



DEPARTMENT OF THE AIR FORCE **ENTERED**  
27TH SPECIAL OPERATIONS CIVIL ENGINEER SQUADRON (AFSOC)  
CANNON AIR FORCE BASE NEW MEXICO



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Mr. Gabriel Acevedo  
Environmental Scientist & Specialist-Operational  
New Mexico Environment Department  
Hazardous Waste Bureau  
2905 Rodeo Park Drive East, Bldg. 1  
Santa Fe NM 87501

Dear Mr. Acevedo:

Cannon Air Force Base is pleased to provide the amended replacement pages for the “*Monitoring Well Abandonment and Installation Work Plan*” as requested by NMED in the 7 July 2017 “Approval with Modifications” letter. Also included are responses to NMED comments and electronic copies of these files to include an MS Word file with redlines.

Cannon AFB appreciates the valued working relationship established with you and your department. If you have further comments or questions pertaining to the referenced replacement pages and Response Letter, please contact Steven Palmer, [steven.palmer@us.af.mil](mailto:steven.palmer@us.af.mil) (575) 904-6744 or Sheen T. Kottkamp, [sheen.kottkamp.ctr@us.af.mil](mailto:sheen.kottkamp.ctr@us.af.mil) (575) 904-6743.

Sincerely,

Steven Leonard Palmer

Attachments:

Replacement Pages; Monitoring Well Abandonment and Installation Work Plan  
Response Letter

# Common Comment and Response Worksheet (Version 3)

Date		Reviewer					Document Title (version)	Contract/TO Number
7-Jul-17		NMED					<b>Monitoring Well Abandonment and Installation Work Plan</b>	<b>FA8903-13-C-0008</b>
Item	Source	Section	Page	Para	Line	Class	Comment	Response
1		Well Completion, Screen Lengths	3				In order to prevent the dilution of detected chemicals of concern, the submerged portion of the well screen must not exceed 30-feet for replacement monitoring wells MW-Sa, MW-Ta, and MW-Ua. The well screens for replacement monitoring wells MW-Sa, MW-Ta, and MW-Ua must be set with approximately three feet of screen above the groundwater table and 32-feet of screen below the groundwater table for a maximum length of 35-feet of screen for each monitoring well. Revise the Work Plan to reflect the required change to the replacement monitoring well screen lengths.	Agree. The screen lengths for wells MW-Sa, MW-Ta, and MW-Ua will be revised in the table. A note will be added to the table reading "Top of screen will be based on field observations of water table during drilling. Top of screen will be placed approximately 3' above top of water." Additionally, the following will be added to the text on page 3: "Screen placement will be based on field observations of groundwater depth during drilling. Top of screen will be placed approximately 3 feet above the water table."
2		Field Activities Documentation Reporting					The results of monitoring well abandonment, new monitoring well installation, monitoring well development, and groundwater sampling activities must be provided in a summary report that includes descriptions of all field activities, data collection, and supporting documentation. The Report must be provided to NMED no later than 90 days following completion of the proposed field activities. Revise the Work Plan to include the reporting requirements.	Agree. A "Reporting" section will be added to the text after "Investigation Derived Waste and Waste Characterization" that reads "The results of monitoring well abandonment, new monitoring well installation, monitoring well development, and groundwater sampling activities will be provided in a summary report that includes descriptions of all field activities, data collection, and supporting documentation. The After Action Report will be provided to NMED no later than 90-days following completion of the proposed field activities."

- Column A: Comment Identifier Number
- Column B: Source (Commenter/Authority)
- Column C: Section Number of Comment
- Column D: Page Number of Comment (first page associated with comment)
- Column E: Paragraph number, on page, of Comment
- Column F: Line Number (within Paragraph above) of Comment
- Column G: Comment Classification
- Column H: Comment
- Column I: Response
- Notes: Comments must be actionable ("add the following text:...", "delete...", "change text to:")  
Place only one comment per row.  
Classify comment as C, M, S, or A.

