DEPARTMENT OF THE AIR FORCE
27TH SPECIAL OPERATIONS MISSION SUPPORT GROUP (AFSOC)
CANNON AIR FORCE BASE NEW MEXICO

ENTERED

JAN 25 2011

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Ms. Patricia Stewart
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East Bldg 1
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Dear Ms. Stewart

Attached is the Revised Facility-Wide Long Term Groundwater Monitoring Plan, December 2010 Version, Cannon Air Force Base, New Mexico, for your review and approval. The revised document incorporates responses to discrepancies presented in a letter from Mr. James Bearzi, Chief, Hazardous Waste Bureau, New Mexico Environment Department, dated November 24, 2010.

If you have any questions regarding this submittal, please contact Mr. Ronald Lancaster, Chief, Asset Management Flight, at (575) 784-1146.

Sincerely

STEVEN A. KIMBALL, Colonel, USAF

Attachment:
Facility-Wide Long Term Groundwater Monitoring Plan

cc:
New Mexico Environment Department, Mr. David Cobrain w/o Attachment
Environmental Protection Agency, Region VI, Ms. Wendy Jacques w/o Attachment

FACILITY-WIDE LONG TERM GROUNDWATER MONITORING PLAN

CANNON AIR FORCE BASE, NEW MEXICO

January 2011

Prepared For
AFCEE/TDV
Building 171
2261 Hughes Avenue, Suite 155
Lackland AFB, Texas 78236-9853
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ACRONYMS

ACC	Air Combat Command
AFCEE	Air Force Center for Engineering and the Environment
AFSOC	Air Force Special Operations Command
AOC	Area of Concern
bls	below land surface
°C	degrees Celsius
CAFB	Cannon Air Force Base
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cm	centimeter
cm/sec	centimeters per second
COC	Contaminants of Concern
CSM	Conceptual Site Model
DTW	depth to water
DOD	Department of Defense
DQO	Data Quality Objective
EIAP	Environmental Analysis Impact Analysis Process
EPA	United States Environmental Protection Agency
ERP	Environmental Restoration Program
ERPIMS	Environmental Resources Program Information System
ERPTools	Environmental Resources Program Tools
ft	feet
ft/mi	feet per mile
gal/ft	gallons per foot
gpm	gallons per minute
HSWA	Hazardous and Solid Waste Authority
IDW	Investigation Derived Waste
in/yr	inch per year or inches per year
LF	Landfill
Lee Wan	Lee Wan and Associates
LTM	Long term monitoring
MCL	Maximum Contaminant Level
m/m	meters per meter
m^3/m	cubic meters per meter
mg/L	milligrams per liter
msl	mean sea Level
N	nitrogen
NFA	No Further Action
NM	New Mexico
NMED	New Mexico Environment Department
NMGWQS	New Mexico Ground Water Quality Standards
NOV	Notice of Violation
NTU	Nephelometric Turbidity Units
ORP	oxidation-reduction potential
PCB	Polychlorinated Biphenyl
PID	Photo Ionization Detector
Plan	Facility-Wide Long Term Groundwater Monitoring Plan
POL	Petroleum, Oils, and Lubricants
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act
Report	Facility-Wide Groundwater Monitoring Report
RFI	RCRA Facility Investigation
SOP	Standard Operating Procedure

ACRONYMS (continued)

SPCC	Spill Prevention, Control, and Countermeasures
SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbon
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VOC	Volatile organic compound
WQCCR	Water Quality Control Commission Regulations
µg/L	microgram per liter
µmhos/cm	micro mhos per centimeter

EXECUTIVE SUMMARY

This Facility-Wide Long Term Groundwater Monitoring Plan (Plan) for Cannon Air Force Base, New Mexico (CAFB) is a dual purpose document that includes a Work Plan for comprehensive groundwater monitoring and a basewide Conceptual Site Model (CSM) to aid in decision-making. The Plan proposes a groundwater monitoring well network that encompasses all existing monitoring wells associated with the four Solid Waste Management Units (SWMUs) previously identified as requiring biennial monitoring (Landfill 03 [LF03]/SWMU105, LF04/SWMU104, LF25/SWMU97, and the Sewage Lagoons/SWMU101), and includes wells associated with LF05/SWMU113. The Plan also includes sampling locations at the Base boundary hydraulically upgradient and downgradient from base activities to monitor groundwater quality entering and leaving the Base. The Plan also includes potential areas where additional monitoring wells are proposed based on proposed future land use. Currently the General Plan for CAFB development is only in draft form and decisions regarding additional wells will be made after the general plan is made public and finalized. In all, 18 existing monitoring wells are included in the monitoring network. Inspection and maintenance of the covers at Landfills 3, 4, and 25 and the Sewage Lagoons will be incorporated into the groundwater monitoring efforts as will annual monitoring well inspection and water level measurements.

The Plan includes the proposed sampling locations, wells, parameters, and frequency. The Plan was developed in accordance with the requirements of the CAFB Hazardous and Solid Waste Amendments (HSWA) Permit (EPA ID No. NM7572124454-1 dated 14 October 2003) and is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Environmental Impact Analysis Process (EIAP) 32 CFR 989. The Air Force is the lead agency. The New Mexico Environment Department (NMED) is the regulatory agency. Once approved, the Plan will constitute the agreed upon Basewide Monitoring Plan for CAFB. As regulatory status of SWMUs change, amendments to this Plan may be required to accommodate change in status.

CAFB is located approximately seven miles west of the town of Clovis in Curry County, New Mexico, and covers approximately 3,782 acres. Historically, CAFB dates from 1929 when Portair Field was established on the site as a civilian passenger terminal for early commercial transcontinental flights. In 1942, the Army Air Corps took control of the civilian airfield, and it became known as the Clovis Army Air Base. In early 1945, the Base was renamed Clovis Army Air Field. Flying, bombing, and gunnery classes continued through the end of World War II. The installation was deactivated in May 1947, but was formally reactivated in November 1951 as Clovis Air Force Base and renamed CAFB in 1957. Recently, the Base has transitioned from an Air Combat Command (ACC) base and is now an Air Force Special Operations Command (AFSOC) base.

The CSM for CAFB can be summarized as follows: To support the primary mission of CAFB, quantities of petroleum (fuels), oils, and lubricants (POL); solvents; explosives used in training; fire suppressants; pesticides; herbicides; metals; and protective coatings were used resulting in waste generation. Sewage treatment and landfill disposal also have occurred. These types of wastes have been generated and disposed of at CAFB since the beginning of industrial operations in 1942. Industrial operations included jet engine repair, pneumatic and hydraulic systems maintenance, aerospace ground equipment maintenance, corrosion control, vehicle maintenance shops, and the non-destructive inspection lab.

CAFB is situated on a nearly flat, gently sloping plain. The most prominent geomorphic features are playas, which are natural depressions. One playa has been used to collect stormwater runoff from the jet runways and another was used to store treated water from the sewage lagoons. CAFB overlies the Ogallala Formation which is the primary regional aquifer and extends across parts of southeast New

Mexico and northwest Texas. Below the Ogallala is Triassic red sandstone that serves as a basal confining unit for the saturated Ogallala, referred to as the Southern High Plains aquifer. Water levels in the aquifer have been dropping due to pumping for irrigation. At CAFB, groundwater levels have declined approximately 44 feet (ft) since the 1930's and is now about 300 ft below ground surface. Numerous nearly continuous to discontinuous caliche layers occur in the thick unsaturated zone, but may be thin or absent below playas.

At CAFB, soil has been the primary contaminated media and for the most part has been remediated. Transport to groundwater is limited by the depth to the saturated zone of over 200 ft, the semiarid climate, and the presence of caliche layers. Also, the underlying Ogallala formation contains clay minerals that attenuate contaminants by adsorption. The apparent impact to groundwater from CAFB activities appears to be limited to nitrate in seepage from the now-closed sewage lagoons. The continuous source of water previously provided by the sewage lagoons would have provided a hydraulic head that allowed water movement through the unsaturated zone. Since the sewage lagoons have been closed, the source of nitrate-contaminated water no longer exists and concentrations in wells in the vicinity have decreased.

In addition to the CSM, the Plan includes development of Data Quality Objectives (DQOs), data analysis and reporting requirements. The DQOs include wells to sample, frequency of sampling, analytical testing parameters, and data analysis methods. Also included in the Plan are reporting requirements and database management procedures. Based on the DQOs and CSM, the Plan supersedes the existing monitoring plan for four SWMUs. The existing plan consists of eight wells: LF03/SWMU105 – Well Oa; LF04/SWMU104 – Well Na; LF25/SWMU97 – Wells Pa and Ra; and the Sewage Lagoons/SWMU101 - Wells E, F, G, and H. The Plan proposes including existing wells A, B, C, D, S, and U (associated with LF05/SWMU113); and Wells V, X and W (hydraulically upgradient) and T (downgradient) from Base activities. Thus, the Plan is increased from eight wells to 18 wells to be sampled biennially, which expands the program from monitoring four SWMUs to Basewide monitoring.

Maintenance, monitoring, and decommissioning logic diagrams are presented to guide decision making. As data are collected and comparisons are made to historical values and action levels, it is probable that the monitoring frequency can be decreased while still remaining protective. Analytical testing parameters described in the Plan include: volatile organic compounds, metals, perchlorate, selected anions, selected cations, total organic carbon and field parameters. A control chart approach to data analysis is presented to identify sample results requiring scrutiny that could be related to releases. Requirements for a database containing all results, including groundwater levels, are presented.

1 INTRODUCTION

In a letter dated 20 January 2010 (Appendix A), New Mexico Environment Department (NMED) requested Cannon Air Force Base (CAFB) identify a groundwater monitoring well network, prepare a basewide Conceptual Site Model (CSM), and prepare a Facility-Wide Long-Term Groundwater Monitoring Plan (Plan). The Plan is to include all existing monitoring wells associated with the four Solid Waste Management Units (SWMUs) previously identified (Tetra Tech EC, 2009) as requiring biennial monitoring (Landfill 03 [LF03]/SWMU105, LF04/SWMU104, LF25/SWMU97, and the Sewage Lagoons/SWMU101), and must include LF05/SWMU113 wells (NMED, 2010). The Plan is also to include sampling locations at the Base boundary hydraulically upgradient and downgradient from base activities to monitor groundwater quality entering and leaving the Base (conference call with NMED representatives on August 3, 2010). Once approved, this Plan will replace the existing Long Term Monitoring and Maintenance Work Plan (Tetra Tech EC, 2009) approved by NMED in August, 2009.

This Plan is a dual purpose document that includes a basewide CSM and long term groundwater monitoring work plan, including the proposed sampling locations, wells, parameters, and frequency. This Plan was developed in accordance with the requirements of the CAFB Hazardous and Solid Waste Amendments (HSWA) Permit (EPA ID No. NM7572124454-1 dated 14 October 2003) and consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Environmental Impact Analysis Process (EIAP; 32 CFR 989). The Air Force is the lead agency. NMED is the regulatory agency. Once approved, the Plan will constitute the agreed upon Basewide Monitoring Plan for CAFB. As regulatory status of SWMUs change, amendments to this Plan may be required to accommodate change in status.

1.1 Conceptual Site Model

This CSM was developed to provide an overview of conditions and factors across the Base which may impact or influence the presence and potential migration of contaminants. The purpose of the CSM is to provide the basis for identifying potential pathways and receptors that may be impacted by hazardous waste generated as part of the mission of CAFB. This will ensure that the monitoring wells included in the Plan are located appropriately to fulfill the Plan's purpose of protecting human health and the environment.

1.1.1 Location and General Description

CAFB is located approximately seven miles west of the town of Clovis in Curry County, New Mexico, and covers approximately 3,782 acres. Figure 1 shows the location of the Base. CAFB dates from 1929 when Portair Field was established on the site as a civilian passenger terminal for early commercial transcontinental flights. In 1942, the Army Air Corps took control of the civilian airfield, and it became known as the Clovis Army Air Base. In early 1945, the Base was renamed Clovis Army Air Field. Flying, bombing, and gunnery classes continued through the end of World War II. The installation was deactivated in May 1947. It was formally reactivated in November 1951 as Clovis Air Force Base and renamed CAFB in 1957. Recently, the Base has transitioned from an Air Combat Command (ACC) base and is now an Air Force Special Operations Command (AFSOC) base. A plan view of CAFB is provided in Figure 2.

1.1.2 Physiology, Geology, and Hydrogeology

CAFB is situated in the Southern High Plains Physiographic Province near the center of the Llano Estacado subprovince. This area is a nearly flat plain sloping gently (10 to 15 feet per mile [ft/mi]) to the east and southeast. In the vicinity of CAFB, elevations range from 4,250 feet (ft) to 4,350 ft above mean sea level (msl). The most prominent geomorphic features in the vicinity of CAFB are broad, widely spaced valleys and shallow depressions called “playas”. Playas are wide-spread across the area and may originate from collapse at the surface due to dissolution-induced subsidence of underlying Permian evaporite-bearing strata (Paine, 1994) or due to leaching and wind deflation (Sabin and Holliday, 1995). During periods of rainfall, runoff collects in the playas to form ephemeral lakes. Playas have no external surface drainage. Water is lost by infiltration to the soil and evaporation. Without recharge, water in playa lakes persist for only a few days or weeks (CH2M Hill, 1983).

Surface water streams are non-existent in the CAFB vicinity. Running Water Draw (Figure 1), located approximately 10 miles north of the Base, is the nearest drainage feature and it is dry most of the time. Stream drainage of the plateau is very poorly developed because of the low annual rainfall and lack of relief. Drainage patterns generally consist of long, shallow valleys with almost no tributaries, such as Running Water Draw. These valleys, sloping to the east and southeast, eventually enter the valley of one of three major rivers: the Red, the Brazos, and the Colorado. However, the Southern High Plains area does not generally contribute to stream flow except during rare periods of excessive rainfall. Water is lost to evapotranspiration and shallow infiltration before it has a chance to run off (CH2M Hill, 1983).

Historically, surface runoff at CAFB has drained into four natural, ephemeral playas. The two northern playas were converted into plastic-lined golf course ponds (Foster Wheeler Environmental Corporation, 2001). The southern playa occupies approximately nine acres south of the intersection of the main jet runways and is approximately 15 ft deep. Since 1943, stormwater runoff from the flightline has collected in this playa where it either evaporates or percolates into the soil (Walk, Haydel & Associates, Inc., 1988). The eastern playa, known as “Playa Lake”, was bermed on the north, west, and south sides with topsoil and concrete debris. It covers approximately 13 acres and received treated effluent from the Sewage Lagoons (Figure 2) (Woodward Clyde, 1994).

The subsurface geology at CAFB includes the Permian (undifferentiated), Chinle, Ogallala, and Blackwater Draw Formations. The Permian Formation consists predominantly of red shale, siltstone, sandstone, gypsum, anhydrite, dolomite, bedded salt, and local limestone beds (Gutentag and others, 1984). Dissolution of more soluble beds, such as salt or anhydrite, may be responsible for playa formation (Paine, 1994). The Chinle Formation, referred to as Triassic red beds due to their color and geologic age, represent the greatest depth penetrated by wells in the CAFB vicinity; therefore, the formation thickness in the vicinity of CAFB is not known (CH2M Hill, 1983). The thickness of the Chinle Formation ranges from 0 to 400 ft in eastern New Mexico (McGowen et al, 1977, as referenced in Langman et al, 2006). The Chinle dips to the east and consists mostly of clay with some intermixed sand and silt (Langman et al, 2006). In the area of CAFB, the Ogallala Formation unconformably overlies the Chinle Formation (Gutentag et al, 1984). Figure 3 provides a generalized section of geologic units in the CAFB area.

The Ogallala Formation underlying CAFB dips gently and monoclinally to the southeast. Drillers' logs from CAFB indicate that the Ogallala Formation varies from 360 ft to 415 ft in thickness. The underlying Triassic strata were eroded prior to deposition of the Ogallala Formation. The incised upper surface of Triassic redbeds strongly influences Ogallala thickness. Paleovalleys eroded in the upper post-Triassic unconformity are deep and trend dominantly east-west, so that Ogallala thickness may vary significantly over short north-south distances. The formation is composed of unconsolidated, poorly sorted gravel, sand, silt, and clay and its internal stratigraphy varies vertically and horizontally over short distances. Coarser material was deposited in the paleochannels, and finer sediments were deposited in the interchannel areas so the base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Clays are found as a trace to abundant matrix mineral. Smectites (montmorillonites) and attapulgite are the dominant clays throughout the Ogallala and illite and kaolinite are also found (Lee Wan and Associates [Lee Wan], 1990; Langman et al, 2006).

The Blackwater Draw Formation of Quaternary age generally overlies the Ogallala Formation at CAFB and is composed mostly of aeolian sand deposits. It ranges in thickness from 0 to 80 ft in eastern New Mexico (Langman et al, 2006) and is estimated to range from 0 to 25 ft thick at CAFB (Radian, 1986). A caliche layer is typically present in the unsaturated zone of the Blackwater or Ogallala Formations in New Mexico (Langman et al, 2006). Geologic logs recorded at the Base indicate that caliche occurs as shallow as 2 ft below land surface (bls) and isup to 54 ft in thickness (CH2M Hill, 1983). Caliche occurs as numerous nearly continuous to discontinuous layers throughout the Ogallala Formation, but may be thin or absent below playas. Caliche forms as calcium carbonate which is leached from overlying sediments and precipitates in the pore space of the host sediments due to the evaporation of downward percolating water. The upper caliche layer that crops out around playas is typically 3 to 5 ft thick. Caliches which occur lower in the Ogallala are platy and harder than the upper caliche layer (Lee Wan, 1990).

The Blackwater Draw Formation and upper part of the Ogallala Formation are not saturated at CAFB. The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. Water quality is generally good, with hardness and fluorides being somewhat high (Lee Wan, 1990). No deeper aquifers are utilized for groundwater production in the vicinity of CAFB. The Ogallala aquifer is part of the Southern High Plains Aquifer which extends across parts of southeast New Mexico and northwest Texas (Tillery, 2008), which in turn is part of the larger High Plains Aquifer that extends continuously from Wyoming and South Dakota into New Mexico and Texas (McGuire, 2004). CAFB is underlain by the portion of the aquifer designated the Curry County Underground Water Basin (Tillery, 2008). The Ogallala is a water table, or unconfined aquifer with the underlying Chinle redbeds serving as the basal confining layer in eastern New Mexico. Well yields vary from less than one gallon per minute (gpm) in thin silts and sands to as much as 1,600 gpm in thick sands and gravels.

The Ogallala aquifer has a southeasterly regional hydraulic gradient of approximately 17 ft/mi (0.0032 meters per meter [m/m]; URS, 2009) and a similar local southeasterly hydraulic gradient of approximately 0.003 m/m (Figure 4). The general direction of groundwater flow in the CAFB area is from northwest to southeast but some localized changes have occurred due to the decline in water levels in the Southern High Plains aquifer. These changes are illustrated on Figure 5, which shows groundwater elevations and the general direction of groundwater flow in the CAFB area for 1962, 1967, 1977, 1987, and 1997. Groundwater elevation data collected in October 2008, indicate the continuing decline in groundwater levels (Figure 4), which is due to withdrawal of groundwater from the Ogallala aquifer by pumping for agricultural use (Langman et al, 2006; Tillery, 2008).

