National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

SEP 23 2010

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive, Bldg. 1
Santa Fe, New Mexico 87505

Subject: Response to the New Mexico Environment Department (NMED) Comments on Solid Waste Management Unit (SWMU) 68 and SWMUs 8-58 Groundwater Characterization Work Plans

Dear Mr. Bearzi:

On behalf of the Department of Energy/National Nuclear Security Administration (DOE/NNSA) and Sandia Corporation (Sandia), DOE/NNSA is submitting, *"SWMU 68 and SWMUs 8/58 Groundwater Characterization Work Plans - U.S. Department of Energy/Sandia Corporation Response to the New Mexico Environment Department Letter of April 8, 2010 entitled, Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUS/ Area of Concern (AOC) (Request of March 1, 2006) and 5 Other SWMUS/AOC (Request of January 7, 2008) Sandia National Laboratories Environmental Protection Agency Identification Number NM5890110518."*

The NMED April 8, 2010 letter contains a section entitled, *"SWMUs Requiring Corrective Action,"* and specifies additional site characterization requirements for Sandia National Laboratories/New Mexico SWMUs 68 (Old Burn Site), 149 (Building 9930 Septic System), 154 (Building 9960 Septic System and Seepage Pits), and 8 and 58 (Open Dump and Coyote Canyon Blast Area). The responses for SWMUs 149 and 154 were submitted to NMED on June 30, 2010. This DOE/NNSA, and Sandia response addresses groundwater characterization requirements for SWMUs 68 and 8-58.

Should you have any questions regarding this correspondence, please feel free to contact me at (505) 845-6036, or John Gould of my staff at (505) 845-6089.

Sincerely,

Kimberly A Davis for

Patty Wagner
Manager

Enclosure

SNL1125

cc w/enclosure:
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AOP 95-45, 06

CERTIFICATION STATEMENT FOR APPROVAL AND FINAL RELEASE OF DOCUMENTS

Document title: **SWMU 68 and SWMUs 8/58 Groundwater Characterization Work Plans - U.S. Department of Energy/Sandia Corporation Response to the New Mexico Environment Department Letter of April 8, 2010 entitled, Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUS/AOCS (Request of March 1, 2006) and 5 Other SWMUS/AOCS (Request of January 7, 2008).**

Document author: **Alicia Aragon, Department 06765**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signature: Marianne C Walck 9-20-10
Date

Marianne Walck
Director
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Operator

and

Signature: Kimberly A Davis for 9/21/10
Date

Patty Wagner
Manager
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office
Owner and Co-Operator

September 2010

SWMU 68 and SWMUs 8/58 Groundwater Characterization Work Plans - U.S. Department of Energy/Sandia Corporation Response to the New Mexico Environment Department letter of April 8, 2010 entitled, "Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUs/AOCs (Request of March 1, 2006) and 5 Other SWMUs/AOCs (Request of January 7, 2008) Sandia National Laboratories EPA ID# NM5890110518 HWB-SNL-06-007 and HWB-SNL-08-001"

INTRODUCTION

This document responds to the New Mexico Environment Department (NMED) letter to the U.S. Department of Energy (DOE) and Sandia Corporation (Sandia) dated April 8, 2010 regarding the DOE/Sandia request for granting Corrective Action Complete (CAC) status for 31 Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at Sandia National Laboratories/New Mexico (SNL/NM). The NMED letter is entitled: "Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUs/AOCs (Request of March 1, 2006) and 5 Other SWMUs/AOCs (Request of January 7, 2008), Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-06-007 and HWB-SNL-08-001" (NMED April 2010).

The NMED April 8, 2010 letter contains a section entitled "SWMUs Requiring Corrective Action," and specifies additional site characterization requirements for SNL/NM SWMUs 68 (Old Burn Site), 149 (Building 9930 Septic System), 154 (Building 9960 Septic System and Seepage Pits), and 8 and 58 (Open Dump [Coyote Canyon Blast Area] and Coyote Canyon Blast Area). The responses for SWMUs 149 and 154 have been submitted to the NMED (SNL/NM June 2010). This DOE/Sandia response addresses additional site characterization requirements for SWMUs 8 and 58 and SWMU 68 only.

The specific requirements for SWMUs 8 and 58 and SWMU 68 in the NMED letter are repeated in boldface on Page 4, and are followed by the DOE/Sandia response written in normal font under "Response."

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SWMUs Requiring Additional Corrective Action

1. **<u>SWMU 68 (Old Burn Site):</u> Groundwater monitoring wells must be installed at SWMU 68 near the burn pan and associated ditch/surface impoundment. The groundwater must be sampled and analyzed for general chemistry, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), high explosives (HE) compounds, perchlorate, metals, hexavalent chromium, cyanide, nitrate plus nitrite, gross alpha and beta, and gamma spectrum. The Permittees must submit to the NMED for its review and approval a work plan to determine the gradient and direction of groundwater flow, and to sample and analyze the water quality of the groundwater at the site. The work plan shall include construction details and the locations and anticipated depths of the groundwater monitoring wells, and must summarize the geology and hydrology of the site to the extent that is currently known. The plan shall also present details on field procedures, sampling and analysis of the groundwater, and related quality control. The plan shall also contain a summary of the results to be reported after the investigation phase is completed, and a schedule for implementation of the work.**

   <u>Response</u>: DOE/Sandia will install three groundwater monitoring wells (OBS-MW1, OBS-MW2, and OBS-MW3) surrounding the burn pan (Attachment A, Figure A-2) to determine the hydraulic gradient and direction of groundwater flow. DOE/Sandia will also conduct groundwater sample collection and analysis from the newly installed wells for at least eight quarters. A work plan for the well installation and development, including field procedures and a sampling and analysis plan (SAP) for the monitoring of all wells, is provided as Attachment A of this response for NMED review.

   Preparations for field work will begin upon approval of the work plan by NMED. Wells will be drilled and developed *<u>within five months</u>* of NMED's approval of the work plan, contingent upon funding. Groundwater sampling will commence in the quarter following successful well installation and development (*<u>within 90 days</u>* of well completions). A well installation report will be submitted *<u>within three months</u>* after well completions (six months from NMED's approval of the work plan). The SWMU 68 Groundwater Characterization Report summarizing the results of this work will be completed and submitted to the NMED for review *<u>within six months</u>* of completion of the final (eighth) quarter of sampling. Results will also be presented as part of the Groundwater Protection Program's Annual Groundwater Monitoring Reports.

4. **<u>SWMUs 8 and 58 Open Dump (Coyote Canyon Blast Area), and Coyote Canyon Blast Area:</u> At least two groundwater monitoring wells must to [*sic*] be installed west of and near Features YY and OO. The groundwater must be sampled and analyzed for general chemistry, VOCs, SVOCs, HE compounds, perchlorate, metals, cyanide, nitrate plus nitrite, gross alpha and beta, and gamma spectrum. The Permittees must submit to NMED for its review and approval a work plan to sample and analyze the water quality of the groundwater at the site. The work plan shall include construction details and the locations and anticipated depths of the groundwater monitoring wells, and must summarize the geology and hydrology of the site to the extent that is currently known. The plan shall also present details on field procedures, sampling and analysis of the groundwater, related quality control, and contain a summary of the results to be reported after the investigation phase is completed, and a schedule for implementation**

of the work.

Response: DOE/Sandia will install two groundwater monitoring wells (CCBA-MW1 and CCBA-MW2) west of and near Features OO and YY (Attachment B, Figures B-2 through B-4). DOE/Sandia will also conduct groundwater sample collection and analysis from the newly installed wells for at least eight quarters. A work plan for the well installation and development, including field procedures and a sampling and analysis plan for the monitoring of all wells, is provided as Attachment B of this response for NMED review.

Preparations for field work will begin upon approval of the work plan by NMED. Wells will be drilled and developed *within five months* of NMED's approval of the work plan, contingent upon funding. Groundwater sampling will commence in the quarter following successful well installation and development (*within 90 days* of well completions). A well installation report will be submitted *within three months* after well completions (six months from NMED's approval of the work plan). The SWMUs 8 and 58 Groundwater Characterization Report summarizing the results of this work will be completed and submitted to the NMED for review *within six months* of completion of the final (eighth) quarter of sampling. Results will also be presented as part of the Groundwater Protection Program's Annual Groundwater Monitoring Reports.

References

New Mexico Environment Department (NMED), April 2010, "Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUs/AOCs (Request of March 1, 2006) and 5 Other SWMUs/AOCs (Request of January 7, 2008), Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-06-007 and HWB-SNL-08-001," New Mexico Environment Department, Santa Fe, New Mexico. April 8, 2010.

Sandia National Laboratories/New Mexico (SNL/NM), June 2010, "U.S. Department of Energy/Sandia Corporation Response to the New Mexico Environment Department letter of April 8, 2010 entitled, 'Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUs/AOCs (Request of March 1, 2006) and 5 Other SWMUs/AOCs (Request of January 7, 2008) Sandia National Laboratories EPA ID# NM5890110518 HWB-SNL-06-007 and HWB-SNL-08-001,'" Sandia National Laboratories, Albuquerque, New Mexico.

Attachment A

Groundwater Characterization Work Plan for SWMU 68, Old Burn Site

September 2010

Environmental Restoration Project
Sandia National Laboratories/New Mexico

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Acronyms and Abbreviations

AOC	Area of Concern
AOP	Administrative Operating Procedure
AR/COC	analysis request/chain of custody
ARCH	Air-Rotary Casing-Hammer
bgs	below ground surface
CAC	corrective action complete
CSSP	Contract-Specific Safety Plan
DOE	U. S. Department of Energy
DQO	data quality objective
EPA	U. S. Environmental Protection Agency
ER	Environmental Restoration
FOP	Field Operating Procedure
ft	feet
GWPP	Groundwater Protection Program
HASP	health and safety plan
HSWA	Hazardous and Solid Waste Amendments
KAFB	Kirtland Air Force Base
LOP	Laboratory Operating Procedure
LC	laboratory control
MCL	Maximum Contaminant Level
MS	matrix spike
MSD	matrix spike duplicate
NEPA	National Environmental Policy Act
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
NNSA	National Nuclear Security Administration
OSHA	Occupational Safety and Health Administration
OU	Operational Unit
PVC	polyvinyl chloride
QC	quality control
RCRA	Resource Conservation and Recovery Act

Acronyms and Abbreviations (concluded)

Sandia	Sandia Corporation
SAP	sampling and analysis plan
SME	subject matter expert
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SSO	Sandia Site Office
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
VOC	volatile organic compound

1. PROJECT AND SITE INFORMATION

This Groundwater Characterization Work Plan describes the procedures that will be adhered to by the U.S. Department of Energy/National Nuclear Security Administration/Sandia Site Office (DOE/NNSA/SSO) and Sandia Corporation (Sandia) for the installation of monitoring wells and the collection and analysis of groundwater samples associated with Sandia National Laboratories/New Mexico (SNL/NM) Solid Waste Management Unit (SWMU) 68, the Old Burn Site, which is located in the Foothills Test Area.

Task Description:	SNL/NM SWMU 68 installation of groundwater monitoring wells, preparation of well installation report, quarterly sampling of groundwater, submittal of groundwater monitoring data in annual report.
Project Leader/Department No.:	John Cochran / Sandia Department 6765
Scheduled Start Date:	March 2011 -- contingent upon New Mexico Environment Department (NMED) Approval of this Work Plan
Estimated Completion Date:	July 2014 -- Submittal of the Groundwater Characterization Report

2. REGULATORY CRITERIA

The NMED Hazardous Waste Bureau provides regulatory oversight of the SNL/NM Environmental Restoration (ER) Project and implements and enforces federal regulations mandated by the Resource Conservation and Recovery Act (RCRA). All ER Project SWMUs and Areas of Concern (AOCs) are listed in Module IV of the SNL/NM RCRA Part B Operating Permit, *Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA for Sandia National Laboratories* (NMED 1993).

In April 2004 the NMED issued a Compliance Order on Consent (the Order) (NMED April 2004) to the DOE/NNSA/SSO and Sandia, which specifically identified SWMU 68 (Old Burn Site) as requiring investigation. All investigations and corrective action requirements pertaining to SWMUs and AOCs are contained in the Order (NMED April 2004). A final investigation report and proposal for corrective action complete (CAC) (SNL/NM September 2005) was submitted and was approved by the NMED in October 2005 (NMED October 2005). The NMED issued a Certificate of Completion for CAC without controls for SWMU 68 and instructed DOE/NNSA/SSO and Sandia to initiate the Class 3 Permit modification request for CAC for SWMU 68.

The Justification for Class 3 Permit Modification was submitted to the NMED in March 2006 (SNL/NM March 2006) and made available for public comment. In December 2007, the NMED issued a public notice on the Class 3 Permit Modification with its intent to designate SWMU 68

as CAC with controls (NMED December 2007). In February 2008, Sandia and DOE/NNSA/SSO responded with an objection to NMED's designation of SWMU 68 as CAC with controls (SNL/NM February 2008). In a June 9, 2009 meeting with NMED and participating members of the public, these comments were discussed and NMED decided that SWMU 68 had not satisfied the requirements for CAC and that additional site characterization activities are required due to insufficient information about the hydrogeology and historical site usage.

This SWMU 68 Groundwater Characterization Work Plan was prepared in response to a letter received from the NMED to the DOE and Sandia on April 8, 2010 (NMED April 2010). The letter is entitled: “Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUs/AOCs (Request of March 1, 2006) and 5 Other SWMUs/AOCs (Request of January 7, 2008), Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-06-007 and HWB-SNL-08-001.” The letter required that DOE/Sandia submit this Groundwater Characterization Work Plan to the NMED by September 30, 2010.

This SWMU 68 Groundwater Characterization Work Plan outlines the activities and procedures to install and sample groundwater monitoring wells to comply with the requirements of the April 2010 NMED letter (NMED April 2010) and guidance of the New Mexico Office of the State Engineer (NMOSE) (NMOSE August 2005). To meet these regulatory requirements, the following tasks will be completed at SNL/NM:

- Submit this Groundwater Characterization Work Plan to the NMED for review and approval.
- Use a licensed well driller and approved materials to install three groundwater monitoring wells.
- After completion of the well-installation field activities, submit a Well Installation Report describing the well installation field activities to the NMED.
- Sample the newly installed groundwater wells for eight consecutive quarters.
- Submit the groundwater monitoring data to NMED using the Groundwater Protection Program (GWPP) Annual Groundwater Monitoring Report.
- Prepare a Groundwater Characterization Report describing groundwater analytical results and submit to the NMED.

