DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

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NMED
Hazardous Waste Bureau

Colonel David S. Miller, USAF
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

Mr. Dave Cobrain
Hazardous Waste Bureau
New Mexico Environment Department (NMED)
2905 Rodeo Park Drive East, Building 1
Santa Fe NM 87505

Dear Mr. Cobrain

Please find the *Work Plan (WP) for Data Gap Monitoring Well Installation KAFB-106248 to KAFB-106252, Bulk Fuels Facility, Solid Waste Management Units (SWMU) ST-106/SS-111*, Kirtland Air Force Base (AFB), New Mexico dated December 2019. This WP has been prepared in response to the New Mexico Environment Department's (NMED's) letter dated November 4, 2019.

This WP is submitted in accordance with the requirements in Part 6.2.4.2 of the Kirtland AFB Hazardous Waste Treatment Facility Operating Permit, U.S. Environmental Protection Agency Identification No. NM9570024423, including detailed background information, a description of site conditions, and a signed certification by the responsible official.

If you have any questions or concerns, please contact Mr. Scott Clark at commercial line (505) 846-9017 or email scott.clark@us.af.mil; or Mr. Sheen Kottkamp at commercial line (505) 846-7674 or email sheen.kottkamp.1@us.af.mil.

Sincerely

DAVID S. MILLER, Colonel, USAF
Commander

Attachments:
1. Work Plan for Shallow Soil Vapor Sampling, Bulk Fuels Facility, November 2019
2. Comment Response Worksheet

cc:
NMED-OOTS (Pruett), letter
NMED-RPD (Stringer), letter and CD
EPA Region 6 (King, Ellinger), letter and CD
COA (Ziegler), letter and CD
ABCWUA (Agnew), letter and CD
SAF-IEE (Lynnes), electronic only
AFCEC/CZ (Renaghan, Clark, Kottkamp, Segura, Fitzner), electronic only
Public Info Repository, Administrative Record/Information Repository (AR/IR) and File

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

WORK PLAN FOR DATA GAP MONITORING WELL INSTALLATION KAFB-106248 TO KAFB-106252 BULK FUELS FACILITY SOLID WASTE MANAGEMENT UNITS ST-106/SS-111

December 2019

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KIRTLAND AIR FORCE BASE

ALBUQUERQUE, NEW MEXICO

Work Plan for Data Gap Monitoring Well Installation
KAFB-106248 to KAFB-106252
Bulk Fuels Facility
Solid Waste Management Units ST-106/SS-111

December 2019

Prepared for

Kirtland Air Force Base
Environmental Restoration Program
2050 Wyoming Blvd SE
Kirtland AFB, NM 87117

USACE Contract Number: W912PP-17-C-0028

Prepared by

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14. ABSTRACT
This Work Plan for Data Gap Monitoring Well Installation KAFB-106248 to KAFB-106252 is provided by Kirtland Air Force Base (AFB). It pertains to the Kirtland AFB Bulk Fuels Facility site at Solid Waste Management Units (SWMUs) ST-106/SS-111, located in Albuquerque, New Mexico. This work plan was prepared in accordance with the corrective action provisions in Part 6 of the Resource Conservation and Recovery Act (RCRA) permit issued to Kirtland AFB by the New Mexico Environment Department (EPA ID No. NM 9570024423). This work plan was prepared in accordance with applicable federal, state, and local laws and regulations. The objective of the work plan is to describe proposed groundwater monitoring (GWM) well installation activities to address existing data gaps. Details on the installation of new GWM wells and the incorporation of those wells into the GWM program are provided in this work plan. The work plan was prepared under Kirtland AFB and U.S. Army Corps of Engineers review. Mr. Scott Clark is the Kirtland AFB Restoration Section Chief.

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Bulk Fuels Facility, Solid Waste Management Units ST-106/SS-111, ethylene dibromide, EDB, interim measures, RCRA, groundwater sampling, groundwater well installation

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I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure 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 fines and imprisonment for knowing violations.

[signature] 11 December 2019

DAVID S. MILLER, Colonel, U.S. Air Force
Commander, 377th Air Base Wing

Date

This document has been approved for public release.

[signature] 6 Dec 19

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

Date

PREFACE

This Work Plan for Data Gap Monitoring Well Installation KAFB-106248 to KAFB-106252 was prepared in response to in response to the New Mexico Environment Department (NMED) letter of November 4, 2019 by Sundance Consulting, Inc. (Sundance) for Kirtland Air Force Base (AFB) under U.S. Army Corps of Engineers (USACE) contract number W912PP-17-C-0028. It pertains to the Kirtland AFB Bulk Fuels Facility site at Solid Waste Management Units (SWMUs) ST-106/SS-111, located in Albuquerque, New Mexico. This work plan was prepared in accordance with the Resource Conservation and Recovery Act (RCRA) permit issued to Kirtland AFB under RCRA and applicable federal, state, and local laws and regulations.

This work plan contains data collected by Sundance itself as well as from other entities/sources that are not under Sundance's direct control (collectively "non-Sundance data"). All non-Sundance data reported herein are displayed in the form they were received from their source entity, and Sundance assumes no liability for the accuracy of any non-Sundance data in this report.

The objective of the work plan is to describe proposed groundwater monitoring (GWM) well installation activities to address existing data gaps. Details on the installation of new GWM wells and the incorporation of those wells into the GWM program are provided in this work plan.

The work plan was prepared under Kirtland AFB and USACE review. Mr. Scott Clark is the Kirtland AFB Restoration Section Chief.

Rachel Hobbs

Rachel Hobbs, PG, PMP
Sundance Consulting, Inc.
Project Manager

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ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
AFB	Air Force base
ANG	Air National Guard
APP	Accident Prevention Plan
BFF	Bulk Fuels Facility
bgs	below ground surface
C&D	construction and demolition
DoD	Department of Defense
EDB	ethylene dibromide
EDD	electronic data deliverable
ELLE	Eurofins Lancaster Laboratories Environmental
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
eV	electronvolt
ft	feet
GWM	groundwater monitoring
GWTS	groundwater treatment system
IDW	investigation-derived waste
J	estimated concentration
KAFB	Kirtland Air Force Base
kgal	kilogallon
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
mg/kg	milligram per kilogram
NMED	New Mexico Environment Department
O&M	operations and maintenance
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
Q	quarter
QSM	Quality Systems Manual, version 5.1
RCRA	Resource Conservation and Recovery Act
RCRA permit	Hazardous Waste Treatment Facility Operating Permit EPA ID No. NM 9570024423
REI	reference elevation interval
RFI	RCRA Facility Investigation

Ridgecrest	Ridgecrest Drive SE
SSHP	Site Safety and Health Plan
Sundance	Sundance Consulting, Inc.
SWMU	solid waste management unit
USACE	U.S. Army Corps of Engineers
UV	ultraviolet
Water Authority	Albuquerque Bernalillo County Water Utility Authority
Work Plan	Work Plan for Data Gap Monitoring Well Installation KAFB-106248 to KAFB-106252

EXECUTIVE SUMMARY

This Work Plan for Data Gap Monitoring Well Installation KAFB-106248 to KAFB-106252 (Work Plan) has been prepared in response to the New Mexico Environment Department (NMED) letter of November 4, 2019 (NMED, 2019), to describe activities to be performed at Solid Waste Management Units (SWMUs) ST-106/SS-111, Kirtland Air Force Base (AFB), New Mexico. This Work Plan proposes activities to address data gaps in the groundwater monitoring (GWM) and gauging network that were identified by the Air Force following the quarter 2 2019 sampling event and are primarily the result of the rising groundwater elevations. This Work Plan will become the procedural guidance document for conducting these activities. This Work Plan was written in accordance with Part 6.2.4.2 of the Kirtland AFB Resource Conservation and Recovery Act permit U.S. Environmental Protection Agency ID Number NM9570024423 (NMED, 2010).

