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Final
Operation and Maintenance Manual for the FT-31 Site Bioventing System

Holloman AFB
Alamogordo, NM

July 1997

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49 CES/CEVR
Holloman Air Force Base
New Mexico

FINAL OPERATION AND MAINTENANCE MANUAL
FOR THE FT-31 SITE BIOVENTING SYSTEM
HOLLOMAN AIR FORCE BASE, NEW MEXICO

Received 7/29/97

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Under Contract No. DACW45-94-D-0003

Delivery Order 8, Work Authorization Directive 3

U.S. Army Corps of Engineers

Omaha District

Omaha, Nebraska

July 1997

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LIST OF ACRONYMS

AFB	Air Force Base
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BEC	Base Environmental Coordinator
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CIH	Certified Industrial Hygienist
COC	Chain-of-Custody
CMC	Corporate Medical Consultant
CPR	Cardiopulmonary Resuscitation
CPVC	Chlorinated Polyvinyl Chloride
DO	Delivery Order
DOT	Department of Transportation
DPT	Direct Push Technology
DQCRs	Daily Quality Control Reports
DQO	Data Quality Objective
DRMO	Defense Reutilization and Marketing Office
DPT	Direct Push Technology
EMS	Emergency Medical Services
°F	Degrees Fahrenheit
FID	Flame-Ionization Detector
FNPT	Female National Pipe Thread
fpm	Feet Per Minute
FTA	Fire Training Area
FWENC	Foster Wheeler Environmental Corporation
GFCI	Ground Fault Circuit Interrupter
HWMR	Hazardous Waste Management Regulations
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
JSA	Job Safety Analysis
LDR	Land Disposal Restriction
LEL	Lower Explosive Limit
LTO	Long-Term Operations
mg/kg	Milligrams Per Kilogram
MNPT	Male National Pipe Thread
NMED	New Mexico Environmental Department
NOI	Notice of Intent
O & M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration

OVA	Organic Vapor Analyzer
O/WS	Oil/Water Separator
PEL	Permissible Exposure Limit
PHSM	Project Health and Safety Manager
P & I	Piping and Instrumentation
PID	Photoionization Detector
POC	Point of Contact
PPE	Personal Protective Equipment
psig	Pounds Per Square Inch Gauge
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
rpm	Revolutions Per Minute
SAP	Sample Analysis Plan
SCFM	Standard Cubic Feet Per Minute
SHSO	Site Safety and Health Officer
SOP	Standard Operating Procedures
SSHP	Site Safety and Health Plan
SWMR	Solid Waste Management Regulations
SWMU	Solid Waste Management Unit
TERC	Total Environmental Restoration Contract
TCLP	Toxicity Characteristic Leaching Procedure
TLV	Threshold Limit Value
TKN	Total Kjeldahl Nitrogen
TRPH	Total Recoverable Petroleum Hydrocarbons
TSDF	Treatment, Storage, and Disposal Facility
UEL	Upper Explosive Limit
USACE	United States Army Corp. of Engineers
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WAD	Work Authorization Directive
WOT	Waste Oil Tank
WWTF	Wastewater Treatment Facility

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (FWENC) was retained by the United States Army Corps of Engineers (USACE)-Omaha District to furnish operation and maintenance (O & M) manual preparation services for the former Fire Training Area (FTA), which is designated as Installation Restoration Program (IRP) Site FT-31, at Holloman Air Force Base (AFB) in New Mexico. These services involve the preparation of a manual for the O & M procedures for the FT-31 site bioventing system.

This O & M manual is written to meet the requirements stipulated within the Total Environmental Restoration Contract (TERC) No. DACW45-94-D-0003, Delivery Order (DO) No. 8, Work Authorization Directive (WAD) 3. This O & M manual provides a system description, operational strategy, system maintenance requirements, system shutdown and closure sampling guidance, waste management and contingency plans, and sampling, analysis, and reporting procedures for the FT-31 site bioventing system.

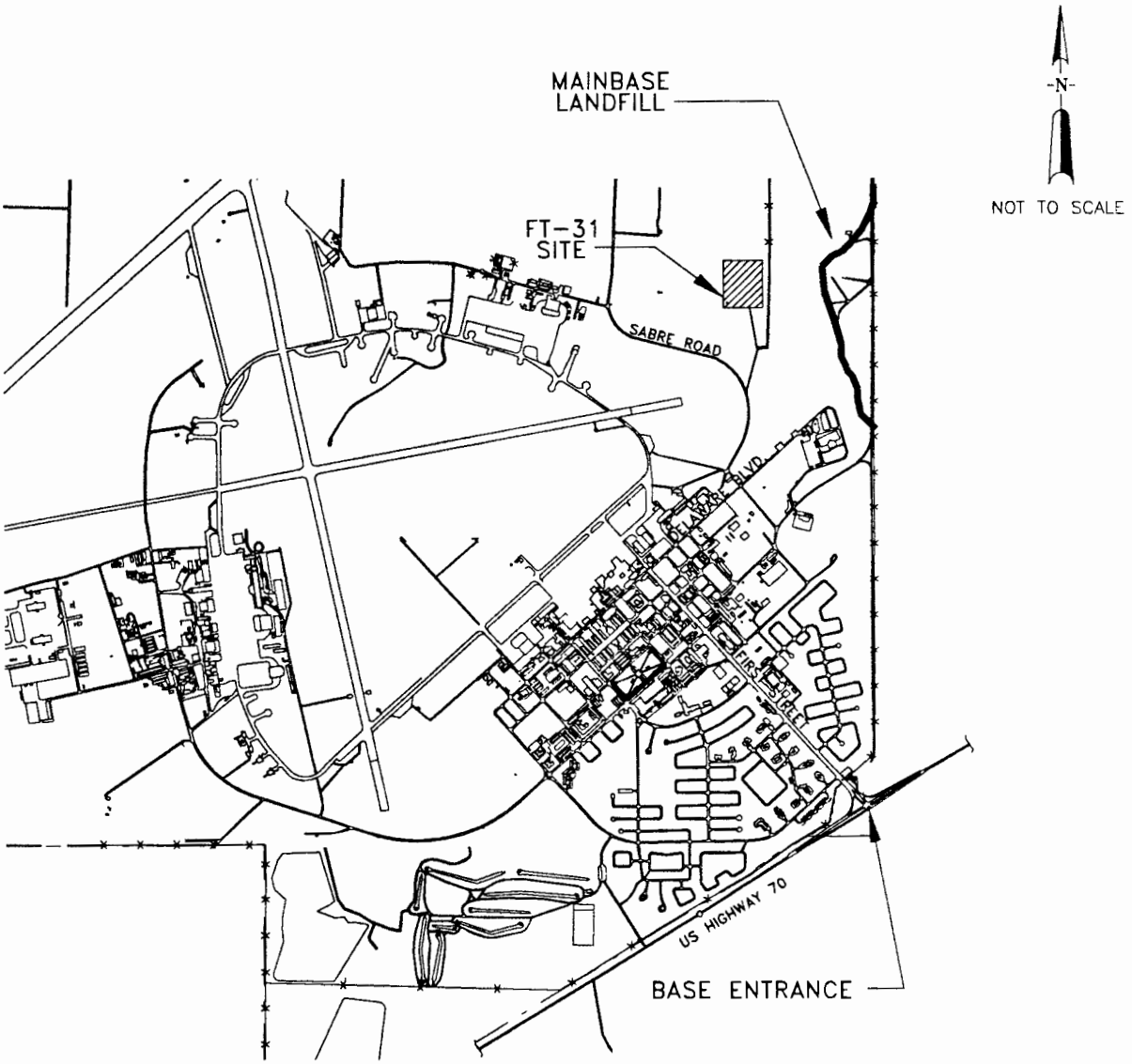
1.1 PURPOSE

The purpose of this document is to provide guidance for the initial startup, daily operation, periodic maintenance, and system monitoring and shutdown of the FT-31 site bioventing system. This guidance will ensure that the system is run efficiently and for the shortest duration possible to effectively remediate the Site FT-31 plume.

1.2 SITE LOCATION

Holloman AFB is located in the Tularosa Basin in Otero County in southern New Mexico. It is located immediately southwest of the City of Alamogordo. The FTA is located northeast of Saber Road and west of the Main Base Landfill, as identified on the Vicinity Map in Figure 1-1.

Site FT-31 is defined by a circular, gravel-covered area, approximately 400 feet in diameter, that contains five Solid Waste Management Units (SWMUs). The five SWMUs are 39, 127, 135, 170, and 171. SWMUs 39, 127, and 135 consist of an abandoned oil/water separator (O/WS), a



VICINITY MAP

Prepared for:
U.S. Army Corps of Engineers
for Holloman A.F.B.
Prepared July 1996

FIGURE 1-1
Vicinity Map

Holloman A.F.B., New Mexico
Prepared by:
Foster Wheeler Environmental Corporation

waste oil tank (WOT), and a drainage pit, respectively. The O/WS and WOT, which were removed in 1996, were located within the 70-foot-diameter, 6-foot-deep drainage pit located approximately 200 feet north of the central test area of Site FT-31. SWMU 170 is a circular, gravel-covered burn area with a 12-inch-high gravel berm, approximately 100 feet in diameter, located near the center of Site FT-31. SWMU 171 is also a circular, gravel-covered burn area with a 12-inch-high gravel berm, approximately 60 feet in diameter, and is located in the northeast corner of Site FT-31. The topography of Site FT-31 is relatively flat with the exception of the drainage pit, which contains the abandoned O/WS and WOT.

1.3 SITE HISTORY

The FTA was used by the Base Fire Department for fire training exercises from 1945 to 1991. From 1945 to 1979, approximately 1,800 to 2,700 gallons of waste fuels, oils, and some solvents were delivered to the FTA each month. Approximately 2,500 gallons of JP-4 were used every 6 weeks in the training exercises conducted from 1979 to 1991. Prior to commencing training exercises, the training areas were soaked with water before fuel application and ignition. The flammable liquids were sprayed primarily at SWMUs 170 and 171 and were ignited for these training exercises only.

In 1979, SWMUs 39, 127, and 135 and an aboveground storage tank were installed at the FTA. SWMUs 39, 127, and 135 were installed to collect and handle runoff from the burn areas. The aboveground storage tank was installed in the southeastern portion of the site to store and supply JP-4 to the burn areas through valve boxes via underground pipe. In 1979, JP-4 replaced the waste fuels, solvents, and oils as the fuel source used for training exercises.

2.0 SYSTEM DESCRIPTION

Remediation of contamination at Site FT-31 will be accomplished by a bioventing system. The bioventing system is comprised of a positive displacement rotary lobe blower, 22 bioventing wells, and the appurtenances necessary to monitor and control the injection of pressurized air into subsurface soils. The injection of pressurized air will accelerate the biodegradation rate of subsurface contamination by naturally occurring organisms.

2.1 MONITORING/ INJECTION WELL CONFIGURATION

Two types of wells were installed at Site FT-31: bioventing and monitoring wells. Bioventing wells were installed to introduce pressurized air directly into the contaminated area. Monitoring wells were installed or configured from existing wells in or around the contaminated area to monitor the degradation process.

The bioventing wells were constructed of 4-inch-diameter, schedule 40 polyvinyl chloride (PVC) pipe and screen placed inside of a 10-inch-diameter borehole. Bioventing wells were screened with 0.040-slot schedule 40 PVC from 9 to 21 feet below grade. The filter pack material used for packing the well casing has either a 8-12 or 10-20 gradation. The wells were sealed with a minimum 6-foot length of bentonite pellets to prevent short circuiting (escape) of the injected air via the well annulus. The bioventing well were secured with 2 feet of concrete/bentonite mixture extending from the top of the bentonite layer to the ground surface.

Two new PVC monitoring wells with metal protective enclosures and hinged lockable caps were installed within both the South and East plume areas. The metal enclosures will protect the 2-inch-diameter schedule 40 PVC wells from degradation due to exposure to ultraviolet light. These wells were constructed in the same manner as the bioventing wells with the exception of the metal enclosure and borehole diameter. The 2-inch-diameter monitoring wells were constructed in 8-inch-diameter boreholes. One monitoring well was screened from 6 to 11 feet below grade and the other well was screened from 16 to 21 feet below grade. Both wells were

located in close proximity to each other (5 feet apart) so that monitoring data will be obtained from essentially the same area.

An existing well, IW-02, located in the North Area will also be used for monitoring. Well IW-02 is screened at two isolated intervals, from 5 to 11 feet below grade and from 15 to 22 feet below grade.

2.2 BLOWER

A Roots model 59 positive displacement rotary lobe type blower, capable of providing a minimum flow rate of 330 standard cubic feet per minute (SCFM) and a maximum flow rate of 425 SCFM, will be used to provide pressurized air to the bioventing system. The anticipated discharge pressure at the blower outlet will range from 4.0 to 6.0 pounds per square inch gauge (psig). The blower is belt driven and capable of operating at multiple speeds by replacing the blower and/or motor sheaves. Multiple blower speeds results in the capacity to achieve multiple performance curves, thereby accommodating a wide range of operating conditions.

The blower will provide no more than 75% of the manufacturer's published design capacity and will not operate at speeds exceeding 80% of the maximum speed. The blower will operate at no more than 2,500 revolutions per minute (rpm) and will have a gear tip speed of less than 3,500 feet per minute (fpm). The blower motor was designed to operate at 60% to 80% of its rated maximum capacity. At the specified maximum flow rate, the blower will operate at 68% maximum speed and will have a gear tip speed of 2,553 fpm. The blower system is equipped with inlet and outlet silencers and an oversized inlet air filter, which will remove particulates from the influent air stream that could clog or damage mechanical equipment.

2.3 SYSTEM PIPING

System piping was installed abovegrade and fabricated for pressurized air service. System piping is comprised of schedule 40 galvanized carbon steel, chlorinated polyvinyl chloride (CPVC), and PVC pipe.

The galvanized carbon steel pipe was used to construct the air distribution header and the air supply risers, which are installed at each injection well. Galvanized steel pipe manufactured in accordance with American Society for Testing and Materials (ASTM) A-53 was used for these locations. The galvanized steel piping has male national pipe thread (MNPT) threaded ends and were joined using female national pipe thread (FNPT) coupler fittings. The galvanized steel pipe was coupled with CPVC pipe with an 150-pound American National Standards Institute (ANSI) bolted flanged end transition connection.

CPVC pipe was used to join the galvanized steel air distribution header and the PVC distribution piping. CPVC pipe has a maximum temperature rating of 210 degrees Fahrenheit (°F) and was used for the specified length to dissipate enough heat to reduce the inline air temperature to 140°F, the maximum rated service temperature for PVC piping.

PVC pipe was used for the remainder of the air distribution system. PVC pipe runs from the CPVC transition point to all the individual bioventing wells before linking back into the galvanized steel supply riser.

2.4 INSTRUMENTATION AND CONTROLS

The blower system has instrumentation and controls that monitor the inlet filter differential pressure, system pressure, blower discharge air temperature, flow rate, and injection temperature. The blower control panels have "BLOWER RUN" and "BLOWER STOP" indicator lights and a "RUN" beacon for visual indication of whether the blower is running or has stopped.

A manually adjustable pressure relief valve was installed at one end of the tee fitting, mounted on the side of the blower's discharge silencer. The relief valve is set to open when a specified pressure is exceeded.

A manually adjustable low-pressure switch was installed on the other side of the tee fitting. The low-pressure switch will disengage the blower when the system pressure reaches a preset low

discharge pressure. The low-pressure switch is capable of operating from 1/8 to 20 psig and has a 100% adjustable deadband.

The inlet air filter has a pressure differential switch to stop the blower when a high differential pressure exists across the filter, indicating fouling. The differential switch is equipped with either pitot tubes or equivalent in-line pressure transmitting devices and is adjustable.

Following the blower discharge, a temperature switch was installed to stop the blower when a preset high temperature is reached. This is needed to prevent injecting air exceeding 165°F into subsurface soil and damaging the biological organisms responsible for the degradation process. The temperature switch is fully adjustable from 32°F to 210°F. A manually adjustable time delay relay located in the blower panel will restart the blower following a specified duration to allow ambient and system temperatures to recede.

A run time indicator was installed with the blower motor. The resulting run time information will be used to schedule and perform maintenance activities such as adding or changing filters, lubricating oil, bearing grease, and drive belts. The run time information will also be used to indicate total operational time of the bioventing system.

Flowmeters were mounted on the individual air injection headers and will measure the flow rate of air being distributed to each of the three plume areas of the site. In addition, dedicated flowmeters were also mounted on the air supply risers at each of the bioventing wells. Both types of flowmeters are vane-style, direct-reading meters with an accuracy of ±2% of full scale. Flowmeters were factory calibrated for the flow ranges, process temperatures, and pressure under which they are expected to operate.

Pressure gauges were mounted at the blower outlet, on the distribution header, and on the air supply risers at each individual bioventing well. The pressure gauges at the blower outlet and distribution header are heavy-duty gauges with a burst pressure rating of 500% full scale and a

proof pressure of 150%. The heavy-duty pressure gauges are capable of providing an accuracy of ±2% of full scale. The pressure gauges at the individual bioventing wells are general-duty, low-pressure, bronze-diaphragm gauges with a 2-1/2-inch-diameter dial. Both types of pressure gauges will indicate pressure from 0 to 300 inches of water.

3.0 SYSTEM STARTUP AND OPERATIONAL STRATEGY

This section presents an overall startup and operational strategy for Site FT-31. Monitoring of the system's physical, chemical, and biological parameters, system balancing, nutrient addition, and troubleshooting are also discussed. The intent is to provide a description of and general guidelines for successful system operation and to give the operator flexibility in operational strategy, not to provide inflexible stepwise "how to" instructions.

3.1 SYSTEM STARTUP

System startup consists of three steps: equipment checkout, prestartup testing, and actual startup. These steps are discussed briefly below.

3.1.1 Equipment Checkout

This is an inspection to verify that all system equipment has been properly installed. First, all equipment is checked, using engineering drawings, as-built drawings, statements of work, and manufacturer's installation instructions as references, to ensure it is in place and correctly connected. Piping and Instrumentation (P&I) diagrams and electrical one-line diagrams are invaluable for verifying piping and wiring connections. Protective covers should be in place, grounding wires should be connected, and initial lubrication of the blower and motor should have been performed (if required). All piping and electrical connections are inspected to verify that connections are secure. Table 3-1 provides an equipment checkout checklist to be used.

Particular attention is paid to inspection of equipment lockouts, safety valves, pressure relief devices, and other site safety and security devices. The Health and Safety requirements specified in the Standard Operating Procedures (SOPs), Appendix A, and Section 4.0, System Maintenance, are implemented to ensure that all safety systems are installed and their proper operation understood.

Table 3-1. Equipment Checkout Checklist

Checklist Item	Responsible	Initials	Date
Subsurface			
Wells installed per specification			
Monitoring points installed			
Temperature/pressure gauges/flow indicators installed on well heads and monitoring points			
Piping on blower pad installed/tested			
Piping Installation			
Piping complete			
Piping cleaned			
Filters installed/cleaned			
Valves installed and operation verified			
Thermometers and gauges installed on piping			
Pressure test complete			
Pumps			
Foundations complete			
Equipment grouted in place			
Vibration dampers installed			
Coupling alignment/level to specifications			
Pipe connections installed/tested			
Pumps and seals intact (no leaks)			
Electrical			
Grounding installed/checked			
Lighting functional			
Lockouts/covers/panels in place			
Pump rotation verified			
Disconnects in sight of unit being controlled			
Controls/alarms and interlocks functional			
Power connected to monitoring instruments			
Subsystems			
Instruments calibrated			
Air treatment system installed/functional			
Safety interlocks functional			

3.1.2 Prestartup Testing

Prestartup testing requires ignition of the equipment and control systems to verify their proper operation. Control and safety systems are tested first to ensure their operation meets design and plan specifications. Table 3-2 is a functional performance checklist to be used for prestartup testing. The following paragraphs describe the testing procedure.

Table 3-2. Suggested Functional Performance Checklist

Checklist Item	Responsible	Initials	Date
Subsurface			
No piping/well air leaks			
Monitoring point compositions within expected ranges (if measured)			
Monitoring point pressures and temperatures within expected ranges			
Pumps			
Start/Stop from all control mechanisms			
Operating points match pump curve specifications Flow rate vs. pressure through startup			
Current draw and voltage balance match specifications for all phases			
Support systems operate within specifications			
No excessive vibration/noise/temperature rise			
Systems			
Safety shutdown system functional			
Monitoring system/instruments hold calibration			

With the main valves to the North, South, and East areas closed and all well head valves closed, start up the blower. Verify proper operation of all associated blower electrical equipment, inlet and outlet silencers, and inlet filter. Verify that all piping connections are not leaking. Make sure the pressure relief valve functions at the correct pressure. It is extremely important to verify that the blower safety shutdowns are functioning. Controls monitoring the inlet filter pressure, the blower discharge pressure, and the blower outlet temperature will shut down the blower in the event that proper operating ranges are exceeded.

Sequentially open the main valves to the three bioventing areas and check along all aboveground pipelines for air leaks, primarily at connections and fittings. Carefully check all fittings at each well head for air leaks. If leaks are found, mark the affected area and then tighten or secure connections to eliminate the air leak. Retest the affected area after securing the connection. Carefully open both valves at each well head to allow a small amount of air to flow through. Verify the operation of each well head air flow indicator and pressure gauge. The air flow indicators and pressure gauges are factory calibrated and typically require no field calibration. However, note the response of each and, if the response seems unusual, replace the indicator or gauge. After each well head is checked, close the well head valves.

3.1.3 Startup

Startup is a incremental process of bringing each well head into operation. Before startup, all valves are checked to verify they are in the closed position. Bring each area into operation by opening the main valve on the blower pad to that area and then opening the well head valves for that area.

Once the valves to all wells are open and all wells are injecting air into the subsurface, the system air flow must be balanced. First, adjust the three area valves on the blower pad to approximate the specified design flows as closely as possible. Then, adjust the 22 well head valves in all areas to their approximate specified design flows. Readjust the three area valves on the blower pad as required. Readjust the well head valves. Continue this process until the specified design air flow rates are achieved for all wells. Target air flow rates and well head pressures for each well are to be maintained at approximately 19 SCFM and at a maximum pressure estimated to range between 3.5 and 4.5 psig.

During startup it is very important not to inject excessive air flows or pressures into the subsurface, thus avoiding soil rupture and subsequent air short circuiting.

The recommended approach is to initially inject very low air flow rates (2–5 SCFM) into each well and gradually, in a stepwise manner, increase the air flows until the air rates achieve the recommended goals. Suggested rates are 2–5 SCFM, 5–10 SCFM, 10–15 SCFM, and the final target rate of approximately 19 SCFM (plus 1–2 SCFM or minus 2–3 SCFM). All wells should be uniformly increased to the next air flow step before returning to the initial well and again increasing the air flows by the next increment.

Do not inject excessive air flow rates into the subsurface. Additional air flows above the recommended goal of 19 SCFM will not increase the rate of bioremediation because at the target goal the soil will be completely oxygenated. In addition, excessive air flows may cause soil rupture and short circuiting or may unnecessarily decrease the moisture available in the subsurface soil.

It is likely that the target design air flow rate of 19 SCFM will be achieved in the wells at well head pressures substantially below the design **maximum** pressures of 3.5 to 4.5 psig. The 19 SCFM air flow rate may be achieved in the wells at pressures as low as 0.5 to 1.0 psig. This is acceptable and within the operating design parameters for the system.

It is also important that the air control valves are never inadvertently thrown wide-open, as this may result in excessive air flow into a single well and subsequent soil rupturing and short circuiting

It is also of critical importance that the wells are not over pressurized. If the initial startup field measurements indicate that the well head pressure is at approximately 4.0 psig (±0.5 psig) and that the air flows are less than approximately 19 SCFM (minus 2–3 SCFM), then the air control valves should not be opened further to attempt to increase the air flows to the target air flow rate of 19 SCFM. Instead, the system should be allowed to stabilize and the design engineer informed of the final air flow rates that were actually able to be achieved at maximum well head pressures of 3.5 to 4.5 psig.

Subsurface conditions may be slow to respond to air flow valve adjustments. Differing subsurface conditions among the three bioventing areas may create small well head pressure differences. Recheck air flow rates and well head pressure gauges daily during startup and then weekly until the system is in steady-state operation. More frequent checks may be required during startup. Record the final flows and pressures in the field log book or operating log sheet. Note and record the blower outlet air temperature.

Note any unusual flow or pressure values. Unusual values may be indicative of unknown subsurface flow barriers or short circuits. If unusual values are detected, consult with the site or design engineer for corrective action.

3.2 ROUTINE OPERATING PROCEDURES

Once the bioventing system equipment is running and the air flow rates are balanced, there are few operating requirements other than routine checks and maintenance.

The inlet air filter should be checked daily during maintenance inspections per the manufacturer's specifications to ensure efficient blower operation. Flow, pressure, and temperature data should also be logged daily. As this data is collected, make a visual check around each well head. Note and correct any deficiencies. Minor valve adjustments to maintain a balanced flow are not likely to be necessary, but may be needed. If valve adjustments to maintain air balance are frequent or are significant, consult with the site or design engineer.

Lubrication of the blower and motor will be performed in accordance with manufacturers instructions. Perform any other routine maintenance on the blower and motor specified by the manufacturer. Visually inspect all equipment on the blower pad on a periodic basis. Note and correct any deficiencies. Good housekeeping will help equipment run free of trouble. Clear dust, dirt, and debris as required from the blower pad.