Applicable Field Operating Procedures (FOPs), Administrative Operating Procedures (AOPs), Laboratory Operating Procedures (LOPs), and Sample Management Office (SMO) procedures are listed in Table A-1; however, this site-specific Work Plan will be used as the primary guidance in the field.

Table A-1. Applicable Operating Procedures

Number of Procedure	Title of Procedure
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings Rev. 1, 12/16/96
FOP 94-05	Borehole Lithologic Logging, Rev. 0, 2/10/94
FOP 94-25	Documentation of Field Activities, Rev. 0, 11/4/94
FOP 94-26	General Equipment Decontamination
FOP 94-28	Health and Safety Monitoring of Organic Vapors (FID and PID), Rev. 2, 4/27/97
FOP 94-38	Drilling Methods and Drill Site Management, Rev. 0, 4/14/94
FOP 94-41	Well Development, Rev. 0, 11/21/94
FOP 94-42	Integration of the Design, Installation, Rehabilitation, and Decommissioning of Environmental Restoration Wells, Rev. 1, 5/31/94
FOP 94-45	Designing and Installing Groundwater Monitoring Wells, Rev. 0, 5/31/94
FOP 94-57	Decontaminating Drilling and Other Field Equipment, Rev. 0, 5/31/94
FOP 94-68	Field Change Control, Rev. 2 (in revision)
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection), Rev. 1, 1/23/98
FOP 97-01	Well Registry and Tracking System, Rev. 0, 2/1/97
FOP 03-02	Groundwater Level Data Acquisition and Management
FOP 05-01	Groundwater Monitoring Well Sampling and Field Analytical Measurements
FOP 05-02	Groundwater Monitoring Equipment Field Check for Water Quality Measurements
FOP 05-03	Groundwater Sampling Equipment Decontamination
FOP 05-04	Groundwater Monitoring Waste Management
AOP 00-03	Data Validation Procedure for Chemical and Radiochemical Data
AOP 94-24	System and Performance Audits, Rev. 0, 1/12/95
AOP 94-25	Deficiency Reporting, Rev. 0, 1/12/95
AOP 95-16	Sample Management and Custody, Rev. 1, 4/18/96
AOP 08-05	Monitoring Well Installation, Decommissioning, and Planning
LOP 94-03	Sample Handling, Packaging, and Shipping
PLA 05-09	Groundwater Monitoring Health and Safety Plan
SMO 05-03	Procedure for Completing the Contract Verification Review
Not Applicable	SNL/NM Statement of Work for Analytical Laboratories
Not Applicable	Quality Assurance Project Plan for the Sample Management Office

3. PRE-FIELD ACTIVITIES

Pre-field activities that will be completed internally by Sandia prior to drilling include:

- Preparation of the contract (Statement of Work) with the drilling company for the drilling and monitoring well installation;
- SNL/NM excavation permit request and approval;
- SNL/NM site-specific Health and Safety Plan (HASP) and Contract-Specific Safety Plan (CSSP) preparation, review, and approval;
- NMOSE permit to install monitoring wells;
- National Environmental Policy Act (NEPA) review and approval;
- Waste Management Plan preparation;
- Field checklist completion; and
- Readiness review meeting with SNL/NM management personnel.

3.1 Health and Safety

All groundwater monitoring personnel will perform field activities safely in accordance with the SNL/NM Groundwater Health and Safety Plan, PLA 05-09. Level D personal protective equipment is anticipated for all drilling operations. Health and Safety records associated with drilling and development personnel will be maintained on site and will be available from the commencement of drilling activities. All field personnel will operate under a SNL/NM HASP or CSSP and will have SNL/NM-required training, including 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response training and subsequent yearly refresher courses. A SNL/NM Subject Matter Expert (SME) will perform a safety inspection of the drilling equipment before drilling commences.

3.2 Mobilization and Site Setup

SNL/NM personnel will ensure that containers for cuttings have been obtained and are ready for drilling operations. If required, roll-off bins supplied by SNL/NM personnel will be used to collect drill cuttings for waste management purposes.

4. EQUIPMENT DECONTAMINATION

All equipment used to construct groundwater monitoring wells and coming into contact with a sample, the interior of a well, or groundwater will be decontaminated prior to entering any well or contacting any sample to prevent cross-contamination. Equipment and materials (including chemicals and protective clothing), decontamination procedures, and waste management procedures are presented in the FOPs 05-01, 05-02, 05-03, and 05-04. The drill rig and related equipment will be decontaminated at the SNL/NM decontamination pad in Technical Area III prior to the beginning of drilling operations at each location. Decontamination of sampling equipment will also be required after each core barrel is retrieved and the sample collected. Decontamination waste will be contained in drums placed on a spill control pallet at the decontamination pad.

5. GROUNDWATER MONITORING WELL INSTALLATION

Three 5-inch nominal diameter polyvinyl chloride (PVC) casing groundwater monitoring wells (OBS-MW1, OBS-MW2 and OBS-MW3) will be installed surrounding the SWMU 68 burn pan to provide representative groundwater samples. The groundwater monitoring well boreholes will be drilled using a combination of Air-Rotary Casing-Hammer (ARCH) and Air-Rotary drilling methods.

The precise location of the wells will be determined in the field to avoid existing above-ground and underground utilities and structures. The specific well locations will be chosen in coordination with NMED staff. The wells will be installed at the following proposed locations (Figure A-1 and Figure A-2):

- OBS-MW1 will be installed approximately 100 ft east of the burn pan, approximately midway between the burn pan and eastern SWMU 68 boundary;
- OBS-MW2 will be installed approximately 220 ft southwest of the burn pan and west of the drainage ditch and surface impoundment (overflow basin), approximately 180 ft east of the western SWMU 68 boundary and 80 ft north of the southern SWMU 68 boundary (midway between the burn pan and the southwest SWMU 68 boundary).
- OBS-MW3 will be installed approximately 150 ft west burn pan (midway between the burn pan and the western SWMU 68 boundary).

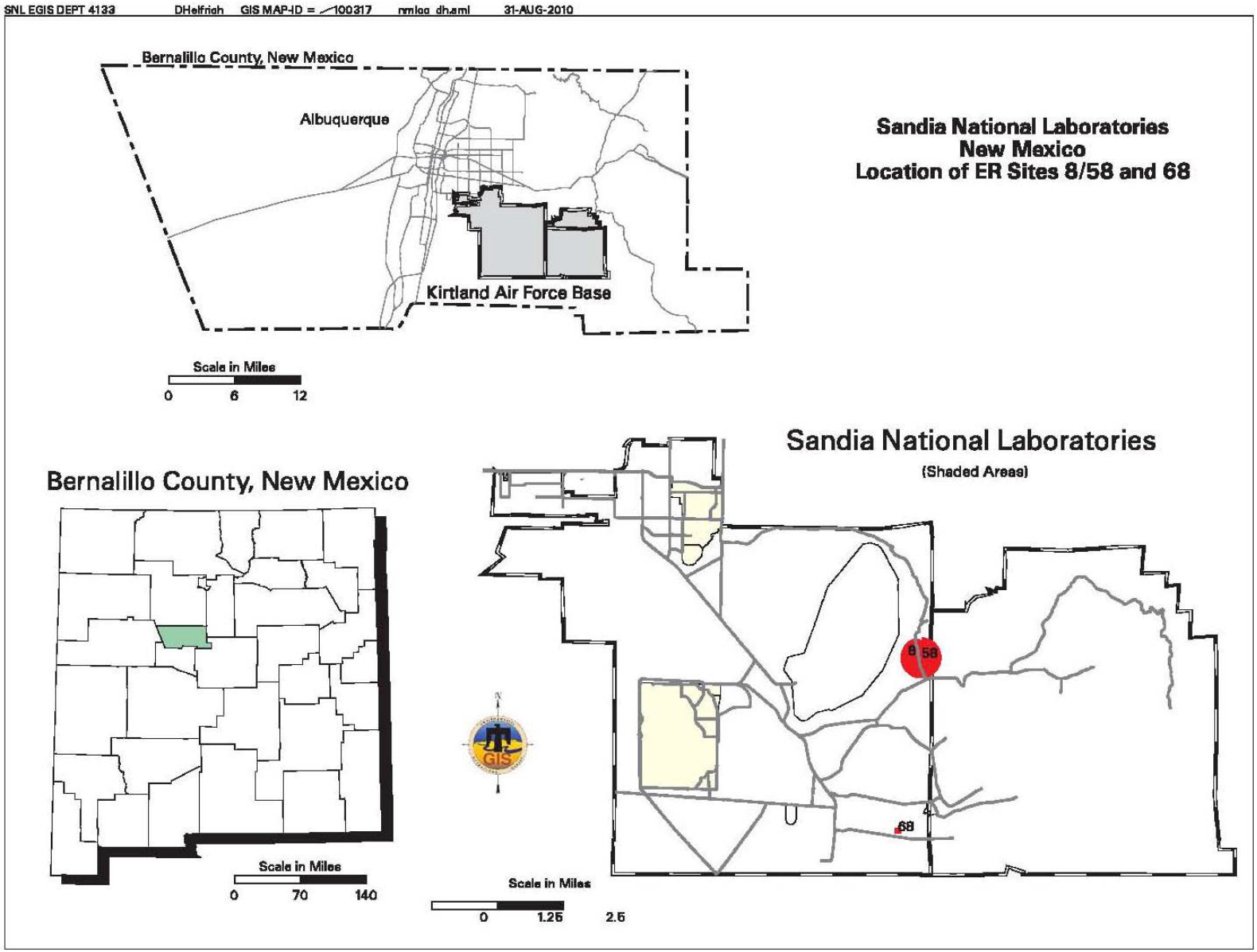

Figure A-1. Map of Bernalillo County, Kirtland Air Force Base, and SWMU 68

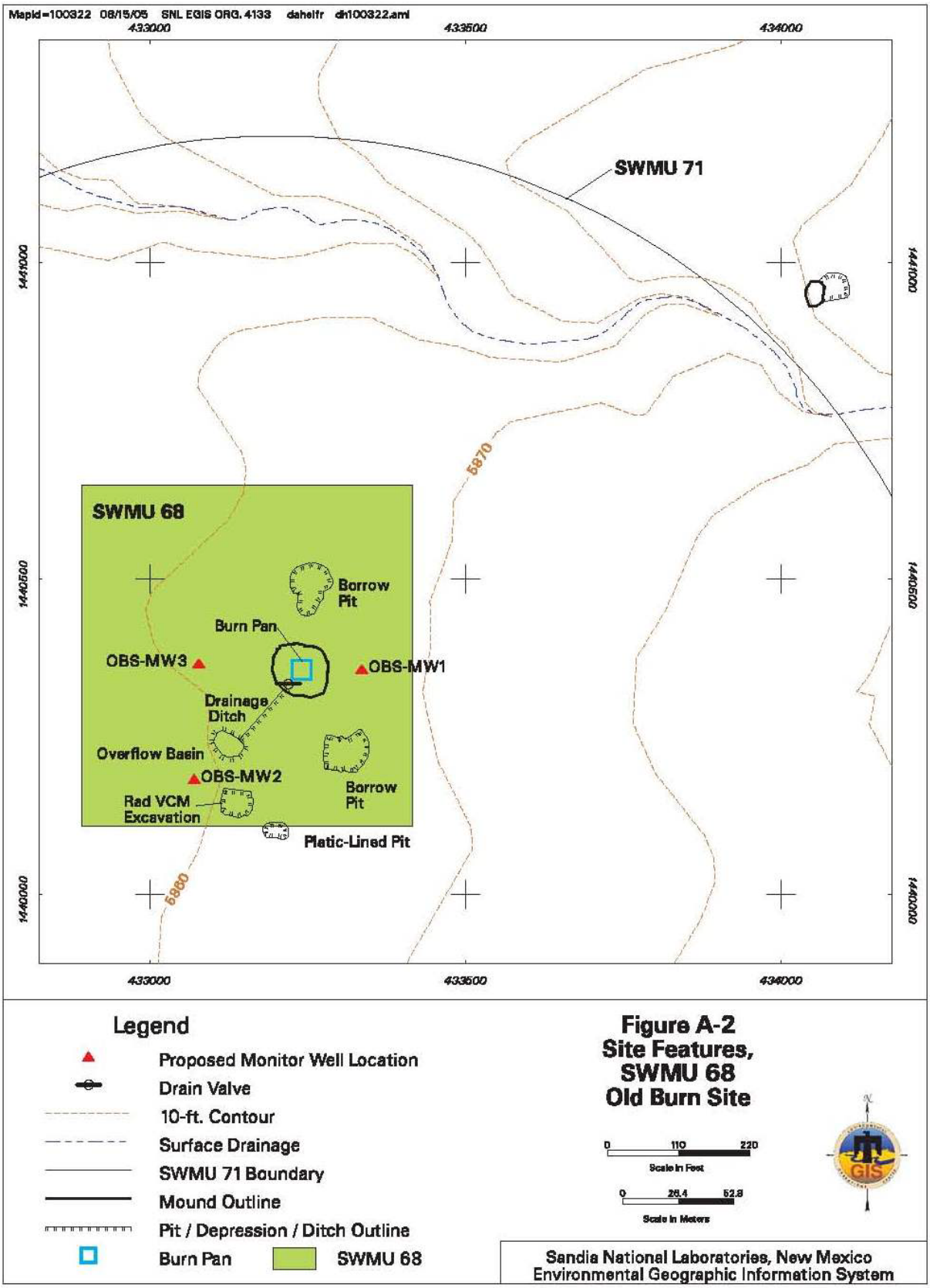

Figure A-2. Map of Proposed Well Locations

5.1 Summary of Well Site Geology and Hydrology

The elevation at SWMU 68 is approximately 5,860 feet (ft) above mean sea level. The terrain slopes gently to the west. No significant arroyos are located in the vicinity of SWMU 68. No springs are located downgradient of the site. Sheetflow from precipitation only occurs immediately following significant thunderstorms. The average rainfall, as measured at Albuquerque International Sunport, is 8.3 inches per year (NOAA 1997). Estimates of evapotranspiration for the Kirtland Air Force Base (KAFB) area range from 95 to 99 percent of the annual rainfall (SNL/NM February 1998).