The objective of this Work Plan is to detail well installation activities, and groundwater sampling and gauging activities for newly installed wells. The work to be completed is presented under each of the tasks listed below.

- Install five GWM wells—one north of Ridgecrest Drive SE (Ridgecrest), and four south of Ridgecrest—to delineate volatile organic compound contamination in groundwater, including ethylene dibromide.
- Report the data collected for the newly installed wells, including well installation details, groundwater elevations, light non-aqueous phase liquid thickness (if present), and groundwater laboratory analytical data.
- Sampling, gauging, and maintenance of these wells will be incorporated into the existing groundwater monitoring program.

1 INTRODUCTION

This Work Plan for Data Gap Monitoring Well Installation KAFB-106248 to KAFB-106252 (Work Plan) has been prepared in response to the New Mexico Environment Department's (NMED) letter of November 4, 2019 (NMED, 2019), and describes tasks associated with monitoring well installation and inclusion of newly installed wells into the groundwater monitoring (GWM) network at Solid Waste Management Units (SWMUs) ST-106/SS-111, at Kirtland Air Force Base (AFB), New Mexico (Figure 1-1). This work is being conducted under requirements set forth in Part 6 of the Resource Conservation and Recovery Act (RCRA) permit (RCRA permit - U.S. Environmental Protection Agency [EPA] ID Number NM9570024423). NMED enforces this permit under delegated authority from EPA.

1.1 Document Purpose and Scope

Tasks outlined in this Work Plan include drilling and installing five new GWM wells, sampling the newly installed wells, and managing investigation-derived waste (IDW). This Work Plan was prepared in accordance with the requirements of section 6.2.4.2 of the RCRA permit, "Investigation Work Plans."

1.2 Work Plan Organization

The Work Plan is divided into the following sections. These sections include the required information for an investigation work plan as described in Part 6.2.4.2 of the RCRA permit.

- Section 1 – Introduces the Work Plan and its purpose.
- Section 2 – Presents the background information.
- Section 3 – Presents the current site conditions.
- Section 4 – Presents the scope of activities.
- Section 5 – Describes the investigation methods.
- Section 6 – Describes the monitoring and sampling associated with well installation.
- Section 7 – Presents the project schedule.
- Section 8 – Provides references cited in the Work Plan.

2 BACKGROUND INFORMATION

Kirtland AFB is in Bernalillo County, in central New Mexico, southeast of and adjacent to the city of Albuquerque and the Albuquerque International Sunport (Figure 1-1). The approximate area of Kirtland AFB is 52,287 acres. SWMUs ST-106/SS-111 is in the northwestern portion of Kirtland AFB.

2.1 Site History

The Bulk Fuels Facility (BFF) operated from 1953 until 1999 and received fuels by railcar and later by truck. The fueling area was separated into two areas: a tank holding area to receive bulk fuel shipments and a fuel loading area to refuel individual trucks. Kirtland AFB removed the underground piping at the facility from service in 1999 due to discovery of underground leakage. The exact history of the leaks or releases is unknown. Kirtland AFB learned through characterization actions that the leaked fuel had reached the groundwater and the dissolved-phase fuel contamination migrated north and northeast of Kirtland AFB.

GWM activities have been ongoing at the site since 2000. As of quarter (Q)2 2019, the groundwater monitoring network consists of 162 wells. Select wells are identified for additional or more frequent monitoring of risk-driving constituents (Kirtland Air Force Base [KAFB], 2019b). GWM data are evaluated in quarterly monitoring reports, which describe current site conditions and assess the performance of interim measures.

Interim measures have been implemented in accordance with Part 6.2.2.2.12 of the RCRA permit for both groundwater and soil, including a groundwater treatment system (GWTS), which was constructed in 2015. The goal of this interim measure was to protect drinking water supply wells and collapse the distal, dissolved-phase ethylene dibromide (EDB) plume north of Ridgecrest Drive SE (Ridgecrest; Figure 2-1). EDB is the only constituent detected above its maximum contaminant level (MCL) north of Ridgecrest. South of Ridgecrest, fuel constituents in addition to EDB are detected in exceedance of their respective MCLs including benzene (Figure 2-2).

GWM activities have documented changes in groundwater elevations at SWMUs ST-106/SS-111. When the fuel leak began, the water table was approximately 60 feet (ft) higher than current elevations (Rice et al., 2014). Water levels began dropping due to the development of the city of Albuquerque well fields and reached their lowest level at the end of 2009. The San Juan-Chama Project was implemented in 2008 by the Albuquerque Bernalillo County Water Utility Authority (Water Authority). As a result of the San Juan-Chama Project, as well as increased water conservation practices by the Water Authority, withdrawals from Water Authority wells decreased, and groundwater levels have risen in this area since 2009.

Appendix A-1 (originally published as Appendix L-2 from the Q4 2018 report; KAFB, 2019a) illustrates groundwater elevations from 2011 through 2018 along two transects through the EDB plume. These time series graphs illustrate that the most pronounced increases in groundwater elevation are in the northern area of the site. The northernmost wells are most responsive to changes in the pumping rates at the Water Authority Ridgecrest well field, the closest Water Authority drinking water supply wells to SWMUs ST-106/SS-111. Groundwater levels continued to rise throughout the GWM network over the course of the year from Q4 2017 to Q4 2018. The average increase in groundwater level during 2018 was 1.79 ft. The average annual rise in water table in 2017 was 1.3 ft, and the calculated annual average of water table rise from Q1 2016 through Q4 2018 was 1.61 ft (Section 3.7.1 of KAFB, 2019a). The Water Authority predicts that based on current and planned conservation practices water levels in Albuquerque's aquifer will continue to rise into the 2020s (Water Authority, 2016).

Due to the rising water table, groundwater elevations have exceeded the tops of well screens that were originally installed to intersect the water table. This is an ongoing phenomenon. Appendix A-2 includes compiled potentiometric surface maps, EDB plume maps, and benzene plume maps at the 4,857 reference elevation interval (REI) from quarterly monitoring reports Q4 2016 through Q4 2018. These figures show which locations have submerged screens and which still have screens that intersect the water table with each passing quarter. The Phase I RCRA Facility Investigation (RFI) Report identified that that changes in dissolved-phase concentrations and apparent plume configuration could be influenced by the rising water table, and that this would be evaluated with the installation of additional GWM wells (KAFB, 2018a).

