Long-Term Monitoring and Maintenance Work Plan for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), Landfill No. 25 (LF-25/SWMU 97), and Sewage Lagoons (SWMU 101)
Cannon Air Force Base, New Mexico

Final
July 2009

27 SOCES/CEAN
Cannon Air Force Base
New Mexico

Long-Term Monitoring and Maintenance Work Plan for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), Landfill No. 25 (LF-25/SWMU 97), and Sewage Lagoons (SWMU 101) Cannon Air Force Base, New Mexico

Contract No. FA4890-04-D-0006, Task Order DK02
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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
CMS	Corrective Measures Study
EPA	United States Environmental Protection Agency
ERP	Environmental Restoration Program
IDW	investigation-derived waste
LTM	Long-Term Monitoring
NFA	No Further Action
NMED	New Mexico Environment Department
NMGWQS	New Mexico Groundwater Quality Standard
MCL	Maximum Contaminant Level
M&M	Monitoring and Maintenance
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SOP	Standard Operating Procedure
SWMU	Solid Waste Management Unit
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WQCCR	Water Quality Control Commission Regulations

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EXECUTIVE SUMMARY

This Long-Term Monitoring and Maintenance Work Plan addresses the landfill vegetative cover system inspection, maintenance, repair, and groundwater monitoring activities that will be performed at four Environmental Restoration Program (ERP) sites located at Cannon Air Force Base, New Mexico. The New Mexico Environment Department (NMED) outlined the specific landfill cover inspection, biennial sampling, and reporting actions required at LF-03 (Solid Waste Management Unit [SWMU] 105), LF-04 (SWMU 104), LF-25 (SWMU 97), and the Sewage Lagoons (SWMU 101) in a letter dated March 26, 2008. In addition, the NMED letter specified preparation of a work plan to direct the inspection, maintenance, sampling, and reporting activities required at the sites.

This plan provides Cannon AFB with basic guidance to:

1. Perform annual inspections, routine maintenance, and repair to ensure the cover systems function as designed and meet operational objectives. Because the vegetative covers constructed at LF-03, LF-04, LF-25, and the Sewage Lagoon site are similar, a single, comprehensive long-term inspection and maintenance work plan for all four sites is appropriate.

2. Conduct biennial activities at monitoring wells including gauging, groundwater sample collection, and analysis.

This work plan was prepared in accordance with the requirements of the United States Army Corps of Engineers (USACE), Omaha District, Contract No. FA4890-04-D-0006, Task Order DK02.

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1. INTRODUCTION

This Long-Term Monitoring and Maintenance Work Plan addresses the inspection, maintenance, repair, and monitoring activities that will be performed at Landfill No. 3 (LF-03/Solid Waste Management Unit [SWMU] 105), Landfill No. 4 (LF-04/SWMU 104), Landfill No. 25 (LF-25/SWMU 97), and the Sewage Lagoons (SWMU 101) at Cannon Air Force Base (AFB), Curry County, New Mexico (Figure 1). The locations of these sites are shown in Figure 2. The plan was prepared in accordance with the requirements of the New Mexico Environment Department (NMED) and the United States Army Corps of Engineers (USACE), Omaha District, Contract No. FA4890-04-D-0006, Task Order DK02.

The procedures detailed in this plan will be adhered to for the cover inspection, maintenance, and repair activities required at the four sites. The *Revised Draft Long-Term Monitoring Work Plan, Sampling and Analysis Plan, and Site Safety and Health Plan, Landfill No. 3 (SWMU 105), Landfill No. 4 (SWMU 104), and Landfill No. 25 (SWMU 97)* (Bhate, 2002) serves as the procedural guidance for the groundwater monitoring activities that will be conducted at the sites in support of the Cannon AFB Long-Term Monitoring (LTM) Program. The contractor will oversee all technical and field work. Site work conducted by subcontractors will be performed under the contractor's oversight and coordination.

1.1 Purpose and Scope

This plan describes the monitoring and maintenance activities that will be performed at LF-03, LF-04, LF-25, and the Sewage Lagoons. The purpose of this plan is to provide Cannon AFB with the basic guidance to:

- Perform required inspections, routine maintenance, and repair to ensure the vegetative cover systems at each site function as designed and meet operational objectives.
- Conduct biennial groundwater sampling and gauging at wells associated with the three landfills (LF-03, LF-04, and LF-25) and the Sewage Lagoons.

This plan addresses the following elements:

- Maps
  - General site map showing Cannon AFB in relation to the state of New Mexico and city of Clovis and the locations of LF-03, LF-04, LF-25, and the Sewage Lagoons
  - Site maps of LF-25 and the southern sewage lagoon showing general topography, existing drainage patterns, and features requiring inspection and maintenance
  - Map showing location of monitoring wells at LF-03, LF-04, LF-25, and Sewage Lagoons requiring monitoring
  - Map showing groundwater elevation contours (October 2008)

- General site description and history
- Inspection requirements
- Description of runon/runoff and erosion control measures implemented at the sites that require inspection and maintenance
- Maintenance and repair procedures
- Perimeter fence, gates, and signage inspection and maintenance
- Groundwater monitoring requirements
- Documentation and reporting requirements

At the direction of Cannon AFB, the inspection and maintenance portion of this plan will be revised to incorporate changes that come about as a result of the inspections, maintenance, and major repairs. The groundwater monitoring portion of the plan will be updated to reflect changes in LTM scope or schedule.

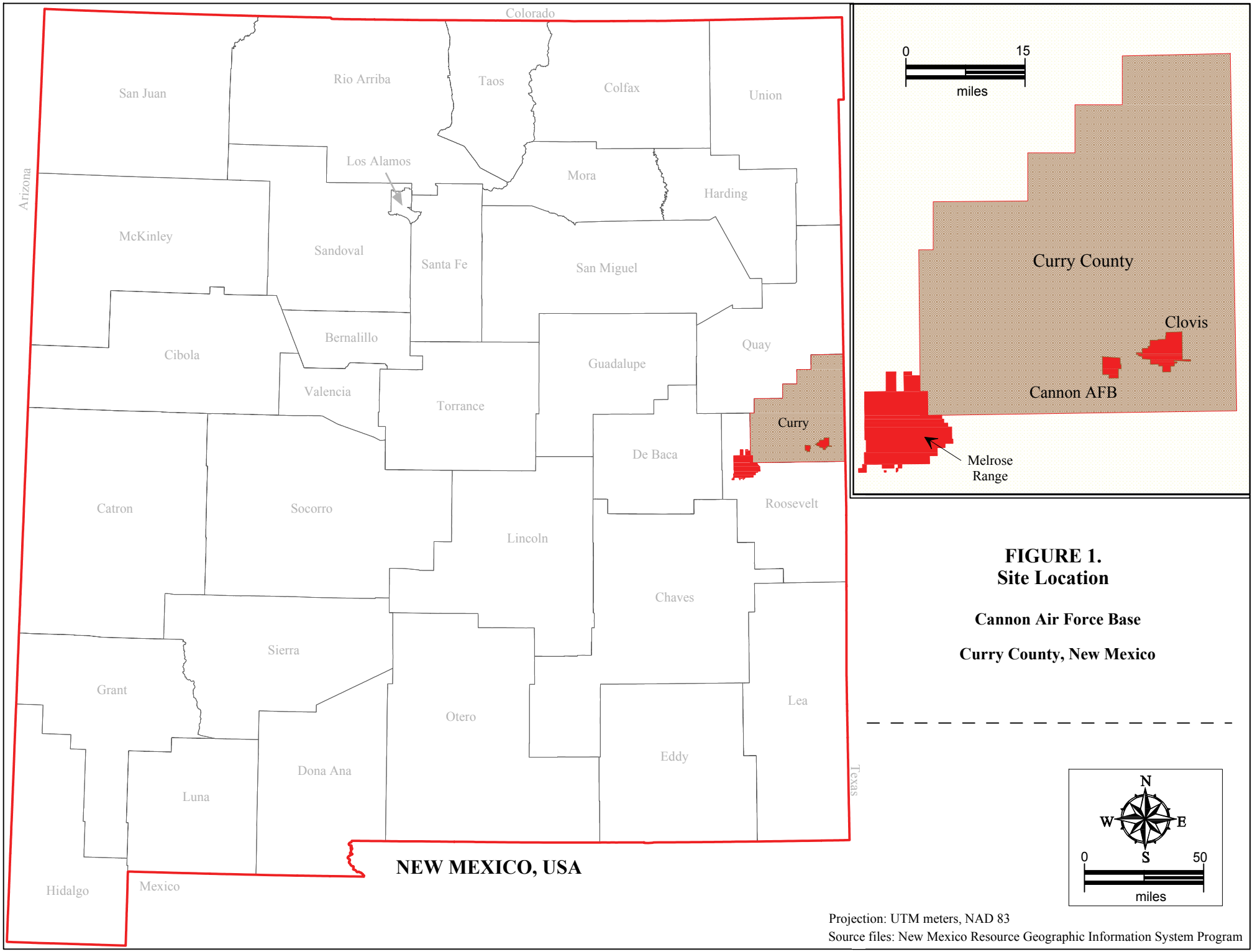

FIGURE 1.
Site Location

Cannon Air Force Base

Curry County, New Mexico

Projection: UTM meters, NAD 83
Source files: New Mexico Resource Geographic Information System Program

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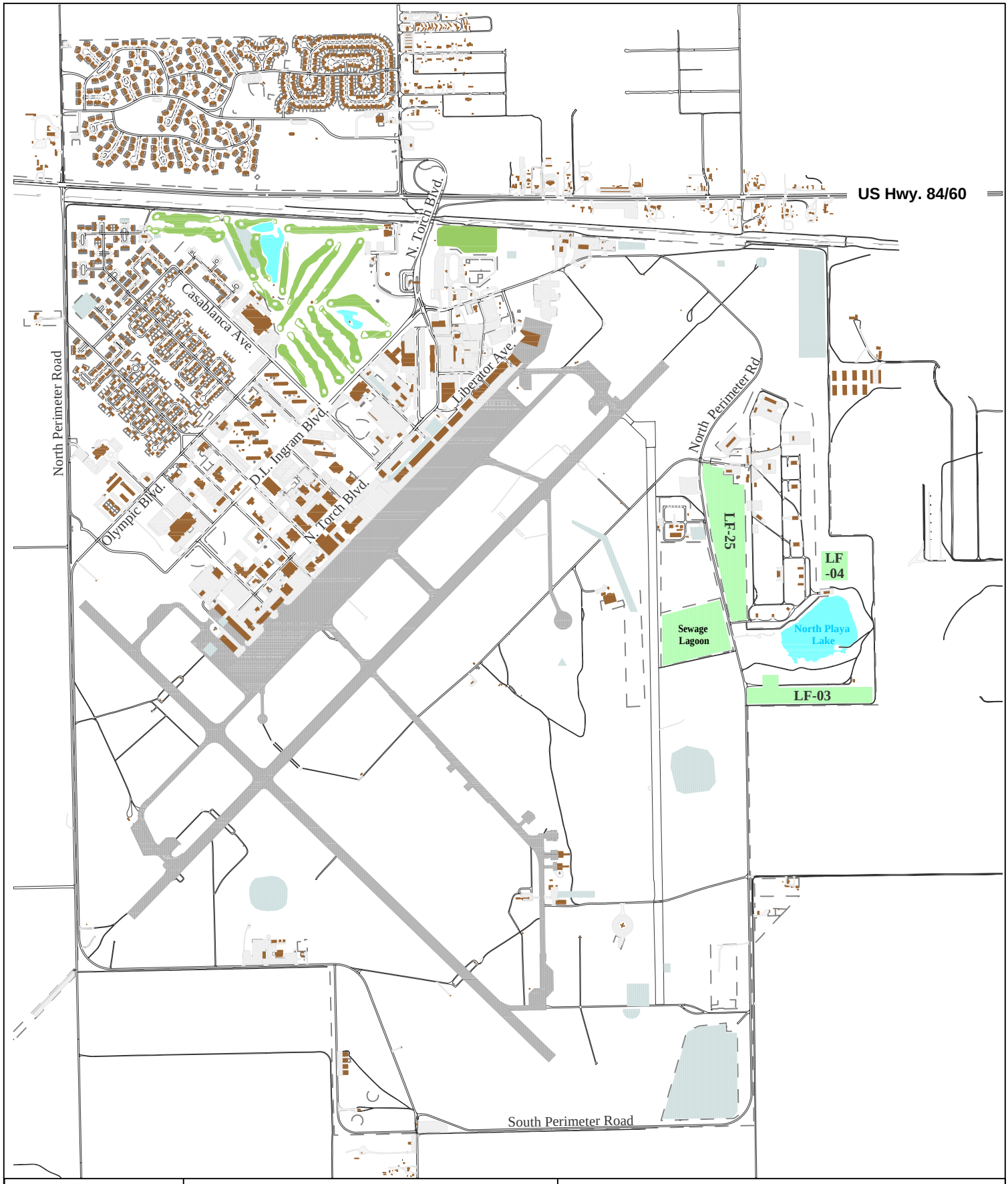

NOTES

ERP Site/SWMU
ERP LTM Sites
Existing building
Airfield surface

Digital data files provided by GeoBase/CAFB
Projection: UTM Zone 13N, NAD 83

FIGURE 2.
Plan View

Cannon Air Force Base

Curry County, New Mexico

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2. BACKGROUND AND HISTORY

As specified by the NMED in a letter dated December 5, 2007, Cannon AFB is required to collect groundwater samples biennially from downgradient monitoring wells located at LF-03, LF-04, and LF-25, and perform annual inspections of each landfill to verify establishment and maintenance of a vegetative cover and repair any identified damage. The requirement for biennial sampling of wells and annual inspection, maintenance, and repair of the engineered cover constructed at the Sewage Lagoon site was addressed in an NMED letter dated March 26, 2008. Copies of the NMED correspondence are included in Appendix B.

The covers were installed at LF-03, LF-04, LF-25, and the Sewage Lagoons to minimize percolation and leachate production, and prevent any potential impact to groundwater beneath each site. This plan provides the requirements for long-term inspection and maintenance of the vegetative cover systems, including erosion repair, erosion-control measure repair, and upkeep of the vegetation and fencing, as well as continued groundwater monitoring of wells associated with each site.

2.1 Landfill No. 3 (LF-03)/SWMU 105

This section provides a brief background and history of LF-03. A detailed summary of the site's background and history, results of previous investigations, corrective measures, and current status is presented in the *RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No.4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97)* (HGL, 2006).

LF-03 is an inactive landfill formerly used for burn and disposal trenching operations. The 9-acre site is located in the east-central portion of Cannon AFB and is bounded to the north by a road leading to the transmitter tower, to the south and east by barbed-wire fences and agricultural fields, and on the west by Perimeter Road. The ground surface in this area is slightly hummocky and is covered with prairie grasses. Limited, shallow areas of subsidence are visible and associated with the waste burial trenches at the landfill. There is no evidence of a constructed berm surrounding this relatively level landfill site. Playa Lake, which lies approximately 450 feet north of LF-03, is the closest surface water body to the former landfill. The location of the former landfill with respect to the surrounding facility is shown in Figure 3.

The landfill was operated from 1959 to 1967 and was reported to have received domestic and industrial wastes including solvents, paints, thinners, waste oils, and peroxide containers. Disposal activities consisted of placing collected waste material into a trench, burning the accumulated waste, and then covering the burned material with soil the following day. Disposal trenches were excavated to a maximum depth of 16.5 feet and possibly extended 250 feet in length. The amount of waste material disposed within the landfill trenches has not been determined. No waste disposal activities are known to have occurred for over 40 years. Subsurface investigation activities encountered waste material such as soda and beer bottles, plastic sheeting and bags, clothing, synthetic rubber machinery belt, Styrofoam, scrap metal, insulated and non-insulated wiring, and a crushed 5-gallon can with no lid. The uncovered material was found to be both burnt and unburnt.

Field activities conducted at the site include borehole installation and sampling, excavation of an exploratory trench, monitoring well installation, and soil and groundwater sampling and analysis.

This site was investigated along with LF-04 during the Appendix I, Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) (Radian, 1994a). Minor impacts to soil were identified during the RFI. NMED concurred with the 1994 final RFI report's recommendation for No Further Action (NFA) status and Class III modification. The United States Environmental Protection Agency (EPA) Region 6 accepted the final RFI but required boundary markers and the installation and sampling of a downgradient monitoring well. The boundary markers were installed around the suspected landfill location under the Appendix I Phase II Investigation and downgradient well MW-O was installed in October 1994.