SWMU 68 is located on alluvial deposits correlated to Tijeras/Latene soil units (IT May 1994), with permeabilities ranging from 0.6 to 2.0 inches per hour (USDA et al. June 1977). The geologic and hydrologic conditions are expected to be similar to those encountered at groundwater monitoring wells (TRS-1D, TRS-1S, and TRS-2) which are located approximately 3,200 ft to the west of SWMU 68 (See Figure A-3). Geologic information from TRS-1 borehole indicates that the local area is covered with approximately 122 feet of proximal to mid-fan alluvial sediments. Bedrock underlying the alluvial fan sediments consists of the Pennsylvanian Madera Group, Los Moyos Formation lime muds and limestone (SNL/NM December 1995). An outcrop of Paleozoic limestone is present just west of the burn pan, and Precambrian basement granite is exposed in the arroyo north of the site.

Water levels are fairly stable in the bedrock aquifer (SNL/NM March 1998). Depth to groundwater in the three wells varied from 124 to 132 ft bgs in April 2010. The direction of groundwater flow in the vicinity of SWMU 68 is generally to the west-southwest. A detailed discussion of the local setting at SWMU 68 is presented in the Operational Unit (OU) 1334 (Central Coyote Test Area) RCRA Facility Investigation Work Plan (SNL/NM October 1994).

5.2 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and is suitable for penetrating highly variable unconsolidated lithologies such as cobbles, boulders, gravel, sand, clay, and caliche. Once competent bedrock (Paleozoic sedimentary rocks) is encountered, air rotary drilling without casing advance will be used to drill to the total depth.

The borehole lithology will be logged by the SNL/NM field geologist during drilling. The total depth of the boreholes for the wells will be determined by the SNL/NM field geologist and will be dependent on water yield encountered during drilling. The total depths are anticipated to be about 25 to 30 ft below the water table. The depth of the first groundwater will be noted on the borehole log. If first groundwater is encounter in bedrock, the uncased portion of the borehole will be video logged using a wire-line camera for the purpose of evaluating bedrock fracture patterns.

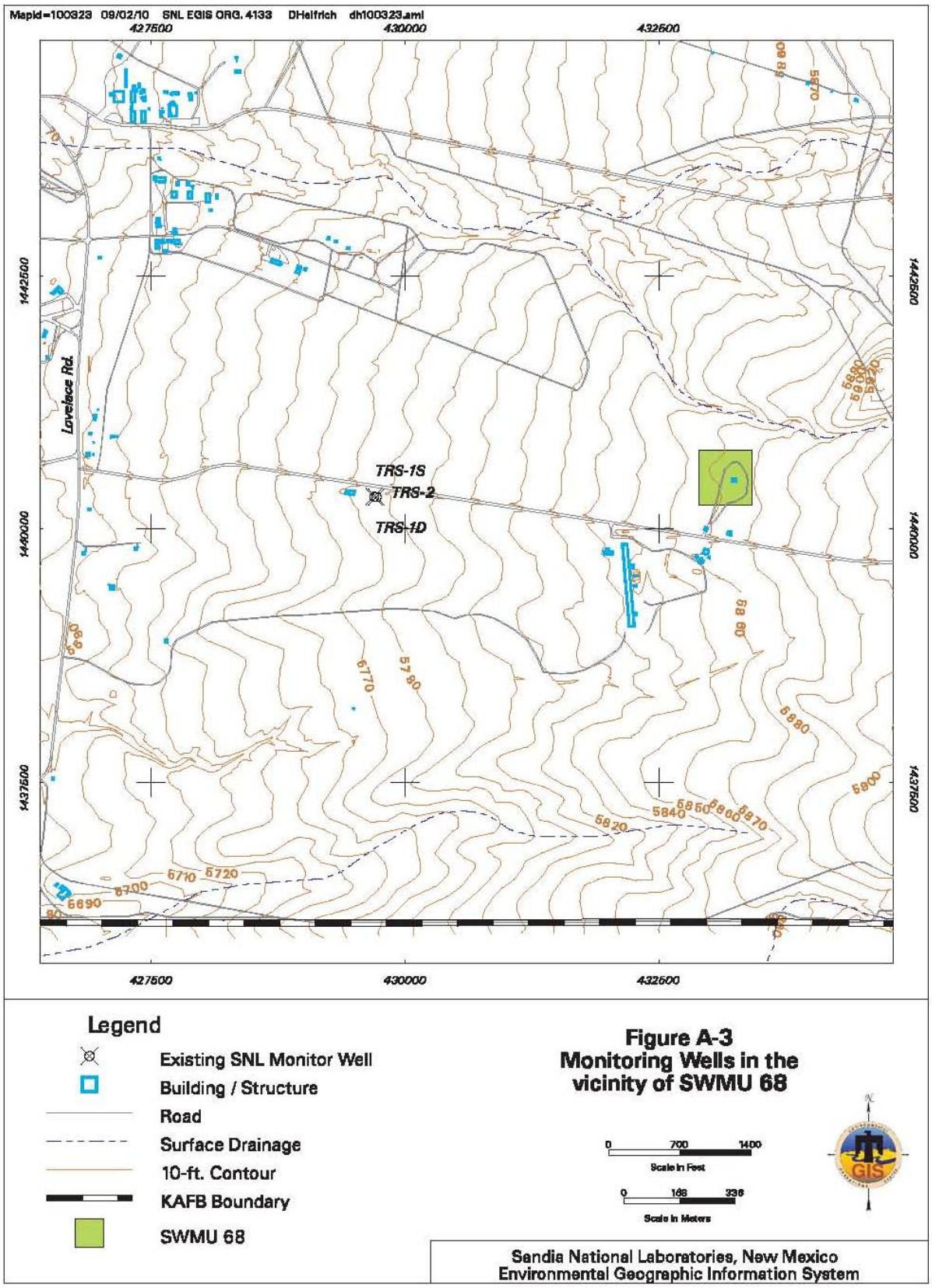

Figure A-3. Map showing nearby, existing wells TRS-1D, TRS-1S, and TRS-2

Minimal water (but no other foams/liquids) in the form of “mist” may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets. Management and final disposition of cuttings and water will be performed as stipulated in the project Waste Management Plan.

5.3 Well Construction

The groundwater monitoring wells will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch nominal diameter, flush-threaded, PVC Schedule 80 casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The well casing will be delivered pre-cleaned and bagged, or steam-cleaned on site prior to installation. To preserve the integrity of the well materials, the well screen and riser pipe will be suspended in the borehole as the sand packs, bentonite-pellet seal, and annular seal are installed.

It is anticipated that the SWMU 68 wells will be screened in the bedrock portion of the boreholes, based in part on drilling in the vicinity of SWMU 68. A 20-ft length of PVC screen with a 0.020-inch slot size will be used for each well. The screens will be set adjacent to the most productive groundwater unit. A 5-ft sump will be placed at the base of each screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen and then at intervals not to exceed 100 ft up to the ground surface. The screens will be placed so that the top of the screen is approximately 5 ft above the first significant water producing zone.

The primary filter pack will extend from the bottom of the sump to at least 5 ft above the top of the screen. A secondary 5-ft thick layer of clean #60 silica sand will be placed above the primary filter pack. Both sand packs will be tagged using a tag line to verify their depth. Preliminary well development using a surge block will be performed to help settle the filter pack.

An approximately 30-ft thick layer of 1/4-inch bentonite pellets or 3/8-inch bentonite chips will be placed and hydrated above the filter pack prior to emplacement of the bentonite-grout annular seal. The bentonite pellets/chips will be allowed to set for at least one hour to permit adequate time for hydration. The remaining annular space to ground surface will then be filled with bentonite grout. To prevent overloading, the bentonite grout will be installed in multiple lifts if necessary. The first bentonite grout lift will not exceed 100 ft in thickness and will be allowed to set a minimum of 24 hours before installation of the next lift, if additional grout is required. Based on the anticipated depth to groundwater, it is likely that only one bentonite grout lift will be required. The bentonite grout will be topped off to within 10 ft bgs.

The well casing will extend approximately 30 inches above ground surface and will be fitted with a water-tight cap. The monitoring well will be completed with a 36-inch high protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete pad will be constructed around the protective casing. The pad will

contain a 3-inch brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well.

5.4 Well Development

Well development will be completed no sooner than 48 hours after grouting. Each well will be developed for approximately 10 hours, and will consist of pumping, surge-blocking, swabbing, and/or bailing. During development, groundwater field parameters (pH, specific conductance, temperature, and turbidity) will be continuously monitored, and well development will continue until the parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface. The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented in writing during well development. If required, only potable water shall be added to the well during development.

During well development, a minimum of five well bore volumes will be removed. After the minimum volume has been removed, development will continue until representative water is obtained. Representative water is assumed to be obtained when the groundwater field parameters stabilize and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units.

5.5 Aquifer Parameters

Aquifer testing provides estimates of hydraulic parameters by measuring the effects of induced stress in an aquifer around a well. Stress can be induced by either withdrawing or injecting water into the well, creating a change in the water level in the well. Such a change in water level can be made instantaneously with a discrete displacement of the water column, referred to as a slug test.

Slug tests will be performed on OBS-MW1, OBS-MW2 and OBS-MW3 with a solid aluminum rod “slug” lowered into the well to raise and lower the water level in the well. Water level changes will be measured using a Solinst™ electronic pressure transducer (or equivalent) and data logger software. The “slug out” (removal of slug from the water column) portion of the test for each well will be recorded and analyzed. The Hvorslev analytical method (Hvorslev 1951) will be applied to the slug test data and the hydraulic conductivities calculated from the slug tests performed on the SWMU 68 wells will be presented in the SWMU 68 Groundwater Characterization Report

6. GROUNDWATER SAMPLING AND ANALYSIS

SNL/NM personnel will perform eight quarters of groundwater sampling at the installed SWMU 68 groundwater monitoring wells (OBS-MW1, OBS-MW2 and OBS-MW3). Groundwater sampling will be conducted in conformance with mini-Sampling and Analysis Plans (mini-SAPs) prepared for each quarterly sampling event.

Sampling will be conducted in accordance with the NMED Position Paper "Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring" (NMED October 2001) or in accordance with U.S. Environmental Protection Agency (EPA) guidance "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (EPA September 1986).

A portable Bennett™ sampling system will be used to collect the groundwater samples. The Bennett™ sampling pump and tubing bundle shall be decontaminated prior to installation in monitoring wells according to procedures described in FOP 05-03 "General Sampling Equipment Decontamination." After decontamination, the pump intake will be set at or near the bottom of the screen interval in each of the wells. A pumping rate that creates minimal disturbance to the groundwater flow regime, given equipment limitations, will be employed. The maximum pumping rate in any case will not exceed 12 liters per minute, and groundwater samples for volatile organic compound (VOC) analyses will be collected by filling the sample containers at a slow flow rate, given equipment limitations, to minimize volatilization. The sampling system may be adjusted in order to split the flow of water, such that the flow of water through the sampling side can be reduced to a rate of 0.1 liter per minute or less (<100 mL/min) to facilitate the filling of VOC sample containers without significant volatilization of any potential volatile organics. The flow rate through the other (purging) side will be the minimum rate that is reasonably achievable.

The static water level will be measured at each well prior to well purging, and water levels will be measured during purging and recorded on the field measurement log. Water level information is used to calculate the volume of water in a well casing and the amount required for purging. Measurements will be referenced to a surveyed mark of known elevation at the top of each well casing. The static water level will be measured in OBS-MW1, OBS-MW2 and OBS-MW3 prior to purging or obtaining a sample, and measurements will be taken to the nearest 0.01-foot using a water level meter. Other requirements for water level measurements are provided in FOP 05-01. Water levels in the wells will be measured during each sampling event. Water level measurements in OBS-MW1, OBS-MW2 and OBS-MW3 will be used to produce water-level hydrographs for the monitoring period, and will be presented in the SWMU 68 Groundwater Characterization Report.

In accordance with procedures described in FOP 05-01, the wells will be purged a minimum of one saturated casing volume (the volume of one length of the saturated screen plus the borehole annulus around the saturated screen interval). After the minimum volume is removed, purging will continue until four consecutive measurements of water quality parameters (turbidity,

pH, temperature, and specific conductance) exhibit stabilized conditions. Groundwater stability is considered acceptable for monitoring when:

- Turbidity measurements are within 10% or less than 5 Nephelometric Turbidity Units
- pH is within 0.1 units
- Temperature is within 1.0 degree Celsius
- Specific conductance is within 5%

If a monitoring well is purged dry prior to meeting the above purging and stability requirements, sampling will then be conducted once the well has recovered such that the volume of water available in the well is the minimum necessary to fill the sample containers.

6.1 Waste Management

All waste generated during groundwater sampling activities will be managed in accordance with federal, state, and local regulations. The purge and decontamination water will be managed as non-regulated waste, unless sample analytical results indicated that it must be managed as hazardous waste. Analytical data from sampling events will be compared to discharge and disposal criteria. The anticipated disposal path for purge water and decontamination water is discharge to the KAFB sanitary sewer. If the Albuquerque Bernalillo County Water Utility Authority discharge standards are not met, purge and decontamination water will be managed appropriately through the SNL/NM Hazardous Waste Management Facility. The disposal path for solid waste that comes into contact with groundwater will be determined by the associated groundwater analytical data results. Waste management activities associated with groundwater monitoring are discussed in FOP 05-04.

6.2 Sampling Location and Frequency

Groundwater monitoring samples will be collected quarterly for at least two years. Sample collection procedures are provided in FOP 05-01. Groundwater samples will be collected directly from the sample discharge tube into laboratory prepared sample containers. If required, chemical preservatives will be added to the sample containers at the analytical laboratories prior to shipment to the field crew. Immediately after collection, all sample containers will be custody-taped, sealed in plastic bags, and placed on blue ice in shipping containers. Sample documentation and custody will be performed in accordance with SNL/NM SMO procedures and protocols (AOP 95-16 and LOP 94-03). To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented in writing. Primary elements in the documentation of samples are: sample identification numbers, sample labels, custody tape, and Analysis Request/Chain of Custody (AR/COC) forms. AR/COC forms will be completed at the time of collection and will accompany the sample containers to the analytical laboratories.

