FINAL

PARCEL 3 GROUNDWATER RCRA FACILITY INVESTIGATION SUPPLEMENTAL SAMPLING WORK PLAN

FORT WINGATE DEPOT ACTIVITY
MCKINLEY COUNTY, NEW MEXICO

April 2023

Contract No. W912PP21C0028

Prepared for:

U.S. Army Corps of Engineers®

Albuquerque District
4101 Jefferson St. NE
Albuquerque, New Mexico 87109

Prepared by:

NDN Sundance JV, LLC
3740 St. Johns Bluff Road South, Suite 10
Jacksonville, Florida 32224

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JohnDavid Nance, NDN Sundance JV, LLC
McKenze Booth, NDN Sundance JV, LLC

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
NDN Sundance JV, LLC
3740 St. Johns Bluff Road South, Suite 10
Jacksonville, Florida 32224

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14. ABSTRACT
This Parcel 3 Groundwater RCRA Facility Investigation Supplemental Sampling Work Plan outlines the activities and methodologies to sample groundwater monitoring wells within and adjacent to the Parcel 3 Hazardous Waste Management Unit.

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Fort Wingate Depot Activity, groundwater, background, replacement, monitoring well, drilling, Parcel 3, HWMU

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Upon approval by the New Mexico Environment Department–Hazardous Waste Bureau of this Parcel 3 Groundwater RCRA Facility Investigation Supplemental Sampling Work Plan, a copy of the signed approval letter will be placed here.

Document Certification

40 Code of Federal Regulations 270.11

April, 2023

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

George H. Cushman IV

George H. Cushman IV
BRAC Environmental Coordinator
Fort Wingate Depot Activity
BRAC Operations Branch
Environmental Division

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Notes:
BIA = Bureau of Indian Affairs
BEC = Base Realignment and Closure Environmental Coordinator
BRACD = Base Realignment and Closure Division
DOI = Department of the Interior
FWDA = Fort Wingate Depot Activity
HWB = Hazardous Waste Bureau
NMED = New Mexico Environment Department
NN = Navajo Nation
NR = Natural Resources
OH = Ohio
POZ = Pueblo of Zuni
USACE = U.S. Army Corps of Engineers
USEPA = U.S. Environmental Protection Agency

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Acronyms and Abbreviations

µg/L	micrograms per liter
ADR	automated data review
BR	borehole radius
CFR	Code of Federal Regulations
CoPC	constituent of potential concern
COR	Contracting Officer's Representative
DoD	Department of Defense
DOE	Department of Energy
DQE	Data Quality Evaluation
DTW	depth to water
EDMS	electronic data management system
EPA	U.S. Environmental Protection Agency
Eurofins	Eurofins TestAmerica
FTL	Field Team Leader
FWDA	Fort Wingate Depot Activity
gpm	gallons per minute
HCBD	Hexachlorobutadiene
HWB	Hazardous Waste Bureau
HWMU	hazardous waste management unit
IAW	in accordance with
IDW	investigation-derived waste
LOD	limit of detection
LOQ	limit of quantitation
MCL	maximum contaminant level
MEC	munitions and explosives of concern
MS	matrix spike
MSD	matrix spike duplicate
NDN Sundance	NDN Sundance Joint Venture, LLC
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department

NMWQCC	New Mexico Water Quality Control Commission
OB/OD	open burn/open detonation
PA	Programmatic Agreement
PPE	personal protective equipment
QA	quality assurance
QASP	Quality Assurance Surveillance Plan
QC	quality control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSL	regional screening level
SSHO	Site Safety and Health Officer
Sundance	Sundance Consulting, Inc.
TPMC	Terranear-Project Management Company
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
Work Plan	Parcel 3 Groundwater RCRA Facility Investigation Supplemental Sampling Work Plan
ZIST	Zone Isolation Sampling Technologies™

ES.1 EXECUTIVE SUMMARY

Fort Wingate Depot Activity (FWDA) currently occupies approximately 24 square miles (15,277 acres) of land in western New Mexico in McKinley County. FWDA is located approximately 7 miles east of Gallup and 130 miles west of Albuquerque, New Mexico. The main entrance to FWDA is on U.S. Highway 66, west from Exit 33 off Interstate 40.

Historical activities at FWDA that may have contributed to soil and groundwater contamination include munitions storage, maintenance, and disposal; petroleum fuels use and storage; and equipment maintenance (Terranear-Project Management Company, 2008). As part of the planned property transfer to the U.S. Department of the Interior, FWDA has been divided into reuse parcels, with each site being addressed on a parcel-by-parcel basis, as specified by the Resource Conservation and Recovery Act (RCRA) permit number NM 6213820974 originally issued in 2005 and revised in 2015 (New Mexico Environment Department [NMED], 2015).

This Parcel 3 Groundwater RCRA Facility Investigation (RFI) Supplemental Sampling Work Plan (Work Plan) describes the specific field methods, activities, and procedures for sampling the groundwater monitoring wells within the hazardous waste management unit boundary of Parcel 3 and adjacent areas of Parcel 2 and Parcel 1 at FWDA, New Mexico.

ES.2 PURPOSE

The objectives of performing groundwater monitoring as an addendum to the Parcel 3 groundwater RFI include the following.

- Evaluate compliance with the RCRA permit groundwater screening values.
- Monitor groundwater flow and water quality parameters that affect contaminant fate and transport.
- Monitor groundwater for the presence of constituents of potential concern (CoPCs) from known contaminant releases.
- Monitor the migration of and changes to groundwater contaminants.

ES.3 PROPOSED ACTIVITIES

Field activities proposed within this Work Plan include the following.

- **Collect Groundwater Level Measurements**. Measure water levels at each newly installed and developed background well and monitoring well prior to groundwater sampling.
- **Perform Groundwater Sampling**. Groundwater sample in eight successive quarterly sampling events for the CoPCs identified in the conceptual site model.
- **Reporting**. Results of quarterly sampling events will be submitted in an Investigation Report prepared in accordance with NMED guidance entitled General Reporting Requirements for Routine Groundwater Monitoring at RCRA Sites (NMED, 2003).

1.0 INTRODUCTION

This Parcel 3 Groundwater Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Supplemental Sampling Work Plan (Work Plan) provides guidance for the groundwater monitoring activities to be conducted by NDN Sundance Joint Venture, LLC (NDN Sundance) at Fort Wingate Depot Activity (FWDA) in McKinley County, New Mexico (Figure 1-1). This Work Plan has been prepared in accordance with (IAW) the performance work statement under contract number W912PP21C0028.

This Work Plan has been prepared IAW the RCRA permit NM 6213820974, first issued in 2005. The RCRA Permit became effective on December 1, 2005, and was most recently revised in February 2015 (New Mexico Environment Department [NMED], 2015). Proposed monitoring includes semiannual water-elevation measurements and quarterly sampling for newly installed and existing monitoring wells.

1.1 PURPOSE

The objectives of performing the prescribed eight consecutive quarters of groundwater monitoring as an addendum to the Parcel 3 groundwater RFI are as follows.

- Conduct quarterly groundwater water-level measurements to determine if seasonal trends exist.
- Monitor and determine if dry monitoring wells have groundwater following precipitation events.
- Collect and analyze groundwater from newly installed and existing wells for metals, volatile organic compounds (VOCs), explosives, and perchlorate to evaluate contaminant concentrations to supplement data from the first mobilization in the *Final Parcel 3 Groundwater RCRA Facility Investigation* (Sundance Consulting, Inc. [Sundance], 2019).
- Collect and analyze groundwater from newly installed and existing background wells to determine if background monitoring wells are sufficient to perform a groundwater background study.
- Monitor groundwater flow and water quality parameters that affect contaminant fate and transport.
- Collect sufficient data to evaluate the results and conclusions from the 2017 Parcel 3 groundwater RFI report, fill data gaps from that report, and develop future recommendations.

1.2 REGULATORY BACKGROUND

The Army conducted a groundwater RFI in 2017 and reported the findings and recommendations in the *Final Parcel 3 Groundwater RCRA Facility Investigation Report* (Sundance, 2019). Following submission of the initial Final RFI report, a conference call between NMED and the Army in September 2018 was held. NMED and the Army agreed to conduct eight consecutive rounds of quarterly groundwater monitoring to provide data to expand on the findings from the 2017 RFI Report. NMED comments in the letter *Disapproval for Final Parcel 3 Groundwater RCRA Facility Investigation Report* dated October 17, 2018, and NMED comments in the *Approval with Modifications, Final Revision 1 Parcel 3 Groundwater RCRA Facility Investigation Report* dated June 14, 2019 (FWDA-18-001) documented the required additional monitoring within and adjacent to Parcel 3. This supplemental Work Plan has been prepared in response to the conference call and the NMED letters to perform eight consecutive events of quarterly groundwater monitoring at Parcel 3.

Attachment 7 of the RCRA permit (NMED, 2015) provides a hierarchy for the selection of screening value criteria application to Parcel 3 groundwater monitoring. Groundwater analytical results are evaluated and compared to these screening values. The following documents and regulations are used to determine whether the concentration of a particular hazardous constituent exceeds the RCRA permit screening value (NMED, 2015).

1. New Mexico Water Quality Control Commission (NMWQCC) standards for the analytes listed in the New Mexico Administrative Code (NMAC) 20.6.2.7.T having the values listed in NMAC 20.6.2.3103 A and B.
2. U.S. Environmental Protection Agency (EPA) drinking water maximum contaminant levels (MCLs) provided under 40 Code of Federal Regulations (CFR) 141 and 40 CFR 143.
3. If both an NMWQCC standard and an EPA MCL have been established for a constituent of potential concern (CoPC), the lowest value of (1) and (2) above will be selected.
4. If no NMWQCC standard or EPA MCL has been established for a carcinogenic hazardous constituent, values will be selected from the most recent version of the EPA regional screening levels (RSLs) (EPA, 2022a) for tap water, adjusted to a target excess cancer risk level of 1×10^{-5}.
5. If no NMWQCC standard or EPA MCL has been established for a non-carcinogenic hazardous constituent, values will be selected from the most recent version of the EPA RSLs for tap water with a target hazard index of 1.0.
6. Previously, no NMWQCC standard or EPA MCL standard was published for perchlorate. An EPA MCL standard of 15 micrograms per liter (µg/L) was published in the November 2017 update, and was rescinded as of July 2020 (EPA, 2020). The previously selected EPA tap water RSL of 14 µg/L was followed for perchlorate IAW Attachment 7 of the RCRA permit for FWDA (NMED, 2015).

For some analytes, selected screening values have RSLs listed for both carcinogenic risks and non-carcinogenic hazards. IAW the RCRA permit, only the RSLs for carcinogens are adjusted to a cancer risk of 1×10^{-5}. Subsequent to this modification, the lower of the adjusted carcinogenic and the non-carcinogenic RSLs will be selected as the final screening value.

Reporting requirements are specified in the Work Plan IAW the RCRA permit. A schedule of regulatory deliverables is included in the Work Plan. RCRA permit Section V.A.2 requires the format to be consistent with General Reporting Requirements for Routine Groundwater Monitoring at RCRA Sites (NMED, 2003).

1.3 Document Organization

The remainder of this Work Plan is organized into the following sections.

- **Section 2 –** presents the available site history and general description of FWDA and summarizes previous groundwater investigations.

- **Section 3 –** describes the proposed field methodology for groundwater sampling, sample management and sample handling, laboratory analysis requirements, and data quality assurance (QA).
- **Section 4 –** discusses project reporting.
- **Section 5 –** presents the project schedule.
- **Section 6** – presents works cited within this Work Plan.
- **Appendix A** – contains example field forms used for data collection and documentation during execution of the quarterly monitoring activities.

2.0 INSTALLATION AND SITE BACKGROUND

The FWDA installation is located approximately 7 miles east of Gallup, New Mexico, and currently occupies approximately 15,277 acres of land in McKinley County, New Mexico. FWDA is mostly surrounded by federally owned or administered lands, including both national forest and Tribal lands.

The installation has been divided into several sub-areas (parcels) based on their location and historical land use (Figure 2-1). This Work Plan focuses on the southern area of FWDA, specifically Parcel 3 and adjacent areas in Parcel 2 and Parcel 1, and will be referred to as the Study Area (Figure 2-1).

Groundwater investigations were conducted between 1996 through 2005. Groundwater monitoring of wells installed during these investigations was conducted between 2008 and 2013, and reported in facility-wide groundwater monitoring reports.

A groundwater RFI was conducted in 2017, which concluded shallow groundwater bearing units within Parcel 3 are located proximate to drainage arroyos (Sundance, 2019). The groundwater RFI indicated the need for additional groundwater background locations because background groundwater monitoring well locations within Parcel 3 did not produce sufficient, if any, groundwater to sample. It was determined that additional background well locations should be installed outside of the Parcel 3 boundary and within proximity of identified arroyos. Three additional background well locations have been identified to potentially produce sufficient groundwater upgradient of known activities and are being installed under separate cover.

The groundwater RFI field efforts preceded the current hazardous waste management unit (HWMU) soil excavation removal action. Additional groundwater monitoring wells were installed during the groundwater RFI to supplement the existing groundwater monitoring well network within the parcel. The HWMU soil excavation operations encroached on existing groundwater monitoring wells and required these wells to be abandoned before excavating surrounding soil. Nine groundwater monitoring wells within the HWMU were abandoned as a result of soil excavation operations. Two additional groundwater monitoring wells were damaged and/or buried during flooding events within Parcel 3. Monitoring well CMW19, located at the north gate of the HWMU, had monument cement slab damage that compromised the inner well casing, and CMW21, located within an arroyo north of the HWMU, was buried with sand following high-energy flooding events. These two wells have also been abandoned. Eleven total replacement wells are proposed to replace abandoned wells and to have the same approximate location as the abandoned wells. Four replacement wells were installed in 2022, including replacement wells for CMW19 and CMW21. The installation of the remaining seven monitoring wells will be completed once the HWMU soil excavation project completes sufficient progress, allowing for each well’s safe installation and use. This Work Plan is intended to be the guidance document for quarterly monitoring of the existing well network, including the remaining proposed replacement wells and background wells not yet installed.

2.1 CULTURAL RESOURCES

Traditional cultural properties and other cultural resources have been documented within the FWDA boundaries. Based on a review of available mapping (University of New Mexico/Office of Contract Archaeology, 1994), a limited number of identified sites are located within the southern FWDA groundwater area.

The Army has developed a Programmatic Agreement (PA) to specify procedures to be employed during environmental characterization and remediation activities. These procedures will be followed while performing fieldwork. The PA has been presented in previous works and for this Work Plan is referenced from the *Parcel 3 Groundwater RFI Work Plan* (Sundance, 2016).

2.2 SITE CONDITIONS

2.2.1 Geology

Mapped geologic units exposed at ground surface in the southwestern portion of FWDA are shown on Figure 2-2. The geologic and stratigraphic setting described in the following sections is based on this geologic mapping in combination with available geologic literature and recent subsurface investigations in the southern areas of FWDA.

2.2.1.1 Structural Geology

FWDA lies within a small basin defined by the Zuni Mountains (Zuni uplift) to the south and east, the Nutria Monocline to the west, and the South Fork of the Rio Puerco to the north (Figure 2-3; U.S. Geological Survey [USGS], 2009). Laramide Orogeny processes, occurring approximately 75 million to 35 million years ago, provided the main uplifting force for the formation of the Zuni uplift’s current configuration, tilting the bedrock underlying the majority of FWDA to the northwest at an angle of approximately 5 degrees (U.S. Army Corps of Engineers [USACE], 2011).

The northern boundary of FWDA terminates in the strike valley of the South Fork of the Rio Puerco. The valley represents the transition between the Zuni uplift to the south and the gently north-dipping Chaco Slope to the north (USACE, 2011).

To the west, the dominant FWDA topographic and structural feature is the Nutria Monocline. The Nutria Monocline is a regionally northwest trending sharp-crested ridge that dips steeply to the west–southwest and defines the northwestern flank of the Zuni uplift. The Nutria Monocline rises as much as 2,000 feet above the surrounding area exposing Mesozoic formations whose dips commonly exceed 60 degrees (USACE, 2011).

To the west of the Study Area is the axis of the Nutria Monocline fold, cut by roughly north–south trending high-angle faults. This fault zone is overlain by Quaternary alluvium; with no surface exposure, the slip angle and direction have not been determined (Terranear-Project Management Company [TPMC], 2008).

2.2.1.2 Stratigraphy

The majority of FWDA is underlain by the Triassic-age Chinle Group, which is predominantly non-marine, red-bed siliciclastics. The Chinle Group consists of the Shinarump, Bluewater Creek, Petrified Forest, and Owl Rock Formations (Anderson et al., 2003). The Petrified Forest Formation directly underlies much of the installation and is subdivided into three members: Blue Mesa, Sonsela, and Painted Desert. All three members of the Petrified Forest Formation crop out in various locations across the installation. The Blue Mesa, Sonsela, and Painted Desert lithologies are green-gray smectitic mudstone, light gray to yellowish-brown cross-bedded sandstone, and reddish-brown and grayish-red smectitic mudstone, respectively (McCraw et al., 2009).