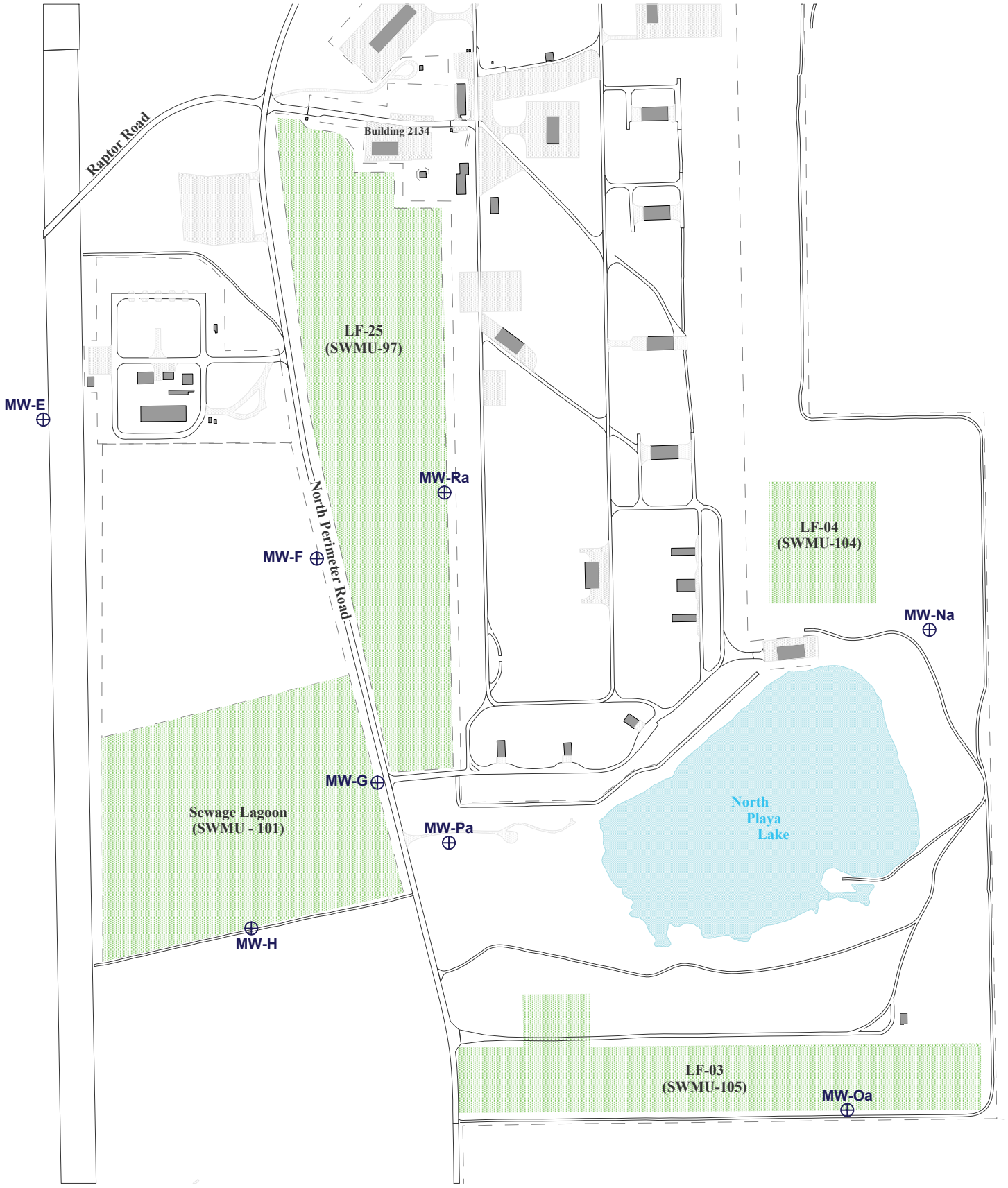
Beginning in 1996, long-term monitoring of regional groundwater was initiated at LF-03 using well MW-O. During the December 2003 sampling event, however, the well became dry during purging as a result of declining water levels in the regional aquifer and could no longer be sampled. Well MW-O was abandoned and the United States Geological Survey (USGS) installed replacement downgradient well MW-Oa in February 2004 (Bhate, 2005). Groundwater at this site is currently being monitored at MW-Oa to meet state LTM requirements, and this well will be sampled on a biennial basis under the Long-Term Monitoring and Maintenance Plan. The 2008 biennial sampling event at MW-Oa was conducted in October (Bhate, 2008). Well construction details for wells MW-O and MW-Oa are summarized in Table 4-1. No organic compounds or metals associated with former disposal activities at LF-03 have exceeded federal Maximum Contaminant Levels (MCLs) or New Mexico Groundwater Quality Standards (NMGWQS). Chloride is the only target constituent to slightly exceed screening criteria but is attributed to background conditions.

Based on no soil impacts detected beneath the landfill above soil screening levels, absence of groundwater contamination detected in the downgradient compliance monitoring well, and risk assessment evaluations indicating no unacceptable risks to human health and the environment, a petition for NFA under NMED criterion 5 and a Class III permit modification was requested for LF-03 in the *RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97)* (HGL, 2006). NMED approved the report in a letter dated December 5, 2007 (Appendix B) that specified additional monitoring and inspection requirements for LF-03. In response to NMED letter dated March 26, 2008, this plan was prepared to address biennial groundwater monitoring and annual inspection and maintenance of the vegetative cover.

2.2 Landfill No. 4 (LF-04)/SWMU 104

This section provides a brief background and history of LF-04. A detailed summary of the site's background and history, results of previous investigations, corrective measures, and current status is presented in the *RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97)* (HGL, 2006).

LF-04 is an inactive landfill formerly used for burn and disposal trenching operations. The 7-acre site is located in the east-central portion of Cannon AFB and lies approximately 800 feet west of the ordnance area and is bounded to the north by Perimeter Road, to the west by a barbed-wire fence,



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W E
S
0 500
feet

NOTES

ERP Sites/SWMUs

Long-Term Monitoring Wells

Digital data files provided by GeoBase/CAFB

Projection: UTM Zone 13N, NAD 83

FIGURE 3.
LF-03, -04, and -25
(SWMU 105, 104, and 97)

Cannon Air Force Base

Curry County, New Mexico

Brown, Burdine & Associates, LLC

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and to the east and south by vacant fields. The site is an open field covered with prairie grasses. Limited, shallow areas of subsidence are visible and associated with the waste burial trenches at the landfill. A constructed earthen berm surrounds the landfill site, providing an additional erosion control and containment mechanism. Playa Lake, which lies approximately 1,000 feet south of LF-04, is the closest surface water body to the former landfill. The location of the former landfill with respect to the surrounding facility is shown in Figure 3.

The 7-acre landfill was operated for 1 year from 1967 to 1968. The landfill reportedly received domestic and industrial wastes including solvents, paints, thinners, waste oils, and peroxide containers. Disposal activities consisted of placing collected waste material into a trench, burning the accumulated waste, and then covering the burned material with soil the following day. Disposal trenches were excavated to a maximum depth of 16.5 feet and possibly extended 250 feet in length.

The amount of waste material disposed within the landfill trenches has not been determined. No waste disposal activities are known to have occurred for 40 years. Subsurface investigation activities encountered waste material such as glass, soda and beer cans, clothing, plastic sheeting and bags, scrap metal, insulated and non-insulated wiring, and one crushed 5-gallon can.

Field activities conducted at the site include borehole installation and sampling, excavation of an exploratory trench, monitoring well installation, and soil and groundwater sampling and analysis. This site was investigated along with LF-03 during the Appendix I, Phase I RFI (Radian, 1994b). Minor impacts to soil were identified during the RFI. NMED concurred with the final RFI report's recommendation for NFA status and Class III modification. The EPA Region 6 accepted the RFI but required boundary markers and installation and sampling of a downgradient monitoring well. The boundary markers were installed around the suspected landfill location under the Appendix I Phase II Investigation and downgradient well MW-N was installed in December 1994.

Beginning in 1996, long-term monitoring of regional groundwater was initiated at LF-04 using well MW-N. During the December 2003 sampling event, however, the well was dry and the pump inoperable. The pump was repaired and the well was sampled for the last time in March 2004 (Bhate, 2005). Well MW-N was abandoned and the USGS installed replacement downgradient well MW-Na in December 2004. The groundwater at this site is currently being monitored at well MW-Na to meet state long-term monitoring requirements, and this well will be sampled on a biennial basis under the Long-Term Monitoring and Maintenance Plan. The 2008 biennial sampling event at MW-Na was conducted in October (Bhate, 2008). Well construction details for wells MW-N and MW-Na are summarized in Table 4-1. No organic compounds or metals associated with former disposal activities at LF-04 have exceeded federal MCLs or NMGWQS.

Based on no soil impacts detected beneath the landfill above soil screening levels, absence of groundwater contamination detected in the downgradient compliance monitoring well, and risk assessment evaluations indicating no unacceptable risks to human health and the environment, a petition for NFA under NMED criterion 5 and a Class III permit modification was requested for LF-04 in the *RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97)* (HGL, 2006). NMED approved the report in a letter dated December 5, 2007 (Appendix B) that specified additional monitoring and inspection requirements for LF-04. In response to NMED letter dated March 26, 2008 (Appendix

B), this plan was prepared to address biennial groundwater monitoring and annual inspection and maintenance of the vegetative cover.

2.3 Landfill No. 25 (LF-25)/SWMU 97

This section provides a brief background and history of LF-25. A detailed summary of site's background and history, results of previous investigations, corrective measures, and current status is presented in the *RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97)* (HGL, 2006).

LF-25 is an inactive construction rubble landfill in the east-central portion of Cannon AFB. The former landfill covers a 32-acre area roughly trapezoidal in shape, located east of Perimeter Road and approximately 500 feet northwest of Playa Lake. The topography of the LF-25 area slopes from north to south. The site encompasses multiple rubble piles that vary in height across the site and reach a maximum of 15 feet in the northern portion of the unit. Most of the rubble piles are approximately 3 to 4 feet high. The oldest piles of rubble are present on the north and west sides of the unit and are covered with grasses, shrubs, and small trees. A 2-foot-high permanent earthen berm is present adjacent to the southern and eastern borders of the unit to prevent stormwater runoff from leaving the site. Near the northeastern corner of the site, base personnel have placed concrete slabs (rip-rap) to control erosion. The landfill location with respect to the surrounding facility is shown in Figure 3.

The landfill was used as a waste disposal site from approximately 1945 through the 1980s, but the exact period of operation is unknown. After World War II, construction demolition debris was disposed at the landfill. The startup date of the former concrete rubble pile is unknown but is believed to be around 1961. The debris consisted of concrete, wood, asbestos tiles, metal, transite and cement pipe, and asphalt mixed with soil. Trenches excavated during a 1990 environmental assessment revealed the majority of material was airfield pavement and subgrade material, followed by building demolition rubble. Glass, metal cinders, ash, and other burned material were encountered in what appeared to be burn trenches.

Field activities conducted within the boundaries of the landfill include installation of soil borings, monitoring well installation, excavation of exploratory trenches, and soil and groundwater sampling and analysis. This site was investigated during an Appendix I, Phase I RFI (Radian, 1994c). Minor impacts to soil were identified during the RFI. NMED concurred with the 1994 final RFI report's recommendation for NFA status and Class III modification. The EPA Region 6 accepted the RFI but required the installation and sampling of a downgradient monitoring well.

Long-term groundwater monitoring at MW-K, installed immediately downgradient of the rubble pile, began in June 1997. MW-K was abandoned and replaced by MW-R in 1998 after it could no longer be sampled due to declining regional groundwater levels. MW-R was sampled twice yearly until December 2000. However, elevated metals detected in MW-R groundwater samples were attributed to corrosion of the well's stainless steel well screen, and the well was replaced with a polyvinyl chloride-constructed well, MW-Ra, in June 2001 (BHATE, 2002b). Well MW-Ra is located approximately 30 feet north and sidegradient from the abandoned well MW-R.

LF-25 requires continued groundwater monitoring to meet state long-term monitoring requirements. Under the Long-Term Monitoring and Maintenance Plan two downgradient wells, MW-Ra and MW-Pa, will be sampled on a biennial basis. Well MW-Pa was installed in February 2004 to replace well MW-P, which was abandoned after it could no longer be sampled. The 2008 biennial sampling event at wells MW-Pa and MW-Ra was conducted in October (Bhate, 2008). Well construction details for wells MW-P, MW-Pa, and MW-Ra are summarized in Table 4-1.

A site walk-through and visual inspection conducted in August 2001 revealed exposed asbestos containing material (intact transite pipe, transite siding, and roofing) identified as non-friable. Remedial action activities associated with asbestos removal were conducted in 2000 as documented in the Construction Completion Report (Foster Wheeler, 2001a). Remedial action included initial and final site surveys; tree removal and trimming; asbestos containing material separation, transportation, and disposal; concrete separation, crushing, and removal; native soil cover/debris consolidation; grading and drainage construction; and site revegetation.

Approximately 56 cubic yards of asbestos containing material waste was removed from LF-25. In addition, 16,000 cubic yards of concrete rubble was removed and a permanent earthen berm was constructed to a height of 2 feet above ground surface along the landfill's southern and eastern edges to prevent stormwater runoff from leaving the site. Final site contouring is designed to retain and control stormwater runoff within the SWMU. A 6-inch topsoil cover was installed using clean fill generated from site grading to minimize percolation through the landfill, leachate production, and potential impact to the groundwater. Revegetation was conducted by seeding and mulching with native grasses using an approved seed mix. A three-strand barbed-wire fence with gates and signage was also installed around the site boundary. Revegetation of the former landfill was completed by June 2001.

Based on the minor soil impacts detected beneath the landfill, lack of groundwater contaminants in a downgradient compliance monitoring well, risk assessment evaluations indicating no unacceptable risks to human health and the environment, completion of remedial activities associated with removal of the construction debris, regrading of the former landfill, and implementation of engineering controls to contain surface water runoff, a petition for NFA under NMED criterion 5 and a Class III permit modification was requested for LF-25 in the *RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97)* (HGL, 2006). NMED approved the report in a letter dated December 5, 2007 (Appendix B) that specified additional monitoring and inspection requirements for LF-25. In response to NMED letter dated March 26, 2008, this plan was prepared to address biennial groundwater monitoring and annual inspection and maintenance of the vegetative cover.

2.4 Sewage Lagoons (SWMU 101)

The former Sewage Lagoons are located in east-central portion of Cannon AFB. The landfill location with respect to the surrounding facility is shown in Figure 3.

The Sewage Lagoons, which were constructed in 1966, consisted of two unlined surface impoundments that received combined sanitary and industrial wastewater from base facilities. The north and south lagoon areas had concrete-lined banks and unlined earthen bottoms, operated in series, and had a combined surface area of approximately 39 acres. In 1998, a new wastewater

treatment plant was put in operation at Cannon AFB. Although sewage discharge to the lagoons stopped in 1998, the base continued to discharge treated wastewater to the lagoons in order to prevent direct exposure to the underlying sludge. In early 1998 the base stopped discharging treated wastewater to the lagoons and allowed them to dry.

In 1992 SWMU 101 was investigated during the Appendix I RFI (Woodward-Clyde, 1992). Based on the results the Sewage Lagoons were recommended for continued annual groundwater monitoring. A Corrective Measures Study (CMS) for closure identified potential corrective actions (Foster Wheeler, 2001b). Human health and ecological risk assessments were conducted as part of the CMS to determine the requirements for contaminant containment and source control. The CMS recommended sludge removal from the former north lagoon, in-place consolidation in the former south lagoon, and closure using an engineered cover with a biotic barrier as voluntary corrective actions for closing the lagoons.

The Phase III Sludge Management, Compliance Evaluation, and Requirements Identification report (E&E, 1998) and the Sewage Lagoons Closure Final Specifications (USACE, 2002) concurred that dewatering, consolidation, and compaction of the contaminated material, followed by installation of a protective cover was an economical solution to close the lagoons permanently. The cover design assumed that the contaminated media at the site consisted of approximately 2 feet of sludge overlying a 1-foot-thick layer of soil.

The Construction Completion Report (Foster Wheeler, 2006) documents the activities conducted to complete the voluntary remedial action at the Sewage Lagoons. The preliminary construction activities included grading and drainage construction, and demolition and removal of concrete and piping. Contaminated media was then excavated from the north lagoon area followed by in-place consolidation of excavated material, random fill, and grading in the south lagoon area. Finally, a 42-inch-thick engineered cover was constructed over the south lagoon to reduce infiltration of moisture into the underlying layer of contaminated material. The cover consists of an 18- to 21-inch-thick earthen soil-barrier layer, an 18-inch-thick biota barrier of recycled, crushed concrete, and a 6-inch erosion/vegetation layer. A drainage ditch surrounds the cover to prevent stormwater runoff from leaving the site. In April 2004 the cover was revegetated by seeding with native species. A five-strand barbed-wire fence was installed on the northern boundary of the capped area to separate the north and south lagoon areas and control access. This fence was tied in with the existing fencing that was around the other sides of the site.