3.3 SYSTEM MONITORING

3.3.1 Physical Parameters

Physical parameters that will be monitored on a regular basis include pressure drop, well head pressures, air flow rates, and air temperature. Data will be recorded on operating log sheets along with the date and time of measurement. This will provide a tracking mechanism for assistance in the interpretation of system upsets.

At startup and at weekly intervals, the well head pressure and air flow rate at each bioventing well will be recorded. In addition, the pressure and air flow rate in each of the three main air headers on the blower pad will also be recorded. Blower outlet air temperature will be monitored and recorded as well.

The air flow measurements will require temperature correction.

For correcting variable area flowmeter readings when the fluid or operating conditions vary from the values for which the scale is calibrated. Applicable to standard (normal) units of measure such as scfm, scfh, and nm^3/h. Formula values are inch-pound units.

$$\text{Corrected Flow Rate} = \text{Scale Reading} \times \frac{\sqrt{\dfrac{(460+T_1)\times SG_1}{12.6+P_1}}}{\sqrt{\dfrac{(460+T_2)\times SG_2}{12.6+P_2}}}$$

Where:
SG_1 = Scale specific gravity
SG_2 = New specific gravity
P_1 = Scale operating pressure (psig)
P_2 = New operating pressure (psig)
T_1 = Scale operating temperature (°F)
T_2 = New operating temperature (°F)

The monitoring wells will be used for respirometry testing as described in Section 3.3.3 and SOP A6, Appendix A.

3.3.2 Chemical Parameters

Oxygen, carbon dioxide, and hydrocarbon concentrations will be measured during respirometry tests. Respirometry will be tested monthly for the first 3 months of operation and quarterly for the remainder of the project. The respirometry data will be used to characterize the progress of the cleanup and to determine any limitation to biological activity. See Section 3.3.3 and SOP A6, Appendix A, for additional discussion of respirometry testing.

3.3.3 Biological Parameters

The progress of the remediation will be tracked by performing monthly/quarterly respirometry tests. The site manager will oversee the performance of the monthly tests. During each test, the blower will be turned off or the South and East areas of the system will be isolated from injection flow and the rate of oxygen decline (consumption) will be measured over a period of 1 to 5 days. The respirometry testing will be performed in monitoring wells TW-01, MW-A, MW-B, MW-C, and MW-D. The rate of oxygen decline will be used by the Project Engineer to estimate a biodegradation rate. The biodegradation rate gives a current estimate of biological activity. As the cleanup progresses and fewer total recoverable petroleum hydrocarbons (TRPH) are available for biological consumption, the biodegradation rate will likely decrease. This indicates cleanup progress. By comparing several biodegradation rate measurements collected over a period of time, the Project Engineer will calculate an estimate of the overall cleanup. At the conclusion of the respirometry test, the air injection flow will be started again.

Monthly and quarterly estimates of biodegradation rates will be used by the Project Engineer to estimate a cumulative quantity of degraded TRPH. This cumulative amount will be compared to the historical (initial contamination quantity) estimate of TRPH for each area. This will provide an estimate of the progress of remediation. The results of the data evaluation will be documented in the Quarterly Progress Reports (see Section 5.4).

If the measured biodegradation rate drops precipitously from one monitoring period to the next and the cumulative quantity of TRPH degraded does not match the historical estimate it is possible that the subsurface may have become deficient in biological nutrients. The Project Engineer should give careful consideration to the operating and pilot test data and soil analytical results to determine the correct course of action. Nutrient addition is not typically required at bioventing sites and is not anticipated to be necessary for Site FT-31 (Leeson and Hinchee 1995). However, in the event that the Project Engineer deems this activity necessary, Section 3.5 provides a discussion of nutrient addition.

3.4 SYSTEM BALANCING

Each of the three areas at Site FT-31 (North Area consisting of SWMUs 39, 127, and 135; South Area consisting of SWMU 170; and East Area) will be supplied with injection air from a central blower station. The blower is capable of supplying all bioventing wells simultaneously.

Initially, pressure and flow rates for all wells will be monitored to document complete well coverage. As air flow is initiated and the wells are sequentially activated, pressures in the remaining wells will be observed and recorded. In addition, after all the bioventing wells are activated pressure and air flow rates will be observed and recorded. The nominal balanced airflow rate for all wells is 19 SCFM. Section 3.1.3 provides an additional discussion of system balancing at startup.

A log sheet will be maintained indicating date/time, pressure, and flow rate data for all wells during startup and during routine operation as a means to document air flow to each well. At startup, system balancing and data collection will be conducted daily. As experience is gained and operation becomes routine, flow rate and pressure data collection will occur weekly or less frequently.

3.5 NUTRIENT AND MOISTURE ADDITION

As discussed in Section 3.3.3, the addition of nutrients and moisture is not commonly required for bioventing systems (Leeson and Hinchee 1995). In addition, it is not anticipated that nutrients will be depleted or subsurface soils will desiccate to the point of affecting biodegradation at Site FT-31. The need for moisture addition is even more unlikely because the groundwater table at Site FT-31 is just below the bioventing soil zone. The project engineer will track the progress of bioventing through evaluation of the data collected during the monthly respirometry tests (see Section 3.3.3). If biodegradation drops precipitously from one month to the next and the cumulative quantity of TRPH degraded does not match the historical estimate, the project engineer will evaluate necessity for addition of nutrients or moisture. Successfully adding these components to the subsurface soils (12 to 26 feet bgs for Site FT-31) is a complex process. Therefore, before a decision is made to add nutrients or moisture, analyses for soil moisture and nutrient content should be conducted. If these analyses show reduced levels, then the project engineer will develop a detailed procedure for addition of the required components, including method of introduction to the subsurface, chemicals, quantities, application rates, and duration/frequency of application. These procedures cannot be prepared at this time because they are highly dependent upon the peculiar characteristics of the site and the results of the data collected from the respirometry tests and soil analyses. The following sections describe options for nutrient and moisture addition.

3.5.1 Nutrients

A key nutrient that may possibly limit biological activity at Site FT-31 is nitrogen. Lack of water may also limit biodegradation. Soil at the site has a measured total Kjeldahl nitrogen (TKN) level of 2 to 6 milligrams per kilogram (mg/kg). Typical bioventing sites have a minimum of 20 mg total nitrogen/kg soil (Leeson and Hinchee 1995). However, Site FT-31 has demonstrated that it can promote biodegradation at lower concentrations of vital components. Oxygen utilization and bioremediation performance may potentially be limited by a lack of nitrogen. Nitrogen nutrient addition may be required to achieve cleanup goals.

Two possible nitrogen nutrient addition options would be gaseous injection of ammonia into the injected air stream or application of a liquid nitrogenous fertilizer to the surface. If it is determined that the biodegradation process is nitrogen deficient, an engineering evaluation of the best nutrient addition scheme will be performed.

The simplest method for nutrient addition is through application of a liquid nitrogenous fertilizer to the surface using an irrigation truck. The quantity and concentration of the fertilizer solution should be determined by the project engineer depending upon the nutrient depletion, quantity of nutrient needed to raise the concentration to desired levels, and the site soil transport characteristics. At the next monthly respirometry test, the biodegradation rate will be evaluated to determine the success of the nutrient addition. Additional periods of irrigation may be necessary to obtain the desired soil nutrient content. The project engineer will determine the quantity, application rate, duration, and frequency of application required.

The second possible method for introduction of nutrient to the subsurface is through gaseous injection of ammonia into the bioventing system air supply. This method is much more involved and would require addition of ammonia injection equipment to the system blower. In addition, this method introduces worker health and safety concerns because of the use of a hazardous substance (i.e., gaseous ammonia). If the surface irrigation method is found to be inadequate in establishing the soil nutrient level needed for biodegradation, then the project engineer will evaluate the use of gaseous ammonia injection, including design specifications, feed rates, and frequency.

If analytical data indicates a deficiency in nutrients, both the liquid nitrogenous fertilizer and ammonia gas application methods will be evaluated to determine the best alternative. This evaluation will be performed by the Project Engineer.

3.5.2 Moisture

Bioventing injection air tends to dry subsurface soil. Local soils are generally greater than 4% moisture; however, there is little moisture recharge in this arid setting. The sensitivity of biological activity at Site FT-31 to moisture is unknown. Also, high native chloride levels in the soil may interact with low soil moisture to adversely impact biological activity. Should moisture become dramatically reduced, surface addition of water through the use of an irrigation truck or humidification of injected air can be performed to supply additional moisture. An engineering evaluation of the best moisture addition technique will be performed.

The simplest method for moisture addition is through application of water to the surface using an irrigation truck. Water has been added by this method at other bioventing sites in arid climates (Leeson and Hinchee 1995). In these instances, irrigation was performed for a period of 1 week, followed by 1 month of air injection. The level of surface soil saturation at Site FT-31, which is highly dependent on the season, should be evaluated taking into consideration evaporation of applied water to the atmosphere. At the next monthly respirometry test, the biodegradation rate will be evaluated to determine the success of the moisture addition. Additional periods of irrigation may be necessary to obtain the desired soil moisture content. The project engineer will determine the quantity, application rate, duration, and frequency of application required.

The second possible method for introduction of moisture to the subsurface is through injection of water into the bioventing system air supply (i.e., humidified air). This method is much more involved and would require addition of equipment to the system blower. If the surface irrigation method is found to be inadequate in establishing the soil moisture level needed for biodegradation, then the project engineer will evaluate the use of humidified air injection, including design specifications, feed rates, and frequency. If this method is used, the condensation of moisture downstream in the piping as it enters the lower temperature soil depths should be considered.

3.6 TROUBLESHOOTING GUIDE

Failure of mechanical components, inefficiency in the biological consumption process, and occurrence of external events (e.g., power outage) can result in system inoperation or inefficiency. The following discussions describe some of the possible problems that may require troubleshooting during system startup and operation.

3.6.1 Control Systems

Operational problems with control systems are usually caused by electrical problems in the controller, which requires a service call to the equipment supplier, or by exposure of components to extreme weather for which they were not designed. Enclosing the control system in a heated (or cooled) shed will help this situation, if weather extremes are anticipated.

3.6.2 Blower Shutdown

Events that may trigger a blower shutdown include a power failure, overheating of the blower, a no-flow condition caused by flow blockages upstream, or an opened pressure relief valve caused by overpressurization resulting from a downstream blockage.

3.6.3 Limited Biological Activity

As described in Section 3.5, biological activity at Site FT-31 may be limited by deficiencies in nitrogen or moisture. If this occurs, ammonia or water may need to be added to increase biological activity.

3.6.4 Power Loss

Power loss may be caused by many external circumstances, including power outage, inclement weather, and power line interruptions. If a power loss occurs, the automatic blower and other electrically operated equipment will shut down and the bioventing process will be interrupted. All electrically operated equipment should be checked to ensure they are in operation following any electrical interruption.

4.0 SYSTEM MAINTENANCE

Routine system O & M activities will consist of specific daily, weekly, and monthly baseline procedures that are to be followed. During the course of O & M, it is expected that other unscheduled tasks will also need to be conducted to maintain the operation of the equipment. Therefore, routine O & M procedures can be augmented by a change order prepared by the site manager. Routine activities are discussed in detail in the following three subsections.

4.1 OPERATIONAL INSPECTIONS

4.1.1 Daily Site Visits

Daily site visits will be conducted by an on-site technician. The primary purpose of these visits is to identify if the system is operating properly and to check the air filter, which, due to high amounts of airborne particulates, requires cleaning almost daily. Specific daily tasks are detailed on the Daily Site Visit Log (Appendix B) and include the following:

- Checking overall system operation.
- Checking the blower operation and collecting operational data, including hours of operation, air flow rates, and blower oil level.
- Recording any parts or equipment used on the system (including air filters) in the comment section of the visitation log.
- Conducting a visual inspection to make sure that the air filter is not plugged.

All data collected, including any additional comments, should be recorded on the Daily Site Visitation Log (Appendix B). These sheets should be copied daily and added to the document files as described in Section 5.3, Data Management.

4.1.2 Weekly/Biweekly Site Visits

Weekly and biweekly site visits will be conducted by a trained project technician. The purpose of these visits is to conduct a more thorough inspection of the system, to perform both routine and periodic maintenance on the various components of the remediation system, and to collect additional operational data. Specific routine biweekly tasks are detailed on the Weekly/Biweekly Site Visitation Log (Appendix B) and include the following:

- Checking overall system operation and checking for and removing any sand or debris from the equipment.
- Checking the blower and recording the following information: hours of operation, ambient air temperature, differential air filter pressure, oil level, air flow rates, discharge pressures, and discharge air temperatures for the North, South, and East legs of the air distribution system.
- Recording parts or equipment used on the system (including air filters) in the comment section of the visitation log.
- Sampling of oxygen, carbon dioxide, and methane gases in the monitoring wells with a GA-90 gas analyzer (biweekly).

All data collected, including any additional comments, should be recorded on the Weekly/Biweekly Site Visitation Log (Appendix B). These sheets will be copied and submitted in the document files as described in Section 5.3, Data Management.

An inventory and parts database will be established and maintained by the operator of the interim system. The database includes a list of replaced equipment such as air filters, oil, belts, etc.

4.1.3 Monthly Site Visits

Additional O & M and/or sampling activities are scheduled for the project on a monthly basis. The purpose of the monthly visits includes conducting routine and periodic maintenance of various components of the remediation system, collecting soil samples for nutrient analysis (biannually), and measuring gases in the monitoring wells. The activities are conducted in addition to the standard weekly/biweekly activities detailed in Section 4.1.2. The monthly O & M activities include the following:

- Cleaning the air filters and replacing them as necessary.
- Checking bolts for tightness.
- Checking belt integrity and tension.
- Checking inlet and outlet temperatures and pressures.
- Measuring gases in monitoring wells.

The O & M activities at other intervals include the following:

- Every 1,000 hours: grease bearings and change oil.
- Biannually: collect soil samples with a Direct Push Technology (DPT) rig for analyses as specified in Section 5.

4.2 ROUTINE MAINTENANCE PROCEDURES

Several general system operational procedures are detailed below. Note that these procedures should only be conducted by qualified, trained personnel.

4.2.1 Weekly Maintenance

- Check the gearbox oil level and fill as necessary.
- Inspect the belt tension and wear.
- Inspect bolt tightness.
- Check inlet and outlet temperatures and pressures.

4.2.2 Monthly Maintenance

- Change gearbox oil and refill to appropriate level.
- Grease all bearings with sufficient amount to push old grease out of bearings (every 1,000 hours).

4.3 STARTUP AND TROUBLESHOOTING

This section discusses the procedures for startup and troubleshooting of the Roots model 59 blower. Following these procedures will prevent unnecessary wear on the components of the Roots blower and reduce maintenance costs.

4.3.1 Prestartup Checklist

The prestartup checklist (Table 4-1) is as follows:

- Check leveling and belt and bolt tensions.
- Be certain that no bolts, tools, rags, or dirt have been left in the blower air chamber.
- Be certain that inlet piping is free of debris. If an outdoor intake without a filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen at the blower as described in the installation instructions is strongly recommended.
- Recheck blower leveling, drive alignment, and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- Make sure oil level in blower gearbox is correct.
- Check lubrication of driver. If it is an electric motor, be sure that power is available and that

electrical overload devices are installed and functional.

- Open the manual unloading valve in the discharge air line. If a valve is located in the inlet piping, be sure it is open.
- Bump blower a few revolutions with driver to check that direction of rotation is correct and that both units coast freely to a stop.

Table 4-1. Prestartup Checklist

Item Checked	Approved by	Date
System level		
Bolts tightened		
Belt tension		
Blower air chamber cleared of debris		
Air intake screened or air filter installed		
Drive alignment		
Impeller clearance		
Oil level		
Electrical installation		
Impeller rotation direction		
Inlet valve open		
Lubrication		

The no-load trial operation is to be performed as follows:

- Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.
- Repeat above procedure but let blower run 2 or 3 minutes. Check for noises and vibrations of 5 millimeters or greater.
- Operate blower for about 10 minutes unloaded. Check oil levels. Feel cylinder and headplate surfaces for development of spots too hot to touch, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Procedures for the 1-hour test run under normal operating conditions are as follows:

- After blower is restarted, gradually close the discharge unloading valve to apply working pressure.

- Measure discharge pressure and inlet and outlet air temperatures to make sure the blower is operating within its specified rating limits.
- Perform periodic oil level checks.
- If excessive noise or local heating develops, shut down immediately and perform troubleshooting to determine the cause.

4.3.2 Troubleshooting

The following table presents a checklist for troubleshooting the Roots blower.

Table 4-2. Troubleshooting Checklist

No Air Flow	Speed too low	Check by tachometer and compare with speed shown on Roots Order Acknowledgment.
	Wrong rotation	Rotate breather upward. Change driver if wrong.
	Obstruction in piping	Check piping, screen, valves, filter, silencer, to ensure an open flow path.
Low Capacity	Speed too low	See No Air Flow. If belt drive, check for slippage and readjust tension.
	Excessive pressure	Check inlet vacuum and discharge pressure, and compare these figures with specified operating conditions on Order.
	Obstruction in piping	See No Air Flow.
	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances.
Excessive Power	Speed too high	Check speed and compare with Roots Order Acknowledgment.
	Pressure too high	See Low Capacity.
	Impellers rubbing	Inspect outside of cylinder and headplates for high temperature areas, then check for impeller contacts at these points. Correct blower mounting, drive alignment.
Overheating of Bearings or Gears	Inadequate lubrication	Restore correct oil levels in gearbox and lubricate.
	Excessive lubrication	Check gear oil level. If incorrect, drain and refill with clean oil of recommended grade.
	Excessive pressure rise	See Low Capacity.
	Coupling misalignment	Check carefully. Realign if questionable.
	Excessive belt tension	Readjust for correct tension.
	Speed too low	Speeds lower than the minimum recommended will overheat the entire blower.
Vibration	Misalignment	See Overheating of Bearings or Gears.
	Impellers rubbing	See Excessive Power.
	Worn bearings/gears	Check gear backlash and condition of bearings.
	Unbalanced or rubbing impellers	Scale or process material may build up on casing and impellers or inside impellers. Remove buildup to restore original clearances and impeller balance.
	Driver or blower loose	Tighten mounting bolts securely.
	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping. Refer to Distributors.

4.4 CONSUMABLES AND SPARE PARTS INVENTORY

The FT-31 site bioventing system is a simplified unit and requires minimal spare parts and consumables. Air filters, grease, seals, and oil should be on hand for general maintenance and repairs. The air filters are Solberg Big Boy-type filters constructed of polyurethane foam and paper. The order number for the air filters is F-234P-400. The lubricating oil to be used will be of a good grade industrial-type rust, oxidation, and foam-inhibited, nondetergent oil such as Mobil DTE BB, Texaco R & O 220, Amoco 220, or equivalent. Grease used for lubricating bearings will be a NLGI #2 premium-grade, petroleum-base grease with high temperature (300°F service temperature), moisture resistance, and good mechanical stability. An inventory of spare shaft seals and belts should be maintained for the Roots Model 59 blower.

5.0 SAMPLING, ANALYSIS, AND REPORTING DOCUMENTATION

This section provides guidance for remediation goals, reporting, documentation, and sampling. Remediation goals for the bioventing system include the target level for remediation of TRPH at Holloman AFB. The sampling and analysis schedule indicates the frequency and types of sample collection. The subsection on data management and reporting provides a description of the types and formats of information to be recorded. Quality assurance (QA) procedures include the tasks to be performed to ensure the accuracy, completeness, and validity of information and data.

5.1 REMEDIATION GOALS

The Base cleanup level of 1,000 mg/kg TRPH is the remediation goal for the FT-31 site bioventing system. The duration of system operation is dependent on nutrient and oxygen levels, which significantly effect the contaminant degradation rate. The nutrient, oxygen, and contaminant levels will be monitored through real-time monitoring of gases in wells and collection of soil samples for laboratory analysis.

5.2 SAMPLING AND ANALYSIS SCHEDULE

Sampling will include the field screening of monitoring well gases and laboratory analysis of soil samples. During respirometry testing, the monitoring wells will be field screened for oxygen, carbon dioxide, and methane gases with a GA-90 gas analyzer. A Century organic vapor analyzer (OVA) model 128 or equivalent flame-ionization detector (FID) calibrated for hexane will be used to monitor levels of hydrocarbons in these same monitoring wells for respirometry data collection. Respirometry testing will initially be performed monthly and decreased in frequency depending on variation in results. Shortly after system startup, baseline soil samples will be collected for nutrients by DPT. During long-term operation of the bioventing system, soil samples will be collected by DPT biannually, depending on system performance. These soil samples will be analyzed for nutrients and contaminants. Nutrients consist of ammonia-nitrogen, nitrate/nitrite-nitrogen, TKN, iron and phosphorus. Contaminants consist of benzene, toluene, ethylbenzene, and xylene (BTEX) and TRPH. Decontamination water will be analyzed for

volatile organic compounds (VOCs). The nutrient parameter to be monitored for each sampling event will be determined based on the evaluation of the analytical data for the previous event. BTEX and TRPH will be analyzed for each sampling event.

Ammonia-nitrogen, nitrate/nitrite-nitrogen, TKN, phosphorus, iron, VOCs, BTEX, and TRPH will be analyzed in accordance with the United States Environmental Protection Agency (USEPA) Methods for Chemical Analysis of Water and Wastes methods 350.1, 353.2, 351.2 and 365.2 and USEPA SW 846 Test Methods for Evaluating Solid Waste methods 6010, 8260A, 8020A and 418.1, respectively. The frequency of sampling may be reduced on the basis of variation in sample results.

Table 5-1 presents the analytical method, container type (sample quantity), preservation, and holding time for the various soil and water parameters. SOPA3 discusses sample depths and locations for DPT soil collection.

Procedures for calibration of instrumentation and respirometry testing are included in SOPs A5 and A6, respectively.

5.3 DATA MANAGEMENT

This section provides a comprehensive guide for the management of all data generated during O & M activities. This includes analytical data, field notebooks, project files, and progress reports. This section describes how collected data will be properly handled and documented for future use. To track and document project data, the contractor will use a field notebook; daily, weekly, and monthly site visitation logs; chain-of-custody (COC) forms; sample inventories; and laboratory log books. The contractor will establish a data management plan to meet all data deliverables, which for this project does not include the requirements of the Installation Restoration Program Information Management System (IRPIMS).

Table 5-1. Sample Requirements

Matrix	Parameter	Method	Container	Preservation	Holding Time
Soil	Volatile Organics	8020A	1 x 2 oz G	Ice to 4°C	14d
Water	Volatile Organics	8260A	3 x 40 ml G Septa Vial	HCL to pH<2 Ice to 4°C	14d
Soil	Total Recoverable Petroleum Hydrocarbons	9071/418.1	1 x 4 oz G	Ice to 4°C	28d
Soil	Total Phosphorus	365.2	1 x 8 oz G [1]	Ice to 4°C	28d
Soil	Total Iron	6010	----------	Ice to 4°C	180d
Soil	Ammonia-Nitrogen	350.1	----------	Ice to 4°C	28d
Soil	Total Kjeldahl Nitrogen	351.2	----------	Ice to 4°C	28d
Soil	Nitrate/Nitrite-Nitrogen	353.2	----------	Ice to 4°C	28d

ml milliliter
G glass
°C degrees centigrade
d days
oz ounce
L liter
H_2SO_4 sulfuric acid
HCL hydrochloric acid

1) All inorganics are composited in one 8 oz glass jar.

There are five goals for the data management task:

- Archive project data and procedures to substantiate conclusions and recommendations drawn from the O & M activities.
- Provide timely access to an organized body of data to facilitate analysis and decision making throughout the investigation.
- Provide a useful centralized index of project information.
- Present project information in tabular and graphic form.
- Provide convenient and efficient access to project data for potential future investigation or remediation activities, if warranted.

The data management process is discussed below and addresses data and reporting requirements for O & M activities. There are multiple data streams and multiple possible end users of the data associated with the O & M of the FT-31 site bioventing system. The data management system implemented by the contractor will be capable of accurately and quickly tracking all pertinent

information associated with the O & M activities. In particular, once the contractor receives the laboratory results and performs necessary data loading and data validation procedures, the Base will be notified within 5 working days of the nature and extent of contamination.

5.3.1 Field Data Record

A bound field notebook will be used to permanently record all field activities and general observations. All pages of the field notebook will be signed and dated by the supervising field scientist who is entering the data. Also, the names and affiliations of all visitors on site will be entered in the notebook as well as general notes on project progress, problems encountered, and deviations from plans with rationale.

Data collected during the O & M activities will be recorded on individual forms provided in Appendix B. These forms, in addition to any site maps that are generated on graph paper, will be kept in a three-ring binder. Site visitation forms will be completed during each site visit. In addition, Daily Quality Control Reports (DQCRs) will be completed and submitted daily (Appendix B).

COC records will be completed to document the chain of possession and track the samples throughout shipping, handling, and analysis (Standard Operating Procedure (SOP) A1, Appendix A).

5.3.2 Field Data

Field data will include the data record (log books, site visitations, etc.) and results of field screening data. Field screening data (including results, duplicates, blanks, standards, etc.) should be recorded in a laboratory log book (similar to the field notebook) and on the site-specific data sheets provided in the appendices.