2.2 Initial Data Gap Groundwater Wells and Vadose Zone Coring Activities

As a result of the fluctuations in groundwater elevations at the site, Kirtland AFB submitted the Work Plan for Data Gap Monitoring Well Installation (KAFB, 2017d) in December 2017. This work plan proposed installing six groundwater monitoring wells and incorporating six existing wells (i.e., GWM wells and soil vapor monitoring wells that were previously dry and that now have water in the screens due to rising water table) into the GWM network for quarterly sampling (Figure 2-3). These wells were installed or incorporated into the GWM network in Q4 2018 and Q1 2019 to address this data gap.

The new wells installed under the Work Plan for Data Gap Monitoring Well Installation were designed to address the problem of continued water table rise (Section 3.1.1 of KAFB, 2017d). Wells were constructed with two nested wells in each borehole: a water table well and a contingency well. The water table well was constructed with a 40-ft screen intersecting the water table. The contingency well was constructed with a 25-ft screen, the bottom of which was placed 9 ft above the screen interval of the water table well. This design will allow the GWM wells to remain functional for more than 50 additional feet of increase in groundwater elevation. The installation and incorporation of these GWM wells screened across the water table was reported in Section 3 of the Q4 2018 and Q2 2019 Quarterly Monitoring Reports (KAFB, 2019a and KAFB, 2019b; respectively). Passive sampling techniques were approved for these wells by NMED (NMED, 2018).

The Work Plan for Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling was submitted to NMED in December 2017 to address the data gaps of horizontal and vertical extent of light non-aqueous phase liquid (LNAPL) caused by the fluctuating water table (Section 1.0 of KAFB, 2017e). A total of 11 continuous core locations (including one background location) were advanced to characterize hydrocarbon concentrations within the vadose and saturated zones. These coring locations were all advanced south of Ridgecrest, where LNAPL had historically been measured associated with SWMUs ST-106/SS-111 (Figure 2-3).

Once cores were collected, the locations were constructed as monitoring wells. Two locations were constructed as soil vapor monitoring locations, and nine were constructed as GWM locations (Figure 2-3). Soil cores collected from the boreholes were screened for the presence of LNAPL (using ultraviolet [UV] light flashlights) and hydrocarbons (using the heated headspace method; Section 4.1.3 of KAFB, 2019c). Selected cores were then sent for laboratory UV analysis to further confirm or deny the presence of LNAPL. This information was used to select sample locations for further laboratory LNAPL analysis (Section 4.1.6 of KAFB, 2019c). The Source Zone Characterization Report (Section 4.1.6 of KAFB, 2019c), describes the complete suite of analyses performed to characterize LNAPL in the soil cores. The report also describes the conclusions of the LNAPL analyses.

3 SITE CONDITIONS

Q2 2019 groundwater data identified two data gap areas that this Work Plan intends to address. First, the eastern and southern extent of the EDB and benzene plumes south of Ridgecrest at the 4,857 REI requires further delineation. REIs are below ground surface elevations that divide the GWM network into datasets comprised of wells that are screened across their respective elevations, allowing for a vertical evaluation of groundwater parameters and contaminant locations. Currently, there are three REIs (4,857; 4,838; and 4,814). A detailed explanation of how the REIs are defined is presented in Section 3.0 of the Q4 2016 Quarterly and Annual Report (KAFB, 2017b).

The Q2 2019 EDB and benzene plumes at the REI of 4,857 ft above mean sea level (the shallowest reference level evaluated in Q2 2019) are shown on Figure 2-1 and Figure 2-2. The area on base, south of Ridgecrest is where the highest concentrations of EDB and benzene are detected. It is important to note that the benzene plume is limited to the area south of Ridgecrest as shown on Figure 2-2. As shown on Figure 2-1, the dissolved-phase EDB plume north of Ridgecrest is the target capture zone of the GWTS.

The groundwater elevation graphs shown in Appendix A-1, illustrate that the operation of the Ridgecrest wellfield has a significant influence on the groundwater gradient at SWMUs ST-106/SS-111. Measurements from 2010 to 2015 indicated a north–northeast-oriented hydraulic gradient toward the Ridgecrest wellfield (Section 7.6.1.2 of KAFB, 2018a). However, with changes in Water Authority and Kirtland AFB pumping practices, the hydraulic gradient no longer has a consistent orientation each quarter. As described in the Q2 2018 report (Section 5.4.4.1 of KAFB, 2018c), the observed rise in groundwater levels across the plume area has occurred at the same time as a continual decrease in groundwater extraction at the Ridgecrest wellfield.

Between 2010 and 2017, the yearly extraction volume for the Ridgecrest wellfield has decreased from approximately 2,000,000 kilogallons (kgal) per year to approximately 1,000,000 kgal per year, an average rate decrease of approximately 175,000 kgal per year. Comparatively, total extraction from Kirtland AFB supply wells over the same time period has decreased from approximately 790,000 kgal to 545,000 kgal per year, an average rate decrease of approximately 37,000 kgal per year (Appendix I-7 of KAFB, 2018c. The result is that the total extraction from the two adjacent wellfields has become nearly equal since 2016, creating two equally strong aquifer stresses on the plume area: one northeast of the plume and one east–southeast of the plume. In 2013 and 2014, when Ridgecrest wellfield extraction was significantly greater than Kirtland AFB extraction, the gradient across the plume area was toward the Ridgecrest wellfield; however, as the two extraction centers became more equal in 2015, the gradient flow direction started to shift eastward. In 2016 and 2017, when extraction had nearly equilibrated, the gradient direction shifted to the east–southeast becoming increasingly influenced by Kirtland AFB extraction (KAFB, 2018c). Additional detail on this evaluation of groundwater gradients is presented in Section 5.4.4.1 of the Q2 2018 report (KAFB, 2018c). Additional groundwater monitoring wells in the eastern and southern area of the plume will help determine whether this shift in the hydraulic gradient is affecting EDB and benzene plume extents in this area.

Groundwater samples collected in Q2 2019 at the newly installed/incorporated wells screened across the water table in the eastern and southern extent of the EDB plume (area of the EDB plume south of Ridgecrest) had detections of EDB and benzene that exceeded the MCLs of 0.05 microgram per liter (ug/L) and 5 ug/L respectively (Figure 2-1 and Figure 2-2). Currently, these exceedances of EDB and benzene cannot be accurately bounded because GWM wells with non-detect concentrations of EDB and benzene to the southeast have submerged well screens. The EDB concentrations at wells located within the plume, and the submergence of wells outside the eastern and southern edge of the plume, exaggerate the modeled EDB and benzene plume boundary at the water table to the east and south. Additional well locations screened across the water table will further define the plume boundary in this area. Section 4 discusses the specific well locations and screened intervals necessary to further delineate the EDB plume at the 4,857 REI.