In response to NMED letter dated March 26, 2008, this plan was prepared to address annual inspection and maintenance of the vegetative cover over the south sewage lagoon. Groundwater monitoring will be conducted at wells associated with the Sewage Lagoons in support of the Cannon AFB LTM Program. Four wells will be sampled on a biennial basis: MW-E (upgradient), MW-F (cross-gradient), and MW-G and MW-H (downgradient). The locations of these wells are shown in Figure 3. Well construction details for wells MW-E, MW-F, MW-G, and MW-H are summarized in Table 4-1.

3. VEGETATIVE COVER INSPECTION AND MAINTENANCE

3.1 Frequency

The vegetative cover inspection and maintenance at LF-03, LF-04, LF-25, and the Sewage Lagoon site will be conducted on an annual basis beginning in 2008.

3.2 Procedures

The Long-Term Monitoring and Maintenance contractor will be responsible for performing and documenting the site inspections, routine maintenance, and repairs at each of the sites. The inspection, maintenance, and repair activities are described in this section.

- **Inspections**. Inspections shall consist of a review of the condition of the cover system, including vegetation and any associated drainage and erosion control features, to determine whether all components are functioning as designed. The perimeter fence, gates, and signage will be included in the inspection, if present at the site.

  All site inspections will be recorded on the applicable Cover System Inspection Report provided in Appendix A. Inspection Report forms were developed for each site. A manually updated copy of the site map will accompany the Inspection Report as necessary to reflect any changes to the site condition, maintenance activities performed, and areas requiring repairs. A complete photographic record will be taken during inspections to document site conditions. An annual inspection and maintenance report will be submitted to Cannon AFB and a biennial report documenting the annual activities will be provided to Cannon AFB and NMED as described in Section 6.

- **Maintenance.** The contractor will perform maintenance as required to ensure all erosion control features and other protection measures are in effective operating condition. Sediment or debris accumulations in areas that threaten proper function of an erosion control feature will be removed. Areas impacted by erosion will be filled in and contoured to maintain proper grade. Similarly, low graded areas designed to control stormwater runoff will be recontoured to maintain proper function. Perimeter fence signage and locks will be replaced as necessary. Maintenance activities and description of areas or features requiring repair will be noted on the Cover System Inspection Report, along with photographic documentation and manually updated copy of the site map, if necessary.

  Tumbleweeds and other uprooted vegetation will be removed from areas within the landfill where they accumulate, such as along perimeter fencelines. The uprooted vegetation will be loaded on trucks for disposal as clean construction waste at a local municipal landfill or other approved facility. No material or debris will be disposed of within the limits of LF-03, LF-04, LF-25, or the Sewage Lagoon site.

- **Repair.** As needed, the contractor will perform minor repairs within 2 weeks of inspection unless otherwise directed by Cannon AFB. Minor repairs are those performed to restore original site conditions, such backfilling gullies, rebuilding berms, and replacing signage. Repair activities may be scheduled jointly at the four sites to increase efficiency and limit the

number of required mobilizations. The repair activities will be documented by photographs taken before beginning repairs and after the repairs have been implemented. The Cover System Inspection Report will be completed to document details of the repair action, including a site map showing the locations of all completed repairs. Descriptions of all repair activities will be summarized in the annual inspection and maintenance report submitted to Cannon AFB and the biennial report submitted to Cannon AFB and NMED.

Any repairs that require modification to the existing design, or re-engineering and generation of record drawings, are considered major repairs and are not included under this plan.

3.2.1 Landfill No. 3 (LF-03/SWMU 105) and Landfill No. 4 (LF-04/SWMU 104)

3.2.1.1 Inspection and Maintenance Activities

LF-03 and LF-04 are very similar and are addressed in this plan together. Figure 3 shows the locations and plan view outlines of the sites. A vegetative cover (open field) is present over both landfill sites. The surface of each landfill is relatively flat and no defined drainage pathways have formed on the cover surface or away from the former landfill sites. A constructed earthen berm surrounds LF-04. Table 3-1 summarizes the inspection and maintenance requirements for the vegetative covers at LF-03 and LF-04.

Table 3-1. Summary of Inspection and Maintenance Activities—Landfill No. 3 (LF-03/SWMU 105) and Landfill No. 4 (LF-04/SWMU 104)

Feature	Location	Inspection	Routine Maintenance
Cover surface	Over entire cover	▪ Integrity of soil cover; surface erosion, gully formation ▪ Exposure of buried waste ▪ Surface contours in low areas/depressions graded to prevent stormwater runoff from discharging offsite ▪ Areas of subsidence associated with burial trenches. ▪ Build up of excessive debris that diverts intended stormwater flow ▪ Tumbleweed/uprooted vegetation	▪ Fill in gullies as necessary to restore grade ▪ Restore cover over any exposed waste to original contours of cover surface ▪ Maintain original contours of cover surface ▪ Fill in and grade to prevent pooling and percolation of storm water. ▪ Clean out excess debris ▪ Remove uprooted vegetation
Earthen berm (LF-04)	Surrounding cover system	▪ Erosion along and adjacent to berm; ponding and leakage through berm	▪ Restore berm to original contours to prevent runoff from the landfill; minor grading
Vegetation	Over entire cover	▪ Extent of vegetation cover; type of vegetation; general condition	▪ Document condition of vegetation; site photographs

3.2.1.2 Repair Activities

The basic categories of potential repairs at LF-03 and LF-04 include:

- Grade and fill to repair erosion of cover surface.
- Grade and fill areas of subsidence associated with burial trenches.

- Grade/recontour surface to conform with original contours to prevent stormwater flows from discharging offsite.
- Restore cover system over any exposed waste to original contours.
- Maintain areas along and adjacent to berm to prevent ponding and leakage through the berms or release of stormwater flows offsite.
- Remove excessive silt and debris that diverts intended direction of stormwater flows.
- Reseed localized areas where vegetation is sparse or where repairs have been performed.

3.2.2 Landfill No. 25 (LF-25/SWMU 97)

3.2.2.1 Inspection and Maintenance Activities

Figure 4 shows the current conditions of LF-25 including the general topography and existing drainage patterns at the site, and identifies the unique drainage and erosion control features that require inspection and maintenance. A 2-foot-high permanent earthen berm extends along the southern and eastern borders of the unit and concrete slabs (rip-rap) have been placed near the northeastern corner of the site to control erosion. Table 3-2 summarizes the inspection and maintenance requirements for the vegetative cover at LF-25.

3.2.2.2 Repair Activities

The basic categories of potential repairs at LF-25 include at a minimum:

- Grade and fill to repair erosion of cover surface.
- Restore grade at low areas/depressions to maintain original contours designed to prevent stormwater runoff from discharging offsite.
- Grade and fill low areas along and adjacent to berm to prevent ponding and leakage through the berms.
- Restore cover system over any exposed waste to original contours.
- Repair or replace displaced concrete slabs (rip-rap).
- Remove excessive silt and debris that diverts intended direction of runon/runoff flows.
- Restore structural integrity of affected sections of the perimeter fence and gates.
- Replace faulty or missing locks on gates.
- Replace or repair damaged or missing perimeter fence signage as necessary.
- Remove tumbleweeds or other uprooted vegetation from fenceline.
- Reseed localized areas where vegetation is sparse or where repairs have been performed.

Table 3-2. Summary of Inspection and Maintenance Activities—Landfill No. 25 (LF-25/SWMU 97)

Feature	Location	Inspection	Routine Maintenance
Cover surface, especially steeper slopes	Over entire cover	▪ Integrity of cover; surface erosion, gully formation ▪ Exposure of buried waste ▪ Surface contours in low areas/depressions graded to prevent stormwater runoff from discharging offsite ▪ Build up of excessive debris that diverts intended direction of stormwater flow ▪ Accumulation of tumbleweeds or uprooted vegetation	▪ Fill in gullies as necessary to restore grade ▪ Restore cover over any exposed waste to original contours of cover surface ▪ Maintain/restore original contours of cover surface ▪ Clean out excess debris ▪ Remove uprooted vegetation
Concrete slabs (rip-rap)	Northeastern portion of site	▪ Erosion in area of rip-rap ▪ Displaced concrete (rip-rap) ▪ Build up of excessive debris that diverts intended direction of stormwater flow ▪ Accumulation of tumbleweeds or uprooted vegetation	▪ Fill in eroded areas/gullies as necessary to restore grade ▪ Repair or replace displaced rip-rap ▪ Clean out excess debris ▪ Remove uprooted vegetation
Berm	Landfill's southern and eastern edges	▪ Erosion along and adjacent to berm; ponding and leakage through berm	▪ Restore berm to original contours to prevent runoff from the landfill; minor grading
Perimeter fence and gates	Fenceline	▪ Structural integrity ▪ Tumbleweed and debris accumulation ▪ Locks on gates	▪ Repairs to fence structure ▪ Remove tumbleweed and debris accumulation ▪ Replace damaged or missing locks
Signage on perimeter fence	Various	▪ Inspect signage for damage. Note missing signage.	▪ Replace damaged or missing signage
Vegetation	Over entire cover	▪ Extent of vegetation cover; type of vegetation; general condition	▪ Document condition of vegetation; site photographs

3.2.3 Sewage Lagoons (SWMU 101)

3.2.3.1 Inspection and Maintenance Activities

Figure 5 shows the current condition of the south area of the Sewage Lagoon site including the general topography and existing drainage patterns at the site, and identifies the unique drainage and erosion control features that require inspection and maintenance. Table 3-3 summarizes the inspection and maintenance requirements for the vegetative cover system at the south lagoon. No contaminated media remains in the north lagoon area and inspection and maintenance is not required.

GRAPHIC SCALE

(IN FEET)
1 inch = 200 ft.

N1236500 N1236000 N1235500 N1235000 N1234500 N1234000

E811500 E811000 E810500

CHAIN LINK FENCE
BARB WIRE FENCE
OVERHEAD UTILITIES
WELL
PAVED ROAD
GATE
BARB WIRE FENCE
PAVED ROAD

4280 4275 4285 4290 4291.4 4280.2 4268.1

Entire Site Re-Graded

No.	DATE	REVISIONS
1.		
2.		
3.		
4.		
5.		
6.		

SURVEYOR'S CERTIFICATION

I, PHILIP W. TURNER, A PROFESSIONAL SURVEYOR REGISTERED IN ACCORDANCE WITH THE LAWS OF THE STATE OF NEW MEXICO, DO HEREBY CERTIFY THAT THIS TOPOGRAPHIC MAP WAS PREPARED BY ME FROM THE RETURNS OF AN ACTUAL FIELD SURVEY AND THAT IT SATISFIES THE NATIONAL MAP STANDARDS FOR VERTICAL AND HORIZONTAL POSITIONAL ACCURACY.

PHILIP W. TURNER N.M.P.S. 10204 DATE

DATE OF SURVEY: JANUARY 3-4, 2001

TOPOGRAPHIC SURVEY MAP

FIGURE 4. Site Map LF-25 (SWMU 97)

CANNON AIR FORCE BASE
SWMU 97
CURRY COUNTY, NEW MEXICO
JANUARY, 2001

SCALE: 1" = 200'

SHEET 1 OF 1

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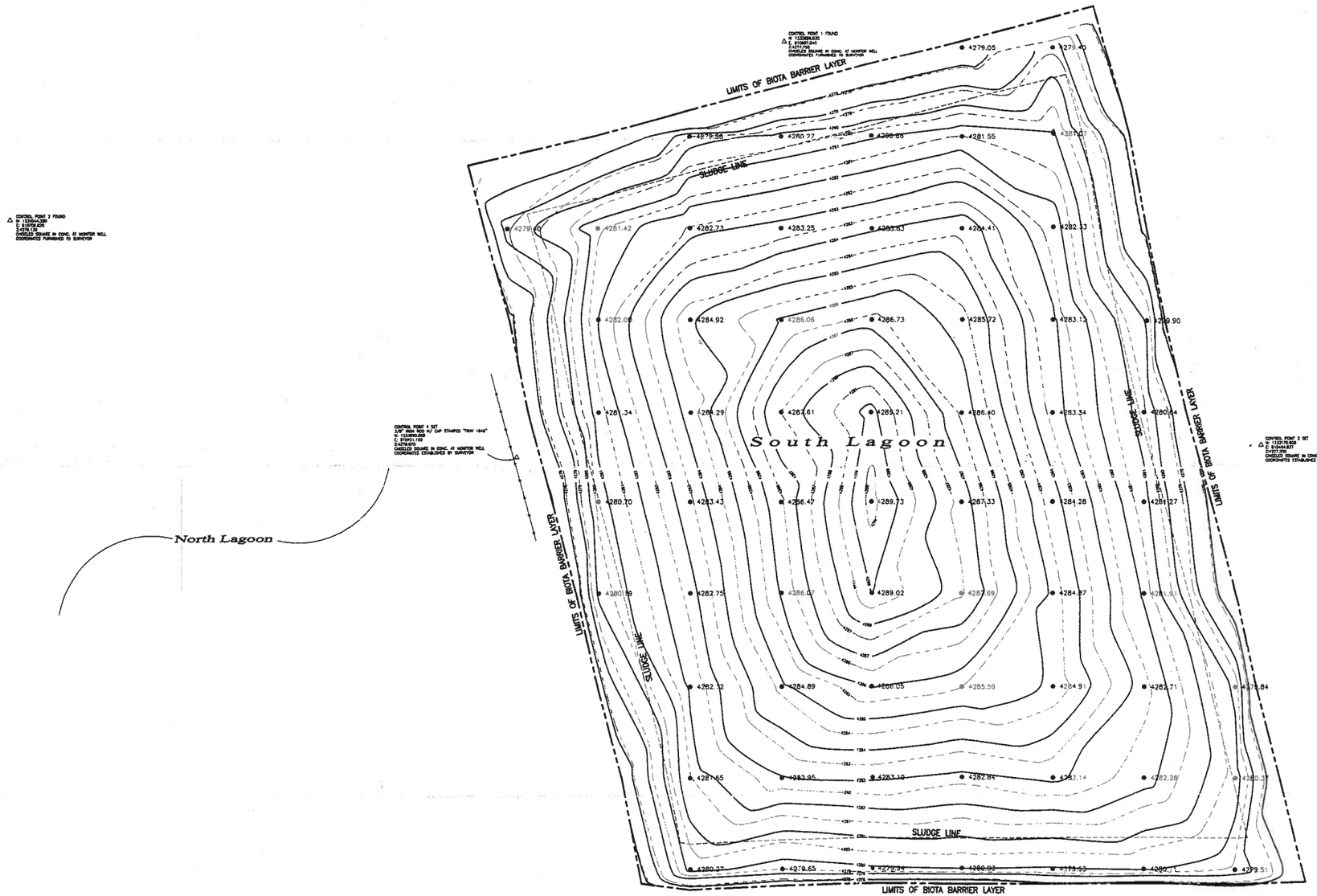
FIGURE 5.
Site Map Sewage Lagoons (SWMU 101)

" TOPOGRAPHIC SURVEY "

CANNON AIR FORCE BASE,
CURRY COUNTY, NEW MEXICO,
SEWAGE LAGOON FINAL CLOSURE
AS-BUILT SURVEY - 12/16/03
Erosion Vegetation Layer



Scale 1" = 60'

0 15' 30' 60'

LEGEND

- AS-BUILT BIOTA BARRIER LAYER
- AS-BUILT EROSION VEGETATION LAYER
- 4280.18 SPOT ELEVATION -- CURRENT SURVEY DATA

NOTES

1. *Additional control monuments for this survey were created using coordinate and elevation data supplied to the surveyor. Surveyor makes no claims as to the accuracy of the original survey control data, horizontal or vertical.*

2. *Contour interval: 1.0'*

3. *Source of data provided to surveyor: Lydick Engineers and Surveyors topographic survey, Plat No. 15880B & 15880D furnished by Arrowhead Contractors.*

4. *Sludge Line Location: 50 feet inside of Soil Barrier Limits provided to Surveyor by Arrowhead Contractors and Foster Wheeler. December 11, 2003.*

I, Kenneth W. Hagar, New Mexico Professional Surveyor No. 15514, do hereby certify that this Topographic Survey Plat and the actual survey on the ground upon which it is based were performed by me or under my direct supervision; that I am responsible for this survey; that this survey meets the Minimum Standards for Surveying in New Mexico; and that it is true and correct to the best of my knowledge and belief.

Ground survey completed December 16, 2003.

This 19th day of December, 2003.