The contractor will maintain field records sufficient to recreate all sampling and measurement activities.

5.3.3 Laboratory Data

The laboratory will maintain the project-specific analytical data in hardcopy format and in electronic data files generated from instrumentation outputs. These data will include permanent records of laboratory documentation including analytical results, detection limits, analytical methods, sample preparation logs, instrument run logs, calibration data, and other related data. Both electronic and hardcopy logs will be required as part of routine data transfer. Analytical turn around time will not exceed 14 days. In addition, the contractor will provide USACE with copies of the laboratory data packages for Quality Assurance/Quality Control (QA/QC) evaluation.

5.3.4 Project File

The contractor will maintain a project file at a single location in which copies of all project data and written communications are stored. Contents of the project file will include progress reports, field data, laboratory data, copies of maps, and all other facility description data. Copies of these data will also be provided to the Base Environmental Coordinator (BEC), as required.

The BEC will maintain a project file at Holloman AFB that contains all information and data reports regarding the interim O & M project. The contractor will provide the Base with copies of all files and documents discussed below. A subject file index will be maintained such that documents in the file may be found easily. The project file will be maintained for a minimum of 5 years after the completion of the FT-31 site bioventing system O & M.

5.3.5 Status Reports

System status reports detailing the O & M activities and results will be prepared quarterly. The quarterly status report will contain the following:

- Review of system performance data

- Calculation of monthly and cumulative contaminant removal (Metrix Report)
- Operational summary of monthly and cumulative totals of total operation time (hours)
- Maintenance summary
- Field logs, visitation logs, and DQCRs
- Summary discussion on the effectiveness of the previous month's system enhancements
- Recommendations for future system enhancement

5.4 REPORTING

Progress reports will be submitted on a quarterly basis. These reports will be prepared to parallel the FWENC format used for previously submitted Long-Term Operations (LTO) reports. The previously submitted LTO reports contain a summary of system operations, recommended modifications, operational difficulties, analytical results, site visitation logs, DQCRs, and log book entries.

5.5 QUALITY ASSURANCE

Quality assurance will be performed to ensure the validity, completeness, and accuracy of reporting data. The reporting data, which include analytical results, DQCRs, site visitation logs, and log book entries, will be reviewed for correct formatting and completeness. Laboratory reports will be reviewed for accuracy and validity of analytical data. An evaluation of the quality control data associated with the project-specific data will be performed to ensure laboratory and method precision and data completeness.

5.6 QUALITY OBJECTIVES

5.6.1 Data Quality Objectives (DQOs)

Sampling and analysis will be conducted to determine the proper disposal options for decontamination water generated during remedial activities.

5.6.2 Analytical Support Levels

The analytical support levels for the FT-31 site bioventing system IRP will include screening level and definitive data as determined by the project DQOs. Screening level data will be

generated from the on-site screening of well gases using a GA-90 and Century OVA model 128 for determination of TRPH and respirometry. Definitive data will be generated by the off-site analytical laboratory for the analysis of soil for TRPH, BTEX, and nutrients and for the VOC analysis of the decontamination water.

5.6.3 Data Quality Indicators

Laboratory precision and accuracy data and reporting limits are provided in Appendix C.

5.6.4 Level of Field Quality Control Effort

One soil sample per sampling event will be collected and sent to the off-site laboratory as a field duplicate to assess sampling and analytical precision. Decontamination water samples will be packaged together and shipped to the off-site laboratory with one trip blank to be analyzed for VOCs.

One soil sample per sampling event will be collected and sent to the Missouri River Division laboratory as a quality assurance replicate. The sample will be analyzed for BTEX, TRPH, and the nitrogen parameters listed in Table 5-1.

5.7 SPECIAL VALIDATION

Laucks Testing is validated by USACE - Missouri River Division to perform the analytical procedures delineated in this project. All contact with Laucks will be made to the following address:

Laucks Testing Laboratories, Inc.
940 S. Harney Street
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6.0 WASTE MANAGEMENT PROCEDURES

Investigation-derived waste (IDW) generated during the O & M field activities will be handled in accordance with applicable New Mexico and federal regulations as discussed in Section 6.1, Waste Characterization Requirements.

6.1 WASTE CHARACTERIZATION REQUIREMENTS

The waste streams expected to be generated during the O & M activities will consist of decontamination water, personal protective equipment (PPE), paper towels, and used oil and equipment. Waste minimization techniques will be employed where possible to reduce the quantity of waste generated. Waste characterization will primarily be based on documented process knowledge. If necessary, waste will be directly sampled and analyzed for characterization purposes.

6.1.1 Regulatory Requirements

Project activities are expected to generate nonhazardous wastes and potentially hazardous wastes. As such, the following federal and state regulations are applicable and must be complied with during implementation of planned project activities:

- 40 Code of Federal Regulations (CFR) Parts 190–256 USEPA Regulations for Solid Waste
- 40 CFR Parts 260–299 USEPA Regulations for Identification and Management of Hazardous Waste
- 49 CFR Parts 100–178 Department of Transportation (DOT) Rules For Hazardous Materials Transport
- New Mexico Solid Waste Management Regulations
- New Mexico Water Quality Control Commission Regulations

As previously indicated, the purpose of this project is to achieve site closure objectives through bioventing of subsurface soils to reduce petroleum contamination to required levels while minimizing air emissions in a timely and cost-effective fashion. The following information is provided in reference to management and disposal of waste streams generated as part of the O & M during remedial activities.

Holloman AFB has reached an agreement with New Mexico Environmental Department (NMED) that NMED groundwater standards are applicable to any discharge of water to the ground and a Notice of Intent to discharge (NOI) is not required provided that the water discharged meets the NMED groundwater discharge standards.

Table 6-1 summarizes the NMED groundwater discharge standards applicable to discharges of water at Holloman AFB.

Table 6-1. Groundwater Discharge Standards at Holloman AFB

METHOD	PARAMETER	WATER CONCENTRATION (mg/L) (1)
USEPA Method 8260A: Volatile Organic Compounds	Benzene	0.01 (2)
	Toluene	0.75
	Carbon Tetrachloride	0.01
	1,2 - Dichloroethane	0.01
	Ethylbenzene	0.75
	Total Xylenes	0.62
	Methylene Chloride	0.1
	Chloroform	0.1
	1,1 - Dichloroethane	0.025
	1,1 - Trichloroethane	0.06
	1,1,2 - Trichloroethane	0.01
	1,1,2,2 - Tetrachloroethane	0.01
	Vinyl Chloride	0.001

(1) Mew Mexico discharge standards (2) 0.5-mg/l toxicity characteristic regulatory level
mg/l milligrams per liter

6.1.2 Anticipated Waste Streams

The anticipated waste streams associated with FT-31 site bioventing system O & M activities can be categorized as follows:

- Used oil
- Used equipment
- Decontamination fluids used to decontaminate field equipment and
- PPE

In addition to the waste descriptions below, Table 6-2 presents detailed waste management, transportation, and disposal requirements for each waste category.

6.1.3 Waste Descriptions

The following descriptions pertain to used oil and equipment, decontamination fluids, and disposable PPE.

6.1.3.1 Used Oil and Oil Filters

Oil drained and/or removed from the remediation equipment will be recycled at the Base's on-site recycling center. Oil will be collected in a DOT-approved container sealed with a lid. These materials will be taken to the used oil container at Building 231 or at the BX service station on the same day that they are accumulated. The used oil will be managed per 40 CFR 279 "Standards for the Management of Used Oil" as a nonhazardous recyclable material.

Used oil filters will also be managed as nonhazardous solid waste. These filters will be placed in sealed plastic trash bags and submitted to the Base's recycling center (Building 80) for disposal. The oil filters will be submitted to the Base's recycling center on the same day that they are accumulated.

Table 6-2. Waste Management Requirements

WASTE TYPES	CHARACTERIZATION REQUIREMENTS	APPLICABLE REGULATIONS	ALLOWABLE CONTAINMENT	STORAGE REQUIREMENTS	TRANSPORTATION REQUIREMENTS	DISPOSAL REQUIREMENTS
Used Oil & Equipment	Used equipment such as filters and oil will be handled as a Solid Waste (SW) and no analysis required. Used equipment, i.e., piping. Vessels and valves will be decontaminated and handled as a SW.	EIB/SWMR - 4 "Solid Waste Management Regulations." EIB/HWMR-7 Part II.201 and Part III.301 - "Identification & Listing of Hazardous Waste" and "Stds. Applicable to Generators of Hazardous Waste." 40 CFR 279 - Used oil. 40 CFR 268.48 - LDRs (UTS). 40 CFR 261.7 - RCRA empty container rule. 40 CFR 262 - Generator STDs.	DOT-approved 55 gal. (bunghole-type) metal drums (1A1 or 1A2), DOT-approved portable tanks (DOT 51,52, 53, 56, 57, and 60) or 55-gal bucket with sealed lid. Must be sealed when not being filled/unloaded. Used equipment such as filters will be double bagged. Piping will be cut to manageable lengths and put in Base-designated dumpsters.	Oil shall be delivered to the Base's recycle center (Bldg. 80) on the day that it is accumulated. Used equipment such as filters will be disposed on the day of accumulation.	None.	Dispose of oil at Bldg. 80. Dispose of filters and piping in a designated Base dumpster.
Decon Water	Need to determine whether decontamination water is a hazardous waste. Run a VOC analysis using EPA 8020A.	EIB/HWMR-7 Part II.201 and Part III.301 - "Identification & Listing of Hazardous Waste" and "Stds. Applicable to Generators of Hazardous Waste." 40 CFR 268.48 - LDRs (UTS). 40 CFR 262 - Generator STDs. EIB/SWMR - 4 "Solid Waste Management Regulations."	DOT-approved 55-gal. (bunghole-type) metal drums (1A1 or 1A2) or DOT-approved portable tanks (DOT 51,52, 53, 56, 57, and 60). Must be sealed when not being filled/unloaded.	90-day storage limit if determined to be a HW. Must be labeled with a completed HW label. Storage clock starts from the date that waste is first put into the container.	HW manifest DOT placarding. Must use an EPA-permitted transporter. Must also have LDR certifications as necessary. Individuals involved in overseeing or shipping hazardous materials must meet HM-181 & HM-126F training requirements.	If a HW, must be disposed at an approved RCRA TSDF having been approved CERCLA off-site waste. If not a HW, may dispose of into Base's WWTF or to a designated wastewater treatment unit, i.e., an O/WS approved in advance by HAFB personnel. RAA must approve TSDF and transporter prior to shipment of waste.
PPE	Decontaminated PPE will be handled as a SW and no analysis required. If not decontaminated then need to determine whether the PPE is a hazardous waste or not. Can run total analysis[1] or a TCLP.	EIB/SWMR - 4 "Solid Waste Management Regulations." EIB/HWMR-7 Part II.201 and Part III.301 - "Identification & Listing of Hazardous Waste" and "Stds. Applicable to Generators of Hazardous Waste." 40 CFR 268.48 - LDRs (UTS). 40 CFR 261.7 - RCRA empty container rule. 40 CFR 262 - Generator STDs.	Double plastic bags. DOT-approved 55-gal. (bunghole-type) metal drums (1A1 or 1A2) or DOT-approved portable tanks (DOT 51,52, 53, 56, 57, and 60). Must be sealed when not being filled/unloaded. If a container involved and is "empty," i.e., < 1-inch liquid then container is not a HW.	Once bagged, keep separate from other waste. 90-day storage limit if determined to be a HW. Must be labeled with a completed HW label. Storage clock starts from the date that waste is first put into the container.	None HW manifest DOT placarding. Must use an EPA-permitted transporter. Must also have LDR certifications as necessary. Individuals involved in overseeing or shipping hazardous materials must meet HM-181 & HM-126F training requirements.	Dispose at approved landfill. If a HW, must be disposed at an approved CERCLA off-site TSDF. RAA must approve TSDF and transporter prior to shipment of waste.

Note: 1 If a total analysis is chosen and the results indicate that a constituent is more than 20x the appropriate TC level then a TCLP will have to be run.

6.1.3.2 Used Equipment

There is one 4-inch-diameter combination paper/polyurethane foam filter mounted on the blower intake. This filter is used to prevent damaging airborne particulates from entering the blower through the air intake. Because of the high quantity of airborne particulates in the area, cleaning of these filters is required almost daily. These filters will be disposed when they become unsuitable for reuse.

Spent filters will be placed in sealed plastic trash bags and disposed as nonhazardous solid waste. The filters will be placed in a dumpster designated by Base personnel.

6.1.3.3 Decontamination Water

Equipment will be decontaminated as described in this SOP A2, Appendix A. Decontamination water will be containerized in drums or tanks and will be sampled, analyzed, and characterized prior to disposal. If decontamination water analysis indicates that no hazardous waste is present and the water meets NMED groundwater discharge standards, it can be discharged to the ground. If the analysis indicates that constituent levels are above NMED groundwater standards and that the decontamination water is not a hazardous waste, it will be discharged to the Base wastewater treatment facility. An alternate disposal method would be to discharge the decontamination water at a designated O/WS or to the Holloman AFB wastewater treatment facility if the system is on line and the discharge is approved by Base personnel. Wastewater that is characterized as a hazardous waste will be disposed at an approved off-site, fully permitted Resource Conservation and Recovery Act (RCRA) Subtitle C Treatment, Storage, and Disposal Facility (TSDF).

6.1.3.4 Personal Protective Equipment

Protective clothing and sampling equipment is typically collected on a daily basis in plastic garbage bags and disposed in a drum or storage container dedicated for this type of waste. PPE worn by observers or other site personnel who do not come into any contact with contaminated media can be disposed as domestic waste. Properly decontaminated PPE, clothing, and/or miscellaneous sampling equipment solid waste may be considered nonhazardous. If disposable PPE and equipment are used to manage characteristic hazardous waste, the PPE itself should be managed as

a solid waste unless extremely contaminated. The proposed classifications will be reviewed and approved by Holloman AFB.

6.1.4 Waste Characterization/Classification

Decontamination water will be sampled and characterized in accordance with 40 CFR 262.11. To meet these testing requirements, representative samples will be taken in accordance with federal and New Mexico Hazardous Waste Management Regulations (HWMR). Any additional waste streams not addressed in this manual will be sampled and/or characterized in accordance with 40 CFR 262.11.

To determine proper waste management requirements for waste generated during remedial activities, hazardous waste characterization is necessary. Wastes are determined to be characteristically hazardous on the basis of their chemical constituents or physical properties. Listed wastes are specifically identified in 40 CFR 261 Subpart D. Based on process knowledge and existing supporting data, as established in the FT-31 RCRA Facility Investigation (RFI), no hazardous constituents have been identified in soil in excess of site screening levels or established background levels with the exception of TRPH and BTEX contamination (FWENC and Radian 1995).

Characteristic hazardous wastes are those wastes that exhibit toxicity in excess of the values indicated in 40 CFR 261 Subpart C. An exceedance of a toxicity characteristic is generally determined through comparison of a waste's constituent concentration with listed Toxicity Characteristic Leaching Procedure (TCLP) regulatory levels. In lieu of performing a TCLP test, a total analysis of a waste may instead be performed to determine whether individual analytes are not present at concentrations greater than 20 times the listed toxicity characteristic values for TCLP analytes. The 20 times value mentioned above is related to the dilution factor used in the TCLP test. Consequently, TCLP analyses may not have to be performed if the total value is less than 20 times the indicated regulatory level for a particular constituent.

The RFI data indicate that the only potentially hazardous analyte of concern present at Site FT-31 is benzene, which is below the regulatory threshold level to be a characteristic hazardous waste. A VOC analysis performed according to USEPA Method 8260A for VOC constituents will be used to characterize decontamination water to determine whether the water can be discharged on site or whether it has to go to the wastewater treatment facility (WWTF).

Waste testing necessary to characterize and manage wastes generated during remedial activities has been reduced by using RFI- and construction-generated analytical data. Consequently, testing requirements for hazardous waste and special waste classification have been established to include the following testing protocols:

- VOCs - for decontamination water (USEPA Method 8260A for VOC constituents)

Documentation of all proposed waste classifications will be provided to Holloman AFB.

6.1.5 Hazardous Waste Management

New Mexico's HWMR stipulations are found in EIB/HWMR-7. RCRA Subtitle C and the New Mexico HWMR govern hazardous wastes from the point of generation through treatment and storage to their ultimate disposal. The NMED Hazardous Waste Bureau oversees management of the hazardous waste program in New Mexico. FWENC will be responsible for proposing waste classification to Holloman AFB for their approval an subsequent decision to ship waste off site, if necessary.

Hazardous waste must comply with the following requirements:

- Any waste generated during Site FT-31 remedial activities that will be shipped off site for disposal must be characterized to determine if it is a hazardous waste. Based on RFI data, testing will be limited to VOC analysis for decontamination water.

- Hazardous waste must be managed in accordance with 40 CFR 262 "Standards Applicable to Generators of Hazardous Waste."

- Hazardous waste transported off site must be manifested in accordance with 40 CFR 262 Subpart B "Manifests" and accompanied by Land Disposal Restriction (LDR) certification notices as per 40 CFR 268.7 "Waste Analysis and Recordkeeping."

- Hazardous waste must be stored in accordance with 40 CFR 265 Subpart I "Use and Management of Containers."

- All containers of hazardous waste to be stored or disposed will be clearly marked with a completed hazardous waste label, indicating the starting date of accumulation, USEPA identification number, USEPA waste code, etc., and DOT markings.

- Hazardous waste may be stored on site for a maximum of 90 days. The 90 days begin on the date that the waste is first generated and containerized (i.e., the first drop of waste is placed in a container).

- Hazardous waste must be disposed only at a hazardous waste disposal facility permitted for the disposal of the particular type of hazardous waste generated.

6.1.6 Waste Containerization and Storage

Container selection will be performed by DOT-trained personnel and will be based on type and quantity of waste to be generated. Containers may include either DOT-specification drums or rolloffs for regulated hazardous material.

Prior to starting remedial activities, the FWENC site manager will, in conjunction with Holloman AFB personnel, select areas for the temporary staging and storage of decontamination fluids and hazardous waste.

Waste material must be classified according to USEPA and DOT criteria prior to affixing labels. Upon classification, the regulatory specialist will direct the application of appropriate hazardous/nonhazardous waste and DOT labels, complete with proper information specific to each waste stream. Each container will be marked and labeled as required by USEPA and DOT, if applicable. All DOT functions will be conducted by trained personnel as required by 49 CFR 172 Subpart H.

At the time of generation, all waste containers will be labeled, using indelible ink, with the following information:

- Source and location
- Contents and quantity of material in the container
- Potential health, safety, and environmental hazards

- Accumulation start date (the date the first drop of material was placed in the container)
- Date container sampled
- Parameters analyzed for
- "ANALYSIS PENDING"

Containers determined to contain hazardous waste will immediately be labeled with a completed commercial USEPA "HAZARDOUS WASTE" label, which will include the accumulation start date and other requested information.

All hazardous waste will be stored on wooden pallets in DOT-approved containers at Holloman AFB's 90-day storage facility or the Defense Reutilization and Marketing Office (DRMO). The area will be secured with a standard Holloman AFB chain link fence, and signs reading "DANGER-UNAUTHORIZED PERSONNEL KEEP OUT" will be posted at the entrance and on all sides of the enclosure. An inventory of waste containers will be maintained for later submittal to and inspection by the USACE and Holloman AFB.

Containers of hazardous waste will be inspected and logged weekly while the field work is in progress. Inspection will encompass evaluation of proper labeling, secure closure, the condition of each container, number of containers, and the condition of the storage area. Any signs of deterioration, leaking, or dents will be noted, and containers will be immediately overpacked, if necessary. Standing water will be removed from the containment area as necessary. Inspection results will be provided to the USACE and Holloman AFB. The containers will be transferred over to Holloman AFB after waste characterization, as defined in this section.

All containers will be checked to ensure labels and markings are in good condition. DOT information for hazardous materials, including proper shipping descriptions and hazard class labels, will be added prior to shipping.

Hazardous waste will be disposed by sending it to either the Holloman AFB 90-day storage area or the DRMO RCRA storage facility or to an off-site TSDF that has been approved by the Base and USACE.

6.1.7 Documentation

The information contained in this section applies to all waste managed during environmental data collection activities. Field records will be kept of all disposal activities. The logs and records will include the following information as required for the type of waste generated:

- Description of generating activities
- Location of generation (including depth, if applicable)
- Type of waste
- Date and time of generation
- Date and time of disposal of each type
- Disposal location of each type
- Disposal method and description of any waste sampling, including:
  - — Type of test
  - — Laboratory where sample is to be sent
  - — Sampling method
  - — Name of sampler
- Name of person recording information
- Name of field manager at time of generation and at time of disposal
- Test results
- Inspection logs
- Waste documentation, including:
  - — Waste profile sheets
  - — LDR certification
  - — Hazardous waste manifest
  - — Trip tickets or bills of lading
  - — Copies of any state or local permits or approvals

Transportation

Transportation documentation will comply with DOT regulations (49 CFR 100-178) and will be prepared by personnel trained according to the requirements of HM-181 and HM-126F (DOT 1982 and 1992).

Containers will be marked, labeled, and/or placarded prior to off-site transport. TSDF waste profile sheets, LDR notifications, waste manifests, and shipping documents will be prepared for Holloman AFB officials to review and sign.

All waste transporters used for Holloman AFB projects will be registered with NMED and approved in accordance with FWENC procedures for TSDF and transporter approval.

Hazardous Waste Manifests and LDR Certification

All hazardous waste transported from the site will be accompanied by a Hazardous Waste Manifest. New Mexico does not provide a standard state manifest, so the receiving state manifest must be used unless that state does not have a state manifest, and then a Uniform Hazardous Waste Manifest may be used.

Holloman AFB personnel will be responsible for reviewing and signing all waste documentation, including waste profiles, manifests, and LDR notifications (manifest packages). Prior to signing the manifest, the designated Holloman AFB official will ensure that the pretransport requirements of packaging, labeling, marking, and placarding are met according to 40 CFR 262.30-262.33 and 49 CFR 100-177.

If more than one transporter is used, each transporter will provide the date of receipt and total weight or volume of said waste received from the previous transporter, information to be provided by the current transporter.

The manifest will be signed by Holloman AFB personnel, each transporter of the waste, and the TSDF operator. All signatories will be duly authorized agents of their organizations. Significant discrepancies will be reported to the NMED Solid Waste Bureau within 24 hours of discovery.

Holloman AFB will receive one copy of the manifest; the remaining copies will be given to the transporter. The manifest will be returned to the Holloman AFB signatory official to be placed on file.

Copies of all manifests for waste generated at the site will also be kept in a central file. The state copy of the manifest will be sent to the state by Holloman AFB.

An LDR form will accompany the shipment of hazardous waste to the TSDF. The TSDF must be notified prior to sending the waste. The following items must accompany the notification and are included in one of the following facility-specific forms:

- USEPA and New Mexico Hazardous Waste Generator ID number (provided by Holloman AFB)
- Manifest number, including state disposal application number
- Waste analysis data
- If the waste is also restricted, corresponding concentration-based or technology-based treatment standards or prohibition

6.1.8 RCRA Records Retention

The designated Holloman AFB manifest signatory official will be responsible for ensuring that all RCRA record-keeping requirements are met according to 40 CFR 262.20-262.44, including retention of signed copies of manifests from the designated facility that received the waste. The copy must be maintained for a period of at least 3 years from the date the waste was accepted by the initial transporter. Additionally, biennial and exception reporting must be submitted, as necessary, according to 40 CFR 262.41 and 262.42, respectively. Additional reporting may be required according to 40 CFR 262.43.

Compliance files will be maintained by the delivery order manager in the project files. The compliance file must contain a completed project questionnaire, this plan, and any updates to this plan or the questionnaire. Filing of project documents shall conform to Foster Wheeler Environmental Regulatory Compliance Program Manual Policy and Procedure RC 7 "Documentation and Records Retention - Environmental Compliance File Index."

6.2 TRAINING/CERTIFICATION REQUIREMENTS

This section presents the DOT training and certification requirements for personnel involved in the remediation project. In addition, all employees will be trained in Foster Wheeler's Environmental Compliance Policies and Procedures to ensure that they are familiar with the program. These policies and procedures meet Department of Justice requirements for a sound environmental management program. Occupational Safety and Health Administration (OSHA) training and certification requirements are detailed in Section 9.8, Training and Communication.

All personnel who perform or oversee DOT-related activities must be DOT trained. DOT training records will be maintained in project files on site. A copy of the DOT training records should also be sent to the compliance officer for the regulatory compliance files.

7.0 CONTINGENCY PLAN

7.1 MECHANICAL CONTINGENCIES

As a contingency, if underground transfer pipes between the JP-4 tank and the burn areas are encountered during O & M activities, they will be drained and managed as a recovered product and will subsequently be abandoned in place (Section 3.0, FWENC 1996).

7.2 SYSTEM MODIFICATIONS

Most bioventing system modifications are made because air movement is not occurring where it is needed or the equipment is not functioning as designed. The system is initially designed so that the well spacing allows for overlap of coverage to ensure an adequate supply of air. Optimization may become necessary if hot spots remain following an extended period of system operation. In addition, if respirometry testing shows limited biological activity, nutrients may be added or modifications to the flow rate may be necessary. Flow rates may be modified by partially closing some valves at the well heads. If a system modification is determined to be necessary, then the problem should be documented, an analysis conducted to determine the solution, and approval for modification obtained.