Samples will be delivered to the shipping facility for repackaging in shipping coolers in accordance with appropriate U.S. Department of Transportation shipping regulations (49 CFR Parts 171–179). Samples will be packaged and shipped to General Engineering Laboratories

(or other EPA-certified contract laboratory) for analysis in accordance with SMO procedures detailed in LOP 94-03. Prior to shipment, sample collection documentation will be verified. Any error will be noted in writing and corrected.

Environmental samples will be collected and analyzed for constituents listed in Table A-2. Quality control samples will include trip blank samples, duplicate samples, equipment blank samples, and field blank samples.

Table A-2. Analytical Parameters for Groundwater Samples

Analyte	Analytical Method	Reference
General chemistry		
Major Cations: calcium, magnesium, sodium, potassium	SW846-6020A	EPA November 1986
Major Anions: chloride, sulfate, carbonate, bicarbonate, total alkalinity	SW846-9056A, SM 2320B	EPA November 1986, Clesceri, et al., 1998
TCL volatile organic compounds	SW846-8260B	EPA November 1986
TCL semivolatile organic compounds	SW846-8270D	EPA November 1986
High explosive compounds	SW846-8321A	EPA November 1986
Perchlorate	EPA 314.0	EPA 1999
TAL metals plus uranium	SW846-6020A, SW846-7470A	EPA November 1986
Hexavalent chromium	SW846-7196A	EPA November 1986
Cyanide	SW846-9012A	EPA November 1986
Nitrate plus nitrite	EPA 353.2	EPA 1983
Gross alpha and beta	EPA 900.0	EPA 1980
Gamma spectrum	EPA 901.0	EPA 1980

EPA = U.S. Environmental Protection Agency
TAL = Target Analyte List
TCL = Target Compound List

6.3 Data Quality Objectives and Quality Control

The data quality objective (DQO) for groundwater monitoring is to collect accurate, representative, and defensible data of sufficient quality to assess the concentrations of constituents in the groundwater associated with SWMU 68. DOE/Sandia will evaluate accuracy, precision, representativeness, completeness, and comparability of the groundwater data to verify that data are of sufficient quality and ensure that the DQO is met. Quality Control (QC) procedures discussed in this section will also be used to determine whether the DQO has been attained. QC samples generated in both the field and the laboratory will be analyzed and evaluated. Data not meeting DQO requirements are subject to corrective action(s) as discussed in SNL/NM SMO procedures and protocol.

Laboratory measurements will comply with SNL/NM SMO procedures and protocols listed in Table A-1, including qualification or validation of laboratory analytical data, and will also comply with all SAPs. This procedure for determining the quality and usability of analytical data acquired during groundwater sampling will be summarized in data validation reports regarding the overall quality of the data and the resulting data qualifiers. All associated data validation reports will be submitted to the NMED in the Groundwater Characterization Report which will summarize the results of this additional SWMU 68 work.

QC samples will be collected in the field and prepared in the laboratory to ensure that the data generated meet the DQO requirements. Mandatory QC samples are identified in the following sections.

6.3.1 Field Quality Control

Field QC samples are used to document data quality and identify any potential errors that may be introduced by field conditions, in sample collection, storage, transportation, and equipment decontamination. Field QC samples submitted to the analytical laboratory will be handled and analyzed in an identical manner as environmental samples. DOE/Sandia will collect and send to the analytical laboratory for analysis the following field QC sample types: equipment blanks, duplicates, field blanks, and trip blanks.

Equipment blanks demonstrate the effectiveness of equipment decontamination and monitor the cleanliness of the sampling system. After sampling equipment decontamination has been completed, an equipment blank is prepared by pumping de-ionized water through the portable sampling equipment and collecting a sample of this water. Equipment blanks will be collected at a frequency of 25 percent (minimum of one per sampling event) and will be analyzed for all of the constituents listed in Table A-2.

Duplicate environmental samples are collected in the field and analyzed to document the precision of the sampling and analysis process. The duplicate samples will be collected immediately after the original environmental sample in order to reduce variability caused by time and/or the sampling process. Duplicates will be collected at a frequency of 25 percent (minimum of one per sampling event) and will be analyzed for all of the constituents listed in Table A-2.

Field blanks are collected to assess whether any contamination of the samples was caused by ambient field conditions. The field blanks will be prepared by pouring deionized water into sample containers at the sample collection point to simulate the transfer of environmental samples from the sampling system to the sample container. Field blank samples will be collected at a frequency of 25 percent (minimum of one per sampling event) and will be analyzed for VOCs only.

Trip blanks are used to assess the potential for cross-contamination between environmental samples during sample handling and shipping activities. The trip blanks will be analyzed for VOCs only. Each batch of groundwater samples from OBS-MW1, OBS-MW2 and OBS-MW3 to

be analyzed for VOCs will be accompanied by at least one trip blank during shipping. The analytical laboratory will prepare the trip blank by filling a VOC-sample vial with deionized water and using the same sample preservation method designated for VOC environmental samples. Each vial will be sealed with custody tape and dated when it is prepared. The trip blanks will accompany the empty sample containers when they are shipped to SNL/NM prior to the start of sample collection. The trip blanks will be taken into the field during sample collection and will be included in the shipment of environmental samples to the laboratory. The trip blanks must remain sealed during this entire cycle and may be opened only for analysis on return to the analytical laboratory.

6.3.2 Laboratory Quality Control

The analytical laboratory is required to have established procedures that demonstrate the analytical process is always in control during each sample analysis step. These procedures are used for all samples including environmental samples, method blank samples, and matrix spike (MS) samples.

A laboratory control (LC) sample consists of a control matrix (e.g., deionized water) spiked with known concentrations of analytes representative of the target analytes. A LC sample will be prepared and analyzed for each analytical procedure and batch to determine accuracy of the data. The laboratory will also evaluate the precision of the data by analyzing twice either the environmental samples, LC samples, or MS samples and calculating the relative percent difference between corresponding results.

Method blank samples will be used to check for contamination in the laboratory during sample preparation and analysis. Method blank samples will be concurrently prepared and analyzed with each analytical batch. Method blanks will be reported in the same units as corresponding environmental samples, and the results will be included with each analytical report.

Surrogate spike analysis will be performed for all samples analyzed by Gas Chromatography/ Mass Spectroscopy. The surrogate compounds added to the sample will be those specified in the applicable EPA analytical method procedure (EPA November 1986). Recovery values for surrogate compounds that are outside specified control limits require corrective action, which is detailed in the Statement of Work for Analytical Laboratories.

The analytical process will be systematically evaluated for the effects of naturally occurring constituents present in the environmental sample matrix. MS/matrix spike duplicate (MSD) analyses will be performed in accordance with the specified analytical procedures.

6.4 Data Validation, Review, and Reporting

Data validation and review of analytical and field documentation will be performed. Field and analytical QC data will be reviewed for conformance to QC acceptance criteria. The entire data package will be reviewed for completeness, comparability, representativeness, precision, and accuracy to determine whether the DQO has been met. All groundwater monitoring data will be

reported in the SWMU 68 Groundwater Characterization Report as well as the GWPP Annual Groundwater Monitoring Report.

6.4.1 Field Water Quality Data and Documentation Review

Completed field documentation will be reviewed and checked for errors, completeness, and conformance with the applicable procedures. The review will occur at the end of each day in the field to allow verification, correction, and retrieval of missing information as appropriate. Field documentation found to be incomplete or to contain questionable data will be corrected prior to finalizing the field reports. If necessary, measurements of water quality parameters will be repeated.

6.4.2 Laboratory Data Verification and Validation

DOE/Sandia will review laboratory reports for completeness and conformance to the performance criteria of the laboratory contract according to the "Procedure for Completing the Contract Verification Review," SMO 05-03.

Upon receipt of the analytical results from the analytical laboratory, DOE/Sandia will arrange for the third-party validation of the data. The purpose of the validation is to determine the usability and establish the defensibility of the results in support of environmental and waste management activities. Data qualification will be based upon review of field and laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the QC criteria for meeting the DQO. Data validation will be conducted according to AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data." All associated data validation reports will be submitted in the SWMU 68 Groundwater Characterization Report.

6.4.3 Data Reporting

All groundwater monitoring data will be reported in the SWMU 68 Groundwater Characterization Report. This report will include a description of sampling activities, field water quality data, laboratory analytical data, a discussion of QC evaluations and data reviews, a description of any project variance or nonconformance, and data validation summaries. All analytical data results will be compared to EPA Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) for public drinking water systems. In addition, perchlorate will be compared to the screening level/method detection limit of 4 μg/L identified in the Order (NMED April 2004). The report will also include plots displaying constituents exceeding established EPA MCLs, and the screening level for perchlorate only, for samples collected from wells OBS-MW1, OBS-MW2 and OBS-MW3 during the compliance period.

6.4.4 Records Management

Records associated with groundwater monitoring, including field documentation, chains of custody, laboratory analytical results, data validation reports, and technical data evaluations will be maintained at the SNL/NM Customer Funded Records Center.

6.5 Nonconformances and Variances

Corrective actions will be taken to rectify or prevent a nonconformance or variance that could adversely affect the quality of data generated. Corrective actions will be documented in writing by the persons identifying the need for action.

A nonconformance is any action or condition that does not meet the requirements of this Work Plan. The analytical laboratory, SMO, groundwater monitoring team members, or the Project Leader may identify a nonconformance. The person noting a nonconformance will document the nonconformance in writing and suggest an appropriate corrective action. Resolution of the nonconformance will be documented in writing and acknowledged by DOE/Sandia.

DOE/Sandia and the analytical laboratories will have systems in place to identify QC issues and initiate corrective actions. In accordance with SMO procedures, the laboratories are required to notify the SMO of QC problems that may affect data quality. DOE/Sandia will evaluate and determine whether data are comparable to historical values and whether or not corrective action is required based upon the specific issue. Corrective action may include documentation of QC issues in an analytical laboratory report, data qualifiers, and/or sample re-analysis.

7. REPORTING

Based on the requirements and guidance established by the NMED, NMOSE and SNL/NM, the field activities associated with installation of the monitoring wells will be documented.

7.1 Groundwater Monitoring Well Installation Documentation

All well installation field activities will be documented in a field log book per guidance in FOP 94-45. Upon completion of the well installation, the Well Installation Report will document all site activities and provide final as-built well completion diagrams. The Well Installation Report will contain a brief narrative describing actual work performed at the site and any variances to the SWMU 68 Groundwater Characterization Work Plan. Information to be contained in the Field Report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" well completion diagram, and (4) documentation of notification of SNL/NM Geographic Information System group and the appropriate regulatory agencies. The documentation will also include the 37 information elements required in Section VIII.D of the Order (NMED April 2004). The following list of documents and records that are generated as part of the well installation process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well data summary sheet
- Statement of work for drilling the well
- Drilling permit
- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)
- Surveyed elevations and location in New Mexico state plane coordinates (with a degree of accuracy of ± 0.01 ft)
- Location map
- Water level measurements
- Aquifer test data
- Analytical data
- Waste management documentation
- Photographs

7.2 GWPP Annual Groundwater Monitoring Report

The GWPP annual report will include the groundwater monitoring data for the new wells as the data becomes available for SWMU 68. The ongoing annual reports will document all sampling events that took place in that particular calendar year and will present all relevant groundwater analytical results.

7.3 Groundwater Characterization Report

The final report documenting the groundwater characterization effort at SWMU 68 will include a current conceptual model of groundwater flow and contaminant transport at the site. Data and analysis from the slug tests will also be incorporated into the model. This Groundwater Characterization Report will be submitted to NMED after all eight consecutive quarters of groundwater monitoring have been completed.

8. SCHEDULE

The basis for the notional schedule shown in Figure A-4 is the logical development of project tasks and activities to implement the tasks described in this SWMU 68 Groundwater Characterization Work Plan. Per the requirements of the NMED's April 2010 letter (NMED April 2010) the schedule describes the implementation of the characterization work that is planned.

Initiation of field work is dependent upon NMED's approval of this work plan. Pre-field activities will commence upon notice of approval. Wells will be drilled and developed *within five months* of NMED's approval of the work plan, contingent upon funding. Groundwater sampling will

commence in the quarter following successful well installation and development (*within 90 days* of well completions). A well installation report will be submitted *within three months* after well completions (six months from NMED's approval of the work plan).

