 samples | %D ≤10% | Correct problem and reanalyze sample and duplicate | If corrective action fails, apply Q to specific analyte(s) in the sample | |
| **Results reported between MDL and RL** | NA | NA | NA | Apply J to all results between MDL and RL | |

## ACRONYMS FOR SECTION B

**CC3:** The third of five solutions for instrument calibration used in method 8280A
**CCC:** Calibration check compounds
**CCV:** Continuing calibration verification
**CFR:** Code of Federal Regulations
**COD:** Coefficient of determination
**COE:** Army Corps of Engineers
**CV:** Calibration verification
**CV-IS:** Calibration verification of internal standards
**D:** Difference or drift
**DDT:** 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane/dichlorodiphenyl-trichloroethane/p,p'-DDT
**DoD:** Department of Defense
**DQO:** Data quality objective
**DRO:** Diesel range organics
**EDL:** Estimated detection limit
**EICP:** Extraction ion current profile
**GC:** Gas chromatography
**GC/MS:** Gas chromatography with subsequent mass spectrometry
**GFAA:** Graphite furnace atomic absorption spectrometry
**GRO:** Gasoline range organics
**HPLC:** High performance liquid chromatography
**HxCDD:** Hexachlorodibenzo-p-dioxin (solution used for calibration verification)
**ICAL:** Initial calibration
**ICP:** Inductively coupled plasma
**ICP/MS:** Inductively coupled plasma with subsequent mass spectrometry
**ICS:** Interference check solution
**ICV:** Initial Calibration Verification
**IS:** Internal standard
**IDL:** Instrument detection limit
**LCS:** Laboratory control sample
**MDL:** Method detection limit
**MS:** Mass spectrometry
**MS:** Matrix spike
**MSA:** Method of standard additions
**MSD:** Matrix spike duplicate
**PCB:** Polychlorinated biphenyl
**PCDD:** Polychlorinated dibenzodioxin
**PCDF:** Polychlorinated dibenzofuran
**PDS:** Post-digestion spike
**PE:** Performance evaluation
**PT:** Proficiency testing
**QC:** Quality control
**QSM:** Quality Systems Manual
**RF:** Response factor
**RL:** Reporting limit
**RPD:** Relative percent difference
**RRT:** Relative retention time
**RSD:** Relative standard deviation
**RT:** Retention time
**SICP:** Selected ion current profile
**S/N:** Signal to noise ratio
**SPCC:** System performance check compound
**SVOC:** Semi-volatile organic compound

**TCDD:** Tetrachlorodibenzo-p-dioxin

**TCDF:** Tetrachlorodibenzofuran
**VOC:** Volatile Organic Compound

## GLOSSARY FOR Section B

**Aliquot:** A discrete, measured, representative portion of a sample taken for analysis. (Team; EPA QAD glossary)

**Analyte:** The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together. (EPA Risk Assessment Guide for Superfund; OSHA glossary)

**Atomization:** A process in which a sample is converted to free atoms. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry.1992)

**Congener:** A member of a class of related ohemical compounds (e.g., PCBs, PCDDs).

**Digestion:** A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form.

**Duplicate:** The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

**Eluent:** A solvent used to carry the components of a mixture though a stationary phase. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry. 1992)

**Elute:** To extract; specifically, to remove (adsorbed material) from an adsorbent by means of a solvent. (Merriam-Webster's Collegiate Dictionary, 2000)

**Elution:** A process in which solutes are washed though a stationary phase by the movement of a mobile phase. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry. 1992)

**False Negative:** An analyte incorrectly reported as absent from the sample, resulting in potential risks from their presence.

**False Positive:** An item incorrectly identified as present in the sample, resulting in a high reporting value for the analyte of concern.

**Homologue:** One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, $CH_3OH$ (methanol), $C_2H_5OH$ (ethanol), $C_3H_7OH$ (propanol), $C_4H_9OH$ (butanol), etc., form a homologous series. (The Condensed Chemical Dictionary G.G.Hawley, ed. 1981)

**Interference, spectral:** Occurs when particulate matter from the atomization scatters the incident radiation from the source or when the absorption or emission of an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry. 1992)

**Interference, chemical:** Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry. 1992)

**Internal Standard:** A pure substance that is introduced in known amount into each calibration standard and field and QC sample of the analyte. The ratio of the analyte signal to the internal standard signal is then used to determine the analyte concentration. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry. 1992)

**Isomer:** Generally, any two chemicals with the same chemical formula but a different structure. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane. (http://www.kcpc.usyd.edu.au/discovery/glossary-all.html)

**Matrix:** The collection of all of the various constituents making up an analytical sample. (Skoog, Holler, and Nieman. Principles of Instrumental Analysis. 1998)

**Method of Standard Additions:** A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration. (This process is often called spiking the sample.) (Modified Skoog, Holler, and Nieman. Principles of Instrumental Analysis. 1998)

**Retention Time:** The time between sample injection and the appearance of a solute peak at the detector. (Skoog, West, and Holler. Fundamentals of Analytical Chemistry. 1992)

**Signal to Noise Ratio:** The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. In most measurements, the average strength of the noise is constant and independent of the magnitude of the signal. Thus, the effect of noise on the relative error of a measurement becomes greater and greater as the quantity being measured (producing the signal) decreases in magnitude. (Skoog, Holler, and Nieman. Principles of Instrumental Analysis. 1998)

**Standard:** Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by the US National Institute of Standards and Technology (NIST) and characterized for absolute content, independent of analytical test method.

## C – TARGET ANALYTE LISTS

The lists of analytes provided in this Section are to be used as a default whenever no analyte list has been provided by the client. It is anticipated that project-specific information will identify the analyses needed. The client may also identify specific analytes associated with those analyses. If not, the following target analyte lists shall be the default for those analyses identified as appropriate to the site. This Section is not needed when Bhate personnel have used site-specific information to identify project-specific target analytes. If limited site-specific information is available, the target analyte lists may be used as a baseline list from which the client may add or subtract specific analytes. The following target analyte lists were compiled by all three DoD components to include common analytes of concern at DoD sites as well as the Superfund list of 110 most frequently occurring chemicals.

The analytes are organized by SW-846 methods. The organization is for convenience only and is not meant to infer that the laboratory must conduct the analysis with these specific methods. The project-specific QAPP will identify the analytical method to be used, and the target analytes may be carried over to those different methods. In several cases one analyte may be detected by multiple methods. The comment field in each table identifies what alternative SW-846 method(s) can detect the analyte. The following tables list the default HAFB target analytes for SW-846 methods commonly used:

**SW-846 Methods**

Although the target analyte lists in this Section are organized by SW-846 methods, the laboratory is not restricted to those methods when conducting analyses. In addition, this Section refers to the method versions current at the time of publication. As methods are updated subsequent versions of this manual will incorporate the changes. If the tables in this Section do not yet correspond with the most recent version of the SW-846 method, or if a new method that analyzes for the same group of analytes becomes available, the target analyte lists in this Section still apply.

Table C-1: Method 8260B (volatile organic compounds)
Table C-2: Method 8270C (semivolatile organic compounds)
Table C-3: Methods 8280A and 8290 (dioxins/furans)
Table C-4: Method 8141A (organophosphorus pesticides)
Table C-5: Method 8151A (phenoxyacid herbicides)
Table C-6: Method 8310 (polynuclear aromatic hydrocarbons)
Table C-7: Method 8330 (explosives)
Table C-8: Method 8081A (organochlorine pesticides)
Table C-9: Method 8082 (polychlorinated biphenyls)
Table C-10: Methods 6010B, 7000A series, 9010B, 9012A, and 9056 (inorganics).

[Note: Analytes often have many synonyms; refer to the CAS number when there is uncertainty regarding an analyte name.]

During a multi-laboratory study of laboratory control sample (LCS) recoveries, several compounds on the target analyte lists were identified as poor performing analytes for certain methods. These analytes are included in the target analyte lists in the following tables since they should be included in the calibration standard; however, they should be treated separately in the LCS. For further explanation on how to treat poor performing analytes when they are detected in the calibration or are target analytes of concern see Section D. The analytes are identified as poor performers on the following tables. For methods 8151A and 8330, results will be published following further analysis. No data were gathered for the following methods; therefore, no conclusions on analyte performance can be made: 8280A, 8290, 8141A, 7000A series (GFAA), 9010B, 9012A and 9056.

## TABLE C-1. SW-846 METHOD 8260B (VOLATILE ORGANIC COMPOUNDS) TARGET ANALYTE LIST[3]

| Volatile Organic Compound | CAS # | Comments | Volatile Organic Compound | CAS # | Comments |
|---|---|---|---|---|---|
| Acetone | 67-64-1 | | Trans-1,3-Dichloropropene | 10061-02-6 | |
| Benzene | 71-43-2 | | Ethylbenzene | 100-41-4 | |
| Bromobenzene | 108-86-1 | | 2-Hexanone | 591-78-6 | |
| Bromochloromethane | 74-97-5 | | Hexachlorobutadiene | 87-68-3 | |
| Bromodichloromethane | 75-27-4 | | Isopropylbenzene | 98-82-8 | |
| Bromoform | 75-25-2 | | p-Isopropyltoluene | 99-87-6 | |
| Bromomethane (Methyl bromide) | 74-83-9 | | Methylene chloride | 75-09-2 | |
| 2-Butanone (MEK) | 78-93-3 | | 4-Methyl-2-pentanone (MIBK) | 108-10-1 | |
| n-Butylbenzene | 104-51-8 | | Methyl Tert-butyl Ether (MTBE) | 1634-04-4 | |
| sec-Butylbenzene | 135-98-9 | | Naphthalene | 91-20-3 | See also 8270C and 8310 |
| tert-Butylbenzene | 98-06-6 | | n-Propylbenzene | 106-65-1 | |
| Carbon disulfide | 75-15-0 | | Styrene | 100-42-5 | |
| Carbon tetrachloride | 56-23-5 | | 1,1,1,2-Tetrachloroethane | 630-20-6 | |
| Chlorobenzene | 108-90-7 | | 1,1,2,2-Tetrachloroethane | 79-34-5 | |
| Chlorodibromomethane[4] | 124-48-1 | | Tetrachloroethene | 127-18-4 | |
| Chloroethane | 75-00-3 | | Toluene | 108-88-3 | |
| Chloroform | 67-66-3 | | 1,2,3-Trichlorobenzene | 87-61-6 | |
| Chloromethane | 74-87-3 | | 1,2,4-Trichlorobenzene | 120-82-1 | |
| 2-Chlorotoluene | 95-49-8 | | 1,1,1-Trichloroethane | 71-55-6 | |
| 4-Chlorotoluene | 106-43-4 | | 1,1,2-Trichloroethane | 79-00-5 | |
| 1,2-Dibromo-3-chloropropane | 96-12-8 | | Trichloroethene | 79-01-6 | |
| 1,2-Dibromoethane (Ethylene dibromide) | 106-93-4 | | Trichlorofluoromethane | 75-69-4 | |
| Dibromomethane | 74-95-3 | | 1,2,3-Trichloropropane | 96-18-4 | |
| 1,2-Dichlorobenzene | 95-50-1 | See also 8270C | 1,2,4-Trimethylbenzene | 95-63-6 | |
| 1,3-Dichlorobenzene | 541-73-1 | See also 8270C | 1,3,5-Trimethylbenzene | 108-67-8 | |
| 1,4-Dichlorobenzene | 106-46-7 | See also 8270C | Vinyl chloride | 75-01-4 | |
| Dichlorodifluoromethane | 75-71-8 | | o-Xylene | 95-47-6 | |
| 1,1-Dichloroethane | 75-34-3 | | m,p-Xylene | 108-38-3/ 106-42-3 | |
| 1,2-Dichloroethane | 107-06-2 | | Xylene (total)[5] | 1330-20-7 | |
| 1,1-Dichloroethene | 75-35-4 | | 4-Bromofluorobenzene | 460-00-4 | Surrogate |
| Cis-1,2-Dichloroethene | 156-59-2 | | Dibromofluoromethane | 1868-53-7 | Surrogate |

TABLE C-1. SW-846 METHOD 8260B (VOLATILE ORGANIC COMPOUNDS) TARGET ANALYTE LIST (Continued)

[3] Vinyl acetate has often been included on DoD target analyte lists for method 8260B in the past. Data indicate that it may not consistently produce quantitative data with this method. Therefore, it has purposely been removed from the target analyte list. The compound may be added back to the list on a project-specific basis.
[4] Though not selected by DoD, this compound was retained due to its inclusion on the Superfund list of 110 most frequently occurring chemicals.
[5] Data may be reported on a project-specific basis as Total Xylene, however, for purposes of the Bhate QAPP, it will be analyzed and reported as m,p-Xylene and o-Xylene.