The Chinle Group is underlain by the older San Andres Limestone and Glorieta Sandstone, both Permian in age. The San Andres Limestone generally consists of fossiliferous limestone that intertongues the Glorieta Sandstone (Anderson et al., 2003). These two formations do not have outcrops within the boundaries of FWDA; however, the Glorieta Sandstone Formation does crop out south of the installation where a thrust fault juxtaposes Permian strata against the Cretaceous Dakota Sandstone. These two formations comprise the San Andres-Glorieta aquifer, which is the principal source of drinking water in the area (Anderson et al., 2003).

Within the FWDA boundaries, bedrock outcrops of clastic sedimentary rocks are predominately Triassic in age, but in the western and southern portions of FWDA, Jurassic and Cretaceous sandstone, claystone, and shale are present. Jurassic and Cretaceous rocks are exposed in the Nutria Monocline, which is the dominant topographic feature within FWDA boundaries and west of the Study Area. Quaternary alluvial and colluvial deposits, derived from weathered bedrock, are present throughout FWDA.

Within the Study Area, the stratigraphy on the eastern side of the Nutria Monocline is largely the Triassic-aged Petrified Forest Formation. The Petrified Forest Formation is a purplish-red, cross-bedded mudstone and sandstone containing greenish-gray calcrete nodules and petrified wood. The Petrified Forest Formation has low apparent permeability due to the fine to ultra-fine muddy matrix. Extensive mudstone units of the underlying Blue Mesa Member of the Petrified Forest Formation, being of lower apparent permeability, will inhibit vertical movement of groundwater to underlying potable aquifer units, such as the San Andres-Glorieta aquifer (TPMC, 2008). The Petrified Forest Formation has a combined thickness of approximately 980 feet (Sundance, 2019).

2.2.2 Hydrogeologic Conceptual Model

Based on surface water flow and the overall groundwater gradient observed along the south-to-north arroyo east of the Nutria Monocline, limited shallow groundwater may enter beneath Parcel 3 from south of well CMW02, the southernmost groundwater monitoring well located along the main arroyo (Figure 2-4). Groundwater also may be encountered in wells in the south-to-north-trending arroyo along the west side of the monocline, which cuts across the monocline from west to east through Fenced-up Horse Valley to join the main arroyo near the northern limit of the Study Area (Figure 2-4). However, the limited groundwater found beneath Parcel 3 appears likely to result from recharge from local precipitation and surface runoff in the arroyos.

As observed and presented in the Parcel 3 RFI report, groundwater monitoring wells located along the north–south trending arroyo east of the Nutria Monocline have sufficient groundwater for sampling and include CMW36A, CMW36B, CMW28B, CMW27B, and CMW26 (Sundance, 2019; Figure 2-4). Groundwater monitoring wells BGMW05 and CMW32, located outside and east of the arroyo, and KMW15B, located outside and west of the main arroyo, did not recharge following well development or purging activities during the 2017 RFI and are currently dry. The dry wells represent a boundary between water producing wells within close proximity of the arroyo and wells that do not produce sufficient volume to sample or are dry.

These wells exhibit an approximate distance away from the arroyo where groundwater is generally not encountered. The locations of groundwater-producing monitoring wells provide evidence that groundwater recharge is correlated to surface infiltration from arroyos (Sundance, 2019). Monitoring wells BGMW14 and BGMW16 are new wells installed in 2022 to add to the background monitoring well network. Monitoring wells CMW43 and CMW45 are new wells installed in 2022 to replace wells CMW19 and CMW21, which were damaged during flooding events. The installation details, data, and reporting for these four wells will be presented under separate cover. The project area monitoring and background well construction details are shown in Table 2-1.

3.0 FIELD METHODOLOGY

Field activities proposed under this Work Plan include groundwater elevation surveys and collection of groundwater samples from the monitoring wells (Figure 3-1) in the southern area at FWDA. The various types of purge methods required for sampling are identified in Table 3-1 and described in the sections below. Table 3-2 presents the list of analytes with screening values and laboratory limits from the laboratory contracted to perform analyses under this Work Plan. Table 3-3 contains the sample analysis matrix, and Table 3-4 presents the sample containers, preservation, and hold times.

3.1 UNEXPLODED ORDNANCE AVOIDANCE

Munitions and explosives of concern (MEC) investigation and removal actions have been performed in selected locations within FWDA, and additional MEC removal actions are ongoing. The potential for encountering MEC items in the open burn/open detonation (OB/OD) area is high.

3.1.1 Munitions and Explosives of Concern

MEC are defined as ammunition, ammunition components, chemical or biological warfare materiel, or explosives that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried, or fired. Unexploded ordnance (UXO)-qualified technicians are trained in identifying, handling, defusing, and classifying UXO items, including MEC and materiel potentially presenting an explosive hazard.

3.1.2 General Munitions and Explosives of Concern Work Procedures

When areas with a high potential for encountering MEC need to be entered, personnel must first get authorization from the Site Safety and Health Officer (SSHO), Field Team Leader (FTL), and the on-site Senior UXO Supervisor. Upon receiving authorization, the procedures and practices listed below will be strictly enforced.

- UXO-qualified technicians are to be on site at all times during field activities within areas potentially containing MEC.
- UXO-qualified technicians will be primary points of contact with the USACE Ordnance and Explosives Safety Specialists on site for personnel accountability and coordination within hazardous areas.
- UXO-qualified technicians will identify MEC or subsurface anomalies for ordnance avoidance purposes.
- Only the minimum number of personnel required to perform a given activity within the areas potentially containing MEC will be involved in the operation.
- Field personnel are not permitted to move and/or handle MEC at any time.
- Non-UXO-qualified personnel will receive site-specific MEC recognition training prior to entering and performing work in these areas.
- Personnel who are working in areas potentially containing MEC items will not wear inner or outer garments having static-electricity-generating characteristics while in these areas.
- Only UXO-qualified personnel will be involved in the investigation, identification, and marking of known or potential MEC items.

- No smoking, or possession or use of open flame or spark producing sources will be allowed within the boundaries of the 51 gate or the 209 gate. Unless the task performed requires the use of open flame or a spark-producing source, then the SSHO or FTL may approve possession or use only in designated areas.
- Personnel will not attempt to extinguish burning explosives or any fire that might involve explosive materiel.
- Personnel will stay on roads and paths designated by UXO-qualified staff.

3.2 GROUNDWATER ELEVATION SURVEY

Groundwater elevations will be measured in the wells listed in Table 3-1 at a quarterly frequency. The groundwater elevation data will be used to calculate hydraulic gradients and determine groundwater flow directions. All groundwater measurements will be collected during a 48-hour period to ensure accuracy. Static water elevation data will be collected prior to well-purging activities to provide representative data. Current measurements will be compared to recently collected measurements and assessed for accuracy. In the event the difference between the current measured elevation and the last event measurement is greater than 1 foot, the water elevation will be remeasured by either another field team member or the FTL. If the difference is accurate, the second reading will be recorded and documented in the day’s field notes.

Depth to groundwater will be measured with an electronic water level meter as follows.

- Lower the probe of the water level meter down into the well casing until the indicator lights or chimes.
- Compare the depth-to-water (DTW) measurement to the previous DTW reading. If the measurement differs from the last event measurement by more than 1 foot, the measurement will be performed a second time.
- Record measurement to the nearest 0.01 foot to the top-of-casing reference notch or mark and document in the field logbook.
- Remove water level probe from the well casing and decontaminate with non-phosphate detergent and deionized water as described in Section 3.8.

3.2.1 Groundwater Elevation Transducers

Several of the groundwater monitoring wells within the FWDA boundary, specifically Parcel 3, have been identified as dry wells (Figure 3-1) based on previous water level measurements. Water level transducers will be installed into the groundwater monitoring wells identified as dry to assess seasonal variability throughout the year. Two monitoring wells that contain measurable groundwater, with a water column of greater than 5 feet, will be selected as a control for transducer operation. These transducers will capture seasonal wetting patterns and groundwater level influence following storm events. These data will identify an optimal sampling schedule and if changes to the current sampling schedule should be proposed. The groundwater elevation data will be downloaded quarterly during each quarter’s groundwater elevation measurement event. To ensure accuracy of the transducers’ data, transducer measurements at the time of the water level measurement event will be verified by the manual groundwater elevation survey.

3.3 GROUNDWATER SAMPLING

Sampling of southern area monitoring wells within and adjacent to Parcel 3 at FWDA involves a variety of purging and sampling methods. Use of a low-flow pump is the preferred method at FWDA according to the NMED guidance document on low-flow sampling, *Use of Low-Flow and Other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring* (NMED-Hazardous Waste Bureau [HWB], 2001). Field sample methods, equipment, and sample handling information are presented in Table 3-1. Field procedures for sample collection and handling are outlined in the following subsections. All water generated during purging activities, as well as the excess groundwater from sampling, will be collected in designated containers with sealing lids or caps and managed as investigation-derived waste (IDW) following procedures described in Section 3.8.

Table 2-1 contains well construction data, including top-of-casing and ground-surface elevation data, for calculation of well volumes. Monitoring wells that do not contain water saturation in the well screen sufficient to collect a sample are identified as dry. Saturated well volume will be calculated following the groundwater elevation survey, using a simple volume calculation for a cylinder to determine the volume of water contained within the well casing, and will be documented in the day's field notes.

During each sampling event, if a dedicated pump system fails to operate as designed, the pump issue will be documented in field notes. That pump will be either replaced with a comparable submersible pump or sampled by bailing during that event. Also, if the purging rate of any low-flow well location falls below 100 milliliters per minute to maintain less than a 1-foot drop in water level, that well may be purged dry and sampled upon recovery of sufficient groundwater volume to collect a sample.

3.3.1 Initial Inspection

Upon arrival at each monitoring well, the field team will inspect the wellhead and exposed casing for evidence of tampering or other damage. The field team will record observations in the field logbook and will notify the USACE Contracting Officer's Representative (COR) or the on-site USACE representative of any vandalism or damage. A staging area will be designated for equipment decontamination, including non-phosphate detergent cleaning solutions, reusable dedicated decontamination buckets and brushes, and plastic sheeting or absorbent pads, as appropriate. Field personnel will wear disposable nitrile gloves for all activities when in contact with purge water, equipment used for purging, or sample bottles and their preservatives.

3.3.2 Measure Initial Water Level and Calculate Well Volume

Before purging and sampling, the field team will measure depth to groundwater from the top of casing reference notch or mark and record the measurement to the nearest 0.01 foot by following the procedure described in Section 3.1. The well volume will be calculated using the measured groundwater level and casing dimension as follows.

Borehole Volume = Saturated Casing Volume + Saturated Filter Pack Volume

Where:

$$\text{Saturated Casing Volume} = \pi \times WR^2 \times (TD\text{-}DTW)$$

Saturated Filter Pack Volume = ((π x BR^2 x SFPL) – (π x WR^2 x SFPL)) x 0.2 and

WR = well screen radius

TD = total well depth

DTW = depth to water

BR = borehole radius

SFPL = saturated filter pack length

Groundwater elevation and well volume calculations will be recorded in the field logbook and/or on the Groundwater Sampling Field Data Sheet (Appendix A) as appropriate.

3.3.3 Low-Flow Pump Purging and Sampling Methods

Low-flow purging at FWDA is performed using dedicated pneumatic pumps for wells designated as low-flow in Table 3-1. Blatypus model pumps manufactured by BESST, Inc., are currently used but may be replaced by comparable equipment. The low-flow equipment currently installed consists of a flow-control system connected to the wellhead, which applies pneumatic pressure to a dedicated sample spring-loaded valve placed in the well screen. Dedicated pumps and associated tubing are constructed of stainless steel and polyethylene and are Teflon™ lined. This low-flow pump system is powered by pressurized nitrogen gas cylinders.

Pumps and gas-control devices are operated and maintained IAW manufacturer specifications. Pneumatic power is applied by compressed gas cylinders. Nitrogen gas is selected because of its inert properties and because it contains fewer impurities (as compared to compressed air). Electrical power is provided by a marine battery.

The dedicated low-flow pumps are operated to produce water flow rates at which minimal drawdown is observed. These methods comply with low-flow guidance (NMED-HWB, 2001). Well purging and stabilization at these locations is performed IAW standard practice (EPA, 2022b) and site-specific methods previously implemented for FWDA groundwater monitoring. Water-quality parameters and DTW measurements are used to ensure representative samples are collected.

Low hydraulic conductivity conditions exist in many monitoring locations and result in poor well yield. In some wells, a modified system was used to maintain the general low-flow methodology. In these locations, a Zone Isolation Sampling Technologies™ (ZIST) model packer system manufactured by BESST, Inc., was installed (Table 3-1). The packer system creates a seal above the well screen to minimize drawdown and produce water directly from the aquifer formation. The pump intake is locked into the packers before purging operations and is unsealed after sample collection to allow for representative measurement of groundwater elevations. Otherwise, the purging, field reading, and sampling procedures are the same as low-flow techniques described in this Work Plan.

Because the low-flow pumps are dedicated (traditional and ZIST) and will remain in place between sampling events, the volume of water in the dedicated tubing and pump will be purged to clear any stagnant water before taking water-quality readings.

The field team will use drawdown and final pump cycling setting information for each well from previous sampling event(s) before purging at that location. The extraction rate of the previous sampling event(s) will be duplicated to the extent practical and modified to ensure minimal drawdown and optimal flow rates. The following steps will be performed for purging with traditional low-flow pumps.

1. Start pump at the lowest speed setting and slowly increase until discharge occurs.
2. Measure water level.
3. Adjust pump speed until there is little or no water-level drawdown. Make any necessary adjustments to pumping rates within the first 15 minutes of purging, reducing pumping rates as needed. If the static water level is above the well screen, avoid lowering the water level into the screen, if possible. Once water-quality readings are stabilized (step 7), the established water-level drawdown must not be more than 4 inches/0.33 foot from the water level recorded at stabilization until the end of sample collection.
4. Begin purging well to previously determined volume. The calculation of purge water volumes is presented in Section 3.3.2.
5. Monitor and record water level, purge volume, purging rate, and the following field parameters approximately every 2 to 5 minutes during purging depending on flow rate on the Groundwater Sampling Field Data Sheet (Appendix A). Each measurement (listed below) should allow the flow-through cell to completely evacuate the purge water from the previous reading. Also, ensure the meter sensors are completely submerged during the purging and measurement process.
    a. Turbidity
    b. Temperature
    c. Specific conductivity
    d. Hydrogen ion activity (pH)
    e. Dissolved oxygen
    f. Oxidation-reduction potential
6. Record all adjustments to pumping rate (both time and flow rate).
7. Purging is considered complete, and sampling will begin, when the field parameters have stabilized, or three borehole volumes have been purged. Stabilization has occurred when three consecutive readings are within the following limits.
    a. Temperature ± 10 % in degrees centigrade
    b. pH ± 0.5 standard units
    c. Specific conductivity ± in millisiemens per centimeter
    d. Dissolved oxygen ± 10% or less than 1.0 milligrams per liter (within theoretical maximum thresholds)
    e. Turbidity ± 10% or less than 1 nephelometric turbidity unit
    f. Oxidation reduction potential ±10 millivolt
    g. Water level = 0.00 to 0.33 foot (or 4 inches) or less drawdown during the stabilized water-quality readings

In the event the water-level drawdown cannot be stabilized, or if the pump malfunctions, including but not limited to excessive air bubbles in the line, discontinue purging and document the issues in the field notes. The field team and FTL will communicate the issue with the Project Manager and USACE representatives. The sampling system will then be removed from the well, and the well will be sampled using one of the alternative groundwater purging and sampling procedures described in the next section. The Army will document the variance for reporting.

All measurements will be obtained using a field-parameter monitoring instrument with a transparent flow-through cell that prevents air bubble entrapment in the cell. Extraction rates from the initial pump setup are located on sample collection logs from previous sampling events and will be duplicated to the extent practical. The steps that will be performed for purging with ZIST low-flow pumps are the same as the traditional low-flow pumps with the following differences.

1. Before pumping, lower the pump into the packer.
2. Begin purging of the well.
3. During purging, monitor the water-level measurements and ensure drawdown of the water column does not occur. If drawdown occurs, the mechanical packer system was not sealed properly and has failed. The pump must then be reset or the ZIST will need to be removed, inspected, and repaired before continuing.

After stabilizing field parameters, groundwater samples will be collected IAW the following steps.