The second data gap area is adjacent to extraction well KAFB-106234. Q2 2019 groundwater monitoring data indicate that EDB exceeding the MCL is no longer present in this area. An additional groundwater monitoring well near this extraction well would help confirm EDB concentrations and help clarify groundwater gradients in this area.

4 SCOPE OF ACTIVITIES

This Work Plan addresses tasks supporting monitoring well installation and baseline water-quality sampling and is the procedural guidance document for these activities to be executed as part of the RCRA corrective action process.

4.1 Proposed Drilling Location and Justification

The GWM well locations proposed in this Work Plan are shown on Figure 2-1 and Figure 2-2. The specific justification and construction specification for each location is listed on Table 4-1. Construction diagrams are presented on Figure 4-1 and Figure 4-2.

Four of the five proposed GWM wells (KAFB-106249 through KAFB-106252) will be constructed with the same design employed by the Work Plan for Data Gap Monitoring Well Installation (Section 3.1.1 of KAFB, 2017d) as shown on the construction diagram (Figure 4-1). Wells are proposed to be constructed as nested wells, with a well screen that straddles the water table and an additional contingency well screen (a well screened in the vadose zone approximately 9 ft above the top of the water table well screen). The contingency well screen, as listed on Table 4-1, allows the GWM wells to continue to provide EDB concentration data at the water table as groundwater elevations continue to rise. The nested well design will allow wells to continue to provide data throughout the implementation of interim measures, and the selection and implementation of a final remedy.

KAFB-106248 will primarily serve as an additional data point to assess the performance of the extraction well KAFB-106234 for semiannual plume capture modeling of the EDB plume north of Ridgecrest and the corrective measures evaluation. This location will be constructed with an additional piezometer shown on Figure 4-2. This location was selected to refine evaluation of any residual mass of EDB around extraction well KAFB-106234 (Figure 2-1). The EDB plume was previously present in this area. In Q4 2018 EDB was detected at KAFB-106225 in excess of the MCL at 0.17 µg/L (Section 3.6.1.1 of KAFB, 2019a). In Q2 2019 there were no detections of EDB exceeding the MCL near extraction well KAFB-106234 (Section 3.6.1.1 of KAFB, 2019b). Table 4-2 includes EDB groundwater data from 2017, 2018, and 2019 for wells located near extraction well KAFB-106234.

The piezometer at KAFB-106248 will be screened between 505 ft and 515 ft below ground surface (bgs) to intersect a gravel unit identified on the borehole log for KAFB-106234 (Figure 4-2). Data gathered from KAFB-106248 and the piezometer well will provide more accurate drawdown data for the extraction well and will provide more accurate representation of the groundwater gradients in this area.

The objective of four of the five GWM wells (KAFB-106249 through KAFB-106252), is to better delineate the eastern and southern extent of the EDB and benzene plumes at 4,875 REI (area of the EDB plume south of Ridgecrest). As discussed in Section 3 the EDB and benzene plumes at the 4,857 REI require additional well screens straddling the water table to more accurately delineate the eastern and southern plume extent. Table 4-1 and Figure 2-1 provide more information for the proposed locations described below. Table 4-3 provides EDB and benzene data from Q4 2018 and Q2 2019 for groundwater wells in the vicinity of the proposed locations. The following analytical information was reported in Section 3 of the Quarterly Monitoring Report April-June 2019 (KAFB, 2019b) and is further illustrated on Figure 2-1 and Figure 2-2.

- KAFB-106249 is proposed for installation in Bullhead Park. This location will fill the EDB plume boundary gap at the water table. In Q2 2019, KAFB-106019 was submerged and had an EDB concentration of 0.016 J ug/L. KAFB-106S5-446 is a newly installed unsubmerged location west of KAFB-106019 with a Q2 2019 EDB concentration of 15 ug/L. There are currently no wells east of KAFB-106019 to bound the EDB plume in this area.

- KAFB-106250 is proposed to be installed in the parking lot of the Air National Guard (ANG) adjacent to the existing well KAFB-106046. This location will help to bound both the EDB and benzene plumes in this area. KAFB-106046 was non-detect for both EDB and benzene in Q2 2019 and has a submerged well screen. The groundwater monitoring well directly west of this location, KAFB-106S2-451, which is screened across the water table, had a detected EDB concentration of 260 µg/L in Q2 2019, and a detected benzene concentration of 8,800 µg/L.
- KAFB-106251 is also proposed for installation on ANG property, adjacent to the boundary with the BFF. KAFB-106S1-447 and KAFB-106S8-451 are screened across the water table west of proposed well KAFB-106251. EDB concentrations at these locations exceeded the MCL in Q2 2019 with detections of 250 µg/L and 96 µg/L, respectively. Benzene concentrations at these locations also exceeded the MCL in Q2 2019 with detections of 6,600 µg/L and 2,100 µg/L; respectively. KAFB-106007 was non-detect for EDB in Q2 2019 and is located near the proposed well location but is submerged. KAFB-106247-450 is not submerged, was non-detect for EDB and benzene in Q2 2019, and is in the southeastern corner of the BFF. However, water table wells are needed closer to the source area to more accurately delineate the EDB and benzene plumes in this area.
- KAFB-106252 is proposed for installation south of the former fuel tanks in the BFF. This location will provide further delineation for the southern EDB and benzene plume extents. In Q2 2019, EDB concentrations exceeded the MCL at two unsubmerged locations north of the proposed well location: KAFB-106149-484 and KAFB-106S1-447 (36 ug/L and 250 ug/L, respectively). Benzene concentrations also exceeded the MCL at these locations in Q2 2019 (26,000 ug/L and 6,600 ug/L; respectively). Locations KAFB-106007 and KAFB-106027 have formerly delineated the EDB and benzene plumes in this area, but now have submerged screens.

5 INVESTIGATION METHODS

Tasks outlined in this Work Plan include drilling and installing new GWM wells, sampling the newly installed wells, and managing IDW. Applicable field forms may be found in Appendix B. These tasks are described in more detail in the sections below. The procedures, methods, and techniques discussed in this Work Plan were presented in the Work Plan for Data Gap Monitoring Well Installation (KAFB, 2017d) and approved by NMED in February 2018 (NMED, 2018).

5.1 Pre-Mobilization Activities

Before any mobilization, copies of the right-of-entry agreements will be obtained for the location where work will be performed, and documentation will be on site with the field crew so that it is available for inspection. In addition to access and site clearance, the appropriate permits will be obtained for the various field activities. An effort will be made to time the permitting process such that permit approvals will be received in time to meet the project schedule, but not too early in the process that they expire before work is initiated. All permit expiration dates will be tracked to ensure that no permits expire before work is completed. Permit renewals will be initiated such that the work will proceed without interruption. Depending on the timing, permits may be combined. The project schedule may be impacted if there are delays in permit approvals.

The list of permits/plans required for this project follow.