| Volatile Compound | CAS # | Comments | Volatile Compound | CAS # | Comments |
|---|---|---|---|---|---|
| trans-1,2-Dichloroethene | 156-60-5 | | 1,2-Dichlorobenzene-d4 | 2199-69-1 | Surrogate |
| 1,2-Dichloropropane | 78-87-5 | | 1,2-Dichloroethane-d4 | 17060-07-0 | Surrogate |
| 1,3-Dichloropropane | 142-28-9 | | Fluorobenzene | 462-06-6 | Surrogate |
| 2,2-Dichloropropane | 594-20-7 | | Toluene-d8 | 2037-26-5 | Surrogate |
| 1,1-Dichloropropene | 563-58-6 | | Pentafluorobenzene | 363-72-4 | Surrogate |
| cis-1,3-Dichloropropene | 10061-01-5 | | | | |

## TABLE C-2. SW-846 METHOD 8270C (SEMIVOLATILE ORGANIC COMPOUNDS) TARGET ANALYTE LIST[6]

| Semivolatile Compound | CAS # | Comments | Semivolatile Compound | CAS # | Comments |
|---|---|---|---|---|---|
| Acenaphthene | 83-32-9 | See also 8310 | 2,4-Dinitrotoluene | 121-14-2 | |
| Acenaphthylene | 208-96-8 | See also 8310 | 2,6-Dinitrotoluene | 606-20-2 | |
| Anthracene | 120-12-7 | See also 8310 | 1,2-Diphenylhydrazine | 122-66-7 | |
| Benzidine | 92-87-5 | | Di-n-octyl phthalate | 117-84-0 | |
| ***Benzoic acid***[7,8] | 65-85-0 | | Fluoranthene | 206-44-0 | See also 8310 |
| Benz(a)anthracene | 56-55-3 | See also 8310 | Fluorene | 86-73-7 | See also 8310 |
| Benzo(b)fluoranthene | 205-99-2 | See also 8310 | Hexachlorobenzene | 118-74-1 | |
| Benzo(k)fluoranthene | 207-08-9 | See also 8310 | Hexachlorobutadiene | 87-68-3 | |
| Benzo(g,h,i)perylene | 191-24-2 | See also 8310 | Hexachloroethane | 67-72-1 | |
| Benzo(a)pyrene | 50-32-8 | See also 8310 | Indeno(1,2,3-cd)pyrene | 193-39-5 | See also 8310 |
| Benzyl alcohol | 100-51-6 | | Isophorone | 78-59-1 | |
| Bis(2-chlorethoxy)methane | 111-91-1 | | 2-Methylnaphthalene | 91-57-6 | |
| Bis(2-chloroethyl) ether | 111-44-4 | | 2-Methylphenol | 95-48-7 | |
| Bis(2-chloroisopropyl) ether | 108-60-1 | | 3-Methylphenol/4-Methylphenol | 108-39-4 / 106-44-5 | |
| Bis(2-ethylhexyl) phthalate | 117-81-7 | | Naphthalene | 91-20-3 | See also 8260B, 8310 |
| 4-Bromophenyl phenyl ether | 101-55-3 | | 2-Nitroaniline | 88-74-4 | |
| Butyl benzyl phthalate | 85-68-7 | | 3-Nitroaniline | 99-09-2 | |
| Carbazole | 86-74-8 | | 4-Nitroaniline | 100-01-6 | |
| ***4-Chloroaniline***[7] | 106-47-8 | | Nitrobenzene | 98-95-3 | See also 8330 |
| 4-Chloro-3-methylphenol | 59-50-7 | | 2-Nitrophenol | 88-75-5 | |

[6] Hexachlorocyclopentadiene has often been included on DoD target analyte lists for method 8270C in the past. The analyte is an intermediate product of pesticide manufacturing and would not be expected to be found on a DoD site. Therefore, it has purposely been removed from the target analyte list. If pesticide manufacturing has occurred at the site, the compound should be added back in on a project-specific basis.

[7] Poor performing analyte for the solid matrix. Must be in the calibration standard but data indicate it may not consistently produce quantitative data. See Section D.5 of Section D for further explanation.

## TABLE C-2. SW-846 METHOD 8270C (SEMIVOLATILE ORGANIC COMPOUNDS) TARGET ANALYTE LIST (Continued)

| Semivolatile Compound | CAS # | Comments | Semivolatile Compound | CAS # | Comments |
|---|---|---|---|---|---|
| 2-Chloronaphthalene | 91-58-7 | | ***4-Nitrophenol***[8] | 100-02-7 | |
| 2-Chlorophenol | 95-57-8 | | N-Nitrosodimethylamine | 62-75-9 | |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | | N-Nitrosodiphenylamine | 86-30-6 | |
| Chrysene | 218-01-9 | See also 8310 | N-Nitrosodi-n-propylamine | 621-64-7 | |
| Dibenz(a,h)anthracene | 53-70-3 | See also 8310 | N-Nitrosopyrrolidine | 930-55-2 | |
| Dibenzofuran | 132-64-9 | | Pentachlorophenol | 87-86-5 | |
| Di-n-butyl phthalate | 84-74-2 | | Phenanthrene | 85-01-8 | See also 8310 |
| 1,2-Dichlorobenzene | 95-50-1 | See also 8260B | ***Phenol***[8] | 108-95-2 | |
| 1,3-Dichlorobenzene | 541-73-1 | See also 8260B | Pyrene | 129-00-0 | See also 8310 |
| 1,4-Dichlorobenzene | 106-46-7 | See also 8260B | 1,2,4-Trichlorobenzene | 120-82-1 | See also 8260B |
| ***3,3'-Dichlorobenzidine***[7] | 91-94-1 | | 2,4,5-Trichlorophenol | 95-95-4 | |
| 2,4-Dichlorophenol | 120-83-2 | | 2,4,6-Trichlorophenol | 88-06-2 | |
| 2,6-Dichlorophenol | 87-65-0 | | 2-Fluorophenol | 367-12-4 | Surrogate |
| Diethyl phthalate | 84-66-2 | | ***Phenol-d5/d6***[8] | | Surrogate |
| 2,4-Dimethylphenol | 105-67-9 | | Nitrobenzene-d5 | | Surrogate |
| Dimethyl phthalate | 131-11-3 | | 2-Fluorobiphenyl | 321-60-8 | Surrogate |
| 4,6-Dintro-2-methylphenol | 534-52-1 | | 2,4,6-Tribromophenol | 118-79-6 | Surrogate |
| 2,4-Dinitrophenol | 51-28-5 | | Terphenyl-d14 | 1718-51-0 | Surrogate |

[8] Poor performing analyte for water. Must be in the calibration standard but data indicate it may not consistently produce quantitative data. See Section D.5 of Section D for further explanation.

## TABLE C-3. SW-846 METHODS 8280A AND 8290 (DIOXINS/FURANS) TARGET ANALYTE LIST

| Dioxin/Furan Compound | CAS # | Comments |
|---|---|---|
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin | 1746-01-6 | 8280A |
| 2,3,7,8-Tetrachlorodibenzofuran | 51207-31-9 | 8280A |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin | 1746-01-6 | 8290 |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin | 40321-76-4 | 8290 |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin | 39227-28-6 | 8290 |
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin | 57653-85-7 | 8290 |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin | 19408-74-3 | 8290 |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin | 35822-46-9 | 8290 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin | 3268-87-9 | 8290 |
| 2,3,7,8-Tetrachlorodibenzofuran | 51207-31-9 | 8290 |
| 1,2,3,7,8-Pentachlorodibenzofuran | 57117-41-6 | 8290 |
| 2,3,4,7,8-Pentachlorodibenzofuran | 57117-31-4 | 8290 |
| 1,2,3,4,7,8-Hexachlorodibenzofuran | 70648-26-9 | 8290 |
| 1,2,3,6,7,8-Hexachlorodibenzofuran | 57117-44-9 | 8290 |
| 1,2,3,7,8,9-Hexachlorodibenzofuran | 72918-21-9 | 8290 |
| 2,3,4,6,7,8-Hexachlorodibenzofuran | 60851-34-5 | 8290 |
| 1,2,3,4,6,7,8-Heptachlorodibenzofuran | 67562-39-4 | 8290 |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran | 55673-87-7 | 8290 |
| 1,2,3,4,6,7,8,9-Octachlorodibenzofurans | 39001-02-0 | 8290 |
| $^{13}C_{12}$-1,2,3,4-TCDD | | Recovery standard |
| $^{13}C_{12}$-1,2,3,7,8,9-HxCDD | | Recovery standard |
| $^{37}C1_4$-2,3,7,8-TCDD | | Cleanup standard |

## TABLE C-4. SW-846 METHOD 8141A (ORGANOPHOSPHORUS PESTICIDES) TARGET ANALYTE LIST

| Organophosphorus Pesticide Compound | CAS # | Comments |
|---|---|---|
| Azinphos-methyl | 86-50-1 | |
| Bolstar (Sulprofos) | 33400-43-2 | |
| Chlorpyrifos | 2921-88-2 | |
| Coumaphos | 56-72-4 | |
| Demeton-O | 298-03-3 | |
| Demeton-S | 126-75-0 | |
| Diazinon | 333-41-5 | |
| Dichlorvos (DDVP) | 62-73-7 | |
| Disulfoton | 298-04-4 | |
| Ethoprop | 13194-48-4 | |
| Fensulfothion | 115-90-2 | |
| Fenthion | 55-38-9 | |
| Merphos | 150-50-5 | |
| Naled | 300-76-5 | |
| Parathion, methyl | 298-00-0 | |
| Phorate | 298-02-2 | |
| Ronnel | 299-84-3 | |
| Stirophos (Tetrachlorovinphos) | 961-11-5 | |
| Tokuthion (Protothiofos) | 34643-46-4 | |
| Trichloronate | 327-98-0 | |
| 4-Chloro-3-nitrobenzo-trifluoride | 121-17-5 | Surrogate |
| Tributyl phosphate | 126-73-8 | Surrogate |
| Triphenyl phosphate | 115-86-6 | Surrogate |

## TABLE C-5. SW-846 METHOD 8151A (PHENOXYACID HERBICIDES) TARGET ANALYTE LIST

| Phenoxyacid Herbicide Compound | CAS # | Comments |
|---|---|---|
| 2,4-D | 94-75-7 | |
| 2,4-DB | 94-82-6 | |
| 2,4,5-TP (Silvex) | 93-72-1 | |
| 2,4,5-T | 93-76-5 | |
| Dalapon | 75-99-0 | |
| Dicamba | 1918-00-9 | |
| Dichloroprop | 120-36-5 | |
| Dinoseb | 88-85-7 | |
| MCPA | 94-74-6 | |
| MCPP | 93-65-2 | |
| 2,4-Dichlorophenylacetic acid | 19719-28-9 | Surrogate |

## TABLE C-6. SW-846 METHOD 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS) TARGET ANALYTE LIST

| Polynuclear Aromatic Hydrocarbon Compound | CAS # | Comments |
|---|---|---|
| Acenaphthene | 83-32-9 | See also 8270C |
| Acenaphthylene | 208-96-8 | See also 8270C |
| Anthracene | 120-12-7 | See also 8270C |
| Benzo(a)anthracene | 56-55-3 | See also 8270C |
| Benzo(a)pyrene | 50-32-8 | See also 8270C |
| Benzo(b)fluoranthene | 205-99-2 | See also 8270C |
| Benzo(g,h,i)perylene | 191-24-2 | See also 8270C |
| Benzo(k)fluoranthene | 207-08-9 | See also 8270C |
| Chrysene | 218-01-9 | See also 8270C |
| Dibenzo(a,h)anthracene | 53-70-3 | See also 8270C |
| Fluoranthene | 206-44-0 | See also 8270C |
| Fluorene | 86-73-7 | See also 8270C |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | See also 8270C |
| Naphthalene | 91-20-3 | See also 8270C |
| Phenanthrene | 85-01-8 | See also 8270C |
| Pyrene | 129-00-0 | See also 8270C |
| Decafluorobiphenyl | 434-90-2 | Surrogate |

## TABLE C-7. SW-846 METHOD 8330 (EXPLOSIVES) TARGET ANALYTE LIST[9]

| Explosive Compound | CAS # | Comments |
|---|---|---|
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 2691-41-0 | |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 121-82-4 | |
| 1,3,5-Trinitrobenzene | 99-35-4 | |
| 1,3-Dinitrobenzene | 99-65-0 | |
| Methyl-2,4,6-trinitrophenylnitramine (Tetryl) | 479-45-8 | |
| Nitrobenzene | 98-95-3 | See also 8260B and 8270C |
| 2,4,6-Trinitrotoluene (TNT) | 118-96-7 | |
| 4-Amino-2,6-dinitrotoluene | 19406-51-0 | |
| 2-Amino-4,6-dinitrotoluene | 35572-78-2 | |
| 2,4-Dinitrotoluene | 121-14-2 | See also 8270C |
| 2,6-Dinitrotoluene | 606-20-2 | See also 8270C |

[9] When surrogate compounds are not identified by the client, use an analyte from the method that is not expected to be present in the samples as the surrogate.