Kenneth W. Hagar
Professional Surveyor of New Mexico No. 15514
December 19, 2003

Hagar & Associates, P.C.
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PLAT: H3870A
DRAWING DWG

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Table 3-3. Summary of Inspection and Maintenance Activities—Sewage Lagoons (SWMU 101)

Feature	Location	Inspection	Routine Maintenance
Cover surface	Over entire cover	▪ Integrity of cover; surface erosion, gully formation ▪ Exposure of crushed concrete in eroded areas ▪ Surface contours in low areas/depressions graded to prevent stormwater runoff from discharging offsite ▪ Build up of excessive silt and debris that diverts intended direction of stormwater flow; blockages ▪ Accumulation of tumbleweeds or uprooted vegetation	▪ Fill in gullies as necessary to restore grade ▪ Restore cover over any exposed concrete to original contours of cover surface ▪ Maintain/restore original contours of cover surface ▪ Clean out excess debris ▪ Remove uprooted vegetation
Drainage Ditches	Perimeter of cover	▪ Erosion ▪ Exposure/displacement of crushed concrete in eroded areas ▪ Build up of excessive silt and debris that diverts intended direction of stormwater flow; blockages ▪ Accumulation of tumbleweeds or uprooted vegetation	▪ Fill in eroded areas/gullies as necessary to restore grade ▪ Restore cover over any exposed concrete to original contours of cover surface ▪ Replace displaced concrete ▪ Clean out excess debris ▪ Remove uprooted vegetation
Perimeter fence and gates	Fenceline	▪ Structural integrity ▪ Tumbleweed and debris accumulation ▪ Locks on gates	▪ Repairs to fence structure ▪ Remove tumbleweed and debris accumulation ▪ Replace damaged or missing locks
Signage on perimeter fence	Various	▪ Inspect signage for damage. Note missing signage.	▪ Replace damaged or missing signage
Vegetation	Over entire cover	▪ Extent of vegetation cover; type of vegetation; general condition	▪ Document condition of vegetation; site photographs

3.2.3.2 Repair Activities

The basic categories of potential repairs at the south lagoon include:

- Grade and fill to repair erosion of the engineered cover.
- Grade and fill low spots to original configuration.
- Remove silt or debris and accumulated tumbleweeds from drainage channels and fill in eroded areas to original configuration.
- Repair erosion along or adjacent to the drainage channels to direct stormwater into channels.
- Replace crushed concrete displaced by stormwater flows.
- Remove any excessive silt and debris that diverts intended direction of runon/runoff flows.

- Restore structural integrity of affected sections of the perimeter fence and gates.
- Replace faulty or missing locks in gates.
- Replace damaged or missing perimeter fence signage as necessary.
- Reseed localized areas where vegetation is sparse or where repairs have been performed.

4. LONG-TERM GROUNDWATER MONITORING

4.1 Monitoring Requirements

Groundwater monitoring at the three landfills (LF-03, LF-04, and LF-25) and Sewage Lagoons will be continued as part of this plan. The monitoring events will be conducted on a biennial basis beginning in 2008 and will coincide with the annual cover inspection. The locations of the wells requiring monitoring are shown in Figure 3. Figure 6 shows the October 2008 groundwater elevation contours for the east-central portion of Cannon AFB.

The groundwater monitoring contractor will conduct gauging and sampling in accordance with the *Revised Draft Long-Term Monitoring Sampling and Analysis Plan* (Bhate, 2002) and the low-flow sampling technique described in the attached Standard Operating Procedures (SOPs) (Appendix C). Field forms to be completed during LTM activities are provided in Appendix D.

Table 4-1 summarizes the well construction details for the eight wells included in the LTM Program.

Groundwater samples will be analyzed for the parameters listed in Table 4-2. Sample handling, analyses, and quality assurance/quality control procedures will comply with the *Revised Draft Long-Term Monitoring Work Plan, Sampling and Analysis Plan, and Site Safety and Health Plan, Landfill No. 3 (SWMU 105), Landfill No. 4 (SWMU 104), and Landfill No. 25 (SWMU 97)* (Bhate, 2002); *Department of Defense Quality Systems Manual for Laboratories, version 3* (DOD, 2006); and attached SOPs. The groundwater data are evaluated against current EPA MCLs and NWGWQS (20 New Mexico Administrative Code 6.2).

4.2 Maintenance Requirements

Pump maintenance will be performed on any dedicated sampling pumps on a biennial basis.

4.3 Equipment Decontamination

Non-dedicated sampling equipment will be decontaminated between sample locations following the procedures described in the *Revised Draft Long-Term Monitoring Work Plan, Sampling and Analysis Plan, and Site Safety and Health Plan, Landfill No. 3 (SWMU 105), Landfill No. 4 (SWMU 104), and Landfill No. 25 (SWMU 97)* (Bhate, 2002) and attached SOP (Appendix C). Dedicated sampling equipment will not require decontamination.

Table 4-1. Cannon Air Force Base Monitoring Well Information

Site ID/ SWMU	Well No. [1]	Date Installed	Ground Surface Elevation (ft NAVD 88)	Latitude (NAD 83)	Longitude (NAD 83)	Total Well Depth (ft)	TOC Elevation (ft NAVD 88)	Stickup (ft)	Casing Material	Screened Interval (ft)	Top of Screen Elevation (ft NAVD 88)	Comments
LF-03 (SWMU 105)	MW-O[2]	10/30/1994	4,269.26	34°23'00.25"	103°17'50.42"	303	4,271.76[6]	2.5	PVC	30.00	3,995.95	Abandoned; dry
	MW-Oa[3]	02/29/2004	4,270.11	34°23'00.33"	103°17'50.60"	365	4,271.07	0.96	PVC	60.00	3,970.11	Replacement well for MW-O
LF-04 (SWMU 104)	MW-N[2]	12/13/1994	4,265.88	34°23'18.11"	103°17'46.60"	297	4,267.68[6]	1.8	PVC	30.00	3,998.88	Abandoned; dry
	MW-Na[3]	12/16/2004	4,266.00	34°23'18.11"	103°17'46.60"	358	4,268.40	2.40	PVC	60.00	3,972.88	Replacement well for MW-N
LF-25 (SWMU 97)	MW-P[5]	NA	4,270.55	34°23'10.43"	103°18'08.02"	300	NA	NA	PVC	20.00	4,000.55	Abandoned; dry
	MW-Pa[3]	02/21/2004	4,270.85	34°23'10.05"	103°18'08.27"	360	4,271.82	0.97	PVC	60.00	3,975.85	Replacement well for MW-P
	MW-R[4,5]	Abandoned after construction because of corrosion of stainless steel pipe.										
	MW-Ra[4,5]	06/29/2001	4,272.31	34°23'23.50"	103°18'08.23"	311	4,275.31[6]	3.00	PVC	30.00	3,991.75	Replacement well for MW-R
Sewage Lagoons (SWMU 101)	MW-E[2,3]	11/17/1985	4,279.70	34°23'26.51"	103°18'26.23"	373	4,282.61	2.91	PVC	15.00	3,924.70	
	MW-F[2,3]	11/19/1985	4,274.93	34°23'21.29"	103°18'14.32"	375	4,278.50	3.57	PVC	15.00	3,919.93	
	MW-G[2,3]	11/10/1985	4,276.46	34°23'12.86"	103°18'12.07"	372	4,279.55	3.09	PVC	15.00	3,919.46	
	MW-H[2,3]	11/18/1985	4,275.98	34°23'07.22"	103°18'17.43"	375	4,278.98	3.00	PVC	15.00	3,920.98	

[1] Wells will be sampled on a biennial basis.

[2] Information from Appendix A, Groundwater Monitoring Well Management Plan, Cannon Air Force Base, Clovis, New Mexico (Woodward-Clyde Consultants, 1995).

[3] Information from Monitoring Well Identification Reports, RCRA Ground-Water Monitoring at Sewage Lagoon, Landfill 5, and non-RCRA Sites, Analytical Results of Samples Collected July 23, 24, 25, and 26, 2007 (Cannon AFB, 2007).

[4] Information from Final Semi-Annual Monitoring Report, July 2001 Sampling Event, Long-Term Monitoring Landfill No. 25 (MW-Ra) (BHATE, 2002b).

[5] Information from Table 1, Ground-Water Hydrology and Water Quality of the Southern High Plains Aquifer, Cannon Air Force Base, Curry County, New Mexico, 1994–2005. Scientific Investigations Report 2006–5280 (Langman et al., 2006).

[6] TOC elevation estimated.

ft feet
NA Not available
NAV 83 North American Datum of 1983
NAVD 88 North American Vertical Datum of 1988
PVC polyvinyl chloride
TOC Top of Casing

Table 4-2. Groundwater Sample Analysis and Methods

Analysis	Methods
Volatile Organic Compounds	EPA 8260B
Priority Pollutant (PP) Metals[1] (Total)	EPA 6020/7470A
Total Chromium +3/+6	EPA 7196A and calculation
Nitrate Nitrogen	EPA 300.0A
Nitrate-Nitrite Nitrogen	EPA 353.2
Perchlorate	EPA 6860
Field parameters: pH, dissolved oxygen, oxidation reduction potential, specific conductance, turbidity, and temperature	Field measurements using portable meters

[1] Total antimony, arsenic, barium, beryllium, cadmium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc

4.4 Investigation-Derived Waste

The investigation-derived waste (IDW) generated during groundwater sampling activities include purge water from each well, personal protection equipment (PPE), paper towels, and soapy decontamination water. Waste minimization techniques, including the use of low-flow sampling techniques, will be employed where possible to reduce the quantity of IDW generated. Waste characterization will be evaluated based on comparison of the field analytical data with applicable regulatory levels.

Wastewater from pre-sampling well purging and equipment decontamination will be placed in storage tanks installed adjacent to each monitoring well. A label will be posted on each tank that identifies the contents and conveys a warning that no material should be added or removed. Waste characterization will be performed by reviewing the groundwater sample analytical results for each well. Any detected constituents will be compared to New Mexico Water Quality Control Commission Regulations (WQCCR), Part 2, 3103, A, B, and C groundwater quality standards (20 NMAC 6.2, 1995). Cannon AFB will notify the NMED Groundwater Bureau of any wells exceeding the New Mexico WQCCR criteria and the amount of purge water to be discharged. Wastewater will be discharged to the ground surface in the vicinity of the sampling location upon approval from the NMED.

All PPE and disposable equipment will be put into double plastic bags and sealed for disposal in dumpsters at the base.

4.5 Personal Protective Equipment and Sampling Equipment

All PPE and disposable sampling equipment will be placed in double plastic trash bags and sealed. These items will be disposed of in dumpsters.

4.6 Quality Assurance Project Plan

All environmental monitoring activities will be conducted in accordance with the *Revised Draft Long-Term Monitoring Project Quality Assurance Project Plan* (Bhate, 2002) and the *Department of Defense Quality Systems Manual for Laboratories, version 3* (DOD, 2006).

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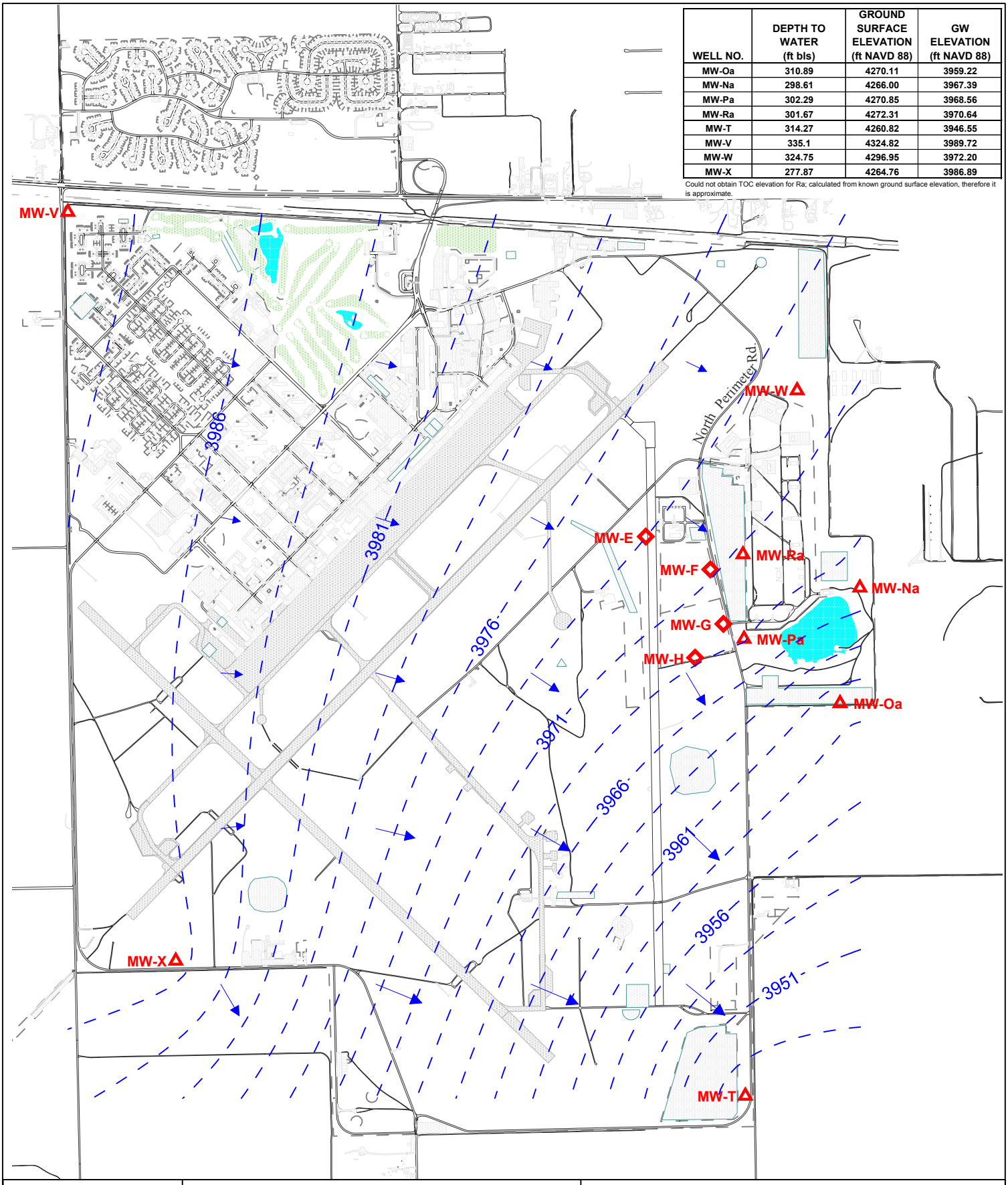
WELL NO.	DEPTH TO WATER (ft bls)	GROUND SURFACE ELEVATION (ft NAVD 88)	GW ELEVATION (ft NAVD 88)
MW-Oa	310.89	4270.11	3959.22
MW-Na	298.61	4266.00	3967.39
MW-Pa	302.29	4270.85	3968.56
MW-Ra	301.67	4272.31	3970.64
MW-T	314.27	4260.82	3946.55
MW-V	335.1	4324.82	3989.72
MW-W	324.75	4296.95	3972.20
MW-X	277.87	4264.76	3986.89

Could not obtain TOC elevation for Ra; calculated from known ground surface elevation, therefore it is approximate.



N
W E
S
0 2000
feet

NOTES

Wells utilized for water levels

Wells not utilized for water levels

3976 Water table elevation contours (feet NAVD 88)

Water levels taken on 10/27/2008, except MW-Na (10/28/2008)

Top of casing elevations derived from USGS Report 2006-5280

Digital data files provided by GeoBase/CAFB

Projection: UTM Zone 13N, NAD 83

FIGURE 6.
Ground Water Flow Map
10-27-2008

Cannon Air Force Base

Curry County, New Mexico

Brown, Burdine & Associates, LLC

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5. SITE SAFETY AND HEALTH PLAN

All cover inspection, maintenance, repair, and long-term groundwater monitoring activities will be conducted in accordance with the *Revised Draft Long-Term Monitoring Work Plan, Sampling and Analysis Plan, and Site Safety and Health Plan, Landfill No. 3 (SWMU 105), Landfill No. 4 (SWMU 104), and Landfill No. 25 (SWMU 97)* (Bhate, 2002a); the *Basewide Health and Safety Plan (Foster Wheeler, 2000); and United States Army Corps of Engineers Engineering Manual 385-1-1, Safety and Health Requirements Manual* (2003).

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6. REPORT PREPARATION AND SCHEDULE

The reports to be prepared for this project and proposed frequency are listed in Table 6-1. NMED requires submittal of a biennial report summarizing the results of biennial groundwater monitoring and annual site inspection, maintenance, and repair activities by December 31 beginning in 2008.