7.3 CRITERIA FOR TRIGGERING CORRECTIVE ACTIONS

If determined to be necessary, nutrients (nitrogen and phosphorous) may be added at the sites to facilitate microbial growth to promote biodegradation. Nutrients may be added via surface liquid application or gaseous subsurface injection using the blower. Specific requirements for nutrient addition and sampling are addressed in Section 3.5. One criterion for making this decision is a dramatic decrease in biodegradation rates that is not the result of depleted petroleum.

8.0 SYSTEM SHUTDOWN AND CONFIRMATION OF CLEANUP

8.1 SHUTDOWN STRATEGY

After 1 year of operation, subsurface soil test samples will be collected from each site to document in situ remediation progress and assess continued operational requirements. If bioventing continues beyond the first year, sampling may be conducted on a quarterly or biannual cycle until it can be confirmed that cleanup goals have been achieved (Section 4.0, FWENC 1996). The cleanup goal for Site FT-31 is 1,000 mg/kg residual TRPH.

8.2 CONFIRMATION SAMPLING REQUIREMENTS

To verify that cleanup criteria have been achieved, confirmatory soil sampling will be performed. The sampling will follow the procedures described in Section 5.0 and Appendix A. Soil samples will be collected by DPT. One confirmatory soil sample will be collected from each of the three plume areas on a biannually basis, depending on system performance. The samples will be analyzed for nutrients, BTEX, and TRPH using the analytical methods specified in the Section 5.0 and results will be verified using the contract standard QA/QC procedures. The results of the sampling analyses will be compared to the cleanup criteria (1,000 mg/kg residual TRPH) to determine if remediation has been achieved.

8.3 SYSTEM SHUTDOWN CHECKLIST

There are three ways the system may be shut down: (1) emergency, which may result from power loss or equipment failure; (2) maintenance shutdown; and (3) remediation shutdown. When the system is shut down, it is important to check the systems to minimize hazards, to ensure proper operation, and to aid in future decontamination of equipment and remediation areas. The steps that should be taken for each of the three types of shutdown are described below.

8.3.1 Emergency Shutdown

If the system is automatically shut down, it should be carefully checked before being returned to operation to determine the cause of the shutdown. The system should be inspected for

broken/failed equipment, upgradient or downgradient blockages, and electrical power failure. If there are no apparent causes for system shutdown, the system can be restarted but should be monitored for problems.

8.3.2 Maintenance Shutdown

If the system is intentionally shutdown, subsystems should be checked. Decontamination of the system can lessen exposure problems during maintenance and dismantling of equipment. Steps include the following:

- Shutting down blowers
- Closing isolation valves
- Disconnecting electrical power to equipment
- Logging the event in the field log book

Once the system has been safely shut down, maintenance activities, as described in Section 4.0, can be conducted.

8.3.3 Remediation Shutdown

If any one of the three Site FT-31 areas is determined to meet the cleanup goal and remediation is completed, final shutdown may begin. The wells for each area can be fitted with a well head valve to isolate each well or area when criteria have been met. If any one of the areas is shut down before the others, then the flow rate to the other areas should be readjusted. Final shutdown of the system should follow the same procedures as those stipulated for maintenance shutdown and should include system decontamination prior to removal of system equipment.

8.4 CLOSURE REPORT

Once remediation has been completed, a closure report will be prepared to verify and document the activities and results of the remediation at Site FT-31. The report should contain the following:

- Review of system performance data
- Calculation of cumulative contaminant removal

- Documentation of the cleanup, including results of the respirometry testing and confirmatory soil sample analyses
- Recommendation for closure

9.0 SITE HEALTH AND SAFETY REQUIREMENTS FOR O & M ACTIVITIES

9.1 PERSONNEL AND RESPONSIBILITIES

- On-site Personnel:

Team	Project Title/Assigned Role	Phone Numbers
Dan Holmquist	Site Manager	(505) 479-2668
Dave Rizzuto/Dino Bonaldo	Task Supervisor(s)	(505) 479-2668
Dino Bonaldo	Site Safety and Health Supervisor	(505) 479-2668

- Other Project Personnel:

Name	Project Title/Assigned Role	Phone Numbers
Sina Seyedian	Project Manager	(303) 988-2202
Diane Morrell, CIH	Project Health and Safety Manager	(303) 988-2202
Ron Versaw	Delivery Order Manager	(303) 988-2202

9.1.1 Roles and Responsibilities

The roles and responsibilities of site and home office personnel are addressed in the Final Basewide Health and Safety Plan (EBASCO 1995).

9.2 HAZARD ANALYSIS

Job safety analysis (JSA) are used to identify hazards associated with job tasks. The Basewide Health and Safety Plan has several JSAs applicable to the tasks associated with long-term operations for the O & M of the FT-31 site bioventing system (EBASCO 1995).

Table 9-1 contains JSAs for potential hazards that may be encountered while engaging in site-specific tasks for this project that are not addressed by the Basewide Health and Safety Plan. The Site Health and Safety Officer (SHSO) will inspect the site to ensure that all of the tasks conducted at the site are performed according to the JSAs. Additional JSAs can be added in the future as an amendment to this document to address any unexpected or unforeseeable hazards. The minimum PPE required for job tasks is work clothes; however, upgrades may be necessary based on dermal or inhalation exposure potential (Table 9-2). The site and safety requirements of this document will be periodically reviewed by the Project Manager, SHSO, and the Project

Table 9-1. Job Safety Analysis

Activity	Potential Hazards	Recommended Control Measures
Routine Maintenance, Operation, or Repair -- No contact with contaminated liquids, solids, or other hazardous chemicals.	Improper lifting	Recommended Control Measures Controls include: • Design of work flow to minimize manual lifting and minimize distances load area carried. • Lift heavy or awkward loads using a mechanical device or ask other individuals for help. • Provide training in proper lifting technique.
	Struck by equipment	Controls include: • Use a spotter to direct equipment movement.
	Slips, trips, and falls	Controls include: • Keep work area clean and orderly at all times. Regularly dispose of all debris. • Use guard rails or other appropriate fall-protection systems for all work activities that take place 6 feet or more above the next working surface.
	End running or rotating nip or pinch points	Controls include: • Only use equipment for which machine guarding is provided for all belts, pulleys, fly wheels, or other potential end running or rotating nip or pinch points. • De-energize and lock out all equipment in accordance with HS 6-5[1] prior to removing the machine guards for any purpose.

Table 9-1. Job Safety Analysis **Page 2 of 3**

Activity	Potential Hazards	Recommended Control Measures
	Electrical	Controls include: • Adequately cover all electrical contacts. • Before exposing or working on electrical systems, de-energize and lock out in accordance with HS 6-5[1]. • Do not perform maintenance procedures requiring voltage or amperage measurements of live systems unless you are a Competent Person. Currently, only Dave Rizzuto is approved to perform this work.
	Noise	Controls include: • Use hearing protection when performing work activities inside the fenced areas.
	Heat Stress	Controls include: • Training in hazards of heat stress. • Provide adequate supplies of cool drinking water or electrolyte drinks. • Implement buddy system. • Take breaks in shaded areas as necessary.
	Fire	Controls include: • NEC/NFPA-approved electrical and mechanical components as required by the design specifications. • Complete training in the use of fire extinguishers. • Use fire extinguishers on small fires. • Coordinate emergency response procedures with the Fire Department. • Store all flammable liquids in accordance with 29 CFR 1910.106. • Only use bonded and grounded containers to transfer flammable liquids. • Only use UL- or FM-approved fuel storage cans used for gasoline or diesel.

Table 9-1. Job Safety Analysis

Activity	Potential Hazards	Recommended Control Measures
	Cuts, abrasions, contusions or burns	Controls include: • Use hand tools for the job they were designed. • Wear leather gloves as appropriate. • Be aware of and avoid hot surfaces.
Routine Maintenance, Operation, or Repair -- Potential for contact with hazardous liquids or solids	All Potential Hazards addressed above are applicable	Controls include: • See control measures for all hazards above.
	Exposure to contaminated groundwater	Controls include: • PPE as required by Table 9-2 • Air monitoring as required by Table 9-3. • Decontamination as required by Section 9.4.
	Exposure to LNAPLs	Controls include: • PPE as required by Table 9-2. • Air monitoring as required by Table 9-3. • Decontamination as required by Section 9.4.
	Exposure to muriatic acid	Controls include: • PPE as required by Table 9-2. • Air monitoring as required by Table 9-3. • Decontamination as required by Section 9.4.
	Exposure to oils, lubricants or greases	Controls include: • PPE as required by Table 9-2. • Air monitoring as required by Table 9-3 • Decontamination as required by Section 9.4.

1 - Procedure located in Foster Wheeler Environmental Corporation's Health and Safety Program Manual

Table 9-2 PPE Requirements **Page 1 of 1**

Activity	Required PPE
Routine maintenance, operation, or repair activities: no contact with contaminated liquids, solids, or muriatic acid.	• Work clothing (sleeved shirts, long pants) • Hard hat • Safety glasses • Steel-toed work boots • Hearing protection around T-38, 828, and BX systems when operating • Leather or cotton gloves optional
Routine maintenance, operation, or repair activities: potential contact with contaminated liquids or solids other than muriatic acid and well-level measurement and well-sampling activities.	• Work clothing (sleeved shirts, long pants) • Hard hat • Safety glasses • Steel-toed work boots • Hearing protection (see above) • Nitrite gloves • Respirator (in accordance with Table 7-1)–Level C • Tyvek coveralls if contact extends to areas of the body–Level C
Repair of refractory lining in the T-38 and Building 828 Thermox units: confined space entry.	• Cotton coveralls • Tyvek coveralls • Full facepiece air-purifying respirator with organic vapor/HEPA cartridges • Steel-toed work boots • Leather (no chemical contamination) or nitrile gloves for refractory removal and application
Cleaning of T-38 and Building 828 aerator trays with muriatic acid.	• Poly-coated or Saran-coated tyvek or rubber splash apron–Level C • Nitrile gloves • Splash goggles • Face shield • Hard hat • Steel-toed work boots • Full face piece air-purifying respirator with acid gases cartridges (in accordance with Table 7-1)–Level C

Health and Safety Manager (PHSM) to determine if changes are needed. If any of these changes are due to change in the scope of work of this project and/or site conditions, this section will be amended in writing on the Field Change Request Form, provided in the Basewide Health and Safety Plan and approved by the PHSM.

9.2.1 Chemical Hazards

The only waste contaminants identified in groundwater or soils at the sites are TRPH and gasoline. The toxicological information regarding this compound is provided in subsequent text.

9.2.1.1 TRPH and Gasoline as Total Volatile Organics/BTEX Compounds

Exposure to the vapors of BTEX above their respective permissible exposure limit (PEL), as defined by OSHA, may produce irritation of the mucous membranes of the upper respiratory tract, nose, and mouth. Overexposure may also result in the depression of the central nervous system. Symptoms of such exposure include drowsiness, headache, fatigue, and drunken-like behavior. Benzene has been determined to be carcinogenic, targeting blood-forming organs and bone marrow.

It is unlikely that site activities will generate significant quantities of airborne vapors in open or well ventilated spaces. Therefore, the inhalation exposure potential is expected to be less than the OSHA PEL or the American Conference of Governmental Industrial Hygienist threshold limit values (TLV).

Repeated skin contact with the contaminants or contaminated soils can cause skin and mucous membrane irritation and dermatitis depending on duration of exposure and the employee's personal hygiene habits. Employees will be provided chemical protective gloves as necessary and encourage good personal hygiene habits while performing O & M activities at Site FT-31.

9.2.2 Physical Hazards

A Competent Person must perform frequent and regular inspections of the site, materials, and equipment in accordance with 29 CFR 1926.20 to identify site hazards. All personnel on site should be provided with the information and training necessary to avoid accidental injury. This includes assuring that the site is maintained in such a way that slip, trip, and fall hazards are recognized and eliminated or controlled. Basic PPE (steel-toed boots, hardhats, and safety eyewear) must be available and its use enforced.

9.2.2.1 Electrical

OSHA and USACE (EM 385-1-1) regulations require that employees who may be exposed to electrical equipment be trained to recognize the associated hazards and the appropriate control methods. All extension cords used for portable tools or other equipment must be designed for hard or extra usage and be (three-wire) grounded.

All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites and other locations where moisture/water contact may occur must be equipped with ground fault circuit interrupters (GFCI) units. GFCI units must be attached directly to or as close as possible to the receptacle because only the wiring plugged into the GFCI and outward will be protected by the GFCI.

Whenever conducting maintenance on electrical equipment, lockout/tagout procedures to isolate the unit and all associated equipment must be used. Site specific lockout/tagout procedures are presented in the Basewide Health and Safety Plan, and in Foster Wheeler Environmental Corporation Health and Safety Procedure HS 6-5 (FWENC 1995).

All temporary lighting lamps for general illumination must be protected from accidental breakage. Metal case sockets must be grounded.

All electrical equipment (tools, lights, extension cords, etc.) must be visually inspected prior to use. Equipment which could expose personnel to electric shock must be removed from service.

9.2.2.2 Fire and Explosion

The possibility of flammable materials being encountered during field activities must be recognized and the appropriate steps necessary to minimize fire and explosion must be observed. This includes situations where excessive organic vapors (sustained readings 500 units on a photoionization detector (PID) or FID) or free product are encountered. When this occurs, monitoring with a combustible gas indicator (CGI) is required.

If vapor concentrations are likely to be in the flammable ($\geq$ lower explosive limit (LEL) $\leq$ upper explosive limit (UEL)) range the following requirements apply:

- If forced (mechanical) ventilation is used, all such equipment must be approved for Class I, Division I hazardous atmospheres. The blower must be positioned to blow across the source so that gases and vapors may be diluted as they exist. Do not attempt to suck out the gases or vapors. Blowers, all other mechanical equipment, and tools which could release sparks or static electricity must be bonded and grounded.

- The atmosphere surrounding the source must be frequently monitored using direct reading instruments approved for Class I, Division I hazardous atmospheres. Monitoring should be conducted within 1 to 2 feet of the source.

- If combustible gas levels equal or exceed 10 percent of the lower explosive limit (LEL), when monitored as described above, operations should be immediately shut down and the area evacuated until appropriate control measures have been implemented and levels have been resampled and verified safe for reentry.

- Regardless of actual instrument readings, if all sources of ignition cannot be controlled, operations should be immediately shut down and the area evacuated until ignition sources have been eliminated. Ignition sources include, but are not limited to: smoking, static electricity, lighting, open flames, spontaneously ignitable substances, frictional heat or sparks, hot surfaces, radiant heat, electrical sparks, stray currents, cutting and welding, and ovens, furnaces and heating equipment.

- In situations where flammable solvents are used for O & M activities, the following precautions must be observed: Keep flammable and combustible materials away from heat,

sparks and open flames. Do not smoke around flammable or combustible materials. Keep all flammable and combustible liquids in approved and properly labeled safety containers.

- At least one 10-pound ABC fire extinguisher must be located within 100 feet of each work area.

9.2.2.3 Heat and Cold Stress

Overexposure to temperature extremes can represent significant risks to personnel if simple precautions are not observed. Typical control measures designed to prevent heat stress include dressing properly, drinking plenty of the right fluids, and establishing an appropriate work/break regimen. Typical control measures designed to prevent cold stress also include dressing properly, and establishing an appropriate work/break regimen. The Project Manager must assure that the appropriate measures are observed. Refer to the Basewide Health and Safety for more information.

9.2.2.4 Traffic Safety

All project staff operating a vehicle on site must follow all base traffic regulations. The use of seat belt is required when vehicles are in motion.

9.2.2.5 Pedestrian Traffic

The uncontrolled presence of pedestrians at Site FT-31 can be hazardous to both pedestrians and site workers. Prior to the initiation of site activities, the site should be surveyed to determine when and where pedestrians may gain access. This includes walkways, gates, and doorways. If work activities are subject to pedestrian traffic, barriers or caution tape should be used to exclude all non-work related pedestrian traffic.

9.2.2.6 Noise

The mechanical equipment for FT-31 site bioventing system is a potential source of noise exposure. In order to reduce the exposure to this noise, personnel working in areas of potential noise exposure must use appropriate hearing protectors (ear plugs or ear muffs).

9.2.2.7 Thermal Hazards

Whenever possible all hot surfaces in the FT-31 site bioventing system will be insulated to protect personnel working in the area. Hot surfaces that cannot be insulated (i.e. control valves) are posted with warning signs.

9.2.2.8 Manual Lifting and Material Handling

Always bend at the knees when lifting heavy object such as hand tools and equipment. Keep the weight close to your body. Do not twist or turn the body while lifting. Get help or use a mechanical device when lifting awkward shaped objects or objects too heavy to comfortably lift alone.

9.2.2.9 Poisonous Plants

Cactus spines can inflict painful injuries to unwary site personnel (Table 9-4). Avoidance procedures include the following:

- Visually survey each area of site where cacti may grow prior to walking across.
- Be particularly alert to cacti which are low to the ground.
- Avoid stepping on or scraping up against cactus plants.
- Be aware that spines may not always be readily apparent to the casual observer.

9.2.2.10 Insects

Stinging insects, primarily spiders, scorpions, bees, and wasps, are prevalent in the area of the sites during the warmer months (Table 9-4). Spiders are routinely found under all the well heads. Field personnel should be cautious to avoid contact by always looking ahead to where they are walking, standing, sitting, or leaning.

Persons who have experienced serious reactions from previous insect bites should be urged to secure any possible immunization or have an antidote readily available to prevent more serious reactions from future insect bites and stings.

The signs and symptoms of insect bites and stings are as follows:

- The stings of bees and the bites of mosquitoes, ticks, fleas, and bedbugs usually cause only local irritation and pain in the region stung or bitten.
- Moderate swelling and redness may occur and some itching, burning, and pain may be present.

The effect of stings and bites of spiders, centipedes, tarantulas, and scorpions in some instances are much more severe than those of the insects previously mentioned. They may cause alarming symptoms.

The signs and symptoms of these bites are as follows:

- Generally, the bite consists of two small pinpoint punctures of the skin and produce local swelling and redness with a smarting, burning pain.
- Exhaustion, sweating, and nausea may appear.
- Pain or cramping may develop in the back, shoulders, chest, and limbs.
- In some instances the symptoms are mild and subside within 6 to 12 hours, but occasionally they are severe and can cause a state of collapse.

The black widow spider is a moderately large, glossy black spider with very fine hairs over the body, which give it a silky appearance. On the abdomen is a characteristic red or crimson marking in the form of an hourglass. Only the female is poisonous; the male, which is smaller, is harmless.

The brown recluse spider injects a venom which causes a limited destruction of red blood cells and certain other blood changes. The victim may develop chills, fever, joint pains, nausea, and vomiting. A rash may also develop within 24 to 48 hours.

Tarantulas are hairy spiders. Those found in the southwestern United States are not poisonous, but occasionally a victim will have an allergic reaction to the injected venom. Tarantulas coming

into the country in imported fruit may be poisonous. Their bites may cause marked pain and local redness with swelling. Death is extremely rare.

Most species of scorpions in this country do not inject a toxin that is generally harmful to humans. The sting may result in local swelling and discoloration, similar to a wasp sting, and may sometimes cause allergic reactions. The sting of the more dangerous species of scorpions causes little or no swelling or discoloration, but locally there will be a tingling or burning sensation. Considerable discomfort may ensue. Death, although unlikely, occurs occasionally in infants and young children and might conceivably occur in older persons. The poison acts mainly on the nervous system.

9.2.2.11 Rattlesnakes

Rattlesnakes could be encountered during site activities. Employees are advised to be alert to this danger. Snake bites can be painful and lead to serious illness if not treated immediately. If bitten, employees must seek medical attention immediately. The best thing to do, however is to avoid contact. Wear sturdy leather boots. Avoid walking in areas where snakes may hide. Use extreme caution when moving or lifting objects which could be used by snakes as cover. Never reach under or behind such objects or into other areas where snakes may hide.

The signs and symptoms of a snakebite are as follows:

- A sharp, stinging pain with one or more puncture marks in the area.
- Swelling, discoloration, and pain in the bitten area.

As the poison goes through the body, other symptoms develop such as:

- Weakness
- Nausea and vomiting
- Weak and rapid pulse
- Respiratory distress
- Shock

9.3 SITE WORK ZONES AND PERSONAL PROTECTIVE EQUIPMENT

9.3.1 Site Work Zones

The exclusion zone and contamination reduction zone for the FT-31 site bioventing system is the entire system area including all pumps, wells, and piping. All personnel entering these areas must have the appropriate training to conduct work activities. Untrained visitors may enter the area if escorted by a trained worker.

All areas outside the FT-31 site bioventing system are not access controlled and are considered a part of the support zone. Activities conducted in the support zone will be considered unregulated.

9.3.2 Personal Protective Equipment

PPE will be required based on the activities covered by this plan. Based on the nature of the work activities, standard work clothing (long pants, sleeved shirts, hard hat, safety glasses, and steel-toed boots) will be worn. Some activities as described in this section will require additional PPE. The PHSM will make the determination as to PPE selection and use. Table 9-2 defines the minimum PPE required for site activities.

9.4 DECONTAMINATION

9.4.1 Personnel Decontamination

Personnel decontamination will be accomplished by following a systematic procedure of cleaning and removal of PPE. Disposable gloves or Tyvek will be rinsed free of gross contamination and disposed of as general refuse. Respirators will be cleaned after each use and will be stored in plastic bags after cleaning. General refuse will be placed in plastic bags and then into an on-site dumpster.

Personnel are required to wash their hands and face following all maintenance, operation, monitoring, or repair activities to minimize the potential for ingestion of contaminants.

9.4.2 Equipment Decontamination

All equipment used to perform maintenance, operation, monitoring, or repair activities for the long term treatment systems shall be decontaminated. Decontamination of equipment will be performed with a surfactant wash and rinse or by proper disposal methods.

9.5 MEDICAL SURVEILLANCE

Personnel covered by this SSHP are active participants in FWENC or similar medical surveillance program which complies with OSHA 29 CFR 1910.120(f), ANSI Z88.2 and the USACE Safety and Health Requirements Manual EM 385-1-1, Appendix K (USACE 1992). Each individual has completed an annual surveillance examination and/or an initial baseline examination within the last year prior to performing any work on this site covered by this SSHP.

9.6 AIR MONITORING

Air monitoring will be conducted during activities in which the potential for exposure to vapors exist. The activities and air monitoring requirements are addressed in Table 9-3.

9.6.1 Personal Exposure Monitoring

According to OSHA 29 CFR 1910.120, personal exposure monitoring for the purpose of determining individual time-weighted average exposures is required during certain site cleanup or other remedial activities. Determinations regarding individual exposure potentials will be based on the work area monitoring described above. Personal air sampling is not anticipated at this time. If the PHSM identifies higher than expected total organic vapor or benzene concentrations during work activities, the need to collect personal samples will be re-evaluated.

9.7 RESPIRATORY PROTECTION PROGRAM

If required (based on air monitoring results), Level C respiratory protection will be worn, consisting of full-face air purifying respirator with the appropriate cartridges selected for contaminants. Use and selection of respirators will be in accordance with FWENC's Environmental Respiratory Protection Program, HS 5-2.

Table 9-3. Air Monitoring Requirements and Action Levels

Contaminant	Activity	Instrument	Action Levels*	Action
TRPH and BTEX	Routine Operating Procedures -- Section 3.0 System Startup and Operational Strategy	None required	None required	None
	System Maintenance -- Section 4.0 Measuring gases in monitoring wells and collecting soil samples	PID	Background - 10 ppm	No action
			10 ppm - 25 ppm	Upgrade to Level C
			>25 ppm	Stop work and contact PHSM
	Routine Maintenance -- Section 4.2 Routine Maintenance Procedures	None required	None required	None

ppm - parts per million

9.8 TRAINING AND COMMUNICATION

9.8.1 General Training Requirements

Personnel covered by this SSHP must be active participants in the FWENC Hazardous Waste Operation and Health and Safety Training Program, which complies with OSHA 29 CFR 1910.120(e), OSHA 29 CFR 1926.20, and the USACE Safety and Health Requirements Manual EM 385-1-1 (Section 28.D) (USACE 1992).

Individuals who plan to work in the active/designated exclusion zones and/or contamination reduction zones where the potential for exposure to safety or health hazards exists must have completed an annual 8-hour refresher training course and/or initial (40-hour classroom and 3-day on-site supervised) training course prior to performing any such work.

9.8.1.1 First Aid Training

Individuals assigned to perform first aid and Cardiopulmonary Resuscitation (CPR) must hold current American Red Cross or equivalent training certification. All FWENC personnel located on site are trained in First Aid and CPR.

9.8.2 On-Site Communications

Verbal communication at the sites may be impeded by on-site background noise or on-going activities, or the use of PPE. Hand signals may be used between personnel and will be reviewed during daily safety/pre-shift meetings. The use of the "Buddy System" will ensure that any information is communicated between all workers on site. Visual contact must be maintained between pairs when respiratory protection is used.

External communications between on-site personnel will be conducted through the use of cellular telephones. Exact locations of the site facility telephones and emergency telephone numbers will be obtained before site activities begin and will be communicated to all site personnel.

9.8.3 Notification of Activities

Prior to starting work at the site, the Holloman AFB fire department and hospital will be contacted by the SHSO regarding the scope of work, potential hazards at the site, and to confirm that the emergency services are capable of handling an emergency situation.