## TABLE C-7. SW-846 METHOD 8330 (EXPLOSIVES) TARGET ANALYTE LIST (Continued)

| Explosive Compound | CAS # | Comments |
|---|---|---|
| 2-Nitrotoluene | 88-72-2 | |
| 3-Nitrotoluene | 99-08-1 | |
| 4-Nitrotoluene | 99-99-0 | |

## TABLE C-8. SW-846 METHOD 8081A (ORGANOCHLORINE PESTICIDES) TARGET ANALYTE LIST

| Organochlorine Pesticide Compound | CAS # | Comments |
|---|---|---|
| Aldrin | 309-00-2 | |
| alpha-BHC | 319-84-6 | |
| beta-BHC | 319-85-7 | |
| delta-BHC | 319-86-8 | |
| gamma-BHC (Lindane) | 58-89-9 | |
| alpha-Chlordane | 5103-71-9 | |
| gamma-Chlordane | 5103-74-2 | |
| 4,4'-DDD | 72-54-8 | |
| 4,4'-DDE | 72-55-9 | |
| 4,4'-DDT | 50-29-3 | |
| Dieldrin | 60-57-1 | |
| Endosulfan I | 959-98-8 | |
| Endosulfan II | 33213-65-9 | |
| Endosulfan sulfate | 1031-07-8 | |
| Endrin | 72-20-8 | |
| Endrin aldehyde | 7421-93-4 | |
| Endrin ketone | 53494-70-5 | |
| Heptachlor | 76-44-8 | |
| Heptachlor epoxide | 1024-57-3 | |
| Hexachlorobenzene | 118-74-1 | |
| Methoxychlor | 72-43-5 | |
| Toxaphene | 8001-35-2 | |
| 4-Chloro-3-nitrobenzo-trifluoride | 121-17-5 | Surrogate |
| Tetrachloro-m-xylene (TCMX) | 877-09-8 | Surrogate |
| Decachlorobiphenyl | 2051-24-3 | Surrogate |

## TABLE C-9. SW-846 METHOD 8082 (POLYCHLORINATED BIPHENYLS) TARGET ANALYTE LIST

| PCB Compound | CAS # | Comments |
|---|---|---|
| Aroclor 1016 | 12674-11-2 | |
| Aroclor 1221 | 11104-28-2 | |
| Aroclor 1232 | 11141-16-5 | |
| Aroclor 1242 | 53469-21-9 | |
| Aroclor 1248 | 12672-29-6 | |
| Aroclor 1254 | 11097-69-1 | |
| Aroclor 1260 | 11096-82-5 | |
| Aroclor 1268 | 11100-14-4 | |
| Aroclor 1016/1260 | 12674-11-2/11096-82-5 | |
| Decachlorobiphenyl | 2051-24-3 | Surrogate |
| Tetrachloro-m-xylene (TCMX) | 877-09-8 | Surrogate |

## TABLE C-10. SW-846 METHODS 6010B, 7000A SERIES, 9010B, 9012A, AND 9056 (INORGANICS) TARGET ANALYTE LIST

| Inorganic Compound | CAS # | Comments |
|---|---|---|
| Aluminum | 7429-90-5 | 6010B/6020 |
| Antimony | 7440-36-0 | 6010B//6020/7041 |
| Arsenic | 7440-38-2 | 6010B/6020/7060A/7061A |
| Barium | 7440-39-3 | 6010B/6020 |
| Beryllium | 7440-41-7 | 6010B//6020/7090 |
| Cadmium | 7440-43-9 | 6010B/6020/7131A |
| Calcium | 7440-70-2 | 6010B |
| Chromium | 7440-47-3 | 6010B/6020 |
| Chromium, hexavalent | 18540-29-9 | 7195/7196A/7197/7198/7199 |
| Cobalt | 7440-48-4 | 6010B/6020 |
| Copper | 7440-50-8 | 6010B/6020 |
| Iron | 7439-89-6 | 6010B |
| Lead | 7439-92-1 | 6010B/6020/7421 |
| Magnesium | 7439-95-4 | 6010B |
| Manganese | 7439-96-5 | 6010B/6020 |
| Mercury | 7439-97-6 | 7470/7471/7472 |
| Molybdenum | 7439-98-7 | 6010B/7481 |
| Nickel | 7440-02-0 | 6010B/6020 |
| Potassium | 7440-09-7 | 6010B |
| Selenium | 7782-49-2 | 6010B/7240 |
| Silver | 7440-22-4 | 6010B/6020 |
| Sodium | 7440-23-5 | 6010B |
| Thallium | 7440-28-0 | 6010B/6020/7841 |
| Vanadium | 7440-62-2 | 6010B/7911 |
| Zinc | 7440-66-6 | 6010B/6020 |
| Cyanide | 57-12-5 | 9010B/9012A |
| Bromide | 24959-67-9 | |
| Chloride | 16887-00-6 | |
| Fluoride | 16984-48-8 | |
| Nitrate | 14797-55-8 | |
| Nitrite | 14979-65-0 | |
| Phosphate | 14265-44-2 | |
| Sulfate | 14808-79-8 | |

# D – LCS CONTROL LIMITS

DoD conducted a study to establish control limits for laboratory control samples using data collected from environmental laboratories that analyze samples for DoD. LCS recoveries for all the analytes on the target analyte lists were pooled, and statistical analyses (such as outlier tests and analysis of variance) were performed on the data before generating the final LCS control limits (LCS-CL). A complete description of the methodology and findings for method 8270C can be found in the Laboratory Control Sample Pilot Study (DoD, 2000).

Environmental testing laboratories that perform work for HAFB must utilize the Bhate-specified LCS control limits when assessing batch acceptance whenever they are available. This Section presents the control limits generated by the LCS study and the methodology for applying the limits to LCS data. All analytes spiked in the LCS shall meet the Bhate-generated LCS control limits. Bhate will allow a number of sporadic marginal exceedances. Depending on the length of the list of analytes, a specified small number of analytes may exceed the generated control limit. These are based on a probability of 0.9 that any given analyte will exceed its LCS-CL and a probability of 9 out of 100 that the total number of exceedances for a LCS is less than the allowable value. Upper and lower marginal exceedance (ME) limits, calculated at 4 standard deviations around the mean, are established to mark the boundaries of marginal exceedances. If more analytes exceed the LCS-CLs than is allowed, or if any one analyte exceeds the ME limits, then the LCS has failed. This marginal exceedance approach is relevant for methods with longer lists of analytes. It will not apply to some target analyte lists (fewer than 30 analytes).

**LCS Control Limits Policy**

- The laboratory shall use project-specific control limits based on data quality objectives (DQOs), if available. If not, DoD-generated LCS-CLs shall be used, if available. Otherwise, the lab's own in-house control limits shall be used.
- The LCS-CLs are based on the current promulgated versions of SW-846 methods at the time of the study (2000). They should be used as a benchmark to evaluate acceptability even as methods are updated or alternative methods for the same class of compounds become available.
- The fact that the LCS-CLs are based on certain SW-846 methods should not limit the use of alternative analytical methods, as appropriate. If an alternative method is used, however, it should be capable of producing LCS recoveries that are at least as good as the DoD-generated LCS-CLs, unless project-specific DQOs allow less stringent criteria.
- The LCS study shows that preparatory methods may have a significant influence on a laboratory's ability to achieve certain LCS-CLs. If a laboratory is unable to achieve the LCS-CLs presented in this Section, it should investigate the use of alternative preparatory methods as a means to improve precision and accuracy.

## D.1 Generated LCS Control Limits

As mentioned above, DoD compiled LCS data from multiple laboratories, performing statistical analyses on the data sets before generating control limits. The control limits were set at 3 standard deviations around the mean for all methods except 8151A (see below for further explanation). The ME limits were set at 4 standard deviations around the mean. The lower ME limit was then raised to 10% for those analytes in which 4 standard deviations falls below that level. Tables D-4 through D-7 and D-10 through D-19 at the end of this Section present the mean, standard deviation, lower control limit, and upper control limit for each analyte in methods 8260B, 8270C, 8310, 8330, 8081A, 8082, 6010, and 7470A/7471A, for the water and solid matrices. The lower and upper ME limits are presented for methods 8260B and 8270C as well, since those are the two methods with greater than 30 analytes and therefore capable of utilizing the sporadic marginal exceedance allowance. The analytes for method 8270C are grouped by compound class.

The control limits for explosives method 8330 in the water matrix were generated using data that were based on solid phase extraction (SPE) with acetonitrile elution (method 3535A) only. Analysis of the data received from the LCS study showed that the SPE method produced recoveries with higher means and lower standard deviations than the salting out extraction method. This results in significantly narrower control limits. Since SPE produces higher recoveries and is less expensive, cumbersome and time and labor intensive, the LCS control limits for method 8330 in water were set with data using only that method. A limited amount of data were received that used SPE/acetonitrile, therefore, no outliers were removed during the statistical analysis. This ensures a representative data set was used to generate the control limits (see Table D-12). Note: Laboratories may use any extraction method they feel is appropriate; however, the LCS recoveries must fall within the LCS-CLS presented in Table D-12.

Control limits for phenoxyacid herbicides method 8151A were generated using a non-parametric statistical approach. This is a different approach than for the other methods in the LCS study due to the large amount of intralaboratory variability in recoveries for all analytes in the method. The control limits for method 8151A, both solid and water matrices, were set at the 5$^{th}$ and 95$^{th}$ percentile of all data received in the study (no outliers were removed). Tables D-8 and D-9 present the median, lower control limit, and upper control limit for each analyte. LCS failure is assessed and corrective action applied the same way for all methods with control limits in this Section (see Sections D.3 and D.4).

[Note: These data represent the current capability of the SW-846 analytical and preparatory methods. Use of alternative preparatory procedures and/or improvements through PBMS are encouraged. Project-specific control limits can supersede these DoD limits.] If limits are not available for a project-specific analyte, the laboratory shall discuss with the client appropriate limits considering the project-specific DQOs.

## D.2 Marginal Exceedance

Bhate will allow a statistically based number of sporadic marginal exceedances of the LCS-CLs. The number of exceedances is based on the total number of analytes spiked in the LCS. As the number of analytes in the LCS increases, more marginal exceedances are allowed. The number of allowable marginal exceedances is based on a probability of 0.9 that any given analyte will exceed its LCS-CL and a probability of 9 out of 100 that the total number of exceedances for a LCS is outside the allowable value. Table D-1 presents the allowable number of marginal exceedances for a given number of analytes in the LCS.

**TABLE D-1. NUMBER OF MARGINAL EXCEEDANCES**

| Number of Analytes in LCS | Allowable Number of Marginal Exceedances of LCS-CLs |
|---|---|
| 74 – 70 | 5 |
| 69 – 60 | 4 |
| 59 – 51 | 3 |
| 50 – 40 | 2 |
| 39 – 30 | 1 |
| < 30 | 0 |

A *marginal* exceedance is defined as beyond the LCS-CL but still within the marginal exceedance limits (set at 4 standard deviations around the mean, see Tables D-4 through D-7 for method 8260B and 8270C). This outside boundary prevents a grossly out-of-control LCS from passing.

Bhate requires that the marginal exceedances be sporadic (i.e., random). If the same analyte exceeds the LCS-CL repeatedly, that is an indication that the problem is systemic and something is wrong with the measurement system. The source of error should be located and the appropriate corrective action taken. Laboratories must monitor through QA channels the application of the sporadic marginal exceedance allowance to the LCS results to ensure random behavior. The allowance for marginal exceedances is a new policy being introduced DoD-wide. Its effective implementation requires cooperation from the laboratory. If the laboratory fails to implement the policy properly, the privilege of using the marginal exceedance option will be revoked. Oversight and appropriate corrective action will be a focus of DoD laboratory audits in the future.

## D.3 LCS Failure

Each LCS must be evaluated against DoD's control limits and ME limits before being accepted (see Tables D-4 through D-19). First, the recoveries for the analytes spiked in the LCS should be compared to the LCS control limits. If a recovery is less than the lower control limit or greater than the upper control limit, that is an exceedance. The laboratory should note which analytes exceeded the control limits and make a comparison to the list of project-specific analytes of concern. **If a project-specific analyte of concern exceeds its LCS-CL, the LCS has failed.** Next, the laboratory should add up the total number of exceedances for the LCS. Based on the number of analytes spiked in the LCS, the total number of exceedances should be compared with the allowable number from Table D-1. **If a LCS has more than the allowable number of marginal exceedances, the LCS has failed.** Finally, the recoveries for those analytes that exceeded the LCS-CL should be compared to the ME limits from Tables D-4 through D-7. **If a single analyte exceeds its marginal exceedance limit, the LCS has failed.** (This applies only to methods 8260B and 8270C because of the large size of the analyte lists.)