At CAFB, the depth to groundwater has increased and is now approximately 300 ft. The saturated thickness and other properties of the Ogallala aquifer are influenced by the pre-Ogallala depositional topography of the Triassic redbeds (Radian,1986), Saturated thickness ranged from 93 to 143 ft in 1990 (Lee Wan, 1990) and continues to decrease. Between 1937 and 1978, groundwater levels declined approximately 23 to 24 ft in the vicinity of CAFB (CH2M Hill, 1983). Between 1994 and 2005, groundwater elevation changes of as much as 32.6 ft were measured, with an average decline of approximately 12 ft across the Base (Langman et al, 2006). Groundwater measurements taken in 2008 (Tetra Tech and Brown, 2008) indicate that groundwater elevations have declined on average an additional 9.5 ft since 2005. Thus, the saturated thickness is continuing to decline at a rate of over 2 ft/year. These declining water elevations have necessitated replacement of some monitoring wells by wells with deeper screened intervals.

Yields in tests of CAFB water wells have ranged from 205 gpm to 1150 gpm. Figure 6 shows the locations of the nine on-base water supply wells. Specific capacities range from 0.14 cubic meters per meter (m^3/m; 11.4 gallons per foot [gal/ft]) to 0.35 m^3/m (27.9 gal/ft; Lee Wan,1990). Hydraulic conductivity was estimated to be 2.0 x 10^{-3} centimeters per second (cm/sec) based on pump tests of production wells 5 and 9 and of 2.0 x 10^{-2} cm/sec based on water level recovery at production well 8 (Lee Wan, 1990). Slug tests in wells MW-N and MW-O yielded hydraulic conductivities of 3.0 x 10^{-3} cm/sec (Woodward Clyde, 1997).

Cannon AFB is located within a semiarid region where the average precipitation [17.9 inches/year (in/yr) in Clovis] is much less than the evaporation (110 in/yr) (Tillery, 2008). While recharge to the Southern High Plains Aquifer has been estimated to range from 0.01 in/yr to 1.71 in/yr, most estimates are less than 1 in/yr (CH2M Hill, 1983; Langman et al, 2006 and included references). An investigation of chloride concentrations and moisture content of soil at Cannon AFB indicated that most recharge occurs through areas of focused recharge, such as playas and stormwater detention areas and that interplaya areas contribute little recharge (Falk, 2005 as cited in Langman et al, 2006). Caliche inhibits the downward percolation of moisture and provides evidence that evaporation exceeds precipitation and percolation does not reach the water table in many areas of the Base.

Discharge from the Ogallala occurs through groundwater pumping, mainly for irrigation. Figure 6 shows off-base water supply wells. Acres of irrigated cropland increased in Curry County from 3,000 acres in 1950 to a peak of 222,200 acres in 1990. By 1953, groundwater withdrawals in the New Mexico part of the Southern High Plains Aquifer had already greatly exceeded groundwater recharge and water levels were declining (Tillery, 2008). Declines in water levels at and surrounding CAFB are attributed to groundwater pumping. The closest water supply well for the municipality of Clovis, New Mexico (NM) is six miles to the north of the base. Additional wells for Clovis are located at least nine miles to the south and southeast. The shallowest well screen depth for the municipal supply wells is 320 ft.

1.1.3 Geochemistry

Chemical data and field parameters for groundwater have been collected at the monitoring wells and production wells shown on Figure 2 (except for MW-J and production wells 4, 7, and 9). Data collected between 1994 and 2008 were evaluated to interpret geochemical conditions. These data indicate that groundwater typically has a neutral pH and dominantly oxidizing conditions that are favorable for metals attenuation. The data are summarized below:

- Neutral to alkaline pH (range of 6.7 to 9.7; median and average values of 7.6)
- Dominantly oxidizing conditions:
    - Dissolved oxygen concentrations ranging from 0.7 to 13.5 milligrams per liter (mg/L; 5.7 mg/L median and 5.4 mg/L average values).
    - Detectable nitrate[1] (as nitrogen [N]) concentrations ranging from less than 0.01 to 27.9 mg/L (1.7 mg/L median and 3.4 mg/L average values). Nitrite was detected in concentrations ranging from 2.5 to 9.2 mg/L at wells in the Sewage Lagoon/ Playa Lake area in 1999; however, concentrations decreased to <0.1 mg/L in more recent (2004 and 2005) sampling.
    - Relatively low total organic carbon concentrations with only 4 percent of values of 2 mg/L or more. Over half of the measurements were less than the detection limit of 1 mg/L.

[1] Includes both nitrate as N and nitrate plus nitrite as N; nitrite as N values were mainly 0.01 mg/L or less so not considered significant except in the Sewage Lagoon areas.

Values greater than 2 mg/L occurred in the Sewage Lagoon/ Playa Lake area in 1996; however, concentrations decreased to 1.5 or less in later (1997, 1998, 2006) sampling.
    - Less than 1 mg/L total iron in all but four percent of samples. Iron concentrations have consistently been less than 1 mg/L in more recent (since 2002) samples.
- Low to moderate total dissolved solids ranging from 300 to 1,230 mg/L (504 mg/L median and 543 mg/L average values).
- Low metals concentrations with the following maximum values in unfiltered groundwater samples: copper, 28 micrograms per liter (µg/L); lead, 13 µg/L; zinc, 690 µg/L. The zinc concentration at the same location was 24 µg/L in 2007. The well was not sampled in 2008.

The geochemical conditions are favorable for attenuation of metals. Additionally, clays are present in the Ogallala Formation. Smectite, in particular, and to a lesser extent, attapulgite and illite, have moderate to high cation exchange capacities (CEC). Therefore, the Ogallala as a whole should have a relatively high CEC, which should inhibit the migration of positively charged contaminants such as ionic forms of metals. Clays also adsorb many of the organic contaminants, such as pesticides and herbicides, thereby inhibiting their transport through the unsaturated zone.

1.1.4 History of Environmental Programs

CAFB began its restoration program in 1983 with a Phase I records search (CH2M Hill, 1983) followed by a Phase II confirmation/quantification study in 1986 (Radian, 1986). In 1987, the Base underwent a Resource Conservation and Recovery Act (RCRA) Facility Assessment (Walk, Haydel & Associates, Inc., 1988) following submittal of an application for a RCRA Part B Permit to store hazardous waste. NMED issued a RCRA Operating Permit effective December 17, 1989 (revised 2003). The HSWA module required investigation of 128 environmental restoration sites, referred to as SWMUs and Areas of Concern (AOCs) in the permit. The permit invoked the New Mexico requirements of 40 CFR 265 and 40 CFR 264, which required the permitted facility to perform groundwater monitoring for detection, assessment and compliance. NMED issued a notice of violation (NOV) in August 1989 citing that CAFB violated these groundwater monitoring requirements. CAFB and NMED signed a compliance agreement in July 1990 to establish a groundwater monitoring system and produce a sampling and analysis plan. In January 1996, NMED received authorization for corrective action under the HSWA and became the administrative authority for this action (CAFB, 2008a).

Removal actions have taken place at some CAFB sites to limit exposure risks and as voluntary actions. These actions include:

- 56 cubic yards of asbestos-containing material waste and 16,000 cubic yards of concrete rubble were removed from Landfill 25 (SWMU 97). The site was contoured to retain and control stormwater runoff and revegetated to minimize percolation through the landfill (Tetra Tech, 2009).
- Tilling and grass planting occurred at SWMU 34 in 1988 (URS, 2009).
- Underground storage tanks were removed at SWMU 6 and SWMU 10 in 1992 (CAFB, 2008b).
- The oil/water separator system and approximately 1,400 cubic yards of petroleum-contaminated soils were excavated during a removal action in 1994 in the SWMU 86-90 area (CAFB, 2008a).
- Two underground storage tanks were removed at SWMU 125 in 1996 (CAFB, 2008b).
- During 2003-2004, soils and sludge were removed from the former north sewage lagoon and consolidated into the former south sewage lagoon (SWMU 101). The south lagoon was closed using an engineered permanent cover with a biotic barrier (US Army Corp of Engineers [USACE], 2008).

- Approximately 340 cubic yards of petroleum-contaminated soil and 100 cubic yards of concrete debris were excavated from the area of SWMU 31 and the adjacent former wash pad in 2009 (Tetra Tech, 2010).

1.1.5 Extent and Distribution of Contaminants

To support the primary mission of CAFB, petroleum (fuels), oils, and lubricants (POL)); solvents; explosives used in training; fire suppressants; pesticides; herbicides; metals; and protective coatings were used resulting in waste generation (CAFB, 2006). These types of wastes have been generated at CAFB since the beginning of industrial operations in 1942. The major industrial operations that have occurred at the Base include jet engine repair, pneumatic and hydraulic systems maintenance, aerospace ground equipment maintenance, corrosion control, vehicle maintenance shops, and the non-destructive inspection lab. Routine Air Force operations have also involved use of pesticides, herbicides, and metals. Additionally, sewage treatment and disposal of materials in landfills have occurred (discussed in Section 1.3). Planning for future operations and uses of facilities is described in section 5. In conjunction with the CSM, this information provides a basis for locating monitoring wells in addition to the present base-wide monitoring network.

Field investigations for Environmental Restoration Program (ERP)/SWMU/AOC sites at CAFB have consisted of surface and subsurface soil drilling and sampling, surface water and groundwater sample collection, and sediment sampling at the Sewage Lagoons. Samples were analyzed for various chemical parameters based on the history of use for each site. The analyses performed depended on the site history and the sample location and have included total organic lead, polychlorinated biphenyl (PCB), pesticides, metals, semi-volatile organic compounds, (SVOCs), total petroleum hydrocarbons (TPH), total organic carbon, and target compound list volatile organic compounds (VOCs) (CAFB, 2006).

Twelve of the 143 sites at CAFB have yet to be investigated and two of these sites are in “Deferred” status because they remain active. Eight of the sites are newly identified sites and are currently in the early stages of investigation (sites C501, C502, C503, C504, C505, C507, C508, and C510). Of the new sites, four are associated with former underground storage tanks (USTs), two are associated with refueling yards, one site is an Aerospace Ground Equipment (AGE) Dispatch Facility, and one site is a surface disposal area. All eight of these sites have varying levels of total petroleum hydrocarbon (TPH) – gasoline range organic (GRO) contamination. In addition, one of these sites also has metals contamination and one site also has polychlorinated biphenyl’s (PCB) contamination. Additionally, SWMU 73, is a historic storm water drainage and retention pond which should have had limited use and is, therefore, expected to have limited TPH contamination. The other final site, SWMU 128, is a known area where an oil/water separator and leach field were located. TPH contamination at SWMU 128 is also expected to be limited because only system leaks or process upsets are expected sources of contamination. Remediation of all sites should be a simple “dig and haul” process followed by backfilling with clean, native soils. Of the remaining 131 sites 96 are closed or approved for closure, 28 are currently under field investigation and/or remediation, five are in Long-Term Management, and 14 are awaiting regulatory approval for closure[2]. Administrative action is still required to remove approximately 36 of these sites from the RCRA Permit.

The United States Geological Survey and other ERP contractors have been monitoring groundwater levels and quality through the long term monitoring program since 1994 at selected CAFB wells. Long Term Monitoring (LTM) has been conducted since 1994 at Landfill 5 (SWMU 113) and the Sewage

[2] Discrepancy of total site numbers is due to some sites being in more than one category. Also, SWMU status will change based on regulatory decisions.

Lagoons (SWMU 101), since 1996 at Landfill 4 (SWMU 104) and Landfill 3 (SWMU 105), and since 1997 at Landfill 25 (SWMU 97). Analytes measured include: cyanide, sulfide, organic carbon, major cations, perchlorate, trace metals, organic halogens, VOCs, SVOCs, dioxins and furans, polynuclear aromatics, organochlorine pesticides, polychlorinated biphenyls, chlorinated herbicides, dissolved solids, nitrate/nitrite, and sulfate. These data are currently available in data reports and are being assembled into an accessible database (discussed in Section 3.2).

The analytical data indicate that there has been very little impact to groundwater from base activities. From 2004 through 2007, there were 38,152 analyses for organic constituents in groundwater. The target constituent was only detected 276 times (0.7 percent) and less than 0.5 percent of the detections were greater than the analytical reporting limit. There have been three exceedances of the methylene chloride United States Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 5 µg/L, but no exceedances of the New Mexico Groundwater Quality Standard (NMGWQS) of 100 µg/L. There have been two exceedances of the phenol NMGWQS of 5 µg/L. There is no federal MCL for phenol. These isolated exceedances have not reoccurred since 2004, and may be due to laboratory error, or may have been introduced to the sample during collection or analysis (small concentrations of these compounds have been found in field-equipment- and method-blank samples on occasion) (Langman et al, 2006).

There were over 4,000 analyses for metals that have primary or secondary MCLs or NMGWQSs. Of these, 37 percent were detected, but only 18 percent of the detections were greater than the analytical reporting limit. Metals can be naturally occurring as part of aquifer material. Therefore, some of the detections may be due to the presence of particulates in the unfiltered groundwater samples (Langman et al, 2006). There were only five exceedances of primary drinking water standards: one exceedance of the selenium standard of 50 µg/L and four exceedances of the thallium MCL of 2 µg/L. The most recent exceedance occurred during a 2005 sampling event and has not reoccurred. The inorganic constituents chloride, nitrate, sulfate, and total dissolved solids have been detected in groundwater. Some exceedances of secondary MCLs or domestic water supply NMGWQS for chloride, sulfate, and total dissolved solids have occurred and may be due to their natural presence in groundwater. The primary nitrate (as N) MCL and NMGWQS for nitrate of 10 mg/L was exceeded at wells MW-G and MW-P associated with the Sewage Lagoons (SWMU 101). Nitrate concentrations decreased in groundwater near the Sewage Lagoons during and following decommissioning of the lagoons, and concentrations decreased to levels detected in groundwater in wells not affected by the infiltrated wastewater (Langman et al, 2006).

The most recent groundwater sampling was the biennial sampling event conducted on October 30 through November 14, 2008 (Tetra Tech and Brown, 2008). Monitoring wells associated with SWMUs 97, 104, and 105 were sampled. There was a single detection of an organic contaminant. Tetrachloroethene was detected at a concentration of 0.28 µg/L, which was less than the reporting limit. Several metals were detected, but at concentrations well below MCLs and NMGWQS. Nitrate concentrations did not exceed the groundwater standards.

The environmental issues under management by CAFB appear to be limited to surface and subsurface soil contamination, much of which has been addressed. Based on 15 years of groundwater monitoring, the impact to groundwater appears to have been limited to seepage from the Sewage Lagoons (SWMU 101). Groundwater monitoring indicates that this impact has dissipated. No additional corrective action is required at SWMUS 97, 104, or 105 (Landfill 25, Landfill 4, and Landfill 3) other than groundwater monitoring (NMED, 2007). No further action is required for SWMU 113 (Landfill 5).

1.1.6 Site-Specific Fate and Transport

At CAFB, soil has been the primary contaminated media, and for the most part has been remediated. Transport to groundwater is limited by the depth to the saturated zone of about 300 ft, the semiarid climate, and the presence of caliche layers. Also, the underlying Ogallala formation contains clay minerals that attenuate contaminants by adsorption.

The apparent impact to groundwater from CAFB activities appears to be limited to nitrate in seepage from the now-closed Sewage Lagoons. Nitrate is a conservative constituent under oxidizing conditions that moves with water and is only attenuated by nitrate-reducing conditions. The continuous source of water previously stored in the sewage lagoons and Playa Lake would have provided a hydraulic head that allowed movement of nitrate-containing water through the unsaturated zone. Since the sewage lagoons have been closed, the source of nitrate-contaminated water no longer exists and concentrations of nitrate in wells in the vicinity have decreased. The last exceedence of the EPA MCL of 10 mg/L as nitrogen occurred in March, 2000 (at a concentration of 11 mg/L.

1.1.7 Exposure Scenarios

CAFB is an integral part of the defense system of the United States; therefore, the Base will remain active for the foreseeable future. Use classification will continue to remain industrial in nature and measures will continue to be in place to be protective of human health and the environment. The current land use of off-base property surrounding the CAFB boundary is mainly agricultural, primarily for cattle and crops grown for cattle feed (CAFB, 2006). Groundwater beneath the Base does not discharge naturally through seeps or springs in the area and would not affect ecological receptors.

Risk assessments have been performed for many of the sites to evaluate potential impacts to human and ecological receptors and are key elements in determining the status of sites. Approximately 96 sites have been granted No Further Action (NFA) status by NMED and others are currently under review. NMED's determination that corrective action is complete at sites is based on reports submitted by CAFB that demonstrate no additional corrective action is required to protect human health and the environment. General criteria that NMED considers in making a determination of NFA include:

1. The site does not exist.
2. The site was not used for the management of hazardous constituents.
3. There was no release nor is there likely to be a release of hazardous constituents to the environment.
4. There was a release, but a release assessment indicates that the concentrations of hazardous constituents are at acceptably low levels as determined by regulators. The release assessment includes site characterization, release assessment sampling, and risk assessment.
5. There was a release, but the site was characterized and/or remediated under another authority, such as the New Mexico Underground Storage Tank Bureau, and documentation such as a closure letter is available. Regulation of a site by another authority is not necessarily sufficient justification for a determination for NFA.
6. There was a release, but the site has been remediated. Typically, the site would have been remediated by means of Voluntary Corrective Actions or Expedited Cleanups/ Voluntary Corrective Measures. After remediation, evidence should show that concentrations of hazardous constituents are at acceptable levels as determined by regulators.

As discussed in Section 1.1.5, all but 12 SWMUs have been investigated. Soil cleanup of these sites, if needed, and other sites where in progress, will meet residential or industrial criteria, as appropriate.

Exposure to groundwater has been, and continues to be, evaluated through long-term groundwater monitoring, such as described in this document. To date, monitoring has indicated that risks due to exposure to groundwater are minimal because there has been very little if any impact due to base activities. Movement of contaminants within the Ogallala Formation from soil or sediment is limited to the near surface based on subsurface investigation results. This limitation is due to the semi-arid climate, caliche layers in the subsurface, and depth to groundwater of approximately 300 ft. These factors all serve to inhibit contaminant transport to groundwater. Nitrate associated with the Sewage Lagoons (SWMU 101) appears to have reached groundwater because treated effluent was stored in Playa Lake. The combination of the hydraulic head provided by the treated effluent and apparent absence of caliche layers directly below the playa allowed vertical transport of nitrate. Unlike many other contaminants, nitrate does not attenuate readily due to adsorption so is more likely to be transported dissolved in subsurface water. Unlike many other contaminants, nitrate does not attenuate readily due to adsorption so is more likely to be transported dissolved in subsurface water.

Groundwater is used as the source of water supply for Clovis; however, the water-supply well closest to the Base is six miles north of CAFB. At this time, it is not known if residences near the Base receive water from the water supply company, American Water, or from another source that is nearer to CAFB.
The Sewage Lagoons were found to contain chemical concentrations that could pose some risk to waterfowl and aquatic organisms (Woodward Clyde, 1992). However, the lagoons were not intended for use as wildlife habitat and have been closed.

1.2 Existing Monitoring Wells

CAFB well construction details are provided in Table 1. A well inventory is scheduled for completion in Fall 2010. The well inventory will verify the location and integrity of each monitoring well.

1.3 SWMUs with Existing Monitoring Wells

Existing monitoring wells have been installed in association with the following five SWMUs.

1.3.1 Landfill 25 (SWMU 97)

Landfill 25 (LF-25) is an inactive construction rubble landfill in the east-central portion of CAFB. The former landfill covers a 32-acre area roughly trapezoidal in shape, located east of Perimeter Road and approximately 500 ft 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 ft in the northern portion of the unit. Most of the rubble piles are approximately 3 to 4 ft high. The oldest piles of rubble are present on the north and west sides of the landfill and are covered with grasses, shrubs, and small trees. A 2-ft high permanent earthen berm is present adjacent to the southern and eastern borders of the unit to prevent storm water 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 base is shown in Figure 2.