9.8.4 Safety Orientation and Tailgate Meetings

A tailgate safety meeting will be provided to the workers daily by the SHSO to review the chemical, physical, and toxicological properties of the contaminants that may be present at the site. Proper and safe work practices will be reviewed. Contingency plans for potential emergency situations and location(s) of available safety equipment (i.e. eyewash, first aid kit, and fire extinguisher located behind the seat of every FWENC vehicle) will be addressed at this meeting. The SHSO shall inspect the site to ensure that the SSHP is being properly implemented. The SSHP will be periodically reviewed to ensure that all physical and chemical hazards encountered during field activities are recognized and addressed by the SSHP.

9.9 GENERAL SAFETY RULES

1. All site personnel must attend each day's Health and Safety Briefing.
2. Any individual taking prescribed drugs shall inform the SHSO of the type of medication. The SHSO will review the matter with the PHSM and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on site while taking medication.
3. The PPE specified by the SHSO and this document shall be worn by all site personnel. This includes hard hats and safety glasses which must be worn at all times in active work areas.
4. Facial hair (beards, long sideburns, or mustaches) which may interfere with a satisfactory fit of a respiratory mask is not allowed on any person who may be required to wear a respirator.
5. Personnel must follow proper decontamination procedures.
6. Eating, drinking, chewing tobacco or gum, smoking, and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the PHSM to allow fluid intake during heat stress conditions.)
7. All lighters, matches, cigarettes, and other forms of tobacco are prohibited in the exclusion zone.

8. All signs and demarcations shall be followed. Such signs and demarcation shall not be removed except as authorized by the SHSO.

9. All personnel must follow Hot Work Permits as issued.

10. All personnel must use the Buddy System in the exclusion zone.

11. All personnel must follow the work-rest regimens and other practices required by the heat stress program.

12. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.

13. No person shall operate equipment unless trained and authorized.

14. Ladders and scaffolds shall be solidly constructed, in good working condition and inspected prior to use. No one may use defective ladders or scaffolds.

15. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.

16. Safety belts, harnesses, and lanyards must be selected by your Supervisor. The user must inspect the equipment prior to use. No defective personal fall protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.

17. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.

18. GFCIs shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out walkways and puddles unless protected and rated for service.

19. Improper use, mishandling, or tampering with health and safety equipment and samples is prohibited.

20. Horseplay of any kind is prohibited.

21. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.

22. All accidents, no matter how minor must be reported immediately to your Supervisor.

All personnel shall be familiar with the Emergency Response Plan, Section 9.12.

9.10 FIRST AID PLAN

The following general guidelines will apply first aid services:

1. Survey the situation. Do not endanger your own life. Do not enter a confined space to rescue someone who has been overcome unless properly equipped and a standby person is present.

2. Call the fire department immediately. Explain the physical injury, chemical exposure, fire, or release.

3. Decontaminate the victim without delaying life-saving procedures.

4. If the victim's condition appears to be noncritical, but seems to be more severe than minor cuts, he/she should be transported to the nearest hospital by trained Emergency Medical Services (EMS) personnel. The attending physician has the responsibility for determining the severity of the injury.

5. When transporting an injured person to a hospital, bring the Basewide Health and Safety Plan to assist medical personnel with diagnosis and treatment. In all cases of chemical overexposure, follow standard procedures as outlined for poison management, first aid, and, if applicable, CPR.

6. Notify the Project Manager and the SSHO. Complete the Accident/Incident Report Form, (found in the Basewide Health and Safety Plan) within 24 hours.

7. MSDSs will be provided to the medical facility at the beginning of the project.

Additional information is provided in Table 9-4.

9.11 VISITOR REQUIREMENTS

Visitors to the site will be required to participate in a site safety orientation briefing. In accordance with the contract requirements, four sets of protective equipment (excluding respirators, prescription glasses, and safety shoes) specified in this section will be continuously maintained on site for government representatives. All visitors are required to sign the Daily Briefing sign-in sheet.

Table 9-4. Emergency First Aid Procedures

Emergency	Procedure
Stopping Bleeding	1. Give medical statement, that you are trained in first aid/CPR. 2. Assure airway, breathing, circulation 3. Use DIRECT PRESSURE over the wound with clean dressing or your hand (use nonpermeable gloves). Direct pressure will control most bleeding. 4. Bleeding from an artery or several injury sites may require DIRECT PRESSURE on a PRESSURE POINT. Use pressure points for 30-60 seconds to help control sever bleeding. 5. Continue primary care and seek medical aid as needed.
Cardiopulmonary Resuscitation (CPR)	1. Give medical statement, that you are trained in first aid/CPR. 2. Arousal: Check for consciousness. 3. Open airway with chin-lift. 4. Look, listen, and feel for breathing. 5. If breathing is absent, give 2 slow, full rescue breaths. 6. Check the pulse for 5 to 10 seconds.
Contact with Poisonous Plants	1. Contaminated clothing and jewelry should be removed. 2. Wash area with soap and water. 3. A lotion may be applied to ease the victim's discomfort, if the rash is mild. 4. If a severe reaction appears, seek medical help.
Insect Bites	The first aid for insect bites and stings includes: 1. The sting area should be inspected to determine whether the stinger is still left in the body. If it is, remove it in order to prevent further injection of toxin. The stinger should be carefully scraped of the skin, rather than grasped with tweezers, so as not to squeeze toxin into the body. 2. Application of ice or ice water to the bite helps to slow absorption of toxin into the blood stream. A past of baking soda and water can also be applied to the bite. 3. The victim should be observed for signs of an allergic reaction. For people who are allergic, maintain an open airway and get the victim to medical help as quickly as possible. The first aid for an allergic reaction to bites and stings of bees, wasps, spiders, centipedes, tarantulas, and scorpions includes: I. Apply constricting band between the bite and stings and the head if the bite is on an extremity. 2. Apply a cold pack on the area. 3. Get the victim to medical help as quickly as possible.

Table 9-4. Emergency First Aid Procedures **Page 2 of 2**

Emergency	Procedure
Snake Bites	1. Begin care at once. 2. Keep the victim lying down and quiet with the injured part immobile and lower than the rest of the body. 3. Remove all rings, watches, and bracelets from the extremity. 4. Apply constricting bands above and below the area. The constricting bands should be tight enough to slow down surface circulation but not so tight as to cut off arterial flow. 5. Treat for shock. 6. Apply an ice pack to the wound only if the poison control center or a physician advises to do so. Do not cut into the bite and suction or squeeze unless you are directed to do so by a physician. NEVER suck the venom from the wound using your mouth. 7. Do not give the victim anything by mouth. 8. Identify the snake if possible. If the snake can be killed, take it to the hospital with the victim. 9. Monitor vital signs while transporting victim to a medical facility. 10. For persons who frequent regions infested with poisonous snakes, it is recommended that a snakebite kit be carried.

9.12 EMERGENCY RESPONSE PLAN

9.12.1 General Requirements

OSHA defines emergency response as any "response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance." Personnel covered by this section are not expected to participate in an emergency response where there are potential safety or health hazards (i.e., fire, explosion, or chemical exposure).

9.12.2 Emergency Telephone Numbers

Name	Project Title/Assigned Role	Phone Number
Ambulance (Base)		9-911
Fire Dept. (Base)		(505) 475-1117 or 479-6117
Base Hospital		(505) 475-3111
Poison Control		(800) 432-6866
USEPA (info line)		(800) 424-9346
Nat. Response Center		(800) 424-8802
Chemtrec		(800) 424-9300
Base Hospital	49th Medical Group Hospital	(505) 475-3111
Civilian Hospital	Gerald Champion Memorial Hospital	(505) 439-2100
Sina Seyedian	Project Manager	(303) 988-2202
Daniel Holmquist	Site Manager	(505) 479-2668
Diane Morrell, CIH	PHSM	(303) 988-2202
Ron Versaw	DO Manager	(303) 980-3598
Mark Mercier	Technical Mgr.	(402) 221-7666
Warren Neff	Base POC	(505) 479-5395

9.12.3 Incident Reporting Procedures

In the event of an accident or incident, an Accident/Incident Report must be completed within 24 hours. Depending upon the nature of the incident, additional agencies or individuals that may need to be notified include the USEPA, NMED, OSHA, Base Point of Contact (POC). Unless otherwise mandated by law, no outside agency may be contacted without explicit approval by the Air Force.

All incidents resulting in injury, illness or property damage requires an accident investigation and report. The investigation should be initiated as soon as emergency conditions are under control. The purpose of this investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided.

The investigation should begin while details are still fresh in the mind of anyone involved. The person administering first aid may be able to start the fact gathering process if the injured are able to speak. Pertinent facts must be determined. Questions beginning with who, what, when, where, and how are usually most effective to discover ways to improve job performance in terms of efficiency and quality of work, as well as safety and health concerns.

9.12.4 Medical Treatment Facilities

The routes to the Holloman AFB Hospital and to Gerald Champion Memorial Hospital in Alamogordo are shown in Figure 9-1.

9.13 DANGEROUS WEATHER RESPONSE PLAN

Work will not be permitted during severe weather conditions or if there is an imminent threat of severe weather conditions which threaten the health and safety of on-site workers. Additionally site workers are advised to:

1. Stop work during electrical storms and other extreme weather conditions such as extreme heat or cold temperatures.

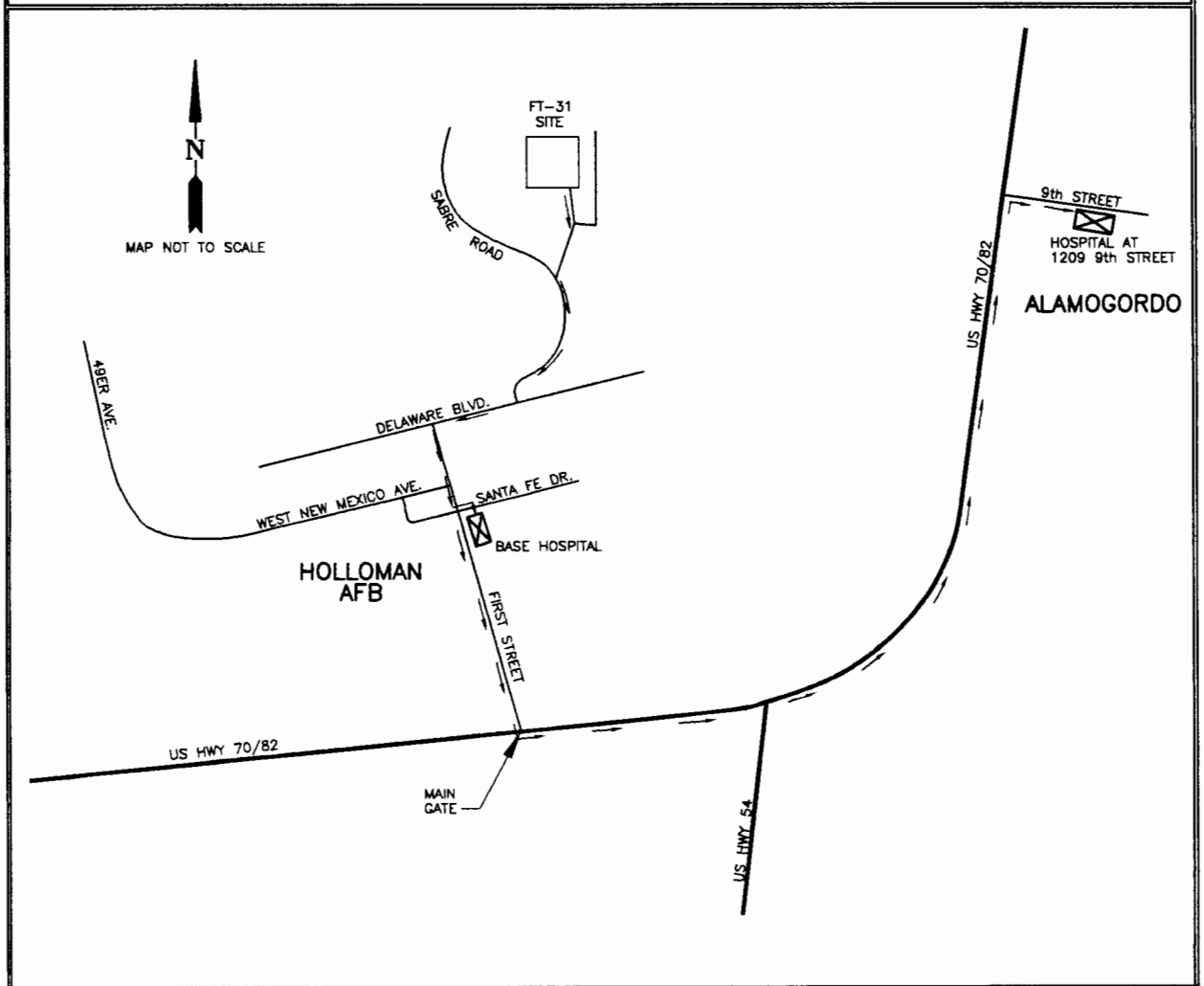
2. Take cover indoors or in vehicle.

3. Listen to local forecasts for warnings about specific weather hazards such as tornadoes, flash floods or electrical storms.

4. Take frequent work breaks during extreme heat or cold conditions.

FIGURE 9-1

LOCATION MAP FOR HOSPITALS



Holloman Air Force Base Hospital:

Name: Holloman AFB Hospital
Address: Intersection of First Street and Santa Fe Drive
City, State: Holloman AFB, NM
Phone: (505) 475-3111

HOSPITAL DIRECTIONS FROM FT-31:
Exit site south to Sabre Road turn left on Sabre Road to Delaware Blvd. Turn left on Delaware to First Street. Turn left on First Street. Hospital is located at southeast quadrant of intersection of First Street and Santa Fe Drive.

Alamogordo Hospital:

Name: Gerald Champion Memorial Hospital
Address: 1209 9th Street
City, State: Alamogordo, NM
Phone: (505) 439-2170 (Emergency Room)

HOSPITAL DIRECTIONS FROM BASE MAIN GATE:
Turn right onto US Highway 70/82. Proceed to Alamogordo. Turn right onto 9th Street. Proceed to the Hospital at 1209 9th Street.

C:\PROJECTS\HOLLO\FT-31\HOSP-LOC.DWG, 10/11/96, 14:15:00

9.14 APPROVALS

The following individuals have reviewed this plan and have determined that it adequately addresses the site hazards and control measures; and meets the requirements of the FWENC Health and Safety Program HS 3-2.

Dan Holmquist, Site Manager, Foster Wheeler Environmental Corporation

Signature _____ Date 6/26/97

Ron Versaw, Delivery Order Manager, Foster Wheeler Environmental Corporation

Signature _____ Date 6/27/97

Andrew Strickland, CIH, Project Health and Safety Manager, Foster Wheeler Environmental Corporation

Signature _____ Date 6/27/97

10.0 REFERENCES

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1992 Hazardous Materials Regulations Amendments, Docket HM-126F.

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APPENDIX A

STANDARD OPERATING PROCEDURES

LIST OF STANDARD OPERATING PROCEDURES

SOP A1	SAMPLE HANDLING AND DOCUMENTATION
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SOP A1 SAMPLE HANDLING AND DOCUMENTATION

A1.1 PURPOSE

Sample handling and documentation procedures will be used to ensure the integrity of the sample from sample collection to receipt at the laboratory. Documentation of sample handling will be completed to ensure the traceability and integrity of the sample.

A1.2 PROCEDURE

Labeling

All sample containers will be labeled. Labels may be partially completed prior to sample collection. The date, time, and sampler's name should **NOT** be completed until the time of sample collection. Preprinted, self-adhesive sample labels containing all appropriate sample information including sample identification, field sample number, sample type, and analyses requested will be used. Sample labels will be completed with waterproof ink and should be completed and attached prior to sample collection for soil samples collected in jars and all decontamination samples collected in bottles.

At a minimum, each numbered label will contain the following information:

- Project/facility
- Sample type (e.g., grab, composite)
- Sampler's company affiliation
- Date and time of sample collection
- Analyses required
- Preservation used
- Sampler's initials
- Missouri River (MR) identified if sample is collected for the United States Army Corps of Engineers (USACE) laboratory
- Sample identification (see below)
- MR Laboratory Information Management System (LIMS) number

Sampling Containers

Certified, commercially clean sample containers will be obtained from the contract analytical laboratory. If appropriate, the bottles will be labeled by the laboratory to indicate the type of sample to be collected. Surface soil samples will typically be in collected wide-mouth sample jars or in stainless steel liners.

Sample Preservation

All samples will be stored on ice in an insulated cooler immediately following sample collection. Soil samples do not require additional preservation. Sample containers for aqueous samples will be supplied by the laboratory and will contain the appropriate preservatives.

Sample Handling And Shipping

Sample containers will be placed in recloseable plastic storage bags and wrapped in protective packing material (if appropriate). Ice (double bagged using plastic trash bags) will be placed on top of the samples in a cooler for shipment to the laboratory. The drain on the cooler will be taped shut. Samples collected in glass containers will be packed in foam liners and bubble packing or styrofoam peanuts to ensure that no breakage occurs during shipment. Samples will be shipped by overnight express carrier for delivery to the analytical laboratory and to the MR laboratory. The MR laboratory will be notified prior to the arrival of the first shipment, after the final shipment, and prior to any Saturday delivery.

A completed chain-of-custody (COC) form for each cooler will be placed in a ziplock bag and taped to the inside of the cooler lid. Coolers will be wrapped with strapping tape at two locations to secure lids. Signed custody seals will be placed on the outside of each cooler. In addition, "Fragile" labels and "This Side Up" labels will be placed on the outside of each cooler containing glass bottles. "This Side Up" labels will be placed on all four sides and "Fragile" labels on at least two sides. Note that each cooler cannot exceed the weight limit set by the shipper.

Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction and is, based on the analyte of interest, stability factors, and preservation methods. The allowable holding time for ammonia nitrogen, nitrate/nitrite, and TKN is 28 days. The allowable holding times for TRPH and BTEX are 28 and 14 days, respectively. Samples should be sent by overnight courier service to the laboratory daily after collection.

Sample Documentation and Tracking

This section describes documentation required in the field notes, Daily Quality Control Reports (DQCRs), and sample COC requirements.

Field Notes

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and will also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field book with consecutively numbered pages and, if applicable, on field sampling data sheets.

The information in the field book will include the following at a minimum. Additional information is included in the specific Standard Operating Procedures (SOPs) regarding the appropriate data sheets:

- Project name
- Location of sample
- Sampler's signature
- Date and time of sample collection
- Sample identification numbers
- Description of samples (matrix sampled), composite or grab sample
- Analysis to be performed
- Number and volume of samples
- Description of Quality Assurance/Quality Control (QA/QC) samples
- Sample methods or reference to the appropriate SOP
- Sample handling as appropriate for samples
- Field observations
- Personnel present

Changes or deletions in the field book should be crossed out with a single strike mark, initialed, and dated by person making change and must be legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the collector's memory.

Each page of the field book will be signed by the person making the entry. Anyone making entries in another person's field book will sign and date those entries.

Daily Quality Control Report

To supplement the information recorded in the field book, DQCRs will also be maintained to document daily field activities and will note any nonconformances and corrective actions taken at every sampling location. DQCRs will be maintained by each field sampling team and cross-checked for completeness at the end of each day by a sampling team member and/or the field operations leader. They will be signed and dated by the individual making entries and initialed by the reviewer upon completion. Copies of the DQCR will be forwarded to the USACE resident engineer by noon of the following day. Copies of the DQCR will be forwarded to the Foster Wheeler Environmental Corporation (FWENC) QA officer for review on a weekly basis.

Sample Chain-of-Custody

During field sampling activities, the path of the sample must be able to be traced from the time the samples are collected until laboratory data are issued. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. COCs will include site identification, field sample number, sample type, and analysis requested.

The sample handler will be responsible for completing the COC form. The COC will be signed by the sampler when the sampler relinquishes the samples to anyone else. It is not necessary for Federal Express to sign the COC; however, the airbill will be retained by the sample handler for tracking purposes. A COC form will be completed for each set of samples collected daily and will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type/matrix
- Grab or composite sample
- Preservative used
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times (laboratory)
- Method of shipment (i.e., Federal Express)

The person responsible for delivery of the samples to the air carrier will sign the COC form, retain the last copy of the three-part COC form, document the method of shipment, and send the original and the second copy of the COC form with the sample (taped in a ziplock bag to inner cooler lid). Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the project manager. Copies of the COC forms and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent to the project manager by the analytical laboratory to be incorporated into the central files.

SOP A2 EQUIPMENT DECONTAMINATION

A2.1 PURPOSE

The purpose of this SOP is to provide guidance for the decontamination of equipment and sampling materials.

A2.2 PROCEDURE

Decontamination of Large Equipment

The following procedure will be used to decontaminate large pieces of equipment such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casings, auger flights, pipes, or rods:

1. Wash the external surfaces of equipment with high-pressure hot water and Alconox or equivalent nonphosphate, laboratory-grade detergent. If necessary, scrub until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The inside surfaces of the casing, drill rod, and auger flights will also be washed as described above. Specific decontamination instructions will be included in the project-specific addenda.
2. Rinse with potable water.
3. This decontamination procedure will be performed before equipment is used and between each well or other sampling locations.

Decontamination of Sampling Equipment

The following procedure will be used to decontaminate devices such as split-spoons, bailers, and augers that come into direct contact with the samples:

1. Wash and scrub with Alconox or equivalent nonphosphate, laboratory-grade detergent.
2. Rinse with potable water.
3. Rinse with deionized, analyte-free water.
4. Rinse with methanol (may be omitted if samples will not undergo organic chemical analyses).
5. Rinse with deionized, analyte-free water.
6. Air dry.

Solvents used (methanol and hexane) will be pesticide grade or better. Decontamination of sampling equipment will be kept to a minimum in the field, and, whenever possible, dedicated sampling equipment will be used. Decontamination fluids will be disposed as specified in Section 5.0, Waste Management. Personnel directly involved in equipment decontamination will wear appropriate personal protective equipment as specified in the Site Safety and Health Plan (SSHP).

SOP A3 SUBSURFACE SOIL SAMPLING

A3.1 PURPOSE

The purpose of this SOP is to provide guidance for the collection of soil samples, which will be analyzed for nutrients and contaminants.

A3.2 PROCEDURE

The following elements regarding soil borings should be considered when developing project-specific plans:

- All drilling will conform to state and local regulations. Permits, applications, and other documents required by state and local authorities will be obtained.
- The locations of all borings will be approved in writing by the Base before drilling commences.
- The drill rig and all equipment that enters a borehole will be decontaminated in accordance with SOP A2.
- The drill rig will not leak any fluids that may enter the hole or contaminate equipment that is placed in the hole. The use of rags or diapers to absorb leaking fluids is unacceptable. All leaking fluids will be caught in a proper container until the leak is repaired. If sample integrity could be comprised by leaking drill rig fluids, then sample operation may be shut down until the leak is repaired.
- No fluids will be used to advance soil borings.
- Surface water and extraneous materials will not enter the boring.
- Boreholes will be abandoned by grouting.
- All trash will be disposed as solid waste in a designated dumpster.
- If analytical results are less than 1,000 milligrams per kilogram (mg/kg) total recoverable petroleum hydrocarbons (TRPH), drill cuttings will be disposed on site by evenly spreading.

Before digging begins, a digging permit, "Base Civil Engineering Work Clearance Request" form, needs to be completed and approved by the chief of operations or chief of engineering and environmental planning at the Base. The work clearance request is processed immediately prior

to the start of work. If delays are encountered and the conditions at the job site change (or may have to be changed), this work clearance request must be reprocessed. The type of information that must accompany this permit includes the following:

- Location
- Work order/job number
- Contract number
- If the area has been staked/clearly marked or not
- Sketch of the excavation
- Type of facility work involved, i.e., pavements, drainage systems, railroad tracks, overhead or underground utility or communications, aircraft or vehicular traffic flow, security, etc.
- Date clearance requested and terminated
- Requesting official, phone number, and organization

Direct Push Sampling for Soil and Groundwater

Direct push technology (DPT) will be used to rapidly collect soil and water samples whenever possible. This technique provides for collection of undisturbed samples and does not generate soil cuttings. This section discusses DPT methodology only.

The contractor will need a copy of the DPT subcontractor work plan, waste containers, and appropriate health and safety gear. All additional equipment and materials will be provided by the DPT subcontractor. The DPT subcontractor should be equipped with a rig capable of pushing 30 feet 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
- Stainless steel piston-type, split-spoon, or equivalent soil sampling device that allows for lithologic characterization and retrieval of at least 400 milliliters of sample volume
- Geoprobe®, Hydrocone®, bailer, Teflon® tubing and peristaltic pump or equivalent water sampling device
- Small diameter polyvinyl chloride (PVC) riser and screen to make temporary wells if recovery is too slow

- Decontamination equipment
- Health and safety equipment

If a situation arises in which the groundwater recharge is too slow to allow for efficient sampling, a temporary PVC well can be installed for sampling at a later time. This well, however, must be installed according to the following specifications:

- The well will be narrower in diameter than the DPT borehole, leaving annular space around the casing.
- The well will be installed between 2 and 5 feet into the water table.
- New PVC casing and screen will be used, decontaminated with a stream cleaner, and rinsed with copious quantities of deionized water.
- Installation of well will occur using decontaminated gloves.
- The well will be sampled and removed within 48 hours of installation.
- If left unattended or overnight, the well should be fitted with locking well caps or a seal should be used that indicates tampering.
- One volume of the sampling device will be purged prior to sampling.