ID	Task Name	Duration
1	**Work Plan/Response to April 2010 Characterization Request**	**991 days**
2	NMED Review of Work Plan	131 days
3	NMED Approval of Work Plan	0 days
4	**Install Groundwater Wells**	**282 days**
5	Pre-Field Planning (permits, plans)	55 days
6	Drill & Develop Groundwater Wells - Field Effort	40 days
7	Perform Slug Tests	15 days
8	Draft Well Installation Report (incl. reviews, NOD, approval)	160 days
9	Submit Final Well Installation Report to NMED	0 days
10	**Quarterly Groundwater Sampling**	**520 days**
11	Q1 Sampling	65 days
12	Q2 Sampling	65 days
13	Q3 Sampling	65 days
14	Q4 Sampling	65 days
15	Q5 Sampling	65 days
16	Q6 Sampling	65 days
17	Q7 Sampling	65 days
18	Q8 Sampling	65 days
19	**Groundwater Characterization Report**	**133 days**
20	Draft Groundwater Characterization Report	80 days
21	Internal review and approval	40 days
22	Submit Final Groundwater Characterization Report	0 days

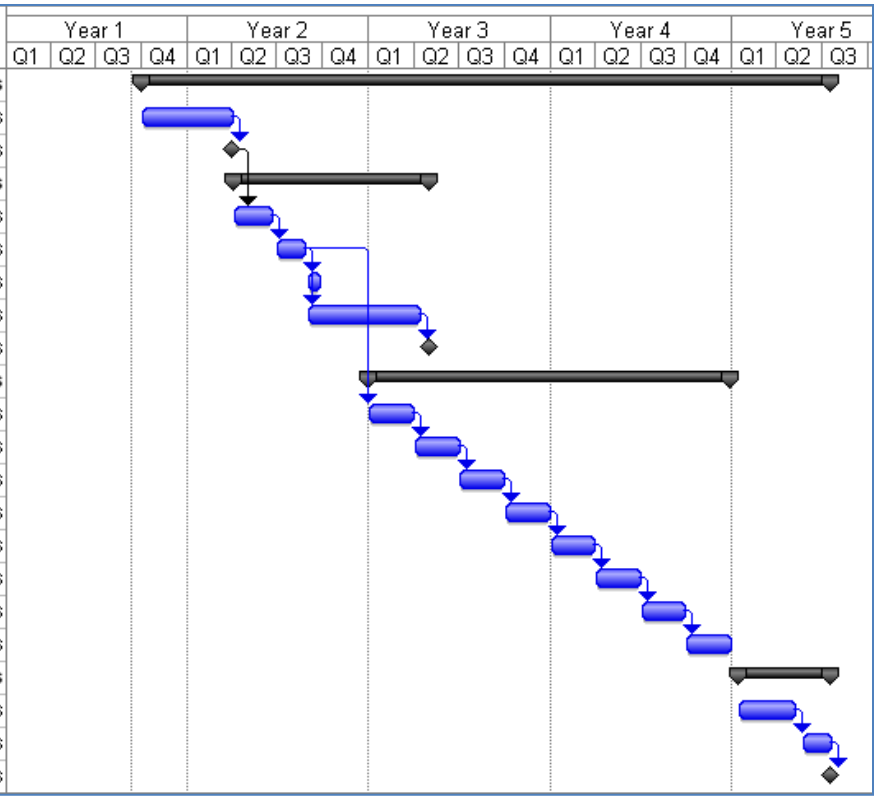

Figure A-4. SWMU 68 Groundwater Characterization Notional Schedule

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Attachment B

Groundwater Characterization Work Plan for SWMU 8 - Open Dump (Coyote Canyon Blast Area) and SWMU 58 - Coyote Canyon Blast Area, Foothills Test Area

September 2010

Environmental Restoration Project
Sandia National Laboratories/New Mexico

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Acronyms and Abbreviations

AOC	Area of Concern
AOP	Administrative Operating Procedure
AR/COC	analysis request/chain of custody
ARCH	Air-Rotary Casing-Hammer
bgs	below ground surface
CAC	corrective action complete
CCBA	Coyote Canyon Blast Area
CSSP	Contract-Specific Safety Plan
DOE	U. S. Department of Energy
DQO	data quality objective
EPA	U. S. Environmental Protection Agency
ER	Environmental Restoration
FOP	Field Operating Procedure
ft	feet
GWPP	Groundwater Protection Program
HASP	health and safety plan
HSWA	Hazardous and Solid Waste Amendments
KAFB	Kirtland Air Force Base
LOP	Laboratory Operating Procedure
LC	laboratory control
MCL	Maximum Contaminant Level
MS	matrix spike
MSD	matrix spike duplicate
NEPA	National Environmental Policy Act
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
NNSA	National Nuclear Security Administration
OSHA	Occupational Safety and Health Administration
PVC	polyvinyl chloride
QC	quality control
RCRA	Resource Conservation and Recovery Act
RSI	Request for Supplemental Information

Acronyms and Abbreviations (concluded)

Sandia	Sandia Corporation
SAP	sampling and analysis plan
SMO	Sample Management Office
SNL/NM	Sandia National Laboratories/New Mexico
SSO	Sandia Site Office
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
VOC	volatile organic compound

1. PROJECT AND SITE INFORMATION

This Groundwater Characterization Work Plan describes the procedures that will be adhered to by the Department of Energy/National Nuclear Security Administration/Sandia Site Office (DOE/NNSA/SSO) and Sandia Corporation (Sandia) for the installation of monitoring wells and the collection and analysis of groundwater samples associated with Sandia National Laboratories/New Mexico (SNL/NM) Solid Waste Management Units (SWMUs) 8 and 58, collectively known hereafter as SWMUs 8/58.

Task Description:	SNL/NM SWMUs 8/58 installation of groundwater monitoring wells, preparation of well installation report, quarterly sampling of groundwater, submittal of groundwater monitoring data in annual report.
Project Leader/Department No.:	John Cochran / Sandia Department 6765
Scheduled Start Date:	June 2011 -- contingent upon New Mexico Environment Department (NMED) Approval of this Work Plan
Estimated Completion Date:	July 2014 -- Submittal of the Groundwater Characterization Report

2. REGULATORY CRITERIA

The NMED Hazardous Waste Bureau provides regulatory oversight of the SNL/NM Environmental Restoration (ER) Project and implements and enforces federal regulations mandated by the Resource Conservation and Recovery Act (RCRA). All ER Project SWMUs and Areas of Concern (AOCs) are listed in Module IV of the SNL/NM RCRA Part B Operating Permit, *Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA for Sandia National Laboratories* (NMED 1993).

In April 2004 the NMED issued a Compliance Order on Consent (the Order) (NMED April 2004) to the DOE/NNSA/SSO and Sandia, which specifically identified SWMUs 8/58 as requiring investigation. All investigations and corrective action requirements pertaining to SWMUs and AOCs are contained in the Order (NMED April 2004).

A proposal for corrective action complete (CAC) for SWMUs 8/58 was submitted to NMED in April 2005 (SNL/NM April 2005). NMED responded to the CAC proposal with a Request for Supplemental Information (RSI) in June 2005, and required additional characterization at the site (NMED June 2005). DOE and Sandia responded to this RSI in June 2005 (SNL/NM June 2005) and agreed to complete the additional site characterization work. NMED approved the RSI response contingent on the results of field investigations proposed in the response (NMED September 2005). SNL/NM personnel completed the field work in September and October 2005, and submitted the results of the field investigations to NMED in March 2006 (SNL/NM

March 2006). NMED reviewed the March 2006 supplemental response, and issued a second RSI (which required additional site characterization work) in June 2006 (NMED June 2006). DOE and Sandia responded to the second RSI in August 2006 (SNL/NM August 2006), and again agreed to complete the additional site characterization work. The second RSI response was verbally approved by NMED in early August 2006, and the additional field work was completed in September 2006. NMED officially approved the second RSI response in October 2006 (NMED October 2006), after field work had been completed. NMED approved SWMUs 8/58 for CAC with controls in June 2007 (NMED June 2007).

In a June 9, 2009 meeting with NMED and participating members of the public, NMED decided that characterization of SWMUs 8/58 had not satisfied the requirements for CAC and that additional corrective actions are required due to insufficient information about the site hydrogeology and insufficient information about the contaminant source terms. This SWMUs 8/58 Groundwater Characterization Work Plan was prepared in response to a letter received from the NMED to the DOE and Sandia on April 8, 2010 (NMED April 2010). The letter is entitled: "Class 3 Permit Modification Requests for Granting Corrective Action Complete Status for 26 SWMUs/AOCs (Request of March 1, 2006) and 5 Other SWMUs/AOCs (Request of January 7, 2008), Sandia National Laboratories, EPA ID# NM5890110518, HWB-SNL-06-007 and HWB-SNL-08-001." The letter required that DOE/Sandia submit this Work Plan to the NMED by September 30, 2010.

This SWMUs 8/58 Groundwater Characterization Work Plan describes the activities and procedures to install and sample groundwater monitoring wells to comply with the requirements of the April 2010 NMED letter (NMED April 2010) and guidance of the New Mexico Office of the State Engineer (NMOSE) (NMOSE August 2005). To meet these regulatory requirements, the following tasks will be completed at SNL/NM:

- Submit this Groundwater Characterization Work Plan to the NMED for review and approval.
- Use a licensed well driller and approved materials to install two groundwater monitoring wells.
- After completion of the well-installation field activities, submit a Well Installation Report describing the well installation field activities to the NMED.
- Sample the newly installed groundwater wells for eight consecutive quarters.
- Prepare a Groundwater Characterization Report describing groundwater analytical results and submit to the NMED.
- Submit the groundwater monitoring data to the NMED using the Groundwater Protection Program (GWPP) Annual Groundwater Monitoring Report.

Applicable Field Operating Procedures (FOPs) Administrative Operating Procedures (AOPs), Laboratory Operating Procedures (LOPs), and Sample Management Office (SMO) procedures are listed in Table B-1; however, this site-specific Work Plan will be used as the primary guidance in the field.

Table B-1. Applicable Operating Procedures

Number of Procedure	Title of Procedure
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings Rev. 1, 12/16/96
FOP 94-05	Borehole Lithologic Logging, Rev. 0, 2/10/94
FOP 94-25	Documentation of Field Activities, Rev. 0, 11/4/94
FOP 94-26	General Equipment Decontamination
FOP 94-28	Health and Safety Monitoring of Organic Vapors (FID and PID), Rev. 2, 4/27/97
FOP 94-38	Drilling Methods and Drill Site Management, Rev. 0, 4/14/94
FOP 94-41	Well Development, Rev. 0, 11/21/94
FOP 94-42	Integration of the Design, Installation, Rehabilitation, and Decommissioning of Environmental Restoration Wells, Rev. 1, 5/31/94
FOP 94-45	Designing and Installing Groundwater Monitoring Wells, Rev. 0, 5/31/94
FOP 94-57	Decontaminating Drilling and Other Field Equipment, Rev. 0, 5/31/94
FOP 94-68	Field Change Control, Rev. 2 (in revision)
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection), Rev. 1, 1/23/98
FOP 97-01	Well Registry and Tracking System, Rev. 0, 2/1/97
FOP 03-02	Groundwater Level Data Acquisition and Management
FOP 05-01	Groundwater Monitoring Well Sampling and Field Analytical Measurements
FOP 05-02	Groundwater Monitoring Equipment Field Check for Water Quality Measurements
FOP 05-03	Groundwater Sampling Equipment Decontamination
FOP 05-04	Groundwater Monitoring Waste Management
AOP 00-03	Data Validation Procedure for Chemical and Radiochemical Data
AOP 94-24	System and Performance Audits, Rev. 0, 1/12/95
AOP 94-25	Deficiency Reporting, Rev. 0, 1/12/95
AOP 95-16	Sample Management and Custody, Rev. 1, 4/18/96
AOP 08-05	Monitoring Well Installation, Decommissioning, and Planning
LOP 94-03	Sample Handling, Packaging, and Shipping
PLA 05-09	Groundwater Monitoring Health and Safety Plan
SMO 05-03	Procedure for Completing the Contract Verification Review
Not Applicable	SNL/NM Statement of Work for Analytical Laboratories
Not Applicable	Quality Assurance Project Plan for the Sample Management Office

3. PRE-FIELD ACTIVITIES

Pre-field activities that will be completed internally by Sandia prior to drilling include:

- Preparation of the contract (Statement of Work) with the drilling company for the drilling and monitoring well installation;
- SNL/NM excavation permit request and approval;
- SNL/NM site-specific Health and Safety Plan (HASP) and Contract-Specific Safety Plan (CSSP) preparation, review, and approval;
- NMOSE permit to install monitoring wells;
- National Environmental Policy Act (NEPA) review and approval;
- Waste Management Plan preparation;
- Field checklist completion; and
- Readiness review meeting with SNL/NM management personnel.

3.1 Health and Safety

All groundwater monitoring personnel will perform field activities safely in accordance with the SNL/NM Groundwater Health and Safety Plan, PLA 05-09. Level D personal protective equipment is anticipated for all drilling operations. Health and Safety records associated with drilling and development personnel will be maintained on site and will be available from the commencement of drilling activities. All field personnel will operate under a SNL/NM HASP or CSSP, and will have SNL/NM-required training, including 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response training, and subsequent yearly refresher courses. A SNL/NM Subject Matter Expert will perform a safety inspection of the drilling equipment before drilling commences.

3.2 Mobilization and Site Setup

SNL/NM personnel will ensure that containers for cuttings have been obtained and are ready for drilling operations. If required, roll-off bins supplied by SNL/NM personnel will be used to collect drill cuttings for waste management purposes.

4. EQUIPMENT DECONTAMINATION

All equipment used to construct groundwater monitoring wells and coming into contact with a sample, the interior of a well, or groundwater will be decontaminated prior to entering any well or contacting any sample to prevent cross-contamination. Equipment and materials (including chemicals and protective clothing), decontamination procedures, and waste management procedures are presented in the FOPs 05-01, 05-02, 05-03, and 05-04. The drill rig and related equipment will be decontaminated at the SNL/NM decontamination pad in Technical Area III prior to the beginning of drilling at each location. Decontamination of sampling equipment will also be required after each core barrel is retrieved and the sample collected. Decontamination waste will be contained in drums placed on a spill control pallet at the decontamination pad.

5. GROUNDWATER MONITORING WELL INSTALLATION

Two 5-inch nominal diameter polyvinyl chloride (PVC) groundwater monitoring wells (CCBA-MW1 and CCBA-MW2) will be installed at SWMUs 8/58 (Figure B-1), west of and near Features OO and YY (Figure B-2). The boreholes will be drilled using a combination of Air-Rotary Casing-Hammer (ARCH) and Air-Rotary drilling methods.

The precise location of the wells will be determined in the field to avoid existing above-ground and underground utilities and structures. The wells will be installed at the following proposed locations:

- CCBA-MW1 will be installed approximately 50 ft due west of Feature OO (Figure B-3).
- CCBA-MW2 will be installed approximately 50 ft due west of Feature YY (Figure B-4).

5.1 Summary of Well Site Geology and Hydrology

The elevation at SWMUs 8/58 ranges from approximately 5,880 to 6,280 feet (ft) above mean sea level. SWMU 8 and the central portion of SWMU 58 are generally flat with a slight slope to the south-southwest. SWMU 58 is bordered on the northwest by a ridge. A small arroyo runs from the north to the south through the western side of the site. This arroyo is a tributary of Arroyo del Coyote, a medium-sized arroyo that runs from east to west just south of the site. Both arroyos are dry except during and immediately following significant thunderstorms. The average rainfall, as measured at Albuquerque International Sunport, is 8.3 inches per year (NOAA 1997). Estimates of evapotranspiration for the Kirtland Air Force Base (KAFB) area range from 95 to 99 percent of the annual rainfall (SNL/NM February 1998).