The current regulatory status of LF-25 is that of Corrective Action Complete with Controls. CAFB proposed that the SWMU be granted the status of Corrective Action Complete with Controls in the document titled Corrective Action Complete Proposals, Cannon Air Force Base, Clovis, New Mexico dated July 2008. NMED approved the proposal November 25, 2009. LF-25 requires continued groundwater monitoring to meet NMED long term monitoring requirements. Under the 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 1. Well Rb is scheduled to be installed to replace well Ra, which is going dry.

1.3.2 Sewage Lagoons (SWMU 101)

The former Sewage Lagoons are located in east-central portion of CAFB. The lagoon locations with respect to the surrounding Base are shown in Figure 2. 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 CAFB. Although sewage discharge to the lagoons stopped in 1998, the Base continued to discharge treated wastewater to the lagoons 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. A voluntary closure effort was completed in 2004 that included sludge removal from the former north lagoon, in-place consolidation in the former south lagoon, and closure using an engineered permanent cover with a biotic barrier (Tetra Tech EC, 2005).

The current regulatory status of SWMU 101 is Corrective Action Complete with Controls. The Final No Further Action Report for SWMU 101 - Sewage Lagoons is dated July 2008. In a 25 November 2009 letter, the NMED indicates that SWMU 101 is eligible for a Class III Permit Modification. In response to an NMED letter dated March 26, 2008, the *Long Term Monitoring and Maintenance Work Plan* (Tetra Tech EC, Inc., 2009) included sampling of four monitoring wells: MW-E (upgradient), MW-F, and MW-G (within the footprint of the Sewage Lagoon) and MW-H (downgradient) of the Sewage Lagoons. The locations of these wells are shown in Figure 2. Well construction details for wells MW-E, MW-F, MW-G, and MW-H are summarized in Table 1.

1.3.3 Landfill 4 (SWMU 104)

Landfill (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 CAFB and lies approximately 800 ft west of the ordnance area. It is bounded to the north by Perimeter Road, to the west by a barbed-wire fence, and to the east and south by a vacant field. 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 ft 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 Base is shown in Figure 2.

The current status of LF-4 is that of Corrective Action Complete with Controls. CAFB proposed that the SWMU be granted the status of Corrective Action Complete with Controls in the document titled Corrective Action Complete Proposals, Cannon Air Force Base, Clovis, New Mexico dated July 2008. NMED approved the proposal November 25, 2009. NMED approved the report in a letter dated December 5, 2007 that specified additional monitoring and inspection requirements for LF-04. In response to an NMED letter dated March 26, 2008, the *Long Term Monitoring and Maintenance Work Plan* (Tetra Tech EC, Inc., 2009) included biennial groundwater monitoring at monitoring well MW-Na and annual inspection and maintenance of the vegetative cover.

1.3.4 Landfill 3 (SWMU 105)

Landfill 3 (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 CAFB 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 ft 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 2.

Beginning in 1996, long term monitoring of 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 a replacement well MW-Oa was installed downgradient in February 2004 (Bhate, 2005). Groundwater at this site is currently being monitored at MW-Oa to meet NMED long term monitoring requirements. The well will be sampled on a biennial basis under the 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 1. No organic compounds or metals associated with former disposal activities at LF-03 have exceeded federal MCLs or NMGWQS. Chloride is the only target constituent to exceed screening criteria. The slight exceedance is attributed to background conditions.

The current regulatory status of LF-3 is that of Corrective Action Complete with Controls. CAFB proposed that the SWMU be granted the status of Corrective Action Complete with Controls in the document titled Corrective Action Complete Proposals, Cannon Air Force Base, Clovis, New Mexico dated July 2008. NMED approved the proposal November 25, 2009. In response to an NMED letter dated March 26, 2008, the *Long Term Monitoring and Maintenance Work Plan* (Tetra Tech EC, Inc., 2009) addressed biennial groundwater monitoring and annual inspection and maintenance of the vegetative cover.

1.3.5 Landfill 5 (SWMU 113)

Landfill 5 (LF-05) is a 70-acre inactive landfill located in the southeastern area of the Base. Cell No. 3 of LF-05, which is closed, is RCRA regulated because this cell received hazardous waste until mid-1981. From 1981 until the cell was closed in 1983, it did not receive additional hazardous waste. Closure consisted of placing an impermeable cap over Cell No. 3, in accordance with NMED and EPA requirements. Additional groundwater monitoring wells were installed in 1984 (Radian, 1986) and 1992 to meet RCRA release detection monitoring requirements.

The current regulatory status of LF-5 is that of a closed site. The Site appears in Table 2 of the 2006 HWSA Permit modification – List of Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) not Currently Requiring Corrective Action. In response to an NMED letter dated March 26, 2008 (NMED, 2008), the *Long Term Monitoring and Maintenance Work Plan* (Tetra Tech EC, Inc., 2009) included the sampling of six monitoring wells: MW-A (upgradient), MW-B, MW-C, MW-S, and MW-U (downgradient) and MW-D (side-gradient). The locations of the landfill and these monitoring wells are shown on Figure 2. Well construction details for the wells are summarized in Table 1.

2 LONG-TERM GROUNDWATER MONITORING

This Plan addresses the groundwater monitoring activities that will be performed at CAFB. The Plan was developed in accordance with the following: the requirements of the NMED as stated in the correspondence dated 20 January 2010 (Appendix A); a conference call with NMED representatives on August 3, 2010; the requirements of the CAFB HSWA Permit (EPA ID No. NM7572124454-1 dated 14 October 2003); CERCLA; and the EIAP (32 CFR 989).

2.1 Data Quality Objectives

Data quality objectives (DQOs) for the Plan are summarized in Table 2. In summary, the DQOs include:

- How to monitor for threats to human health and the environment (receptors) via groundwater;
- What contaminants to monitor, and how to assess results;
- What frequency to monitor and for how long;
- What procedures to follow if new sources of contamination are possible or detected; and
- How to monitor groundwater flow direction.

In general, existing monitoring wells will be sampled for metals (including Chromium III and Chromium VI), VOCs, perchlorate, nitrate/nitrite and field parameters biennially. This parameter set and a biennial sampling frequency approach is consistent with the existing Long Term Monitoring Plan (Tetra Tech EC, 2009). Close coordination with the laboratory will be maintained during the lab selection and throughout the project to ensure that lab PQLs for each analyte are lower than the MCLs or NMED water quality standards that the analytical results will be be compared to. If new groundwater monitoring wells are required, installation will proceed according to (19.27.4 NMAC, 8-31-2005). Prior to new monitoring well installation, work plans will be submitted for NMED review and approval. For all wells, results will be compared with MCLs or NMED water quality standards considering current land use and approved risk-based standards as described in this Plan. A control chart approach will be used to determine trends and set warning and response levels (EPA, 2009; Gilbert, 1987). Decision logic regarding well maintenance and decommissioning is shown in Figure 7. Decommissioning will be in accordance with 19.27.4 NMAC, 8-31-2005. If trends are stable or decreasing (see Figure 6), sampling frequency and the well network can be optimized (EPA, 2004), including decreasing the sampling frequency to a minimum of five year intervals, decreasing the number of wells to monitor, and modifying the analyte list. If threats to groundwater from new processes or actual releases occur, then the CSM (Section 1.1) will be revised to include the optimal monitoring process, based on the transport properties of the contaminants in the subsurface, the groundwater flow direction, and the exposure pathways. If concentrations of monitored contaminants exceed either the control chart response level or a regulatory action level, further assessment will be required to determine if the exceedence represents a release of contaminants to the environment. Further assessment may include the following: re-sampling and analysis to exclude false positive results, investigation into potential release mechanisms, adding additional analytes, or adding/ sampling additional wells.

2.2 Monitoring Requirements

The Plan includes monitoring of groundwater wells at four landfills (LF-03, LF-04, LF-05, LF-25), the former Sewage Lagoons (SWMU 101), and perimeter wells (T, V, W, and X). The monitoring events will initially be conducted on a biennial basis to be consistent with the existing plan (Tetra Tech, 2009). Decision logic diagrams for well maintenance, monitoring, optimization and eventual decommissioning are shown in Figure 7. The locations of the groundwater monitoring and Base production wells are shown in Figure 2. If new wells are installed, two years of quarterly sampling will be initiated (EPA, 2009). For all wells, a minimum of eight data points will be required to construct control charts.

Long term monitoring field activities will include water level measurements and groundwater sampling in accordance with the standard operating procedures (SOPs) described in Appendix B. As the regional water table continues to drop, existing monitoring well screen zones may no longer yield water and may require replacement. For example, well Ra is scheduled to be replaced with well Rb due to this issue.

2.2.1 Water Level Measurements

Water levels will be measured in each of the monitoring wells to be sampled as part of the Plan. Water levels will be measured and the condition of each monitoring well will be assessed on an annual basis. At each monitoring well, a decontaminated electric water level tape will be slowly lowered until the groundwater level is detected. The depth to groundwater will be measured from the top of the casing to the nearest 0.01 ft. The depth will be recorded. The groundwater elevation will be calculated for each monitoring well for use in developing a basewide potentiometric map for each sampling event. The potentiometric map will be updated and included in each report as discussed in Section 3. Based on the groundwater elevation and the screened interval of the individual wells, each well will be evaluated on an annual basis with regard to the decline in the regional groundwater table. When appropriate, plans will be developed and presented to NMED for review for monitoring well replacement if the screened interval has less than ten feet of water present.

2.2.2 Sampling Locations

Groundwater monitoring will be conducted at the following sites: Landfill No. 25 (SWMU 97), Sewage Lagoons (SWMU 101), Landfill No. 4 (SWMU 104), Landfill No. 3 (SWMU 105), Landfill No. 5 (SWMU 113) and at select locations located on the CAFB boundary. Perimeter wells will be utilized to monitor conditions both upgradient and downgradient of the installation boundary. A preliminary comprehensive list of all existing monitoring wells along with well construction details is provided in Table 1. A facility-wide monitoring well inventory and survey is planned for completion in the fall of 2010. The inventory will validate the location and condition of each monitoring well. Groundwater sampling for the facility-wide LTM will be focused on the 18 existing wells presented in Table 3. The table will be updated as new monitoring wells are added to the long term monitoring program. Wells V, W, and X are considered upgradient wells (as specified in the NMED letter dated January 20, 2010) and will document the quality of the groundwater flowing to the CAFB. The remaining wells included in this program were selected based on their associations with active SWMUs or their locations and projected longevity with regards to the regional groundwater flow direction and drop of water table elevation.

As activities at the Base are modified, additional groundwater monitoring wells may be installed at additional sites. The inclusion of additional monitoring wells into the long term monitoring program will be based on trends established during more frequent sampling periods. The construction details of any new monitoring wells will require consideration of the potential of a change in groundwater flow direction, a change in water table elevation, screen placement within the water table, and the capacity to accept dedicated sampling equipment. Potential areas for additional monitoring wells are shown in Appendix E and discussed below in Section 5.

2.2.3 Sampling Frequency

The initial sampling frequency is biennial for the monitoring wells included in this Plan and quarterly for newly installed monitoring wells. Biennial sampling of the existing well network was selected because analytical trends have been established from historical data. After trends are established and if appropriate, sampling frequency may be decreased to every five years. A Sampling Frequency Decision Diagram for determining the appropriate sampling frequency for each monitoring well in this program is shown in Figure 8.

2.2.4 Sampling Parameters

Groundwater samples will be sent for off-site laboratory analyses as listed in Table 3. Sample handling, analyses, and quality assurance/quality control procedures will comply with the *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 (Department of Defense [DOD], 2006); and attached SOPs (Appendix B). The groundwater data will be evaluated against current EPA MCLs and NMGWQSs (20 New Mexico Administrative Code 6.2). In the event that no evaluation criteria are listed for an analyte in the EPA MCLs or the NMGWQS, the results will be evaluated against the criteria for tapwater as specified in the Soil Screening Levels, (NMED 2009).

2.2.4.1 Field Parameters

Prior to collection of samples for laboratory analysis, field parameters will be collected from each monitoring well. Table 3 lists the field parameters to be collected.

2.3 Groundwater Sampling Procedures

The following subsections provide detailed groundwater sampling procedures. SOPs and field forms are provided in Appendix B and C, respectively.

2.3.1 Well Purging and Stabilization (Field Measurements, Calibration and Quality)

The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation being sampled while minimizing disturbance to the collected samples. Before a sample is taken, the well will be purged until a minimum of three consecutive readings of the field parameters have stabilized. All wells shall be purged on the same day that samples are taken. Evacuated well water shall be contained for proper disposal as investigation-derived waste (IDW) and necessary precautions shall be taken to prevent spilling of water.

Before well purging begins, the following procedures will be performed at each well:

- The condition of the outer well casing and concrete well pad and any unusual conditions of the area around the well will be noted in the field logbook.
- Clean plastic sheeting will be placed around the well.
- The well will be opened.
- Appropriate readings will be taken in the breathing zone and well head using a photoionization detector (PID). The reading will be recorded on the Monitoring Well Sampling form (Appendix C).
- The condition of the inner well cap and casing will be noted.
- The depth of static water level will be measured (to nearest 0.01 ft) and recorded from on the top of the well casing. The measuring point should be identified and time indicated in the field logbook.
- The total depth of the well from the same measuring point on the casing will be measured and recorded.
- The pump intake will be positioned in the top one-third of the saturated area of the well screen.

- Water in the casing will be evacuated using low-flow purging (0.1 to 0.5 liter/minute) which will achieve minimal (< 4 inches) to no drawdown in the static water level in the well.
- Temperature, dissolved oxygen, redox potential, conductivity, turbidity and pH measurements will be taken as soon as the proper flow can be established and then every 3 to 5 minutes (based on pump rate of 0.1 to 0.5 liter/min) to determine whether the water chemistry has stabilized for three consecutive readings. Generally, pH values within +0.1 pH unit, temperature within +0.5 degrees Celsius (°C) and conductivity within +10 micro mhos per centimeter (µmhos/cm) between consecutive readings indicate adequate stability of the water chemistry. A target value of 10 Nephelometric Turbidity Units (NTUs) will be used to indicate acceptable turbidity levels prior to sample collection. If turbidity targets cannot be attained after a minimum of five readings, the sample will be collected and turbidity issues noted on the sampling form.

2.3.2 Well Sampling

Unfiltered samples for chemical analysis will be collected immediately following purging using the following sampling procedure:

- Identification labels for sample bottles will be filled out for each sample.
- The samples will be collected in the appropriate sample containers obtained directly from the laboratory providing the chemical analysis.
- The pump rate will remain the same as for purging or be reduced to minimize aeration (VOC samples), bubble formation, or turbulent filling of sample bottles.
- Any in-line water quality measurement equipment (e.g., flow-through cell) should be disconnected or bypassed during sample collection.
- VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Time of sampling will be recorded.
- Seal, label, and place the sample in an iced cooler held at a temperature of less than 4°C.
- The well cap will be replaced and locked.
- Field documentation will be completed, including the chain-of-custody.

2.4 Equipment Decontamination

Before any purging or sampling activities begin, all applicable sampling devices and instruments shall be decontaminated. The following procedure shall be used for decontamination:

- Scrub or immerse the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent.
- Rinse the equipment with potable water followed by a laboratory-grade distilled water rinse.

If the sampling device shall not be used immediately after being decontaminated, it shall be kept clean until use. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of purging or sampling equipment shall be decontaminated before sampling operations. Used solutions will be placed in the container with purged well water for disposal as IDW as outlined in Section 2.5.

2.5 Investigation Derived Waste

The 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). CAFB 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.

2.6 Field Documentation

All field activities will be recorded in field log books. The appropriate field form will be completed for each monitoring well. Field forms are located in Appendix C.

2.7 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.

2.8 Quality Assurance Project Plan

All environmental monitoring activities will be conducted in accordance with the *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 the Department of Defense Quality Systems Manual for Laboratories, version 3 (DOD, 2006).

3 VEGETATIVE COVER INSPECTIONS AND MAINTENANCE

Inspection and maintenance of the covers at Landfills 3, 4, and 25 and the Sewage Lagoons will be implemented as outlined in Appendix D. Inspections will occur on an annual basis in conjunction with the annual monitoring well inspection and water level measurements. Cover System Inspection forms are included in Appendix C.

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. The contractor will perform maintenance as required to ensure all erosion control features and other protection measures are in effective operating condition. Tumbleweeds and other uprooted vegetation will be removed from areas within the landfill where they accumulate, such as along perimeter fencelines. As needed, the contractor will perform minor repairs within 2 weeks of inspection unless otherwise directed by Cannon AFB. 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

4 REPORTING REQUIREMENTS

A Facility-Wide Groundwater Monitoring and Landfill Inspection Report (Report) summarizing the results of each groundwater sampling event will be submitted biennially for regulatory approval following the requirements as presented in the *General Reporting Requirements for Routine groundwater Monitoring at RCRA Sites* Position Paper (NMED Hazardous and Radioactive Material Bureau, 2003). Each report will describe the field method and results from the latest monitoring event compared to preceding events for comparison. Each report will include:

- An Executive Summary providing a brief summary of the purpose, and results of the groundwater monitoring;
- A summary of the results of the annual well inspection and groundwater level measurements;
- A summary of the annual landfill cover inspections and maintenance;
- A summary of all activities actually performed during the latest groundwater sampling event;
- Information regarding the applicable groundwater cleanup standards;
- A summary of the results of the groundwater monitoring conducted;
- A summary table of the groundwater analytical results from the four latest groundwater sampling events (tables in Microsoft Excel®), test methods used, dates of sample collection, practical quantitation limits for each analyte, and regulatory evaluation criteria;
- Appropriate figures with trend analyses;
- An assessment of whether groundwater results are indicative of a release;
- An assessment of whether proposed new or existing base activities could pose a threat to groundwater; and
- An analysis of the status of the program relative to the decision logic presented in Figure 7; i.e., whether to adjust sampling frequency, locations, or parameters.

The Report will conclude with a final summary of the groundwater sampling events covered under the reporting period and analytical testing results. If routine groundwater sampling is required out of the biennial sequence, NMED will receive the sampling results in tabular format with a discussion of the full results included in the following sequential Report.

Tables presented in the Report will include:

- A summary table showing the latest depth to groundwater measurements;
- A summary table of the latest groundwater quality data plus water quality data from the three previous sampling events; and
- A summary table of the groundwater analytical results, test methods used, dates of sample collection, and regulatory comparison requirements.

Figures presented in the Report will include:

- A site vicinity map including topography;
- A site plan showing monitoring well locations;
- A potentiometric surface map indicating the groundwater flow direction; and
- Figures and trend analyses presenting the historical and most recent groundwater analytical data.

Appendices will include the field forms completed by crews during the sampling event and the laboratory analytical reports, including a Quality Assurance/Quality Control/Data Usability assessment.

4.1 Data Reporting

All laboratory analytical data will be reported in the Air Force Center for Engineering and the Environment (AFCEE) level IV format and submitted in a format compatible with the AFCEE Environmental Restoration Program Information Management System (ERPIMS) database. The latest version of Environmental Resources Program Tools (ERPTools) will be used to facilitate data entry and meet quality assurance/quality check requirements.

The range of data submissions will include analytical chemistry samples, tests, and results in addition to hydrogeological information, site/location descriptions, and monitoring well characteristics. The information will be generated from the long term monitoring studies.