Table 6-1. Proposed Reporting and Schedule

Task	Report Contents	Frequency	Submittal
Inspection and Maintenance Report	▪ Inspection Report ▪ Summary of inspection, monitoring, maintenance, and repair activities for fiscal year at each of the landfills ▪ Photographs showing initial site conditions, including status of vegetative cover, perimeter fence, and signage ▪ Description of any routine maintenance performed ▪ Site map noting features inspected and location of routine maintenance performed ▪ Conclusions and recommendations for upcoming year	Annual	Submit to Cannon AFB on annual basis beginning in 2008[1] Submit to Cannon AFB and NMED on biennial basis with Long-Term Groundwater Monitoring and Maintenance Report beginning in 2008[1]
Inspection Reports (after repairs)	▪ Inspection Report completed after repairs have been completed ▪ Description of any repairs performed ▪ Update site map to note features inspected and location of repairs performed. ▪ Photographs showing conditions before and after repairs	Annual	Submit with associated Inspection and Maintenance Report
Groundwater Elevation Measurements	Provide in Long-Term Groundwater Monitoring and Maintenance Report: ▪ Groundwater gauging data in tabular form ▪ Field reporting forms ▪ Groundwater elevation contour map	Biennial (coordinate with LTM sampling event)	Submit to Cannon AFB and NMED on biennial basis beginning in 2008[2]
Groundwater LTM Analytical Results	Provide in Long-Term Groundwater Monitoring and Maintenance Report: ▪ Analytical results in tabular format ▪ Summary of complete analytical results ▪ Environmental Resources Program Information Management System deliverable as required ▪ Discussion of results/exceedances of groundwater standards ▪ Field reporting forms ▪ Laboratory data packages ▪ Data Quality Summary Report	Biennial	Submit to Cannon AFB and NMED on biennial basis beginning in 2008[2]
Pump Maintenance	Provide in Long-Term Groundwater Monitoring and Maintenance Report: ▪ Description of pump maintenance activities	Biennial (coordinate with LTM sampling event)	Submit to Cannon AFB and NMED on biennial basis beginning in 2008[2]

[1] First annual inspection of Sewage Lagoon site will occur in 2009.

[2] First biennial sampling event of Sewage Lagoon wells will occur in 2010.

7. REFERENCES

Cannon Air Force Base

2007 RCRA Ground-Water Monitoring at Sewage Lagoons, Landfills and non-RCRA Sites, Analytical Results of Samples Collected July 23, 24, 25 and 26, 2007. Cannon Air Force Base, New Mexico.

Bhate (Bhate Environmental Associates, Inc.)

2002a. Revised Draft Long-Term Monitoring Work Plan, Sampling and Analysis Plan, and Site Safety and Health Plan, Landfill No. 03 (SWMU 105), Landfill No. 04 (SWMU 104), and Landfill No. 25 (SWMU 97). Cannon Air Force Base, New Mexico.

2002b. Final Semi-Annual Monitoring Report, July 2001 Sampling Event, Long-Term Monitoring Landfill No. 25 (MW-Ra). Cannon Air Force Base, New Mexico.

2005. Final December 2003 Annual Monitoring Report, Long-Term Monitoring Event, Landfill Nos. LF-25 (MR-Ra), Lf-03 (MW-O), and LF-04 (MW-N), Revision 1. Cannon Air Force Base, New Mexico.

2008. 2008 Biennial Groundwater Monitoring and Annual Landfill Inspection Report, Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97), Cannon Air Force Base, New Mexico.

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1998. Sludge Management Compliance Evaluation and Requirements Identifiatin Phase III Customer Concept Document. Cannon Air Force Base, New Mexico.

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2000. Final Cannon Basewide Health and Safety Plan. Cannon Air Force Base, New Mexico.

2001a. Construction Completion Report for the Remedial Action at SWMU 97—Landfill No. 25. Cannon Air Force Base, New Mexico.

2001b. Revised Corrective Measures Study Report for SWMU 101—Sewage Lagoons. Cannon Air Force Base, New Mexico.

2006. Final Construction Completion Report for the Remedial Action at SWMU 101—Sewage Lagoons. Cannon Air Force Base, New Mexico.

HGL (HydroGeoLogic, Inc.)

2006. RCRA Facility Investigation Report for Landfill No. 3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), and Landfill No. 25 (LF-25/SWMU 97). Cannon Air Force Base, New Mexico.

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2006 Ground-Water Hydrology and Water Quality of the Southern High Plains Aquifer, Cannon Air Force Base, Curry County, New Mexico. 1994–2005. U.S. Geological Survey Scientific Investigations Report 2006–5280.

Radian (Radian Corporation)
1994a. RCRA Facility Investigation (RFI) Final Report, SWMU No. 105, Landfill No. 3, IRP Site LF-3. Cannon Air Force Base, New Mexico.

1994b. RCRA Facility Investigation (RFI) Final Report, SWMU No. 104, Landfill No. 4, IRP Site LF-4. Cannon Air Force Base, New Mexico.

1994c. RCRA Facility Investigation (RFI) Final Report, SWMU No. 97, Landfill No. 25, IRP Site LF-25. Cannon Air Force Base, New Mexico.

USACE (United States Army Corps of Engineers)
2002. Sewage Lagoons Closure Final Specifications. Cannon Force Base, New Mexico.

2003. United States Army Corps of Engineers Engineering Manual 385-1-1, Safety and Health Requirements Manual.

Woodward-Clyde (Woodward-Clyde Consultants)
1992. Remedial Investigation Report for 18 Solid Waste management Units. Cannon Air Force Base, New Mexico.

1995. Groundwater Monitoring Well Management Plan, Cannon Air Force Base, New Mexico.

Appendix A
Cover System Inspection Report

Cover System Inspection Report
Landfill 3 (SWMU 105)
Cannon Air Force Base, Curry County, New Mexico

Inspector Name and Title: _____ Date: _____
Days since last rain fall: _____ Amount of rainfall: _____
(Contact Base Weather Service)

Inspection Type	Check as Appropriate
Annual	
Other (identify)	

	LF-03	
1. Cover:	Yes	No
• Overall structural integrity maintained?		
• Surface erosion present?		
• Gullies/washouts or areas of subsidence present?		
• Exposed buried waste?		
• As-constructed contours (topographic highs) intact?		
• As-constructed contours (depressions) intact?		
• Stormwater runoff contained within boundaries of site?		
• Evidence of drainage pathways/diverted runoff?		
• Tumbleweeds or silt built up?		
Describe overall condition:		
Problems observed with the cover:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		

	LF-03	
2. Vegetation:	Yes	No
• Vegetation native perennial?		
• Vegetation in good condition?		
• Bare/sparse areas?		
Describe overall condition:		
Estimate extent and type of vegetative cover:		

Maintenance or repairs required:
Maintenance to be performed by (Subcontractor name and date):

	LF-03	
3. Berms (Indicate NA if no berms are present):	Yes	No
• Is any erosion present?		
• Is any ponding present?		
• Stormwater runoff contained onsite?		

Describe location and condition:
Problems observed with berms:
Maintenance or repairs required:
Maintenance to be performed by (Subcontractor name and date):

	LF-03	
4. Drainage Ditches/Channels (Indicate NA if no channels are present):	Yes	No
• Is any erosion present?		
• Is buildup of sediment/silt debris present?		
• Stormwater runoff contained onsite?		
• Excess accumulation of tumbleweeds present?		

Describe location and condition:
Problems observed with channels:
Maintenance or repair required:
Maintenance to be performed by (Subcontractor name and date):

	LF-03	
5. Monitoring Wells:	Yes	No
• Evidence of tampering?		
• Damage?		
Problems observed with wells:		

	LF-03	
6. Fences/Gates/Signage (Indicate NA if not present):	Yes	No
• Structural integrity?		
• Gate locks in place?		
• Signage in place?		
• Tumbleweeds or silt built up?		
Problems observed with fencing/gates/signage:		
Maintenance or repair required:		
Maintenance to be performed by (Subcontractor name and date):		
7. Changes required to the Monitoring and Maintenance Plan?		

Inspector's Name

Inspector's Signature

Date

Cover System Inspection Report
Landfill 4 (SWMU 104)
Cannon Air Force Base, Curry County, New Mexico

Inspector Name and Title: _____ Date: _____
Days since last rain fall: _____ Amount of rainfall: _____
(Contact Base Weather Service)

Inspection Type	Check as Appropriate
Annual	
Other (identify)	

	LF-04	
1. Cover:	Yes	No
• Overall structural integrity maintained?		
• Surface erosion present?		
• Gullies/washouts or areas of subsidence present?		
• Exposed buried waste?		
• As-constructed contours (topographic highs) intact?		
• As-constructed contours (depressions) intact?		
• Stormwater runoff contained within boundaries of site?		
• Evidence of drainage pathways/diverted runoff?		
• Tumbleweeds or silt built up?		
Describe overall condition:		
Problems observed with the cover:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		

	LF-04	
2. Vegetation:	Yes	No
• Vegetation native perennial?		
• Vegetation in good condition?		
• Bare/sparse areas?		
Describe overall condition:		
Estimate extent and type of vegetative cover:		

Maintenance or repairs required:
Maintenance to be performed by (Subcontractor name and date):

	LF-04	
3. Berms (Indicate NA if no berms are present):	Yes	No
• Is any erosion present?		
• Is any ponding present?		
• Stormwater runoff contained onsite?		

Describe location and condition:
Problems observed with berms:
Maintenance or repairs required:
Maintenance to be performed by (Subcontractor name and date):

	LF-04	
4. Drainage Ditches/Channels (Indicate NA if no channels are present):	Yes	No
• Is any erosion present?		
• Is buildup of sediment/silt debris present?		
• Stormwater runoff contained onsite?		
• Excess accumulation of tumbleweeds present?		

Describe location and condition:
Problems observed with channels:
Maintenance or repair required:
Maintenance to be performed by (Subcontractor name and date):

	LF-04	
5. Monitoring Wells:	Yes	No
• Evidence of tampering?		
• Damage?		
Problems observed with wells:		

	LF-04	
6. Fences/Gates/Signage (Indicate NA if not present):	Yes	No
• Structural integrity?		
• Gate locks in place?		
• Signage in place?		
• Tumbleweeds or silt built up?		
Problems observed with fencing/gates/signage:		
Maintenance or repair required:		
Maintenance to be performed by (Subcontractor name and date):		
7. Changes required to the Monitoring and Maintenance Plan?		

Inspector's Name

Inspector's Signature

Date

Cover System Inspection Report
Landfill 25 (SWMU 97)
Cannon Air Force Base, Curry County, New Mexico

Inspector Name and Title: _____ Date: _____
Days since last rain fall: _____ Amount of rainfall: _____
(Contact Base Weather Service)

Inspection Type	Check as Appropriate
Annual	
Other (Identify)	

	LF-25	
1. Fences and Gates:	Yes	No
• Structural integrity?		
• Gates locks in place?		
• Signage in place?		
• Tumbleweeds and silt built up?		
Problems observed with the fences/gates/signage:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		

	LF-25	
2. Cover:	Yes	No
• Overall structural integrity maintained?		
• Surface erosion present?		
• Gullies/washouts or areas of subsidence present?		
• Exposed buried waste?		
• As-constructed contours (topographic highs) intact?		
• As-constructed contours (depressions) intact?		
• Stormwater runoff contained within boundaries of site?		
• Evidence of drainage pathways/diverted runoff?		
• Tumbleweeds or silt built up?		
Problems observed with the cover:		
Maintenance or repair required:		
Maintenance to be performed by (Subcontractor name and date):		

	LF-25	
3. Berms (Indicate NA if not present):	Yes	No
• Is any erosion present?		
• Is any ponding present?		
• Stormwater runoff contained onsite?		
Describe location and condition:		
Problems observed with berms:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		

	LF-25	
4. Rip-Rap (Indicate NA if not present):	Yes	No
• Is any erosion present?		
• Is buildup of sediment/silt debris present?		
• Is displaced concrete present?		
• Excess accumulation of tumble weeds present?		
Describe location and condition:		
Problems observed with rip-rap:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		

	LF-25	
5. Drainage Ditches/Channels (Indicate NA if no channels are present):	Yes	No
• Is any erosion present?		
• Is buildup of sediment/silt debris present?		
• Is displaced crushed concrete present?		
• Is stormwater runoff contained onsite?		
• Excess accumulation of tumbleweeds present?		
Describe location and condition:		
Problems observed with channels:		

Maintenance or repair required:		
Maintenance to be performed by (Subcontractor name and date):		
	LF-25	
6. Vegetation:	Yes	No
• Vegetation native perennial?		
• Vegetation in good condition?		
• Bare/sparse areas?		
Describe overall condition:		
Estimate extent and type of vegetative cover:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		
	LF-25	
7. Monitoring Wells:	Yes	No
• Evidence of tampering?		
• Damage?		
Problems observed with the wells.		
8. Changes required to the Monitoring and Maintenance Plan?		

Inspector's Name

Inspector's Signature

Date

Cover System Inspection Report
Sewage Lagoon (South Area) (SWMU 101)
Cannon Air Force Base, Curry County, New Mexico

Inspector Name and Title: _____ Date: _____
Days since last rain fall: _____ Amount of rainfall: _____
(Contact Base Weather Service)

Inspection Type	Check as Appropriate
Annual	
Other (Identify)	

	Sewage Lagoons	
1. Fences and Gates:	Yes	No
• Structural integrity?		
• Gates locks in place?		
• Signage in place?		
• Tumbleweeds and silt built up?		
Problems observed with the fences/gates/signage:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		

	Sewage Lagoons	
2. Cover:	Yes	No
• Overall structural integrity maintained?		
• Surface erosion present?		
• Gullies/washouts or areas of subsidence present?		
• Exposed buried waste?		
• As-constructed contours (topographic highs) intact?		
• As-constructed contours (depressions) intact?		
• Stormwater runoff contained within boundaries of site?		
• Evidence of drainage pathways/diverted runoff?		
• Tumbleweeds or silt built up?		
Problems observed with the cover:		
Maintenance or repair required:		

Maintenance to be performed by (Subcontractor name and date):		
	Sewage Lagoons	
3. Berms (Indicate NA if not present):	Yes	No
• Is any erosion present?		
• Is any ponding present?		
• Stormwater runoff contained onsite?		
Describe location and condition:		
Problems observed with berms:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		
	Sewage Lagoons	
4. Drainage Ditches/Channels (Indicate NA if no channels are present):	Yes	No
• Is any erosion present?		
• Is buildup of sediment/silt debris present?		
• Is displaced crushed concrete present?		
• Is stormwater runoff contained onsite?		
• Excess accumulation of tumbleweeds present?		
Describe location and condition:		
Problems observed with channels:		
Maintenance or repair required:		
Maintenance to be performed by (Subcontractor name and date):		
	Sewage Lagoons	
5. Vegetation:	Yes	No
• Vegetation native perennial?		
• Vegetation in good condition?		
• Bare/sparse areas?		

Describe overall condition:		
Estimate extent and type of vegetative cover:		
Maintenance or repairs required:		
Maintenance to be performed by (Subcontractor name and date):		
	Sewage Lagoons	
6. Monitoring Wells:	Yes	No
• Evidence of tampering?		
• Damage?		
Problems observed with the wells.		
7. Changes required to the Monitoring and Maintenance Plan?		

Inspector's Name

Inspector's Signature

Date

Appendix B
NMED Correspondence

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us

RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

March 26, 2008

Colonel Timothy J. Leahy
27th Special Operations Wing
100 South D.L. Ingram Boulevard
Cannon Air Force Base, New Mexico 88103-5214

RE: LONG TERM MONITORING AT SOLID WASTE MANAGEMENT UNITS 105, 104, 97, AND 101 CANNON AIR FORCE BASE, EPA ID NO. NM7572124454

Dear Mr. Leahy:

The New Mexico Environment Department (NMED) is providing requested input regarding long term ground water monitoring (LTM) at Solid Waste Management Units (SWMUs) 105, 104, 97, and 101 (Landfill No. 3, Landfill No. 4, Landfill No. 25, and the Sewage Lagoon, respectively). The Permittee must submit to NMED a Long Term Ground Water Monitoring Work Plan (Work Plan) that includes the actions below.

- As specified in NMED's approval letter dated December 5, 2007, the Permittee must collect ground water samples biennially from the ground water wells located at each landfill, perform annual landfill inspections to verify establishment and maintenance of a vegetative cover, and repair any discovered damage. By December 31st of every other year, starting in 2008, the Permittee must submit to NMED a biennial report that summarizes the results of the ground water sampling and landfill inspection.

- The Plan must list all ground water monitoring wells that will be sampled. The Permittee must also include a map showing the locations of all ground water monitoring wells used for long term monitoring.

- The Permittee must list all parameters (including the most current laboratory analytical methods) the ground water samples will be analyzed for. This list must include volatile organic compounds (VOCs) by Method 8260c, Priority Pollutant metals (arsenic, selenium, cadmium, chromium (III and VI), copper, lead, antimony, silver, thallium, zinc, beryllium, mercury and nickel) and barium using EPA Method 6000/7000 series, nitrate using EPA Method 353.3 or equivalent, and perchlorate using EPA Method 6850.