Alluvium fills the valley floors and a veneer of weather bedrock (colluvium) covers the surrounding slopes. Soil types across the two sites consist of Gila sandy loam, the Tesajo-Millet gravelly loam, and the Salas Complex (clayey to gravelly loam) (SNL/NM December 1995). The soils are poorly developed and are primarily derived from Paleoproterozoic granite, quartzite, meteor volcanics, and Paleozoic (Pennsylvanian) Madera Group limestone from the Manzanita Mountains.

SWMUs 8/58 are located in the Arroyo del Coyote watershed which captures runoff from the western flank of the Manzanita Mountains. No surface-water bodies are located at either site. The nearest surface water is Coyote Springs, a perennial spring located approximately 1,400 ft southwest of SWMU 58 in Arroyo del Coyote. Arroyo del Coyote intersects Tijeras Arroyo approximately 7 miles west of the two sites. Tijeras Arroyo eventually drains into the Rio Grande, approximately 16 miles west of the two sites. Surface-water samples are routinely collected at monitoring station MP-06, which is located 1.1 miles southwest of SWMU 58 (SNL/NM September 2003).

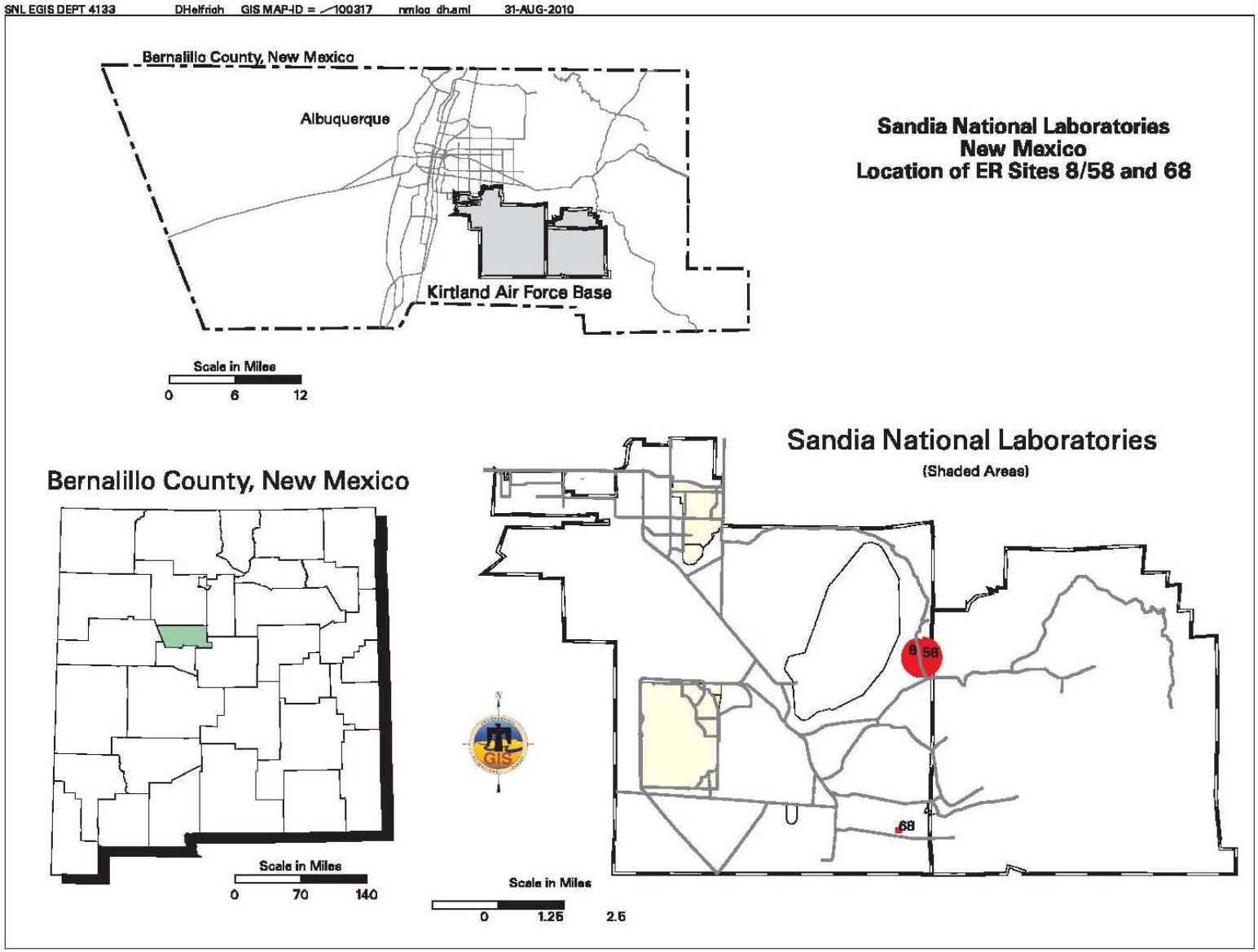

Figure B-1. Map of Bernalillo County, Kirtland Air Force Base and SWMUs 8/58

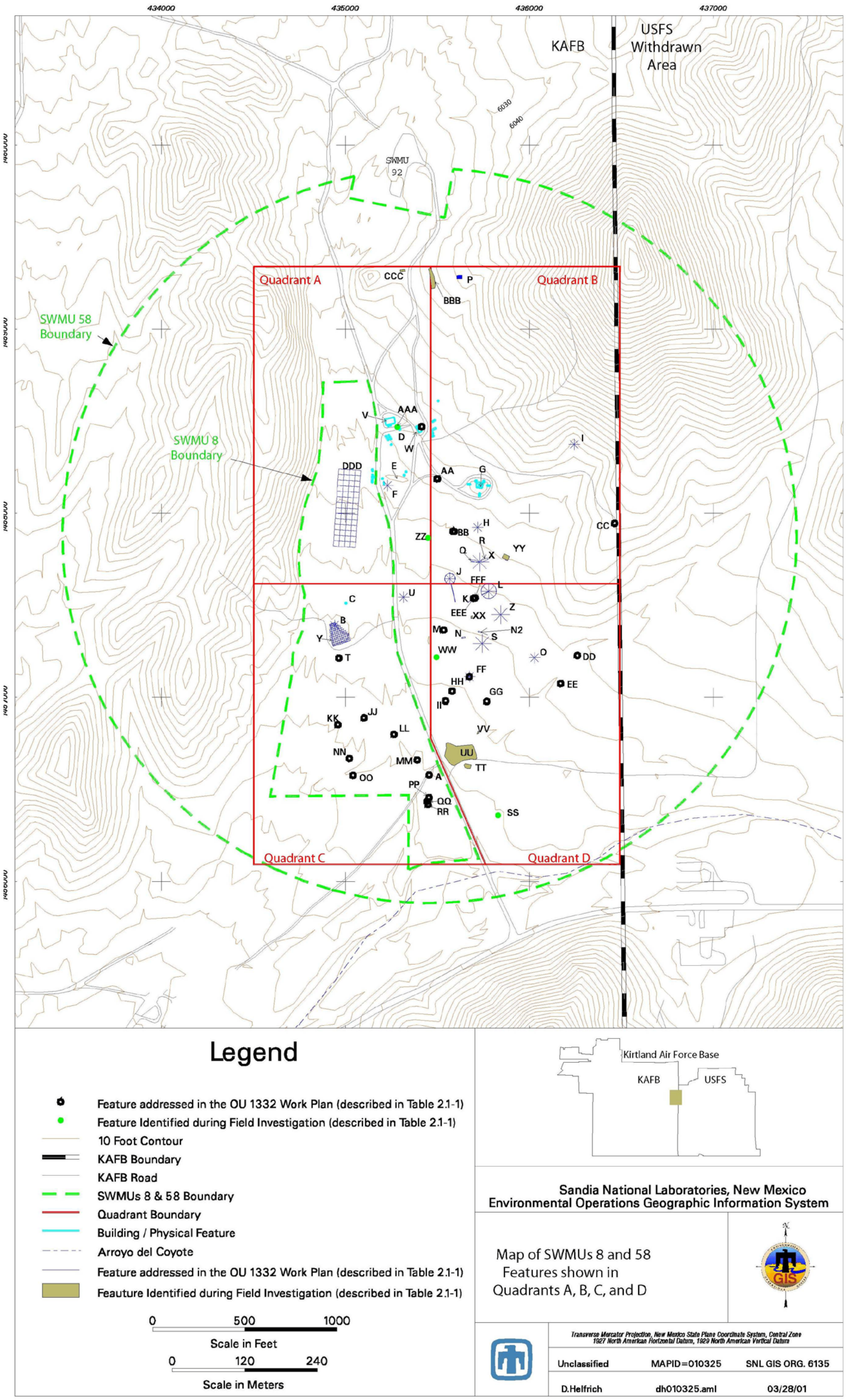

Figure B-2. Map of SWMUs 8/58, showing Features OO and YY

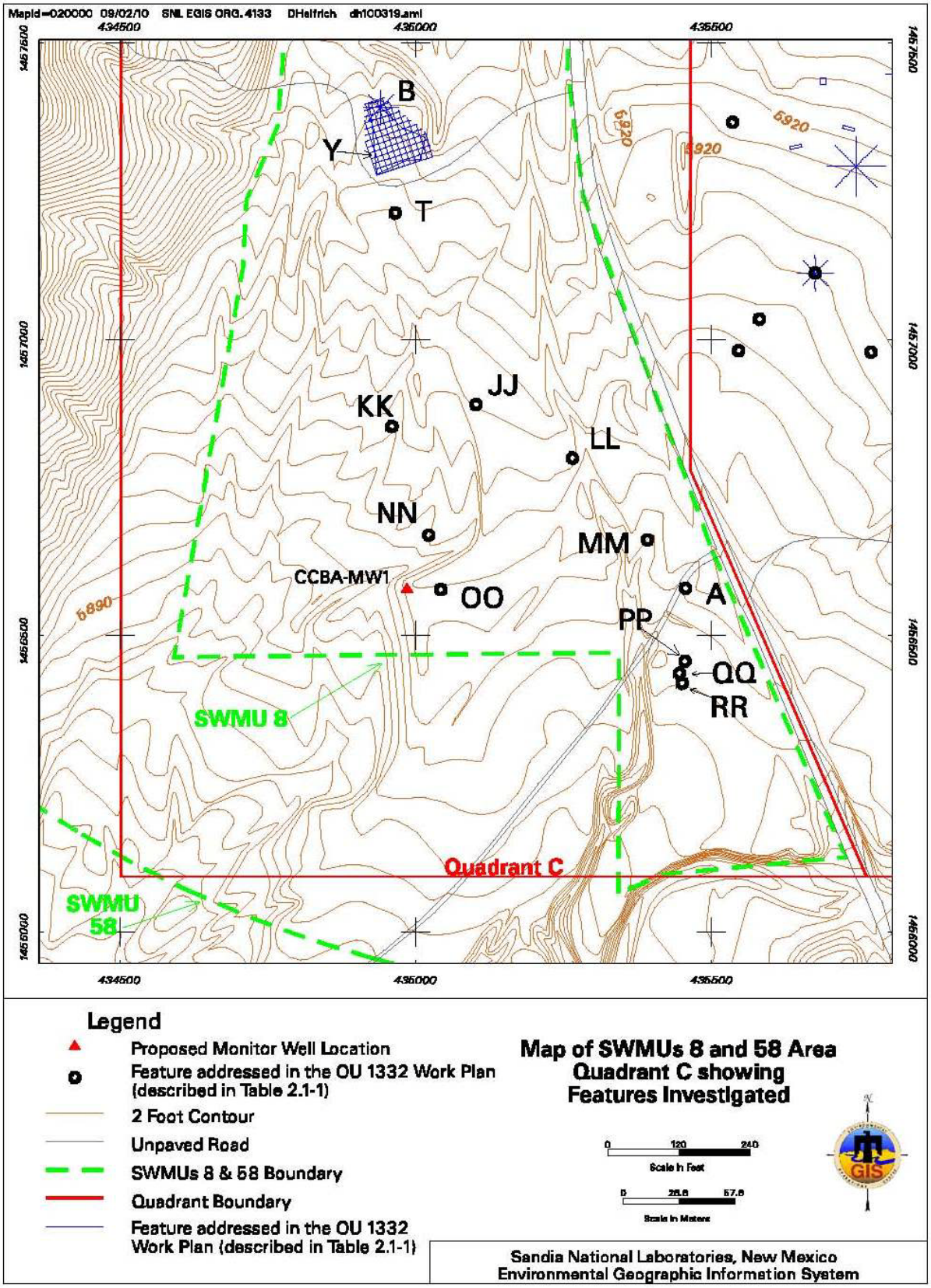

Figure B-3. Map of Proposed Well CCBA-MW1 near Feature OO

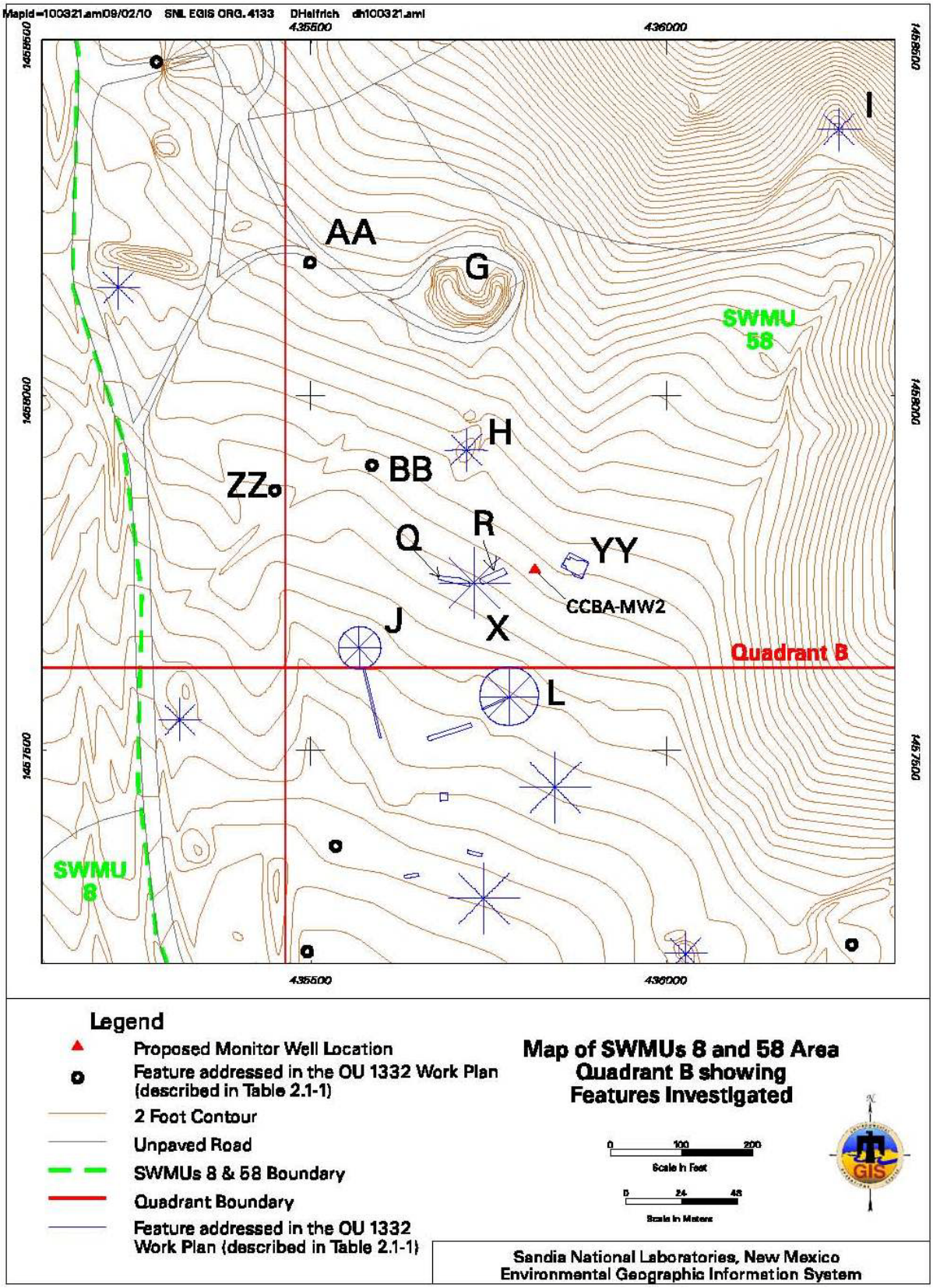

Figure B-4. Map of Proposed Well CCBA-MW2 near Feature YY

The nearest downgradient monitoring well, Greystone MW-2, is located approximately 3,200 ft southwest of SWMU 58. In April 2002, Greystone MW-2 was installed as a replacement well for the old homestead Greystone Manor Well. Because of declining water levels and a severely corroded well casing, the Greystone Manor Well was plugged and abandoned in September 2002. Greystone MW-2 was screened in Quaternary alluvium at a depth of 60 to 80 ft below ground surface (bgs). In April 2010, the depth to water at Greystone MW-2 was 49 ft bgs.

The nearest upgradient monitoring well, CYN-MW5, is located approximately 4,500 ft southeast of the center of SWMU 58. The well was installed in 2001, and was screened in Paleoproterozoic bedrock at a depth of 135 to 155 ft bgs. In April 2010, the depth to water in CYN-MW5 was approximately 104 ft bgs.

Groundwater was not encountered in subsurface boreholes drilled to 100 ft bgs in 2005 and 2006 at SWMUs 8/58. Based on current water levels in Greystone MW-2 and CYN-MW5, and previous subsurface drilling at the site, regional groundwater at the site is expected to be encountered in bedrock below 100 ft bgs, but probably no deeper than 150 ft bgs.

The nearest water-supply well used for drinking water is KAFB-11, which is located approximately 3.6 miles northwest of SWMU 58.

5.2 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and is suitable for penetrating highly variable unconsolidated lithologies such as cobbles, boulders, gravel, sand, clay, and caliche. Once competent bedrock (Paleoproterozoic igneous and metamorphic rocks) is encountered, air rotary drilling without casing advance will be used to drill to the total depth.

The borehole lithology will be logged by the SNL/NM field geologist during drilling. The total depth of the boreholes for the wells will be determined by the SNL/NM field geologist and will be dependent on water yield encountered during drilling. The total depths are anticipated to be about 25 to 30 ft below the water table. The depth of the first groundwater will be noted and recorded on the borehole log. If first groundwater is encounter in bedrock, the uncased portion of the borehole will be video logged using a wire-line camera for the purpose of evaluating bedrock fracture patterns.

Minimal water (but no other foams/liquids) in the form of “mist” may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets. Management and final disposition of cuttings and water will be performed as stipulated in the project Waste Management Plan.

5.3 Well Construction

The groundwater monitoring wells will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch nominal diameter, flush-threaded, PVC Schedule 80 casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The well casing will be delivered pre-cleaned and bagged, or steam-cleaned on site prior to installation. To preserve the integrity of the well materials, the well screen and blank casing will be suspended in the borehole as the sand packs, the bentonite-pellet seal and annular seal are installed.

It is anticipated that the SWMUs 8/58 wells will be screened in the bedrock portion of the boreholes, based on past drilling at the site. A 20-ft length of PVC screen with a 0.020-inch slot size will be used for each well. The screens will be set adjacent to the most productive groundwater unit. A 5-ft sump will be placed at the base of the screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen and then at intervals not to exceed 100 ft up to the ground surface. The screens will be placed so that the top of the screen is approximately 5 ft above the first significant water producing zone.

The primary filter pack will extend from the bottom of the sump to at least 5 ft above the top of the screen. A secondary 5-ft thick layer of clean #60 silica sand will be placed above the primary filter pack. Both sand packs will be tagged using a tag line to verify their depth. Preliminary well development using a surge block will be performed to help settle the filter pack.

An approximately 30-ft thick layer of 1/4-inch bentonite pellets or 3/8-inch bentonite chips will be placed and hydrated above the filter pack prior to emplacement of the bentonite-grout annular seal. The bentonite pellets/chips will be allowed to set for at least one hour to permit adequate time for hydration. The remaining annular space to ground surface will then be filled with bentonite grout. To prevent overloading, the bentonite grout will be installed in multiple lifts if necessary. The first bentonite grout lift will not exceed 100 ft in thickness and will be allowed to set a minimum of 24 hours before installation of the next lift, if additional grout is required. Based on the anticipated depth to groundwater, one additional lift of bentonite grout of less than 100 ft may be required. If settlement occurs, the bentonite grout will be topped off to within 10 ft bgs.

The well casing will extend approximately 30 inches above ground surface and will be sealed with a water-tight cap. The monitoring well will be completed with a 36-inch high protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete pad will be constructed around the protective casing. The pad will contain a 3-inch brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well.

5.4 Well Development

Well development will be conducted no sooner than 48 hours after grouting. Each well will be developed for approximately 10 hours, and will consist of pumping, surge-blocking, swabbing, and/or bailing. During development, the groundwater field parameters (pH, specific conductance, temperature, and turbidity) will be continuously monitored, and well development will continue until the parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface. The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented in writing during well development. If required, only potable water shall be added to the well during development.

During well development, a minimum of five well bore volumes will be removed. After the minimum volume has been removed, development will continue until representative water is obtained. Representative water is assumed to be obtained when the groundwater field parameters stabilize and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units.

5.5 Aquifer Parameters

Aquifer testing provides estimates of hydraulic parameters by measuring the effects of induced stress in an aquifer around a well. Stress can be induced by either withdrawing or injecting water into the well, creating a change in the water level in the well. Such a change in water level can be made instantaneously with a discrete displacement of the water column, referred to as a slug test.

Slug tests will be performed on CCBA-MW1 and CCBA-MW2 with a solid aluminum rod “slug” lowered into the well to raise and lower the water level in the well. Water level will be measured using a Solinst™ electronic pressure transducer (or equivalent) and data logger software. The “slug out” (removal of slug from the water column) portion of the test for each well will be recorded and analyzed. The Hvorslev analytical method (Hvorslev 1951) will be applied to the slug test data and the hydraulic conductivities calculated from the slug tests performed on the wells at SWMUs 8/58 will be presented in the SWMUs 8/58 Groundwater Characterization Report.