- New Mexico Office of the State Engineer well drilling permits for each of the new monitoring well locations with no consumptive use of water.
- New Mexico 811 utility clearance.
- City of Albuquerque license for property access for GWM wells; this license is already in place and will be modified to include the wells on city property listed in this Work Plan.
- City of Albuquerque specific plans:
  - Noise Control Plan/Permit for drilling off base
  - Excavation/Barricade permits for each drilling location off base on roadways.
- Kirtland AFB specific permits:
  - Air Force Form 332 Base Civil Engineer Work Request
  - Civil Engineer Digging Permit Request.

Preconstruction inspections will be performed at each proposed well location and will include photo documentation. Each contractor participating in well installation tasks is required to have an Accident Prevention Plan (APP) on site. The APP will be signed by all project personnel who will perform work on site. The APP is a dynamic document that will be revised to cover all activity-specific concerns and will be updated as necessary.

5.1.1 Mobilization

Contractors (and subcontractors) will maintain laydown areas to support field activities. These laydown areas have been approved with existing agreements and have been coordinated with Kirtland AFB. A field office, equipment laydown yards, and IDW yards for each contractor are located at Kirtland AFB. Secure fenced equipment yards have been established for both heavy machinery and materials; these yards will also hold materials and supplies meant for use on the project locations, as required. Roll-off containers filled with solid waste (soil cuttings and mud) will be kept at the IDW accumulation areas. Due to the large number of roll-off containers required for delivery and transfer during daily drilling activities, waste management support is a key element of mobilization (Section 6.5).

5.1.2 Drilling of Groundwater Monitoring Wells

All five new monitoring nested wells will be installed via air rotary casing hammer technology with casing advancement. Table 4-1 summarizes the drilling methodology and design summary for each location. Boreholes will be advanced using 11-3/4-inch casing diameter to approximately 200 ft bgs, depending on site conditions; thereafter, 9-3/8-inch casing diameter will then be advanced to the total depth of the borehole.

Each borehole will be fully described on boring logs as discussed in Section 5.1.2.1. Soil cuttings will be screened in the field with a photoionization detector (PID) as discussed in Section 5.1.2.2. Land surveying will occur after well installation activities as discussed in Section 5.1.2.3. All IDW generated from drilling activities will be managed in accordance with the procedures outlined in Section 6.5.

5.1.2.1 *Borehole Logging*

During drilling, each boring will be fully described on the boring log form in accordance with ASTM International D5434 or D2488. Lithology will be logged from cyclone cuttings at a minimum of 5-ft intervals. Boring log forms will include the following information, when applicable.

- Identification number and location of each boring
- A general description of the drilling equipment used, such as rod size, bit type, pump type, rig manufacturer, and model
- Date and time of start and completion of boring
- Name of contractor, driller, and field geologist
- Size and length of casing used in each borehole
- Soil classification in accordance with the Unified Soil Classification System, color, relative density and consistency, soil components, soil moisture, stratification, hardness, grain size and size distribution, and odor
- Depth to water as first encountered during drilling, along with method of determination
- Observations during drilling will be noted, such as bit chatter, rod binding, rod drops, and flowing or heaving sands (if drilling fluid is used, the fluid losses, interval over which they occur, and the quantity lost will be recorded)
- Depth limits, type, and number of each sample taken
- Observations of visible contamination for each sample or from cuttings that appear to be contaminated.

5.1.2.2 *Photoionization Detector and Headspace Screening*

PIDs will be used for breathing zone monitoring during drilling and sampling activities, as well as for field screening of hydrocarbons in soil cuttings during drilling. This instrument monitors volatile organic compounds using a PID with a 9.8-electronvolt (eV), 10.6-eV, or 11.7-eV UV lamp. The PID will be calibrated and tested each day that it is used. Headspace field screening will be performed in accordance with the following procedures.

1. Record PID measurements at a minimum of every 25 ft of drill cuttings down to 450-ft depth, and then every 10 ft of drill cuttings to total depth following the process below. PID headspace measurements will be taken from soil cuttings collected from the cyclone separator and bagged.
2. Immediately upon the retrieval, collect a representative portion of the sample and place in a clean, dedicated (e.g., single sample) 1-gallon press-and-seal plastic storage bag.

3. Vigorously agitate the sample for at least 15 seconds and then allow a minimum of 10 minutes for the sample to adequately volatilize.
4. During cold weather, warm the samples to room temperature before taking the headspace measurement.
5. Re-agitate the sample bag and quickly insert the vapor sampling probe and record the maximum meter response (this should be within the first 2–5 seconds).
6. Record headspace screening data on the boring log.

5.1.2.3 *Survey*

Land surveying activities will occur after well installation activities. The surveys will be conducted at locations on Kirtland AFB, adjacent residential neighborhoods, and city of Albuquerque rights-of-way, as required. Surveys will be performed by a New Mexico licensed surveyor. Surveys will be performed to 0.01-ft accuracy. The survey will be tied into the existing well network survey in at least two points plus a benchmark.

The surveys will establish northings, eastings, and elevations at all locations. Daily reports will consist of a tabulation of the location, identification, coordinates, and elevations of each point surveyed that day.

5.1.3 Construction of Groundwater Monitoring Wells

Each well nest will be comprised of two wells within a single borehole, each screened at a different depth interval, beginning with a 40-ft screen across the current water table elevation in the deeper well. A second screen, extending upward to shallower depths, will be completed as a “dry” contingency well to function in the future if necessary with rising groundwater elevations. The contingency wells will have a 25-ft screen length that extends above the 40-ft screen interval in the deeper well. The GWM nested wells will each be constructed using 3-inch diameter Schedule 80 polyvinyl chloride (PVC) casing with a 0.010-inch slot screen size and 10/20 filter pack. Details of the annular material are shown on the well construction diagram Figure 4-1. The well nests are designed with 5-ft bentonite seals between each screen to ensure adequate hydraulic isolation. A minimum of at least 2 ft of sand will extend above and below the screened intervals; the resulting minimum separation distance between well screens will be 9 ft. Based on the current static water elevation from nearby GWM wells, the final well screen depths were selected with the bottom of the deeper screen at approximately 15 ft below the water table, as listed on Table 4-1.

KAFB-106248 will also be completed with a piezometer well in addition to the water table well and the contingency well. The piezometer well will be constructed using a 1-inch diameter Schedule 80 PVC casing with a 0.010-inch slot screen size and 10/20 filter pack. KAFB-106248 is designed with a minimum of a 5-ft bentonite seal between the piezometer screen and the other nested wells. A minimum of at least 2 ft of sand will extend above and below the screened intervals.

After installing the new monitoring wells, a construction diagram will be completed following the procedures discussed below and the well will be developed following the procedures discussed in Section 5.1.3.2. All IDW generated from well development will be managed in accordance with the procedures outlined in Section 6.5.

5.1.3.1 *Well Construction Diagrams*

Construction diagrams will be completed for the new monitoring wells, and well construction will be documented on forms. Each form will include the following.