4.2 Historical Database Creation and Maintenance

The database that will be used to house both future and historical data is the AFCEE ERPIMS database. ERPIMS is maintained by AFCEE to validate and manage data from environmental projects at all Air Force bases. The information within ERPIMS maintains table and record relationships by having common fields within separate, interrelated tables.

All new information will be added to the database and historical information will continue to be added. Summary tables in the Facility-Wide Long Term Groundwater Monitoring Reports will include analytical results from the four latest groundwater sampling events and will be provided to NMED in Microsoft Excel® format, as well as included in the reports.

4.3 Data Analysis

For the Reports, the latest groundwater sampling results will be included and will be compared to those from the previous events for historical assessment, evaluated in terms of current regulatory limits, and development of groundwater trend plots as described below.

4.3.1 Comparison to Regulations

Groundwater analytical results will be compared to the current EPA MCLs and NMGWQS (20 New Mexico Administrative Code 6.2). Based on the sampling collection and analysis uncertainties, comparison will be made as described in EPA guidance (EPA, 2009). In the event that no evaluation criteria are listed for an analyte in the EPA MCLs or the NMGWQS, the results will be evaluated against the criteria for tapwater as specified in the Soil Screening Levels (NMED, 2009).

4.3.2 Trend Analysis

Trend analysis will be completed for each contaminant of concern (coc) at individual monitoring wells. Trends will be developed using the most recent groundwater analytical data and comparing to the previous sampling event results. Trend analysis will be one tool used to determine necessary changes in the long term monitoring well network, sampling frequency, and coc's, as well as whether a release has occurred. The control chart approach (epa, 2009) will be utilized.

5 POTENTIAL AREAS FOR ADDITIONAL MONITORING WELLS

Planning for the transfer of the Base to AFSOC requires the development of a new General Plan for CAFB. The 75% Draft of the General Plan was submitted for internal Air Force review in September 2010. While the general outline and plan have been established, additional refinement of the General Plan and schedule of demolition and construction in support of the Base Mission will continue and will be published in the final General Plan. Generalized future uses of facilities across the Base are shown in figures located in Appendix E. Once the General Plan is finalized, the public will have access to the planning document and it will be furnished to NMED upon request.

Industrial and residential area growth and development will occur in a phased approach. Critical needs in housing, recreation, and aircraft storage and maintenance will have higher priority and will occur in a shorter timeframe. Additional development will take place as infrastructure to support the development is constructed and funding for the additional housing, recreation and operational needs is available. Appendix E includes a draft of the phases planned for the development of the northeast and southeast flightline areas.

Based on the proposed use of facilities, two general areas have been identified that may require groundwater monitoring in the future. These potential areas are northeast and southeast of the flightline. Figures showing proposed development and area uses are included in Appendix E. The northeast and southeast flightline areas will be the most industrialized areas at CAFB with regard to the industrial operations at CAFB. Current plans for the northwest area include primarily residential and recreational new construction and upgrades. Current plans for the southwest area are primarily for open space.

The northeast portion of the flightline area will include fueling operations, aerospace ground equipment facilities, aircraft hangars, and vehicle maintenance shops. All of these facilities will handle aircraft, vehicles or electronic equipment repair, maintenance, or storage and have the potential for hazardous material and fuel storage or usage. As with all material handling operations, a risk of spills or release will be present. CAFB has an active SPCC Plan that outlines preventative measures in place to preclude spills and releases as well as countermeasures in the event a spill or release occurs. The plan will be evaluated when future facilities are built to assure that it is adequate.

The southeast portion of the flightline will experience construction and development for the new mission. Development will include squadron operations facilities, aircraft hangars, aircraft washrack, aerospace ground electronics shops, corrosion control facilities, and a fire training area. All of these facilities will handle aircraft, vehicles or electronic equipment repair, maintenance, or storage facilities which have the potential for hazardous material and fuel storage or usage. As with all material handling operations, a risk of spills or release will be present. CAFB has an active Spill Prevention, Control, and Countermeasures (SPCC) Plan that outlines preventative measures in place to preclude spills and releases as well as countermeasures in the event a spill or release occurs. The plan will be evaluated when future facilities are built to assure that it is adequate.

These generalized areas are only identified as having the potential for a future spill or release, if development and use occurs as planned. Spills or releases may occur in other areas but based on the past history and future planned use of the general areas described above, other areas have a smaller likelihood of release or spill. No known source of contamination currently exists at or upgradient of these general areas. CAFB has an active SPCC Plan that outlines preventative measures in place to preclude spills and releases as well as countermeasures in the event a spill or release occurs (URS, 2004). The installation of additional monitoring wells may be required at some point in time; for example, possibly one well in the northeast portion of the flightline downgradient from industrial activities and one well in the southeast portion of the flightline also downgradient from industrial activities. If the installation of additional monitoring wells is required, the geology and hydrology of the site will be evaluated as part of the process for locating the well. Also, the wells should be installed with sufficient screen length to remain in use for the foreseeable future taking into account the trends of lowering of the regional groundwater table. Monitoring wells would be installed only when necessary to assess or monitor groundwater quality.

6 IMPLEMENTATION SCHEDULE

Groundwater sampling under this Plan will be scheduled following regulatory approval of the Plan. The preliminary schedule for implementation of this Plan is as follows:

- October 2010 – Sample groundwater according to the currently approved Work Plan (TetraTech EC, 2009);
- January – March 2011 – Receive approval of the Plan;
- Fall 2011 – Implement landfill cover inspection, maintenance, monitoring well inventory and groundwater level measurements.

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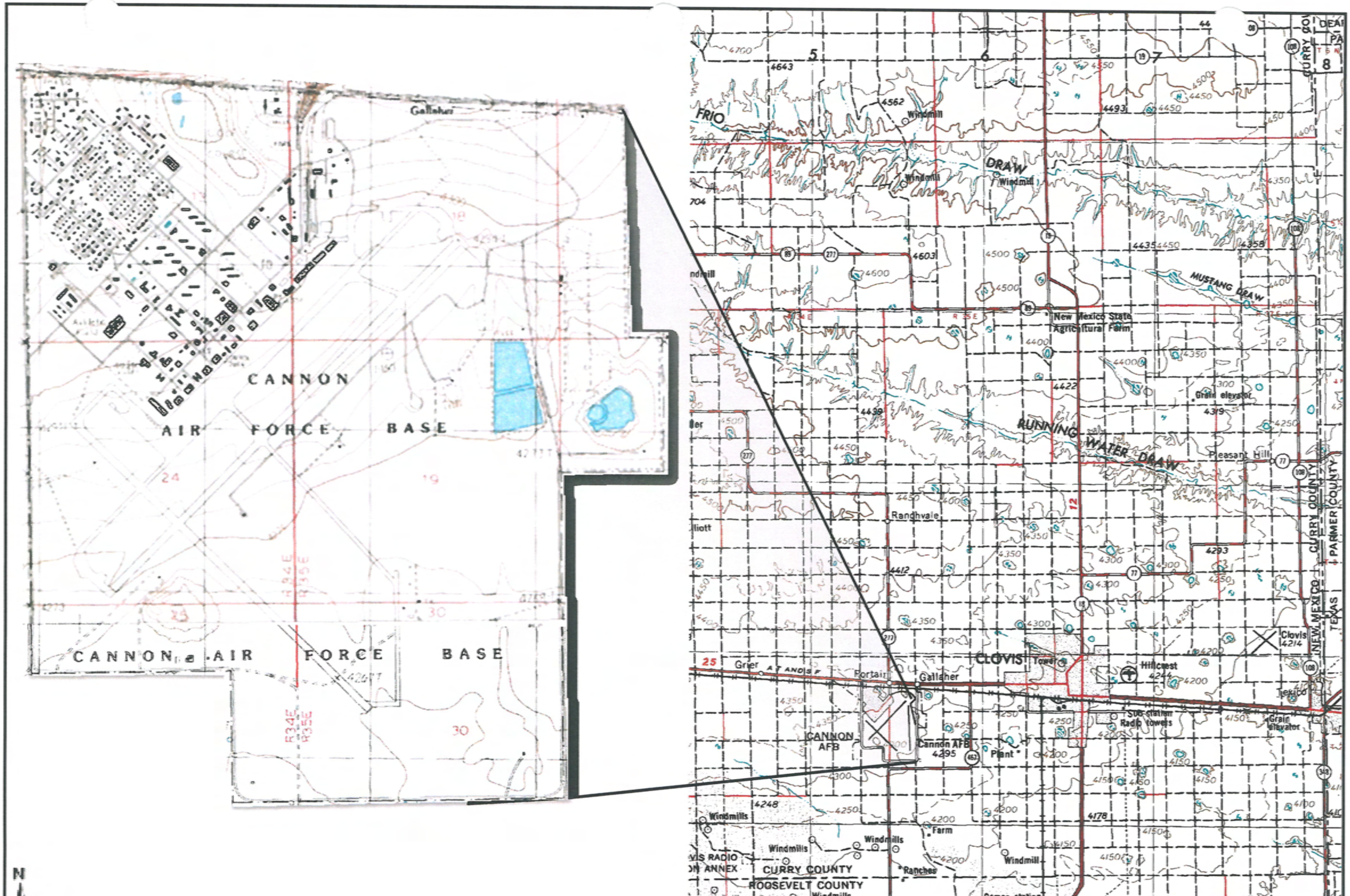
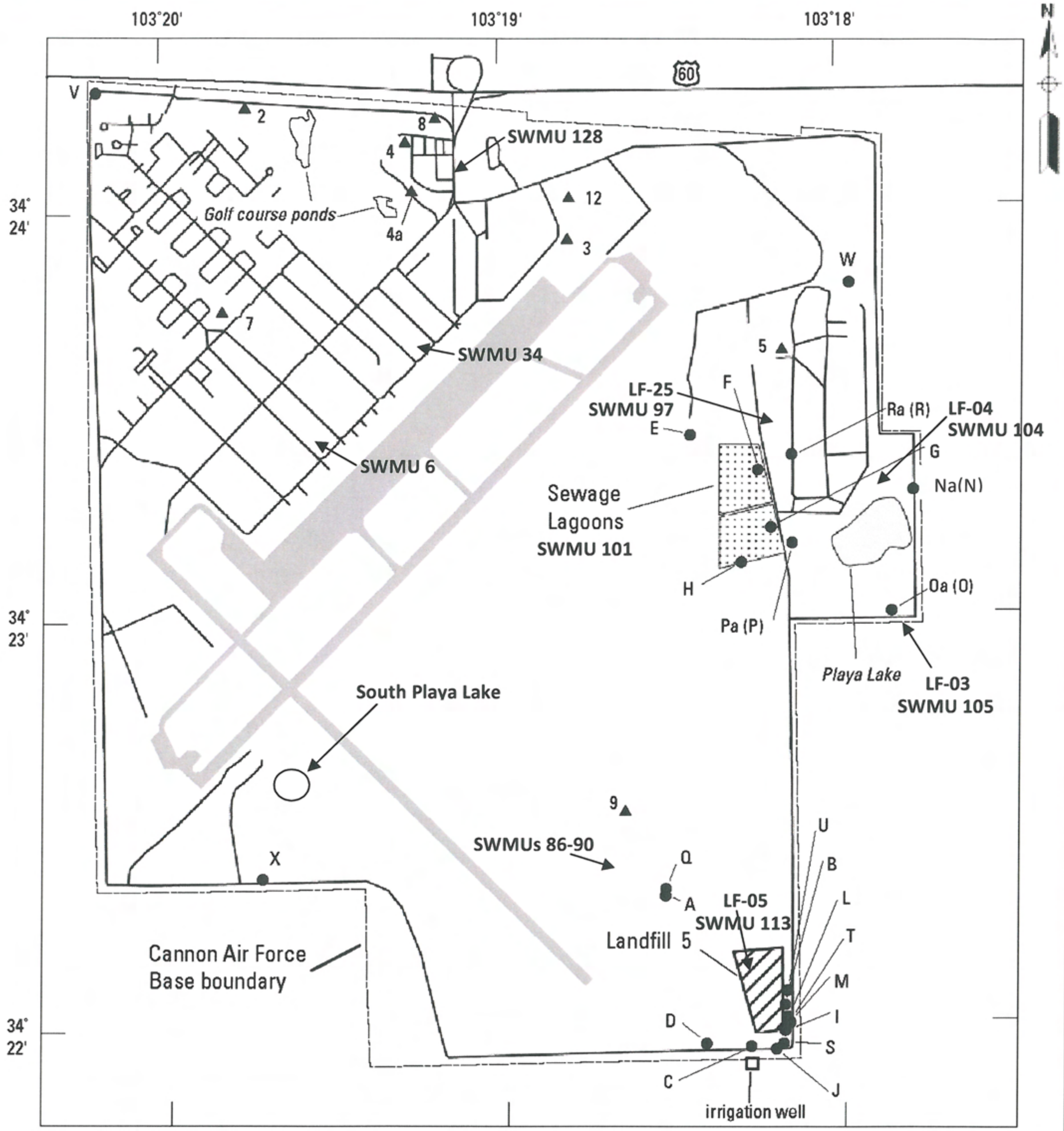
FIGURES



Source: USGS 7.5 Minute Series (Topographic), Portair, New Mexico, Provisional Edition 1985.
USGS 7.5 Minute Series (Topographic), Clovis, New Mexico, Provisional Edition 1954.

AECOM

Figure 1
Site Location
Cannon Air Force Base
Curry County, New Mexico



Base from U.S. Geological Survey digital data, 1994, 1:100,000
Universal Transverse Mercator Zone 13N, NAD 83

0 0.5 1 MILE

0 0.5 1 KILOMETER

EXPLANATION

C ● Monitoring well and well identifier—Identifier in parentheses indicates older well that has been replaced by well indentified with appended "a"

9 ▲ Production well and well identifier

AECOM

Figure 2
Site Map
Cannon Air Force Base
Curry County, New Mexico

Source: Langman and others, 2006.

System	Series	Geologic unit	Thickness, in feet	Physical character
QUATERNARY	Pleistocene and Holocene	Valley-fill deposits	0 to 60	Stream-laid deposits of gravel, sand, silt, and clay associated with the most recent cycle of erosion and deposition along present streams. Forms part of High Plains aquifer where hydraulically connected to underlying Quaternary and Tertiary deposits.
		Dune sand	0 to 300	Fine to medium sand with small amounts of clay, silt, and coarse sand formed into hills and ridges by the wind. Forms part of High Plains aquifer where saturated.
		Loess	0 to 250	Silt with lesser amounts of very fine sand and clay deposited as windblown dust.
	Pleistocene	Unconsolidated alluvial deposits	0 to 550	Stream-laid deposits of gravel, sand, silt, and clay locally cemented by calcium carbonate into caliche or mortar beds. Forms part of High Plains aquifer where hydraulically connected laterally or vertically to Tertiary deposits.
TERTIARY	Miocene	Ogallala Formation	0 to 700	Poorly sorted clay, silt, sand, and gravel generally unconsolidated; forms caliche layers or mortar beds when cemented by calcium carbonate. Includes units equivalent to the locally used terms "Ash Hollow," "Kimball," "Sidney Gravel," and "Valentine" Members or Formations assigned to the Ogallala Formation or "Group," and Delmore and Laverne Formations. Ogallala comprises large part of High Plains aquifer where saturated.
		Arikaree Group	0 to 1000	Predominantly massive very fine to fine grained sandstone with localized beds of volcanic ash, silty sand, siltstone, claystone, sandy clay, limestone, marl, and mortar beds. Includes units assigned to the Hemingford Group of Lugn (1938), Marsland Formation, Rosebud Formation used in South Dakota by Harksen and Macdonald (1969), and Sheep Creek Formation. Also includes units equivalent to Gering Formation, Harrison Sandstone, and Monroe Creek Sandstone. Forms part of the High Plains aquifer.
	Oligocene	White River Group	0 to 700	Upper unit, Brule Formation, predominantly massive siltstone containing sandstone beds and channel deposits of sandstone with localized lenticular beds of volcanic ash, claystone, and fine sand. The Brule Formation is considered part of the High Plains aquifer only where it contains saturated sandstones or interconnected fractures. Lower unit, Chadron Formation, mainly consists of varicolored, bentonitic, loosely to moderately cemented clay and silt that contains channel deposits of sandstone and conglomerate.
CRETACEOUS	Upper Cretaceous	Undifferentiated rocks	0 to 8000	Shales, chalks, limestones, and sandstones. Upper part may contain lignite and coal beds. Unit includes Belle Fourche and Carlile Shales, Codell and Fox Hills Sandstones, Frontier Formation, Graneros Shale, Greenhorn Limestone, Lance Formation, Niobrara Chalk or Formation, and Pierre Shale.
	Lower Cretaceous	Undifferentiated rocks	0 to 700	Fine- to medium-grained, thin-bedded to massive cliff-forming sandstone interbedded with shale. Black and varicolored shale and thin- to thick-bedded limestone. Includes units equivalent to Fredericksburg and Washita Groups; Dakota and Purgatoire Formations; Antlers Sand of Hill (1894), Cheyenne, Fall River, Lakota, Mesa Rica, and Newcastle Sandstones; and Fuson, Kiowa, Mowry, Skull Creek, and Tucumcari Shales.
JURASSIC	Middle and Upper Jurassic	Undifferentiated rocks	0 to 600	Varicolored shale, fine- to very coarse grained sandstone, limestone, dolomite, and conglomerate. Includes units equivalent to Entrada and Exeter Sandstones, and Morrison and Sundance Formations.
TRIASSIC	Upper Triassic	Dockum Group	0 to 2000	Upper unit, Trujillo Formation, varicolored siltstone, claystone, conglomerate, fine-grained sandstone, and limestone. Lower unit, Tecovas Formation, varicolored fine- to medium-grained sandstone with some claystone and interbedded shale. Include units equivalent to Chinle and Redondo Formations, and Santa Rosa Sandstone.
PERMIAN	Lower and Upper Permian	Undifferentiated rocks	300 to 3000	Interbedded predominantly red-shale, siltstone, sandstone, gypsum, anhydrite, dolomite, bedded salt, and local limestone beds. Includes Artesia, Council Grove, Nippewalla Groups; Quartermaster Formation, Sumner and Whitehorse Groups.

Source: Weeks and Gutentag, 1981.