Note: The target analytes from Section C should not be considered project-specific analytes of concern unless the client separately specifies the analytes. A requirement to analyze all compounds on the target analyte list does not define a project-specific analyte.

In summary, failure of the LCS can occur several ways:

- Exceedance of a LCS-CL by any project-specific analyte of concern
- Marginal exceedance of the LCS-CLs by more than the allowable number of analytes
- Exceedance of the ME limits by one or more analytes

Once a LCS has failed, corrective action is required (see section D.4).

## D.4 Corrective Action

If a sample fails based on any of the criteria in section D.3, corrective action is required. The corrective action requirement applies to all analytes that exceeded the LCS-CLs, even if one specific analyte's exceedance was not the trigger of LCS failure (see example in text box). **All exceedances of the LCS-CLs, marginal or otherwise, are subject to corrective action.**

If a LCS fails, an attempt must be made to determine the source of error and find a solution. All the findings and corrective action should be documented. Bhate then requires that the analytes subject to corrective action in the LCS and all the samples in the batch be reprepped and reanalyzed or the batch rerun with a new LCS. The corrective action applied shall be based on professional judgment in the review of other QC measures (i.e., surrogates). If an analyte falls outside the LCS-CL a second time or if there is not sufficient sample material available to be reanalyzed, then all the results in the associated batch for that analyte must be flagged with a "Q" (see DoD clarification box D-19). The recoveries of those analytes subject to corrective action must be documented in the case narrative, whether flagging is needed or not.

**Example of Applying Corrective Action**

- In a single LCS, anthracene has a recovery of 30%.
- The lower ME limit for anthracene is 44, therefore the LCS has failed.
- In the same LCS three other analytes exceeded their LCS-CLs but were within their ME limits.
- The LCS was spiked with 74 analytes; therefore, according to Table D-1, five marginal exceedances are allowed.
- The four total exceedances (anthracene plus the three other analytes) are within the allowable number for that analyte list size.

*Corrective action is triggered for the LCS because the anthracene recovery exceeded its ME limit, but it is required for all four analytes that exceeded the LCS-CLs.*

## D.5 Poor Performing Analytes

On the basis of results from the LCS study, DoD identified certain compounds that do not perform well with specific methods. These compounds produce low mean recoveries and high standard deviations, resulting in wide LCS control limits with particularly low lower control limits (sometimes negative values). The performance of these compounds reflects routine implementation of the method in many laboratories. DoD has defined a poor performing analyte as having a lower control limit of 10% or less. Bhate does not feel it is appropriate to control batch acceptance on these compounds because there is a high level of uncertainty in their recovery. The data may be used; however, routine performance of the method on these compounds can result in being able to identify only a small percentage of the analyte.

The laboratory should include all target analytes in the calibration standard, including the poor performing analytes. If one of the poor performing analytes identified below is a project-specific analyte of concern *or* if it is detected in the project samples, the laboratory should contact the client (Bhate), who will then work with the laboratory on an appropriate course of action. Ideally Bhate and the laboratory would use an alternative method to test for the analyte (one that is known to produce higher recoveries) or else modify the original method to optimize conditions for the poor performing analyte.

Poor performing analytes were only identified in SW-846 methods 8270C, 8151A, and 8330. These analytes, along with the mean, standard deviation, lower control limit, upper control limit, lower ME limit, and upper ME limit (as generated by the LCS study) are presented in Table D-2. [Note: Lower limits calculated as negative values were raised to zero.]

**TABLE D-2. POOR PERFORMING ANALYTES[10]**

| Analyte | Mean/ Median | Standard Deviation | Lower Control Limit | Upper Control Limit | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| **8270C Water:** | | | | | | |
| 4-Nitrophenol | 54 | 23 | 0 | 123 | 0 | 146 |
| Benzoic acid | 54 | 24 | 0 | 127 | 0 | 151 |
| Phenol | 55 | 19 | 0 | 116 | 0 | 136 |
| Phenol-d5/d6 (surrogate) | 62 | 18 | 9 | 117 | 0 | 135 |
| **8270C Solid:** | | | | | | |
| 3,3'Dichlorobenzidine | 68 | 19 | 10 | 128 | 0 | 147 |
| 4-Chloroaniline | 51 | 14 | 8 | 94 | 0 | 108 |
| Benzoic acid | 55 | 18 | 0 | 112 | 0 | 130 |
| **8151A Solid:** | | | | | | |
| Dinoseb | 72 | | 5 | 131 | | |
| **8330 Solid:** | | | | | | |
| Methyl-2,4,6-trinitrophenylnitramine (Tetryl) | 80 | 23 | 10 | 150 | | |

The LCS control limits generated by the study for the poor performing analytes are provided as a benchmark against which laboratories may measure the effectiveness of modifications to the current methods. Batch acceptance should not be calculated using these limits. Laboratories should attempt to raise the mean recoveries and lower the standard deviations. No recovery of less than 10% will be considered acceptable, however.

## D.6 Surrogates

The surrogate compounds for each method are added to all samples, standards, and blanks to assess the ability of the method to recover specific non-target analytes from a given matrix and to monitor sample-specific recovery. Control limits for these compounds were calculated in the same study as the other analytes on the target analyte lists. Below are the limits for some of the surrogates of methods 8260B, 8270C, 8081A, and 8082, based on 3 standard deviations around the mean (Table D-3). Control limits are not available for some

[10] Control limits for method 8151A were generated using non-parametric statistics; therefore, the median and no standard deviation is presented (see Section D.1 for further explanation). ME limits are not used for methods 8151A and 8330 since the target analyte lists have less than 30 analytes.

surrogates that appear on the target analyte lists in Section C. Sufficient data were not received for those analytes during the LCS study to perform statistically significant analyses. No ME limits are presented as marginal exceedances are not acceptable for surrogate spikes. Note: Bhate prefers the use of those surrogates not identified as poor performing analytes in Table D-2 above.

**TABLE D-3. SURROGATES**

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| **8260B Water:** | | | | |
| 1,2-Dichloroethane-d4 | 95 | 8 | 72 | 119 |
| 4-Bromofluorobenzene | 98 | 7 | 76 | 119 |
| Dibromofluoromethane | 100 | 5 | 85 | 115 |
| Toluene-d8 | 102 | 6 | 83 | 120 |
| **8260B Solid:** | | | | |
| 4-Bromofluorobenzene | 101 | 6 | 84 | 118 |
| Toluene-d8 | 100 | 5 | 84 | 116 |
| **8270C Water:** | | | | |
| 2-Fluorobiphenyl | 79 | 10 | 48 | 112 |
| Terphenyl-d14 | 92 | 14 | 51 | 135 |
| 2,4,6-Tribromophenol | 82 | 13 | 42 | 124 |
| 2-Fluorophenol | 63 | 14 | 19 | 108 |
| Nitrobenzene-d5 | 76 | 11 | 41 | 111 |
| **8270C Solid:** | | | | |
| 2-Fluorobiphenyl | 72 | 10 | 43 | 103 |
| Terphenyl-d14 | 78 | 15 | 32 | 125 |
| 2,4,6-Tribromophenol | 80 | 15 | 36 | 126 |
| 2-Fluorophenol | 70 | 11 | 37 | 104 |
| Phenol-d5/d6 | 71 | 10 | 40 | 102 |
| Nitrobenzene-d5 | 69 | 10 | 37 | 102 |
| **8081A Water:** | | | | |
| Decachlorobiphenyl | 83 | 17 | 32 | 135 |
| TCMX | 81 | 19 | 25 | 138 |
| **8081A Solid:** | | | | |
| Decachlorobiphenyl | 94 | 13 | 56 | 132 |
| TCMX | 97 | 9 | 69 | 124 |
| **8082 Water:** | | | | |
| Decachlorobiphenyl | 88 | 15 | 42 | 133 |
| **8082 Solid:** | | | | |
| Decachlorobiphenyl | 91 | 11 | 58 | 125 |

## D.7 In-House LCS Limits

SW-846 methods recommend that laboratories calculate LCS limits on a semiannual basis using at least 15 to 20 data points. The existence of DoD-wide LCS control limits should not eliminate the practice of laboratories' generating independent in-house LCS limits based on statistical analysis of historical LCS results. Laboratories must continue to generate in-house LCS limits annually for all analytes. These limits shall be compared to the DoD LCS control limits, where available, and to the laboratory's in-house limits from the previous year. The in-house limits shall be used as a quality control measure to evaluate change in the laboratory's performance over time. The acceptability of LCS results within any preparatory batch shall no longer be based on the in-house limits, unless DoD has not published LCS-CLs for a particular analyte.

In addition, Bhate strongly recommends that the laboratory track trends in the LCS data over time through the use of control charts. This QA measure can identify potential problems within the measurement system before they result in method failure. The control charts should be reviewed by the quality assurance officer or designee on a regular basis and corrective action implemented when necessary.

## TABLE D-4. LCS CONTROL LIMITS FOR SW-846 METHOD 8260B WATER MATRIX[11]

| Analyte | Mean | Standard Deviation | Lower Control Limit[12] | Upper Control Limit[12] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | 105 | 8 | 81 | 129 | 73 | 137 |
| 1,1,1-Trichloroethane | 100 | 11 | 67 | 132 | 56 | 143 |
| 1,1,2,2-Tetrachloroethane | 96 | 11 | 63 | 128 | 53 | 138 |
| 1,1,2-Trichloroethane | 100 | 8 | 75 | 125 | 66 | 133 |
| 1,1-Dichloroethane | 101 | 11 | 69 | 133 | 58 | 143 |
| 1,1-Dichloroethene | 99 | 10 | 68 | 130 | 57 | 140 |
| 1,1-Dichloropropene | 102 | 10 | 73 | 132 | 63 | 142 |
| 1,2,3-Trichlorobenzene | 99 | 14 | 57 | 142 | 43 | 156 |
| 1,2,3-Trichloropropane | 98 | 9 | 73 | 124 | 64 | 132 |
| 1,2,4-Trichlorobenzene | 100 | 11 | 66 | 134 | 54 | 145 |
| 1,2,4-Trimethylbenzene | 103 | 10 | 74 | 132 | 64 | 142 |
| 1,2-Dibromo-3-chloropropane | 91 | 14 | 50 | 132 | 37 | 146 |
| 1,2-Dibromoethane | 100 | 7 | 80 | 121 | 73 | 127 |
| 1,2-Dichlorobenzene | 96 | 9 | 71 | 122 | 62 | 131 |
| 1,2-Dichloroethane | 100 | 10 | 69 | 132 | 58 | 142 |
| 1,2-Dichloropropane | 100 | 8 | 75 | 125 | 67 | 134 |
| 1,3,5-Trimethylbenzene | 102 | 10 | 74 | 131 | 64 | 140 |
| 1,3-Dichlorobenzene | 100 | 8 | 75 | 124 | 67 | 132 |
| 1,3-Dichloropropane | 100 | 9 | 73 | 126 | 64 | 135 |
| 1,4-Dichlorobenzene | 99 | 8 | 74 | 123 | 66 | 131 |
| 2,2-Dichloropropane | 103 | 11 | 69 | 137 | 58 | 148 |
| 2-Butanone | 91 | 20 | 32 | 150 | 12 | 170 |
| 2-Chlorotoluene | 100 | 9 | 73 | 126 | 64 | 135 |
| 2-Hexanone | 92 | 12 | 56 | 128 | 44 | 140 |
| 4-Chlorotoluene | 101 | 9 | 74 | 128 | 65 | 137 |
| 4-Methyl-2-pentanone | 96 | 13 | 58 | 134 | 45 | 147 |
| Acetone | 91 | 17 | 39 | 142 | 22 | 159 |
| Benzene | 102 | 7 | 81 | 122 | 74 | 129 |
| Bromobenzene | 100 | 8 | 76 | 124 | 69 | 131 |
| Bromochloromethane | 97 | 11 | 65 | 129 | 55 | 140 |
| Bromodichloromethane | 98 | 8 | 76 | 121 | 68 | 128 |
| Bromoform | 99 | 10 | 69 | 128 | 59 | 138 |
| Bromomethane | 88 | 19 | 30 | 146 | 10 | 166 |
| Carbon disulfide | 100 | 21 | 37 | 162 | 17 | 183 |
| Carbon tetrachloride | 102 | 12 | 66 | 138 | 54 | 150 |
| Chlorobenzene | 102 | 7 | 81 | 122 | 74 | 129 |
| Chlorodibromomethane | 96 | 13 | 58 | 133 | 46 | 146 |
| Chloroethane | 99 | 12 | 62 | 135 | 50 | 147 |
| Chloroform | 100 | 12 | 63 | 136 | 51 | 149 |