- Project and site names, well number, and total depth of the well

- Depth of any grouting or sealing, the amount of cement and/or bentonite used, and the total depth of the boring
- Depth and type of well casing
- Static water level upon installation of the well and after well development
- Installation date or dates, and name of the driller and the geologist installing the well; each installation diagram will be signed by the preparer
- All pertinent construction details of the wells, such as depth to and description of backfill materials installed (i.e., gravel pack, bentonite, and grout); gradation of gravel pack, length, location, diameter, slot size, material and manufacturer of well screen(s); position of centralizers; and location of any blank pipe installed in the well
- Description of surface completion, including protective steel casing, protective pipes, and concrete surface seal
- A description of any difficulties encountered during well installation
- Survey coordinates and the elevation of the top of ground and top of well riser.

5.1.3.2 *Well Development*

Well development will be performed by surging and bailing. Development will occur within 2–7 days following well and grout installation (i.e., no sooner than 48 hours following grout installation). Well development details follow.

- Initial development will consist of swabbing and bailing until little or no sediment enters the well (approximately 2–4 hours). Development and purge water will be contained in a temporary tank, tote, or drum. If the addition of water is necessary to facilitate surging and bailing, only clean potable water will be used.
- A bailer fitted with a toggle valve will be lowered into the well and used to gently surge the screen interval to remove any sand, silt, and debris accumulated in the well bore. When the bailer is brought to the surface, an Imhoff cone will be used to collect water from the first bailer run to evaluate the amount of silt and sediment in the water. This process will be repeated after each cycle of surging development. Wells will be bailed until the discharge water contains less than 2 milliliters of sediment per 1 liter of water, as measured using an Imhoff cone.
- A minimum of five casing volumes of water will be purged from the well to develop the filter pack. Additional volume will be purged during development to equal the volume of water added during the drilling process (if applicable).
- At the completion of well development, a sample will be collected and immediately photographed to document the results of the procedure.

The new wells (KAFB-106248 through KAFB-106252) were designed for passive sampling (Section 6), and the 0.010-inch slot size should minimize formation fines in these wells. The site geologist will monitor field parameters including pH, temperature, turbidity, and specific conductance, and record the results and other pertinent information on the Well Development Record Form (Appendix B).

6 MONITORING AND SAMPLING

The five newly added wells will be added to the monitoring schedule once completed. These wells will be monitored in accordance with the procedures for gauging and sampling described below and will be sampled for the parameters and frequency described in Table 6-1. Depth to groundwater and LNAPL will be measured following well development. It is unlikely that LNAPL will be encountered at any the proposed GWM well locations. However, if detected the procedures outlined in Section 6.1 will be followed. The newly installed wells will be allowed to recover a minimum of 24 hours following development before gauging, or any applicable water sampling. All new monitoring wells will be included in the sitewide GWM network for gauging and sampling beginning in the subsequent quarter following well installation.

All newly installed wells will be sampled for four consecutive quarters to establish baseline concentrations for the parameters listed in Table 6-1. Following four consecutive quarters of baseline sampling, the wells will be categorized based on analytical results. The wells will then be sampled in accordance with the Work Plan for the Bulk Fuels Facility Expansion of the Dissolved-Phase Plume Groundwater Treatment System Design Revision 2 (KAFB, 2017a). This work plan was approved with conditions by NMED in May 2017 (NMED, 2017). The anticipated sample frequency based on the proposed locations of the wells is described in Table 6-1.

The five new wells planned for installation in 2020 will begin baseline monitoring in the subsequent quarter following well installation and development. An estimated timeline for well installation and baseline monitoring is included in Section 7. The analytical parameters listed in Table 6-1 represent the current analytical list for quarterly monitoring (Section 3.3 of KAFB, 2019b). This list was developed based on regulatory correspondence with NMED. On July 17, 2015, NMED approved an initial optimization to the GWM program with the removal of 97 chemicals that had not been detected above regulatory criteria for the previous eight quarters (NMED, 2015). Additional revisions to the groundwater monitoring program were requested in December 2015, and approved by NMED in January 2016 (NMED, 2016) to further reduce redundant methods, and to categorize monitoring wells according to their data benefits.

Beginning in 2016 passive sampling techniques were implemented at select GWM well locations. The transition to passive sampling for select GWM well locations was formally approved by NMED on May 31, 2017 (NMED, 2017). A further passive sampling evaluation was performed in Q4 2017 (Section 3.7.7 of KAFB, 2018b). This evaluation demonstrated that analytical results from passive sampling techniques and analytical results from low-flow sampling techniques are generally comparable between the two sampling methods, with no consistent bias identified (i.e., neither method has consistently resulted in higher or lower concentrations).

Groundwater sampling will be performed via passive sampling techniques for all new GWM wells covered in this Work Plan, barring any environmental factors that would preclude the ability to sample with this technology (e.g., significant and continuous LNAPL thickness in the well). The sections below describe the procedures that will be employed for groundwater and LNAPL gauging and groundwater sample collection. Liquid IDW will be generated from groundwater sampling and decontamination activities and will be managed, characterized, and disposed of per the procedures outlined in Section 6.5.

6.1 Light Non-Aqueous Phase Liquid and Groundwater Gauging

Once the five new wells are completed, these wells will be added to the gauging event in the subsequent quarter following well installation. Quarterly, all monitoring wells are gauged in approximately 1 field week so that potentiometric surface maps can be prepared that represent a synoptic period. An electronic oil-water interface probe, or similar device, will be used to determine if LNAPL is present in each well. Depth to groundwater and depth to LNAPL, if present, will be measured in each well. LNAPL thickness will be calculated, if present. LNAPL is not anticipated to be present at the wells proposed in this Work Plan.

The sequence of procedures used when measuring depth to LNAPL, depth to water, and LNAPL thickness follow.

- Segregate the wells between potentially contaminated and not contaminated categories. Wells will be gauged with water-level meters designated for "clean" or "contaminated" wells; although water level meters are decontaminated between wells, this approach will further minimize the potential of cross-contamination.
- Identify which wells require barricading for access (if applicable) and ensure the barricade permit is available at the well location.
- Check operation of the PID aboveground. Before opening the well, don personal protective equipment (PPE) as required by the project safety plan.
- Visually examine the exterior of the monitoring well for signs of damage or tampering and record observations on the Monitoring Well Gauging Form (Appendix B).
- Recite the well identification, as labeled on the protective casing, vault cover, or identification tag, and compare to field forms and dedicated equipment tags to ensure appropriate forms and equipment are being utilized. Document this check on the Monitoring Well Gauging Form (Appendix B).
- Unlock the well cap or outer steel casing lid. Visually examine the interior of the monitoring well for signs of damage or tampering and record observations on the Monitoring Well Gauging Form.
- Take organic vapor readings with the PID at the well head immediately upon opening the cap and record information on the Monitoring Well Gauging Form. If high concentrations are detected, the appropriate measures, as outlined in the Site Safety and Health Plan (SSHP), will be taken.
- Lower interface probe into the well and note depth to LNAPL and depth to groundwater; in order to be consistent with former gauging data, all measurements will be taken from a reference mark located on either the top of the protective casing for wells with aboveground completion or from the top of the vault for wells with flush completion. Measurements are to be made to the nearest 0.01 ft.
- If the interface probe indicates the presence of LNAPL (whether measurable or not with the probe), a clear bailer will be deployed into the well to collect a sample from the top of the water column and confirm the presence of LNAPL. If LNAPL is recovered with the bailer, the thickness will be photo-documented and indicated on the field form, and the LNAPL and water within the bailer will be containerized for proper disposal.
- Once per year, the total well depth will be measured in wells using a tape with weights attached to the end.
- Record all gauging information on the field form.
- Record the time and day of the measurement.
- Decontaminate all groundwater level measurement devices and the weighted tape used for measuring the total well depth before and after each use to prevent cross-contamination of wells.