1. During sampling activities, maintain the pump at approximately the same flow rate during purging and stabilization of field parameters as measured using a graduated cylinder, beaker, or marked 5-gallon bucket.
2. Disconnect the water-quality sensor flow-through cell and collect samples directly from the pump discharge by allowing the discharge to flow gently down the inside of the sample container to minimize turbulence.
3. Continue to monitor DTW to ensure that the water level does not drop during sampling. If drawdown occurs, the mechanical packer system is not sealed properly and has failed. If this occurs, document the incident and measure drawdown, stop sampling, and attempt to re-seat the pump on the packer. Repeat purge until stabilization is achieved, then resample.
4. Fill sample containers. Reduce pressure to avoid splash in VOC containers, if necessary.
5. To field filter groundwater samples for dissolved metals analysis, use a 0.45-micron filter attached to the end of the discharge tubing.
6. To field filter groundwater samples for perchlorate analysis, use a 0.20-micron filter. A 0.45-micron filter may be used to filter water before using the 0.20-micron filter for wells with high turbidity. Fill the perchlorate container only to between half and two thirds volume to allow proper headspace for sample.
7. After filling each sample container, immediately seal, label, and place container into an iced cooler IAW the sample management procedures discussed in Section 3.4.

In the event the ZIST system cannot be repaired, or if groundwater conditions require an alternative sampling method, the FTL will communicate the issue with the Project Manager and USACE representatives. The sampling system will then be removed from the well, and the well will be sampled using one of the alternative groundwater purging and sampling procedures described in the next section. The Army will document the variance for reporting.

3.3.4 Alternative Groundwater Purging and Sampling Procedures

Some wells at FWDA require alternative methods of purging and sampling due to extremely low-yield/low-water levels. For these wells, purging and sampling are performed by hand bailing with disposable bailers, a submersible pump, or dedicated pump. The methods required for purging and sampling are identified for each well in Table 3-1. The sampling method used for each well will be recorded on the individual sample log for each well.

These procedures emphasize the need to remove a sufficient volume of water from each well to ensure that the sampled groundwater is representative of the surrounding formation. Personnel will remove a quantity of water equal to three borehole volumes wherever possible. If yield does not allow for three borehole volumes to be purged, then the well will be purged dry. The well will then be allowed to recharge a minimum of 12 hours, and groundwater sample collection will begin the following day. Samples must be collected within 24 hours of purging a well dry, unless the well is purged dry again during sampling. See Section 3.3.2 for a calculation of the well purge volume.

Field parameters will be monitored at a time interval determined by the purge rate, and values will be recorded on the Sample Collection Form (Appendix A). Ensure that a minimum of three field parameter readings have been collected. Purging is considered complete, and sampling will occur, after evacuating three well volumes, or when the well is emptied due to very slow water-level recovery and is considered dry.

3.3.4.1 Disposable Bailers

The following steps describe purging and collecting groundwater samples with disposable bailers.

1. Attach bailing string to bailer and lower into the monitoring well; allow bailer to fill with groundwater.
2. Raise bailer out of the monitoring well and empty purge water into a reusable bucket or storage containers designated for IDW.
3. Repeat the process until the calculated volume of groundwater has been purged from the monitoring well (three times the well volume), or the well is dry. Collect water-quality measurements from water evacuated from the bailer. A minimum of three measurements will be collected. Ensure there is sufficient water to completely submerge the meter sensors prior to recording water quality parameters.
4. Use a new bailer for sample collection if the well was bailed dry.
5. Collect samples with the disposable bailer in the same manner as the low-flow purging described in Section 3.3.3.
6. To filter groundwater samples for dissolved metals and/or perchlorates analysis, use a hand pump filter or run water through a peristaltic pump with clean unused tubing and in-line filter. Sample filtering and preservation will be performed IAW laboratory and method requirements as listed in Table 3-4.

3.3.4.2 Reusable Submersible Pump

For wells that cannot support low-flow pumping, but that contain more water than can be efficiently bailed, a submersible pump may be used to purge the well. The field team will assess these conditions based on current water-level conditions. Use the following procedures for purging and collecting groundwater samples using a submersible pump.

1. Attach clean, unused tubing to the pump and secure the tubing to the pump.
2. Lower the pump into the well to approximately 6 inches from the bottom of the well.
3. Secure the tubing and lead line, then attach tubing to the flow-through cell and lead line to the control box, and then secure the control box to the power source.
4. Begin purge at a flow rate of between 0.5 gallons per minute (gpm) to 2.0 gpm until well has been purged dry. During well purging, monitor and record a minimum of three field-parameter readings.
5. After purging, remove the pump and tubing. Allow water levels to recharge and collect samples via a disposable bailer.
6. Decontaminate the pump after purging is complete as described in Section 3.7.
7. Remove and dispose of tubing after purging is complete at each monitoring well. Manage all liquid and solid IDW as described in Section 3.8.

3.3.4.3 Dedicated Bennett Pump

The Bennett Sample Pump system consists of a piston activated with pressurized nitrogen gas through a tube, a second tube that returns groundwater to the surface, and a third tube for gas exhaust. Bennett pumps have been installed in deep wells with poor yields that have borehole volumes exceeding 15 gallons. Monitoring wells at FWDA equipped with Bennett pumps are identified in Table 3-1. The Bennett pump intake was placed approximately 2 feet from the bottom of each monitoring well. Procedures for using a Bennett pump to purge and collect groundwater samples are as follows.

1. Connect the air intake tubing from the dedicated pump to the pressurized nitrogen cylinder. Connect the discharge tubing to the flow-through cell.
2. Turn on gas flow from the nitrogen cylinder. Use initial pumping rates previously established for borehole volume purging based on specific well yield.
3. Monitor and record all adjustments to pumping rate. Collect a minimum of three field parameters at a rate of between one per 3 minutes to one per 15 minutes depending on the purge volume.
4. When the well is purged dry, allow for recharge. Collect samples using the methods described in Section 3.3.3.

3.4 SAMPLE MANAGEMENT AND SAMPLE HANDLING

Proper sample handing, shipment, and maintenance of chain-of-custody documentation are key components of the quality system designed to obtain data that can be used to make project decisions. To be successful, all sample-handling protocols and chain-of-custody requirements must be followed completely, accurately, and consistently. All samples shipped to a laboratory must be accompanied by a properly completed chain-of-custody form (Appendix A).

The unique sample identifiers and descriptive information (i.e., sample location, date, and collection time) will be listed on the chain-of-custody form. Individuals relinquishing or receiving possession of samples will sign and note the time on the chain-of-custody form in the "relinquished by" or "received by" boxes, respectively. The signed chain-of-custody form demonstrates the transfer of sample custody from the sampler to the laboratory.

3.4.1 Sample Handling Procedures

After filling each sample container, immediately seal, label, and place the container into an iced cooler for the remainder of the day's sampling activities before packing the samples. Samples may also be transported and stored at a predetermined holding location in coolers with ice or in a sample holding refrigerator. Samples will be shipped daily for any method with sample holding times less than 3 days. If a sample is collected after sample packing and shipment is completed for the day, it may be held overnight in the sample holding refrigerator, pending the sample's laboratory holding time. The analytical sample matrix is presented in Table 3-3 and sample containers, preservation, and holding times are presented in Table 3-4 by analytical method.

Check container lids to verify that they are tight and will not leak during transport. Seal analytical samples in individual resealable plastic bags and position them within the cooler to prevent damage and to maintain sample integrity. Containers may be wrapped in bubble wrap, as necessary.

Ship samples in rigid plastic coolers or ice chests. Coolers or ice chests will be lined with contractor-provided trash bags; all bagged samples will be placed inside the trash bag, and ice will be placed outside the inner trash bag in sealed containment (such as secondary trash bag or resealable plastic bags) to prevent leakage. When ice and samples are packed in the cooler or ice chest, the contractor-provided trash bag will be sealed to prevent leakage outside of the cooler or ice chest.

3.4.2 Chain-of-Custody Requirements

The following information will either be printed clearly and legibly or typed on an electronic chain-of-custody form (Appendix A).

- Site name and project name or number.
- Each sample identification code, date the sample was collected, and sampling times (in military format).
- Total number of containers for each sample, the analysis, and associated number of sample bottles for each analysis.
- Signature of the sample team leader or sample collector.
- Carrier service (such as FedEx or UPS), air bill number, and custody seal number, if applicable.
- Signature, date, and time in the "relinquished by" section.

The signed chain-of-custody form will be placed in a plastic bag and taped to the inside of the lid in each cooler or ice chest. If more than one cooler or ice chest is being used, each cooler will have a copy of the chain-of-custody form. The cooler or ice chest will be closed and secured with strapping tape and custody seals. Custody seals will be placed so that if the cooler or ice chest is opened, the custody seal will be broken. Clear tape will be placed over the custody seal to prevent damage to the seal.

3.4.3 Sample Shipping

Samples will be analyzed at Eurofins TestAmerica (Eurofins) in Arvada, Colorado. All samples will be packed and shipped daily to Eurofins. If requested by USACE, a second laboratory (chosen by USACE) will be used to analyze triplicate samples.

3.5 ANALYTICAL METHODS

The Army has identified CoPCs for these eight quarters of groundwater monitoring based on the Parcel 3 Groundwater RFI conclusions and recommendations (Sundance, 2019). Sample analytical methods were selected based upon the CoPCs recommended for further monitoring (Sundance, 2019). The groundwater analytical program complies with the RCRA permit (NMED, 2015) and the Department of Defense (DoD) Quality Systems Manual (QSM) requirements (DoD/Department of Energy [DOE], 2021).

Attachment 7 of the RCRA permit (NMED, 2015) provides a hierarchy for the selection of screening value criteria applicable to the FWDA groundwater monitoring program. Section 1.2 of this Work Plan summarizes this screening-value hierarchy. Table 3-2 presents the list of analytes, with screening values and contract laboratory analytical limits.

Five analytes in Table 3-2 have screening values that are lower than the limit of quantitation (LOQ) (highlighted in blue), including four VOCs and one explosive. None of these analytes have been previously detected in groundwater within the Parcel 3 southern groundwater area at concentrations above the limit of detection (LOD) as reported in the southern groundwater RFI work plan (Sundance, 2016). The following discusses each analyte in more detail.

- <u>1,2,3-Trichloropropane</u>: 1,2,3-Trichloropropane is a chlorinated hydrocarbon with varying past and current uses. It is currently used as a chemical intermediate in the production of other chemicals, and in the synthesis of hexafluoropropylene. In addition, it is used as a cross-linking agent in the production of polysulfides (Pubchem, 2023). It is used as an industrial solvent and a cleaning and degreasing agent. In the agricultural industry, it has been found to be an impurity resulting from the production of soil fumigants (EPA, 2017). This compound is not associated with historical operations performed within Parcel 3 at FWDA. This compound is also not associated with any munitions demilitarization activities that were performed within Parcel 3. Although the LOQ is greater than the screening level for this constituent, the Army does not view this as a significant data quality exception because this constituent is not associated with any historical FWDA installation activities associated with Parcel 3. Results will be reported at the LOQ and qualified “U” or “J”, as appropriate, and evaluated further under a separate work plan.
- <u>1,2-Dibromo-3-Chloropropane</u>: 1,2-Dibromo-3-Chloropropane is an organic compound that was used as a pesticide to fumigate fields in the agricultural industry (Pubchem, 2023). It has been in the process of being phased out since 1977 (EPA, 2016). This compound is not associated with historical operations or any munitions demilitarization activities that were performed within Parcel 3. Although the LOQ is greater than the screening level for this constituent, the Army does not view this as a significant data quality exception because this constituent is not associated with any historical FWDA installation activities associated with Parcel 3. Results will be reported

at the LOQ and qualified "U" or "J", as appropriate, and evaluated further under a separate work plan.

- 1,2-Dibromoethane (ethylene dibromide): Ethylene dibromide was used in the past as an additive to leaded gasoline; however, since leaded gasoline is now banned, it is no longer used for this purpose. Ethylene dibromide is currently used in the treatment of felled logs for bark beetles and termites, and control of wax moths in beehives (Pubchem, 2023). Although the LOQ is greater than the screening level for this constituent, the Army does not view this as a significant data quality exception because there have been no gasoline stations, storage tanks, or reported spills. This constituent is not associated with historical FWDA installation activities in Parcel 3. Results will be reported at the LOQ and qualified "U" or "J", as appropriate, and evaluated further under a separate work plan.
- Hexachlorobutadiene (HCBD): HCBD is a man-made chlorinated chemical primarily produced as a byproduct in the production of carbon tetrachloride, tetrachloroethene, chlorinated hydrocarbons, perchloroethylene and, trichloroethylene (Pubchem, 2023). It is mainly used to make rubber compounds. It is also used as a solvent, and to make lubricants, in gyroscopes, as a heat transfer liquid, and as a hydraulic fluid. Commercial uses of HCBD include pesticides/agricultural fumigants, insecticides, algicide, herbicide, hydraulic fluid, gyroscope fluid, and as a laboratory reagent. This compound is not linked to historical operations or any munitions demilitarization activities that were performed within Parcel 3. Although the LOQ is greater than the screening level for this constituent, the Army does not view this as a significant data quality exception because this constituent is not associated with historical FWDA installation activities in Parcel 3. Results will be reported at the LOQ and qualified "U" or "J", as appropriate, and evaluated further under a separate work plan.
- Nitroglycerin: Nitroglycerin is a carbon compound of three nitroester bonds on a glycerol base. Although its uses include personal care products (liquid hand soaps, moisturizers, colored lip products, sunblock products, insect repelling products), medications (human and veterinarian), combating fires in oil wells, and as a rocket propellant, its most relevant use to Parcel 3 is its use over time as a high explosive in the production of dynamite and other explosives (Pubchem, 2023). It is also a key component of trinitrotoluene, and due to its association with explosives, nitroglycerin is considered a CoPC in Parcel 3. The LOQ for nitroglycerin is 2.1 µg/L, with a screening value of 2 µg/L (Table 3-2); the screening value of 2 µg/L is equal to the LOD. Therefore, any detections between 2.0 and 2.1 µg/L will be qualified "J". Results will be reported at the LOQ and qualified "U" or "J", as appropriate, and evaluated further under a separate work plan.

Sample analyses will be performed by Eurofins, the contracted DoD Environmental Laboratory Accreditation Program-certified laboratory selected to analyze samples. Reference limits for analytical methods are provided in Table 3-2. Analytical methods are selected IAW the most recent methods consistent with the DoD QSM (DoD/DOE, 2021) and consistent with RCRA regulations. The most recent EPA SW-846 solid waste methods were determined to be the most widely applicable and appropriate methods to conform to RCRA regulations and DoD guidance.

The Project Chemist and Project Manager will coordinate with the Eurofins Project Manager to schedule sample analysis, receive laboratory containers and supplies, resolve sample issues, and report results.

3.6 FIELD DOCUMENTATION

Field documentation will consist of one or more job- or area-specific field logbooks, field forms, sample chain-of-custody forms, and sample logs/labels.

3.6.1 Logbooks

Site and field logbooks provide a daily handwritten record of all field activities. All logbooks will be permanently bound and have a hard cover. Logbooks will be ruled, or ruled and gridded, with sequentially numbered pages. All entries into field logbooks will be made with indelible ink. Field logbooks are detailed daily records that are kept in real time and are assigned to specific activities, positions, or areas within the site. Separate logbooks will be used for each sampling and field team.

Documentation in field logbooks will include the following, as necessary.

- Location
- Date and Time
- Names of field crew
- Names of subcontractors
- Weather conditions during field activity
- Sample type and sampling method
- Location of sample
- Sample identification number
- Decontamination and health and safety procedures
- Sampling notes (such as well condition, unexpected maintenance, work stoppage)

A separate logbook dedicated to calibration records will be maintained and will include the following information.

- Equipment make, model, and serial number (or another unique identifier)
- Date and time
- Calibration results
- Adverse trends in instrument calibration behavior
- Field instrument identification, date of calibration, and standards used

If entries in the field notebooks must be corrected or changed, corrections will be made by crossing out mistakes with a single line, writing the corrections, and initialing and dating the entry. The use of correction fluid is not permitted. After each field day, the sampling team leader will review each page of the logbook for errors and omissions. The sampling team leader will then date and sign each reviewed page.

3.6.2 Field Data Record Forms

In addition to the field logbooks, purging and sampling forms are used to document field efforts (Appendix A). These forms ensure that all required data and observations are recorded in a consistent manner. No blank spaces will be left; all non-applicable items will be marked "not applicable." Forms will include well sampling forms and chain-of-custody forms.

3.6.3 Final Evidence File Documentation

All evidential file documentation will be maintained under an internal project file system. The USACE COR will ensure that all project documentation and QA records are properly stored and retrievable.

3.7 DECONTAMINATION

Non-dedicated measurement and sampling equipment, such as water level meters and submersible pumps, will be decontaminated before and after each use. Water level meters will be decontaminated during extraction from monitoring wells using deionized water and a non-phosphate detergent cleaning solution. Submersible pumps will be decontaminated using the following procedure.