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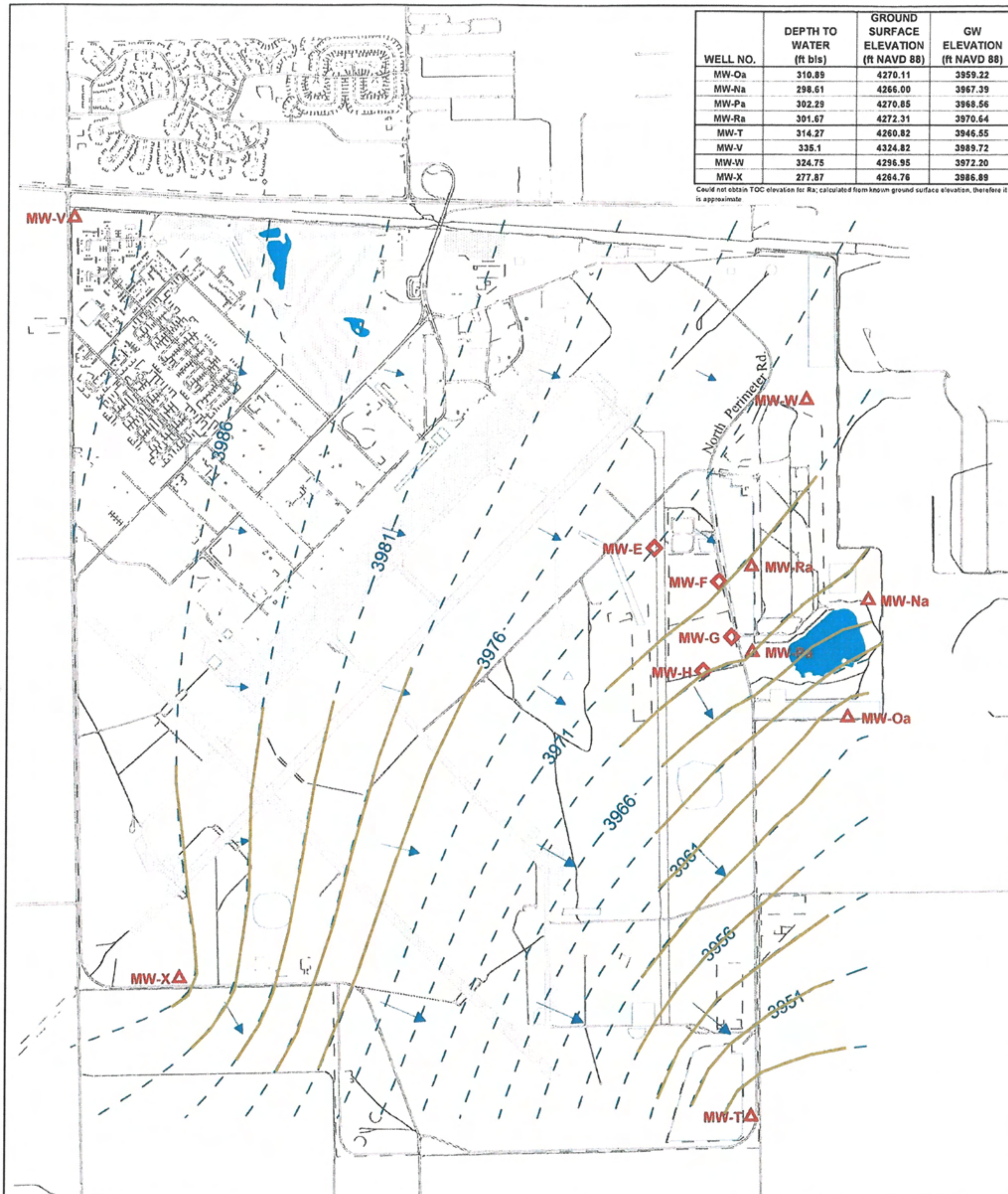
Figure 3
Generalized Section of
Geologic Units
Cannon Air Force Base
Curry County, New Mexico

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

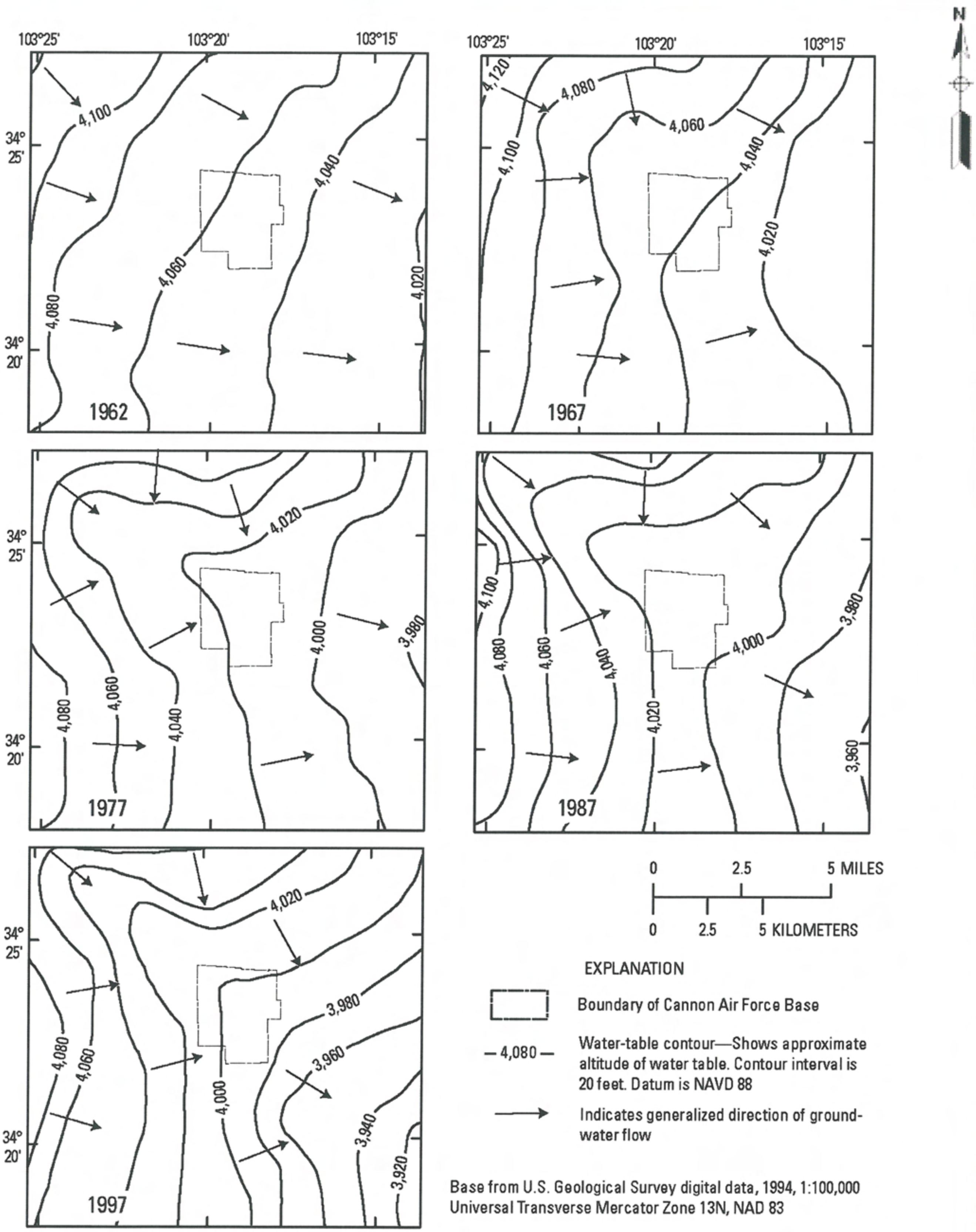
Projection: UTM Zone 13N, NAD 83

→ Flow Path Direction

AECOM

Figure 4
Potentiometric Map
October 2008
Cannon Air Force Base
Curry County, New Mexico

Source: Tera Tech EC, Inc (2009).



Source: Langman and others (2006).

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Figure 5
Regional Potentiometric Map
Years 1962, 1967, 1979, 1987, and 1997
Cannon Air Force Base
Curry County, New Mexico

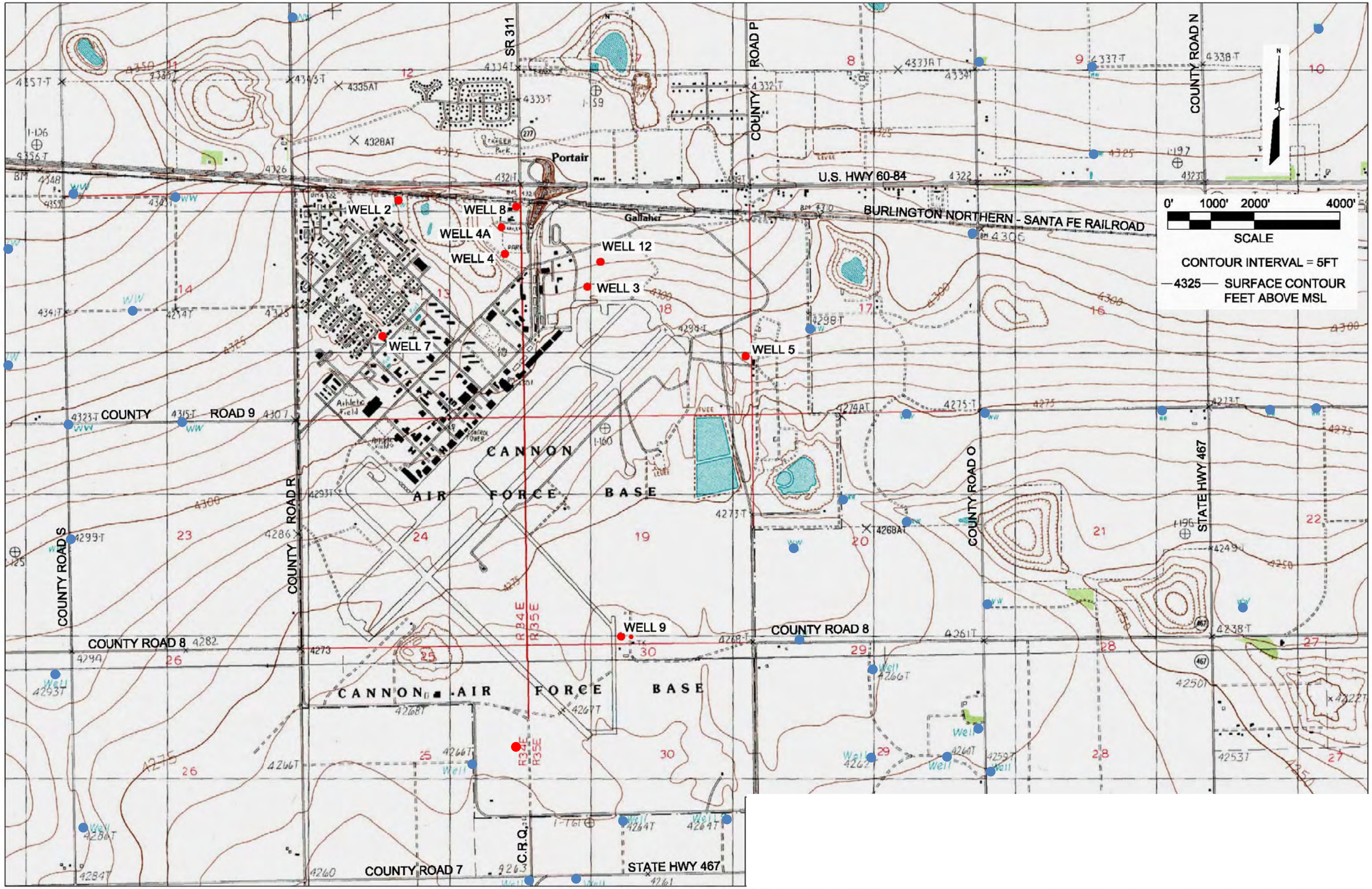

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Figure 6
Location of Water
Supply Wells
Cannon Air Force Base
Curry County, New Mexico

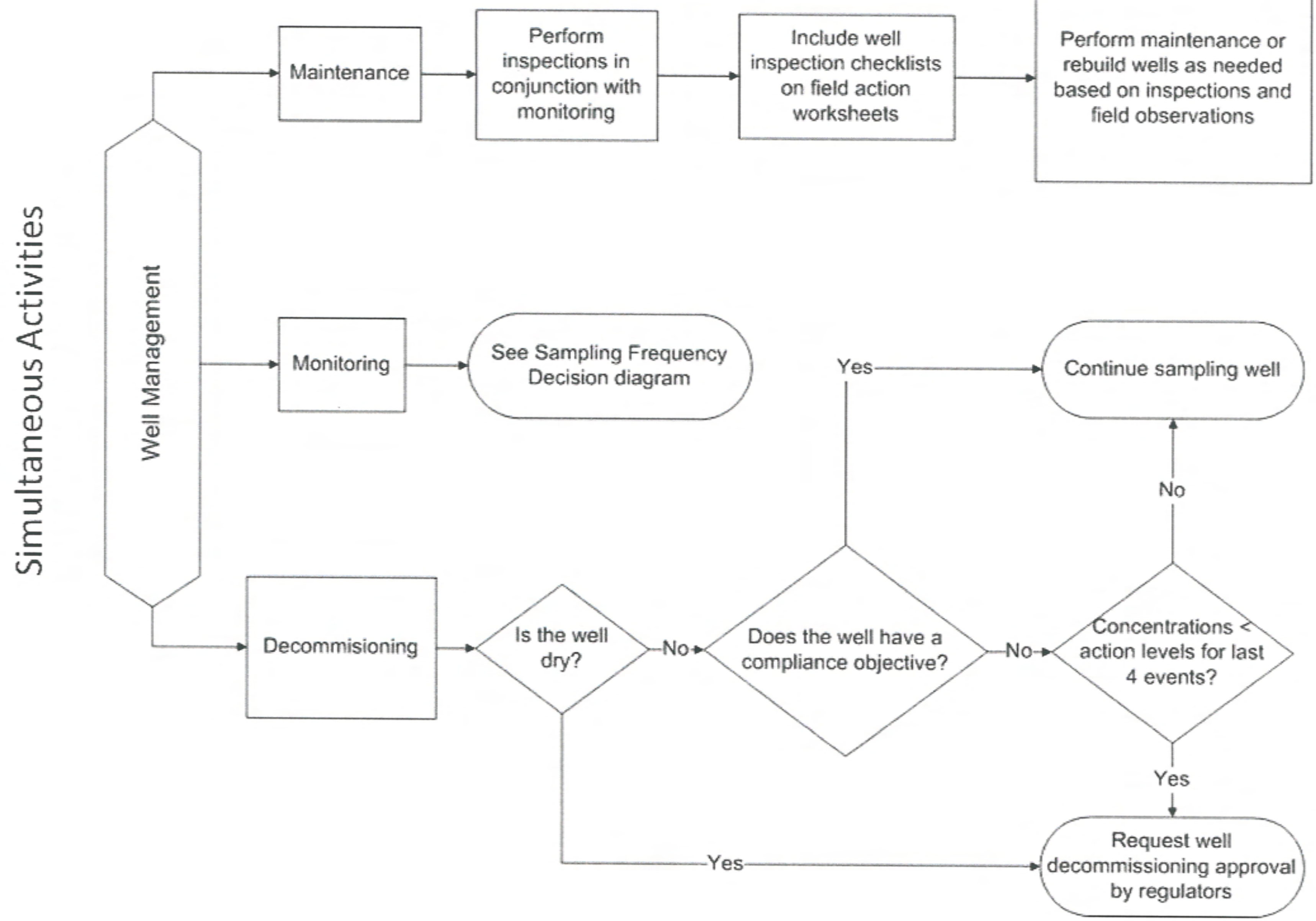

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Figure 7
Well Management Decision Diagram
Cannon Air Force Base
Curry County, New Mexico

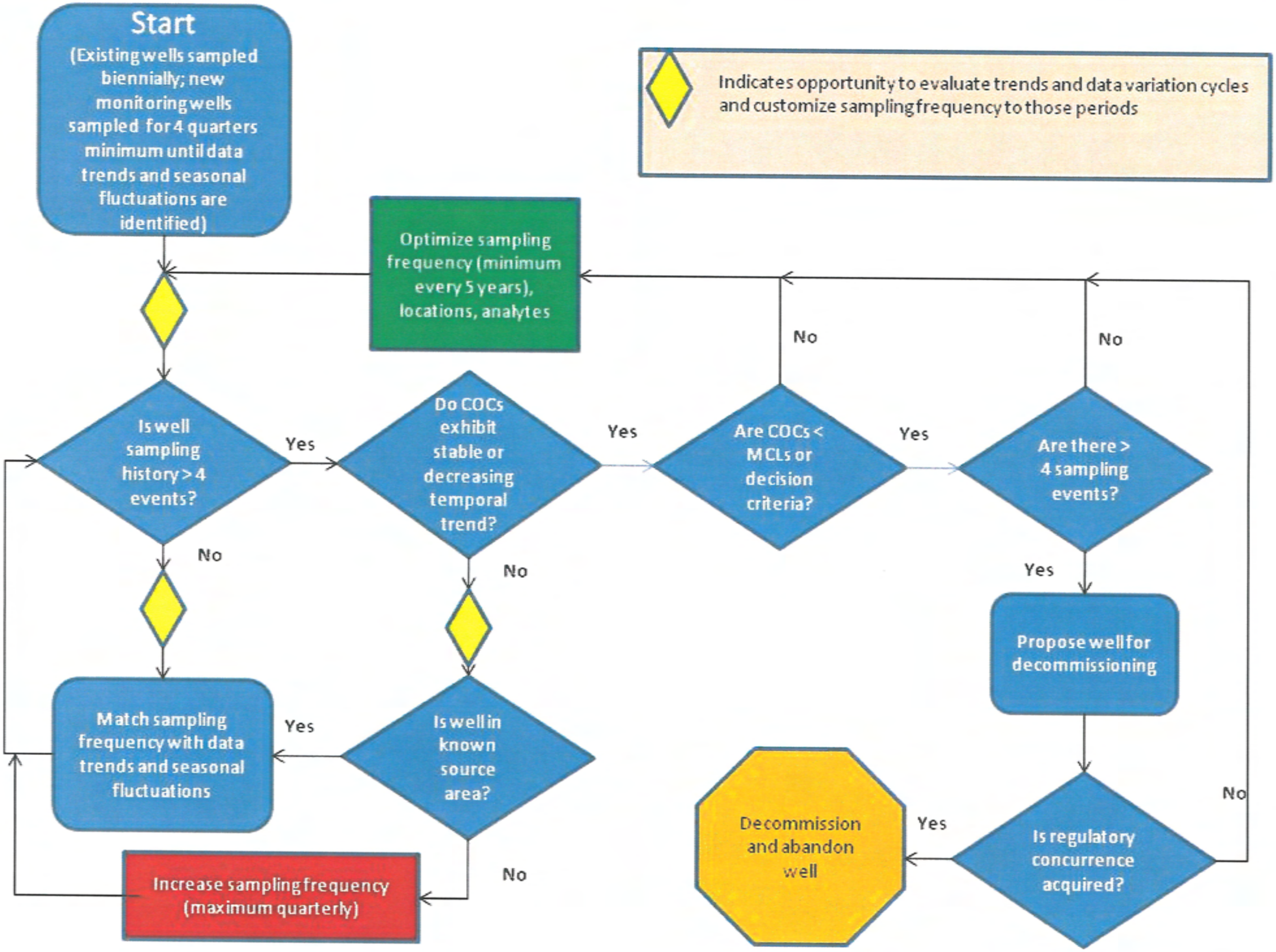

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Figure 8
Sampling Frequency Decision Diagram
Cannon Air Force Base
Curry County, New Mexico

TABLES

Table 1
Well Construction Details
Facility-Wide Long Term Groundwater Monitoring Plan
Cannon, AFB, New Mexico