## TABLE D-4. LCS CONTROL LIMITS FOR SW-846 METHOD 8260B WATER MATRIX (Continued)

| Analyte | Mean | Standard Deviation | Lower Control Limit[12] | Upper Control Limit[12] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| Chloromethane | 83 | 15 | 39 | 127 | 25 | 142 |
| cis-1,2-Dichloroethene | 99 | 9 | 72 | 126 | 62 | 135 |
| cis-1,3-Dichloropropene | 100 | 10 | 69 | 131 | 59 | 142 |
| Dibromomethane | 101 | 8 | 76 | 125 | 67 | 134 |
| Dichlorodifluoromethane | 93 | 21 | 31 | 155 | 11 | 175 |

[11] LCS control limits are not available for Total Xylene because although Xylene may be reported on a project-specific basis as a total number. For the purposes of the Bhate QAPP, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section D.5 and for surrogate compounds in section D.6.
[12] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.

| | | | | | | |
|---|---|---|---|---|---|---|
| Ethylbenzene | 100 | 9 | 73 | 127 | 64 | 137 |
| Hexachlorobutadiene | 97 | 15 | 51 | 142 | 36 | 158 |
| Isopropylbenzene | 101 | 9 | 75 | 127 | 66 | 136 |
| m,p-Xylene | 102 | 9 | 76 | 128 | 67 | 137 |
| Methyl tert-butyl ether | 94 | 10 | 65 | 123 | 55 | 133 |
| Methylene chloride | 96 | 14 | 53 | 140 | 39 | 154 |
| Naphthalene | 96 | 14 | 54 | 138 | 40 | 152 |
| n-Butylbenzene | 103 | 11 | 69 | 137 | 57 | 148 |
| n-Propylbenzene | 101 | 9 | 72 | 129 | 63 | 138 |
| o-Xylene | 100 | 7 | 80 | 121 | 73 | 128 |
| p-Isopropyltoluene | 102 | 10 | 73 | 131 | 63 | 141 |
| sec-Butylbenzene | 100 | 9 | 72 | 127 | 63 | 137 |
| Styrene | 100 | 11 | 65 | 134 | 54 | 146 |
| tert-Butylbenzene | 99 | 10 | 70 | 129 | 60 | 139 |
| Tetrachloroethene | 96 | 18 | 44 | 149 | 26 | 167 |
| Toluene | 100 | 7 | 77 | 122 | 70 | 130 |
| trans-1,2-Dichloroethene | 99 | 13 | 60 | 139 | 46 | 152 |
| trans-1,3-Dichloropropene | 98 | 15 | 53 | 142 | 39 | 157 |
| Trichloroethene | 99 | 9 | 70 | 127 | 61 | 136 |
| Trichlorofluoromethane | 103 | 15 | 59 | 146 | 44 | 161 |
| Vinyl chloride | 99 | 16 | 50 | 147 | 34 | 163 |

**TABLE D-5. LCS CONTROL LIMITS FOR SW-846 METHOD 8260B SOLID MATRIX[13]**

| Analyte | Mean | Standard Deviation | Lower Control Limit[14] | Upper Control Limit[14] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | 100 | 9 | 74 | 125 | 65 | 134 |
| 1,1,1-Trichloroethane | 101 | 11 | 68 | 133 | 57 | 144 |
| 1,1,2,2-Tetrachloroethane | 93 | 13 | 54 | 131 | 41 | 144 |
| 1,1,2-Trichloroethane | 95 | 11 | 62 | 127 | 51 | 138 |
| 1,1-Dichloroethane | 99 | 9 | 73 | 125 | 64 | 134 |
| 1,1-Dichloroethene | 100 | 12 | 65 | 136 | 53 | 148 |
| 1,1-Dichloropropene | 102 | 11 | 70 | 135 | 59 | 145 |
| 1,2,3-Trichlorobenzene | 97 | 12 | 62 | 133 | 51 | 144 |
| 1,2,3-Trichloropropane | 97 | 11 | 63 | 130 | 52 | 141 |
| 1,2,4-Trichlorobenzene | 98 | 11 | 65 | 131 | 54 | 142 |
| 1,2,4-Trimethylbenzene | 100 | 12 | 65 | 135 | 53 | 147 |
| 1,2-Dibromo-3-chloropropane | 87 | 16 | 40 | 135 | 25 | 150 |

**TABLE D-5. LCS CONTROL LIMITS FOR SW-846 METHOD 8260B SOLID MATRIX (Continued)**

| Analyte | Mean | Standard Deviation | Lower Control Limit[14] | Upper Control Limit[14] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| 1,2-Dibromoethane | 97 | 9 | 70 | 124 | 61 | 133 |
| 1,2-Dichlorobenzene | 97 | 7 | 74 | 119 | 67 | 126 |
| 1,2-Dichloroethane | 104 | 11 | 72 | 137 | 61 | 147 |
| 1,2-Dichloropropane | 95 | 8 | 71 | 119 | 63 | 127 |
| 1,3,5-Trimethylbenzene | 99 | 11 | 65 | 133 | 54 | 144 |
| 1,3-Dichlorobenzene | 98 | 9 | 72 | 124 | 63 | 133 |
| 1,3-Dichloropropane | 100 | 8 | 76 | 123 | 68 | 131 |
| 1,4-Dichlorobenzene | 98 | 9 | 72 | 125 | 63 | 134 |
| 2,2-Dichloropropane | 101 | 11 | 67 | 134 | 55 | 146 |
| 2-Butanone | 94 | 22 | 29 | 159 | 10 | 180 |

[13] LCS control limits are not available for Methyl tert-butyl ether and Total Xylene although those compounds do appear on the target analyte list for method 8260B (Table C-1 in Section C). Sufficient data to perform statistically significant analyses were not received for MTBE during the LCS study. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the Bhate QAPP, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section D.5 and for surrogate compounds in sectionD.6.

[14] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.

| | | | | | | |
|---|---|---|---|---|---|---|
| 2-Chlorotoluene | 98 | 10 | 69 | 128 | 59 | 138 |
| 2-Hexanone | 97 | 16 | 47 | 146 | 31 | 162 |
| 4-Chlorotoluene | 100 | 9 | 73 | 126 | 65 | 135 |
| 4-Methyl-2-pentanone | 97 | 17 | 47 | 147 | 31 | 164 |
| Acetone | 88 | 23 | 19 | 158 | 10 | 181 |
| Benzene | 99 | 9 | 73 | 126 | 64 | 134 |
| Bromobenzene[15] | 93 | 9 | 66 | 121 | 56 | 130 |
| Bromochloromethane | 99 | 9 | 71 | 127 | 62 | 137 |
| Bromodichloromethane | 100 | 9 | 72 | 128 | 62 | 137 |
| Bromoform | 96 | 13 | 56 | 137 | 43 | 150 |
| Bromomethane | 95 | 21 | 31 | 159 | 10 | 180 |
| Carbon disulfide | 103 | 19 | 47 | 159 | 28 | 178 |
| Carbon tetrachloride | 100 | 11 | 67 | 133 | 56 | 144 |
| Chlorobenzene | 99 | 8 | 75 | 123 | 67 | 131 |
| Chlorodibromomethane | 98 | 11 | 66 | 130 | 56 | 140 |
| Chloroethane | 98 | 20 | 39 | 157 | 20 | 177 |
| Chloroform | 98 | 9 | 72 | 124 | 63 | 133 |
| Chloromethane | 90 | 13 | 51 | 129 | 38 | 142 |
| cis-1,2-Dichloroethene | 96 | 10 | 67 | 125 | 57 | 135 |
| cis-1,3-Dichloropropene | 99 | 9 | 72 | 126 | 63 | 135 |
| Dibromomethane | 100 | 9 | 73 | 128 | 63 | 137 |
| Dichlorodifluoromethane[15] | 85 | 17 | 34 | 136 | 17 | 153 |
| Ethylbenzene | 101 | 9 | 74 | 127 | 65 | 136 |
| Hexachlorobutadiene | 98 | 15 | 53 | 142 | 38 | 157 |
| Isopropylbenzene | 103 | 9 | 77 | 129 | 68 | 138 |
| m,p-Xylene | 102 | 8 | 79 | 126 | 71 | 134 |
| Methylene chloride | 97 | 14 | 54 | 141 | 40 | 155 |
| Naphthalene | 84 | 14 | 40 | 127 | 26 | 141 |
| n-Butylbenzene | 101 | 12 | 65 | 138 | 52 | 150 |
| n-Propylbenzene | 99 | 12 | 63 | 135 | 51 | 147 |
| o-Xylene | 101 | 8 | 77 | 125 | 69 | 133 |
| p-Isopropyltoluene | 104 | 10 | 75 | 133 | 65 | 142 |
| sec-Butylbenzene | 97 | 11 | 63 | 132 | 51 | 143 |
| Styrene | 101 | 9 | 74 | 128 | 65 | 137 |
| tert-Butylbenzene | 99 | 11 | 65 | 132 | 54 | 143 |
| Tetrachloroethene | 103 | 12 | 67 | 139 | 55 | 150 |
| Toluene | 99 | 9 | 71 | 127 | 62 | 136 |
| trans-1,2-Dichloroethene | 100 | 11 | 66 | 134 | 55 | 145 |
| trans-1,3-Dichloropropene | 96 | 10 | 65 | 127 | 54 | 138 |

**TABLE D-5. LCS CONTROL LIMITS FOR SW-846 METHOD 8260B SOLID MATRIX (Continued)**

| Analyte | Mean | Standard Deviation | Lower Control Limit[14] | Upper Control Limit[14] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| Trichloroethene | 101 | 8 | 77 | 124 | 69 | 132 |
| Trichlorofluoromethane | 106 | 27 | 25 | 186 | 10 | 213 |
| Vinyl chloride | 92 | 11 | 58 | 126 | 46 | 138 |

**TABLE D-6. LCS CONTROL LIMITS FOR SW-846 METHOD 8270C WATER MATRIX[16]**

[15] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from less than four laboratories. Limits may be adjusted in the future as additional data becomes available.

[16] LCS control limits are not available for Benzidine, 2,6-Dichlorophenol, and N-nitrosopyrrolidine, although those compounds do appear on the target analyte list for method 8270C (Table C-2 in Section C). Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section D.5.

| Analyte | Mean | Standard Deviation | Lower Control Limit[17] | Upper Control Limit[17] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| **Polynuclear Aromatics** | | | | | | |
| 2-Methylnaphthalene | 75.0 | 9.5 | 46 | 104 | 37 | 113 |
| Acenaphthene | 77.6 | 10.1 | 47 | 108 | 37 | 118 |
| Acenaphthylene | 78.5 | 9.4 | 50 | 107 | 41 | 116 |
| Anthracene | 83.0 | 9.7 | 54 | 112 | 44 | 122 |
| Benz(a)anthracene | 82.7 | 8.9 | 56 | 109 | 47 | 118 |
| Benzo(a)pyrene | 81.3 | 9.5 | 53 | 110 | 43 | 119 |
| Benzo(b)fluoranthene | 81.8 | 12.1 | 45 | 118 | 33 | 130 |
| Benzo(g,h,i)perylene | 80.5 | 14.1 | 38 | 123 | 24 | 137 |
| Benzo(k)fluoranthene | 84.6 | 13.2 | 45 | 124 | 32 | 137 |
| Chrysene | 82.1 | 8.9 | 55 | 109 | 46 | 118 |
| Dibenz(a,h)anthracene | 84.7 | 14.1 | 42 | 127 | 28 | 141 |
| Fluoranthene | 85.2 | 10.4 | 54 | 116 | 44 | 127 |
| Fluorene | 80.6 | 10.3 | 50 | 112 | 39 | 122 |
| Indeno(1,2,3-cd)pyrene | 84.3 | 13.6 | 43 | 125 | 30 | 139 |
| Naphthalene | 70.8 | 10.5 | 39 | 102 | 29 | 113 |
| Phenanthrene | 84.0 | 11.0 | 51 | 117 | 40 | 128 |
| Pyrene | 88.6 | 13.2 | 49 | 128 | 36 | 142 |
| **Phenolic/Acidic** | | | | | | |
| 2,4,5-Trichlorophenol | 79.7 | 10.3 | 49 | 111 | 38 | 121 |
| 2,4,6-Trichlorophenol | 80.7 | 10.7 | 49 | 113 | 38 | 123 |
| 2,4-Dichlorophenol | 76.3 | 9.6 | 48 | 105 | 38 | 115 |
| 2,4-Dimethylphenol | 68.8 | 13.5 | 28 | 109 | 15 | 123 |
| 2,4-Dinitrophenol | 75.8 | 20.6 | 14 | 138 | 10 | 158 |
| 2-Chlorophenol | 71.3 | 11.4 | 37 | 106 | 26 | 117 |
| 2-Methylphenol | 73.3 | 11.7 | 38 | 109 | 26 | 120 |
| 2-Nitrophenol | 75.8 | 12.4 | 39 | 113 | 26 | 125 |
| 3-Methylphenol/4-Methylphenol | 71.3 | 13.0 | 32 | 110 | 19 | 123 |
| 4,6-Dinitro-2-methylphenol | 84.9 | 15.0 | 40 | 130 | 25 | 145 |