General Methodology

- Verify that the subcontractor has the necessary drilling and sampling equipment as well as proper decontamination supplies.
- 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 utility lines have been marked.
- Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use a hammer-drill or equivalent to drill a hole through the pavement.
- Verify that the sampling tip has been properly decontaminated, as specified in SOP A2.2, before beginning penetration.

Soil Sampling Methodology

- 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 project-specific addendum and ADDSOP A7.

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

- Abandon DPT borehole by grouting or hydrating pellets in maximum lifts of 2 ft to avoid bridging and system short circuiting.

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. Samples to be analyzed for BTEX will not be composited.

- Samples will be collected directly above the smear zone from each of the three plumes. The exact location of DPT drilling will be determined in the field by the site geologist. Future samples will be collected within a 10 foot radius of previously collected samples.

SOP A4 DRUM SAMPLING

A4.1 PURPOSE

The purpose of this SOP is to provide guidance for the sampling of drums containing decontamination water. The laboratory analysis results for these samples will be used in determining the method of disposal.

A4.2 PROCEDURE

Field sampling procedures for the collection of drum contents using a glass pipette are as follows:

NOTE: If drum is bulging, leaking, or indicates a potential to rupture, the drum will not be approached. Only remote opening and sampling will be performed in this case.

- After opening the drum, a liquid phase sample will be collected using a glass pipette, 3 to 4 feet in length. The sample will be transferred to a sample bottle via the pipette. Care is to be taken not to spill any of the sample onto the ground surface.

- Upon completion of sampling, the pipette is to be properly disposed.

- After sampling is complete, the opening on the drum cover will be closed by replacing the bung cap. If no bung cap was present, the hole will be closed using a fiberglass epoxy mix. Red flagging tape will then be tied around the drum indicating that the drum was sampled. The drum will be marked with an indelible marker such as a paint marker to indicate additional details such as sample/drum number, date, etc.

- At the completion of the drum sampling program, all of the drums will be moved to a designated storage area.

- Place analytical samples with preservative (if applicable) in cooler and chill to 4 degrees Celsius (°C). Samples will be shipped within 24 hours to a laboratory.

- Fill out field notebook, sample log sheet, custody seals, labels, and COC forms.

Drums found in a deteriorated condition such that a potential for release is evident will be packed in a salvage drum or in an overpack drum, the latter being preferred. Drums with openings sealed with a fiberglass epoxy mixture will be overpacked.

SOP A5 CALIBRATION PROCEDURES FOR FIELD EQUIPMENT

GA-90 GAS ANALYZER CALIBRATION PROCEDURE

Chapter 3-Field Calibration

Overview

Field Calibration is menu-guided and can be completed in about ten minutes. The pump does not have to be running to pass calibration gas through instrument. Using the pump will consume more gas than necessary. The GA-90 contains a calibration map which is accessed by its microprocessor for baseline reference data. This reference data was programmed into the GA-90 during the factory calibration using various gas mixtures in an environmental chamber. At any time, the GA-90 can be reset by returning to the "factory settings." This clears the GA-90 of any user calibration settings and restores the GA-90 to its original factory calibration.

Factory calibration has been designed to give the best possible results over a wide range of conditions. However, the instrument's accuracy can be improved in specific operating ranges by performing a "field calibration." Most field instruments are calibrated or adjusted prior to taking a series of gas or pressure readings. They may also be checked for calibration during the reading and after readings are taken in order to verify the accuracy of the data collected.

It is important to field calibrate the GA-90 on-site after the instrument has stabilized at working temperature. For this reason, a GA-90 that was calibrated in the cool of the morning may not read as accurately at the hottest part of the day.

> **Note: Field calibration of the GA-90 will improve the data collected in the range of the calibration gases used. Less accurate readings of concentrations outside the calibrated range may occur. For example, a GA-90 field-calibrated using 50% CH4 and 35% CO2 will give improved readings for the higher methane concentrations, but may provide less accurate readings at very low methane concentrations (which are not common in LFG). Recommended gas mixtures for reading landfill wells and probes are 15% methane, 15% carbon dioxide with balance nitrogen; and 4.5% oxygen with balance nitrogen.**

Calibration Gas/Span Gases

Field calibration requires two calibration gas mixtures. One gas mixture is used to span oxygen and zero methane. The other is used to span methane, carbon dioxide and zero oxygen. The oxygen has two curves, 0-5% and 0-25%. The zero point is the same for both curves however the span is different. The user need only to span the instrument using calibration gas below 5% for the 0-5% range or calibration gas below 25% for the 5-25% range. Regardless of the ranges used the instrument **must** be zeroed. Various calibration gas mixtures are available from LANDTEC.

Zero Methane

Calibration of the GA-90 starts by establishing the bottom point of the methane gas curve. The methane (CH4) is zeroed prior to taking readings at the start of each day. This is done by providing the GA-90 a sample that is known to have zero methane — often air is used. This establishes a zero point. This significantly improves the GA-90's CH4 accuracy over the entire range. **It is essential that the gas analyzer is clear of any CH4 at the time of zeroing.** Care must be taken if the GA-90 is to be zeroed on a landfill site. There are situations where methane, which is odorless and colorless, could be in the atmosphere.

After the Zero methane function is performed, the GA-90 recalculates 16 methane calibration points on its methane gas curve and stores the revised data in its memory. The GA-90 does not need to have the CH4 zeroed every time it is switched on because the most recent calibration data is stored in protected memory.

Span Methane

A field calibration spans the methane range prior to taking readings at the start of each day. The best results are obtained after the instrument has stabilized at its working temperature. The procedure alters the methane calibration at all concentrations and stores the revised data in protected memory.

> **Note: The Zero Methane should be set before setting the Methane Span.**

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Span Carbon Dioxide (OPTIONAL FEATURE)

Field calibration spans the CO2. It should be spanned prior to taking readings at the start of each day after the instrument has stabilized at its working temperature. The procedure alters the calibration at all concentrations and stores the revised data in protected memory.

Zero Oxygen (OPTIONAL FEATURE)

This function is essential where low concentrations of oxygen are expected (below 5%). Normally there is very little oxygen in LFG. This establishes the zero point of an oxygen curve that is stored in the GA-90's permanent memory.

Span Oxygen (OPTIONAL FEATURE)

The oxygen calibration map contains two span curves, one for oxygen below 5% and one for oxygen above 5%. The proper curve is automatically selected. If a calibration gas with less than 5% oxygen is used, the lower span curve is set. If the calibration gas has more than 5% oxygen, the higher calibration curve is set. Due to the resolution of the GA-90 processor at higher concentrations, the GA-90 may not display the exact concentration entered. This effect can be reduced by altering the entered value so that the displayed value is as close to the actual value as possible.

Note: The Oxygen Zero must be set before setting the Oxygen Span.

Equipment

To perform a field calibration, the following items are required.

1. Cylinder of methane and carbon dioxide span gas
2. Cylinder of 4/96 (4% O2 and 96% N2) calibration gas
3. Pressure regulators for the above cylinders capable of regulating in the range of 0 - 5 psig fitted with connectors suitable for 1/4" Tygon tubing.
4. LANDTEC's regulator, which is set to deliver the required flow, or a regulator and flowmeter capable of delivering 300-500 cc per minute at 2-5 psig. (See Figure 3.1.a)
5. Interconnecting lengths of 1/4" Tygon tubing.

All this equipment is available from LANDTEC. Other types of tubing can be used but the connections **must** be gas tight and secure. The calibration equipment set up is shown in Figures 3.1.a and 3.1.b.

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Figure 3.1.a

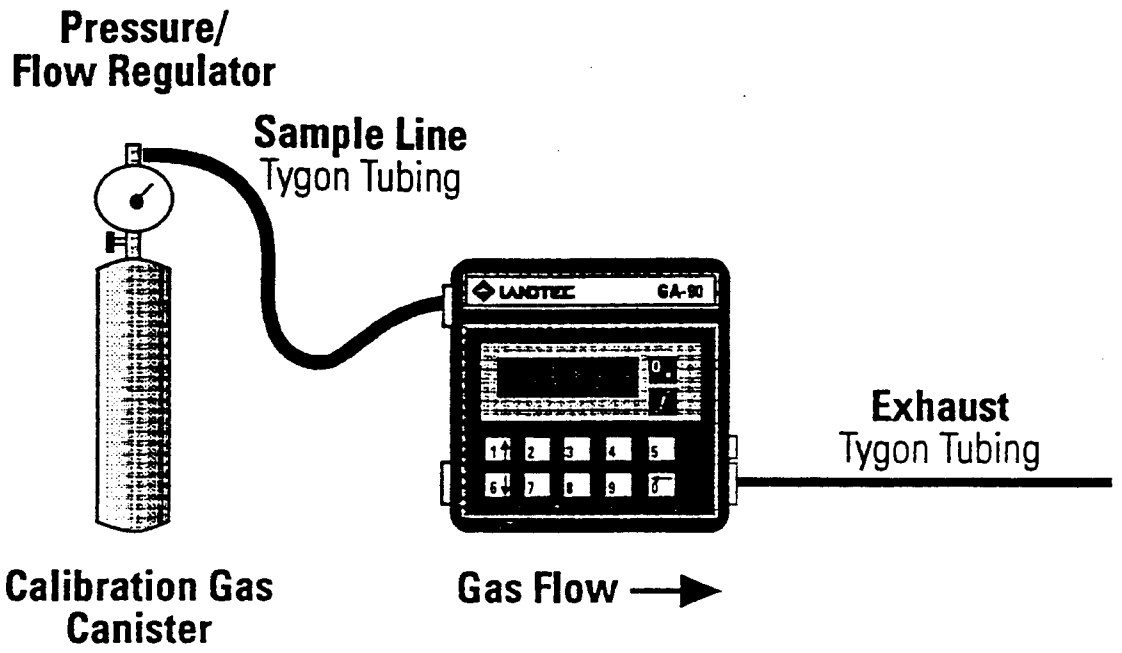
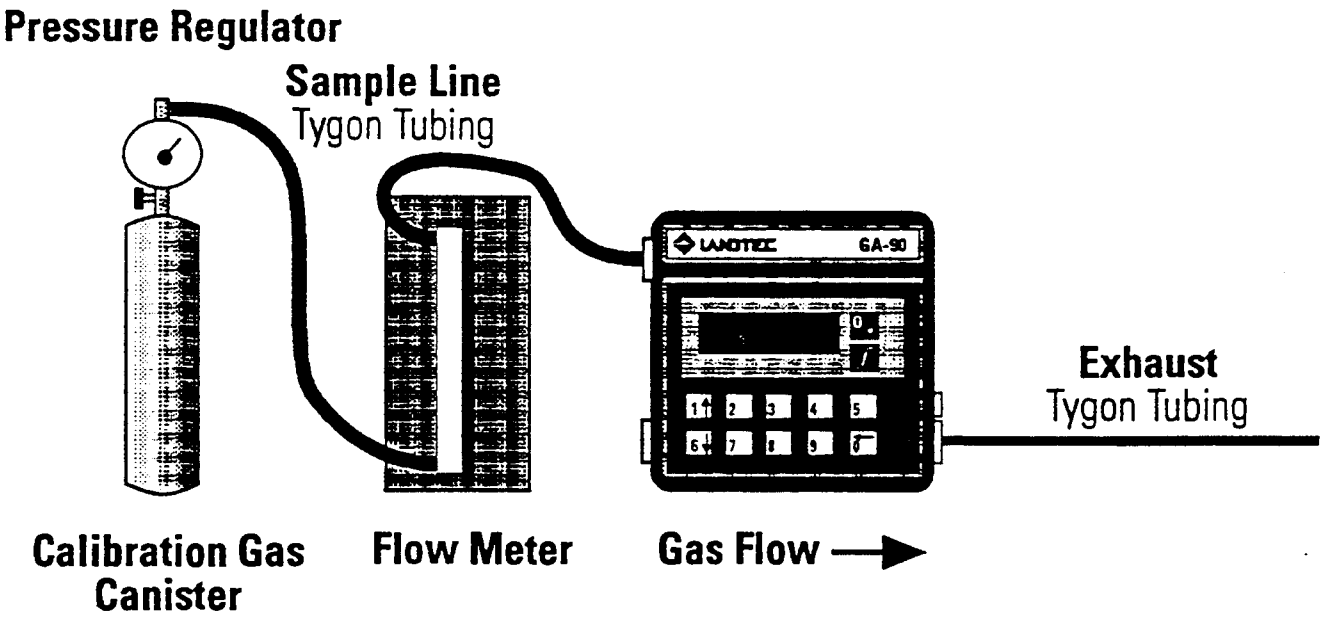


Figure 3.1.b



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Setting Up the Equipment

As described and shown in the Equipment Section, begin assembly of the GA-90:

1. Connect calibration gas cylinder to the pressure regulator.
2. Connect sample input line.
3. Connect second 24" of 1/4" Tygon tubing to the exhaust nozzle of the GA-90. Direct exhaust away from you and out of the immediate area.
4. Turn the calibration gas cylinder valve two turns.
5. If using a LANDTEC regulator, no flow meter is required. Turn off cylinder valve.
6. If **not** using the LANDTEC regulator, adjust the regulator discharge pressure to 2 psig and the flow meter to 300 cc per minute. Pinch the gas supply hose that will attach to the GA-90. The regulator discharge pressure should not climb to over 5 psig. Turn off the cylinder valve.

Note: This procedure will be duplicated for the second span gas when Oxygen is calibrated. The Oxygen/Carbon Dioxide calibration gas cylinder will be substituted for the Methane/Carbon Dioxide calibration gas.

Recommended Calibration Gases

Zero Gases: Air to zero methane (in non-methane environment)
4.5% oxygen balance nitrogen to zero methane in methane environment

Span Gases: 15% methane, 15% carbon dioxide, balance nitrogen (span gas)
4.5% oxygen, balance nitrogen (span gas)

Recommended Calibration Method

1. Zero methane
2. Connect methane/carbon dioxide mixture
3. Span methane and carbon dioxide
4. Zero oxygen using methane/carbon dioxide mixture
5. Disconnect methane/carbon dioxide mixture
6. Connect 4.5% oxygen mixture
7. Span oxygen
8. Disconnect oxygen mixture

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General Utilities 5 - Gas Calibration

The GA-90 is factory calibrated. To improve accuracy, all standard landfill gas instruments are field calibrated, zeroed or in other ways adjusted prior to every use . This function is done from the General Utilities Menu of the GA-90 which is explained in Chapter 2. Because of the importance of Gas Calibration, this function has been made a separate section. To get to the General Utilities Screen on the GA-90, see Chapter 2, Using the Menu Screens.

1. Press **KEY 1-General Utilities** at the Main Menu Screen (See Figure 3.2.).

Figure 3.2

```
1-General Utilities
2-Read Gas Levels
3-View/Print Data
4-Download Data
```

2. The General Utilities Screen appears as shown in Figure 3.3.

Figure 3.3

```
1-Check Time/Date
2-USA/Metric Units
3-Gas Alarms
9-More          0-Exit
```

3. The gas calibration function is not on the first General Utilities Screen. To reach this screen, press **KEY 9-More** and **KEY 5-Gas Calibration** (Figure 3.4). You could also select **KEY 5** while at the first General Utilities Screen and proceed directly to the gas calibration screen.

Figure 3.4

```
4-Memory
5-Calibration
6-ID Maintenance
9-Back          0-Exit
```

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4. After selecting **KEY 5-Gas Calibration** on the General Utilities Sub-Menu Screen, the first Gas Calibration Screen appears as shown in Figure 3.5.

Figure 3.5

```
1-CH4 Calibration
2-CO2 Calibration
3-O2 Calibration
4-Factory Settings
```

5. There are four possible choices. The first allows a field calibration to be performed on the GA-90 for methane. The second choice calibrates carbon dioxide. The third choice calibrates oxygen. The fourth choice returns the GA-90 from a field calibration established by the user to the original factory settings.

6. Each of these calibration options will now be reviewed in order.

Methane (CH4) Calibration

Zero Methane

1. Pressing **KEY 1-CH4 Calibration** on the Calibration Screen brings up the Methane Calibration Screen (Figure 3.6).

Figure 3.6

```
1-Zero CH4
2-Calibrate CH4 Span
0-Previous Menu
```

2. Pressing **KEY 1-Zero CH4** brings up the Zero Methane Screen (Figure 3.7). A methane percentage will not display until the IR Bench warms up. A plus or negative sign may appear on the far left of the display. This symbol can be ignored.

Figure 3.7

```
                    1-Zero
                      Level
+00.2% CH4 Gas      5-Pump
                    0-Exit
```

Note: Do not perform this procedure in the presence of methane.

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3. If using oxygen calibration gas to zero methane, see steps 3-6 in the Span Methane section then return to step of this section.

4. If using air to zero methane, press **KEY 5-Pump** to turn on the GA-90 sample pump. There should be no calibration gas hoses attached to the GA-90 during this procedure. The GA-90 will be drawing in a sample of normal air—**which must be free of methane.** Allow the pump to run for two minutes or until gas reading stabilizes.

5. Press **KEY 1 - Zero level** and one of the following screens (Figure 3.8 or Figure 3.9) will be displayed for three seconds before returning to the Zero Methane Screen shown in Figure 3.7.

Figure 3.8

CH_4 Not Zeroed

Figure 3.9

CH_4 Zeroed

6. If the CH4 Not Zeroed Screen (Figure 3.8) was displayed, return to the Gas Calibration Screen by pressing **KEY 0-Exit.** Recheck that no methane was present and re-zero the methane. If problem continues, proceed to instructions contained in this section for Factory Settings.

7. If the CH4 Zeroed OK Screen (Figure 3.9) appeared, press **KEY 0-Exit** to return to the Methane Calibration Screen (Figure 3.10). Press **KEY 2-Calibrate CH4 Span** and proceed to the next section.

Figure 3.10

1-Zero CH_4
2-Calibrate CH_4 Span
0-Previous Menu

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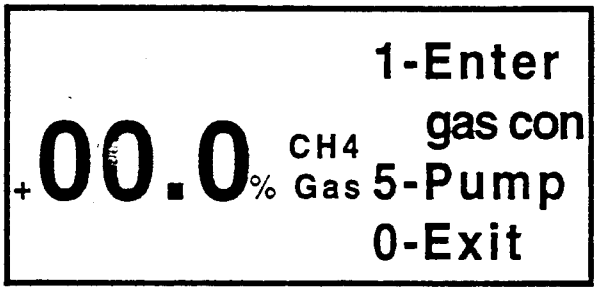
Span Methane

1. Read following warning below before proceeding with the next steps.

> **WARNING: The GA-90 is not certified as intrinsically safe. The following procedure MUST NOT be done in a confined area (such as well vaults, underground and indoors) or where there is any chance of sparking or ignition. No smoking, exposed lighting, or other sources of ignition should be in the area. On the GA-90, ensure that exhaust gas is safe, not blocked and properly vented away from you. Ensure that no leaks are present. Unless all above conditions are maintained, an explosion could occur resulting in serious injury or death.**

2. After selecting **KEY 2-Calibrate CH4 Span** on the Methane Calibration Screen, the following CH4 Span Screen appears (Figure 3.11).

Figure 3.11



3. Connect the 1/4" Tygon tubing from the calibration gas regulator/flow meter to the GA-90 gas sample port (Figure 1.1). Attach, if not already attached, the Tygon tubing to the exhaust port of the GA-90. Direct the exhaust away from you and out of the immediate area.

4. Turn on the calibration gas mixture of methane and carbon dioxide. **Pump does not have to be on and will consume more gas than necessary if used.**

5. If not using LANDTEC supplied regulator, check the calibration gas flow at 300cc and pressure no greater than 2 psig.

6. Allow the calibration gas to flow into the GA-90 for one minute or until instrument gas reading stabilizes.

7. After one minute, read the methane Gas Concentration on the screen. It should be stable and not changing more than a few tenths of one percent at the 15% gas level, 2% at the higher gas level.

8. Press **KEY 1-Enter Gas Con** and input the methane concentration of the calibration gas from the keyboard of the GA-90 (Figure 3.12). Enter the percentage as three digits XX.X%. 15% methane would be input as 150. The GA-90 will automatically place a decimal point in the proper position. After the percentage is entered, press KEY 0-Exit.

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Figure 3.12

```
Enter Concentration
of Calibration Gas
CH4 ?-.-%
                0-Exit
```

9. The next screen is the Caution Re-Calibrate Screen (Figure 3.13).

Figure 3.13

```
Caution  Re-calibrate
Are you sure?

1-Yes            2-No
```

10. Press **KEY 1-Yes** and one of two messages will appear (Figure 3.14 or Figure 3.15).

Figure 3.14

```
Calibration gas NOT
accepted.  Retry?

1-Yes            2-No
```

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Figure 3.15

Re-calibrated OK

11. If the Calibration OK Screen flashed (Figure 3.15), proceed to step 13.

12. If the Calibration Gas Not Accepted Screen appears (Figure 3.14) press **Key 1-Yes** and re-enter methane percentage. If Calibration Gas Not Accepted Screen still appears, press **KEY 0-No** and start procedure again from zero methane. If problem persists, proceed to Factory Settings later in this chapter.

13. If no further calibration is required go to step 15.

14. If CO2 is to be calibrated, press **KEY 0** twice. The Gas Calibration Screen (Figure 3.16) should appear. Follow CO2 calibration instructions on next page.

15. Turn off calibration gas cylinder. Remove gas hose attached to gas sample port. Leave exhaust port hose connnected. Turn on pump and purge instrument with air for 60 seconds (CH4 concentration should read 00.0%). You have successfully completed a CH4 field calibration. Press Key 0 to return to Main Menu Screen. If instrument has CO2 option, press **KEY 0** twice to return to Gas Calibration screen.

Carbon Dioxide (CO2) Calibration (OPTIONAL FEATURE)

1. Because the carbon dioxide used in this calibration contains methane, the following warning must be adhered to before proceeding with the steps below.

   WARNING: The GA-90 is not certified as intrinsically safe. The following procedure MUST NOT be done in a confined area (such as well vaults, underground and indoors) or where there is any chance of sparking or ignition. No smoking, exposed lighting, or other sources of ignition should be in the area . On the GA-90, ensure that exhaust gas is safe, not blocked and properly vented away from you. Ensure that no leaks are present. Unless all above conditions are maintained, an explosion could occur resulting in serious injury or death.

2. Press **Key 2 - CO2 Calibration** on the Gas Calibration Screen (Figure 3.16).

Figure 3.16

1-CH_4 Calibration
2-CO_2 Calibration
3-O_2 Calibration
4-Factory Settings

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3. There is no Zero CO2 function as there is in the methane or oxygen calibration procedures. The following CO2 Span Screen will appear (Figure 3.17).

Figure 3.17

```
                    1-Enter
                    gas con
+00.0% CO2 Gas      5-Pump
                    0-Exit
```

4. Press **KEY 1-Enter Gas Con** and the Enter Concentration Screen shown in Figure 3.18 appears. Input the carbon dioxide concentration of the calibration gas from the keyboard of the GA-90 (Figure 3.18). Enter the percentage as three digits XX.X%. 15% carbon dioxide would be input as 150. The GA-90 will automatically place a decimal point in the proper position. After the percentage is entered, press **KEY 0 - Exit.**

Figure 3.18

```
Enter Concentration
of Calibration Gas
CO2 ?-.-%
                0-Exit
```

5. The next screen, Figure 3.19, is the Caution Re-Calibrate Screen.

Figure 3.19

```
Caution Re-calibrate
Are you sure?

1-Yes           2-No
```

6. Press **KEY 1-Yes** and one of two messages will appear (Figure 3.20 or Figure 3.21).

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Figure 3.20

```
Calibration gas NOT
accepted.  Retry?

1-Yes          2-No
```

Figure 3.21

```
Re-calibrated OK
```

7. If the Calibration OK Screen (Figure 3.21) flashed, proceed to step 9.

8. If the Calibration Gas Not Accepted Screen appears (Figure 3.20) press **Key 1-Yes** and re-enter methane percentage. If Calibration Gas Not Accepted Screen still appears, press **KEY 0-No** and start procedure again. If problem persists, proceed to Factory Settings later in this chapter.

9. If no further calibration is required go to step 11.

10. If oxygen **(OPTIONAL)** is to be calibrated, press **KEY 0.** The Gas Calibration Screen (Figure 3.16) should appear. Perform following O2 calibration instructions.

11. Turn off calibration gas cylinder. Remove gas hose attached to gas sample port. Leave exhaust port hose connnected. Turn on pump and purge instrument with air for 60 seconds (CO2 concentration should read 0.00%). You have successfully completed a CO2 field calibration. Press **KEY 0** twice to return to Main Menu Screen.

OXYGEN (O2) CALIBRATION (OPTIONAL FEATURE)

Zero Oxygen

1. There are two calibration gas mixtures used for the calibration of oxygen. The methane/carbon dioxide calibration gas previously used to calibrate the methane and carbon dioxide is used to Zero oxygen because there is no oxygen in the mixture. A second calibration gas with a mixture of oxygen and nitrogen will be used to set the oxygen level in the next section. Because the calibration gas used in this calibration contains methane, the warning below must be followed before proceeding with the following procedure.