1. If necessary, remove particulate matter or debris using a brush or handheld sprayer filled with deionized water.
2. Scrub the surfaces of the equipment using deionized water and a non-phosphate detergent cleaning solution and reusable dedicated decontamination brushes.
3. Rinse the equipment thoroughly with deionized water.
4. Place the equipment on a clean surface and allow to air dry.
5. Containerize all decontamination liquids and manage as IDW, as described in Section 3.8.
6. After decontamination operations, handle equipment to prevent recontamination. The area where the equipment is stored before reuse will be free of contaminants.

Sampling equipment dedicated for use at specific wells will not require decontamination before use. Disposable sampling equipment that is used once and then disposed of will not require decontamination before use, provided it is wrapped in the manufacturer's packaging or otherwise protected from inadvertent contamination before use.

3.8 WASTE MANAGEMENT

Three types of IDW may be generated during the groundwater sampling events at FWDA: purge water and excess sample water from monitoring wells, decontamination liquids (non-hazardous soap and water), and solid waste (disposable sampling equipment and personal protective equipment [PPE]). These wastes will be managed in the following manner.

Purge water, decontamination water, and other liquid IDW will be containerized at the sample site in liquid waste containers, such as buckets with a watertight lid or polyethylene drums with a sealing bung. Depending on the volumes generated, water from multiple wells may be consolidated into one or more containers. At the end of the sampling day, the liquid IDW containers will be emptied into one of two low-density polyethylene-lined evaporation tanks. The evaporation tanks are located at the site of former Building 542 in Parcel 6.

All solid waste, such as disposable sampling equipment, PPE, and general refuse, will be placed in plastic trash bags. Small quantities of waste will be disposed of in a trash container (dumpster) located in the Administration Area.

3.9 QUALITY ASSURANCE AND QUALITY CONTROL

QA will be monitored by USACE IAW the Quality Assurance Surveillance Plan (QASP). USACE will evaluate field activities to verify the approved Work Plan is being followed. QA audits and inspections will be performed IAW established USACE guidelines and the project QASP.

The FTL will perform quality control (QC) procedures including reviewing the Work Plan and groundwater sampling procedures contained in this document with the field team. The FTL will inspect and approve daily instrument calibration logs and will perform periodic spot checks on the field team's adherence to sampling methods and procedures. The FTL will also review daily field logbooks and review each team's Groundwater Sampling Field Data Sheets for completeness and accuracy of the recorded data. In the event the FTL identifies any field parameters outside of attainable limits, or readings do not indicate stabilized conditions were met prior to sampling, the FTL will document such findings in the daily summary report and will require the sampling team to resample the affected well.

3.9.1 Field Equipment Calibration and Preventative Maintenance

Field instruments will be calibrated, operated, and maintained IAW the manufacturer's instructions. Daily on-site field instrument calibrations will be performed before and during each day's use by trained technicians using certified standards. Instrument calibrations will be recorded in bound logbooks dedicated to calibration data, or as applicable, on standardized calibration forms and will include field instrument identification, date of calibration, standards used, and calibration results. All instrument calibration logs will be reviewed and approved by the FTL prior to deploying the instrument to the field. The review will ensure proper calibrations were performed with satisfactory performance. If an instrument does not pass calibration or inspection, that unit will be removed from service and another unit will be calibrated and used once certified.

If personnel suspect an equipment malfunction, the meter will be removed from service and tagged so that it is not used inadvertently, and a substitute piece of equipment will be used. Additionally, equipment that fails calibration or becomes inoperable during use will be removed from service and tagged. Such equipment will be repaired and satisfactorily recalibrated before reuse. The results of activities performed using equipment that has failed recalibration will be evaluated. If the results are adversely affected, the outcome of the evaluation will be documented and the USACE COR will be notified. Equipment that cannot be repaired will be replaced. Backup equipment will be available for use in the field in case of a malfunction.

Preventative maintenance procedures for the field instruments will be carried out IAW procedures outlined by the manufacturer's equipment manuals. All records of inspection and maintenance will be dated and documented in the appropriate field logbook. Critical spare parts for field instruments will be included in the sampling kits to minimize downtime. In addition, backup meters will be available, if needed. Spare parts will be purchased from accepted vendors.

Daily inspections of field equipment will be conducted to ensure that equipment is functioning properly. If inspection results indicate that a piece of field equipment is deemed faulty or not usable, replacement equipment will be cleaned, calibrated (if necessary), and used in place of the faulty equipment. The faulty equipment will be shipped back to the vendor for repair.

3.9.2 Sample Collection Quality Assurance and Quality Control

Several types of field QC samples will be submitted to the analytical laboratory to assess the quality of the data resulting from the field sampling program IAW the DoD QSM (DoD/DOE, 2019). These samples will include field duplicate samples, trip blanks, equipment rinsate blanks, field blanks, and matrix spike (MS) and matrix spike duplicate (MSD) samples.

- Field duplicate samples will be collected at a frequency of one per 10 environmental samples.
- MS/MSD samples will be collected at a frequency of one per 20 environmental and field duplicate samples.
- QA split samples may be completed at the government's discretion to check the contractor's laboratory quality performance.
- Field equipment rinsate blanks will be collected from each non-dedicated sample pump used during a sampling event. Field equipment rinsate blanks are collected at the beginning of the sample event, once per 20 environmental samples, and/or one at the end of the sample event (minimum of two samples per event), for each non-dedicated pump.

Each shipment that contains samples for VOC analysis will contain trip blanks from each sampling team. Each sampling team collecting VOCs will carry a trip blank during each sampling day. The trip blank will be placed in a cooler containing VOC samples for that day and will stay with the cooler until the cooler is returned to the analytical laboratory.

3.10 DATA MANAGEMENT

After review and approval, the analytical and field data will be loaded into the FWDA electronic data management system (EDMS) database. An EDMS (or comparable) database is maintained for all groundwater monitoring results from 2008 to present. The sample result electronic data deliverables will be loaded into the automated data review (ADR) software for data validation. After validation, data output files from the ADR (or comparable) software will be exported to the FWDA database. The FWDA database will be used to prepare the validated data table output presented in reporting documents.

Geographic Information System data files will be managed using current ESRI™ ArcGIS software and will be delivered to the USACE and NMED upon request.

3.11 LABORATORY DATA REVIEW REQUIREMENTS

All analytical data generated by the laboratory will be verified before submittal to the Project Chemist. The internal data review process, which is multitiered, will include all aspects of data generation, reduction, and QC assessment.

In each laboratory analytical section, the analyst performing the tests will review 100% of the definitive data. After the analyst review has been completed, 100% of the data will be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

Elements for review or verification at each level must include, but is not restricted to, the following.

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate standard operating procedures and analytical methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Documentation completeness (e.g., all anomalies in the preparation and analysis have been identified, appropriate corrective actions have been taken and documented in the case narrative[s], associated data have been appropriately qualified, and anomaly forms are complete)
- Accuracy and completeness of data deliverables (PDF and electronic)

Clear and proactive communication throughout sample analysis is critical to generating data of the type and quality required for project decision-making. As such, the laboratory point of contact shall contact the NDN Sundance Project Manager and Project Chemist, or designees, within 12 hours in the event that QC exceedances, required dilutions, or analytical irregularities occur. The project team must be notified of required dilutions prior to the dilution taking place, whether that dilution is performed on the first sample analysis or subsequent analyses. Once the NDN Sundance Project Manager and Project Chemist receive notice of such occurrence, the NDN Sundance Project Manager will inform the USACE Project Manager and Project Chemist, or designees, within 12 hours of receiving the notification.

3.11.1 Data Verification

Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. It applies to both field and laboratory records. The objective of the data validation is to assess the performance associated with the analysis to determine the quality of the data.

Field data, records, logs, and other project generated documents will be subject to data review and verification. Discussions will summarize the findings of the data verification process in the Parcel 3 Groundwater RFI Supplemental Sampling Report (Final Report).

3.11.2 Data Validation

Data validation will be performed by an independent third party IAW the following hierarchy of applicable guidance documents for data review and validation.

- The latest DoD QSM (currently v5.4 2021)
- The latest DoD General Data Validation Guidelines (currently 2019)
- Engineer Manual 200-1-10 (2005)

Data validation will be accomplished by evaluating whether the collected data comply with the predefined project requirements (including method, procedural, or contractual requirements) and by comparing the collected data with criteria established based on the project quality objectives.

Analytical results will be subjected to 100% Stage 2b validation at a minimum using ADR software (or comparable). ADR output files will be entered into the FWDA EDMS database; 10% of the laboratory data packages will be subjected to Stage 4 validation.

Stage 4 validation will require level 4 data packages reported from the laboratory; however, level 2 data packages will also be requested from the laboratory and will be attached to and presented in the reporting phase. The level 4 data packages will be retained for 5 years following receipt and will be made available upon NMED request.

4.0 REPORTING

Analytical results from each quarter will be validated and presented in an Interim Quarterly Data Summary. These quarterly data summaries will include a summary of the activities performed, presentation of the field forms and data collected, summary of validated detections in table format, and all validated analytical data in table format. The quarterly data summaries will screen against the applicable screening values and provide a determination of data usability. In the event that review of results from a quarterly data summary generates the need for a deviation from the Work Plan to meet project objectives, the Army will contact NMED prior to implementation of the deviation to seek concurrence on the alternative procedure. The resulting decision will be documented in the corresponding data summary. Seven of the quarterly monitoring events will be reported as Interim Quarterly Data Summaries with the eighth quarter presented in the Final Report.

In addition to providing data collected from the eight consecutive quarters of groundwater sampling (as described in this Work Plan), the Final Report will also include the analytical results from the eight quarters of sampling data with interpretations of the full data set. The Final Report will be prepared IAW *General Reporting Requirements for Routine Groundwater Monitoring at RCRA Sites* (NMED, 2003).

Analytical data generated from quarterly monitoring will be evaluated against selected screening values IAW the regulatory hierarchy listed in Section 1.2 of this Work Plan.

The Final Report will describe the activities performed and current findings of the investigation, including a thorough data interpretation of the eight quarterly sampling events and the extent to which the objectives of the RFI supplement have been achieved. The Final Report will include the following.

- Description of field monitoring and maintenance activities performed
- Deviations from the Work Plan
- Evaluation of sampling results
- Data Quality Evaluation (DQE) results
- Tabulated results of field data
- Tabulated validated results of analytical data
- Groundwater elevation maps
- Groundwater contaminant plume maps, if applicable
- Raw laboratory Stage 2 data reports as an appendix
- Discussion relating findings to the conclusions of the 2017 Groundwater RFI and whether there are remaining data gaps

A DQE report will evaluate usability of the data with respect to the project objectives. The Project Chemist will describe variances and rejected data, and present final data qualifiers in the DQE report.

5.0 SCHEDULE

Groundwater elevation data and groundwater samples will be collected on a quarterly basis in March, June, September, and December for eight consecutive quarters beginning after the approval of this Work Plan. The selected months for quarterly sampling were selected to have two sampling events within the monsoon months of New Mexico, from June 15 through September 30 (National Oceanic and Atmospheric Administration, 2022).

Ongoing soil excavation operations in Parcel 3 have required abandoning several existing groundwater monitoring wells within the HWMU and reinstalling the abandoned groundwater monitoring wells. Due to the schedule of the soil excavation activities, a subgroup of monitoring well installations have become delayed (Table 3-1). Monitoring wells not sampled due to the delayed installation will be integrated and sampled as soon as installation, development, and sampling under the installation work plan are complete at each proposed well location.

The following is the proposed schedule for activities covered under this Work Plan.

Activity	Schedule
Begin 1st quarter monitoring of Parcel 3 Wells; install transducers	To begin in the selected quarterly month following receipt of NMED Approval
Conduct groundwater monitoring in Parcel 3 for eight consecutive quarters	Within the month of March, after June 15, before September 30, and in December
Prepare and submit interim data summaries for Q1 through Q7 events	Submitted 90 days following completion of laboratory data validation
Prepare and submit Parcel 3 Groundwater Monitoring Summary Report	Submitted 180 days following the receipt of analytical data from the Q8 sampling event

6.0 REFERENCES

Anderson, Orin et al., 2003. *Geology of the Fort Wingate Quadrangle, McKinley County*, New Mexico by Orin J. Anderson, Charles H. Maxwell, and Spencer G. Lucas. Open-file Report 473. New Mexico Bureau of Geology and Mineral Resources. September.

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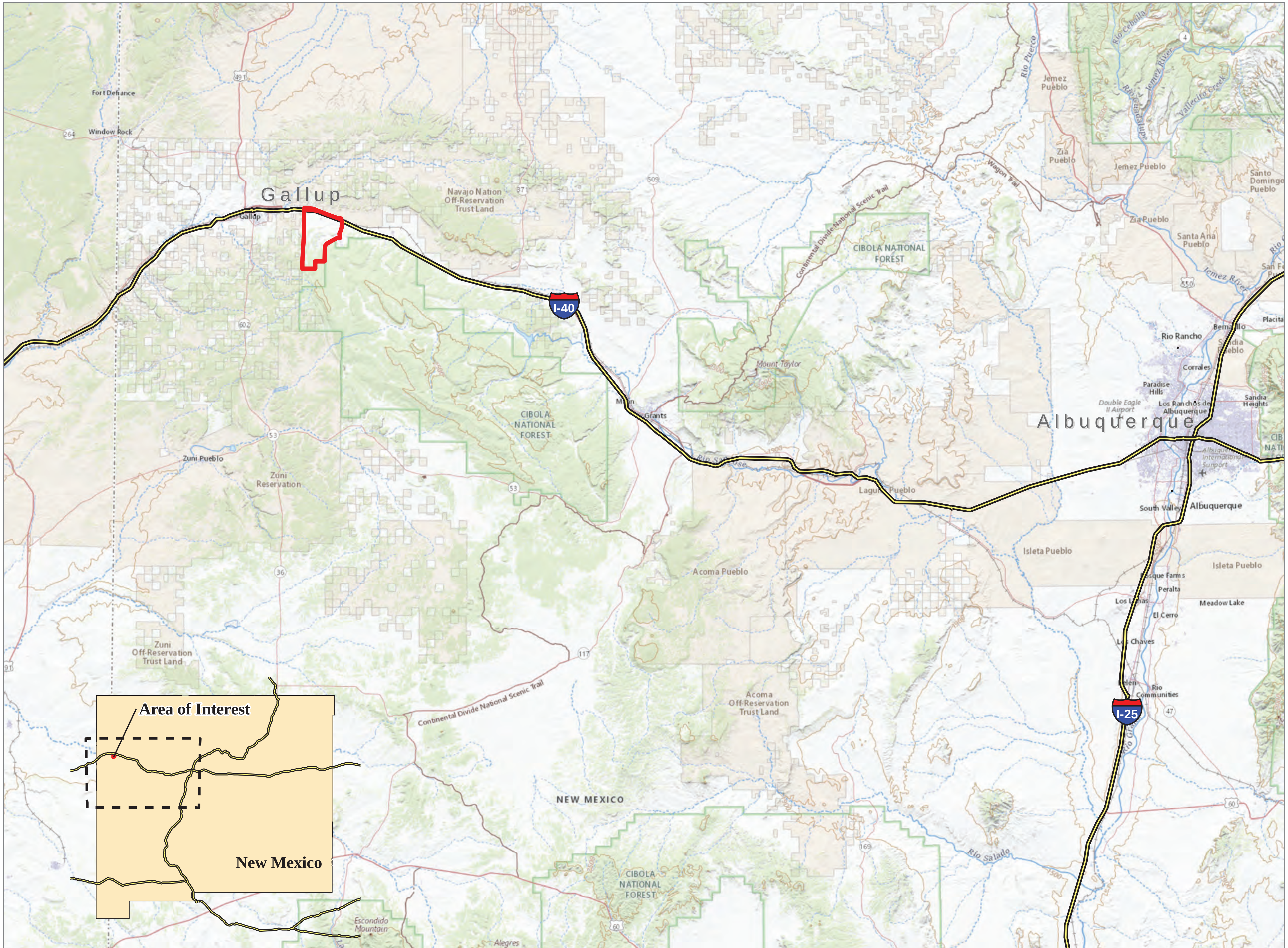
FIGURES



Legend

FWDA Site Boundary

Interstate

Notes

FWDA = Fort Wingate Depot Activity
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