**TABLE D-6. LCS CONTROL LIMITS FOR SW-846 METHOD 8270C WATER MATRIX (Continued)**

| Analyte | Mean | Standard Deviation | Lower Control Limit[18] | Upper Control Limit[18] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| 4-Chloro-3-methylphenol | 78.6 | 10.7 | 47 | 111 | 36 | 121 |
| Pentachlorophenol | 77.6 | 13.3 | 38 | 117 | 24 | 131 |
| **Basic** | | | | | | |
| 3,3'-Dichlorobenzidine | 65.2 | 15.3 | 19 | 111 | 10 | 126 |
| 4-Chloroaniline | 62.2 | 15.6 | 15 | 109 | 10 | 125 |
| **Phthalate Esters** | | | | | | |
| Bis(2-ethylhexyl) phthalate | 84.2 | 14.0 | 42 | 126 | 28 | 140 |
| Butyl benzyl phthalate | 81.1 | 11.7 | 46 | 116 | 34 | 128 |
| Di-n-butyl phthalate | 84.8 | 10.3 | 54 | 116 | 44 | 126 |
| Di-n-octyl phthalate | 87.4 | 16.6 | 37 | 137 | 21 | 154 |

[17] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.
[18] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.

| | | | | | | |
|---|---|---|---|---|---|---|
| Diethyl phthalate | 79.2 | 12.9 | 41 | 118 | 28 | 131 |
| Dimethyl phthalate | 75.9 | 16.9 | 25 | 127 | 10 | 144 |
| **Nitrosoamines** | | | | | | |
| N-Nitrosodi-n-propylamine | 80.9 | 15.7 | 34 | 128 | 18 | 144 |
| N-Nitrosodimethylamine | 67.9 | 14.1 | 26 | 110 | 11 | 124 |
| N-Nitrosodiphenylamine | 79.6 | 10.6 | 48 | 111 | 37 | 122 |
| **Chlorinated Aliphatics** | | | | | | |
| Bis(2-chlorethoxy)methane | 76.2 | 10.2 | 46 | 107 | 35 | 117 |
| Bis(2-chloroethyl) ether | 73.3 | 12.3 | 37 | 110 | 24 | 122 |
| Bis(2-chloroisopropyl) ether | 78.2 | 17.5 | 26 | 131 | 10 | 148 |
| Hexachlorobutadiene | 65.2 | 12.6 | 27 | 103 | 15 | 116 |
| Hexachloroethane | 60.9 | 11.1 | 28 | 94 | 16 | 105 |
| **Halogenated Aromatics** | | | | | | |
| 1,2,4-Trichlorobenzene | 71.7 | 11.6 | 37 | 107 | 25 | 118 |
| 1,2-Dichlorobenzene | 67.3 | 11.4 | 33 | 102 | 22 | 113 |
| 1,3-Dichlorobenzene | 64.8 | 10.9 | 32 | 98 | 21 | 108 |
| 1,4-Dichlorobenzene | 64.8 | 10.9 | 32 | 98 | 21 | 109 |
| 2-Chloronaphthalene | 76.5 | 9.3 | 49 | 104 | 39 | 114 |
| 4-Bromophenyl phenyl ether | 82.9 | 10.2 | 52 | 113 | 42 | 124 |
| 4-Chlorophenyl phenyl ether | 80.6 | 10.3 | 50 | 111 | 39 | 122 |
| Hexachlorobenzene | 82.3 | 10.0 | 52 | 112 | 42 | 122 |
| **Nitroaromatics** | | | | | | |
| 2,4-Dinitrotoluene | 84.3 | 11.2 | 51 | 118 | 39 | 129 |
| 2,6-Dinitrotoluene | 82.7 | 11.3 | 49 | 117 | 37 | 128 |
| 2-Nitroaniline | 81.8 | 11.2 | 48 | 115 | 37 | 126 |
| 3-Nitroaniline | 72.6 | 17.7 | 19 | 126 | 10 | 143 |
| 4-Nitroaniline | 77.2 | 13.7 | 36 | 118 | 22 | 132 |
| Nitrobenzene | 76.8 | 10.8 | 44 | 109 | 34 | 120 |
| **Neutral Aromatics** | | | | | | |
| Carbazole | 82.5 | 11.4 | 48 | 117 | 37 | 128 |
| Dibenzofuran | 80.3 | 8.8 | 54 | 107 | 45 | 115 |

**TABLE D-6. LCS CONTROL LIMITS FOR SW-846 METHOD 8270C WATER MATRIX (Continued)**

| Analyte | Mean | Standard Deviation | Lower Control Limit[19] | Upper Control Limit[19] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| **Others** | | | | | | |
| 1,2-Diphenylhydrazine | 84.8 | 9.4 | 57 | 113 | 47 | 122 |
| Benzyl alcohol | 71.0 | 13.8 | 30 | 112 | 16 | 126 |
| Isophorone | 81.0 | 10.5 | 50 | 112 | 39 | 123 |

**TABLE D-7. LCS CONTROL LIMITS FOR SW-846 METHOD 8270C SOLID MATRIX[20]**

[19] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.
[20] LCS control limits are not available for Benzidine, 2,6-Dichlorophenol, 1,2-Diphenylhydrazine, and N-nitrosopyrrolidine, although those compounds do appear on the target analyte list for method 8270C (Table C-2 in Section C). Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section D.5.

| Analyte | Mean | Standard Deviation | Lower Control Limit[21] | Upper Control Limit[21] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| **Polynuclear Aromatics** | | | | | | |
| 2-Methylnaphthalene | 77.3 | 10.0 | 47 | 107 | 37 | 117 |
| Acenaphthene | 77.3 | 10.3 | 46 | 108 | 36 | 119 |
| Acenaphthylene | 75.7 | 10.4 | 44 | 107 | 34 | 117 |
| Anthracene | 79.9 | 9.0 | 53 | 107 | 44 | 116 |
| Benz(a)anthracene | 81.6 | 9.8 | 52 | 111 | 42 | 121 |
| Benzo(a)pyrene | 80.7 | 10.3 | 50 | 111 | 40 | 122 |
| Benzo(b)fluoranthene | 79.7 | 11.4 | 45 | 114 | 34 | 125 |
| Benzo(g,h,i)perylene | 81.8 | 14.7 | 38 | 126 | 23 | 140 |
| Benzo(k)fluoranthene | 83.8 | 12.9 | 45 | 123 | 32 | 136 |
| Chrysene | 82.6 | 9.9 | 53 | 112 | 43 | 122 |
| Dibenz(a,h)anthracene | 82.9 | 13.9 | 41 | 125 | 27 | 139 |
| Fluoranthene | 83.9 | 10.1 | 54 | 114 | 44 | 124 |
| Fluorene | 78.3 | 9.8 | 49 | 108 | 39 | 117 |
| Indeno(1,2,3-cd)pyrene | 79.7 | 13.8 | 38 | 121 | 25 | 135 |
| Naphthalene | 73.4 | 11.1 | 40 | 107 | 29 | 118 |
| Phenanthrene | 80.1 | 10.0 | 50 | 110 | 40 | 120 |
| Pyrene | 84.4 | 12.8 | 46 | 123 | 33 | 136 |
| **Phenolic/Acidic** | | | | | | |
| 2,4,5-Trichlorophenol | 80.1 | 10.4 | 49 | 111 | 38 | 122 |
| 2,4,6-Trichlorophenol | 76.3 | 11.0 | 43 | 109 | 32 | 120 |
| 2,4-Dichlorophenol | 77.2 | 10.9 | 45 | 110 | 34 | 121 |
| 2,4-Dimethylphenol | 67.3 | 11.9 | 32 | 103 | 20 | 115 |
| 2,4-Dinitrophenol | 72.6 | 20.0 | 13 | 132 | 10 | 152 |
| 2-Chlorophenol | 74.7 | 10.3 | 44 | 106 | 34 | 116 |
| 2-Methylphenol | 71.7 | 10.6 | 40 | 104 | 29 | 114 |
| 2-Nitrophenol | 76.2 | 11.5 | 42 | 111 | 30 | 122 |

**TABLE D-7. LCS CONTROL LIMITS FOR SW-846 METHOD 8270C SOLID MATRIX (Continued)**

| Analyte | Mean | Standard Deviation | Lower Control Limit[22] | Upper Control Limit[22] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| 3-Methylphenol/4-Methylphenol | 73.9 | 10.9 | 41 | 107 | 30 | 118 |
| 4,6-Dinitro-2-methylphenol | 83.1 | 18.0 | 29 | 137 | 11 | 155 |
| 4-Chloro-3-methylphenol | 79.5 | 11.1 | 46 | 113 | 35 | 124 |
| 4-Nitrophenol | 77.0 | 20.2 | 17 | 138 | 10 | 158 |
| Pentachlorophenol | 71.9 | 15.6 | 25 | 119 | 10 | 134 |
| Phenol | 69.7 | 10.2 | 39 | 100 | 29 | 110 |
| **Phthalate Esters** | | | | | | |
| Bis(2-ethylhexyl) phthalate | 87.4 | 13.3 | 47 | 127 | 34 | 141 |
| Butyl benzyl phthalate | 86.4 | 12.3 | 49 | 123 | 37 | 136 |
| Di-n-butyl phthalate | 83.2 | 9.1 | 56 | 110 | 47 | 120 |
| Di-n-octyl phthalate | 86.4 | 15.2 | 41 | 132 | 26 | 147 |
| Diethyl phthalate | 82.2 | 10.6 | 50 | 114 | 40 | 125 |
| Dimethyl phthalate | 79.6 | 10.2 | 49 | 110 | 39 | 120 |

[21] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.
[22] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Nitrosoamines** | | | | | | |
| N-Nitrosodi-n-propylamine | 76.8 | 12.3 | 40 | 114 | 28 | 126 |
| N-Nitrosodimethylamine | 66.1 | 15.9 | 18 | 114 | 10 | 129 |
| N-Nitrosodiphenylamine | 82.4 | 11.1 | 49 | 116 | 38 | 127 |
| **Chlorinated Aliphatics** | | | | | | |
| Bis(2-chlorethoxy)methane | 75.5 | 10.9 | 43 | 108 | 32 | 119 |
| Bis(2-chloroethyl) ether | 71.1 | 11.2 | 38 | 105 | 26 | 116 |
| Bis(2-chloroisopropyl) ether | 68.4 | 15.7 | 21 | 115 | 10 | 131 |
| Hexachlorobutadiene | 78.2 | 12.9 | 40 | 117 | 27 | 130 |
| Hexachloroethane | 71.9 | 12.6 | 34 | 110 | 22 | 122 |
| **Halogenated Aromatics** | | | | | | |
| 1,2,4-Trichlorobenzene | 77.4 | 11.2 | 44 | 111 | 32 | 122 |
| 1,2-Dichlorobenzene | 70.9 | 8.7 | 45 | 97 | 36 | 106 |
| 1,3-Dichlorobenzene | 69.7 | 10.3 | 39 | 100 | 29 | 111 |
| 1,4-Dichlorobenzene | 69.0 | 11.4 | 35 | 103 | 23 | 115 |
| 2-Chloronaphthalene | 75.2 | 9.9 | 45 | 105 | 35 | 115 |
| 4-Bromophenyl phenyl ether | 81.7 | 11.8 | 46 | 117 | 34 | 129 |
| 4-Chlorophenyl phenyl ether | 79.6 | 10.7 | 47 | 112 | 37 | 122 |
| Hexachlorobenzene | 82.5 | 11.7 | 47 | 118 | 36 | 129 |
| **Nitroaromatics** | | | | | | |
| 2,4-Dinitrotoluene | 82.0 | 11.4 | 48 | 116 | 36 | 128 |
| 2,6-Dinitrotoluene | 80.2 | 10.7 | 48 | 112 | 37 | 123 |
| 2-Nitroaniline | 81.0 | 12.2 | 44 | 118 | 32 | 130 |
| 3-Nitroaniline | 68.8 | 13.8 | 27 | 110 | 13 | 124 |
| 4-Nitroaniline | 73.6 | 13.1 | 34 | 113 | 21 | 126 |
| Nitrobenzene | 77.2 | 11.9 | 41 | 113 | 30 | 125 |
| **Neutral Aromatics** | | | | | | |
| Carbazole | 80.4 | 12.3 | 44 | 117 | 31 | 129 |
| Dibenzofuran | 77.1 | 8.8 | 51 | 103 | 42 | 112 |

**TABLE D-7. LCS CONTROL LIMITS FOR SW-846 METHOD 8270C SOLID MATRIX (Continued)**

| Analyte | Mean | Standard Deviation | Lower Control Limit[23] | Upper Control Limit[23] | Lower ME Limit | Upper ME Limit |
|---|---|---|---|---|---|---|
| **Others** | | | | | | |
| Benzyl alcohol | 70.9 | 17.4 | 19 | 123 | 10 | 140 |
| Isophorone | 77.0 | 11.4 | 43 | 111 | 31 | 123 |

**TABLE D-8. LCS CONTROL LIMITS FOR SW-846 METHOD 8151A WATER MATRIX[24]**

| Analyte | Median | Lower Control Limit | Upper Control Limit |
|---|---|---|---|
| 2,4-D | 88 | 35 | 113 |
| 2,4-DB | 99 | 44 | 132 |
| 2,4,5-T | 83 | 34 | 112 |

[23] Only applied to the acceptable number of marginal exceedances based on the analyte list size from Table D-1.