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WARNING: The GA-90 is not certified as intrinsically safe. The following procedure MUST NOT be done in a confined area (such as well vaults, underground and indoors) or where there is any chance of sparking or ignition. No smoking, exposed lighting, or other sources of ignition should be in the area. On the GA-90, ensure that exhaust gas is safe, not blocked and properly vented away from you. Ensure that no leaks are present. Unless all above conditions are maintained, an explosion could occur resulting in serious injury or death.

2. Press **Key 3-O2 Calibration** on the Gas Calibration Screen (Figure 3.22).

Figure 3.22

```
1-CH4 Calibration
2-CO2 Calibration
3-O2 Calibration
4-Factory Settings
```

3. The Oxygen Calibration Screen will appear (Figure 3.23).

Figure 3.23

```
1-Zero O2
2-Calibrate O2 Span
0-Previous Menu
```

4. Pressing **KEY 1-Zero O2** will bring up the Zero Oxygen Screen (Figure 3.24).

Figure 3.24

```
                  1-Zero
                    Level
+00.2% O2 Gas     5-Pump
                  0-Exit
```

5. Read the oxygen Gas Concentration on the screen. It should be very near 00.0 % and not changing more than a few tenths of one percent.

Note: Even if the screen displays 00.0% oxygen, proceed with step 6 below, the Oxygen must be zeroed anyway.

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6. Press **KEY 1-Zero level** and the one of following screens (Figure 3.25 or Figure 3.26) are displayed for three seconds before returning to the Zero Oxygen Screen shown above. If the O2 Zeroed Screen was displayed proceed to step 9 below.

Figure 3.25

```
Level NOT Zeroed
Please refer to
Operating Manual
```

Figure 3.26

O_2 Zeroed

7. If the Oxygen NOT Zeroed Screen was displayed, return to the Oxygen Calibration Screen. Recheck hose for air leaks and that the calibration gas contains no oxygen. The gas used must be oxygen free. Connect the correct gas (if necessary) and re-zero the oxygen. If the problem continues, proceed to instructions contained in this section for Factory Settings.

8. If the Oxygen Zeroed OK Screen flashed, turn off the calibration gas.

9. Remove the hose to the GA-90 from the flow regulator.

10. Press **KEY 0-Exit** to return to the Oxygen Calibration Screen Shown in Figure 3.27 and proceed to the next section.

Span Oxygen (OPTIONAL FEATURE)

1. From the O2 Calibration Screen (Figure 3.27), press **KEY 2-Calibrate O2 Span** and the Oxygen Calibration Screen (Figure 3.28) will appear.

Figure 3.27

1-Zero O_2
2-Calibrate O_2 Span
0-Previous Menu

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Figure 3.28

```
                    1-Enter
                      gas con
+00.0% O2 Gas       5-Pump
                    0-Exit
```

2. Change the Calibration Gas mixture to Oxygen/Nitrogen. Install the regulator/flow meter on the new Calibration Gas mixture as directed previously in the section Setting Up the Equipment.
3. Connect the 1/4" Tygon tubing from the calibration gas regulator/flowmeter to the GA-90 gas sample port (Figure 1.1). Attach, if not already attached, the Tygon tubing to the exhaust port of the GA-90. Direct the exhaust away from you and out of the immediate area.
4. Turn on the calibration gas mixture of oxygen and nitrogen.
5. Check the calibration gas flow (300 cc) and pressure (2 psig) if not using the LANDTEC regulator.
6. Allow the calibration gas to flow into the GA-90 for two minutes or until O2 reading stablizes.
7. After two minutes, read the oxygen Gas Concentration on the screen. It should be stable and not changing more than a few tenths of one percent.
8. Press **KEY 1-Enter Gas Con** and input the oxygen concentration of the CALIBRATION GAS from the keyboard of the GA-90 (Figure 3.29). Enter the percentage as three digits XX.X%. 4% oxygen would be input as 040. The GA-90 will automatically place a decimal point in the proper position. After the percentage is entered, press **KEY 0-Exit**.

Figure 3.29

```
Enter Concentration
of Calibration Gas
O2 ?-.-%
                0-Exit
```

9. The next screen to appear, Figure 3.30, is the Caution Re-Calibrate Screen.

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Figure 3.30

```
Caution Re-calibrate
Are you sure?

1-Yes          2-No
```

10. Press **KEY 1-Yes** and one of two screens will appear (Figure 3.31 or Figure 3.32). If the Calibration OK Screen flashed, proceed to step 14.

Figure 3.31

```
Calibration gas NOT
accepted. Retry?

1-Yes          2-No
```

Figure 3.32

```
Re-Calibrated OK
```

11. If the Calibration gas NOT Accepted Screen appears, several things could have happened. Press **KEY 1-Yes** and enter the percentage of oxygen in the Calibration Gas. It is possible the wrong percentage was input. If on a second attempt this has not worked, press **KEY 0-No** and return to the oxygen Calibration Menu. Start the procedure over again — Zero oxygen and then calibrate oxygen. If there are still problems, proceed to the Factory Settings section in this section.

12. Press **KEY 0-Exit** and return to the Oxygen Calibration Screen shown on the following page.

13. Turn off the Calibration Gas. Remove the Calibration Gas hose attached to the gas sample port. Leave the exhaust port hose connected. Press **KEY 5-Pump** to purge instrument with air for 60 seconds.

14. Optional Step Upper O2 Scale Calibration- The GA-90 was just calibrated on 0-5% oxygen scale. The 5-21% scale can be calibrated using normal air. While on the Oxygen Calibration Screen press **KEY 5-Pump** and enter an O2 concentration of 21.0% even though the screen will seldom reach more than 20.7%. You have just calibrated the upper oxygen scale.

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Figure 3.33

```
                    1-Zero
                     Level
+20.6% O2 Gas       5-Pump
                    0-Exit
```

15. To exit, press **KEY 0** until the main menu appears. You have successfully completed an oxygen Field Calibration.

Factory Settings Calibration

As previously mentioned, the GA-90 can be returned to its original Factory Settings Calibration. This procedure eliminates the field calibration done in the above procedures. It is sometimes necessary to bring the GA-90 back to factory settings before trying to field calibrate the unit.

1. From the Gas Calibration Screen, Figure 3.34, press **KEY 4-Factory Settings.**

Figure 3.34

```
1-CH4 Calibration
2-CO2 Calibration
3-O2 Calibration
4-Factory Settings
```

2. The Caution Screen, Figure 3.35, shown below will be displayed. If **KEY 0 - No** is pressed, screen represented in Figure 3.36 will appear for two seconds and the Gas Calibration Screen will return.

Figure 3.35

```
CAUTION Return to
Factory Setting of
Calibration & Zero
1-Yes        2-No
```

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Figure 3.36

Factory Setting NOT Set

3. Press **KEY 1-Yes** and the screen shown in Figure 3.37 is displayed for three seconds before returning to the Gas Calibration Screen shown in step 1.

Figure 3.37

Factory Setting Set OK

4. After loading the factory setting, the methane and oxygen calibration **must be rezeroed prior to use.**

After Completing Gas Calibrations

Additional General Utilities functions should be addressed after the GA-90 is field calibrated. These functions are available from the General Utilities Menu and include:

KEY 1-Check Time/Date—to make sure the data collected is properly date stamped.

KEY 4-Check Memory—to see if there is enough space in the GA-90 for the reading you plan to do. Otherwise the memory will have to be cleared.

KEY 3-Set Gas Alarms—if you wish to have the GA-90 alert you to unusual gas conditions or turn alarms off.

After completing the gas calibrations, you can begin to read gas levels. Go to Chapter 5-Read Gas Levels, of this manual.

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MODEL 128 ORGANIC VAPOR ANALYZER CALIBRATION PROCEDURE

FOXBORO # 1-800-321-0322

Instruction

MI
611-132
December 1985

Model OVA 128
CENTURY Organic Vapor Analyzer

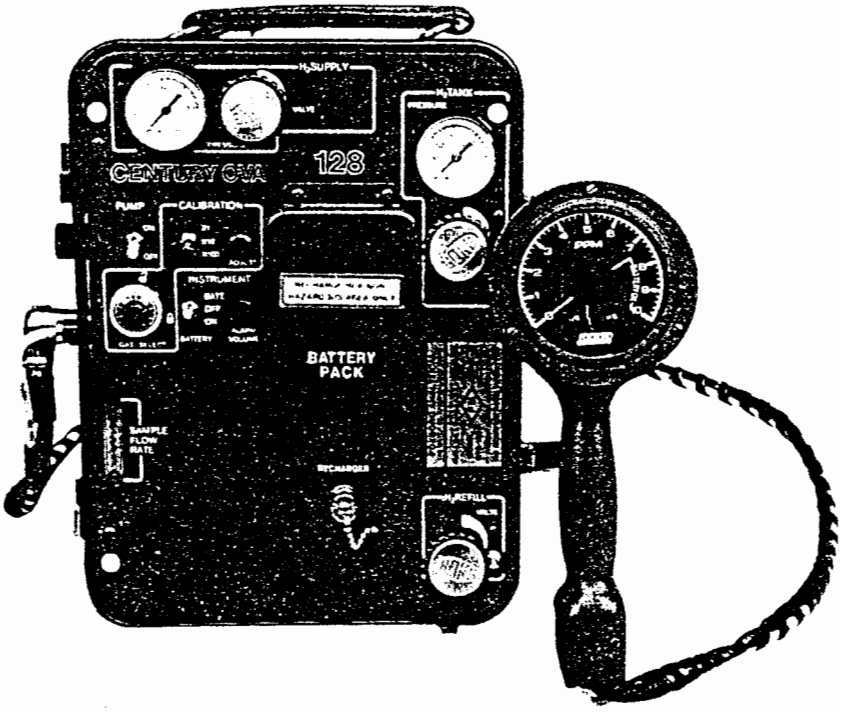

FIGURE 1
PORTABLE ORGANIC VAPOR ANALYZER

INTRODUCTION 1

GENERAL DESCRIPTION 2
Major Features 3
Standard Accessories 4
Particulate Filters 4
Specifications 4

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CALIBRATION

Recalibration to Various Organic Vapors

The OVA 128 is capable of responding to nearly all organic compounds. At the time of manufacture, the analyzer is calibrated to mixtures of methane in air. For precise analysis it is necessary to recalibrate with the specific compound of interest. The GAS SELECT control is used to set the electronic gain for a particular compound.

The instrument is recalibrated using a mixture of a specific vapor in air, with known concentration. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The GAS SELECT Knob on the panel is then used to set the readout meter indication to correspond to the concentration of the calibation gas mixture.

The instrument has now been calibrated to the vapor mixture being used. After this adjustment, the setting on the "digidial" should be recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds, thereby generating a "library" which can be used for future reference without need for additional calibration standards.

To read a particular compound, the GAS SELECT control is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

Using Empirical Data

Relative response data can be used to estimate the concentration of a vapor without need to recalibrate the analyzer. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The response factor (R) in percent, for that vapor is:

$$R = \frac{\text{Actual Concentration}}{\text{Measured Concentration}}$$

To determine the concentration of an unknown sample of that vapor, multiply the measured concentration by R.

Calibration Standards

Commercial Standards

Commercially available standard samples offer the most convenience and are recommended for the most precise analyses. Always remember to obtain the desired vapor in an air background. Samples should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

Preparation of Standards

The following procedure is for generating calibration standards as an alternative to using commercial mixtures.

Obtain a five (5) gallon glass bottle and determine its volume by measuring the volume of water needed to fill it (use of a 1000 mL graduated cylinder is convenient). Another approach is to weigh the empty bottle, fill it with water and weigh again. The difference between the two values is the weight of water. By multiplying the weight of water in pounds by 0.455, obtain the volume of the bottle in liters. Empty the water and allow the bottle to dry. Place a one-foot piece of Teflon tubing in the flask to aid in mixing the vapors uniformly with the air. The volume of such a bottle should be about 20 liters, which is 20,000 mL. If the volume were 20,000 mL, then a 2 mL sample of a gas would be equivalent to 200 mL per 2 million mL or 100 ppm (V/V). Use of a gas tight Syringe, readable in 0.01 mL, allows the preparation of mixtures in the 1-2 ppm range, which are sufficient for the quantitative estimation of concentrations. A plastic stopper is loosely fitted to the tip of the bottle. The needle of the syringe is placed inside the jug neck and the stopper squeezed against the needle to decrease leakage during sample introduction. Inject the sample into the bottle and withdraw the needle without removing the stopper. Tighten the stopper and shake the bottle for a few minutes with sufficient vigor that the plastic tubing in the bottle moves around to ensure good mixture of the vapors with the air.

Calculations

$$\text{Injection} = \frac{\text{Volume Concentration X Molecular Weight X System Volume}}{\text{Density X Molar Volume at STP*}}$$

$$= \frac{(C)\ (MW)\ (V)}{(D)\ (V)}$$

Using the Ideal Gas Law, PV=RT, the molar volume of any gas at STP (25°C and 1 atm) is:

$$V = \frac{RT}{P} = \frac{\text{Universal Gas Constant x Temperature}}{\text{Pressure}}$$

$$= \frac{\left[\left(0.08206\ \frac{\text{litre atm}}{\text{mol K}}\right)\right](298.15\ \text{K})}{1\ \text{atm}}$$

$$= (24.47\ \text{L})\ (\text{mol}^{-1})$$

Therefore, the injection volume necessary to prepare 1 liter of a 100 ppm sample of hexane would be:

$$\text{Injection Volume} = \frac{(100\ \text{ppm})\ [(86.18\ \text{g})\ (\text{mol}^{-1})]\ (1\ \text{liter})}{[(0.659\ \text{g})\ (\text{mL}^{-1})]\ [(24.47\ \text{L})\ (\text{mol}^{-1})]\ [(1000\ \text{mL})\ (\text{l}^{-1})]}$$

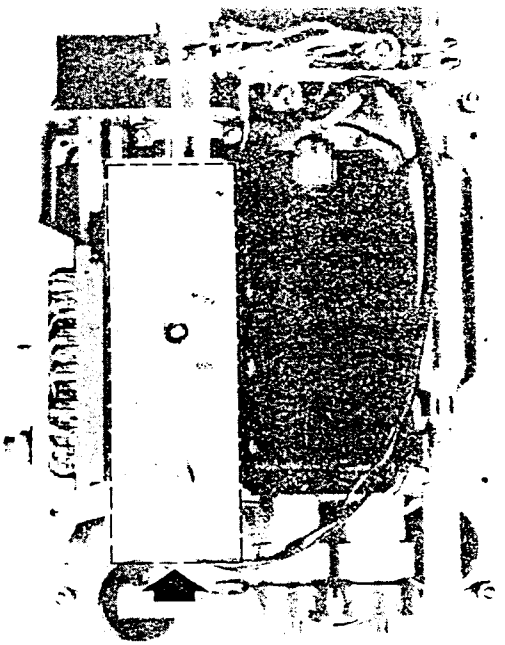
$$= 0.534\ \mu\text{L}$$

* STP - Standard Temperature and Pressure

Primary Calibration for Methane

Internal electronic adjustments are provided to calibrate and align the circuits. After initial factory calibration, it should not be necessary to repeat the calibration unless the analyzer undergoes repairs which affect calibration. If the OVA 128 will be extensively used for analysis of a sample other than methane, recalibration of the electronics (after resetting the GAS SELECT CONTROL) may result in better accuracy. See Recalibration to Various Organic Vapors above.

Primary calibration of this instrument is accomplished at the factory using methane-in-air, sample gases.



R-31 R-32 R-33 R-38

FIGURE 4
LOCATION OF ELECTRONIC ADJUSTMENTS

Calibration Using Known Samples for Each Range *(Refer to Figure 4)*

The accuracy stated under Specifications is obtained when the instrument is calibrated with known concentrations for each range. Prepare separate samples of methane-in-air in these concentration ranges: 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm. Calibrate the instrument as follows:

a) Place the instrument in normal operation and allow a minimum of 15 minutes for warm-up and stabilization.

b) Set the GAS SELECT control to 300.

c) Set the CALIBRATE Switch to X1.

d) Set the CALIBRATE ADJUST (Zero) Knob so that the meter reads zero.

e) Check that the meter reads zero on the X10 and X100 ranges.

f) Set the CALIBRATE Switch to X1 and introduce the sample with known concentration in the 7 to 10 ppm range.

g) Adjust R31 so that the meter reading corresponds to the sample concentration.

h) Set the CALIBRATE Switch to X10 and introduce the sample with known concentration in the 90 to 100 ppm range.

i) Adjust R32 so that the meter reading corresponds to the sample concentration.

j) Set the CALIBRATE Switch to X100 and introduce the sample with known concentration in the 900 to 1000 ppm range.

k) Adjust R33 so that the meter reading corresponds to the sample concentration.

l) The instrument is now calibrated for methane and ready for service.

Calibration Using a Single Sample Calibration *(Refer to Figure 4)*

Calibration may be accomplished using a single known sample of methane in air in the range of 90 to 100 ppm. This may not provide the accuracy stated under specifications but is adequate for field survey work.

a) Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT control set to 300.

b) Use the CALIBRATE ADJUST (zero Knob to adjust the meter reading to zero.

c) Introduce a methane sample of a known concentration (between 90 and 100 ppm not to exceed 100 ppm) and adjust trimpot R-32 so the meter reading corresponds to the known sample.

d) This sets the instrument gain for methane with the panel mounted gain adjustment (GAS SELECT) set at a reference number of 300.

e) Turn off HYDROGEN SUPPLY VALVE to put out flame.

f) Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) Knob to adjust meter reading to 4 ppm.

g) Place CALIBRATE Switch in X1 position and using trimpot R-31 adjust meter reading to 4 ppm.

h) Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) Knob to adjust meter to a reading of 40 ppm.

i) Move CALIBRATE Switch to X100 position and use trimpot R-33 to adjust meter reading to 40 ppm.

j) Move CALIBRATE ADJUST (zero) Knob to adjust meter reading to zero.

k) Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

SOP A6 RESPIROMETRY TESTING

The document Principles and Practices of Bioventing will be used as guidance for performing respirometry testing (Leeson and Hinchee 1995).

A6.1 PURPOSE

Respirometry testing will be conducted in order to monitor the performance of the FT-31 site bioventing system.

A6.2 PROCEDURE

Oxygen, carbon dioxide, and methane gases and hydrocarbon concentrations will be monitored at wells IW-02, MW-01, MW-02, MW-03, and MW-04. A Century OVA model 128 or equivalent flame-ionization detector will be used to measure hydrocarbon concentrations and a Land Control Technologies GA-90 will be used to measure the remaining gases.

Before a reading is taken, the probe is purged for a few minutes until the gas levels are stable. Initial readings are taken every 2 hours and then progressively over 4- to 8-hour intervals. If oxygen uptake is rapid, more frequent monitoring may be required. If it is slower, less frequent readings may be acceptable. The experiment usually is terminated when the soil gas oxygen concentration is approximately 5% (Leeson and Hinchee 1995).

A6.2.1 Interpretation of Respirometry Test Results

Oxygen utilization rates are determined from data obtained during the respirometry test. The rates are calculated as the zero order relationship between percent oxygen and time. Typically, a rapid linear decrease in oxygen is observed, followed by a lag period once oxygen concentrations drop below approximately 5%. To calculate oxygen utilization rates, only the first linear portion of the data is used because this represents oxygen utilization when oxygen is not limiting, as is the case during active bioventing (Leeson and Hinchee 1995).

To estimate hydrocarbon biodegradation rates from the oxygen utilization rates, a stoichiometric relationship for the oxidation of the contaminant is used. For hydrocarbons, hexane is used as the representative hydrocarbon. The stoichiometric relationship used to determine petroleum degradation rates is (Leeson and Hinchee 1995):

$$C_6H_{14} + 9.5O_2 \text{ @ } 6CO_2 + 7H_2O$$

Based on the utilization rates (% oxygen per day), the biodegradation rate in terms of mg hexane-equivalent per kg of soil per day is estimated using the following equation (Leeson and Hinchee 1995):

$$k_B = \frac{-k_o \, 1_a \, p_{O2} \, C \, (0.01)}{p_k}$$

Where: k_B = biodegradtion rate (mg/kg-day)

k_o = oxygen utilization rate (%/day)

1_a = gas-filled pore space (m^3 gas/cm^3 soil)

p_{O2} = density of oxygen (mg/L)

C = mass ratio of hydrocarbons to oxygen

p_k = soil bulk density (g/cm3)

These terms may be derived through either direct measurement or calculation. The oxygen utilization rate, k_o, is directly measured with the GA-90 during the respirometry test. The ratio of hydrocarbons to oxygen required for mineralization, C, is calculated to be 0.29 based on the stoichiometry for hexane. This neglects any conversion to biomass, which probably is small and difficult, if not impossible, to measure. The density of oxygen, p_{O2}, is assumed to be 1,331 mg/L. This assumption is based on a vadose zone air temperature of 68°F, which will not vary with seasonal changes. The bulk density of soil, p_k, is assumed to be 1.36 dry g/cm^3, which is the density for wind deposited silt. The gas-filled porosity, 1_a, is calibrated with the following equations (Leeson and Hinchee 1995):

$$1_a = 1 - 1_w$$

Where: $1 = 1 - p_k / 2.65\ g/cm^3 = 1 - 1.36\ g\ dry\ soil/cm^3 / 2.65\ g/cm^3 = 0.49$

$1_w = M\ (p_k / 2.65\ g/cm^3)$

Where: M = soil moisture (g moisture/g soil); assume M of contaminated zone is 0.40 g/g

$1_w = 0.40\ (1.36\ g\ dry\ soil/cm^3 / 2.65\ g/cm^3) = 0.21$

Therefore: $1_a = 0.49 - 0.21 = 0.28$

Therefore: $k_B = \dfrac{-k_o\ (0.28)\ (1{,}331 mg/L)\ (0.29)\ (0.01)}{1.36\ g\ dry\ soil/cm^3} = -0.79\ k_o$

A6.2.2 Field Instrumentation and Measurement

A Century OVA model 128 or equivalent flame-ionization detector and Land Control Technologies GA-90 will be used to measure hydrocarbon concentrations and gas levels, respectively. After each instrument is connected to the well head, they will purge for a few minutes until the readings stabilized. After the readings have stabilized, they will be recorded on the appropriate site visitation form, Appendix B.

Oxygen, Carbon Dioxide, and Methane

The GA-90 will be calibrated each day prior to performing respirometry testing. The calibration and maintenance of the GA-90 will be performed in accordance with SOP A5, Calibration Procedures for Field Equipment.

Hydrocarbon Concentration

The Century OVA model 128 or equivalent with range settings of 100, 1,000, and 10,000 ppm will be used to measure hydrocarbon concentrations. The analyzer will be calibrated each day in accordance with SOP A5, Calibration Procedures for Field Equipment, prior to performing respirometry testing against two hexane calibration gases (500 ppm and 4,400 ppm). The calibration will require mylar bags and at least 10% oxygen concentration. When the oxygen drops below 10%, a dilution fitting must be added to provide adequate oxygen for analysis. The Trace-Techtor has a dilution fitting that can be used to calibrate the instrument in the low-concentration range.