N W E S

0 10 20 40 Kilometers

0 5 10 20 30 Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 1-1

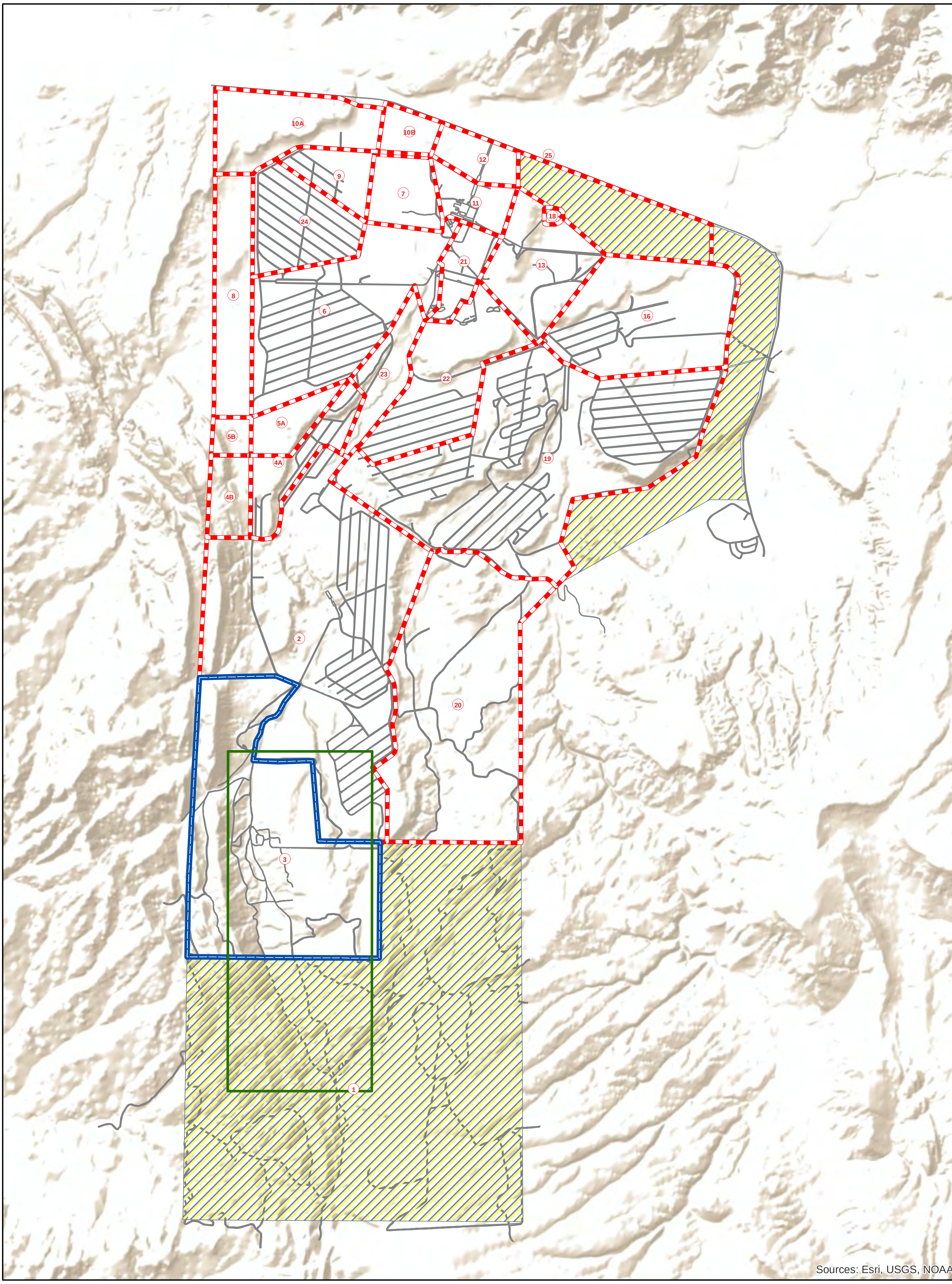
FWDA Geographic Location Map

Parcel 3 Groundwater RFI Supplemental Sampling Work Plan

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Author: L. Beasley Document Path: P:\GIS\ABQ\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\NovemberUpdate\Figure 1-1. Geolocation.mxd Document Name: Figure 1-1. Geolocation



Legend

- Study Area
- Parcel 3
- FWDA Parcels
- Transferred FWDA Property (includes Parcel 1)
- Roads

Notes

FWDA = Fort Wingate Depot Activity

N
W E
S

0 2,050 4,100 8,200
Feet

0 0.5 1 2
Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-1

FWDA Parcel Locations and Study Area Map

Parcel 3 Groundwater RFI Supplemental Sampling Work Plan

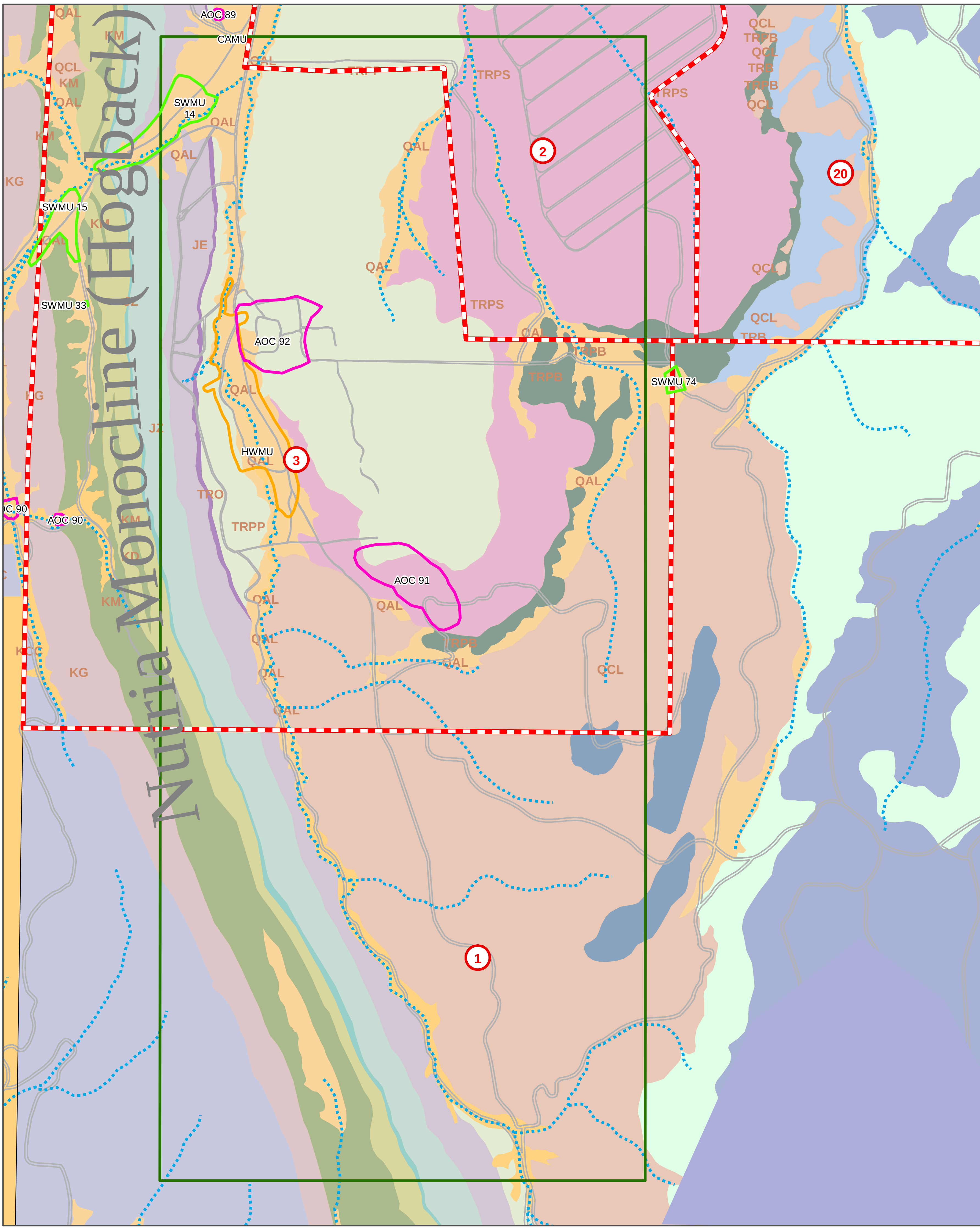
Fort Wingate Depot Activity McKinley County, New Mexico

Sundance Consulting Inc.

Author: L. Beasley Document Path: P:\GIS\ABQ\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\NovemberUpdate\Figure 2-1. ParcelLocationMap.mxd Updated on: 11/21/2022

Surface Geology

- JE-Entrada Sandstone
- JM-Morrison Formation
- JZ-Zuni Sandstone
- KCC-Crevasse Canyon Formation
- KD-Dakota Sandstone
- KG-Gallup Sandstone
- KM-Mancos Shale
- QAL-Quaternary Alluvial Deposits
- QCL-Quarternary Colluvial Deposits
- TRB-Bluewater Creek Formation
- TRBM-Bluewater Creek Formation Member
- TRO-Owl Rock Formation
- TRPB-Petrified Forest Formation-Blue Mesa Member
- TRPP-Petrified Forest Formation-Painted Desert Member
- TRPS-Petrified Forest Formation-Sonsela Sandstone Member



Legend

- AOCs
- HWMU
- SWMUs
- Study Area
- FWDA Parcels
- Arroyo
- Roads
- 1 Parcel 1 - Transferred Property

Notes

AOC = Area of Concern
FWDA = Fort Wingate Depot Activity
HWMU = Hazardous Waste Management Unit
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SWMU = Solid Waste Management Unit

N W E S

0 550 1,100 2,200
Feet

0 0.15 0.3 0.6
Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-2

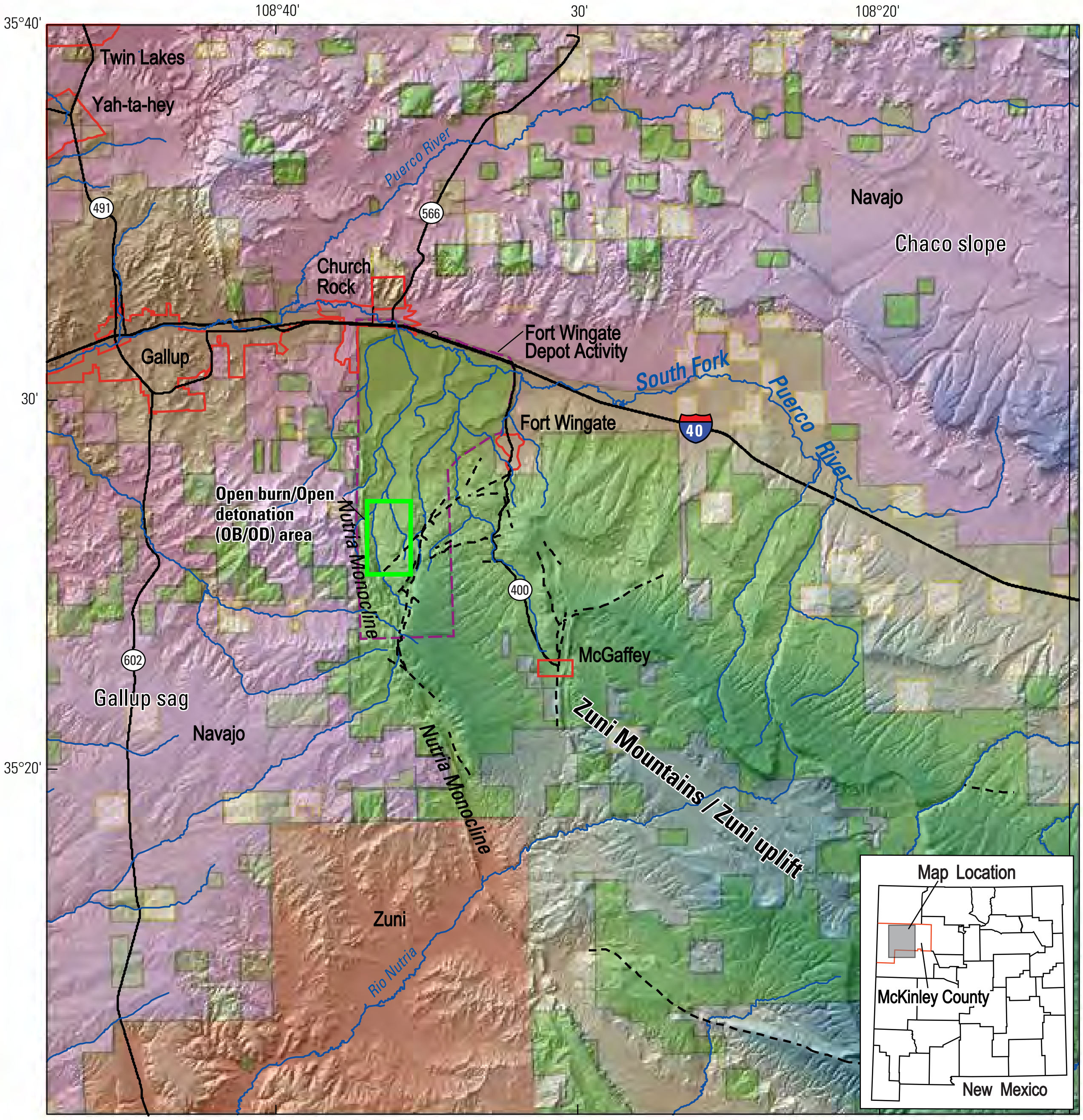
Geologic Map

Parcel 3 Groundwater RFI
Supplemental Sampling Work Plan

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 11/21/2022Author: Luke Beasley Document Path: P:\GIS\ABQ\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\NovemberUpdate\Figure 2-2. GeologicMap.mxd Document Name: Figure 2-2. GeologicMap



Base from U.S. Geological Survey digital data, 1:24,000 and 1:100,000
Universal Transverse Mercator 12° North
North American Vertical Datum of 1988 (NAVD 88)

0 5 10 MILES
0 5 10 KILOMETERS

EXPLANATION

- Navajo / Zuni — Native American Reservation and Trust Lands
- Federal Land
- Urban Areas
- State Land
- Fault
- Study Area

Figure 2-3

Regional Land Features and Land Use

Parcel 3 Groundwater RFI Supplemental Sampling Work Plan

Fort Wingate Depot Activity McKinley County, New Mexico

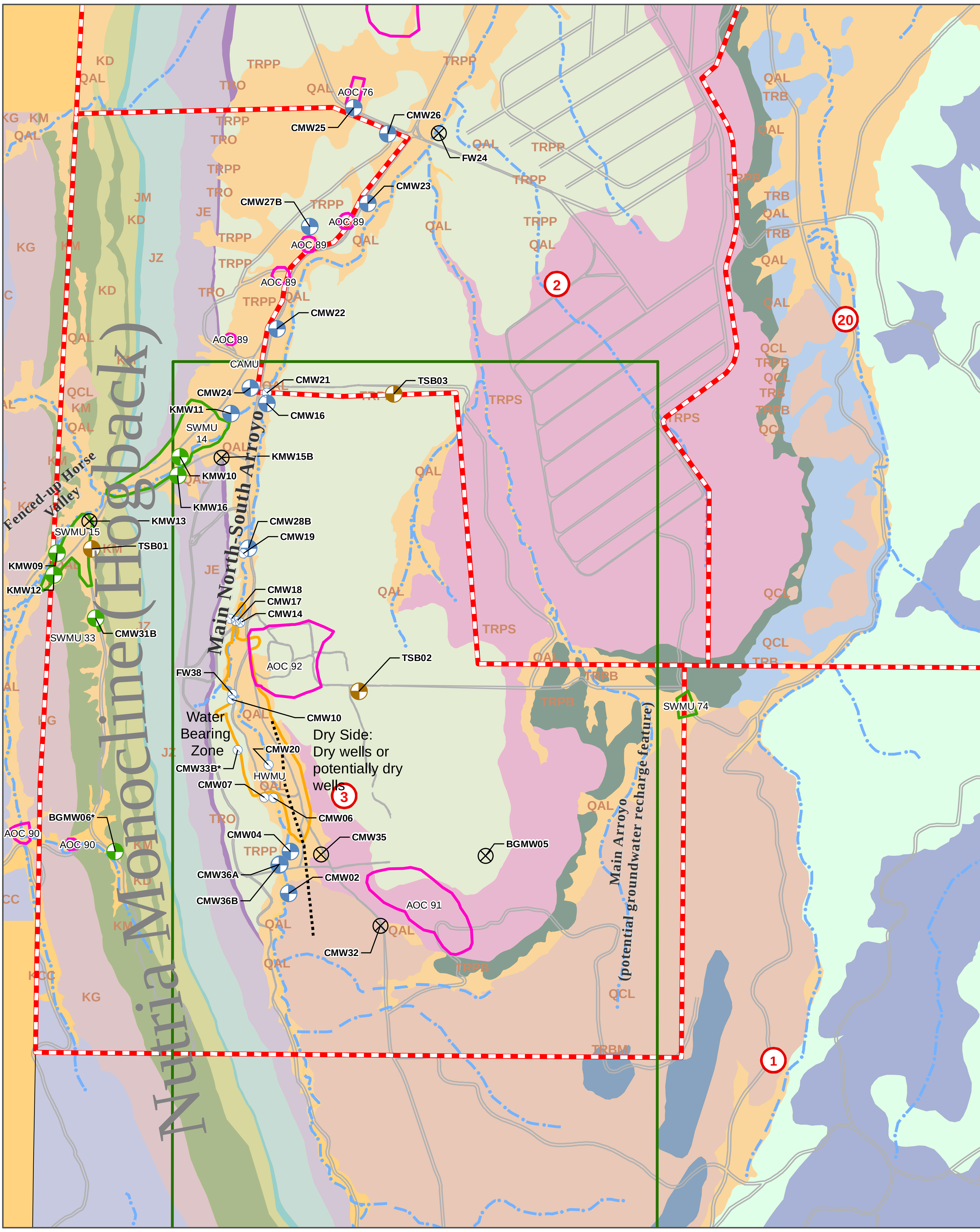
Sundance Consulting Inc.