6. GROUNDWATER SAMPLING AND ANALYSIS

SNL/NM personnel will perform eight quarters of groundwater sampling at the newly installed groundwater monitoring wells (CCBA-MW1 and CCBA-MW2). Groundwater sampling will be conducted in conformance with mini-Sampling and Analysis Plans (mini-SAPs) prepared for each quarterly sampling event.

Sampling will be conducted in accordance with the NMED Position Paper “Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring”

(NMED October 2001) or in accordance with U.S. Environmental Protection Agency (EPA) guidance "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (EPA September 1986).

A portable Bennett™ sampling system will be used to collect the groundwater samples. The Bennett™ sampling pump and tubing bundle shall be decontaminated prior to installation in monitoring wells according to procedures described in FOP 05-03 "General Sampling Equipment Decontamination." After decontamination, the pump intake will be set at or near the bottom of the screen interval in each of the wells. A pumping rate that creates minimal disturbance to the groundwater flow regime, given equipment limitations, will be employed. The maximum pumping rate in any case will not exceed 12 liters per minute, and groundwater samples for volatile organic compound (VOC) analyses will be collected by filling the sample containers at a slow flow rate, given equipment limitations, to minimize volatilization. The sampling system may be adjusted in order to split the flow of water, such that the flow of water through the sampling side can be reduced to a rate of 0.1 liter per minute or less (<100 mL/min) to facilitate the filling of VOC sample containers without significant volatilization of any potential volatile organics. The flow rate through the other (purging) side will be the minimum rate that is reasonably achievable.

The static water level will be measured at each well prior to well purging, and water levels will be measured during purging and recorded on the field measurement log. Water level information is used to calculate the volume of water in a well casing and the amount required for purging. Measurements will be referenced to a surveyed mark of known elevation at the top of each well casing. The static water level will be measured in CCBA-MW1 and CCBA-MW2 prior to purging or obtaining a sample, and measurements will be taken to the nearest 0.01-foot using a water level meter. Other requirements for water level measurements are provided in FOP 05-01. Water levels in the wells will be measured during each sampling event. Water level measurements in CCBA-MW1 and CCBA-MW2 will be used to produce water-level hydrographs for the monitoring period, and will be presented in the SWMUs 8/58 Groundwater Characterization Report.

In accordance with procedures described in FOP 05-01, the wells will be purged a minimum of one saturated casing volume (the volume of one length of the saturated screen plus the borehole annulus around the saturated screen interval). After the minimum volume is removed, purging will continue until four consecutive measurements of water quality parameters (turbidity, pH, temperature, and specific conductance) exhibit stabilized conditions. Groundwater stability is considered acceptable for monitoring when:

- Turbidity measurements are within 10% or less than 5 Nephelometric Turbidity Units
- pH is within 0.1 units
- Temperature is within 1.0 degree Celsius
- Specific conductance is within 5%

If a monitoring well is purged dry prior to meeting the above purging and stability requirements, sampling will then be conducted once the well has recovered such that the volume of water available in the well is the minimum necessary to fill the sample containers.

6.1 Waste Management

All waste generated during groundwater sampling activities will be managed in accordance with federal, state, and local regulations. The purge and decontamination water will be managed as non-regulated waste, unless sample analytical results indicate that it must be managed as hazardous waste. Analytical data from sampling events will be compared to discharge and disposal criteria. The anticipated disposal path for purge water and decontamination water is discharge to the KAFB sanitary sewer. If the Albuquerque Bernalillo County Water Utility Authority discharge standards are not met, purge and decontamination water will be managed appropriately through the SNL/NM Hazardous Waste Management Facility. The disposal path for solid waste that comes into contact with groundwater will be determined by the associated groundwater analytical data results. Waste management activities associated with groundwater monitoring are discussed in FOP 05-04.

6.2 Sampling Location and Frequency

Groundwater monitoring samples will be collected quarterly for at least two years. Sample collection procedures are provided in FOP 05-01. Groundwater samples will be collected directly from the sample discharge tube into laboratory prepared sample containers. If required, chemical preservatives will be added to the sample containers at the analytical laboratories prior to shipment to the field crew. Immediately after collection, all sample containers will be custody-taped, sealed in plastic bags, and placed on blue ice in shipping containers. Sample documentation and custody will be performed in accordance with SNL/NM SMO procedures and protocols (AOP 95-16 and LOP 94-03). To ensure the integrity of samples from the time of collection through the reporting of analytical results, sample collection, handling, and custody will be documented in writing. Primary elements in the documentation of samples are: sample identification numbers, sample labels, custody tape, and Analysis Request/Chain of Custody (AR/COC) forms. AR/COC forms will be completed at the time of collection and will accompany the sample containers to the analytical laboratories.

Samples will be delivered to the shipping facility for repackaging in shipping coolers in accordance with appropriate U.S. Department of Transportation shipping regulations (49 CFR Parts 171–179). Samples will be packaged and shipped to General Engineering Laboratories (or other EPA-certified contract laboratory) for analysis in accordance with SMO procedures detailed in LOP 94-03. Prior to shipment, sample collection documentation will be verified. Any error will be noted in writing and corrected.

Environmental samples will be collected and analyzed for constituents listed in Table B-2. Quality control samples will include trip blank samples, duplicate samples, equipment blank samples, and field blank samples.

Table B-2. Analytical Parameters for Groundwater Samples

Analyte	Analytical Method	Reference
General chemistry		
Major Cations: calcium, magnesium, sodium, potassium	SW846-6020A	EPA November 1986
Major Anions: chloride, sulfate, carbonate, bicarbonate, total alkalinity	SW846-9056A, SM 2320B	EPA November 1986, Clesceri, et al., 1998
TCL Volatile organic compounds	SW846-8260B	EPA November 1986
TCL Semivolatile organic compounds	SW846-8270D	EPA November 1986
High explosive compounds	SW846-8321A	EPA November 1986
Perchlorate	EPA 314.0	EPA 1999
TAL Metals plus uranium	SW846-6020A, SW846-7470A	EPA November 1986
Cyanide	SW846-9012A	EPA November 1986
Nitrate plus nitrite	EPA 353.2	EPA 1983
Gross alpha and beta	EPA 900.0	EPA 1980
Gamma spectroscopy	EPA 901.0	EPA 1980

EPA = U.S. Environmental Protection Agency
TAL = Target Analyte List
TCL = Target Compound List

6.3 Data Quality Objectives and Quality Control

The data quality objective (DQO) for groundwater monitoring is to collect accurate, representative, and defensible data of sufficient quality to assess the concentrations of constituents in the groundwater associated with SWMUs 8/58. DOE/Sandia will evaluate accuracy, precision, representativeness, completeness, and comparability of the groundwater data to verify that data are of sufficient quality and ensure that the DQO is met. Quality Control (QC) procedures discussed in this section will also be used to determine whether the DQO has been attained. QC samples generated in both the field and the laboratory will be analyzed and evaluated. Data not meeting DQO requirements are subject to corrective action(s) as discussed in SNL/NM SMO procedures and protocol.