Well ID	SWMU	Well Identifier	Land Surface Elevation (ft above NAVD88)	Latitude (NAD83)	Longitude (NAD83)	Top of Casing Elevation (ft above NAVD88)	Well Depth (ft)	Casing Material	Screen Length (ft)	Top of Screen Elevation (ft above NAVD88)	Bottom of Screen Elevation (ft above NAVD88)	
A	LF5/SWMU113	65	4263.83	34.221891	103.183144	4265.8	343	PVC	15	3935.83	3920.83	
B	LF5/SWMU113	61	4262.10	34.220267	103.181036	4265.41	362	PVC	15	3914.80	3899.80	
C	LF5/SWMU113	53	4263.72	34.215668	103.181650	4267.9	362	PVC	15	3916.72	3901.72	
D	LF5/SWMU113	56	4261.94	34.215713	103.182444	4265.9	357	PVC	15	3920.19	3905.19	
I	LF5/SWMU113	57	4261.57	34.366372	103.302886	4262.36	291	PVC	20	3990.57	3970.57	
J	LF5/SWMU113	54	4261.11	34.365556	103.302222		na				0.00	Dry
L	LF5/SWMU113	60	4261.38	34.366942	103.302761	4264.72	285	PVC	20	4000.38	3980.38	
M	LF5/SWMU113	59	4261.28	34.366650	103.302797	4264.29	287	PVC	20	3999.00	3979.00	
Q	LF5/SWMU113	66	4263.50	34.366942	103.302761	4266.89	294	PVC	30	3999.10	3969.10	
S	LF5/SWMU113	55	4260.70	34.215701	103.181070	4263.83	365	PVC	40	3976.72	3936.72	
T	LF5/SWMU113	58	4260.82	34.220007	103.180947	4263.69	365	PVC	40	3976.82	3936.82	
U	LF5/SWMU113	62	4262.27	34.220481	103.180993	4265.26	365	PVC	40	3978.27	3938.27	
E	Sewage Lagoons and Playa Lake/SWMU101	94	4279.70	34.232651	103.182623	4281.12	373	PVC	15	3924.70	3909.70	
F	Sewage Lagoons and Playa Lake/SWMU101	89	4274.93	34.231290	103.181432	4278.5	375	PVC	15	3919.93	3904.93	
G	Sewage Lagoons and Playa Lake/SWMU101	86	4276.46	34.231286	103.181207	4279.99	372	PVC	15	3919.46	3904.46	
H	Sewage Lagoons and Playa Lake/SWMU101	81	4275.98	34.230722	103.181743	4276.15	375	PVC	15	3920.98	3905.98	
N	Sewage Lagoons and Playa Lake/SWMU101	87	4265.88	34.388364	103.296278	4267.686	297	PVC	30	3998.88	3968.88	Abandoned
Na	Sewage Lagoons and Playa Lake/SWMU101		4266.00	34.388364	103.296278	4268.4	358	PVC	60	3972.88	3912.88	
O	Sewage Lagoons and Playa Lake/SWMU101	78	4269.26	34.383403	103.297339	4271.766	303	PVC	30	3995.95	3965.95	Abandoned
Oa	Sewage Lagoons and Playa Lake/SWMU101	77	4270.11	34.383425	103.297389	4271.07	365	PVC	60	3970.11	3910.11	
P	LF25/SWMU97	82	4270.55	34.386231	103.302228	4273.39	300	PVC	20	4000.55	3980.55	Abandoned
Pa	LF25/SWMU97	85	4270.85	34.386125	103.302297	4271.82	360	PVC	60	3875.85	3815.85	
R	LF25/SWMU97	n/a		34.389861	103.336839						0.00	Abandoned
Ra	LF25/SWMU97	91	4272.31	34.232350	103.180823	4275.316	311	PVC	30	3991.75	3961.75	
V	Background	107	4324.82	34.405000	103.336839		370	PVC	60	4019.82	3959.82	
X	Background	98	4296.95	34.396844	103.396844		365	PVC	60	3996.95	3936.95	
W	Background	67	7264.76	34.372822	103.328650		336	PVC	40	3973.76	3933.76	

Table 2
Data Quality Objectives
Facility-Wide Long Term Groundwater Monitoring Plan
Cannon AFB, New Mexico

DQO Step	Details of DQO Step per EPA DQO Guidance (2006)	Cannon Facility-Wide LTM Plan - Uncertainty Topic 1	Cannon Facility-Wide LTM Plan - Uncertainty Topic 2	Cannon Facility-Wide LTM Plan - Uncertainty Topic 3	Cannon Facility-Wide LTM Plan - Uncertainty Topic 4	Cannon Facility-Wide LTM Plan - Uncertainty Topic 5	Cannon Facility-Wide LTM Plan - Uncertainty Topic 6
1) State the Problem	Summarize the potential contamination requiring new data, resources available, CSM, etc.	Early indication of impact to human or ecological receptors through contaminated groundwater. Groundwater monitoring on a basewide scale needed in compliance with Cannon AFB Hazardous Waste Facility Permit EPA ID No. NM7572124454-1 dated 14 October 2003.	What are most appropriate and cost effective COPCs/Indicator parameters and screening levels	Frequency of sampling	New potential sources of groundwater contamination unknown	Local groundwater flow direction.	Regional lowering of Water Table
2) Identify the Decision*	Identify the decision that requires new environmental data to address the potential contamination	Determine whether a release that poses a potential threat to human health and the environment has occurred due to activities at the Base and requires further consideration, a response action, a recommendation of continued monitoring, or no further investigation	Determine what the routine sampling parameters are; determine what indicator parameters are most useful; determine what screening levels should be	What is the optimal frequency of sampling to provide sufficient warning of release/threat to groundwater.	What potential future activities will occur that could release hazardous constituents to the environment.	What is the direction and gradient of groundwater flow.	When will monitoring well effectiveness in monitoring groundwater quality be affected by the regional lowering of the groundwater table?
3) Identify Inputs to the Decision	Identify the information needed to support the decision and specify which inputs require new environmental measurements	COPC concentrations in groundwater based on sampling and analysis of groundwater from wells adjacent to SWMUs or Base boundaries compared with respective action levels for each. Action level may be > background, or >95% UTL of background, or above a upper control limit such as NMED groundwater standards (NMGWQS [20 New Nexico Administrative Code 6.2]) or MCLs. For routine comparison, the control chart approach will be used.	Previous LTM plan specified: VOCs; Priority Pollutant Metals; total speciated Cr; Nitrate/Nitrite; Perchlorate; and field parameters (see below). Current data summarized in main body of plan (Section 1.1.5). The groundwater data will be evaluated against current EPA MCLs and NMGWQSs (20 New Mexico Administrative Code 6.2). In the event that no evaluation criteria are listed for an analyte in the EPA MCLs or the NMGWQS, the results will be evaluated against the criteria for tapwater as specified in the Soil Screening Levels, (NMED 2009).	COPC travel time in vadose and saturated zone from potential release site to monitoring location. Groundwater flow directions and velocity, contaminant retardation factors, probability of release, nature and extent of release. Guidance documents including EPA 2004.	Physical and chemical characteristics of potentially hazardous contaminants, routes of release, maximum and routine release volumes and media. Locations on Base of potential use and disposal of RCRA-regulated material.	Determine groundwater flow direction and gradients.	Groundwater elevation measurements and screened zone elevations for each monitoring well.
4) Define the Study Boundaries	Specify the spatial aspects of the environmental media that the data must represent to support the decision	Existing wells associated with SWMUS; background wells; newly installed wells as needed based on installation use and probability for release	All wells	All existing wells associated with current SWMUS or probable release locations.	Locations of new SWMUs	Existing and any newly installed monitoring wells at site and surrounding areas.	Existing and any newly installed monitoring wells at site and surrounding areas.
	Specify the temporal aspects of the environmental media that the data must represent to support the decision	Biennial sampling (with adjustments if warranted by analytical results exceeding screening criteria). If after sufficient data available to establish trends (8 data points), no exceedences observed, and no additional processes/releases occur, then consider decreasing sampling frequency to once every 5 years.	All sampling events	Biennial sampling (with adjustments if warranted by analytical results exceeding screening criteria) to be consistent with existing plans . Sufficient data to construct control charts and trend analyses. See Gilbert (1987), USEPA (2009) and USEPA (2004). An iterative process may be required.	Temporal aspects controlled by the use and disposal activities associated with future activities. At a minimum, temporal sampling must consider transport time from source to monitoring point. At a minimum, 8 quarters of sampline required for any newly installed/sampled wells.	Collect groundwater level measurements during routine sampling events and prepare contour maps and determine groundwater flow directions. Collect groundwater well water level measurements on any newly installed monitoring wells as well.	Measure groundwater levels annually and compare to screened intervals for each well.
5) Develop a Decision Rule	Develop a logical "if…then" statement that defined the conditions that would cause the decision maker to choose among alternative actions	If concentration of COPCs or screening parameters are < decision levels then no further adjustment to sampling is required. If not, then further assessment on a more intensive temporal and/or wider spatial scale may be required until extent defined.	If current parameters are > screening levels after a monitoring event and not due to explainable causes/errors: consider indicative of release, determine if additional contaminants required for monitoring	If data show increasing trends or outliers above the upper control limit of the control chart, investigate reason. Potential additional sampling over a shorter frequency required, along with an assessment of Base activity that could contribute to concentration increases will be required. If after sufficient data collected to establish trends (8 samples), no exceedences observed, and no additional processes/releases occur, then consider decreasing sampling frequency to every 5 years.	If probable future activities may result in release of RCRA regulated materials, then monitoring wells must be installed and sampled.	If groundwater flow direction does not support location of monitoring wells (i.e. downgradient, upgradient, etc.) adjust the location of these wells.	If the measured groundwater elevation is within ten feet of the bottom of the screened interval, plans will be made to replace the monitoring well with a well screened deeper in the aquifer.
6) Specify Limits on Decision Errors* **	Specify the decision maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data	For groundwater. Data level - fixed lab samples for nature and extent of contamination; number of samples (physical or temporal spacing) to be determined by concentration of nearest sample and its potential to be a contaminant source. Field screening samples (i.e., conductivity, PID for VOCs, etc.) may be appropriate depending on probable physio/chemico nature of release. Sufficient prior data needed to construct control charts.	Field parameters for well stabilization. Fixed lab sampling for routine monitoring, unless portable instruments for VOCs are more cost effective.	Data of sufficient quality and quantity to determine with 95% certainty that contamination above background or other screening levels has occurred.	Well locations must be determined based on chemical transport properties. Chemicals to monitor must be based on process knowledge. Laboratory methods must be capable of determining concentrations with sufficient sensitivity to provide early determination of a release.	+- 0.01 ft	+- 0.01 ft
7) Optimized Design	Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs	For existing wells with prior samples, construct a control chart and evaluate new data against previous trends. If concentration of COPCs or screening parameters are < decision levels then continue routine monitoring program. If not, then further assessment is required to determine if the exceedance represents a release of contaminants to the environment. Further assessment may include: re-sampling and analysis, investigation into potential release mechanisms, adding additional analytes, or sampling additional wells.	Field parameters for well stabilization. Fixed lab sampling for routine monitoring, unless portable instruments for VOCs are more cost effective.	Sufficient data to construct control charts and trend analyses. An iterative process may be required. See also Figures 4 and 5. Optimization may occur after sufficient data are collected to verify trends.	Install a minimum of one well downgradient and at optimal depth from future locations that have the potential to release RCRA hazardous material to groundwater, sample for probable contaminants based on institutional knowledge, collect a minimum 2 years of quarterly samples.	Collect and analyze data on same frequency as chemical sampling at existing well network, incorporate into CSM. If needed, install wells adjusting locations to account for probable groundwater flow directions. After each well is installed, incorporat new data into the CSM and make adjustments to any future well locations as needed.	Determine water level elevations annually

Notes:
* Stakeholders include AFCEE, NMED, on- and off-base personnel and contractor personnel for all sites. A basewide CSM is part of the main body of the Work Plan. Resources and constraints include the field team, funding cycles, future land use and the rigors of field work.
**Evaluation may be relative to background well concentrations; EPA MCLs; or NWGWQS (20 New Mexico Administrative Code 6.2).
*** The methods, limits and equations for control chart assessment of trends are provided in R. O. Gilbert (1987) "Statistical Methods for Environmental Pollution Monitoring", Wiley and Sons, NY, 320 pgs, Chapters 10 and 15 ; USEPA "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007". Optimization strategies and techniques are presented in USEPA "Demonstration of Two Long-Term Groundwater Monitoring Optimization Approaches" July, 2004, EPA 542-R-04-001a.

Method - number of + symbols indicates efficacy	Perchlorate by EPA 6860	Total Cr VI/III by EPA 7199	Total Priority Pollutant Metals by EPA 6010C/7470B (Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn)	VOCs by EPA 8260C	Nitrate/Nitrite, Sulfate, Chloride by EPA 300.1; Ammonia by SM4500; TOC by SM 5310B	Field Parameters (pH, SpC, Temperature, DO, Eh, Turbidity)
Groundwater field instruments	-	-	-	++	-	+++
Groundwater monitoring well - LTM - Fixed lab	+++	+++	+++	+++	+++	NA

Table 3
Groundwater Sample Analysis and Methods
Facility-Wide Long Term Groundwater Monitoirng Plan
Cannon AFB, New Mexico

Site/SWMU	Well ID	Analytical Suite									
		VOCs	Metals (incl Hg)	Cr (+3, +6)	Perchlorate	Nitrate & Nitrite	Ammonia	Sulfate	Chloride	TOC	Field Parameters
		Method 8260C	6010C/ 7470B	7199	6860	300.1	SM4500	300.1	300.1	SM5310B	
Boundary	T	X	X	X	X	X	X	X	X	X	X
Boundary	V	X	X	X	X	X	X	X	X	X	X
Boundary	W	X	X	X	X	X	X	X	X	X	X
Boundary	X	X	X	X	X	X	X	X	X	X	X
LF03/SWMU105	Oa	X	X	X	X	X	X	X	X	X	X
LF04/SWMU104	Na	X	X	X	X	X	X	X	X	X	X
LF05/SWMU113	A	X	X	X	X	X	X	X	X	X	X
LF05/SWMU113	B	X	X	X	X	X	X	X	X	X	X
LF05/SWMU113	C	X	X	X	X	X	X	X	X	X	X
LF05/SWMU113	D	X	X	X	X	X	X	X	X	X	X
LF05/SWMU113	S	X	X	X	X	X	X	X	X	X	X
LF05/SWMU113	U	X	X	X	X	X	X	X	X	X	X
LF25/SWMU97	Ra	X	X	X	X	X	X	X	X	X	X
LF25/SWMU97	Pa	X	X	X	X	X	X	X	X	X	X
Sewage Lagoons/SWMU101	E	X	X	X	X	X	X	X	X	X	X
Sewage Lagoons/SWMU101	F	X	X	X	X	X	X	X	X	X	X
Sewage Lagoons/SWMU101	G	X	X	X	X	X	X	X	X	X	X
Sewage Lagoons/SWMU101	H	X	X	X	X	X	X	X	X	X	X
Notes:	Field Parameters: pH, DO, ORP, Sp. Cond., Turbidity, Temp										

APPENDICES

APPENDIX A

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

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

January 20, 2010

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

RE: REQUEST FOR FACILITY-WIDE LONG TERM GROUNDWATER MONITORING PLAN,
CANNON AIR FORCE BASE, CLOVIS, NEW MEXICO
EPA ID #NM7572124454
HWB-CAFB-MISC

Dear Col. Clark:

On August 4, 2009 the New Mexico Environment Department (NMED) approved the Department of the Air Force's (Permittee) *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), Final, July 2009.*

Eight monitoring wells included in the approved work plan are identified as E, F, G, H, Na, Oa, Pa, and Ra. The wells are associated with four solid waste management units (SWMUs); SWMU 97 (Landfill 25), SWMU 101 (Sewage Lagoons), SWMU 104 (Landfill 4) and SWMU 105 (Landfill 3). The eight wells are proposed to be sampled biennially and the groundwater samples analyzed for volatile organic compounds (VOCs), total priority pollutant metals, total chromium, nitrate nitrogen, nitrate-nitrite nitrogen, perchlorate and the field parameters; pH, dissolved oxygen, oxidation reduction potential, specific conductance, turbidity, and temperature.

Because Cannon Air Force Base (CAFB) is implementing new missions and new uses of its facilities, NMED requires the Permittee identify a groundwater monitoring network and prepare a facility-wide long term groundwater monitoring plan. A groundwater monitoring network must include all existing monitoring wells associated with SWMUs, including SWMU 113, sites upgradient to SWMUs and sites where releases of environmental contaminants are likely to occur. The Permittee should propose a schedule of well inspections, the suite of chemical analyses and field parameters to be measured in the monitoring wells in the groundwater monitoring network. The proposed facility-wide long term monitoring plan may replace *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), Final, July 2009.*

NMED requires that the facility-wide long term groundwater monitoring plan include the creation and maintenance of an historical database for all groundwater wells at CAFB. NMED anticipates that a database for well conditions, groundwater field parameters and analytical results will be beneficial to the Permittee as well as NMED. Review of historical data will facilitate detection of trends, over time, of water quality and concentrations of chemicals of potential concern.

The Permittee must submit a work plan for NMED's approval, as described above, no later than June 30, 2010.

Please contact Pat Stewart at (505) 476-6059, should you have any questions.

Sincerely,

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

cc: D. Cobrain, NMED HWB
N. Dhawan, NMED HWB
P. Stewart, NMED HWB
R. Lancaster, CAFB
H. Hanson, CAFB
File: CAFB 20010 and Reading

BILL RICHARDSON
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RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

November 24, 2010

Colonel Stephen A. Kimball, Commander
27th Special Operations Mission Support Group
110 E. Sextant Avenue, Suite 1091
Cannon Air Force Base, New Mexico 88103

RE: NOTICE OF DISAPPROVAL
FACIILTY-WIDE LONG TERM GROUNDWATER MONITORING PLAN
CANNON AIR FORCE BASE, NEW MEXICO, SEPTEMBER 2010
EPA ID #NM7572124454
HWB-CAFB-10-003

Dear Col. Kimball:

The New Mexico Environment Department (NMED) has reviewed Cannon Air Force Base's (Permittee's) *Facility-Wide Long Term Groundwater Monitoring Plan for Cannon Air Force Base, New Mexico* dated September 2010 (Plan). NMED hereby disapproves the Plan and provides the following comments.

Comment 1. Executive Summary, Page ES-1:

In its description of the conceptual site model the Permittee stated that wastes were generated as a result of primary mission support, industrial operations and, routine Air Force operations that involved the use of pesticides, herbicides and metals. The Permittee must also include fuels, solvents, fire suppressants and explosives that are used in training as types of wastes generated at Cannon Air Force Base (CAFB or the Base).

Comment 2. Conceptual Site Model, Pages 1-1 through 1-12:

The Permittee failed to identify optimal locations where additional monitoring wells are necessary based on existing and planned facility operations. The Permittee must generally describe existing and planned operations and their locations within the Base boundaries and identify optimal locations where additional monitoring wells are required to detect potential releases. Figures depicting the locations must also be included in the Plan.

Comment 3. History of Environmental Programs, Section 1.1.4, page 1-5:

The Permittee erroneously indicated that the Hazardous Waste Facility Permit was revised in 2005. The Permittee must indicate the correct revision date as 2003.

Comment 4. Exposure Scenarios, Section 1.1.7, page 1-8:

The Permittee indicated that the semi-arid climate, caliche layers in the subsurface, and depth to groundwater of approximately 300 feet are factors that serve to prevent contaminant transport to groundwater. While the identified factors may decrease infiltration or migration rates, they do not completely prevent contaminant transport to groundwater. The Permittee must replace the word "prevent" with the word "inhibit" or "reduce".