Adapted and altered from Figure 1, *Location of Fort Wingate Depot Activity, New Mexico*. U.S. Geologic Survey (USGS), 2009. *Geochemical Evidence of Groundwater Flow Paths and the Fate and Transport of Constituents of Concern in the Alluvial Aquifer at Fort Wingate Depot Activity, New Mexico*. USGS for the U.S. Army Corps of Engineers, 2009.

RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Surface Geology

JE-Entrada Sandstone
JM-Morrison Formation
JZ-Zuni Sandstone
KCC-Crevasse Canyon Formation
KD-Dakota Sandstone
KG-Gallup Sandstone
KM-Mancos Shale
QAL-Quarternary Alluvial Deposits
QCL-Quarternary Colluvial Deposits
TRB-Bluewater Creek Formation
TRBM-Bluewater Creek Formation Member
TRO-Owl Rock Formation
TRPB-Petrified Forest Formation-Blue Mesa Member
TRPP-Petrified Forest Formation-Painted Desert Member
TRPS-Petrified Forest Formation-Sonsela Sandstone Member



Legend

Inferred Dry Line
Arroyo
Roads
Abandoned Well
East Hogback Well
West Hogback Well
Exploratory Soil Boring
Dry Well
AOCs
HWMU
SWMUs
Study Area
FWDA Parcels

0 550 1,100 2,200 Feet

0 0.125 0.25 0.5 Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Notes

AOC = Area of Concern
FWDA = Fort Wingate Depot Activity
HWMU = Hazardous Waste Management Unit
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SWMU = Solid Waste Management Unit
* = Potentially Dry Well
Dry Line is the estimated extent east from the main arroyo where groundwater is located.

N
W E
S

Figure 2-4

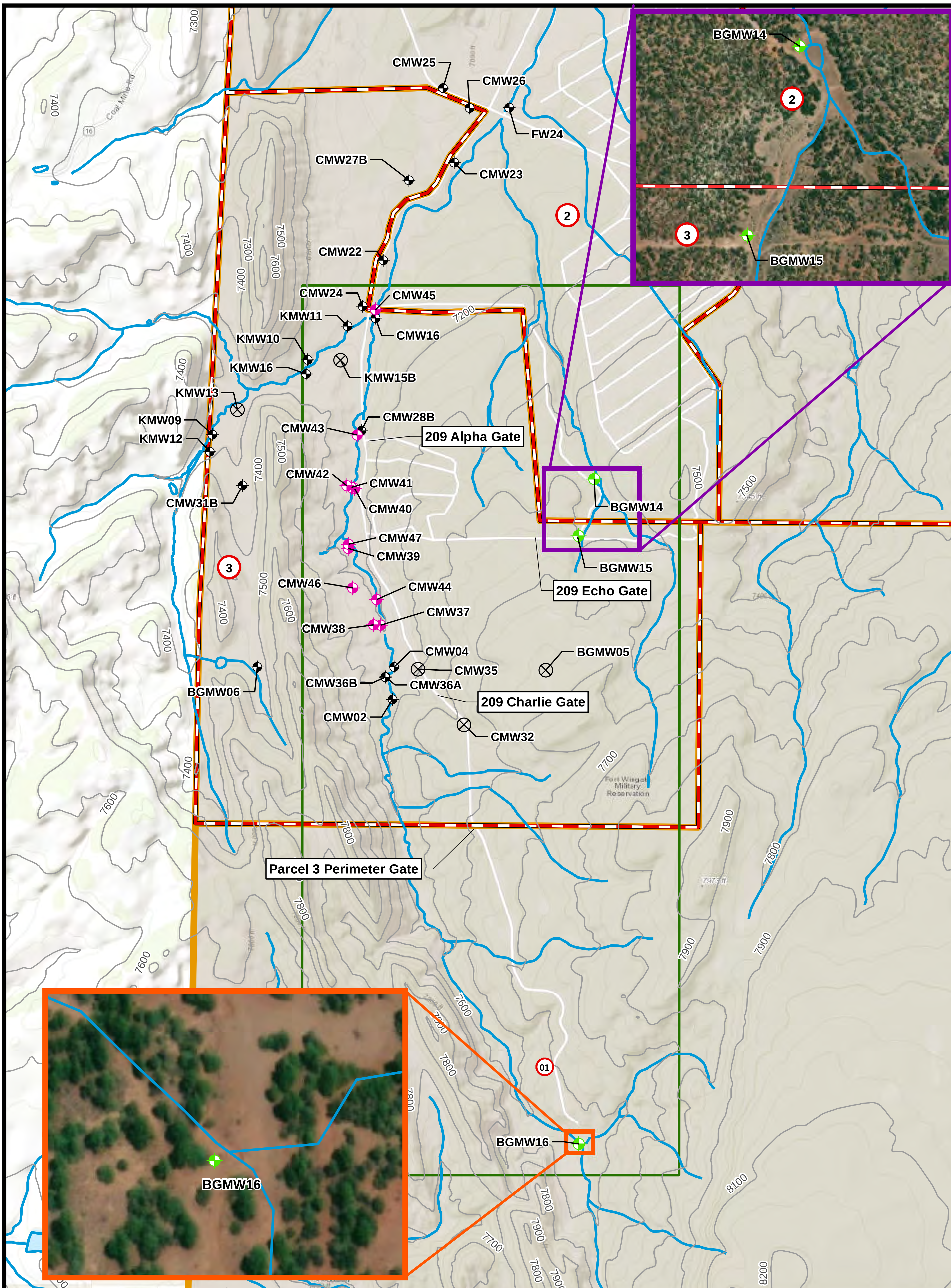
Hydrogeologic Map

Parcel 3 Groundwater RFI
Supplemental Sampling Work Plan

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 11/21/2022 Document Path: P:\GIS\ABQ\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\NovemberUpdate\Figure 2-4. HydrogeologicMap.mxd Document Name: Figure 2-4. HydrogeologicMap



Legend

- Proposed Replacement Well Location
- Proposed Well Location
- Abandoned Well
- Existing Well
- Dry Well
- Elevation Contours
- Drainage Arroyos
- FWDA Parcel Boundaries
- Transferred FWDA Property (Parcel 1)

Notes

FWDA = Fort Wingate Depot Activity

Wells CMW43, CMW45, BGMW14, and BGMW16 have been installed but not surveyed or reported at time of this submission. They are listed as proposed.

0 0.35 0.7
Miles

0 1,400 2,800
Feet

N S E W

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 3-1

Monitoring Well Locations

Parcel 3 Groundwater RFI
Supplemental Sampling Work Plan

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 12/21/2022 Document Path: P:\GIS\ABQ\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\NovemberUpdate\Figure 3-1. ProposedBkgrnd_lb3.mxd

TABLES

Table 2-1. Monitoring Well Construction Details

Well ID	FWDA Parcel	Date Installed	Drilling Method	Northing[a]	Easting[a]	Ground Elevation (ft amsl)[b]	Measuring Point Elevation (ft amsl)[b]	Well Depth (ft bgs)	Boring Diameter (in)	Casing Diameter (in)	Casing/ Screen Type	Screen Length (ft)	Screened Interval (ft bgs)	Screened Interval (ft amsl)	Status	Screened Formation	Description
Existing Monitoring and Background Wells																	
BGMW05	3	winter 2017	sonic	1612699.57	2491941.20	7567.00	7569.46	61.00	6.00	2.00	PVC	20.0	36-56	7533.46-7513.46	***Dry***	Sonsela Member	Sandstone
BGMW06	3	winter 2017	sonic	1612753.64	2486955.92	7346.00	7347.15	131.00	6.00	2.00	PVC	20.0	110-130	7237.15-7217.15	Active	Dakota Formation	Sandstone
CMW02	3	08/15/1996	HSA/AR	1612193.23	2489293.13	7256.32	7258.00	43.00	8.00	2.00	PVC	10.0	25.0 - 35.0	7230.39-7220.39	Active	Alluvium	Silty Clay
CMW04	3	08/15/1996	AR	1612755.29	2489317.38	7249.08	7251.15	136.60	8.00	2.00	PVC	20.0	115.0 - 135.0	7133.30-7113.30	Active	Alluvium	Silty Clay
CMW06 [d]	3	08/12/1996	HSA	1613477.48	2489087.84	7214.13	7216.05	18.60	4.00	2.00	PVC	10.0	8.3 - 18.3	7204.95-7194.95	***Abandoned in 2015***	Alluvium	Silty Clay/Silty Sand
CMW07 [d]	3	10/01/1996	HSA/AR	1613481.11	2488966.19	7233.04	7235.16	65.80	8.00	2.00	PVC	20.0	44.0 - 64.0	7188.90-7168.90	***Abandoned in 2017***	Painted Desert Member	Sandstone
CMW10	3	09/30/1996	HSA/AR	1614801.68	2488525.71	7177.40	7179.31	70.85	8.00	2.00	PVC	20.0	50.5 - 70.5	7126.49-7106.49	***Abandoned in 2019***	Painted Desert Member	Silty Claystone
CMW14 [d]	3	09/06/1996	HSA/AR	1615835.54	2488638.31	7151.34	7153.06	94.55	9.00	2.00	PVC	10.0	84.2 - 94.2	7066.82-7056.82	***Abandoned in 2017***	Painted Desert Member	Silty Claystone
CMW16 [d]	3	08/17/1996	HSA/AR	1618788.98	2488995.95	7082.17	7084.23	31.80	8.00	2.00	PVC	10.0	20.0 - 30.0	7061.51-7051.51	***Buried***	Painted Desert Member	Sandstone
CMW17 [d]	3	08/21/1996	HSA/AR	1615860.63	2488582.47	7143.72	7145.18	53.00	8.00	2.00	PVC	20.0	32.0 - 52.0	7111.15-7091.15	***Abandoned in 2017***	Painted Desert Member	Silty Claystone
CMW18 [d]	3	09/28/1996	HSA/AR	1615886.04	2488504.59	7156.24	7158.24	53.00	8.00	2.00	PVC	20.0	32.0 - 52.0	7124.48-7104.48	***Abandoned in 2017***	Painted Desert Member	Silty Claystone
CMW19	3	10/05/1996	HSA/AR	1616766.18	2488680.46	7128.11	7129.85	52.80	8.00	2.00	PVC	15.0	33.5 - 48.5	7093.89-7078.89	***Abandoned in 2019***	Painted Desert Member	Silty Claystone
CMW20 [d]	3	08/12/1998	HSA	1613921.71	2489020.26	7193.14	7194.68	5.80	4.00	2.00	PVC	3.0	2.5 - 5.5	7189.83-7186.83	***Abandoned in 2015***	Painted Desert Member	Clayey Sandstone
CMW21 [d]	3	08/10/1998	HSA/AR	1618931.48	2488996.15	7192.70	7088.19	74.50	6.00	2.00	PVC	10.0	57.0-67.0	7025.72-7015.72	***Abandoned in 2015***	Sonsela Member	Silty Sandstone
CMW22	3	09/04/1998	HSA/AR	1619789.75	2489133.42	7080.50	7081.94	122.00	5.50	2.00	PVC	20.0	96.5-116.5	7029.68-7009.68	Active	Painted Desert Member	Sandstone/Siltstone
CMW23	3	07/31/1998	HSA/AR	1621477.51	2490357.19	7033.41	7035.58	112.00	5.50	2.00	PVC	20.0	84.0-104.0	6945.82-6925.82	Active	Sonsela Member	Sandstone
CMW24	3	09/15/1998	HSA/AR	1618994.34	2488773.81	7098.27	7099.68	262.00	6.30	2.00	PVC	30.0	230.0-260.0	6864.33-6834.33	Active	Sonsela Member	Sandstone
CMW25	3	09/28/1996	HSA/AR	1622764.90	2490166.62	7005.24	7007.52	97.00	8.75	2.00	PVC	25.0	71.0-96.0	6930.74-6905.74	Active	Painted Desert Member	Sandstone
CMW26	3	winter 2017	sonic	1622418.10	2490627.00	7033.00	7033.98	85.00	6.00	2.00	PVC	20.0	64-84	6969.98-6949.98	Active	Painted Desert Member	Claystone/Sandstone
CMW27B	3	winter 2017	sonic	1621168.40	2489575.35	7072.00	7072.85	94.00	6.00	2.00	PVC	30.0	63-93	7009.85-6979.85	Active	Painted Desert Member	Claystone/Sandstone
CMW28B	3	winter 2017	sonic	1616836.27	2488752.11	7136.00	7137.65	81.50	6.00	2.00	PVC	20.0	60-80	7077.65-7057.65	Active	Alluvium/Painted Desert Member	Silt/Sandstone
CMW31B	3	winter 2017	sonic	1615894.68	2486695.87	7223.00	7225.06	110.00	6.00	2.00	PVC	30.0	78-108	7147.06-7117.06	Active	Dakota Formation	Sandstone
CMW32	3	winter 2017	sonic	1611753.83	2490527.72	7434.00	7435.71	116.50	6.00	2.00	PVC	10.0	95-105	7340.71-7330.71	***Dry***	Sonsela Member	Sandstone

Table 2-1. Monitoring Well Construction Details

Well ID	FWDA Parcel	Date Installed	Drilling Method	Northing[a]	Easting[a]	Ground Elevation (ft amsl)[b]	Measuring Point Elevation (ft amsl)[b]	Well Depth (ft bgs)	Boring Diameter (in)	Casing Diameter (in)	Casing/ Screen Type	Screen Length (ft)	Screened Interval (ft bgs)	Screened Interval (ft amsl)	Status	Screened Formation	Description
CMW33B	3	winter 2017	sonic	1614122.30	2488606.09	7231.00	7231.49	155.00	6.00	2.00	PVC	20.0	135-155	7096.49-7076.49	***Abandoned in 2018***	Sonsela Member	Sandstone
CMW35	3	winter 2017	sonic	1612717.43	2489728.78	7289.00	7290.57	126.50	6.00	2.00	PVC	30.0	95-125	7195.57-7165.57	***Dry***	Sonsela Member	Sandstone
CMW36A	3	winter 2017	sonic	1612582.68	2489172.05	7246.00	7247.79	66.50	6.00	2.00	PVC	20.0	45-65	7202.79-7182.79	Active	Alluvium/Painted Desert Member	Sand/Sandstone
CMW36B	3	winter 2017	sonic	1612576.47	2489162.13	7246.00	7247.99	118.50	6.00	2.00	PVC	30.0	87-117	7160.99-7130.99	Active	Sonsela Member	Claystone/Sandstone
FW24[d]	3	11/14/1980	HSA	1622425.99	2491311.06	6997.49	6999.19	25.00	8.00	4.00	PVC	15.0	33.5-48.5	6984.56-6969.56	***Dry***	Alluvium	Clay
FW38[d]	3	11/19/1993	HSA	1614875.40	2488533.75	7169.43	7172.02	7.50	3.00	2.00	PVC	ND	ND	ND	***Abandoned in 2017***	Alluvium	ND
KMW09	3	09/27/1996	HSA/AR	1616771.44	2486173.70	7186.02	7187.93	80.40	9.00	2.00	PVC	10.0	60.0 - 70.0	7125.48-7115.48	Active	Mancos Formation	Silty Claystone/Silty Sandstone
KMW10	3	08/06/1996	HSA/AR	1618066.89	2487827.76	7129.35	7131.38	168.45	8.00	2.00	PVC	10.0	158.0 - 168.0	6970.71-6960.71	Active	Unknown	Siltstone/Sandstone
KMW11	3	09/02/1998	HSA	1618649.14	2488515.19	7106.97	7108.78	63.00	9.00	2.00	PVC	20.0	35.0 - 55.0	7071.60-7051.60	Active	Painted Desert Member	Silty Claystone
KMW12	3	08/17/1998	HSA/AR	1616476.04	2486128.81	7191.70	7193.08	75.00	8.75	2.00	PVC	20.0	53.0-73.0	7134.74-7114.74	Active	Mancos Formation	Claystone
KMW13	3	11/13/1998	HSA/AR	1617203.45	2486607.14	7167.06	7168.46	52.50	8.75	2.00	PVC	20.0	32.0-52.0	7131.79-7111.79	***Dry***	Dakota Formation	Sandstone
KMW15B	3	winter 2017	sonic	1618061.00	2488390.00	7151.50	7152.63	210.00	6.00	2.00	PVC	20.0	189-209	6963.63-6943.63	***Dry***	Sonsela Member	Sandstone
KMW16	3	winter 2017	sonic	1617818.00	2487800.00	7135.00	7137.11	201.00	7.00	2.00	PVC	40.0	159-199	6978.11-6938.11	Active	Painted Desert Member	Claystone/Sandstone
Newly Installed Proposed Replacement Monitoring and Background Wells																	
BGMW14	2	6/9/2022	sonic	ND[e]	ND[e]	ND[e]	ND[e]	116.00	6.00	2.00	PVC	15.0	101.5-116.5	7248.5-7233.5	Proposed	Sonsela Member	Sandstone
BGMW16	1	6/7/2022	sonic	ND[e]	ND[e]	ND[e]	ND[e]	55.00	6.00	2.00	PVC	20.0	35-55	7535-7515	***Dry***	Bluewater Creek Lower Member	Silty Claystone
CMW43	3	3/25/2022	sonic	ND[e]	ND[e]	ND[e]	ND[e]	51.00	6.00	2.00	PVC	15.0	36-51	7094-7079	Proposed	Painted Desert Member	Silty Claystone
CMW45	3	3/12/2022	sonic	ND[e]	ND[e]	ND[e]	ND[e]	73.00	6.00	2.00	PVC	15.0	58-73	7032.98-7017.98	Proposed	Sonsela Member	Sandstone
Proposed Replacement Monitoring and Background Wells																	
BGMW15	3	Estimated Spring of 2023	sonic	1613481.11	2488966.19	ND	ND	75.00	6.00	2.00	PVC	20.0	45-65	ND	Proposed	Sonsela Member	--
CMW37	3	Estimated Spring of 2023	sonic	1613477.48	2489087.84	ND	ND	18.6+	6.00	2.00	PVC	10.0	8.6-18.6	7204-7194	Proposed	Alluvium	--
CMW38	3	Estimated Spring of 2023	sonic	1613481.11	2488966.19	ND	ND	65.80	6.00	2.00	PVC	20.0	45.80-65.80	7188-7168	Proposed	Painted Desert Member	--
CMW39	3	Estimated Spring of 2023	sonic	1614801.68	2488525.71	ND	ND	70.85	6.00	2.00	PVC	20.0	50.85-70-85	7126-7106	Proposed	Painted Desert Member	--
CMW40	3	Estimated Spring of 2023	sonic	1615835.54	2488638.31	ND	ND	94.55	6.00	2.00	PVC	10.0	84.55-94.55	7066-7056	Proposed	Painted Desert Member	--
CMW41	3	Estimated Spring of 2023	sonic	1615860.63	2488582.47	ND	ND	53.00	6.00	2.00	PVC	20.0	33-53	7111-7091	Proposed	Painted Desert Member	--