Comment Classifications
<p><b>(C) Critical:</b> Critical comments will result in a critical issue. Provide convincing support.</p> <p><b>(M) Major:</b> Major comments are significant concerns that may result in a major issue. This category may be used with a general statement of concern followed by a detailed comment on the specific entries in the document that, considered in total, constitute the concern.</p> <p><b>(S) Substantive:</b> An entry in the document that appears to be or is potentially unnecessary, misleading, incorrect, or confusing.</p> <p><b>(A) Administrative:</b> Administrative comments correct inconsistencies between different sections, typographical and grammatical errors.</p>

**TECHNICAL MEMORANDUM**  
**MONITORING WELL ABANDONMENT AND INSTALLATION WORK PLAN**

**Revision 1.0**

*for*

**PERFORMANCE-BASED REMEDIATION  
CANNON AIR FORCE BASE  
CLOVIS, NM  
Contract Number: FA8903-13-C-0008**

*Prepared for:*



**AIR FORCE CIVIL ENGINEER CENTER  
2261 Hughes Ave., Suite 155  
Joint Base San Antonio Lackland AFB, Texas 78236-9853**

*Prepared by:*

**FPM** Remediations, Inc.

181 Kenwood Avenue  
Oneida, NY 13421

July 2017

## Monitoring Well Abandonment and Installation Work Plan – Cannon Air Force Base

<p>Primary Purpose</p>	<p>This work plan describes the abandonment of three groundwater monitoring wells and the installation of six groundwater monitoring wells at two sites at Cannon Air Force Base (AFB), Clovis, New Mexico. A site location map can be found on <b>Figure 1-1</b>.</p> <p>This work is being completed for the United States Air Force Civil Engineer Center (AFCEC) under the New Mexico - Arizona Group Performance-Based Remediation Contract (Contract Number FA8903-13-C-0008).</p> <p>During a groundwater sampling event at Cannon AFB in June 2016, monitoring wells MW-S, MW-T, and MW-U at Solid Waste Management Unit (SWMU) 113 (LF005) (as shown on <b>Figure 1-2</b>) could not be purged using low flow methods due to insufficient recharge. Upon further investigation, it was determined the water levels at these three wells have dropped below the bottom of their respective screens. Therefore, these wells are no longer suitable for monitoring groundwater and will be replaced.</p> <p>Additionally, the water levels at monitoring well MW-C at LF005, as shown on <b>Figure 1-2</b>, and MW-F and MW-G at SWMU 101 (SI101), as shown on <b>Figure 1-3</b>, are approximately 14 feet above the top of the screen at MW-C, and 30 feet above the top of the screen at MW-F and MW-G. Therefore, clustered wells will be installed adjacent to these wells that are screened across the water table in order to detect potential contamination in groundwater that is above the current screened intervals at these wells.</p>
<p>Conceptual Model</p>	<p>Groundwater at Cannon AFB is monitored for potential impacts from historical activities at landfills LF003, LF004, LF005, LF025, and/or sewage lagoon SI101. The six monitoring wells included in this work plan are being installed to comply with the approved landfill inspection work plan addendum (FPM/URS 2014). This work plan requires biennial groundwater sampling of 11 groundwater wells at Cannon AFB. The required monitoring wells included MW-C, MW-F, MW-G, MW-S, MW-T, and MW-U. Therefore, these replacement wells will be installed to sample the groundwater at the correct screened interval (at the soil/groundwater interface).</p>
<p>Well Abandonment</p>	<p>Monitoring wells MW-S, MW-T, and MW-U will be abandoned due to water levels dropping below the screening depth. A review of historical data showed the 4-inch Schedule 80 wells were installed by the United States Geological Survey to depths of about 366 feet with 40-foot sumps beneath 40-foot long screens.</p> <p>A drill rig with a 32-foot mast will be positioned next to the well such that the winch can be used to lower threaded tremie pipe to the bottom of the well. Batches of Portland cement/bentonite grout will be mixed at approximately 250 gallons at a time and pumped through the tremie pipe to the bottom of the well, filling the well from the bottom to the ground surface. After the well casing has been filled, the tremie pipe will be removed. The</p>