**Comment 5. Landfill 25 (SWMU 97), Section 1.3.1, page 1-9
Landfill 4 (SWMU 104), Section 1.3.3, page 1-10
Landfill 3 (SWMU 105), Section 1.3.4, page 1-11:**

The Permittee indicated that a petition for no further action under NMED criterion 5 and a Class III permit modification were requested for SWMUs 97, 104 and 105 in the *Petition for No Further Action for Landfill 3 (LF-03/SWMU 105), Landfill 4 (LF-04/SWMU 104), and Landfill 25 (LF/SWMU 97, Cannon Air Force Base, New Mexico [HGL, 2006]* and that NMED approved the report in a letter dated December 5, 2007. The term NFA (No Further Action) and the six NMED criteria are no longer used. In accordance with *Final Guidance on Completion of Corrective Action Activities at RCRA Facilities* [Federal Register: February 25, 2003 (Volume 68, Number 37)], NMED reviewed and approved the document as a RCRA Facility Investigation Report (RFI) (See NMED letter dated December 5, 2007). The Permittee proposed that the SWMUs be granted the status of Corrective Action Complete with Controls in the document titled *Corrective Action Complete Proposals, Cannon Air Force Base, Clovis, New Mexico* dated July 2008. NMED approved the proposal November 25, 2009. A petition for a Class III permit modification has not yet been submitted. The Permittee must revise the Plan to accurately describe the documents and regulatory actions.

Comment 6. Data Quality Objectives, Section 2.1, page 2-1:

The Permittee stated, "If new groundwater monitoring wells are required, installation will proceed according to 19.27.4 NMAC, 8-31-2005." The Permittee must also submit work plans for new wells for NMED review and approval. The Permittee must revise the language in the Plan accordingly.

Comment 7. Data Quality Objectives, Section 2.1, page 2-1:

The Permittee stated, "Decommissioning [of a monitoring well] will be in accordance with the CAFB Groundwater Monitoring Plan (CAFB, 1995)." NMED has not received, reviewed or approved the cited document. Decommissioning of a monitoring well must be conducted in accordance with 19.27.4 NMAC. The Permittee must revise the language in the Plan accordingly.

Comment 8. Monitoring Requirements, Section 2.2, page 2-1:

The Permittee described monitoring of groundwater wells at four landfills, the former Sewage Lagoons, and perimeter wells. However, inspection and maintenance of the topography and drainage patterns and the condition of the vegetative covers at the landfills were omitted. In order to replace the existing Long-Term Monitoring Plan, inspection and maintenance of the landfill covers must be conducted as described in the *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*, dated July 2009 (including the forms in Appendix A) and approved by NMED August 4, 2009. The Permittee must revise the Plan to include the approved inspection and maintenance activities for the landfill covers.

Comment 9. Water Level Measurements, page 2-2:

The Permittee did not indicate the frequency of water level measurements. The Permittee must inspect the condition of the monitoring wells and measure water levels annually. The Permittee must revise the Plan accordingly.

**Comment 10. Sampling Parameters, Section 2.2.4, page 2-3
Comparison to Regulations, Section 3.3.1, page 3-2:**

The Permittee stated that groundwater analytical results will be compared to current EPA Maximum Concentration Levels (MCLs) and New Mexico Groundwater Quality Control Commission Standards (NMGWQSs). In the event that no evaluation criteria are listed for an analyte in the EPA MCLs or NMGWQS, the Permittee must use the criteria for tapwater published in NMED's *Technical Background Document for Development of Soil Screening*

Levels, Revision 5.0, August 2009 (NMED SSLs) as updated. The Permittee must include NMED SSLs in the evaluation criteria.

Comment 11. Reporting Requirements, Section 3, page 3-1:

The Permittee stated that each report will include a summary table of the groundwater analytical results, test methods used, dates of sample collection and regulatory cleanup requirements. The Permittee must replace the words "cleanup requirements" with "evaluation criteria." The Permittee must also include practical quantitation limits (PQLs) in the table with analytical results and evaluation criteria. The Permittee must also ensure that PQLs are less than the appropriate evaluation criteria.

Comment 12. Historical Database Creation and Maintenance, Section 3.2, page 3-2:

The Permittee stated it will use the Air Force Center for Engineering and the Environment Environmental Resources Program Information System to house future and historical data. The Permittee must describe how NMED will access the data or how the historical data will be submitted to NMED (e.g., Excel® file).

The Permittee must submit a revised Plan to NMED that addresses all of the comments included in this letter no later than December 31, 2010. The submittal must include an electronic copy with all changes presented in redline-strikeout, in addition to the paper copies.

Please contact Pat Stewart at (505) 476-6059, should you have any questions.

Sincerely,

James Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
D. Cobrain, NMED HWB
N. Dhawan, NMED HWB
P. Stewart, NMED HWB
R. Lancaster, CAFB
A. Lafeuente, CAFB
K. Walker, CAFB
File: CAFB 2010 and Reading

APPENDIX B

Standard Operating Procedures

SOP 1 Water Level Measurements

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 CAFB. 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). 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. 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.

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 arid 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.
- 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 oxidation-reduction dissolved (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 shown on the groundwater sampling form (Field forms). 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 on the groundwater sampling form (Field form), has been removed and the groundwater quality parameters have stabilized according to the stabilization requirements (groundwater sampling form).
- 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 filer 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 the groundwater sampling form (Field Forms), has been removed and the groundwater quality parameters have stabilized according to the stabilization requirements (see groundwater sampling form).

- 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 trine 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 on the groundwater sampling form (Field Forms). **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 (C). 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.
- 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

APPENDIX C

Field Forms

MONITORING WELL SAMPLE COLLECTION FORM

LOCATION	Site:	LocID:	Date:
	Project Number:		Recorded By: Checked By:
EQUIPMENT	Water Quality Meter Type/ID #:	Water Level Indicator Type/ID #:	PID Type/ID #:
		Sampling Equipment:	Equipment Decon.:
WELL INFO	Casing I.D. (in) [a]:	Unit Casing Volume (gal/lin ft) [b]:	Initial Depth to Water (ft) [c]:
	Total Well Depth (ft) [d]:	Water Column Thickness (ft) [d-c]:	Well Volume (gal) {[d-c] x b}:
	Ambient PID (ppm):	Well Mouth PID (ppm):	Ground Condition of Well:
			Remarks:

CASING INFO	Casing I.D. (in) [a]:	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
	Unit Casing Volume (gal/lin ft) [b]:	0.09	0.16	0.20	0.37	0.65	0.75	1.0	1.5	2.0	2.6

Date	Time (24 hr)	Water Level (FTOC)	Volume Removed (gal)	Pumping Rate (Lpm)	Temp. (C)	pH	Cond mS/cm	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-0.5 C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU ideal), for 3 consecutive readings

Time(s)/ Colorimeter Result(s)	No. Containers/Volume/Type	Preserv.	Filter (Y/N)	Pump OR Bailer	Parameter(s)
					VOCs
					TPH (DRO)
					TPH (GRO)
					PAHs

MONITORING WELL SAMPLE COLLECTION FORM

LOCATION	Site:		LocID:	
	Project Number:		Date:	

Date	Time (24 hr)	Water Level	Volume Removed (gal)	Pumping Rate (Lpm)	Temp. (C)	pH	Cond. mS/cm	DO (mg/L)	Turb. (NTU)	ORP (mv)	Remarks (odor, clarity, etc.)

Pump Rate: <=0.5 L/min Drawdown: <0.33 ft Measurements: 3-5 min Stabilization: +/-0.5 C, +/-0.1 pH, +/-3% Cond, +/-10% DO, +/-10%Turb(<=10 NTU ideal), for 3 consecutive readings

EQUIPMENT CALIBRATION DAILY LOG

Date:	Project Name:
Project Number:	Recorded By:

PID	Model:		Bulb: 10.6 meV		Morning Calibration	Evening Check	Additional Calib./Check (if necessary)
	Equipment ID #:						
	Parameter	Standard	Exp. Date	Lot #	Time:	Time:	Time:
					Initials:	Initials:	Initials:
First Point Calibration	Vapor conc. (ppm)	0.0 (ambient air)	NA	NA	Value:	Value:	Value:
Second Point Calibration	Vapor conc. (ppm)	(isobutylene)			Value:	Value:	Value:

COMB. GAS/O_2 METER	Model:				Morning Calibration	Evening Check	Additional Calib./Check (if necessary)
	Equipment ID #:						
	Parameter	Standard	Exp. Date	Lot #	Time:	Time:	Time:
					Initials:	Initials:	Initials:
First Point Calibration	O2 (%)				Value:	Value:	Value:
	% LEL Pentane				Value:	Value:	Value:

WATER QUALITY METER	Model:				Morning Calibration/Check	Evening Check (one point only)	Additional Calib./Check (if necessary)
	Equipment ID #:						
	Parameter	Standard	Exp. Date	Lot #	Time:	Time:	Time:
					Initials:	Initials:	Initials:
First Point Calibration (Auto)	pH	4.00			Value:	Value:	Value:
	Conductivity (mS/cm)	4.49			Value:	Value:	Value:
	Turbidity (NTU)	0			Value:	Value:	Value:
	DO (mg/L)	8.9-9.1 (ambient air)	NA	NA	Value:	Value:	Value:
Second Piont Calibration	pH	6.86			Value:	Value:	Value:
	Conductivity (mS/cm)	53.7			Value:	Value:	Value:
	Turbidity (NTU)	100			Value:	Value:	Value:
Third Piont Calibration	pH	9.18			Value:	Value:	Value:
	Conductivity (mS/cm)	53.7			Value:	Value:	Value:
	Turbidity (NTU)	100			Value:	Value:	Value:

Additional Remarks:

Decontamination Record

Project Name:		Project Number:
Recorded By:		Decon Site:
Date:	Time:	Checked By:
Decontamination after borehole/well/sampling point:		

Equipment	Use	Steam/Hot Water	Detergent/Water	Potable Water	Deionized Water	Type II Water	Methanol	Hexane			Equipment Blank Sample ID
Drill Rig Type:											
Drill Rods											
Augers											
Drill Casing											
Drill Bit											
Downhole Hammer											
Soil Sampler ID:											
Brass/Steel Sleeves:											
Pump Type / ID:											
Bowl ID:											
Trowel ID:											
Hand Auger ID:											
Dipper ID:											
GW Equipment Group _____________equipment											
Soil Equipment Group ______________equipment											
Use key: WG - Groundwater Sampling, SS - Soil Sampling, WP- Well Purging, WS – Surface Water Sampling, SE – Sediment Sampling											

Comments (e.g., initial decon, between which locations, or if last decon for the day):

____

____

____

____

Chain of Custody Record

COC Number:

Laboratory: **POC:**	**Project Manager:**	**Mail to:**
Address:	**Phone/Fax Number:**	
	Sampler (print):	
Phone:		
Client:	**Signature:**	**Fed Ex Airbill No:**
Address:		
	pH:	**Program:**
Turn Around Time:		
Project Name/Location:		
Project Number:	***(Required Field)***	**ERPIMS REQUIRED FIELDS**

Site Name	**Sample ID/Location ID**	**SBD**	**SED**	**Date**	**Time**	**Comp▪**	**Grab**	**Matrix**	**Number of Containers**									**SA CODE**	**Cooler ID**	**LOT CONTROL NUMBERS**		
																				ABLOT	**EBLOT**	**TBLOT**
Site Name																						
	Comments:																					

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Received by: (Signature)	Date	Time	Relinquished by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time		Remarks:

▪Homogenize all composite samples prior to analysis

Distribution: White to Laboratory, Canary to Project Manager, Pink QA/QC Manager

Tailgate Safety Briefing Sign-in Log

Date: ____________
Time: ____________

Briefing Conducted By:	Signature:	Company Name:

This sign-in log documents the tailgate safety briefing conducted in accordance with 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" as well as other applicable regulatory requirements. Personnel who perform work operations onsite are required to attend each safety briefing and acknowledge receipt of such briefings daily or as required.

TOPICS COVERED:

❑ General PPE usage	❑ Decontamination Procedures	❑ Emergency Procedures
❑ Hearing Conservation	❑ Smoking Eating and Drinking	❑ Existing Work Zones
❑ Respiratory Protection	❑ Slips, Trips, and Falls	❑ Lockout/Tagout Safety
❑ Personal Hygiene	❑ Heat/Cold Stress	❑ Excavation/Confined Space Safety
❑ Exposure guidelines	❑ Site Control	❑ New Work Procedures

Personnel Sign-in List

Printed Name	Signature	Company Name

Cover System Inspection Report

Landfill 3 (SWMU 105)

Cannon Air Force Base, Curry County, New Mexico

Inspector Name and Title: ______________________________

Days since last rain fall: ______________________________

(Contact Base Weather Service)

Date: ______________________________

Amount of rainfall: ______________________________

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 D

Vegetative Cover Inspections and Maintenance

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.

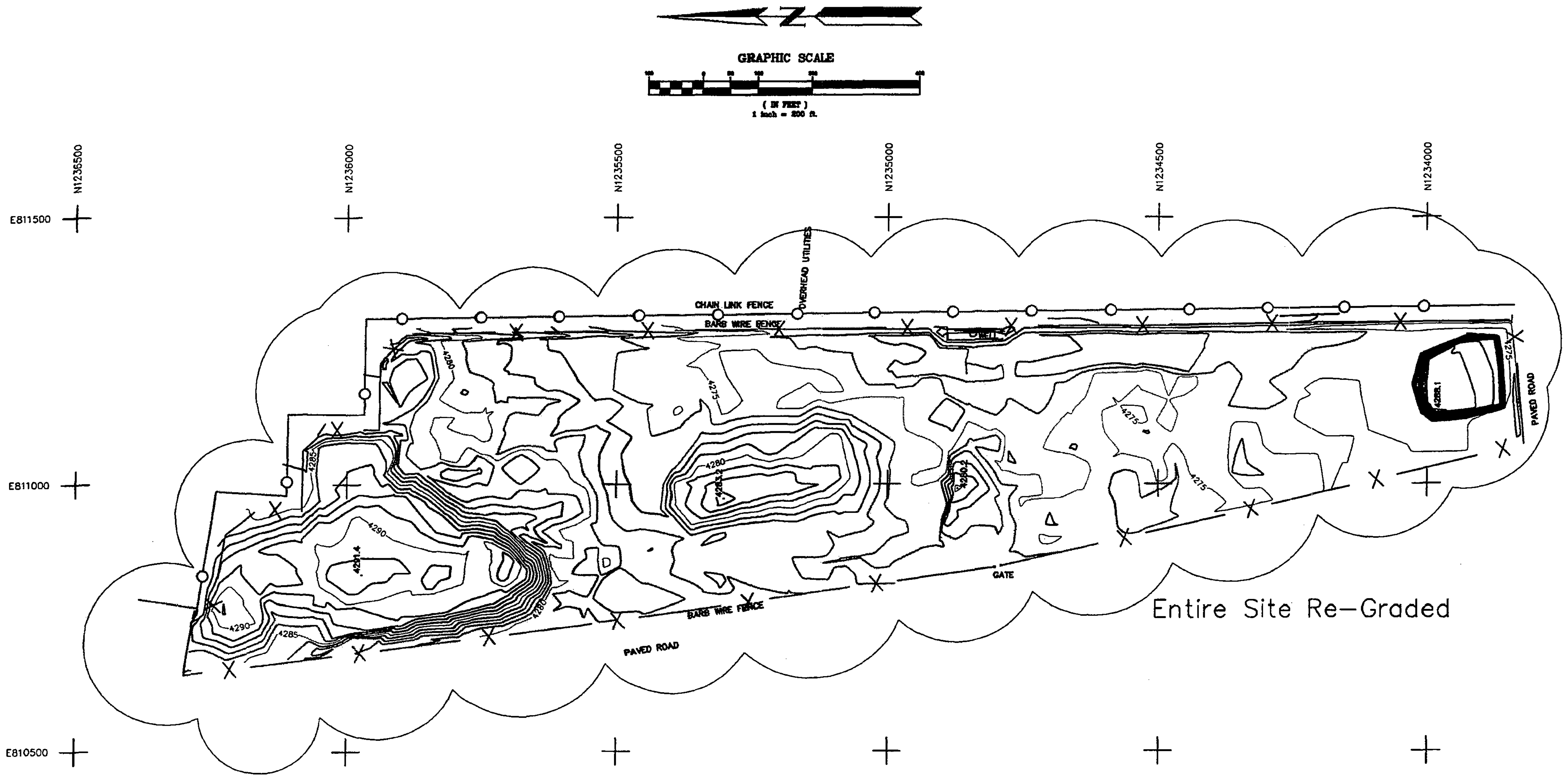
Table 3-2. Summary of Inspection and Maintenance Activities—Landfill No. 25 (LF-25/SWMU 97)

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.



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

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

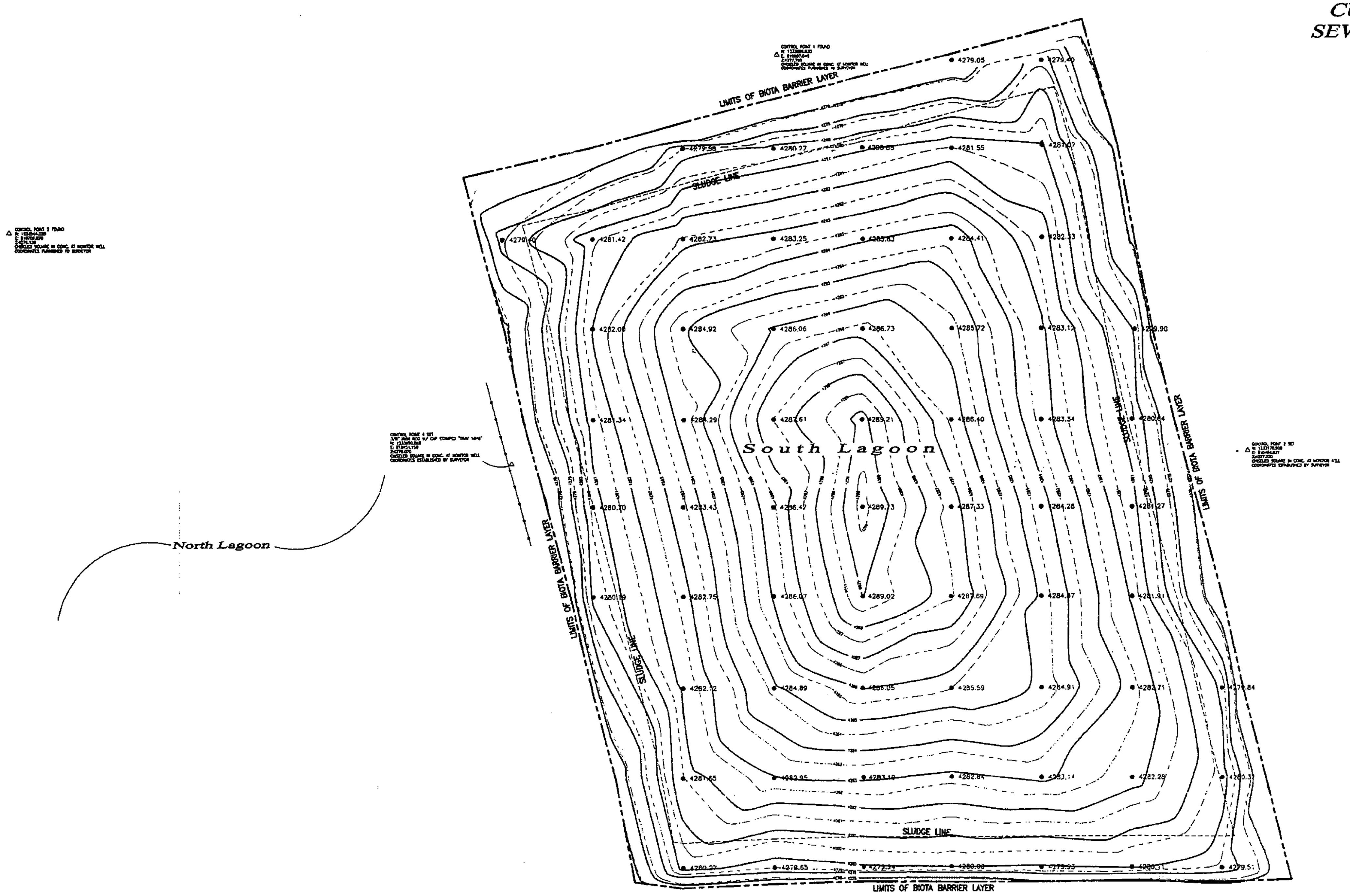
SCALE: 1" = 200' SHEET 1 OF 1

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.
LAND SURVEYORS
P.O. BOX 1248
HEREFORD, TEXAS 79045
hagar@wtrt.net
(806) 364-6084
(806) 364-6088 FAX