Laboratory measurements will comply with SNL/NM SMO procedures and protocols listed in Table B-1, including qualification or validation of laboratory analytical data, and will also comply with all SAPs. This procedure for determining the quality and usability of analytical data acquired during groundwater sampling will be summarized in data validation reports regarding the overall quality of the data and the resulting data qualifiers. All associated data validation reports will be submitted to the NMED in the Groundwater Characterization Report which will summarize the results of this additional SWMUs 8/58 characterization work.

QC samples will be collected in the field and prepared in the laboratory to ensure that the data generated meet the DQO requirements. Mandatory QC samples are identified in the following sections.

6.3.1 Field Quality Control

Field QC samples are used to document data quality and identify any potential errors that may be introduced by field conditions, in sample collection, storage, transportation, and equipment decontamination. Field QC samples submitted to the analytical laboratory will be handled and analyzed in an identical manner as environmental samples. DOE/Sandia will collect and send to the analytical laboratory for analysis the following field QC sample types: equipment blanks, duplicates, field blanks, and trip blanks.

Equipment blanks demonstrate the effectiveness of equipment decontamination and monitor the cleanliness of the sampling system. After sampling equipment decontamination has been completed, an equipment blank is prepared by pumping de-ionized water through the portable sampling equipment and collecting a sample of this water. Equipment blanks will be collected at a frequency of 25 percent (minimum of one per sampling event) and will be analyzed for all of the constituents listed in Table B-2.

Duplicate environmental samples are collected in the field and analyzed to document the precision of the sampling and analysis process. The duplicate samples will be collected immediately after the original environmental sample in order to reduce variability caused by time and/or the sampling process. Duplicates will be collected at a frequency of 25 percent (minimum of one per sampling event) and will be analyzed for all of the constituents listed in Table B-2.

Field blanks are collected to assess whether any contamination of the samples was caused by ambient field conditions. The field blanks will be prepared by pouring deionized water into sample containers at the sample collection point to simulate the transfer of environmental samples from the sampling system to the sample container. Field blank samples will be collected at a frequency of 25 percent (minimum of one per sampling event) and will be analyzed for VOCs only.

Trip blanks are used to assess the potential for cross-contamination between environmental samples during sample handling and shipping activities. The trip blanks will be analyzed for VOCs only. Each batch of groundwater samples from CCBA-MW1 and CCBA-MW2 to be analyzed for VOCs will be accompanied by at least one trip blank during shipping. The analytical laboratory will prepare the trip blank by filling a VOC-sample vial with deionized water and using the same sample preservation method designated for VOC environmental samples. Each vial will be sealed with custody tape and dated when it is prepared. The trip blanks will accompany the empty sample containers when they are shipped to SNL/NM prior to the start of sample collection. The trip blanks will be taken into the field during sample collection and will be included in the shipment of environmental samples to the laboratory. The trip blanks must

remain sealed during this entire cycle and may be opened only for analysis on return to the analytical laboratory.

6.3.2 Laboratory Quality Control

The analytical laboratory is required to have established procedures that demonstrate the analytical process is always in control during each sample analysis step. These procedures are used for all samples including environmental samples, method blank samples, and matrix spike (MS) samples.

A laboratory control (LC) sample consists of a control matrix (e.g., deionized water) spiked with known concentrations of analytes representative of the target analytes. A LC sample will be prepared and analyzed for each analytical procedure and batch to determine accuracy of the data. The laboratory will also evaluate the precision of the data by analyzing twice either the environmental samples, LC samples, or MS samples and calculating the relative percent difference between corresponding results.

Method blank samples will be used to check for contamination in the laboratory during sample preparation and analysis. Method blank samples will be concurrently prepared and analyzed with each analytical batch. Method blanks will be reported in the same units as corresponding environmental samples, and the results will be included with each analytical report.

Surrogate spike analysis will be performed for all samples analyzed by Gas Chromatography/ Mass Spectroscopy. The surrogate compounds added to the sample will be those specified in the applicable EPA analytical method procedure (EPA November 1986). Recovery values for surrogate compounds that are outside specified control limits require corrective action, which is detailed in the Statement of Work for Analytical Laboratories.

The analytical process will be systematically evaluated for the effects of naturally occurring constituents present in the environmental sample matrix. MS/matrix spike duplicate (MSD) analyses will be performed in accordance with the specified analytical procedures.

6.4 Data Validation, Review, and Reporting

Data validation and review of analytical and field documentation will be performed. Field and analytical QC data will be reviewed for conformance to QC acceptance criteria. The entire data package will be reviewed for completeness, comparability, representativeness, precision, and accuracy to determine whether the DQO has been met. The groundwater monitoring data will be reported in the SWMUs 8/58 Groundwater Characterization Report as well as the GWPP's Annual Groundwater Monitoring Report.

6.4.1 Field Water Quality Data and Documentation Review

Completed field documentation will be reviewed and checked for errors, completeness, and conformance with the applicable procedures. The review will occur at the end of each day in

the field to allow verification, correction, and retrieval of missing information as appropriate. Field documentation found to be incomplete or to contain questionable data will be corrected prior to finalizing the field reports. If necessary, measurements of water quality parameters will be repeated.

6.4.2 Laboratory Data Verification and Validation

DOE/Sandia will review laboratory reports for completeness and conformance to the performance criteria of the laboratory contract according to the "Procedure for Completing the Contract Verification Review," SMO 05-03.

Upon receipt of the analytical results from the analytical laboratory, DOE/Sandia will arrange for the third-party validation of the data. The purpose of the validation is to determine the usability and establish the defensibility of the results in support of environmental and waste management activities. Data qualification will be based upon review of field and laboratory-supplied QC data, the specific QC criteria identified in the procedures for the EPA-approved analytical methods, and the QC criteria for meeting the DQO. Data validation will be conducted according to AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data." The associated data validation reports will be submitted in the SWMUs 8/58 Groundwater Characterization Report.

6.4.3 Data Reporting

All groundwater monitoring data will be reported in the SWMUs 8/58 Groundwater Characterization Report. This report will include a description of sampling activities, field water quality data, laboratory analytical data, a discussion of QC evaluations and data reviews, a description of any project variance or nonconformance, and data validation summaries. All analytical data results will be compared to EPA Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) for public drinking water systems. In addition, perchlorate will be compared to the screening level/method detection limit of 4 μg/L identified in the Order (NMED April 2004). The report will also include plots displaying constituents exceeding established EPA MCLs, and the screening level for perchlorate only, for samples collected from wells CCBA-MW1 and CCBA-MW2 during the compliance period.

6.4.4 Records Management

Records associated with groundwater monitoring, including field documentation, chains of custody, laboratory analytical results, data validation reports, and technical data evaluations will be maintained at the SNL/NM Customer Funded Records Center.

6.5 Nonconformances and Variances

Corrective actions will be taken to rectify or prevent a nonconformance or variance that could adversely affect the quality of data generated. Corrective actions will be documented in writing by the persons identifying the need for action.

A nonconformance is any action or condition that does not meet the requirements of this Work Plan. The analytical laboratory, SMO, groundwater monitoring team members, or the Project Leader may identify a nonconformance. The person noting a nonconformance will document the nonconformance in writing and suggest an appropriate corrective action. Resolution of the nonconformance will be documented in writing and acknowledged by DOE/Sandia.

DOE/Sandia and the analytical laboratories will have systems in place to identify QC issues and initiate corrective actions. In accordance with SMO procedures, the laboratories are required to notify the SMO of QC problems that may affect data quality. DOE/Sandia will evaluate and determine whether data are comparable to historical values and whether or not corrective action is required based upon the specific issue. Corrective action may include documentation of QC issues in an analytical laboratory report, data qualifiers, and/or sample re-analysis.

7. REPORTING

Based on the requirements and guidance established by the NMED, NMOSE and SNL/NM, the field activities associated with installation of the monitoring wells will be documented.

7.1 Groundwater Monitoring Well Installation Documentation

All well installation field activities will be documented in a field log book per guidance in FOP 94-45. Upon completion of the well installation, the Well Installation Report will document all site activities and provide final as-built well completion diagrams. The Well Installation Report will contain a brief narrative describing actual work performed at the site and any variances to the SWMUs 8/58 Groundwater Characterization Work Plan. Information to be contained in the report include: (1) daily field activity notes, (2) all materials used, (3) a final "as-built" well completion diagram, and (4) documentation of notification of SNL/NM Geographic Information System group and the appropriate regulatory agencies. The documentation will also include the 37 information elements required in Section VIII.D of the Order (NMED April 2004). The following list of documents and records that are generated as part of the well installation process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well data summary sheet
- Statement of work for drilling the well
- Drilling permit
- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)

- Surveyed elevations and location in New Mexico state plane coordinates (with a degree of accuracy of ± 0.01 ft)
- Location map
- Water level measurements
- Aquifer test data
- Analytical data
- Waste management documentation
- Photographs

7.2 GWPP Annual Groundwater Monitoring Report

The GWPP annual report will include the groundwater monitoring data for the new wells as the data becomes available for SWMUs 8/58. The ongoing annual reports will document all sampling events that took place in that particular calendar year and will present all relevant groundwater analytical results.

7.3 Groundwater Characterization Report

The final report documenting the groundwater characterization effort at SWMUs 8/58 will include a current conceptual model of groundwater flow and contaminant transport at the site. Data and analysis from the slug tests also be incorporated into the model. This report will be submitted to NMED after all eight consecutive quarters of groundwater monitoring have been completed at SWMUs 8/58.

8. SCHEDULE

The basis for the notional schedule shown in Figure B-5 is the logical development of project tasks and activities to implement the tasks described in this SWMUs 8/58 Groundwater Characterization Work Plan. Per the requirements of the NMED's April 2010 letter (NMED April 2010) the schedule describes the implementation of the characterization work that is planned.

Initiation of field work is dependent upon NMED's approval of this work plan. Pre-field activities will commence upon notice of approval. Wells will be drilled and developed *within five months* of NMED's approval of the work plan, contingent upon funding. Groundwater sampling will commence in the quarter following successful well installation and development (*within 90 days* of well completions). A well installation report will be submitted *within three months* after well completions (six months from NMED's approval of the work plan).

ID	Task Name	Duration
1	**Work Plan/Response to April 2010 Characterization Request**	**991 days**
2	NMED Review of Work Plan	180 days
3	NMED Approval of Work Plan	0 days
4	**Install Groundwater Wells**	**282 days**
5	Pre-Field Planning (permits, plans)	55 days
6	Drill and Develop Groundwater Wells - Field Effort	40 days
7	Perform Slug Tests	15 days
8	Draft Well Installation Report (incl. reviews, NOD, approval)	160 days
9	Submit Final Well Installation Report to NMED	0 days
10	**Quarterly Groundwater Sampling**	**520 days**
11	Q1 Sampling	65 days
12	Q2 Sampling	65 days
13	Q3 Sampling	65 days
14	Q4 Sampling	65 days
15	Q5 Sampling	65 days
16	Q6 Sampling	65 days
17	Q7 Sampling	65 days
18	Q8 Sampling	65 days
19	**Groundwater Characterization Report**	**131 days**
20	Draft Groundwater Characterization Report	80 days
21	Internal review and approval	40 days
22	Submit Final Groundwater Characterization Report	0 days

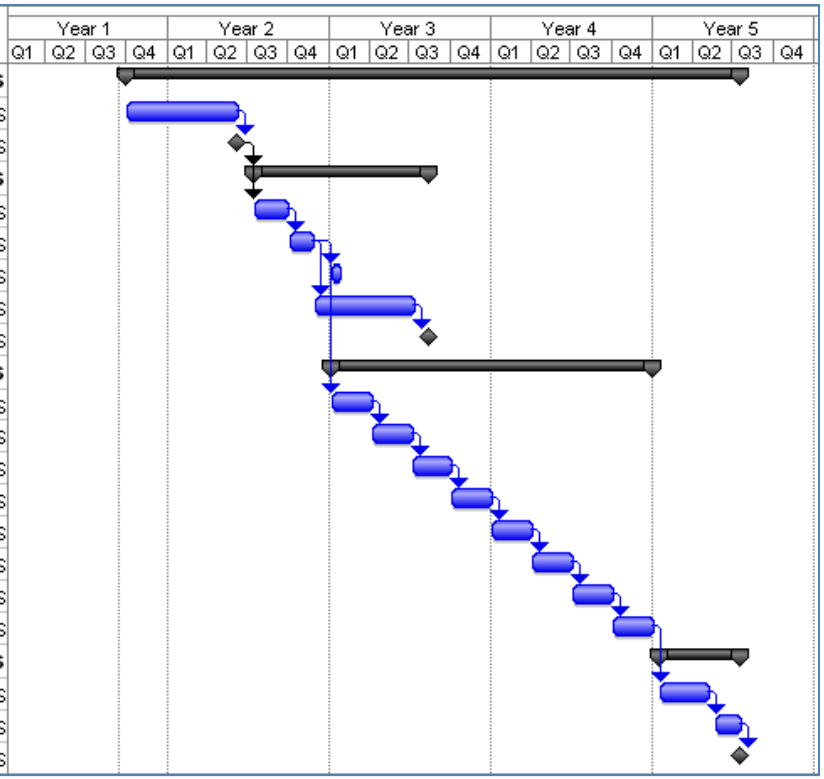

Figure B-5. SWMUs 8/58 Groundwater Characterization Notional Schedule

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