## Monitoring Well Abandonment and Installation Work Plan – Cannon Air Force Base

	<p>well casing will be cutoff below grade and the surface completion (well casing, concrete pad, bollards, etc.) removed. Grout will be topped off as needed following settling of cement/grout mix. Typically, settling will occur within a 24 to 48 hour timeframe. Surface restoration may include, but is not limited to, placing topsoil within impacted areas to grade and reseeded. Daily field notes/logs will be completed in bound sequentially numbered field books and included in the report. Notes will include depth measurement, volume of cement/bentonite used to plug the well, and other field activities associated with the abandonment.</p> <p>The monitoring well abandonment and installation activities described hereafter, will be performed in accordance with New Mexico Environment Department (NMED) Groundwater Quality Bureau Monitoring Well Construction and Abandonment Guidelines Revision 1.1, March 2011 and the Cannon AFB Resource Conservation and Recovery Act Permit requirements. Notification of all monitoring well abandonment and installations will be provided to the NMED and will include copies of either the well plugging record or well installation record and log as specified in 19.27.4 New Mexico Administrative Code (NMAC).</p>
Drilling Approach	Six monitoring wells will be installed using sonic drilling methods to varying depths as specified in <b>Table 1-1</b> . Sonic drilling utilizes a rotary vibratory drill. The drill head is capable of rotary motion as well as oscillation. The drill bit is physically vibrated up and down in addition to being pushed down and rotated. Sonic drilling provides a continuous undisturbed core sample to allow for accurate logging of subsurface soils.
Hydrogeologic and Geochemical Objectives	The monitoring wells are being installed as replacement wells for existing wells included in the biennial groundwater monitoring plan for landfills at Cannon AFB. Monitoring wells MW-F and MW-G evaluate potential impact from SI101 to groundwater. Monitoring wells MW-C, MW-S, MW-T, and MW-U evaluate potential impact from LF005 to groundwater.
Potential Groundwater Occurrence and Detection	Groundwater is anticipated to be encountered at depths ranging from 316 to 340 feet below ground surface (bgs) (approximately). As the wells are replacements for existing wells, the depth to groundwater was identified during the 2016 sampling event and is included in <b>Table 1-1</b> .
Groundwater Screening and Characterization	No groundwater screening or characterization sampling is currently planned or anticipated.
Geophysical Logging	Soil cores will be extruded into clear plastic sleeves. The borings will be sampled continuously for lithology identification by an FPM or URS geologist and recorded in boring logs using the Unified Soil Classification System.
Well Completion	Monitoring wells are to be installed inside the sonic casing when target depth

## Monitoring Well Abandonment and Installation Work Plan – Cannon Air Force Base

	<p>is reached. The well will be hung inside the casing, and filter pack will be placed by pouring sand in the casing and vibrated into place using the sonic rig. Monitoring wells are to be constructed using 4-inch inside diameter, schedule 80, flush-joint threaded polyvinyl chloride (PVC) risers. Screens will be a 0.010-inch stainless steel, wire-wrapped screen. Screen lengths for replacement wells MW-Sa, MW-Ta, and MW-Ua will be 40 feet. Screen lengths for clustered wells are 20 feet for MW-Ca and 35 feet for MW-Fa and MW-Ga. The screen lengths at MW-Sa, MW-Ta, and MW-Ua are based on the depth of water to the bottom of the Ogallala Formation. Screen placement will be based on field observations of groundwater depth during drilling. Top of screen will be placed approximately 3 feet above the water table. The screen lengths at MW-Ca, MW-Fa, and MW-Ga are based on the depth of water from the 2016 sampling event and the depth to the top of the screen in the existing wells. Surface completion will consist of a steel protective casing with locking lid and a 3-foot by 3-foot by 6-inch concrete pad set in the ground. Well construction details will be provided in a monitoring well construction log. A representative log is provided in <b>Attachment A</b>.</p> <p>All drilling equipment used in monitoring well installation is to be decontaminated prior to use, between samples, and at completion of installation. Standard environmental decontamination methods, such as steam cleaning or Alconox-hot water wash of rods with a clean water rinse, will be employed.</p> <p>Following well installations, the horizontal coordinates and elevation of the measuring point on the top of the well riser will be surveyed by a surveyor licensed in the State of New Mexico. Horizontal coordinates for all new monitoring wells will be measured to the nearest 1.0 foot and referenced to the State Plane Coordinate System. Elevations will be measured at the top of the well casing to the nearest 0.01 foot. All elevation measurements will be referenced to NAD 83. The measurement point on the top of the well casing will be clearly and permanently marked for future water level measurements. Monitoring well identification tags will be installed in accordance with applicable guidelines. The measuring point for monitoring wells shall always be the north rim of the top of casing. The measuring point should either be notched, or it should be noted that the north side of the casing is the reference point.</p>
Well Development	<p>The development of a newly installed monitoring well shall proceed only after the neat cement grout has been allowed to set for a minimum of 72 hours (if neat cement grout was used for the annular seal). Wells will be developed by pumping without using acids, flocculents, disinfectants, or dispersing agents. All purged water will be containerized. Well development will be completed by pumping and surging. During development, the pump inlet will be moved through the entire screened interval. The development</p>