**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

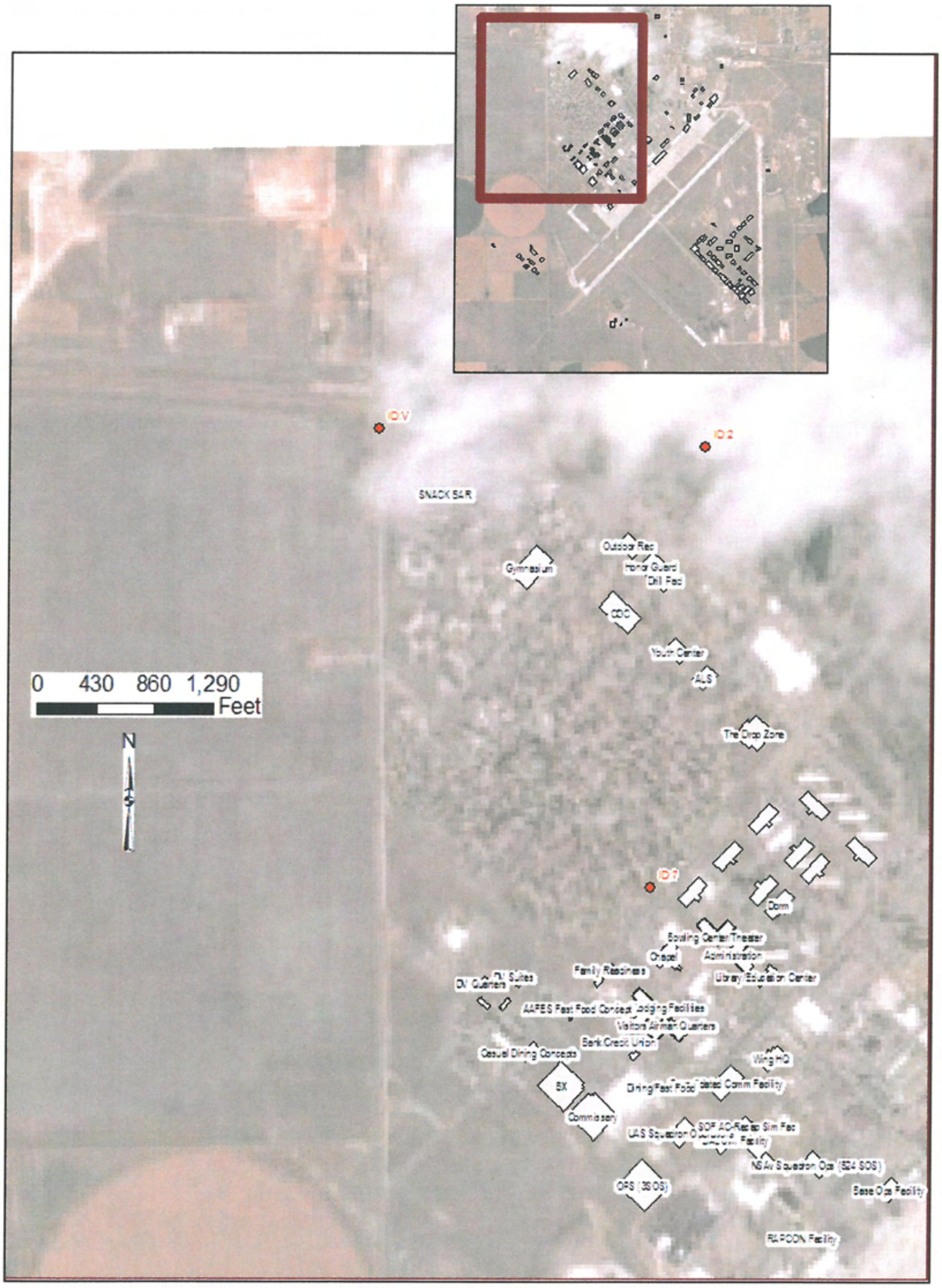
The basic categories of potential repairs at the south lagoon include:

- 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.

APPENDIX E

General Future Base Development Maps (Draft)



CANNON AIR FORCE BASE NORTHWEST
FUTURE BUILDINGS

AECOM

Figure
Future Buildings - Northwest
Cannon Air Force Base
Curry County, New Mexico

CANNON AIR FORCE BASE NORTHEAST FUTURE BUILDINGS

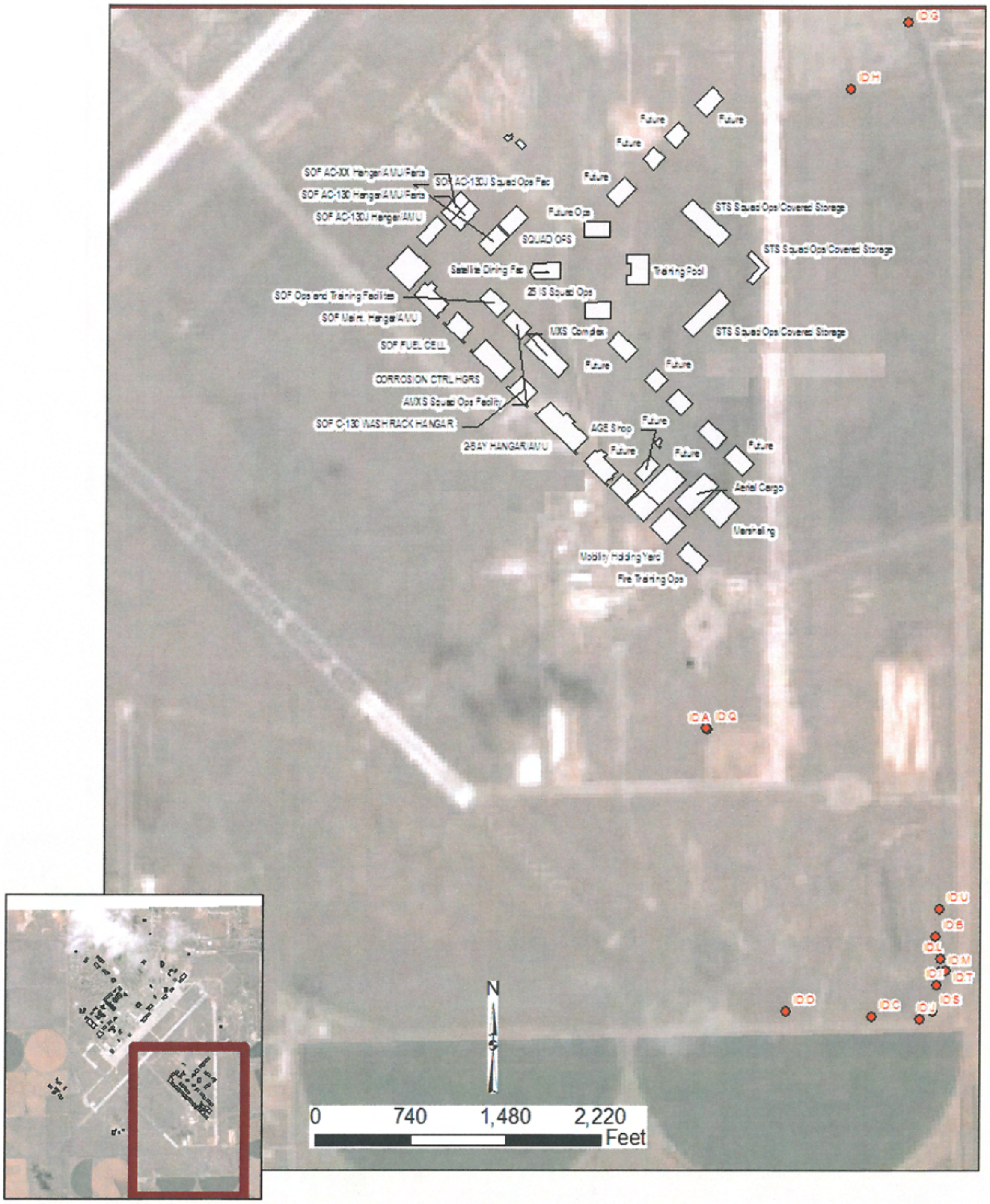
AECOM

Figure
Future Buildings - Northeast
Cannon Air Force Base
Curry County, New Mexico

CANNON AIR FORCE BASE SOUTHWEST FUTURE BUILDINGS

AECOM

Figure
Future Buildings - Southwest
Cannon Air Force Base
Curry County, New Mexico



CANNON AIR FORCE BASE SOUTHEAST FUTURE BUILDINGS

AECOM

Figure
Future Buildings - Southeast
Cannon Air Force Base
Curry County, New Mexico

Northwest Flightline Projects Phasing

Key No.	FY	Project Number	Project Title	Scope (SF)	Cost Opinion ($M)
Phase 1					
1	10	CZQZ063002	Consolidated Communications Facility	44,600	15.2
2	10	CZQZ063035	CV-22 AMU Addition (mezzanine)	Interior	11.8
			Roads and Parking	3,600 (SY)	0.1
			Infrastructure (see Table 6 in the Appendix for more detail)	LS	0.2
Total Phase 1					27.3
Phase 2					
3	11	CZQZ073012	ADAL Simulator Facility for MC-130 (RECAP)	23,680	14.3
			Roads and Parking	NA	0
			Infrastructure (see Table 6 in the Appendix for more detail)	LS	0.1
Total Phase 2					14.4
Phase 3					
4	14	CZQZ063023	CV-22 Squadron Operations Facility	30,000	16.1
5	14	CZQZ063034	ADAL CV-22 Squadron Operations Facility	17,000	7.7
6	15	CZQZ073010	ADAL Simulator Facility for CV-22	15,000	10.0
7	15	CZQZ063033	AMXS Facility	17,000	6.6
			Roads and Parking	3,911 (SY)	0.2
			Infrastructure (see Table 6 in the Appendix for more detail)	LS	0.4
Total Phase 3					41.0
Phase 4—Long Range Projects					
8	XX	TBD	UAS Integrated Operations Center (3 SOS)	40,000	12.8
9	XX	TBD	UAS Squadron Operations (33 SOS)	25,000	6.0
10	XX	TBD	ADAL Simulator Facility for MC-130	23,000	5.7
11	XX	TBD	ADAL Simulator Facility for TBD aircraft	23,000	5.7
12	XX	TBD	ADAL Simulator Facility for AFSOTC Squad Ops	23,000	5.5
13	XX	TBD	CV-22 Taxiway Shoulders/Apron Expansion	11,000 (SY)	2.2
14	XX	TBD	NSAv Squadron Operations (318th SOS)	25,000	6.0
15	XX	TBD	NSAv Squadron Operations (524th SOS)	25,000	6.0
16	XX	TBD	NSAv Maintenance Hangar (524th SOS)	90,000	30.0
17	XX	TBD	RAPCON Facility	6,000	1.8
18	XX	TBD	27th SOW Headquarters	26,400	9.7
19	XX	TBD	Base Operations Facility	15,000	4.3
20	XX	TBD	Satellite AGE	3,600 (SY)	0.2
21	XX	TBD	Aircraft Parking Apron expansion (North End of Flightline)	78,806 (SY)	23.6
22	XX	TBD	Vehicle Maintenance Operations	12,000	3.6
23	XX	TBD	Vehicle Maintenance Shop	11,000	3.4
24	XX	TBD	Vehicle Maintenance Shop	16,000	4.7
25a/b	XX	TBD	Vehicle Operations/Covered Storage/Yard	5,000/5,600 50,000	3.0
26	XX	TBD	Refueler Parking	4,800 (SY)	3.3
27	XX	TBD	Refueler Maintenance	6,000	2.0
28	XX	TBD	POL Operations/Dispatch	3,000	1.1
29	XX	TBD	FARP storage	2,400 (SY)	1.6
30	XX	TBD	Aircraft Parking Apron expansion (South End of Flightline)	16,178 (SY)	5.0
31	XX	TBD	Replace Hangar 119	38,000	13.6
32	XX	TBD	Replace Hangar 208	66,000	22.0
33	XX	TBD	Replace Hangar 204	22,500	8.5
34	XX	TBD	ADAL Base Supply	20,000	3.1
			Roads and Parking	133,000 (SY)	5.0
			Sidewalks	9,462 (SY)	0.3
			Infrastructure (see Table 6 in the Appendix for more detail)	LS	5.6
Total Phase 4					205.3
Total all Phases					288.0

Southeast Flightline ADP Project Phasing

Key No.	FY	Project Number	Project Title	Scope (SF)	Cost Opinion ($M)
Programmed Projects					
Phase 1					
1	09	CZQZ043010	SOF C-130 Maintenance Hangar/AMU	38,300	18.1
2a/b	10	CZQZ063019	SOF Fuel Cell Hangar	31,096	42.0
			SOF Corrosion Control Hangar	57,674	
			Roads/Parking	13,542 (**SY**)	0.6
			Infrastructure—Electrical Substation	1 (ea)	1.0
			Infrastructure—Electrical Distribution, Switches, Transformers—Manholes, and Surface Light Poles	1 (LS)	4.0
			Infrastructure—Communication Network Expansion	1 (LS)	2.5
			Infrastructure—Sanitary Sewer Collection Mains, Lift Station	1 (LS)	1.0
			Infrastructure—Water Main Distribution	1 (LS)	0.7
			Infrastructure—Aerial Water Tank Storage	1 (ea)	0.9
			Infrastructure—Natural Gas Main Extension	15,197	0.8
			Infrastructure—Storm Water Collection and Conveyance	1 (LS)	0.9
Total Phase 1					72.5
Phase 2					
3	11	CZQZ063052	SOF Ops and Training Facilities (MC-130 Sq Ops and RST)	27,709	11.2
4	11	CZQZ063051	SOF C-130 Aircraft Parking Apron, Phase 1	46,594 (**SY**)	13.6
5	11	CZQZ063054	SOF C-130 Parking Apron (RECAP), Phase 1	111,166 (**SY**)	28.0
6	11	CZQZ063049	SOF C-130 Hangar/AMU (Two-Bay)	66,699	26.5
7	12	CZQZ073014	SOF AC-130 Squadron Operations Facility	36,315	14.4
8	12	CZQZ073018	SOF C-130 Wash Rack Hangar	25,000	11.1
			Roads/Parking	9,369 (**SY**)	0.4
			Infrastructure—Electrical Distribution, Switches, Transformers, Manholes and Surface Light Poles	1 (LS)	0.3
			Infrastructure—Communication Network Expansion	1 (LS)	0.2
			Infrastructure—Sanitary Sewer Collection Mains,	1 (LS)	0
			Infrastructure—Water Main Distribution	1 (LS)	0.1
			Infrastructure—Natural Gas Main Extension	1 (LS)	0.1
			Infrastructure—Storm Water Collection and Conveyance	1 (LS)	1.1
Total Phase 2					107.0
Phase 3					
9	13	CZQZ073023	Satellite Dining and Fitness Center	25,020	12.3
10	14	CZQZ073015	SOF AC-130 Munitions Loadout Apron, Phase 1	calculate	17.0
11	14	CZQZ083011	SOF AC-RECAP Apron and Taxiway	67,291 (**SY**)	24.5
12	14	CZQZ083012	SOF AC-RECAP Hangar/AMU/Aircraft Parts Store	66,726	27.0
13	15	CZQZ083013	SOF AC-RECAP Combat Parking Apron	65,129 (**SY**)	22.4
14	15	CZQZ083016	SOF AC-RECAP Squadron Operations Facility	28,000	20.0
15	15	CZQZ073021	SOF AMXS Facility	25,000	15.5
			Roads/Parking	12,717 (**SY**)	0.5
			Infrastructure—Electrical Distribution, Switches, Transformers, Manholes and Surface Light Poles	1 (LS)	0.4
			Infrastructure—Communication Network Expansion	1 (LS)	0
			Infrastructure—Sanitary Sewer Collection Mains,	1 (LS)	0.3
			Infrastructure—Water Main Distribution	1 (LS)	0.1
			Infrastructure—Natural Gas Main Extension	1 (LS)	0
			Infrastructure—Storm Water Collection and Conveyance	1 (LS)	0.5
Total Phase 3					140.5

Southeast Flightline ADP Project Phasing

Key No.	FY	Project Number	Project Title	Scope (SF)	Cost Opinion ($M)
Programmed Projects					
Phase 4					
16a	XX	CZQZ063029	SOF STS Squadron Operations Facility/Pool/Storage	55,000	30.0
16b	XX	TBD	SOF STS Squadron Operations Facility	27,500	20.0
17	XX	CZQZ063050	SOF MC-130 Squadron Operations (RECAP)	28,000	20.0
18	XX	CZQZ073025	Satellite Fire Station	15,000	4.6
19	XX	TBD	SOF AC-RECAP Hangar/AMU	38,000	18.0
20	XX	TBD	SOF AC-RECAP Squadron Operations	28,000	20.0
21	XX	CZQZ063032	SOF MRSP Storage Facility[1]	50,000	7.0
22	XX	TBD	SOF Aircraft Parts Storage[1]	10,000	1.3
23	XX	TBD	MXS Complex[1]	58,000	16.5
24a/ 24b/ 24c	XX	TBD	AGE Shop, Covered Storage/ AGE Outdoor Storage/ Satellite AGE Outdoor Storage[1]	18,000/ 12,000/ 5,980 (**SY**)	12.5
25	XX	TBD	Refueler Parking	5,980 (**SY**)	0.4
26	XX	TBD	Satellite POL complex	calculate	0.5
27	XX	CZQZ073001	Deployment Control Center (DCC)[1]	40,000	13.8
28	XX	TBD	Marshaling Yard	4,276 (**SY**)	0.3
29	XX	CZQZ073019	SOF Mobility Aerial Delivery Facility	26,000	6.2
30	XX	TBD	Outdoor Fitness Fields	LS	0.6
31	XX	CZQZ063055	SOF C-130 Parking Apron (RECAP), Phase 2	calculate	17.0
32	XX	TBD	Maintenance Training Facility	35,000	12.4
33	XX	CZQZ073026	SOF Fuselage Trainer Facility (MC-130 and CV-22)	28,000	6.0
34	XX	TBD	SOF FuT (MC-130 RECAP)	28,000	6.0
			Roads	13,473(**SY**)	0.5
			Infrastructure—Electrical Distribution, Switches, Transformers, Manholes, and Surface Light Poles	1 (LS)	2.3
			Infrastructure—Communication Network Expansion	1 (LS)	0.2
			Infrastructure—Sanitary Sewer Collection Mains,	1 (LS)	0.2
			Infrastructure—Water Main Distribution	1 (LS)	0.3
			Infrastructure—Natural Gas Main Extension	1 (LS)	0.2
			Infrastructure—Storm Water Collection and Conveyance	1 (LS)	0.8
Total Phase 4					232.9
Total All Phases					**553.0**

[1]All estimates based on FY 15 construction with a two year construction duration.