6.2 Preparation for Groundwater Well Sampling

All wells covered in this Work Plan will be sampled via passive sampling technology and, therefore, well purging will not be required in association with sampling (well development is discussed in Section 5.1.3.2). Passive sampling techniques are recommended as a more reliable and sustainable alternative to the dedicated low-flow pump systems. The mechanical issues, corrosion, pump failures, equipment exhaust, and excessive IDW have all contributed to the decline in the reliability of the low-flow pump system to achieve project objectives. Additionally, the passive samplers are only used one time in each well minimizing risk of cross-contamination and eliminating many of the decontamination requirements.

All wells will be sampled in order of increasing contamination based on historical analytical data, or proximity to the contaminant plume based on historical data from nearby monitoring points. Each well will have a dedicated tether from which to attach passive samplers (i.e., dual membrane samplers). The tethers will be designed and built based on the well construction data and latest static groundwater conditions but will be designed with the ability to modify sample depths, as needed, due to fluctuating water-table elevations. Groundwater samples will not be collected within 2 weeks of well development. For new GWM wells that have yet to be installed, the first groundwater sample will be collected in the subsequent quarter following installation.

6.2.1 Collection of Groundwater Samples from Monitoring Wells Using Passive Sampling Techniques

The procedures below will be followed for passive sampling.

- Don appropriate PPE. In addition, field team members will don new sampling gloves at each well before beginning sampling.
- Visually examine the exterior of the monitoring well for signs of damage or tampering and record notes on the Groundwater Sampling Data Sheet (Appendix B).
- Unlock the well cap or outer steel casing lid. Visually examine the interior of the monitoring well for signs of damage or tampering and record notes on the Groundwater Sampling Data Sheet.
- Recite the well identification, as labeled on the protective casing, vault cover, or identification tag, and compare to field forms and dedicated equipment tags to ensure appropriate forms and equipment are being utilized. Document this check on the Groundwater Sampling Data Sheet.
- Take organic vapor readings with the PID at the well head immediately upon opening the cap and record information on the Groundwater Sampling Data Sheet. If high concentrations are detected, the appropriate measures, as outlined in the SSHP, will be taken.
- Measure the static water level and the LNAPL as described in Section 6.1. If LNAPL is measurable in the well, a clear bailer will be deployed into the well to collect a sample from the top of the water column and confirm the presence of LNAPL. If LNAPL is confirmed within the well, passive samplers will not be deployed and a groundwater sample will be excluded from the well for the sampling event.
- Passive samplers will be deployed in wells a minimum of 3 weeks prior to sampling to allow for adequate equilibration between the passive sampler and the groundwater. All deployments will use dedicated passive equipment.
- The midpoint of the uppermost passive sampler will be set 2 ft below the water level if the top of water measured is within the screened interval. If the top of the water is above the screened interval, the midpoint of the topmost passive sampler will be set 2 ft below the top of the screened interval.

- Passive samplers will be retrieved from the wells and sampled per the manufacturer's specifications. All sample aliquots and groundwater quality parameters required will be collected from their respective passive samplers. Field parameters at these wells will not be measured during sampling events until a sitewide in situ program is approved by NMED.
- Dedicated deployable equipment (tethers) will either be retained in dedicated containers (e.g., contractor bags) or replaced down-well between each sampling event.

6.2.2 Sample Packaging and Shipping

Sample packaging and shipping requirements are designed to maintain sample integrity from the time a sample is collected until it is received at the analytical laboratory. All chain-of-custody forms, sample labels, custody seals, and other sample documents will be completed. The following specific procedures for packaging and shipping of environmental samples will be followed.

1. Complete sample label with indelible ink and attach to the sample bottle. Place sample bottles in a cooler for shipping.
2. In preparation for shipping samples, tape the drain plug shut so that no fluids (i.e., melted ice) will drain out of the cooler during shipment. A large plastic bag may be used as a liner for the cooler. Place packing material (i.e., bubble wrap) in the bottom of the liner. Place ice at the bottom of the cooler.
3. Place the containers in the lined cooler. Place cardboard separators or bubble wrap between the containers at the discretion of the shipper.
4. All samples for chemical analysis must be cooled and shipped to arrive at the laboratory at ≤6 degrees Celsius with ice. Include a temperature blank in each sample container prior to shipment.
5. Tape the liner closed, if used, and use sufficient packing material to prevent sample containers from making contact or rolling around during shipment.
6. Place a copy of the chain-of-custody form inside the cooler.
7. Close and tape the cooler shut with strapping tape (filament-type).
8. Place custody seals on the cooler. Place clear tape over the custody seals to help prevent them from being accidentally torn or ripped off.

Ship the cooler of samples via an overnight carrier. A copy of the shipping bill will be retained with the field records and sent electronically to the Project Chemist.

6.3 Analytical Requirements and Quality Control

Groundwater samples will be collected, labeled, packaged, and shipped to Eurofins Lancaster Laboratories Environmental (ELLE) in Lancaster, Pennsylvania. ELLE maintains a current U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program certification for the analyses required under this contract.

Table 6-2 lists the laboratory preservation requirements and hold times for each method of analysis to be collected during GWM. Appendix C includes laboratory detection limits for each chemical to be analyzed during groundwater monitoring and its screening limits.

Data analysis, validation, and verification will be performed in accordance with the *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, version 5.1*. (QSM 5.1; DoD and Department of Energy, 2017). Requirements of the QSM 5.1 are more restrictive, and fully comply with the quality assurance/quality control requirements of the Kirtland AFB RCRA permit.

Chemical analytical data will include Level IV-type data reports. EQuIS version 6.0 electronic data deliverables (EDDs) will be provided by the laboratory for validation and loading into the project database. Environmental Resources Program Information Management System (ERPIMS). Version 6.0 EDDs will be provided by the laboratory for processing and submittal of validated analytical data to the Air Force Civil Engineer Center ERPIMS database.