## Monitoring Well Abandonment and Installation Work Plan – Cannon Air Force Base

	<p>procedure will continue until the following conditions are met:</p> <ul style="list-style-type: none"><li>• Water is clear to the unaided eye, free of sand, and free of drilling fluids</li><li>• Thickness of the accumulated sediment in the well is less than 5 percent of the length of the well screen</li><li>• Temperature, pH, turbidity, and specific conductance values stabilize</li><li>• A volume of water equal to five times the volume of standing water in the well and three times any potable water added during filter pack installation has been removed from the well. One well volume will be taken to be the sum of the volume of water within the annulus assuming 30 percent porosity in the annulus, and using the height of the water column in the well at the time just prior to development.</li></ul> <p>If after 4 hours of well development the groundwater is not clear and free of sand, AFCEC will be contacted for consultation and further instructions. After final development of each well, approximately 1 liter (or 32 ounces) of water from the well will be collected in a clear glass jar, labeled, and digitally photographed. The photograph will be submitted as part of the well development log. The photograph will be a suitably back-lit close-up to show the clarity of the water.</p> <p>The procedure for well development is outlined below:</p> <ol style="list-style-type: none"><li>1. All equipment that comes into contact with the monitoring well will be decontaminated before and after use by placing the equipment into a wash tub containing Alconox or low-sudsing, non-phosphate detergent along with potable water, and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub.</li><li>2. Verify that the water quality multi-meter (pH, temperature, conductivity), as well as nephelometric turbidity meter (or multi-parameter probe), and water level probe are operating properly. The electronic water quality instruments require daily calibration before use and must have the calibration verified at approximately the middle of that day's work. Calibration times and readings shall be recorded in the field log book. Specific instructions for calibrating the various water quality instruments are provided in instrument-specific instruction manuals.</li></ol>
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Monitoring Well Abandonment and Installation Work Plan – Cannon Air Force Base

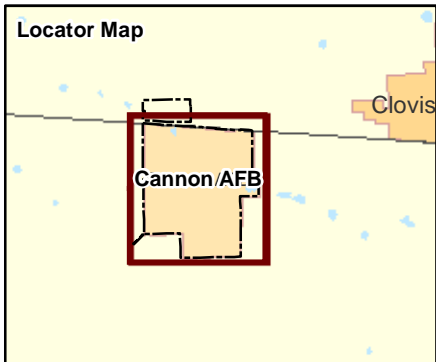
	<p>3. Monitoring wells shall be developed using a submersible pump to flush the screen, sand pack material, and borehole wall of fine sediment resulting from well drilling and installation activities. This procedure also allows for the removal of fine sediment which may have accumulated within the well casing.</p> <p>4. Determine the water column height in the well by measuring the well depth and the depth to water, referencing both measurements to the top of casing. Subtract the depth to water from the well depth to obtain the water column height. The volume of water in one well volume is calculated using the following equation:</p> <p align="center">4-inch well volume = water column height in well (feet) × 0.653 gallons/foot = gallons/one well casing volume</p> <p>5. Remove a minimum of three to five well casing volumes of water during repeated surging and water removal episodes. Well surging is the process of causing water to move through the screen and into and out of the sand pack and aquifer formation. Surge the well by gently raising and lowering the bailer or pump along the entire length of well screen. Remove water from throughout the entire water column by periodically lowering and raising the pump intake or bailer. Collect the development water in drums to be stored in the lay down area until analytical testing for investigation-derived waste (IDW) is completed.</p> <p>6. Measure and record the temperature, pH, nephelometric turbidity, and specific conductivity at the start of development and once for each well volume of water removed during development. Also observe and record the water clarity, color, and presence of odors.</p> <p>Continue to remove water and measure field parameters until three to five well casing volumes and three times any potable water added during filter pack installation have been removed, field parameters have stabilized to within 10 percent or 0.1 units for three consecutive measurements, and the water is as clear of sediment as practical. The turbidity goal during well development is less than or equal to 10 Nephelometric Turbidity Units (NTUs). However, turbidity measurements less than or equal to 50 NTUs are acceptable. Regardless of water clarity, a minimum of three to five well volumes of water shall be removed during the bailing/surging phase of well development. If the well is bailed dry, allow the water to recover and continue development.</p>
Hydraulic	No hydraulic testing is currently planned or anticipated.