[24] LCS control limits were generated using non-parametric statistics (see section D.1 for further explanation). LCS control limits are not available for MCPP, although the compound does appear on the target analyte list for method 8151A (Table C-5 in Section C). Sufficient data to perform statistically significant analyses were not received for the analyte during the LCS study.

| | | | |
|---|---|---|---|
| 2,4,5-TP (Silvex) | 87 | 49 | 116 |
| Dalapon | 62 | 40 | 108 |
| Dicamba | 86 | 60 | 112 |
| Dichloroprop | 91 | 68 | 122 |
| Dinoseb | 65 | 21 | 97 |
| MCPA | 93 | 62 | 144 |

**TABLE D-9. LCS CONTROL LIMITS FOR SW-846 METHOD 8151A SOLID MATRIX[25]**

| Analyte | Median | Lower Control Limit | Upper Control Limit |
|---|---|---|---|
| 2,4-D | 88 | 36 | 144 |
| 2,4-DB | 108 | 52 | 157 |
| 2,4,5-T | 86 | 43 | 137 |
| 2,4,5-TP (Silvex) | 90 | 46 | 125 |
| Dicamba | 90 | 56 | 110 |
| Dichloroprop | 99 | 77 | 138 |

[25] LCS control limits were generated using non-parametric statistics (see section D.1 for further explanation). LCS control limits are not available for Dalapon, MCPA, and MCPP, although those compounds do appear on the target analyte list for method 8151A (Table C-5 in Section C). Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section D.5.

## TABLE D-10. LCS CONTROL LIMITS FOR SW-846 METHOD 8310 WATER MATRIX

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Acenaphthene | 70 | 11 | 35 | 104 |
| Acenaphthylene | 74 | 13 | 34 | 113 |
| Anthracene | 77 | 12 | 41 | 112 |
| Benzo(a)anthracene | 81 | 11 | 49 | 112 |
| Benzo(a)pyrene | 79 | 11 | 45 | 113 |
| Benzo(b)fluoranthene | 82 | 10 | 51 | 112 |
| Benzo(g,h,i)perylene | 77 | 14 | 34 | 119 |
| Benzo(k)fluoranthene | 79 | 10 | 48 | 110 |
| Chrysene | 83 | 11 | 50 | 116 |
| Dibenzo(a,h)anthracene | 64 | 15 | 18 | 111 |
| Fluoranthene | 82 | 11 | 48 | 116 |
| Fluorene | 69 | 11 | 35 | 103 |
| Indeno(1,2,3-cd)pyrene | 80 | 11 | 47 | 112 |
| Naphthalene | 68 | 12 | 33 | 104 |
| Phenanthrene | 80 | 13 | 40 | 120 |
| Pyrene | 80 | 9 | 52 | 108 |

## TABLE D-11. LCS CONTROL LIMITS FOR SW-846 METHOD 8310 SOLID MATRIX

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Acenaphthene | 71 | 12 | 33 | 108 |
| Acenaphthylene | 73 | 13 | 33 | 113 |
| Anthracene | 86 | 13 | 47 | 125 |
| Benzo(a)anthracene | 78 | 9 | 50 | 106 |
| Benzo(a)pyrene | 86 | 15 | 40 | 133 |
| Benzo(b)fluoranthene | 89 | 11 | 57 | 121 |
| Benzo(g,h,i)perylene[26] | 85 | 10 | 53 | 116 |
| Benzo(k)fluoranthene | 84 | 12 | 48 | 121 |
| Chrysene | 87 | 11 | 55 | 119 |
| Dibenzo(a,h)anthracene | 81 | 11 | 47 | 115 |
| Fluoranthene | 88 | 16 | 41 | 135 |
| Fluorene | 76 | 10 | 46 | 107 |
| Indeno(1,2,3-cd)pyrene | 95 | 13 | 56 | 134 |
| Naphthalene | 80 | 11 | 48 | 111 |
| Phenanthrene | 91 | 12 | 57 | 126 |
| Pyrene | 82 | 11 | 49 | 115 |

[26] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from less than four laboratories. Limits may be adjusted in the future as additional data becomes available.

## TABLE D-12. LCS CONTROL LIMITS FOR SW-846 METHOD 8330 WATER MATRIX[27]

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| 1,3,5-Trinitrobenzene | 102 | 13 | 64 | 139 |
| 1,3-Dinitrobenzene | 103 | 18 | 47 | 158 |
| 2,4-Dinitrotoluene | 98 | 12 | 61 | 135 |
| 2,6-Dinitrotoluene | 99 | 13 | 60 | 137 |
| 2,4,6-Trinitrotoluene (TNT) | 98 | 15 | 52 | 143 |
| 2-Amino-4,6-dinitrotoluene[28] | 101 | 17 | 50 | 153 |
| 2-Nitrotoluene | 88 | 15 | 43 | 133 |
| 3-Nitrotoluene | 90 | 14 | 48 | 132 |
| 4-Amino-2,6-dinitrotoluene[28] | 104 | 16 | 55 | 154 |
| 4-Nitrotoluene | 90 | 14 | 48 | 132 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 106 | 18 | 51 | 161 |
| Methyl-2,4,6-trinitrophyenylnitramine (Tetryl)[28] | 98 | 25 | 22 | 174 |
| Nitrobenzene | 94 | 15 | 49 | 138 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 99 | 6 | 81 | 116 |

## TABLE D-13 LCS CONTROL LIMITS FOR SW-846 METHOD 8330 SOLID MATRIX[29]

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| 1,3,5-Trinitrobenzene | 99 | 9 | 73 | 125 |
| 1,3-Dinitrobenzene | 102 | 8 | 79 | 126 |
| 2,4-Dinitrotoluene | 102 | 7 | 80 | 124 |
| 2,6-Dinitrotoluene | 100 | 7 | 78 | 122 |
| 2,4,6-Trinitrotoluene (TNT) | 99 | 14 | 57 | 140 |
| 2-Amino-4,6-dinitrotoluene | 102 | 7 | 80 | 124 |
| 2-Nitrotoluene | 101 | 7 | 80 | 123 |
| 3-Nitrotoluene | 100 | 7 | 77 | 122 |
| 4-Amino-2,6-dinitrotoluene | 101 | 7 | 79 | 124 |
| 4-Nitrotoluene | 101 | 8 | 76 | 125 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | 103 | 10 | 72 | 134 |
| Nitrobenzene | 100 | 8 | 77 | 124 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 100 | 9 | 74 | 126 |

[27] LCS control limits were generated with data using solid phase extraction with acetonitrile only, without removing outliers from the data set (see section D.1 for further explanation).
[28] Provisional limits – LCS-CLs were generated with data from less than four laboratories. Limits may be adjusted in the future as additional data becomes available.
[29] Additional limits for poor performing compounds can be found in section D.5.

## TABLE D-14. LCS CONTROL LIMITS FOR SW-846 METHOD 8081A WATER MATRIX[30]

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| 4,4'-DDD | 88 | 20 | 27 | 149 |
| 4,4'-DDE | 87 | 18 | 33 | 140 |
| 4,4'-DDT | 92 | 15 | 47 | 138 |
| Aldrin | 83 | 19 | 27 | 138 |
| alpha-BHC | 94 | 11 | 60 | 128 |
| alpha-Chlordane | 93 | 10 | 63 | 123 |
| beta-BHC | 96 | 10 | 66 | 126 |
| delta-BHC | 91 | 15 | 46 | 136 |
| Dieldrin | 95 | 11 | 62 | 129 |
| Endosulfan I[31] | 80 | 10 | 49 | 111 |
| Endosulfan II | 79 | 17 | 28 | 130 |
| Endosulfan sulfate | 96 | 14 | 54 | 137 |
| Endrin | 95 | 13 | 56 | 134 |
| Endrin aldehyde | 96 | 14 | 56 | 137 |
| Endrin ketone | 102 | 8 | 77 | 127 |
| gamma-BHC | 82 | 18 | 27 | 137 |
| gamma-Chlordane | 94 | 11 | 62 | 126 |
| Heptachlor | 87 | 15 | 42 | 131 |
| Heptachlor epoxide | 96 | 11 | 62 | 131 |
| Methoxychlor | 103 | 16 | 56 | 150 |

## TABLE D-15. LCS CONTROL LIMITS FOR SW-846 METHOD 8081A SOLID MATRIX[32]

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| 4,4'-DDD | 81 | 18 | 28 | 135 |
| 4,4'-DDE | 97 | 10 | 68 | 126 |
| 4,4'-DDT | 92 | 16 | 45 | 140 |
| Aldrin | 93 | 16 | 47 | 140 |
| alpha-BHC | 93 | 10 | 62 | 125 |
| alpha-Chlordane | 92 | 10 | 63 | 121 |
| Beta-BHC | 95 | 11 | 62 | 127 |
| delta-BHC | 94 | 12 | 57 | 130 |
| Dieldrin | 96 | 10 | 67 | 125 |
| Endosulfan I | 74 | 20 | 14 | 133 |
| Endosulfan II | 89 | 17 | 37 | 141 |
| Endosulfan sulfate | 99 | 12 | 62 | 135 |
| Endrin | 97 | 12 | 61 | 133 |

[30] LCS control limits are not available for Hexachlorobenzene and Toxaphene, although those compounds do appear on the target analyte list for method 8081A (Table C-8 in Section C). Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for surrogate compounds can be found in section D.6.

[31] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from less than four laboratories. Limits may be adjusted in the future as additional data becomes available.

[32] LCS control limits are not available for Hexachlorobenzene, Hexachlorocyclopentadiene, and Toxaphene, although these compounds do appear on the target analyte list for method 8081A (Table C-8 in Section C). Sufficient data were not received for those analytes during the LCS study to perform statistically significant analyses. Additional limits for surrogate compounds can be found in section D.6.

## TABLE D-15. LCS CONTROL LIMITS FOR SW-846 METHOD 8081A SOLID MATRIX (Continued)

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Endrin aldehyde | 92 | 18 | 37 | 147 |
| Endrin ketone | 100 | 11 | 66 | 134 |
| gamma-BHC | 91 | 11 | 59 | 123 |
| gamma-Chlordane | 96 | 10 | 66 | 126 |
| Heptachlor | 96 | 15 | 51 | 140 |
| Heptachlor epoxide | 98 | 11 | 66 | 130 |
| Methoxychlor | 100 | 14 | 57 | 143 |

## TABLE D-16. LCS CONTROL LIMITS FOR SW-846 METHOD 8082 WATER MATRIX[33]

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Aroclor 1016 | 85 | 20 | 25 | 144 |
| Aroclor 1260 | 87 | 19 | 30 | 145 |

## TABLE D-17. LCS CONTROL LIMITS FOR SW-846 METHOD 8082 SOLID MATRIX[33]

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Aroclor 1016 | 90 | 16 | 41 | 138 |
| Aroclor 1260 | 96 | 12 | 61 | 131 |

## TABLE D-18. LCS CONTROL LIMITS FOR SW-846 METHODS 6010 AND 7470A WATER MATRIX

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Aluminum | 97 | 5 | 83 | 111 |
| Antimony | 98 | 4 | 86 | 110 |
| Arsenic | 98 | 4 | 85 | 111 |
| Barium | 99 | 4 | 88 | 111 |
| Beryllium | 99 | 4 | 87 | 111 |
| Cadmium | 100 | 4 | 87 | 112 |
| Calcium | 98 | 4 | 87 | 110 |
| Chromium | 100 | 4 | 88 | 112 |
| Cobalt | 99 | 3 | 89 | 108 |
| Copper | 99 | 3 | 89 | 109 |
| Iron | 102 | 4 | 90 | 113 |
| Lead | 99 | 4 | 87 | 111 |
| Magnesium | 98 | 4 | 88 | 109 |
| Manganese | 100 | 4 | 88 | 112 |

[33] LCS control limits are not available for Aroclors 1221, 1232, 1242, 1248, 1254, 1268, and 1016/1260, although those compounds do appear on the target analyte list for method 8082 (Table C-9 in Section C). Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for surrogate compounds can be found in section D.6.