If you have any questions regarding this letter, please call Cheryl Frischkorn at (505) 476-6058.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
C. Frischkorn, NMED HWB
Gerald Pelfrey, CAFB
File: CAFB 2008 and Reading

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
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BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

CINDY PADILLA
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

December 5, 2007

Colonel Scott D. West, Commander
27th Fighter Wing
Cannon Air Force Base
100 South DL Ingram Blvd.
Cannon AFB, NM 88103-5003

RE: APPROVAL OF THE RCRA FACILITY INVESTIGATION (RFI) REPORT, LANDFILLS 4, 5 AND 25 (SOLID WASTE MANAGEMENT UNITS NO. 105, 104 AND 97), CANNON AIR FORCE BASE, NEW MEXICO, EPA ID#NM7572124454 HWB-CAFB-07-001

Dear Colonel West:

The New Mexico Environment Department (NMED) has reviewed the Department of the Air Force's (Permittee), *RCRA Facility Investigation Report for Landfill No.3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104) and Landfill No. 25 (LF-25/SWMU 97), Cannon Air Force Base, New Mexico* (the Report), dated May 2006. The document was received on July 17, 2007 and initially titled *Petition for No Further Action, Landfill No.3 (LF-03/SWMU 105), Landfill No. 4 (LF-04/SWMU 104), Landfill No. 25 (LF-25/SWMU 97), Cannon Air Force Base, New Mexico.*

NMED hereby approves the Report and at this time no longer requires additional corrective action aside from biennial groundwater monitoring of the wells located at each landfill and performing annual landfill inspections to verify establishment and maintenance of a vegetative cover and repair any erosion damage, if present. Both activities shall commence in 2008. The Permittee must submit a biennial report summarizing the results of biennial groundwater sampling and annual landfill inspections by December 31 of every other year beginning in 2008. The three landfills qualify for corrective action complete with controls determinations. The Permittee may request a permit modification to change the status of these units.

NMED suggests that the Permittee carefully review NMAC 20.4.2 concerning hazardous waste permit and corrective action fees. If appropriate, the Permittee may wish to consider grouping additional Solid Waste Management Units (SWMUs) with the three referenced SWMUs into a single, formal request for a Class III Permit Modification of Cannon Air Force Base's (CAFB's) Hazardous Waste Permit.

In the event the Permittee wishes to pursue a Class III Permit Modification for only the three referenced SWMUs, please submit a completed Class III Permit Modification request.

If you have any questions, please contact Daniel Comeau of my staff at (505) 476-6050.

Sincerely,

John E. Kieling
Program Manager
Permits Management Program
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
C. Frischkorn, NMED HWB
N. Dhawan, NMED HWB
D. Comeau, NMED HWB
K. Doll, CAFB
File: Reading File and CAFB 2007 (SWMUs 105, 104 and 97)
HWB-CAFB-07-001

Appendix C
Standard Operating Procedures

SOP 1 Water Levels

Water levels will be measured using an electric water level indicator. The steps to be followed are as follows:

- Check operation of recording equipment above ground. Prior to opening the well, don personal protective equipment as required.
- Record all information specified below on a Groundwater Level Data form or in the field logbook if the form is not available.
- Record well number, top of casing elevation and surface elevation if available. Well diameter and total depth should be recorded. Water levels will be taken from the surveyed reference mark on the top edge of the inner well casing.
- Use a decontaminated water level indicator to record water level to the nearest 0.01 ft (0.3 cm).
- Record the time and day of the measurement.
- Many water level measuring devices have marked metal or plastic bands clamped at intervals along the measuring line used for reference points to obtain depth measurements. The spacing and accuracy of these bands will be checked frequently as they may loosen and slide up or down the line, resulting in inaccurate reference points.
- All groundwater level measurement devices must be cleaned before and after each use to prevent cross-contamination of wells.

SOP 2 Monitoring Well Sampling

The following guidelines and procedures will be used for sampling monitoring wells at Cannon AFB. This Standard Operating Procedure (SOP) and attachment just provides general procedures for low-flow and non low-flow methods of monitoring well sampling. Please refer to project-specific work plans for any deviations from the procedures outlined in this SOP.

General Pre-Sampling Requirements

- Monitoring wells will be sampled in order of increasing contamination unless the wells are equipped with dedicated systems.
- Samples will not be collected within 2 weeks of well development.
- Samples to be analyzed for volatile and gaseous constituents will not be withdrawn with pumps that exert a vacuum on the sample (e.g., centrifugal).
- Wear appropriate personal protective equipment (PPE) as outlined in the BWHSP (Appendix F of the BWP) and the SSHP. In addition, samplers will don new sampling gloves at each individual well prior to sampling.
- Visually examine the exterior of the monitoring well for signs of damage or tampering and record in the field logbook.
- All purging and sampling equipment will be decontaminated as specified in SOP 3 and will be protected from contamination until ready for use. If a centrifugal or submersible pump is used, discard pump suction line after each well. If the sampling equipment is dedicated to a specified well, the previous step may be eliminated. Portions of the pumps that contact the sample must be made of stainless steel and/or Teflon®.
- Unlock well cap or outer steel casing lid.
- Take photoionization detector (PID), lower explosive limit, and oxygen readings, with the appropriate meter(s), at the well head immediately upon opening the cap and record in field log book. If high concentrations are detected, take the appropriate measures as outlined in the Basewide Health and Safety Plan and the SSHP.
- Measure the static water level in the well with an electronic water level indicator as described in SOP 1 and record in the field logbook. Measure the total depth of the well to verify original construction details and determine if any appreciable fines have entered the well which may cause problems during sampling and/or potential problems with the analytical data. The water level indicator will be rinsed with deionized water in between individual wells to prevent cross-contamination.
- Calculate the volume of water in the well in gallons according to the Well Purge and Water Quality Field Data Sheet (Figure 2-1). This sheet is a typical well purge data sheet that will be used in the field to perform well volume calculations. The information required for the calculation includes well depth (measured from top of casing to bottom of well), well casing

diameter, static water level (measured from top of casing) and the borehole diameter. Table 2-1 lists quick conversions for water volumes.

Monitoring Well Purge Procedures

Non Low-Flow Well Purging Procedure

- Purge three to five well volumes of water from the well using one of the methods described below:
  - Pump with a submersible pump equipped with a check valve to avoid backflush and polyethylene tubing. For a non-dedicated system, set intake at the surface level of the groundwater and start pump; continue to lower the intake line through the well to just above screen depth ensuring that all standing water in the well has been purged. If the system is dedicated, it is not necessary to move the intake from it's set position.
  - Pump with a centrifugal pump and polyethylene tubing. For a non-dedicated system, set intake at the surface level of the groundwater and start pump; continue to lower the intake line through the well to just above screen depth ensuring that all standing water in the well has been purged. If the system is dedicated, it is not necessary to move the intake from its set position. Discard the suction line after each well unless the tubing is dedicated.
  - Bail well with a stainless steel or Teflon® bailer and Teflon®-coated stainless steel wire. Hand bailing the monitoring well is not a highly recommended purge method and should only be utilized as a last resort.
- Measure and record temperature, pH, specific conductance, turbidity, dissolved oxygen and ORP as each volume of groundwater is purged.
- After purging, allow the static water level to recover to approximately 80% of its static level or for 16 hours after purge completion, whichever comes first.
- When a well is pumped dry before three to five well volumes have been purged, the sample will be collected as soon as a sufficient amount of water has re-entered the well.
- Obtain the sample from the well after the required volume of groundwater has been purged and the temperature, pH, specific conductance, dissolved oxygen, ORP and turbidity have stabilized according to the stabilization requirements on Table 2-1. If the parameters do not stabilize within 3 to 5 well volumes the client should be notified and the well should be considered for additional purging or redevelopment.

Low-Flow Purging with Dedicated Submersible Pumps

- The pump intake shall be set at the bottom of the screened interval of each well where the depth to water (DTW) is within the screened interval. Where the DTW is above the screened interval, pump intakes shall be set at the top of the screened interval.

- Begin purging at a rate of approximately one liter per minute or as slow as the conditions and dedicated system allow (if greater than one liter per minute).

- Continuously monitor the water level and potential subsequent drawdown with an electric water level indicator. If the static water level prior to purging is within the screened interval, the drawdown shall not exceed a distance of 25 percent of the length of the saturated screened interval. If the water level falls below the 25 percent drawdown level, the pumping rate should be decreased to stabilize the water level to prevent cascading and potential loss of volatiles, excessive turbidity and entrapment of air in the filter pack. If the static water level is above the screened interval, acceptable drawdown is defined as the lowering of the water level to the top of the screened interval. If continued drawdown occurs below the top of the screened interval, the pump rate will be decreased to stabilize the water level to prevent atmospheric contact with the filter pack and formation, which could alter redox chemistry of the well.

  Note: In wells with slow recharge rates, it may be necessary to stop the pump and allow the well to recharge in order to remain at or above the drawdown limit. If this is necessary, be certain not to allow any water in the tubing to backflush into the well and when purging recommences start at a slower rate to avoid increasing turbidity.

- Purging will be considered complete when a minimum of one saturated screen volume, calculated according to the formula presented in Table 2-1, has been removed and the groundwater quality parameters have stabilized according to the stabilization requirements (Table 2-1).

- In the event the pump seizes and locks up during purging or sampling activities and it is necessary to jiggle or move the pump within the well, the purging will be re-initiated beginning with the first step of this procedure.

Low-Flow Purging with Non-Dedicated Submersible Piston Pumps

- Prior to deploying the pump, it shall be decontaminated in accordance with procedures specified in SOP 3, Equipment Decontamination. If sample collection tubing is non-dedicated, it shall also be decontaminated prior to deployment.

- Collect an equipment blank as described in the Field Sampling Plan.

- Measure the static water level in the well.

- If the DTW is within the screened interval set the pump intake at the bottom of the screened interval. If the DTW is above the screened interval the pump intake shall be set at the top of the screened interval.

- Begin purging at a rate of approximately one liter per minute or as slow as the conditions and dedicated system allow (if greater than one liter per minute).

- Continuously monitor the water level and potential subsequent drawdown with an electric water level indicator. If the static water level prior to purging is within the screened interval, the drawdown shall not exceed a distance of 25 percent of the length of the saturated screened interval. If the water level falls below the 25 percent drawdown level, the pumping rate should be decreased to stabilize the water level to prevent cascading and potential loss of volatiles, excessive turbidity and entrapment of air in the filter pack. If the static water level is above the screened interval, acceptable drawdown is defined as the lowering of the water level to the top of the screened interval. If continued drawdown occurs below the top of the screened interval, the pump rate will be decreased to stabilize the water level to prevent atmospheric contact with the filter pack and formation, which could alter redox chemistry of the well.

  Note: In wells with slow recharge rates, it may be necessary to stop the pump and allow the well to recharge in order to remain at or above the drawdown limit. If this is necessary, be certain not to allow any water in the tubing to backflush into the well and when purging recommences start at a slower rate to avoid increasing turbidity. See section on Low-Flow Purging of Wells with Low Recharge.

- Purging will be considered complete when a minimum of one saturated screen volume, calculated according to the formula presented in Table 2-1, has been removed and the groundwater quality parameters have stabilized according to the stabilization requirements (Table 2-1).

- In the event the pump seizes and locks up during purging or sampling activities and it is necessary to jiggle or move the pump within the well, the purging will be re-initiated beginning with the first step of this procedure.

Low-Flow Purging with Non-Dedicated Submersible Piston Pumps in Wells with Low Recharge Rates

- The pump intake shall be set approximately two feet above the bottom of the well.

- Measure the static water level in the well.

- Begin purging at a rate of approximately one liter per minute or as slow as the conditions and dedicated system allow (if greater than one liter per minute) until a minimum of one well casing volume is removed or the water level reaches the pump intake, whichever occurs first.

- Allow static water level to recover to approximately 80 percent of its static level or for 16 hours after purge completion, whichever occurs first.

- When sufficient time has passed, measure the water level to confirm 80 percent recharge.

- In the event that the pump is withdrawn from the well decontaminate the exterior of the pump and submerged portion of the tubing bundle with an Alconox® wash and deionized water rinse. Collect an equipment blank prior to redeployment of the pump system.

- Set the intake of the pump at the bottom of the screened interval, pump at a low flow rate and collect groundwater quality parameters for temperature, pH, specific conductance, turbidity, dissolved oxygen and ORP at 0.25 gallon intervals. Monitoring will continue until the groundwater quality parameters have stabilized according to the stabilization requirements presented in Table 2-1. **Note: The drawdown shall be monitored continuously during purging and shall not exceed a level less than one foot above the pump intake.**

- Prior to collecting samples, the volume of sample and the volume of the tubing bundle shall be calculates. If the volume of the tubing bundle exceeds the volume of the samples to be collected by more than one gallon the pump may be lowered to a minimum of two feet above the bottom of the well.

- Once readings have stabilized and the pump has been lowered (if the criteria for lowering is satisfied) commence sample collection. Continue to monitor drawdown during sample collection. In the event that the water level reaches a depth of 1 foot above the intake, pumping shall cease until the well has recharged to a level adequate to fill more sample bottles completely.

Low-Flow Purging with Non-Dedicated Submersible Bladder Pumps

- Prior to deploying the pump, it shall be decontaminated in accordance with procedures specified in SOP 3, Equipment Decontamination. If sample collection tubing is non-dedicated, it shall also be decontaminated prior to deployment.

- Collect an equipment blank as described in the Field Sampling Plan.

- Measure the static water level in the well.

- Lower probe to desired drawdown control level.

- Connect compressed gas source (compressed gas cylinder or compressor) to controller to control the timing and delivery of pressurized gas to the bladder pump and the flow rate of water to the surface. Connect controller to the pump supply fitting on the well cap.

- Connect pump discharge tube to flow-through cell inlet tube, turn power on, and verify collection of desired parameters and time interval.

- Follow controller instructions to set desired flow rate.

- Begin purge flow while monitoring to ensure drawdown level is not exceeded. If drawdown limit is exceeded, reduce flow rate as needed. In general, the flow rate goal is a rate equal to or less than the well's recovery rate while remaining within the drawdown limits

- Monitor purge water quality at the flow-through cell, watching for all stabilization parameter readings to stay within the selected limits for the required time period.

- Follow manufacturer specifications and procedure to determine when purging is complete, taking into account purge flow rate and purge cell volume. Attachment 1 outlines the procedure for low-flow bladder pump for one manufacturer as an example.

Sample Collection

- Sample collection will be with a low-flow submersible pump. Flow rates for sampling with low-flow pumps shall be maintained at 1 liter per minute or less.

- Sample containers shall be labeled prior to sample collection.

- Samples for volatile organic analysis shall be collected first. The samples shall be carefully filled to avoid overflow and potential loss of preservative and tapped so entrapment of air is minimized and no head space exists. If bubbles appear, the vial will be refilled.

- Samples for non-volatile organic analysis shall be collected following the volatile organic sample collection. If field filtration is not performed the sample container must be clearly marked to state "laboratory filtration required".

- Place analytical samples in a cooler and chill to 4 degrees Celsius. Samples will be shipped to the appropriate laboratory within 24 hours. The sample cooler shall be shaded from direct sunlight immediately after collection.

Post-Sample Collection Requirements

- Re-lock well cap.

- Fill out field logbook, sample log sheet, custody seals and Chain-of-Custody forms. Example copies of these forms are included in the QAPP

- Decontaminate purging and sampling equipment according to the procedures specified in SOP 3.

References for Other Applicable ASTM Standards

ASTM D4750 – Determining Subsurface Liquid Levels in a Borehole or Monitoring Well

Figure 2-1. Well Purge and Water Quality Data Sheet

Well Purge and Water Quality Field Data Sheet

Page 1 of _____

Project: _____ Well No: _____

Project No.: _____

Date: _____ *Samplers:* _____

Time Start: _____

Time Finish: _____ Checked by: _____

Well Information

Depth to Water: _____ ft. Casing Diameter: _____ in. = _____ ft. Casing Stickup: _____ ft.

Bottom of Screen: _____ ft. Borehole Diameter: _____ in. = _____ ft. Screened Interval: _____ ft.

Sample Depth: _____ ft. Saturated Screen Well Volume: _____ gallons

Drawdown Limit: _____ ft. Calculations: Casing Volume (CV) = $\pi (cr^2) h$ (7.48)

Note: All depths measured from top of casing.

Filter Pack Volume (FPV) = $\pi (br^2 - cr^2)[BS-(TS \text{ or } H)] P$ (7.48)

Saturated Screen Well Volume = CV + FPV

Calculation Notes: cr = casing radius; h = bottom of screen – depth of water in ft.; If TS>H use TS, if TS<H use H

br = borehole radius; P = estimated porosity of filter pack (35%); BS = bottom of screen

H = depth to water; TS = top of screen

Field Equipment

pH Meter: _____ Serial No.: _____ Water Level Meter: _____ Serial No.: _____

Conductivity Meter: _____ Serial No.: _____ Turbidity Meter: _____ Serial No.: _____

Temperature Meter: _____ Serial No.: _____ Bailer: _____ Size: _____

Sample Equipment (check one)

☐ *Submersible Pump* *Pump Type (circle one):* *Piston* *Bladder* *Impeller*

☐ *Disposable Teflon Bailer* *Pump Model:* _____

Serial No.: _____

Field Chemistry

pH ____ = @ _____ °C pH ____ = @ _____ ºC pH ____ = @ _____ ºC Time _____

Conductivity Standard: _____ µmhos/cm @ 25ºC Reading _____ µmhos/cm @ ____ ºC Time _____

Turbidity Standard: _____ N.T.U. @ 25ºC Reading _____ N.T.U. @ _____ ºC Time _____

Figure 2-1. Well Purge and Water Quality Data Sheet (Concluded)

Water Quality Field Data Sheet

Page 2 of _____

Project: _____ Well No: _____

Project No.: _____

Date: _____ *Samplers:* _____

Time Start: _____

Time Finish: _____ Checked by: _____

Field Chemistry (cont'd)

Time	Volume gallons	Temp. ºC	pH	Conductivity µmhos/cm	Turbidity N.T.U.	Dissolved Oxygen	Oxidation/ Reduction Potential	Comments

Table 2-1. Quick Conversions for Water Volumes

Conversions for low flow purge volumes

Monitoring well casing only

Size	Conversion	
2”	0.17	Multiply the height of the water column in the well (Bottom of screen - DTW)
4"	0.65	Multiply the height of the water column in the well (Bottom of screen - DTW)
5"	1.02	Multiply the height of the water column in the well (Bottom of screen - DTW)
6"	1.47	Multiply the height of the water column in the well (Bottom of screen - DTW)

Note: With a dedicated system, where the water is above the top of screen multiply the conversion by the screen length. With a non-dedicated system the whole water column must be included in the calculation.