## Monitoring Well Abandonment and Installation Work Plan – Cannon Air Force Base

Testing and Groundwater Sampling	Groundwater samples collected will be collected from each well following development and analyzed for volatile organic compound (VOCs), target analyte list (TAL) metals (including mercury), chromium VI, perchlorate, chloride, nitrate/nitrite, sulfate, ammonia, total organic carbon (TOC), and field water quality parameters (pH, dissolved oxygen [DO], specific conductance, turbidity, and temperature). All analytical methods and sampling methods identified in the approved landfill work plan addendum (FPM/URS 2014) will be utilized.	
Investigation Derived Waste and Waste Characterization	<p>IDW will consist of soil cuttings, decontamination water, and purge water. Excess soil generated during the well installation activities will be containerized in an on-site roll-off box. A soil sample will be composited and submitted to the laboratory for analysis. Analytical results for soil will be compared to applicable screening standards. If analytical results from the soil IDW indicate contamination is below applicable screening standards, the soil IDW will be disposed of properly in accordance with local and federal regulations. Soil IDW determined to be hazardous will be shipped to a licensed waste disposal facility using a licensed waste disposal contractor.</p> <p>Decontamination water and purge water generated during monitoring well development and sampling will be containerized in 55-gallon drums or large polyethylene tanks. Since the decontamination fluids will start as clean potable water, decontamination fluids will likely contain minimal contamination. A water sample will be collected from each of the drums/storage tanks and submitted to the laboratory for analysis. Analytical results for water will be compared to applicable screening standards.</p>	
Reporting	The results of monitoring well abandonment, new monitoring well installation, monitoring well development, and groundwater sampling activities will be provided in a summary report that includes descriptions of all field activities, data collection, and supporting documentation. The After Action Report will be provided to NMED no later than 90-days following completion of the proposed field activities.	
Schedule	Dig permit meeting	July 27, 2017
	Mobilization of equipment Well Installation Monitoring Well Abandonment Well Sampling	July 31, 2017 – September 22, 2017
References	FPM/URS 2014. Final Work Plan Addendum for Landfills and Institutional Control Inspection Sites. Cannon Air Force Base, New Mexico. June 16.	







**Legend**

- Base Boundary
- Site Boundary

Map projection: NAD83 State Plane Feet  
New Mexico East (FIPS 3001)

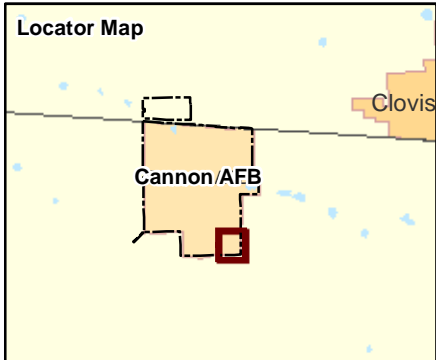

  


**Site Location Map**  
Cannon Air Force Base, New Mexico

Drawn By: DPG	Date: 11/30/2016	Project No. 23446539	
Checked By: MS	Revision: 0		Figure 1-1

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- Legend**
- Monitoring Well
  - Base Boundary
  - Site Boundary