Table 2-1. Monitoring Well Construction Details

Well ID	FWDA Parcel	Date Installed	Drilling Method	Northing[a]	Easting[a]	Ground Elevation (ft amsl)[b]	Measuring Point Elevation (ft amsl)[b]	Well Depth (ft bgs)	Boring Diameter (in)	Casing Diameter (in)	Casing/ Screen Type	Screen Length (ft)	Screened Interval (ft bgs)	Screened Interval (ft amsl)	Status	Screened Formation	Description
CMW42	3	Estimated Spring of 2023	sonic	1615886.04	2488504.59	ND	ND	53.00	6.00	2.00	PVC	20.0	33-53	7124-7104	Proposed	Painted Desert Member	--
CMW44	3	Estimated Spring of 2023	sonic	1613921.71	2489020.26	ND	ND	5.8+	6.00	2.00	PVC	3.0	2.8-5.8	7189-7186	Proposed	Painted Desert Member	--
CMW46	3	Estimated Spring of 2023	sonic	1614122.30	2488606.09	ND	ND	155.00	6.00	2.00	PVC	20.0	135-155	7096-7076	Proposed	Sonsela Member	--
CMW47	3	Estimated Spring of 2023	sonic	1614875.4	2488533.75	ND	ND	7.5+	6.00	2.00	PVC	ND	ND	ND	Proposed	Alluvium	--

Notes:

[a] horizontal coordinate system: NM NAD83 State Plane Central

[b] vertical coordinate system: NAVD88

[c] indicates the well is used for water-level measurements only and is not sampled

[d] *italics* indicate a well is no longer usable for monitoring purposes

[e] wells have not been surveyed by a New Mexico Licensed Surveyor at the time of this Work Plan preparation

Orange shading indicates specification data presented are estimated, as these wells are proposed for installation

Acronyms and Abbreviations:

amsl = above mean sea level
AR = air rotary drilling method
bgs = below ground surface
ft = foot / feet
FWDA = Fort Wingate Depot Activity
HSA = hollow-stem auger drilling method
ID = identification
in = inch / inches
NAD83 = North American Datum of 1983
NAVD88 = North American Vertical Datum of 1988
ND = not documented or no data available
NM = New Mexico
PVC = polyvinyl chloride
sonic = sonic drilling method

Table 3-1. Monitoring Well Purging/Sampling Equipment

Well ID	Purging Method	Sampling Method
Existing Monitoring and Background Wells		
BGMW05	Bailer	Bailer
BGMW06	Bailer	Bailer
CMW02	Low Flow with ZIST	Low Flow
CMW04	Low Flow with ZIST	Low Flow
CMW22	Bailer	Bailer
CMW23	Bailer	Bailer
CMW24	Submersible Pump	Bailer
CMW25	Low Flow	Low Flow
CMW26	Submersible Pump	Bailer
CMW27B	Submersible Pump	Bailer
CMW28B	Bailer	Bailer
CMW31B	Submersible Pump	Bailer
CMW32	Bailer	Bailer
CMW35	Bailer	Bailer
CMW36A	Submersible Pump	Bailer
CMW36B	Submersible Pump	Bailer
KMW09	Low Flow with ZIST	Low Flow
KMW10	Bailer	Bailer
KMW11	Low Flow with BESST	Low Flow
KMW12	Bennett	Bennett
KMW13	Bailer	Bailer
KMW15B	Bailer	Bailer
KMW16	Submersible Pump	Bailer
Newly Installed Replacement Monitoring and Background Wells		
BGMW14	Submersible Pump	Bailer
BGMW16	Submersible Pump	Bailer
CMW43	Submersible Pump	Bailer
CMW45	Submersible Pump	Bailer
Proposed Replacement Monitoring and Background Wells		
BGMW15	Submersible Pump	Bailer
CMW37	Submersible Pump	Bailer
CMW38	Submersible Pump	Bailer
CMW39	Submersible Pump	Bailer
CMW40	Submersible Pump	Bailer
CMW41	Submersible Pump	Bailer
CMW42	Submersible Pump	Bailer
CMW44	Submersible Pump	Bailer
CMW46	Submersible Pump	Bailer
CMW47	Submersible Pump	Bailer

Notes:

BESST = BESST Inc. Global Subsurface Technologies

ZIST = Zone Isolation Sampling Technologies™

Table 3-2. Groundwater Screening Value, Detection Limits, and Control Limits

Method	Analyte	CAS	Units	NM WQCC GW[1]	EPA MCL[2]	EPA RSL Cancer Tap Water[3]	EPA RSL Noncancer Tap Water[4]	Final Selected SL[5]	Final Selected SL Reference	Risk Endpoint c/nc	DL (µg/L or mg/L)	LOD (µg/L or mg/L)	LOQ (µg/L or mg/L)	LCS MS MSD LCL (%)	LCS MS MSD UCL (%)	RPD (%)
6010C	Aluminum	7429-90-5	µg/L	5000			20000	5000	WQCC		18	70	300	86	115	20
6010C	Calcium[6]	7440-70-2	µg/L					NA			34.5	135	1000	87	113	20
6010C	Iron	7439-89-6	µg/L	1000			14000	1000	WQCC		22	85	100	87	115	20
6010C	Magnesium[6]	7439-95-4	µg/L					NA			10.7	40	500	85	113	20
6010C	Potassium[6]	7440-09-7	µg/L					NA			237	940	3000	86	114	20
6010C	Sodium[6]	7440-23-5	µg/L					NA			117	350	5000	87	115	20
6020A	Antimony	7440-36-0	µg/L	6	6		7.8	6	WQCC		0.4	1	6	85	117	20
6020A	Arsenic	7440-38-2	µg/L	10	10	0.52	6	10	WQCC		0.33	1	5	84	116	20
6020A	Barium	7440-39-3	µg/L	2000	2000		3800	2000	WQCC		0.29	0.95	3	86	114	20
6020A	Beryllium	7440-41-7	µg/L	4	4		25	4	WQCC		0.08	0.3	1	83	121	20
6020A	Cadmium	7440-43-9	µg/L	5	5		1.8	5	WQCC		0.265	1	1	87	115	20
6020A	Chromium	7440-47-3	µg/L	50	100			50	WQCC		0.5	1.8	10	85	116	20
6020A	Cobalt	7440-48-4	µg/L	50			6	50	WQCC		0.054	0.2	1	86	115	20
6020A	Copper	7440-50-8	µg/L	1000	1300		800	1000	WQCC		0.56	1.8	2	85	118	20
6020A	Lead	7439-92-1	µg/L	15	15		15	15	WQCC		0.18	0.7	3	88	115	20
6020A	Manganese	7439-96-5	µg/L	200				200	WQCC		0.31	0.95	3.5	87	115	20
6020A	Nickel	7440-02-0	µg/L	200			390	200	WQCC		0.3	1	3	85	117	20
6020A	Selenium	7782-49-2	µg/L	50	50		100	50	WQCC		0.7	2	5	80	120	20
6020A	Silver	7440-22-4	µg/L	50			94	50	WQCC		0.033	0.1	5	85	116	20
6020A	Thallium	7440-28-0	µg/L	2	2		0.2	2	WQCC		0.05	0.2	1	82	116	20
6020A	Vanadium	7440-62-2	µg/L				86	86	RSL	nc	0.5	2	6	86	115	20
6020A	Zinc	7440-66-6	µg/L	10000			6000	10000	WQCC		2	8	20	83	119	20
6860	Perchlorate	14797-73-0	µg/L		15		14	15	MCL		0.004	0.01	0.05	84	119	20
7470A	Mercury	7439-97-6	µg/L	2	2		0.63	2	WQCC		0.027	0.08	0.2	82	119	20
8260C	1,1,1,2-Tetrachloroethane	630-20-6	µg/L			5.7	480	5.7	RSL	c	0.117	0.25	1	78	124	20
8260C	1,1,1-Trichloroethane	71-55-6	µg/L	200	200		8000	200	WQCC		0.171	0.25	1	74	131	20
8260C	1,1,2,2-Tetrachloroethane	79-34-5	µg/L	10		0.76	360	10	WQCC		0.1	0.25	1	71	121	20
8260C	1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L				10000	10000	RSL	nc	0.1	0.25	1	70	136	20
8260C	1,1,2-Trichloroethane	79-00-5	µg/L	5	5	2.8	0.41	5	WQCC		0.132	0.25	1	80	119	20
8260C	1,1-Dichloroethane	75-34-3	µg/L	25		28	3800	25	WQCC		0.07	0.25	1	77	125	20
8260C	1,1-Dichloroethene	75-35-4	µg/L	7	7		280	7	WQCC		0.1	0.25	1	71	131	20
8260C	1,1-Dichloropropene (surrogate dichloropropene, 1,3-)	563-58-6	µg/L			4.7	39	4.7	RSL	c	0.104	0.25	1	79	125	20
8260C	1,2,3-Trichlorobenzene	87-61-6	µg/L				7	7	RSL	nc	0.174	0.25	2	69	129	20
8260C	1,2,3-Trichloropropane	96-18-4	µg/L			0.0075	0.62	0.0075	RSL	c	0.183	0.25	1	73	122	20
8260C	1,2,4-Trichlorobenzene	120-82-1	µg/L	70	70	12	4	70	WQCC		0.1	0.25	5	69	130	20
8260C	1,2,4-Trimethylbenzene	95-63-6	µg/L				56	56	RSL	nc	0.17	0.25	1	76	124	20
8260C	1,2-Dibromo-3-Chloropropane	96-12-8	µg/L		0.2	0.0033	0.37	0.2	MCL		0.3	1	5	62	128	20
8260C	1,2-Dibromoethane (ethylene dibromide [EDB])	106-93-4	µg/L	0.05	0.05	0.075	17	0.05	WQCC		0.2	0.5	1	80	120	20

Table 3-2. Groundwater Screening Value, Detection Limits, and Control Limits

Method	Analyte	CAS	Units	NM WQCC GW[1]	EPA MCL[2]	EPA RSL Cancer Tap Water[3]	EPA RSL Noncancer Tap Water[4]	Final Selected SL[5]	Final Selected SL Reference	Risk Endpoint c/nc	DL (µg/L or mg/L)	LOD (µg/L or mg/L)	LOQ (µg/L or mg/L)	LCS MS MSD LCL (%)	LCS MS MSD UCL (%)	RPD (%)
8260C	1,2-Dichlorobenzene	95-50-1	µg/L	600	600		300	600	WQCC		0.1	0.25	1	80	119	20
8260C	1,2-Dichloroethane	107-06-2	µg/L	5	5	1.7	13	5	WQCC		0.215	0.25	1	73	128	20
8260C	1,3,5-Trimethylbenzene	108-67-8	µg/L				60	60	RSL	nc	0.163	0.25	1	75	124	20
8260C	1,3-Dichlorobenzene (surrogate dichlorobenzene, 1,4-)	541-73-1	µg/L	75	75	4.8	570	75	WQCC		0.106	0.25	1	80	119	20
8260C	1,3-Dichloropropane	142-28-9	µg/L				370	370	RSL	nc	0.1	0.25	1	80	119	20
8260C	1,4-Dichlorobenzene	106-46-7	µg/L	75	75	4.8	570	75	WQCC		0.1	0.25	1	79	118	20
8260C	2,2-Dichloropropane (surrogate dichloropropane, 1,2-)	594-20-7	µg/L	5	5	8.5	8.2	5	WQCC		0.177	0.25	1	60	139	20
8260C	2-Butanone (MEK)	78-93-3	µg/L				5600	5600	RSL	nc	0.469	1	5	56	143	20
8260C	2-Chlorotoluene	95-49-8	µg/L				240	240	RSL	nc	0.153	0.25	1	79	122	20
8260C	2-Hexanone	591-78-6	µg/L				38	38	RSL	nc	0.248	0.5	5	57	139	20
8260C	4-Chlorotoluene	106-43-4	µg/L				250	250	RSL	nc	0.154	0.25	1	78	122	20
8260C	4-Methyl-2-pentanone (MIBK)	108-10-1	µg/L				6300	6300	RSL	nc	0.216	0.5	5	67	130	20
8260C	Acetone	67-64-1	µg/L				18000	18000	RSL	nc	0.554	1	2	39	160	20
8260C	Benzene	71-43-2	µg/L	5	5	4.6	33	5	WQCC		0.1	0.25	1	79	120	20
8260C	Bromobenzene	108-86-1	µg/L				62	62	RSL	nc	0.119	0.25	1	80	120	20
8260C	Bromochloromethane	74-97-5	µg/L				150	150	RSL	nc	0.143	0.5	1	78	123	20
8260C	Bromodichloromethane	75-27-4	µg/L		80	1.3	150	80	MCL		0.138	0.25	1	79	125	20
8260C	Bromoform	75-25-2	µg/L		80	33	380	80	MCL		0.17	0.25	1	66	130	20
8260C	Bromomethane	74-83-9	µg/L				7.5	7.5	RSL	nc	0.25	0.5	2	53	141	20
8260C	Carbon disulfide	75-15-0	µg/L				810	810	RSL	nc	0.1	0.25	2	64	133	20
8260C	Carbon tetrachloride	56-23-5	µg/L	5	5	4.6	49	5	WQCC		0.181	0.25	1	72	136	20
8260C	Chlorobenzene	108-90-7	µg/L		100		78	100	MCL		0.109	0.25	2	82	118	20
8260C	Chloroethane	75-00-3	µg/L				8300	8300	RSL	nc	0.163	0.25	2	60	138	20
8260C	Chloroform	67-66-3	µg/L	100	80	2.2	97	80	MCL		0.1	0.25	1	79	124	20
8260C	Chloromethane	74-87-3	µg/L				190	190	RSL	nc	0.102	0.25	2	50	139	20
8260C	cis-1,2-Dichloroethene	156-59-2	µg/L	70	70		25	70	WQCC		0.1	0.25	1	78	123	20
8260C	cis-1,3-Dichloropropene (surrogate dichloropropene, 1,3-)	10061-01-5	µg/L			4.7	39	4.7	RSL	c	0.158	0.25	1	75	124	20
8260C	Dibromochloromethane	124-48-1	µg/L		80	8.7	380	80	MCL		0.143	0.25	1	74	126	20
8260C	Dibromomethane	74-95-3	µg/L				8.3	8.3	RSL	nc	0.21	0.5	2	79	123	20
8260C	Dichlorodifluoromethane	75-71-8	µg/L				200	200	RSL	nc	0.138	0.25	2	32	152	20
8260C	Ethylbenzene	100-41-4	µg/L	700	700	15	500	700	WQCC		0.122	0.25	1	79	121	20
8260C	Hexachlorobutadiene	87-68-3	µg/L			1.4	6.5	1.4	RSL	c	0.5	1	2	66	134	20
8260C	Isopropylbenzene	98-82-8	µg/L				450	450	RSL	nc	0.167	0.25	1	72	131	20
8260C	Methyl acetate	79-20-9	µg/L				20000	20000	RSL	nc	0.755	1	25	56	136	20
8260C	Methyl tert-butyl ether	1634-04-4	µg/L	100		140	6300	100	WQCC		0.146	0.25	2	71	124	20
8260C	Methylcyclohexane (surrogate cyclohexane)	108-87-2	µg/L				13000	13000	RSL	nc	0.158	0.5	4	72	132	20
8260C	Methylene Chloride	75-09-2	µg/L	5	5	110	110	5	WQCC		0.27	0.5	1	74	124	20
8260C	m-Xylene & p-Xylene (surrogate o-xylene)	179601-23-1	µg/L				190	190	RSL	nc	0.148	0.5	2	80	121	20