Monitoring well casing/Borehole size configuration

2”/6”	0.46	Multiply the occluded screened interval only to get additional volume in gallons
2”/8”	0.86	Multiply the occluded screened interval only to get additional volume in gallons
4"/8"	0.69	Multiply the occluded screened interval only to get additional volume in gallons
4”/10”	1.20	Multiply the occluded screened interval only to get additional volume in gallons
4”/12”	1.83	Multiply the occluded screened interval only to get additional volume in gallons
5"/8"	0.56	Multiply the occluded screened interval only to get additional volume in gallons
5"/10"	1.071	Multiply the occluded screened interval only to get additional volume in gallons
5"/12"	1.70	Multiply the occluded screened interval only to get additional volume in gallons
6"/12"	1.54	Multiply the occluded screened interval only to get additional volume in gallons

Add the two results together to obtain the saturated casing volume in gallons.

Water quality stabilization parameters:

Parameters are stabled after 4 consecutive readings are within the ranges listed below:

The pH range is 6.5 – 8.5. Check meter calibration if current readings are outside this range.

Ensure the water quality meter pH is calibrated with either the 4.0/7.0 or 7.0/10.0 pH standard.

Stabilization Requirements

Temp.	pH	Cond.	Turbidity	Dissolved Oxygen	ORP
± 1°C/2°F	± 0.1 units	± 3 % µmhos/ cm	<10 NTUs or ± 10% when <10 NTUs cannot be achieved	± 0.3 mg/L	± 10 millivolts
	6.5 - 8.5				

Miscellaneous Notes

3.785 Liters = 1 gallon

ATTACHMENT 1

MICRO PURGE basics QED

First in Control & Power For Low-Flow Sampling

Low-Flow Purging Procedure with MicroPurge Basics Equipment

SEVERN TRENT SERVICES

QED ENVIRONMENTAL SYSTEMS
P.O. Box 3726, Ann Arbor, MI 48106-3726 USA www.qedenv.com
(800) 624-2026 734-995-2547 Fax: 734-995-1170 info@qedenv.com

Part No. 2269 REV. # 5-21-01

CONTENTS

MICRO PURGE basics QED

MicroPurge® low-flow sampling offers important advantages over traditional purging and sampling methods, and can benefit many groundwater monitoring programs. It requires three basic steps:

1. Set the purge flow rate;
2. Control drawdown in the well;
3. Stabilize the purge water quality indicator parameters.

MicroPurge basics™ is a revolution in low-flow sampling control. The complete line of new MicroPurge basics products, combined with proven Well Wizard® pumps, will help you through all three steps with equipment that is easier to use, smaller, lighter, more powerful, and lower priced too!

MicroPurge basics™ means you can choose your own system - with the control and power to match your site requirements

Every MicroPurge basics component is complete, ready to use, and engineered for rugged field duty. The whole system is designed to let you choose the control and power options that fit your site needs now, with flexibility to meet future requirements.

Microprocessor-based control with water-level feedback and exclusive monitoring devices delivers the most accurate, precise samples you can get, assuring you consistent, repeatable data and eliminating most regulatory hassles.

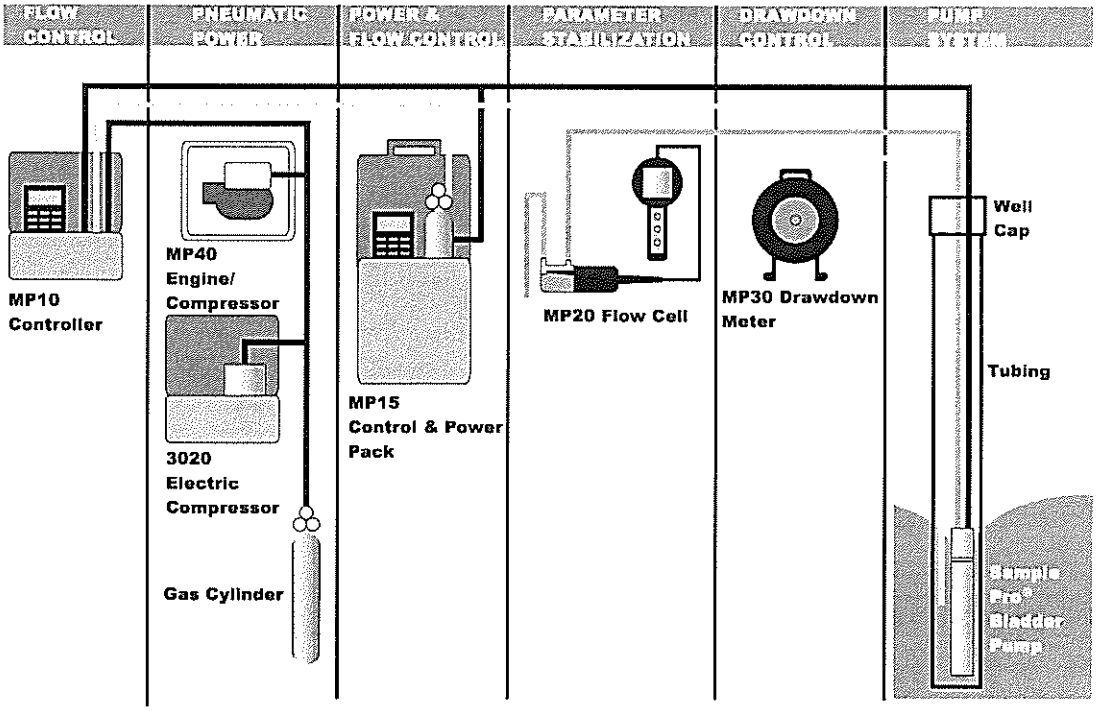
Low-flow Purging Procedure with MicroPurge basics Equipment

The following procedure is intended as an overview of typical operations at the well with MicroPurge **basics** equipment. This procedure assumes that all of the equipment is fully prepared with respect to battery condition, calibration and PurgeScan setup of the flow cell and charging of any compressed gas cylinders. Full detail is provided in the individual manuals for each product.

Summary:

1. Measure static water level with MP30 Drawdown meter.
2. Set MP30 probe at desired drawdown limit.
3. Connect compressed gas source (compressed gas cylinder or compressor) to MP10 or MP15 MicroPurge **basics** controller then connect controller to the pump supply fitting on the well cap.
4. Connect pump discharge tube to MP20 Flow Cell inlet tube, turn MP20 power ON, and verify that PurgeScan setup includes desired parameters and time interval.
5. Follow controller instructions to set desired flow rate; if drawdown limit is exceeded, reduce flow rate as needed to stay within limit.
6. Initiate PurgeScan on MP20 Flow Cell and write down data storage location #.
7. Watch for MP20 sound and flashing display indicators of stabilization, then begin sample collection.

MicroPurge Basics System Overview



Detailed Procedure:

Water Level

1. Determine static water level with MP30 Drawdown Control Meter power switched **"ON"** and Drawdown Control mode switched to **"OFF" (see Figure 1 below)**.

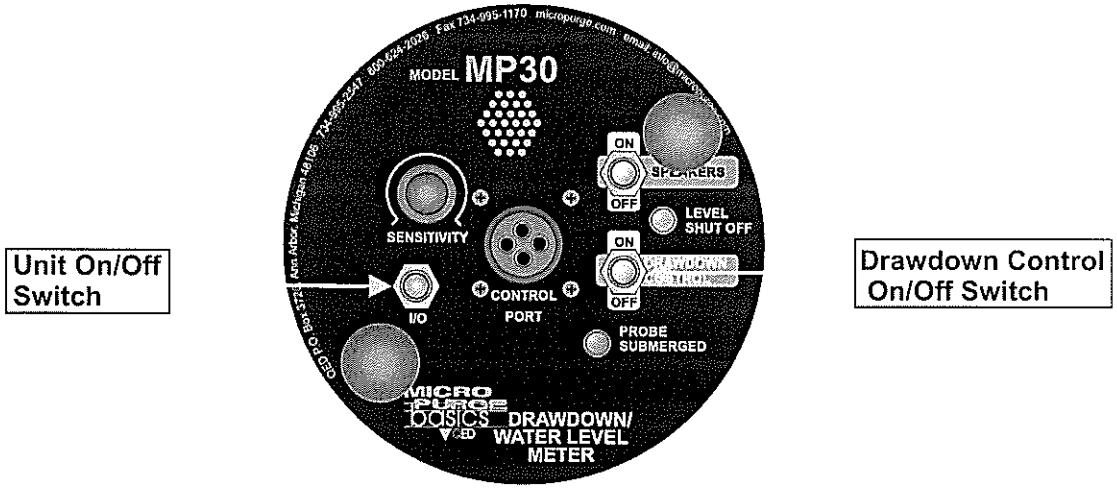


Figure 1
MP30 Control Panel

2. When well purging is to begin, switch the MP30 Drawdown Control switch to **"ON"** and lower the probe to desired drawdown control level.

Purge Flow

3. Connect the MP30 to the MicroPurge **basics** controller with the cable provided **(See Figure 2 below)**.
4. Connect MicroPurge **basics** controller (MP10 or MP15) to pump air supply fitting on the well cap **(See Figure 2 below)**.
5. Connect the pump discharge tube to the MP20 Flow Cell inlet tube **(See Figure 2 below)** and press the MP20 Power "ON" [o|] key.

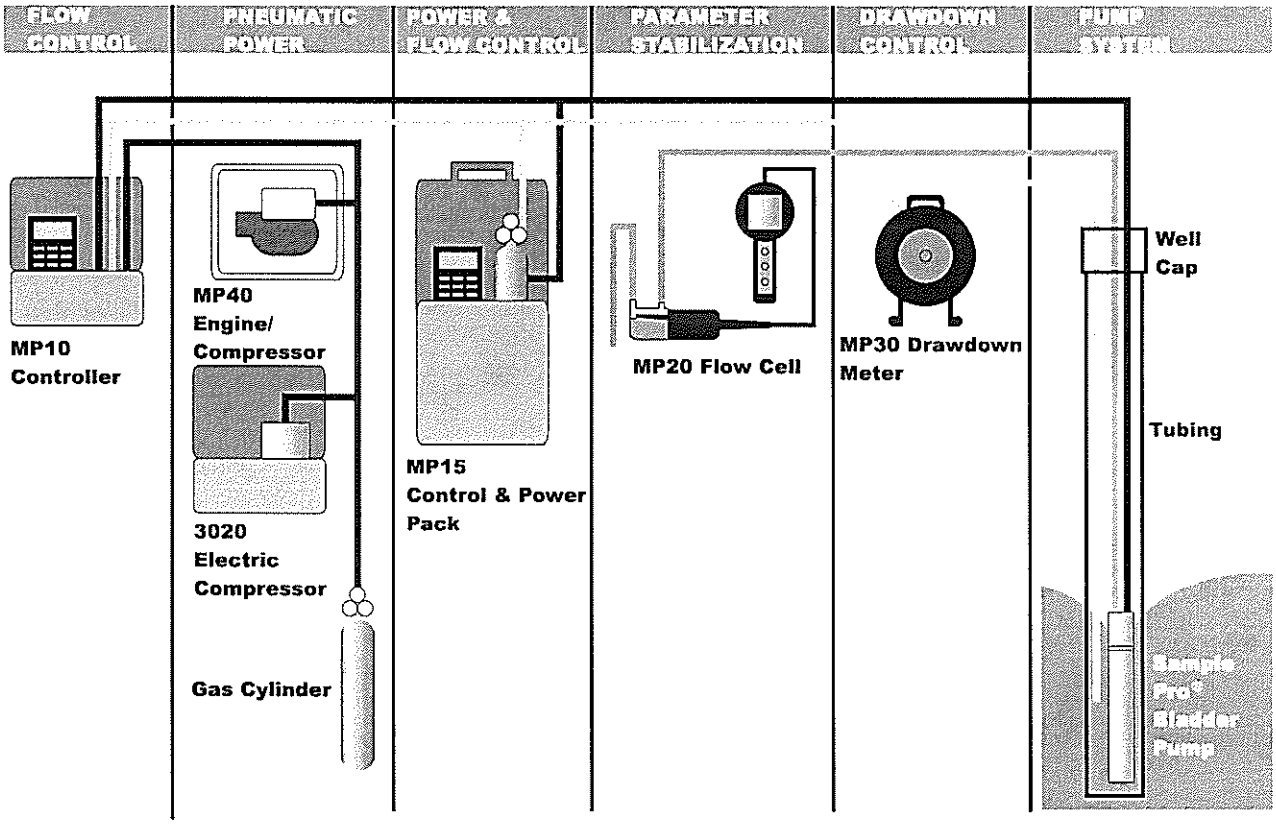


Figure 2
Basic System Diagram

6. Press **basics** controller power **"ON"** ⏻ key **(see Figure 3 below)**.
7. On **basics** controller, select desired Cycles Per Minute (CPM) with ◀▶ arrow key (default value is 4 CPM, lower CPM for deeper wells, higher CPM possible with shallow wells) **(see Figure 3 below)**.

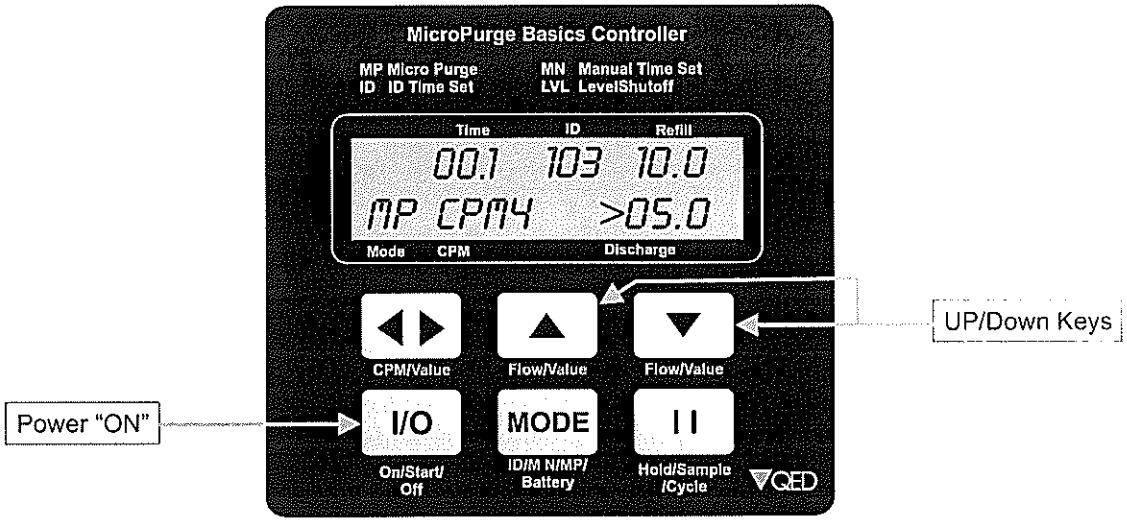


Figure 3
MP10 Keypad

8. Turn **basics** controller throttle to set depth on gauge to 10-20 feet deeper than the pump location in the well **(see Figure 4 below)**.