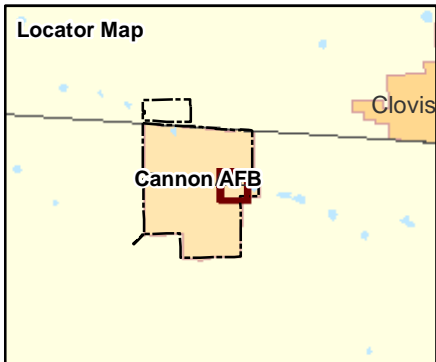
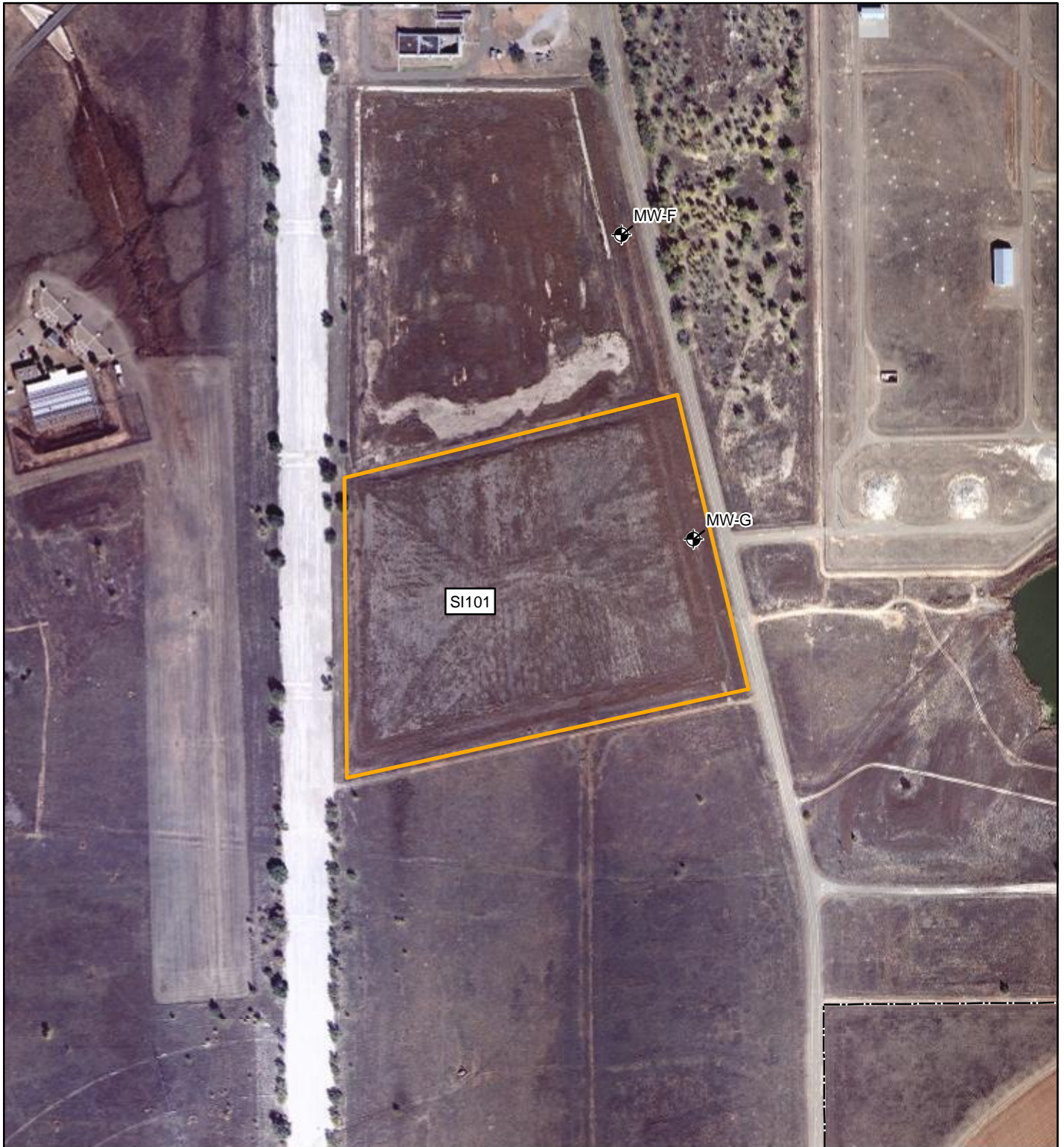
Map projection: NAD83 State Plane Feet  
New Mexico East (FIPS 3001)






**LF005 Location Map**  
Cannon Air Force Base, New Mexico

Drawn By: DPG	Date: 12/1/2016	Project No. 23446539	Figure 1-2
Checked By: MS	Revision: 0		