Table 3-2. Groundwater Screening Value, Detection Limits, and Control Limits

Method	Analyte	CAS	Units	NM WQCC GW[1]	EPA MCL[2]	EPA RSL Cancer Tap Water[3]	EPA RSL Noncancer Tap Water[4]	Final Selected SL[5]	Final Selected SL Reference	Risk Endpoint c/nc	DL (µg/L or mg/L)	LOD (µg/L or mg/L)	LOQ (µg/L or mg/L)	LCS MS MSD LCL (%)	LCS MS MSD UCL (%)	RPD (%)
8260C	Naphthalene	91-20-3	µg/L	30		1.2	6.1	30	WQCC		0.208	0.25	5	61	128	20
8260C	n-Butylbenzene	104-51-8	µg/L				1000	1000	RSL	nc	0.181	0.5	1	75	128	20
8260C	N-Propylbenzene	103-65-1	µg/L				660	660	RSL	nc	0.164	0.25	1	76	126	20
8260C	o-Xylene	95-47-6	µg/L				190	190	RSL	nc	0.126	0.25	1	78	122	20
8260C	p-Isopropyltoluene (surrogate cumene)	99-87-6	µg/L				450	450	RSL	nc	0.171	0.25	1	77	127	20
8260C	sec-Butylbenzene	135-98-8	µg/L				2000	2000	RSL	nc	0.164	0.25	1	77	126	20
8260C	Styrene	100-42-5	µg/L	100	100		1200	100	WQCC		0.134	0.25	1	78	123	20
8260C	tert-Butylbenzene	98-06-6	µg/L				690	690	RSL	nc	0.181	0.25	1	78	124	20
8260C	Toluene	108-88-3	µg/L	1000	1000		1100	1000	WQCC		0.14	0.25	1	80	121	20
8260C	trans-1,2-Dichloroethene	156-60-5	µg/L	100	100		68	100	WQCC		0.103	0.25	1	75	124	20
8260C	trans-1,3-Dichloropropene (surrogate dichloropropene, 1,3-)	10061-02-6	µg/L			4.7	39	4.7	RSL	c	0.1	0.25	1	73	127	20
8260C	Trichloroethene	79-01-6	µg/L	5	5	4.9	2.8	5	WQCC		0.25	0.5	1	79	123	20
8260C	Trichlorofluoromethane	75-69-4	µg/L				5200	5200	RSL	nc	0.11	0.25	1	65	141	20
8260C	Vinyl chloride	75-01-4	µg/L	2	2	0.19	42	2	WQCC		0.2	0.5	1	58	137	20
8330B	1,3,5-Trinitrobenzene	99-35-4	µg/L				590	590	RSL	nc	0.0841	0.2	0.21	73	125	20
8330B	1,3-Dinitrobenzene	99-65-0	µg/L				2	2	RSL	nc	0.0369	0.1	0.11	78	120	20
8330B	2,4,6-Trinitrotoluene	118-96-7	µg/L			25	9.8	9.8	RSL	nc	0.045	0.1	0.11	71	123	20
8330B	2,4-Dinitrotoluene	121-14-2	µg/L			2.4	38	2.4	RSL	c	0.0274	0.08	0.1	78	120	20
8330B	2,6-Dinitrotoluene	606-20-2	µg/L			0.49	5.7	0.49	RSL	c	0.0401	0.08	0.1	77	127	20
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L				1.9	1.9	RSL	nc	0.0507	0.1	0.11	79	120	20
8330B	3,5-Dinitroaniline	618-87-1	µg/L				7.7	7.7	RSL	nc	0.132	0.3	0.4	71	117	20
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L				1.9	1.9	RSL	nc	0.0577	0.12	0.15	76	125	20
8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	µg/L				1000	1000	RSL	nc	0.0876	0.2	0.21	65	135	20
8330B	m-Nitrotoluene	99-08-1	µg/L				1.7	1.7	RSL	nc	0.195	0.35	0.4	73	125	20
8330B	Nitrobenzene	98-95-3	µg/L			1.4	13	1.4	RSL	c	0.091	0.2	0.21	65	134	20
8330B	Nitroglycerin	55-63-0	µg/L			45	2	2	RSL	nc	0.921	2	2.1	74	127	20
8330B	o-Nitrotoluene	88-72-2	µg/L			3.1	16	3.1	RSL	c	0.0855	0.2	0.21	70	127	20
8330B	Pentaerythritol tetranitrate (PETN)	78-11-5	µg/L			170	170	170	RSL	c	0.447	1	1.1	73	127	20
8330B	p-Nitrotoluene	99-99-0	µg/L			43	71	43	RSL	c	0.1	0.4	0.41	71	127	20
8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	µg/L			9.7	80	9.7	RSL	c	0.0515	0.2	0.21	68	130	20
8330B	Trinitrophenylmethylnitramine (Tetryl)	479-45-8	µg/L				39	39	RSL	nc	0.0318	0.1	0.11	64	128	20

Notes:

[1] NM WQCC standards per NMAC 20.6.2.3103.

[2] EPA drinking water primary MCL per 40 CFR Part 141 and Part 143.

[3] EPA RSL tap water carcinogenic risk endpoint with cancer risk adjusted to $1x10^{-5}$, updated Nov. 2022.

[4] EPA RSL tap water non-carcinogenic risk endpoint with hazard quotient of 1.0, updated Nov. 2022.

[5] Screening criteria were selected in accordance with the hierarchy outlined in Attachment 7.1 of the FWDA RCRA Permit (NMED, 2015). The hierarchy is as follows: (1) NM WQCC values, (2) EPA MCL values, if both are available then select the lower of the two. If both are not available, use the lower of the (3) EPA RSL Cancer values adjusted to $1x10^{-5}$ and (4) EPA RSL Noncancer values.

[6] Analyte is considered an essential nutrient and risk in groundwater will not be evaluated.

Shaded lines indicate the selected screening level is lower than the achievable limit of quantitation.

Acronyms and Abbreviations:

µg/L = microgram per liter
c = carcinogenic
CAS = Chemical Abstracts Service registry number
CFR = Code of Federal Regulations
DL = detection limit
EPA = U.S. Environmental Protection Agency
FWDA = Fort Wingate Depot Activity
GW = groundwater
LCL = lower confidence limit
LCS = laboratory control sample
LOD = limit of detection
LOQ = limit of quantitation
MCL = EPA maximum contaminant level (primary or secondary)
mg/L = milligram per liter
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable (essential nutrients and laboratory surrogates used in analytical procedures)
nc = non-carcinogenic
NM WQCC = New Mexico Water Quality Control Commission
NMAC = New Mexico Administrative Code
NMED = New Mexico Environment Department
NS = no standard
RCRA = Resource Conservation and Recovery Act
RPD = relative percent difference
RSL = regional screening level
UCL = upper confidence limit
WQCC = Water Quality Control Commission standard

Table 3-3. Sample Analysis Matrix

Well ID	# of Field Samples	Sample IDs[a]	VOCs[b]	TAL Total Metals[c]	TAL Dissolved Metals[d]	Explosives[e]	Perchlorate[f]
Existing Monitoring and Background Wells							
BGMW05	1	BGMW05ddmmyyyy	✓	✓	✓	✓	✓
BGMW06	1	BGMW06ddmmyyyy	✓	✓	✓	✓	✓
CMW02	1	CMW02ddmmyyyy	✓	✓	✓	✓	✓
CMW04	1	CMW04ddmmyyyy	✓	✓	✓	✓	✓
CMW22	1	CMW22ddmmyyyy	✓	✓	✓	✓	✓
CMW23	1	CMW23ddmmyyyy	✓	✓	✓	✓	✓
CMW24	1	CMW24ddmmyyyy	✓	✓	✓	✓	✓
CMW25	1	CMW25ddmmyyyy	✓	✓	✓	✓	✓
CMW26	1	CMW26ddmmyyyy	✓	✓	✓	✓	✓
CMW27B	1	CMW27Bddmmyyyy	✓	✓	✓	✓	✓
CMW28B	1	CMW28Bddmmyyyy	✓	✓	✓	✓	✓
CMW31B	1	CMW31Bddmmyyyy	✓	✓	✓	✓	✓
CMW32	1	CMW32ddmmyyyy	✓	✓	✓	✓	✓
CMW35	1	CMW35ddmmyyyy	✓	✓	✓	✓	✓
CMW36A	1	CMW36Addmmyyyy	✓	✓	✓	✓	✓
CMW36B	1	CMW36Bddmmyyyy	✓	✓	✓	✓	✓
KMW09	1	KMW09ddmmyyyy	✓	✓	✓	✓	✓
KMW10	1	KMW10ddmmyyyy	✓	✓	✓	✓	✓
KMW11	1	KMW11ddmmyyyy	✓	✓	✓	✓	✓
KMW12	1	KMW12ddmmyyyy	✓	✓	✓	✓	✓
KMW13	1	KMW13ddmmyyyy	✓	✓	✓	✓	✓
KMW15B	1	KMW15Bddmmyyyy	✓	✓	✓	✓	✓
KMW16	1	KMW16ddmmyyyy	✓	✓	✓	✓	✓
Newly Installed Replacement Monitoring and Background Wells							
BGMW14	1	BGMW14ddmmyyyy	✓	✓	✓	✓	✓
BGMW16	1	BGMW16ddmmyyyy	✓	✓	✓	✓	✓
CMW43	1	CMW43ddmmyyyy	✓	✓	✓	✓	✓
CMW45	1	CMW45ddmmyyyy	✓	✓	✓	✓	✓
Proposed Replacement Monitoring and Background Wells							
BGMW15	1	BGMW15ddmmyyyy	✓	✓	✓	✓	✓
CMW37	1	CMW37ddmmyyyy	✓	✓	✓	✓	✓
CMW38	1	CMW38ddmmyyyy	✓	✓	✓	✓	✓
CMW39	1	CMW39ddmmyyyy	✓	✓	✓	✓	✓
CMW40	1	CMW40ddmmyyyy	✓	✓	✓	✓	✓
CMW41	1	CMW41ddmmyyyy	✓	✓	✓	✓	✓
CMW42	1	CMW42ddmmyyyy	✓	✓	✓	✓	✓
CMW44	1	CMW44ddmmyyyy	✓	✓	✓	✓	✓
CMW46	1	CMW46ddmmyyyy	✓	✓	✓	✓	✓
CMW47	1	CMW47ddmmyyyy	✓	✓	✓	✓	✓
Total Field Samples	37						
Total Duplicate Samples[g]	4						
Total Matrix Spike Samples[g]	4						
Total Matrix Spike Duplicate Samples[g]	4						

Notes:

1) Equipment blanks will be collected prior to initial sampling and for each week of sampling. Equipment blanks will be numbered sequentially as collected in the field.

2) The most current version of each analytical method will be applied at the time of sample collection.

[a] = Sample IDs will have the well name, plus the numerical day, month, and year the sample was collected. Duplicates will have a suffix "DUP," matrix spikes will have a suffix "MS," and matrix spike duplicates will have a suffix "MSD."

[b] = VOCs by EPA Method 8360C

[c] = TAL total metals by EPA Method 6010C/6020A/7470A

[d] = TAL dissolved metals by EPA Method 6010C/6020A/7470A

[e] = explosives by EPA Method 8330B

[f] = perchlorate by EPA Method 6860A

[g] = One duplicate, matrix spike, and matrix spike duplicate will be collected at 10% of the total field samples collected.

Acronyms and Abbreviations:

= number

EPA = U.S. Environmental Protection Agency

ID = identification

ddmmyyyy = two digit day, two digit month, four digit year

VOC = volatile organic compounds

TAL = target analyte list

Table 3-4. Sample Containers, Preservation, and Hold Times

Analyte/Analytical Group	Matrix	EPA Analytical Method	Container Size/Type[a]	Preservation	Preparation Holding Time[b]
VOCs	Groundwater	8260C	(3) 40-mL glass VOA vials, PTFE septum caps; no air bubbles	HCl to pH <2; chill to ≤6°C	14 days (preserved)
TAL Total Metals and mercury (unfiltered)	Groundwater	6010C/6020A/7470A	(1) 500-mL HDPE bottle; unfiltered	HNO_3 to pH <2	180 days from sample collection to analysis
TAL dissolved metals and mercury (filtered)	Groundwater	6010C/6020A/7470A	(1) 500-mL HDPE bottle; filtered	HNO_3 to pH <2	180 days from sample collection to analysis
Explosives	Groundwater	8330B	(2) 500-mL amber bottles	≤6°C	7 days to extraction; 40 days to analysis
Perchlorate	Groundwater	6860A	(1) 125-mL poly	≤6°C	7 days to extraction

Notes:

[a] = Minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory MS/MSD sample analysis.

[b] = Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

Acronyms and Abbreviations:

< = less than
≤ = less than or equal to
°C = degree Celsius
EPA = U.S. Environmental Protection Agency
HCl = hydrochloric acid
HDPE = high-density polyethylene
HNO_3 = nitric acid
mL = milliliter
MS = matrix spike
MSD = matrix spike duplicate
poly = polypropylene
pH = potential hydrogen
PFTE = Teflon™
TAL = target analyte list
VOA = volatile organic analysis
VOC = volatile organic compound

APPENDIX A

FIELD FORMS

Sundance Consulting Inc.

Chain of Custody Record & Analytical Service Request

Laboratory Name & Address

Waybill #

COC #:

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

Lab Project No.

Company Name & Address (Reporting Information)

Sundance Consulting, Inc.
8210 Louisiana Blvd Suite C
Albuquerque, NM 87113

PO/Billing Information

Project Name

Project Number

Project Manager

Phone

Fax

Email Address for Result Reporting

Sampler Name/Signature

Analytical Methods:

Comments
e.g. specific instructions

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Sample Matrix	No. Of Containers	Preservative					Sample Volume	

Additional Comments:

Report Tier Levels - please select

Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries) _____
Tier III (Results + QC & Calibration Summaries) _____
Tier IV (Data Validation Package) 10% Surcharge _____

EDD required Yes / No
Type: ____________ Units:___________

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature) | Date: | Time: | Received by: (Signature) | Date: | Time:

Relinquished by: (Signature) | Date: | Time: | Received by: (Signature) | Date: | Time:

Cooler / Blank Temperature ___°C

Sundance Consulting Inc.

Groundwater Sampling Data - Well I.D. Number: ______________________

Project:		**Date/Time Sampled:**	
Task Number:		**Totally Influenced:**	Yes No
Project Manager:		**Well Depth in Feet:**	
Field Team:		**Screened Interval in Feet:**	

1. Purging Data/Field Measurements: All Measurements Relative to Top of Casing

Well Depth in Feet:		**Casing Volume in Gallons:**	
Depth of Sediment (DTS) in Feet:		[1" diameter = x .041 gal/ft, 2" d. = x .163 gal/ft, 4" d. = x .653 gal/ft]	
Depth of Water (DTW) in Feet:		**Purge Volume in Gallons:**	
DTS - DTW:		**Actual Purge in Gallons:**	

Time	No. of Gallons Purged	pH	Temp. in °C	Conductivity (mS/cm)	Turbidity	DO (mg/L)	DTW (ft.)	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand

	Method	Purging Rate in L/min	Depth of Equipment in Feet
Purge			
Sample			

Bails Dry?	Yes No
At Number of Casing Volumes:	
Purge Water Disposal Method/Volume:	

2. Sampling Data

Bottle Type	Number of Containers	Analyses	Preserv.	Filter

Total Number of Bottles:	
Duplicate Sample ID:	
Field Blank ID:	
Rinseate Sample ID:	

3. Field Equipment (Type/Brand/Serial Number/Material/Units)

Pump Type/Tubing Type:		**Temp/pH/E.C./D.O.:**	
Bailer Type:		**Water Level Probe:**	
Filter Type:		**Other:**	

4. Well Conditions

Satisfactory **Unsatisfactory** **Explain:**