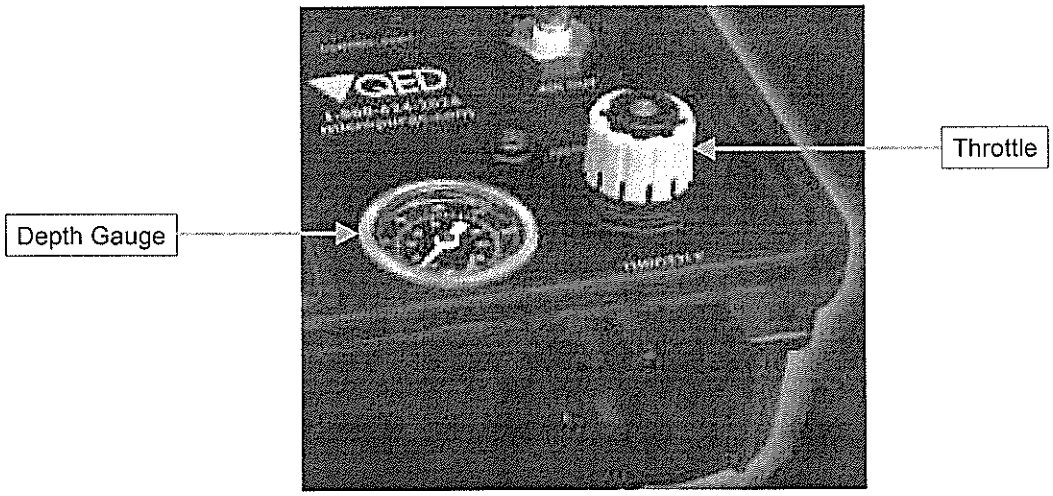


Figure 4
MP10 Throttle and Gauge

9. Press **basics** controller **"ON"** ⏻ key **(see Figure 3 above)** again to start pumping.
10. When water discharge begins, adjust throttle until a slow, steady flow-stream is achieved.
11. Press **basics** controller **"UP/DOWN"** keys **(see Figure 3 above)** to set the desired purge flow rate.

12. The MP30 Drawdown Meter will automatically signal the controller to pause pumping if the probe is no longer submerged, and will also activate the buzzer and the **"Level Shutoff"** (see Figure 4 below) light.
13. If the water level in the well recovers and reaches the probe, the **basics** controller will resume pump operation and the MP30 **"Probe Submerged"** light (see Figure 4 below) will activate
14. If the drawdown level exceeds the selected drawdown limit point too consistently, the flow purge flow rate can be further decreased with adjustment of the controller through one or more presses of the flow **"DOWN"** arrow key (see Figure 5 below). If the flow rate is already at or near a minimum desired rate, in some cases it may be also possible to lower the probe to a new, lower drawdown control point to increase the well recovery rate. Consult the site Sampling and Analysis Plan and regulatory guidance before adjusting purging protocols.

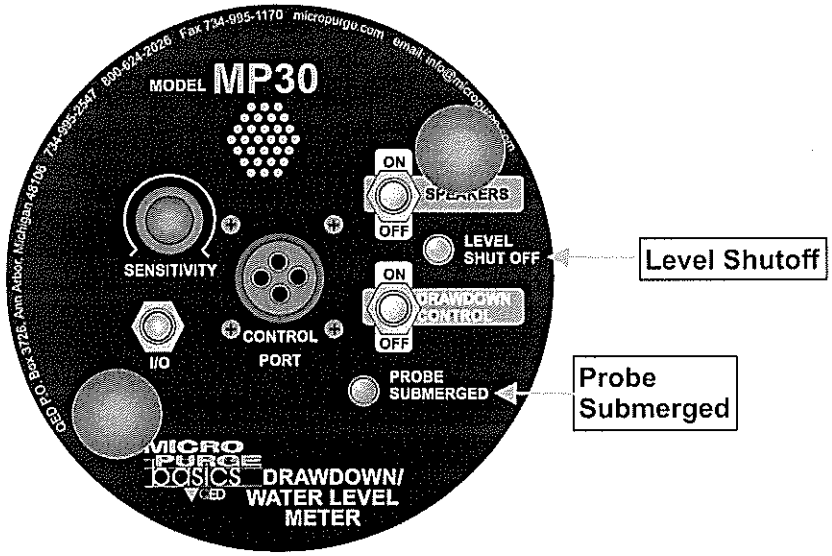


Figure 4
MP30 Control Panel

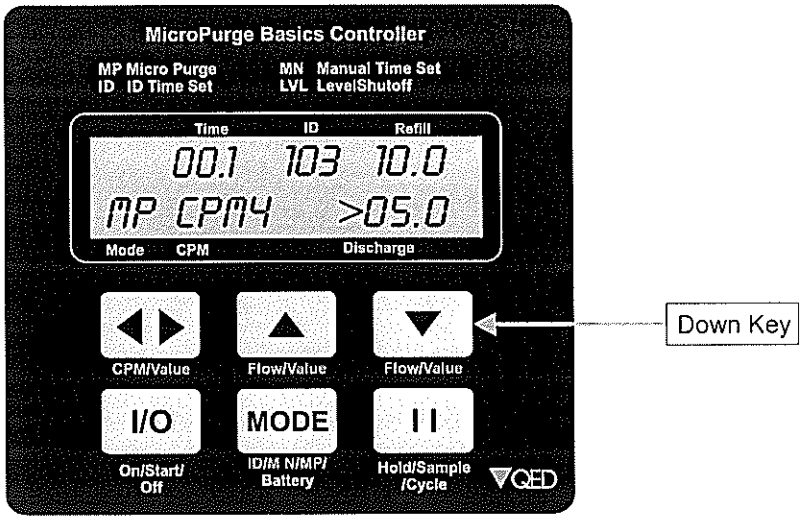
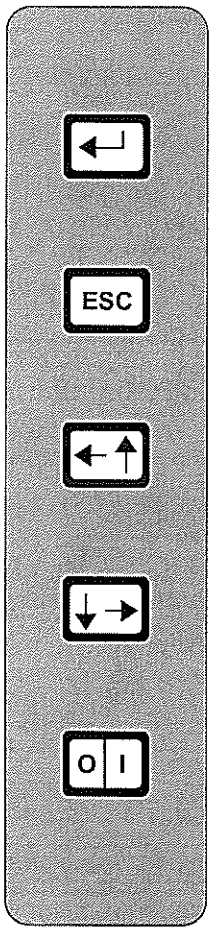


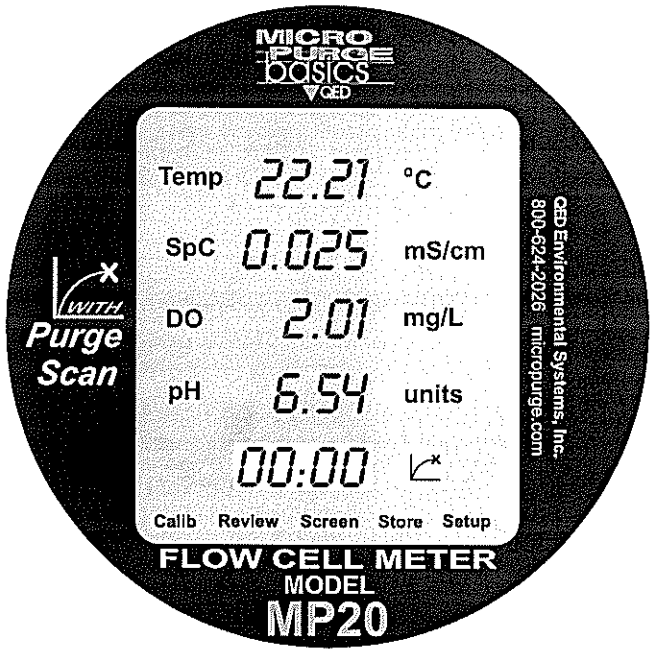
Figure 5
MP10 Keypad

Purge Water Quality Stabilization

15. When the final purge rate is achieved, record the ID value and pressure settings from the MP10/MP15 controller, then initiate PurgeScan on the MP20 Flow Cell by pressing the "**RIGHT**" [↓→] arrow key once to highlight "**STORE**", then pressing "**ENTER**" [↵]. This begins a PurgeScan stabilization cycle, starting at 00:00 elapsed time at the bottom **(See Figure 6 Below)** of the MP20 display, including automatic storage of key data frames. If it is desired to restart PurgeScan, press "**ESC**" [ESC], then "**RIGHT**" arrow [↓→] and "**ENTER**" [↵] again.



MP20 Keypad



MP20 LCD Display

Figure 6

16. Record the data frame Index value from the lower left corner of the MP20 display; this identifies the initial, "**TIME ZERO**" data set of each PurgeScan event, used for later review of stored data.
17. Monitor the MP20 display for the beeping and the flashing PurgeScan icon which signal that three successive readings at the selected time interval were within the stabilization range for selected parameters. Purging is complete and sampling can begin.

Overview on Drawdown, Purge Flow and Stabilization Settings

Drawdown Control Point Selection

The amount of drawdown permissible must be determined for each well on site, and may be affected by federal, state and local regulations or guidance applicable to the site. Once this is determined, the Drawdown Control probe can be positioned using several approaches. First, it can be lowered directly to the point of maximum desirable drawdown and kept in place. Secondly, it can be periodically raised from the set point to detect any changes in water level, then lowered again. Finally, it can positioned just part of the distance to the maximum drawdown point, for quicker feedback of the response between purge flow rate and drawdown. For example, if 10 inches of maximum drawdown is desired, the probe could be initially lowered to just 5" or less below the static water level. Then, if purge flow exceeds well recovery, this imbalance will be signaled more quickly than in waiting for the whole 10" to be drawn down, and purge flow can be reduced sooner to achieve equilibrium of purge flow with well recovery.

Flow Rate Selection

In general, the flow rate goal in low-flow rate sampling is a rate equal to or less than the well's recovery rate while staying within the drawdown limits. Minimizing drawdown reduces the impact of sampling on the aquifer, and helps minimize turbidity and drawing water from different zones than during undisturbed conditions. Actual flow rates typically range from 100ml/min to 1000ml/min. Within this range, if acceptable, higher flow rates allow faster filling of large volume sample containers. In all cases the flow rate should follow applicable regulations and existing sampling plans.

Purge Stabilization

The most common water quality parameters used to determine purging stabilization are dissolved oxygen (DO), specific conductance, and pH; ORP (redox) and turbidity are less commonly used, and arguments exist against their value for this purpose. The MP20 uses the following, fixed ranges as the basis for determining stabilization in the PurgeScan mode:

Stabilization Parameter	Stabilization Range
pH	.2 units
DO	0.2 mg/l
Conductivity	0.020 mS/cm
ORP (Redox)	20 millivolts

The time interval used to determine stabilization with PurgeScan should take the purge flow rate and purge cell volume into account. In general, the minimum PurgeScan time interval setting should be equal to or greater than the time required to replace the internal volume of the flow cell, 175 ml. On this basis, a one-minute or greater interval should be used with purge flow rates of 175 ml/min and higher. A purge flow rate of approximately 90 ml/min would require a time interval of 2 minutes or greater. A 50 ml/min flow rate would require use of a 4 minute interval. A more conservative approach would be to select an interval that allows two or three cell volumes to be purged between readings.

Low-flow Purging Procedure with Other Equipment

This procedure assumes use of a conventional water level meter, pump and control systems other than MicroPurge **basics**, and conventional flow cell instrumentation.

1. Measure static water level.
2. Select maximum drawdown level and lower probe to this level.
3. Adjust purge flow to initial target level, and monitor flow periodically to watch for changes in rate.
4. Begin purge flow, while monitoring continued alarm signals from water level meter to make sure drawdown level is not exceeded.
5. Begin to monitor purge water quality, watching for all stabilization parameter readings to stay within the selected limits for the required time period. Continue to observe the water level meter for excess drawdown.

CONTACT INFORMATION

For additional assistance contact QED Service at:

Phone:	1-800-624-2026 1-734-995-2547
Fax:	1-734-995-1170
E-mail:	service@qedenv.com
24-Hour Service Hot Line:	1-800-272-9559

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SOP 3 Equipment Decontamination

The objective of field decontamination is to remove contaminants of concerns from sampling, drilling and other field equipment to concentrations that will **not** impact study objectives. This SOP was developed for use by field personnel who are responsible for cleaning sampling or other equipment in the field.

Specification for Decontamination Materials

- Use a standard brand of phosphate-free laboratory detergent, either liquid or powder, preferably Liquinox® or (Alconox®).

- Use tap water from any municipal water treatment system or use bottled drinking water. Soap and tap water will remove the gross contamination from the sampling equipment.

Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated, thereby jeopardizing the validity of the sample data. Containers should be constructed of the proper materials to ensure their integrity. The following containers should be used for storing the specified cleaning materials:

- Soap—Keep in clean containers until use. It should be poured directly from the container into the wash bucket or tub.

- Tap water—Keep in clean tanks, hand-pressure sprayers, or squeeze bottles, or apply directly from a hose.

- Deionized water—Store in clean containers that can be closed when not in use. It may be applied from squeeze bottles.

Decontamination of Large Equipment

The following procedure will be used to decontaminate large pieces of equipment, such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. This procedure shall also be employed for the decontamination of heavy machinery such as backhoes, excavators, etc.

- Wash the external surfaces of equipment with high-pressure hot water and Liquinox® or Alconox® or equivalent non-phosphate, laboratory-grade detergent. If necessary, scrub until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The inside surfaces of equipment which come in direct contact the media being sampled will also be washed as described above. Specific decontamination instructions will be included in the project-specific addenda.

- Rinse with potable water.

- This decontamination procedure will be performed before equipment is used and between each well or other sampling locations.

Decontamination of Sampling Equipment

The following procedure will be used to decontaminate devices such as split-spoons, bailers, sample trays, spatulas, spoons and augers that come in direct contact with the sample media:

- Wash and scrub equipment using tap water and laboratory detergent. Wire or plastic bristle brushes can be used.
- Rinse with tap water, removing all visible dirt and soap residue.
- Rinse with deionized water.
- Place onto clean plastic sheeting and allow to completely air dry.
- If not used immediately, wrap in aluminum foil.

Decontamination of sampling equipment will be kept to a minimum in the field and, whenever possible, dedicated sampling equipment will be used. Decontamination fluids will be disposed as required by the project specific addenda to the Waste Management Plan (WMP). Personnel directly involved in equipment decontamination will wear appropriate personal protective equipment as specified in the Basewide Health and Safety Plan and the SSHP.

Whenever possible, decontamination pads provided by Cannon AFB should be used to clean large equipment. In other instances, a decontamination pad may need to be constructed at the investigation site.

Construction of a Decontamination Pad

Decontamination pads constructed in the field should meet the minimum specifications described below:

- The pad should be constructed in an area known or believed to be free of surface contamination. A temporary pad should be lined with a water impermeable material with no seams within the pad. The material should be either easily replaced (disposable) or repairable.
- The location of the pad should be out of the work zone and situated not to interfere with other work in progress.
- The pad should not leak excessively. Any sump or pit should be lined.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above the ground surface to prevent equipment for being splashed and re-contaminated.
- Water collected on the pad will be containerized and disposed of as per the IDW Disposal Plan. Small amounts of water will be left to evaporate.

Personal Protective Equipment

Personnel directly involved in equipment decontamination shall wear appropriate PPE as specified in the Basewide Health and Safety Plan (Appendix F of the BWP) and the SSHP. The appropriate PPE is selected based on the level of contamination present or suspected at the site. Care should be taken so the selected PPE protects decontamination workers from unnecessary contact with soils or decontamination fluids. The following is a list of the minimum PPE required to perform decontamination activities:

- Safety glasses with splash shields or goggles and latex gloves will be worn during all cleaning operations. For decontamination activities involving large amounts of water, rain suits or aprons and rubber over-boots should also be worn.

No eating, smoking, drinking, chewing, or any hand-to-mouth contact should be permitted during cleaning operations.

References for Other Applicable ASTM Standards

ASTM D5088 – Decontamination of Field Equipment Used at Nonradioactive Waste Sites

ASTM D5608 – Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites

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Appendix D
Field Forms

WELL GAUGING DATA FORM

CLIENT: _____ **RECORDED BY:** _____

SITE: _____ **INTERFACE PROBE NO.:** _____

PROJECT NO.: _____ **INTERFACE PROBE CORRECTION:** 0 ft.

DATE: _____ **WEATHER:** _____

WELL NUMBER	WELL DIAMETER (INCHES)	WELL DEPTH FROM TOP OF CASING (FEET)	TOP OF CASING ELEVATION (FEET)	DEPTH OF WELL FROM TOP OF CASING (FEET)	DEPTH TO WATER FROM TOP OF CASING (FEET)	DEPTH TO PRODUCT FROM TOP OF CASING (FEET)	PRODUCT THICKNESS (FEET)	SCREENED INTERVAL FROM TOP OF CASING (FEET)	COMMENTS (WATER IN MANHOLE, LOCK OR CAP MISSING, PURGE AMOUNT)
Wells to be monitored and sampled:									

BGS = Below Ground Surface

REMARKS: _____

Water Quality Field Data Sheet

Project: ____________________ Well No: ____________________

Project No.: ____________________ ____________________

Date: ____________________ *Samplers:* ____________________

Time Start: ____________________ ____________________

Time Finish: ____________________ Checked by: ____________________

Field Chemistry (cont'd)

Time	Volume gallons	Temp. ºC	pH	Conductivity (µmhos/cm)	Turbidity N.T.U.	Dissolved Oxygen	Oxidation/ Reduction Potential	Comments