APPENDIX B

REPORTING FORMS

LIST OF FORMS

DAILY QUALITY CONTROL REPORT
DAILY SITE VISITATION LOG
WEEKLY/BIWEEKLY SITE VISITATION LOG
MONTHLY/QUARTERLY SITE VISITATION LOG

DAILY QUALITY CONTROL REPORT

_____

(Firm Name)

DAILY QUALITY CONTROL REPORT

Daily Report No: _____ Date: _____

Contract No. _____

Project Title & Location: _____

Weather: _____ Precipitation: _____ in. ____ Temp.: Min. ____ Max.. ____

1. Contract/Subcontractors and Area of Responsibility:

NUMBER	TRADE	HOURS	EMPLOYER	LOCATION/DESCRIPTION OF WORK

2. Operating Plant or Equipment: (Excluding hand tools)

Plant/Equipment	Date of Arrival/Departure	Date of Safety Check	Hours Used	Hours Idle	Hours Repair

3. Work Performed Today: (Indicate location and description of work performed by prime and/or subcontractors. When network analysis is used, identify work by NAS activity number)

4. Control Activities Performed:
Preparatory Inspections: (Identify feature of work and attach minutes)
Initial Inspections: (Identify feature of work and attach minutes)
Follow-Up Inspections: (List inspections performed, results of inspection compared to specification requirements, and corrective actions taken when deficiencies are noted)

5. Tests Performed and Test Results: (Identify test requirement by paragraph number in specifications and/or sheet number in plans)

6. Material Received: (Note inspection results and storage provided)

7. Submittals Reviewed:

Submittal No.	Spec./Plan Reference	By Whom	Action

8. Off-site Surveillance Activities, Including Action Taken:

_____

_____

_____

_____

_____

_____

9. Job Safety: (List items checked, results, instructions, and corrective actions taken)

_____

_____

_____

_____

_____

_____

10. Remarks: (List instructions received or given, conflict(s) in plans and/or specifications, delays encountered, etc.)

_____

_____

_____

_____

_____

_____

Contractor's Verification: On behalf of the Contractor, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____

Construction Quality Control System Manager Date

SITE VISITATION LOGS

HOLLOMAN AFB

FT-31

DAILY SITE VISITATION LOG

DATE:	NAME:	
OVERALL SYSTEM OPERATING?	YES	NO

CAUSE OF SHUTDOWN: _____

_____

_____

BIOVENT SKID:

OPERATION DATA:

Hours of Operation (hrs):			
Ambient Air Temperature (°F):			
Discharge Air Temp. (°F):			
Discharge Air Flow (SCFM):	N:	E:	S:
Discharge Air Pressure (in. of H_2O):	N:	E:	S:

MAINTENANCE:

Diff. Air Filter Pressure (psig):	

Additional Activities Performed: _____

_____

Equipment/Materials Used: _____

_____

HOLLOMAN AFB

FT-31

WEEKLY/BIWEEKLY SITE VISITATION LOG

PAGE 1 OF 3

DATE:	NAME:	
OVERALL SYSTEM OPERATING?	YES	NO

CAUSE OF SHUTDOWN: _____

_____

_____

BIOVENT SKID:

OPERATION DATA:

Hours of Operation (hrs):			
Ambient Air Temperature (°F):			
Discharge Air Temp. (°F):			
Discharge Air Flow (SCFM):	N:	E:	S:
Discharge Air Pressure (in. of H_2O):	N:	E:	S:

MAINTENANCE:

Diff. Air Filter Pressure (psig):		
Blower Oil Level OK?	YES	NO

Additional Activities Performed: _____

_____

Equipment/Materials Used: _____

_____

HOLLOMAN AFB

FT-31

WEEKLY/BIWEEKLY SITE VISITATION LOG

PAGE 2 OF 3

RESPIROMETRY MEASUREMENTS

WELL NO.	OXYGEN (%)	CARBON DIOXIDE (%)	METHANE (%)	HYDROCARBONS (PPM)
MW-A (8 ft)				
MW-B (18 ft)				
MW-C (8 ft)				
MW-D (18 ft)				
IW-02 (15 ft)				

WELL NO.	AIR FLOW (SCFM)	PRESSURE (PSIG)
NORTH AREA		
BV-01		
BV-02		
BV-03		
BV-04		
BV-05		
BV-06		
SOUTH AREA		
BV-07		
BV-08		
BV-09		
BV-10		
BV-11		
BV-12		
BV-13		
BV-14		
BV-15		

HOLLOMAN AFB

FT-31

WEEKLY/BIWEEKLY SITE VISITATION LOG

PAGE 3 OF 3

WELL NO.	AIR FLOW (SCFM)	PRESSURE (PSIG)
SOUTH AREA (CONTINUED)		
BV-16		
BV-17		
BV-18		
EAST AREA		
BV-19		
BV-20		
BV-21		
BV-22		

Comments:

HOLLOMAN AFB

FT-31

MONTHLY/QUARTERLY SITE VISITATION LOG

PAGE 1 OF 2

DATE:	NAME:	
OVERALL SYSTEM OPERATING?	YES	NO

CAUSE OF SHUTDOWN: _____

_____

_____

BIOVENT SKID:			
OPERATION DATA:			
Hours of Operation (hrs):			
Ambient Air Temperature (°F):			
Discharge Air Temp. (°F):			
Discharge Air Flow (SCFM):	N:	E:	S:
Discharge Air Pressure (in. of H_2O):	N:	E:	S:
MAINTENANCE:			
Diff. Air Filter Pressure (psig):			
Blower Oil Changed?	YES	NO	
Greased Bearings	YES	NO	
Blower Belt Tension OK?	YES	NO	

Equipment/Materials Used: _____

_____

HOLLOMAN AFB

FT-31

MONTHLY/QUARTERLY SITE VISITATION LOG

PAGE 2 OF 2

RESPIROMETRY MEASUREMENTS

WELL NO.	OXYGEN (%)	CARBON DIOXIDE (%)	METHANE (%)	HYDROCARBONS (PPM)
MW-A (8 ft)				
MW-B (18 ft)				
MW-C (8 ft)				
MW-D (18 ft)				
IW-02 (15 ft)				

DPT SAMPLES

SAMPLE NO.	LOCATION	NH_4-N	NO_2/NO_3	TOTAL N

Comments: _____

_____

_____

_____

_____

APPENDIX C

LABORATORY PRECISION AND ACCURACY DATA

Method**		MDL*	Reporting Limit*	
	Dibromochloromethane	0.3	3	ug/L
	Chlorobenzene	0.4	3	
	Ethylbenzene	0.5	3	
	Bromoform	0.4	3	
	1,1,2,2-Tetrachloroethane	0.5	3	
	Acrolein	3	3	
	Acetone	2	5	
	Acrylonitrile	2	3	
	Vinyl acetate	0.5	3	
	2-Butanone	0.7	5	
	4-Methyl-2-pentanone	2	5	
	2-Hexanone	2	5	
	m,p-Xylenes	0.4	3	
	o-Xylene	0.4	3	
	Styrene	0.4	3	
	Carbon disulfide	0.4	3	
	Dichlorodifluoromethane	0.6	3	
8260A	**Volatile Organics by GC/MS**			
	Dichlorodifluoromethane	0.2	0.5	ug/L
	Chloromethane	0.2	0.5	
	Vinyl chloride	0.2	0.5	
	Bromomethane	0.1	0.5	
	Chloroethane	0.1	0.5	
	Trichlorofluoromethane	0.2	0.5	
	1,1-Dichloroethene	0.2	0.5	
	Methylene chloride	0.2	0.5	
	trans-1,2-Dichloroethene	0.2	0.5	
	1,1-Dichloroethane	0.2	0.5	
	2,2-Dichloropropane	0.2	0.5	
	cis-1,2-Dichloroethene	0.1	0.5	
	Bromochloromethane	0.1	0.5	

*Detection and reporting limits for solid samples are calculated based on the assumption of 100% total solids. Actual values will be adjusted upwards by the percent total solids. Limits for all samples will also be adjusted for any dilutions or matrix interferences.

**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

Method**	MDL*	Reporting Limit*	
Chloroform	0.2	0.5	ug/L
1,1,1-Trichloroethane	0.1	0.5	
Carbon tetrachloride	0.1	0.5	
1,1-Dichloropropene	0.1	0.5	
Benzene	0.1	0.5	
1,2-Dichloroethane	0.1	0.5	
Trichloroethene	0.1	0.5	
1,2-Dichloropropane	0.1	0.5	
Dibromomethane	0.1	0.5	
Bromodichloromethane	0.1	0.5	
cis-1,3-Dichloropropene	0.2	0.5	
Toluene	0.2	0.5	
trans-1,3-Dichloropropene	0.2	0.5	
1,1,2-Trichloroethane	0.1	0.5	
Tetrachloroethene	0.2	0.5	
1,3-Dichloropropane	0.2	0.5	
Chlorodibromomethane	0.2	0.5	
1,2-Dibromoethane	0.2	0.5	
Chlorobenzene	0.1	0.5	
1,1,1,2-Tetrachloroethane	0.2	0.5	
Ethylbenzene	0.1	0.5	
m,p-Xylenes	0.2	0.5	
o-Xylene	0.1	0.5	
Styrene	0.1	0.5	
Bromoform	0.1	0.5	
Isopropylbenzene	0.1	0.5	
Bromobenzene	0.1	0.5	
1,2,3-Trichloropropane	0.2	0.5	
1,1,2,2-Tetrachloroethane	0.1	0.5	
n-Propylbenzene	0.1	0.5	
2-Chlorotoluene	0.1	0.5	

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**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

Method**		MDL*	Reporting Limit*	
415.2	**Total Organic Carbon, UV, persulfate oxidation**			
	Total Organic Carbon	0.3	1	mg/L
418.1	**Total Recoverable Petroleum Hydrocarbons**			
	TPH-418.1	5	20	mg/kg DB
	TPH-418.1	0.2	0.5	mg/L
420.1	**Phenolics, total recoverable, automated 4AAP**			
	Phenolics, Total Recoverable	0.001	0.005	mg/L
425.1	**Methylene Blue Active Substances (MBAS)**			
	Methylene Blue Active Substances		0.02	mg/L
504	**EDB & DBCP by Microextraction and GC**			
	1,2-Dibromoethane	0.01	0.05	ug/L
	1,2-Dibromo-3-chloropropane	0.01	0.05	
508	**Chlorinated Pesticides by GC with ECD**			
	Hexachlorocyclopentadiene	0.001	0.005	ug/L
	Hexachlorobenzene	0.001	0.005	
	gamma-BHC (Lindane)	0.001	0.005	
	Heptachlor	0.001	0.005	
	Aldrin	0.001	0.005	
	Heptachlor Epoxide	0.001	0.005	
	Dieldrin	0.001	0.005	
	Endrin	0.001	0.005	
	4,4'-DDE	0.001	0.005	
	4,4'-DDD	0.001	0.005	
	4,4'-DDT	0.001	0.005	
	Methoxychlor	0.002	0.01	
	Alachlor	0.004	0.02	
	Atrazine	0.046	0.23	
	Simazine	0.123	0.62	

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**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

Method**		MDL*	Reporting Limit*	
	trans-1,3-Dichloropropene	0.03	0.15	ug/L
	1,1,2-Trichloroethane	0.05	0.25	
	Tetrachloroethene	0.1	0.5	
	Dibromochloromethane	0.08	0.4	
	Chlorobenzene	0.1	0.5	
	1,1,1,2-Tetrachloroethane	0.07	0.35	
	Bromoform	0.08	0.4	
	Bromobenzene	0.35	1.7	
	1,1,2,2-Tetrachloroethane	0.19	0.95	
	1,2,3-Trichloropropane	0.22	1.1	
	1,3-Dichlorobenzene	0.08	0.4	
	1,4-Dichlorobenzene	0.06	0.3	
	Benzyl chloride	0.2	1	
	1,2-Dichlorobenzene	0.12	0.6	
8020A	**Aromatic Volatile Organics by GC**			
	Benzene	0.18	0.9	ug/kg DB
	Toluene	0.22	1.1	
	Chlorobenzene	0.16	0.8	
	Ethylbenzene	0.2	1	
	m,p-Xylenes	0.58	2.9	
	o-Xylene	0.24	1.2	
	1,3-Dichlorobenzene	0.24	1.2	
	1,4-Dichlorobenzene	0.24	1.2	
	1,2-Dichlorobenzene	0.36	1.8	
	Total xylenes	0.58	2.9	
	Benzene	0.09	0.45	ug/L
	Toluene	0.11	0.55	
	Chlorobenzene	0.08	0.4	
	Ethylbenzene	0.1	0.5	
	m,p-Xylenes	0.29	1.4	
	o-Xylene	0.12	0.6	

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**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

Laucks Testing Laboratories, Inc. **Detection Limit Summary Report**

10-Nov-95

Method**		MDL*	Reporting Limit*	
340.2	**Fluoride, Ion Selective Electrode**			
	Fluoride		0.2	mg/L
350.1	**Ammonia, automated phenate**			
	Ammonia as N	0.005	0.01	mg/L
351.1	**Total Kjeldahl Nitrogen, automated phenate**			
	Total Kjeldahl Nitrogen as N	0.2	0.2	mg/L
353.2	**Nitrate/Nitrite, automated cadmium reduction**			
	Nitrate/Nitrite	0.01	0.01	mg/L
354.1	**Nitrite, spectrophotometric**			
	Nitrites	0.002	0.005	mg/L
365.3	**Total Phosphorus**			
	Phosphorus in water	0.01	0.01	mg/L
	soil	0.25	0.5	mg/kg
376.1	**Sulfide**			
	Sulfide		0.2	mg/L
376.2	**Sulfide**			
	Sulfide	0.04	0.04	mg/L
405.1	**Biochemical Oxygen Demand (BOD)**			
	Biochemical Oxygen Demand		5	mg/L
410.4	**Chemical Oxygen Demand, manual colorimetric**			
	Chemical Oxygen Demand		10	mg/L
413.1	**Total Recoverable Oil & Grease, gravimetric**			
	Oil and Grease		5	mg/L
413.2	**Total Recoverable Oil & Grease, infrared**			
	Oil and Grease		20	mg/kg DB
	Oil and Grease	0.8	1	mg/L

*Detection and reporting limits for solid samples are calculated based on the assumption of 100% total solids. Actual values will be adjusted upwards by the percent total solids. Limits for all samples will also be adjusted for any dilutions or matrix interferences.

**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

Method**		MDL*	Reporting Limit*	
	4-Chlorotoluene	0.1	0.5	ug/L
	1,3,5-Trimethylbenzene	0.1	0.5	
	tert-Butylbenzene	0.1	0.5	
	1,2,4-Trimethylbenzene	0.1	0.5	
	sec-Butylbenzene	0.1	0.5	
	1,3-Dichlorobenzene	0.1	0.5	
	1,4-Dichlorobenzene	0.1	0.5	
	Isopropyltoluene	0.1	0.5	
	1,2-Dichlorobenzene	0.1	0.5	
	n-Butylbenzene	0.1	0.5	
	1,2-Dibromo-3-chloropropane	0.2	0.5	
	1,2,4-Trichlorobenzene	0.2	0.5	
	Naphthalene	0.2	0.5	
	Hexachlorobutadiene	0.2	0.5	
	1,2,3-Trichlorobenzene	0.2	0.5	
	Acetone	1.7	1.7	
	2-Butanone	1.2	1.2	
	4-Methyl-2-pentanone	0.6	1	
	2-Hexanone	0.8	1	
	Carbon disulfide	0.2	0.5	
	Vinyl acetate	0.5	0.5	
	Iodomethane	0.2	0.5	
	trans-1,4-Dichloro-2-butene	1.5	5	
	Allyl chloride	0.2	0.5	
	Chloroprene	0.2	0.5	
	2-Chloroethyl vinyl ether	0.1	0.5	
8270A	**Semivolatile Organics by GC/MS**			
	Phenol	25	130	ug/kg DB
	Bis(2-chloroethyl)ether	27	140	
	2-Chlorophenol	22	110	
	1,3-Dichlorobenzene	14	70	

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**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

Laucks Testing Laboratories, Inc. **Detection Limit Summary Report**

10-Nov-95

Method**		MDL*	Reporting Limit*	
	trans-1,3-Dichloropropene	0.03	0.15	ug/L
	cis-1,3-Dichloropropene	0.03	0.15	
	1,1,2-Trichloroethane	0.05	0.25	
	1,1,2,2-Tetrachloroethane	0.19	0.95	
	Chlorodibromomethane	0.08	0.4	
	Chlorobenzene	0.11	0.55	
	Bromoform	0.08	0.4	
	Tetrachloroethene	0.1	0.5	
	1,3-Dichlorobenzene	0.08	0.4	
	1,4-Dichlorobenzene	0.07	0.35	
	1,2-Dichlorobenzene	0.12	0.6	
	2-Chloroethyl vinyl ether	1.4	7	
6010A	**Metals by ICP**			
	Aluminum	26	50	mg/kg DB
	Arsenic	2	10	
	Barium	15	50	
	Beryllium	0.3	1	
	Cadmium	0.4	1	
	Calcium	83	100	
	Chromium	2	5	
	Cobalt	3	10	
	Copper	2	5	
SOIL	Iron	5	10	
	Lead	2	10	
	Magnesium	36	100	
	Manganese	2	5	
	Mercury	3	20	
	Antimony	4	6	
	Nickel	3	5	
	Potassium	69	100	
	Selenium	5	20	

*Detection and reporting limits for solid samples are calculated based on the assumption of 100% total solids. Actual values will be adjusted upwards by the percent total solids. Limits for all samples will also be adjusted for any dilutions or matrix interferences.

**The method lists provided represent the entire target analyte list for which Laucks currently has MDL studies. The reported project specific target analytes may vary from this list.

8020
KEYS
.04
504_1
552
8010
8015
8015_MOD
8020
8080SC
8140
8141
8150-2
8310
8310-HAW
8310-HC
8330
8330_GTI
8330_MED
8330_OHM
A8015

MS/MSD Database Configuration

Record name: 8020 Created: 05/15/91
QC Fraction: GVO No: 9 Updated: 08/07/96
Description: Purgeable Aromatic Compounds

	Def Size	Def Vol	Conc Units
Water	10.0	10.0	ug/L
Soil	5.00	10.0	ug/kg

Analyte		Spike Added	Control Limits LCL	UCL	RPD
Benzene	W	20.0	76	113	12
	S	20.0	39	136	31
Toluene	W	20.0	72	113	15
	S	20.0	46	132	29
Chlorobenzene	W	20.0	80	113	11
	S	20.0	70	130	50
Ethylbenzene	W	20.0	73	113	14
	S	20.0	32	129	34
m+p-Xylene	W	20.0	73	111	14
	S	20.0	20	139	50
	S	20.0	20	127	31
1,3-Dichlorobenzene	W	20.0	73	113	18
	S	20.0	70	130	50
1,4-Dichlorobenzene	W	20.0	69	115	19
	S	20.0	70	130	50
1,2-Dichlorobenzene	W	20.0	72	118	20
	S	20.0	70	130	50
	W				
	S				
	W				
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	W				

F7=Del,/n,Name 8=Write,/n,In_use 9=Print,Db_enter?,Keys? 10=More,Help,Key

VOA-
KEYS
THEA-PEST
THM
TKN
TKN_BD
TL-GF
TNT-MS-SOIL
TOC
TOX
TOX_9076
TP
TPH
TPH_GRAV
VAP-MITC
VOA-390-LOW
VOA-390-MED
VOA-524-2
VOA-524-2-02
VOA-8260
VOA-BECHTEL

MS/MSD Database Configuration

Record name: VOA-8260 Created: 01/31/95
QC Fraction: MVO No: 5 Updated: 05/17/96
Description: INHOUSE VOLATILES

	Def Size	Def Vol	Conc Units
Water	25.0	25.0	ug/L
Soil			

Analyte		Spike Added	Control Limits LCL	UCL	RPD
1,1-Dichloroethene	W	4.00	64	124	20
	S		70	130	20
Trichloroethene	W	4.00	60	120	20
	S		70	130	20
Benzene	W	4.00	67	127	20
	S		70	130	20
Toluene	W	4.00	72	132	21
	S		70	130	20
Chlorobenzene	W	4.00	68	128	20
	S		70	130	20

5=QC fractions 6=print F10=More Shft-Fn=Fn Help

TPH
KEYS
NT-MS-SOIL
TOC
TOX
TOX_9076
TP
TPH
TPH_GRAV
VAP-MITC
VOA-390-LOW
VOA-390-MED
VOA-524-2
VOA-524-2-02
VOA-8260
VOA-BECHTEL
VOA-LOW-INH
VOA-MED-INH
WTPH
WTPH_G

MS/MSD Database Configuration

Record name: TPH
QC Fraction: OG No: 1
Description: TPH Oil and Grease by IR

Created: 03/25/92
Updated: 03/15/93

	Def Size	Def Vol	Conc Units
Water			mg/L
Soil			mg/kg DB

Analyte		Spike Added	Control Limits LCL	UCL	RPD
TPH Oil and Grease (IR)	W		71	119	15
	S		51	122	26
	W				
	S				
	W				
	S				
	W				
	S			

KEYS
HG_CV_AA
HG_ICP
HH
HYDRIDE
ICP
ICP_MS
ICP_TCLP
ICP_UMA
ICP_UMATILLA
MBAS
MTDRO
MTGRO
NH3
NO2
NO3-NO2
OG
OG_9071
OG_GRAV
ORG_AMM_NH3

MS/Duplicate Configuration

Record name: ICP — Created: 02/12/93
QC Fraction: ICP — No: 25 — Updated: 03/12/93
Description: ICP metals, LTL control limits

Analyte		Units	Recov LCL	Recov UCL	RPD LLD	RPD >5xLLD
Silver	W	UG/L	50	133	1.0	16
	S	MG/KG	58	132	1.0	30
Aluminum	W	UG/L	50	147	20	27
	S	MG/KG	50	150	20	30
Arsenic	W	UG/L	82	122	20	11
	S	MG/KG	70	127	20	30
Barium	W	UG/L	76	112	2.0	16
	S	MG/KG	61	127	2.0	20
Beryllium	W	UG/L	79	132	1.0	10
	S	MG/KG	84	122	0.10	10
Calcium	W	UG/L	50	150	5000	30
	S	MG/KG	50	150	250	30
CLLD=analyte LLD, >5xLLD=percent		RPD/L	70	127	1.0	14
	S	MG/KG	60	138	0.50	21
Cobalt	W	UG/L	81	115	2.0	16
Chromium	W	UG/L	75	117	1.0	21
	S	MG/KG	60	134	1.0	30
Copper	W	UG/L	77	116	1.0	10
	S	MG/KG	50	150	1.0	30
Iron	W	UG/L	80	120	10	20
	S	MG/KG				
Mercury	W	UG/L	64	115	20	13
	S	MG/KG	56	110	20	10
Potassium	W	UG/L	75	123	5000	12
	S	MG/KG	50	150	250	30
Magnesium	W	UG/L	50	150	5000	22
	S	MG/KG	50	150	250	30
Manganese	W	UG/L	59	131	1.0	30
	S	MG/KG	50	150	1.0	30
Sodium	W	UG/L	50	150	5000	29
	S	MG/KG	50	150	250	30
Nickel	W	UG/L	77	115	2.0	10
	S	MG/KG	69	124	2.0	21
Lead	W	UG/L	69	127	5.0	18
	S	MG/KG	50	148	5.0	30
Antimony	W	UG/L	71	131	60	29
	S	MG/KG	30	94	10	30
Selenium	W	UG/L	74	137	20	24
	S	MG/KG	67	129	20	10
Thallium	W	UG/L	72	113	50	10
	S	MG/KG	68	116	50	10
Vanadium	W	UG/L	84	115	5.0	17
	S	MG/KG	68	125	5.0	22
Zinc	W	UG/L	68	131	1.0	20
	S	MG/KG	50	150	1.0	30
Boron	W	UG/L	50	150	1000	30
	S	MG/KG	50	150	100	30
Molybdenum	W	UG/L	50	150	50	30
	S	MG/KG	50	150	5.0	30
	W					
	S					

F7=Del,,Name 8=Write,,In_use 9=Print,Help menu,PrtSc 10=More,Help,Key

NH
KEYS
KC8015
KC8260
MALATHION
MBAS
MMAN
MS_ORD
MS_TIN
MTBE_GC
MTDRO
MTGRO
NH3
NO2
NO3-NO2
OG
OG_GRAV
OP
ORD-DEG-LC
ORDNANCE_GC
ORDNANCE_LC

MS/MSD Database Configuration

Record name: NH3 Created: 03/01/91
QC Fraction: NH3 No: 1 Updated: 03/15/93
Description: Ammonia, Lachat phenate method

	Def Size	Def Vol	Conc Units
Water			mg/L
Soil			mg/kg DB

Analyte		Spike Added	Control Limits LCL	UCL	RPD
Ammonia as N (EPA 350.1)	W	0.500	53	120	10
	S		50	128	30
	W				
	S				
	W				
	S				
	W				
	S			

TKN
KEYS
CLP-ICP
TCLP-MSVOA
TCLP-PEST
TCLP-PYRIDIN
THEA-PEST
THM
TKN
TKN_BD
TL-GF
TNT-MS-SOIL
TOC
TOX
TOX_9076
TP
TPH
TPH_GRAV
VAP-MITC
VOA-390-LOW
VOA-390-MED

MS/MSD Database Configuration

Record name: TKN
QC Fraction: TKN No: 1
Description: Total Kjeldahl Nitrogen

Created: 03/06/91
Updated: 03/15/93

	Def Size	Def Vol	Conc Units
Water			mg/L
Soil			mg/kg DB

Analyte		Spike Added	Control Limits LCL	UCL	RPD
Total Kjeldahl Nitrogen	W		61	142	19
	S		50	150	30
	W				
	S				
	W				
	S				
	W				
	S			

NO
KEYS
BAS
MMAN
MS_ORD
MS_TIN
MTBE_GC
MTDRO
MTGRO
NH3
NO2
NO3-NO2
OG
OG_GRAV
OP
ORD-DEG-LC
ORDNANCE_GC
ORDNANCE_LC
P-CL-PHENOL
PB-GF
PB_MISC

MS/MSD Database Configuration

Record name: NO3-NO2 Created: 02/26/91
QC Fraction: NN No: 1 Updated: 03/15/93
Description: NO3/NO2, Lachat, Cd reduction

	Def Size	Def Vol	Conc Units
Water			mg/L
Soil			mg/kg DB

Analyte		Spike Added	Control Limits LCL	UCL	RPD
Nitrate/Nitrite (EPA 353.2)	W	0.500	68	122	10
	S		57	109	18
	W				
	S				
	W				
	S				
	W				
	S			

P

KEYS
- NO2
- NO3-NO2
- OG
- OG_9071
- OG_GRAV
- ORG_AMM_NH3
- P-CHLOROPHEN
- P2O5
- PB_MISC
- PCB
- PCB_OIL
- PH
- PHENOL-4AAP
- PIC-PSNS
- PO4_O
- PO4_T
- PROXIMATE
- PULP_METALS
- PYRIDINE

MS/Duplicate Configuration

Record name: PO4_T Created: 08/06/92
QC Fraction: TP No: 1 Updated: 11/28/94
Description: Total phosphorus

Analyte		Units	Recov LCL	Recov UCL	RPD LLD	RPD >5xLLD
Total Phosphorus	W	MG/L	54	129	0.010	27
	S	MG/KG	50	150	0.50	30
	W					
	S					
	W					
	S					
	W					
	S					
	W					
	S					

LLD=analyte LLD, >5xLLD=percent RPD

5=QC fractions,Copy 6=Print F10=More Shft-Fn=Fn Help