## TABLE D-18. LCS CONTROL LIMITS FOR SW-846 METHODS 6010 AND 7470A WATER MATRIX (Continued)

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Mercury | 100 | 5 | 85 | 115 |
| Molybdenum | 95 | 5 | 79 | 111 |
| Nickel | 100 | 4 | 87 | 113 |
| Potassium | 98 | 4 | 85 | 111 |
| Selenium | 98 | 6 | 80 | 116 |
| Silver | 97 | 5 | 82 | 113 |
| Sodium | 99 | 4 | 87 | 111 |
| Thallium | 97 | 4 | 86 | 109 |
| Vanadium | 99 | 4 | 88 | 111 |
| Zinc | 100 | 4 | 86 | 113 |

## TABLE D-19. LCS CONTROL LIMITS FOR SW-846 METHODS 6010 AND 7471A SOLID MATRIX

| Analyte | Mean | Standard Deviation | Lower Control Limit | Upper Control Limit |
|---|---|---|---|---|
| Aluminum | 95 | 5 | 79 | 112 |
| Antimony | 96 | 5 | 82 | 110 |
| Arsenic | 95 | 4 | 84 | 107 |
| Barium | 98 | 3 | 88 | 108 |
| Beryllium | 99 | 4 | 89 | 110 |
| Cadmium | 97 | 4 | 83 | 110 |
| Calcium | 97 | 4 | 84 | 109 |
| Chromium | 99 | 5 | 85 | 112 |
| Cobalt | 98 | 4 | 86 | 110 |
| Copper | 97 | 3 | 88 | 106 |
| Iron | 100 | 4 | 88 | 113 |
| Lead | 95 | 4 | 83 | 107 |
| Magnesium | 96 | 3 | 87 | 106 |
| Manganese | 97 | 4 | 85 | 109 |
| Mercury | 100 | 6 | 83 | 118 |
| Molybdenum | 96 | 5 | 80 | 111 |
| Nickel | 97 | 4 | 86 | 109 |
| Potassium | 96 | 4 | 83 | 108 |
| Selenium | 93 | 4 | 80 | 106 |
| Silver | 96 | 7 | 75 | 118 |
| Sodium | 96 | 4 | 82 | 109 |
| Thallium | 94 | 4 | 82 | 107 |
| Vanadium | 99 | 3 | 89 | 109 |
| Zinc | 95 | 5 | 80 | 110 |

# APPENDIX D

BHATE

# HEADSPACE ANALYSIS LOG

Project Number/Name: _____ DQCR No.: _____

ation: _____ Date Sampled: _____ Date Analyzed: _____

Analyst: _____ Instrument Used: _____

| SAMPLE NUMBER | SAMPLE DETPH (FT) | SAMPLE TYPE | BACKGROUND READING (PPM)[1] | WITHOUT CARBON FILTER | SAMPLE READING (PPM)[1] | | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | | | WITH CARBON FILTER | AMBIENT AIR TEMP. (°F) | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

ES: [1] PPM represents concentration of detectable volatile and gaseous compounds in parts per million of air.
NA = Not Applicable
NMT = No Measurement Taken
NIR = No Instrument Response

# TEST PIT REPORT

**TEST PIT NO.** _____

| | | | |
|---|---|---|---|
| **Project:** | | **Job Number:** | |
| **Location:** | | **Elevation:** | |
| | | **Date Start:** | |
| **Client:** | | **Date End:** | |
| **Contractor:** | | **Field Representative:** | |
| **Equipment:** | | | |

| Depth (Feet) | Sample Number and Depth Range | Strata Change (feet) | Field Classification | Remarks |
|---|---|---|---|---|
| 0 | | | | |
| 2 | | | | |
| 4 | | | | |
| 6 | | | | |
| 8 | | | | |
| 10 | | | | |
| 12 | | | | ASTM Component % |
| 14 | | | | Mostly 50 – 100%<br>Some 30 – 45%<br>Little 15 – 25%<br>Few 5 – 10%<br>Trace <5% |

**Groundwater**

| Date | Time* | Depth (ft) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**Pit Dimensions (feet)**

_____X_____X_____=_____ cubic feet
Length Width Depth

**Boulders**

12 to 18-inch diameter: No, _____ = _____cubic feet

Over 18-inch diameter: No._____= _____cubic feet

**Not Encountered**

***Hours after completion**

**Test Pit No.**

BHATE

# DAILY QUALITY CONTROL REPORT

Project Number/Name: _____ DQCR No.: _____

Date ___/___/___ Time On-Site: _____ Time Off-Site: _____

Site Name: _____ Weather: _____ Temperature: ____ Wind: _____

Contractor PersonnelOn-Site: _____

_____

Visitors On-Site: _____

_____

Summary of Work Performed: _____

_____

_____

_____

_____

_____

Level of Health & Safety Protection: _____

_____

Equipment Used: _____

_____

Calibration(s) Performed: _____

_____

Equipment Problem(s)/Remedies: _____

_____

Samples Collected* _____

_____

Sample Collection Method(s): _____

Quality Control: _____

Proposed Schedule for Tomorrow: _____

Additional Remarks: _____

**Signature:** _____ **Job Title:** _____

*Indicates sample media: groundwater, surface water, soil or sediment; sample type: composite, grab, split, duplicate, rinsate, and sample I.D. numbers

# WATER-LEVEL DATA SUMMARY

| | |
|---|---|
| ject Name/Number | Date |
| | Field Personnel #1 |
| Site Name | Field Personnel #2 |
| Client | Field Personnel #3 |
| Survey Datum (NGVD) | Weather (previous 24 hours) |
| Measuring Device | |

| Well Number | Time (hhmm) | Measuring Point | | Depth to Water (ft, TOC) | Elevation of Water (ft, NGVD) |
|---|---|---|---|---|---|
| | | Description | Elevation (ft, NGVD) | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Notes: NGVD = National Geodetic Vertical Datum
TOC = Top of Well Casing

Comments/Observations

# HTW DRILLING LOG

| | | |
|---|---|---|
| 1. COMPANY NAME | 2. DRILLING CONTRACTOR | HOLE NO. |
| | | SHEET OF SHEETS |
| 3. PROJECT | 4. LOCATION | |
| 5. NAME OF DRILLER | 6. MANUFACTURER'S DESIGNATION OF DRILL | |
| 7. SIZES & TYPES OF DRILLING & SAMPLING EQUIPMENT | 8. HOLE LOCATION<br>North East | |
| | 9. SURFACE ELEVATION (ft. NGVD) | |
| | 10. DATE STARTED | 11. DATE COMPLETED |
| 12. OVERBURDEN THICKNESS | 15. DEPTH GROUNDWATER ENCOUNTERED | |
| 13. DEPTH DRILLED INTO ROCK | 16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED | |
| 14. TOTAL DEPTH OF HOLE | 17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) | |

| 18. GEOTECHNICAL SAMPLES | DISTURBED | UNDISTURBED | 19. TOTAL NUMBER OF CORE BOXES |
|---|---|---|---|
| | | | |

| 20. SAMPLES FOR CHEMICAL ANALYSIS | VOC | METALS | OTHER (SPECIFY) | OTHER (SPECIFY) | OTHER (SPECIFY) | 21. TOTAL CORE REC % |
|---|---|---|---|---|---|---|
| | | | | | | |

| 22. DISPOSITION OF HOLE | BACKFILLED | MONITORING WELL | OTHER (SPECIFY) | 23. SIGNATURE OF INSPECTOR |
|---|---|---|---|---|
| | | | | |

| ELEV a | DEPTH b | DESCRIPTION OF MATERIALS c | Field Screening Results d | Geotech Sample or Core Box No e | Analytical Sample No. f | Blow Counts g | REMARKS h |
|---|---|---|---|---|---|---|---|
| | 0 | | | | | | |
| | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

| PROJECT | HOLE NO |
|---|---|
| | |

# HTW DRILLING LOG

| HOLE NO. |
|---|
| |

| PROJECT | INSPECTOR | SHEET OF SHEETS |
|---|---|---|
| | | |

| ELEV a | DEPTH b | DESCRIPTION OF MATERIALS c | Field Screening Results d | Geotech Sample or Core Box No. e | Analytical Sample No. f | Blow Counts g | REMARKS h |
|---|---|---|---|---|---|---|---|
| | 5 | | | | | | |
| | 6 | | | | | | |
| | 7 | | | | | | |
| | 8 | | | | | | |
| | 9 | | | | | | |
| | 10 | | | | | | |
| | 11 | | | | | | |
| | 12 | | | | | | |
| | 13 | | | | | | |
| | 14 | | | | | | |

PROJECT

HOLE NO.

# HTW DRILLING LOG

HOLE NO.

PROJECT

INSPECTOR

SHEET
OF SHEETS

| EV. a | DEPTH b | DESCRIPTION OF MATERIALS c | Field Screening Results d | Geotech Sample or Core Box No. e | Analytical Sample No. f | Blow Counts g | REMARKS h |
|---|---|---|---|---|---|---|---|
| | 14 | | | | | | |
| | 15 | | | | | | |
| | 16 | | | | | | |
| | 17 | | | | | | |
| | 18 | | | | | | |
| | 19 | | | | | | |
| | 20 | | | | | | |
| | 21 | | | | | | |
| | 22 | | | | | | |

PROJECT

HOLE NO.

BHATE

*Environmental Engineers and Scientists*

# Chain of Custody and Analytical Request

Page _____ of _____

Project Number: _____

Chain of Custody Number [1]: _____

LIMS Number: _____

Facility/Base I.D.:

Project Name / Site Name:

Client Name:

Collected by:

| Field Sample ID (30 Characters Max) | ERPIMS LOCID (15 Characters Max) | Date Collected (dd-mmm-yyyy) | Time Collected (Military) (hhmm) | Sample Depth (beginning - ending) | SA Code [2] | Sample Number [3] | Sample Matrix [4] | Sample Analysis Requested [5] | | | | | | | | | Quality Assurance Samples [6] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Number of containers | | | | | | | | | Ambient Blank Lot Control Number | Equipment Blank Lot Control Number | Trip Blank Lot Control Number | Cooler ID |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | | | | | | | | |

COMMENTS: _____

**Custody Transfers Prior to Receipt by Laboratory**

| Relinquished By (Signed) | Date | Time | Received by (signed) | Date | Time |
|---|---|---|---|---|---|
| 1. | | | 1. | | |
| 2. | | | 2. | | |
| 3. | | | 3. | | |

**Sample Delivery Details / Laboratory Receipt**

Delivered Directly to Lab: _____ Shipped No.: _____

Method of Shipment: _____ Airbill Number: _____

Analytical Lab: _____ Delivery Location: _____

Lab Recipient: Delivery Date/Time:

1.) Chain of Custody Number = date collected + custody number (e.g. 09-02-1999-01)

2.) Sample Type (SA) Codes: N = Normal Sample, TB = Trip Blank (-c) Sample, FD = Field Duplicate (-a) Samples, FR = Field Replicate (-b) Samples, EB = Equipment Blank (-d) Samples, MS = Matrix Spike, SD = Matrix Spike Duplicate, AB = Ambient Blank (-e)

3.) Sample Number: Unique sample number collected from a particular location per day. (e.g. Groundwater sample collected from MW-1 on 10/10/99 = 01, if sampled again on 10/10/99 = 02, etc.)

4.) Matrix Codes: GS = Soil Gas, WG = Groundwater, WS = Surface Water, SO = Soil, SE = Sediment, SL = Sludge, SS = Surface Soil Samples, WQ = Aqueous Blank Samples (trip, equipment, ambient, etc), SQ = Soil Blanks

5.) Sample Analysis Requested: Analytical method requested and number of containers provided for each.

6.) Quality assurance samples are assigned by date (ddmmyy) and the sample number associated with the sample (01, 02, etc) (e.g. Equipment blank collected in association with MW-1 on 10/10/99 will be designated 10109901 in the Equipment Blank Lot Control