- Legend**
-  Monitoring Well
  -  Base Boundary
  -  Site Boundary

Map projection: NAD83 State Plane Feet  
New Mexico East (FIPS 3001)



<b>SI101 Location Map</b> Cannon Air Force Base, New Mexico			
Drawn By: DPG	Date: 12/1/2016	Project No. 23446539	Figure 1-3
Checked By: MS	Revision: 0		

**TABLE 1-1  
WELL ABANDONMENT AND INSTALLATION  
CANNON AFB, NEW MEXICO**

<b>Well Identification</b>	<b>TOC Elevation (feet amsl) (NAVD 88)</b>	<b>Top of Screen (feet bgs)</b>	<b>Bottom of Screen (feet bgs)</b>	<b>Screen Length (feet)</b>	<b>Sump Length (feet)</b>	<b>Bottom of Well (feet bgs)</b>	<b>Boring Depth (feet bgs)</b>	<b>April 2016 Groundwater Elevation (feet bgs)</b>
MW-C	4268.90	346.60	361.60	15	--	361.60	362.00	332.26
MW-F	4280.84	349.55	364.55	15	5	369.55	375.00	316.36
MW-G	4281.55	350.90	365.90	15	--	365.90	372.00	320.03
MW-S	4265.75	284.87	324.87	40	40	364.87	365.00	335.06
MW-T	4265.72	284.57	324.57	40	40	364.57	365.00	340.42
MW-U	4267.30	284.14	324.14	40	40	364.14	365.00	329.42
MW-Ca <sup>1</sup>	TBD	327*	347	20	--	347.00	TBD	332.26
MW-Fa <sup>1</sup>	TBD	315*	350	35	--	350.00	TBD	316.36
MW-Ga <sup>1</sup>	TBD	315*	350	35	--	350.00	TBD	320.03
MW-Sa <sup>2</sup>	TBD	330*	365	35	--	370.00	TBD	335.06
MW-Ta <sup>2</sup>	TBD	330*	365	35	--	370.00	TBD	340.42
MW-Ua <sup>2</sup>	TBD	330*	365	35	--	370.00	TBD	329.42

**Notes:**

<sup>1</sup> Indicates clustered well.

<sup>2</sup> Indicates replacement well.

\* Top of screen will be based on field observations of water table during drilling. Top of screen will be placed approximately 3' above top of water.

Shaded boxes indicate well has not yet been installed. Boxes containing values are proposed depths and screen intervals.

Existing wells were measured using NAVD 88 system, however, newly installed wells will be measured using North American Datum (NAD) 83 system.

**Acronyms and Abbreviations:**

NAVD 88 = North American Vertical Datum of 1988

AFB = Air Force Base

TBD = to be determined



amsl = above mean sea level

bgs = below ground surface

# MONITORING WELL CONSTRUCTION LOG

**Project Name** \_\_\_\_\_  
**Location** \_\_\_\_\_  
**Installed By** \_\_\_\_\_  
**Inspected By** \_\_\_\_\_  
**Method of Installation** \_\_\_\_\_  
**Remarks** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Piez./Well No.** \_\_\_\_\_  
**Project No.** \_\_\_\_\_  
**Date** \_\_\_\_\_ **Time** \_\_\_\_\_

		AGS Elevation (feet)	
Type of guard posts		_____ / _____	
	Elevation of top of	_____ / _____	
	Height of riser above ground	_____ / _____	
	Ground	_____ / _____	
<b>Generalized Stratigraphy</b> 	I.D./Type of surface casing	BGS Elevation (feet)	_____ / _____
	Type of surface seal	_____ / _____	
	Depth of surface	_____ / _____	
	I.D./Type of riser pipe	_____ / _____	
	Type of backfill	_____ / _____	
	Depth to top of seal	_____ / _____	
	Type of seal	_____ / _____	
	Depth of top of filter pack	_____ / _____	
	Depth of top of screen	_____ / _____	
	Type of filter	_____ / _____	
	I.D./Type of screen	_____ / _____	
	Screen slot size	_____ / _____	
	Depth of bottom of screen section	_____ / _____	
	Type of backfill below observation well	_____ / _____	
	Depth of bottom of boring	_____ / _____	
	Diameter of boring	_____ / _____	