Groundwater sample data will undergo EPA 100% Level III data validation by an independent third-party subcontractor following data verification. Data verification is performed on a dataset to ensure method, procedural, and contractual compliance with project-specific requirements and is typically performed by the contractor responsible for data collection. Data validation is an analyte- and sample-specific process that extends the evaluation of analytical data beyond the data verification process to determine the analytical quality of a specific dataset.

Data verification and data validation are sequential steps in a data review process that can be performed by either the contractor collecting the data or an independent third-party subcontractor. Data verification will be performed during or at the completion of field or laboratory data collection activities. EPA Stage 3 data validation will be conducted by a third-party subcontractor and incorporates the data verification process and further evaluates data quality based on analytical method-specific quality control criteria and QSM requirements. Further detail regarding EPA data verification and validation processes is documented in Figure 2 and Figure 4 of *Guidance on Environmental Data Verification and Data Validation* (EPA, 2002).

Subsequent to performing data validation, the data qualifiers will be uploaded to the EQuIS project database. Data will be further assessed for precision, accuracy, representativeness, comparability, completeness, and sensitivity and determined to achieve the project data quality objectives. Data Quality Assessment Reports will be included as attachments to quarterly reporting documents.

6.4 Reporting

Information and data collected during any quarter from drilling, installation, sampling, and gauging activities performed on the newly added monitoring wells will be submitted in SWMUs ST-106/SS-111 Quarterly Monitoring Reports. These reports present a summary of quarterly field activities performed, analytical data for groundwater samples and data evaluation reports, information associated with the operations and maintenance (O&M) of the GWM network, and a discussion of the hydrogeologic conditions at the site, including a presentation of the potentiometric surface maps for the different REIs.

6.5 Investigation-Derived Waste

IDW generated during this project will be managed as specified in this Work Plan. Waste volumes will be minimized to the extent practical and to eliminate the potential for exposing the local population to IDW during and after work hours.

6.5.1 Nonhazardous Water Investigation-Derived Waste

All water generated during well development or during sampling events will be 100% captured and contained during generation. All water IDW is anticipated to be non-hazardous. The following categories of non-hazardous water are discussed below.

- Development of GWM wells installed under this Work Plan. Although this water is considered nonhazardous, IDW sample results will be used for waste profiling prior to disposal.
- Purge water or excess water from sampling all wells included in this Work Plan will be held in the IDW accumulation area pending receipt of analytical data until at least two consecutive

sampling events establish a nonhazardous waste profile do not meet the definition of characteristic hazardous waste (40 Code of Federal Regulations Part 261).

- Decontamination water from equipment cleaning across all site activities.

Nonhazardous water generated from well development or groundwater sampling activities may contain concentrations of dissolved iron and manganese that exceed the influent acceptance limits specified in the O&M Plan (Appendix L of KAFB, 2017c). Nonhazardous water will be managed as described below depending on dissolved metals concentrations.

6.5.1.1 *Nonhazardous Water with Dissolved Metal Exceeding Groundwater Treatment System Influent Acceptance Limits*

IDW water that contains dissolved iron and manganese exceeding the GWTS influent acceptance limits (KAFB, 2017c) will be kept segregated by point of origin both during transport and accumulation and will not be discharged directly to the GWTS. Upon generation, the water will be placed in dedicated containers (i.e., drums, totes, or storage tanks) and transported to the “pending analysis” accumulation facility where the drums will be labeled and kept pending laboratory analytical results. This water will be profiled for off-site disposal based on the IDW analytical data, or the analytical data from the sample collected from the well purged.

6.5.1.2 *Nonhazardous Water with Dissolved Metals Less than the Groundwater Treatment System Influent Acceptance Limits*

For IDW waste with dissolved iron and manganese concentrations that meet influent acceptance limits (Appendix L of KAFB, 2017c), the water will be segregated until waste profile analytical data are available. Fluids purged or generated at the wellheads will be placed in dedicated containers (i.e., drums, totes, or storage tanks) and transported to the IDW accumulation area. The quantity of IDW water from each well and the total quantity of water transferred to the GWTS will be recorded. A minimal amount of fines is anticipated to be present in this water and pre-filtering before batching into the GWTS is not anticipated.

If, for any reason, the GWTS cannot accept the purge water as it is generated (e.g., shut down for maintenance), the water will be temporarily kept in the IDW accumulation area on pallets and properly labeled until it can be discharged to the GWTS.

6.5.2 Hazardous Water Investigation-Derived Waste

No hazardous/potentially hazardous IDW is anticipated to be generated from the activities outlined in this Work Plan. Concentrations of samples collected at nearby wells are not hazardous. However, if analytical results suggest water is hazardous, it will be segregated. Any characteristically hazardous IDW will be accumulated for no longer than 90 days before disposal.

Characteristically hazardous water generated from any well development or sampling activities will be kept segregated by point of origin both during transport and while accumulated prior to off-site disposal. Upon generation, the water will be placed in dedicated drums and transported to the less-than-90-day accumulation area for hazardous waste where the drums will be labeled pending laboratory analytical results. This water will be profiled for disposal based on the analytical data from the sample collected from the well purged and, if proven hazardous, will be disposed of accordingly within the 90-day hold time. A minimal amount of fines is anticipated to be present in this water.

6.5.3 Soil Investigation-Derived Waste

Soil will be 100% captured and contained at the drill site during well drilling. All necessary equipment will be provided to contain and transport soil IDW back to the IDW accumulation area for further handling (i.e., characterization, temporary storage, and disposal). IDW soil from drilling sites will be collected, secured, and transported in 20-cubic-yard, lined roll-off bins to the IDW accumulation area pending receipt of waste characterization profiling results.

For profiling of solid waste (soil cuttings), each roll-off containing soil will be characterized for disposal at the Kirtland AFB construction and demolition (C&D) landfill with a 5-point composite IDW sample. The soil samples will be analyzed for the suites outlined in Table 6-3 to determine if they meet the waste acceptance criteria for the Kirtland C&D landfill (U.S. Air Force, 2009).

Once the analytical results for soil IDW are received and reviewed, a request for disposal letter will be provided to Kirtland AFB for approval to dispose of the contents of each container. All documentation regarding waste characterization and disposal will be provided in the appendices of the document describing the activities during which waste was generated.

Should the petroleum levels exceed what the Kirtland AFB C&D landfill is allowed to accept (benzene, toluene, ethylbenzene, and toluene >50 milligrams per kilogram [mg/kg], benzene >10 mg/kg, or total petroleum hydrocarbons >100 mg/kg), it will require characterization as "special waste" and disposed of at an off-site permitted landfill.

7 PROJECT SCHEDULE

Work Plan submission to NMED	December 20, 2019
NMED approval	September 15, 2020 (270-day review period in accordance with New Mexico Administrative Code 20.4.2)
Mobilization	90 days from approval
Field construction complete	60 days from mobilization
Analytical and validation complete	60 days from completion of construction
Reporting	Will be included in applicable Quarterly Monitoring report(s)

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KAFB, 2019b. *Quarterly Monitoring Report April-June 2019, Bulk Fuels Facility, SWMUs ST-106/SS-111*. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006. September.

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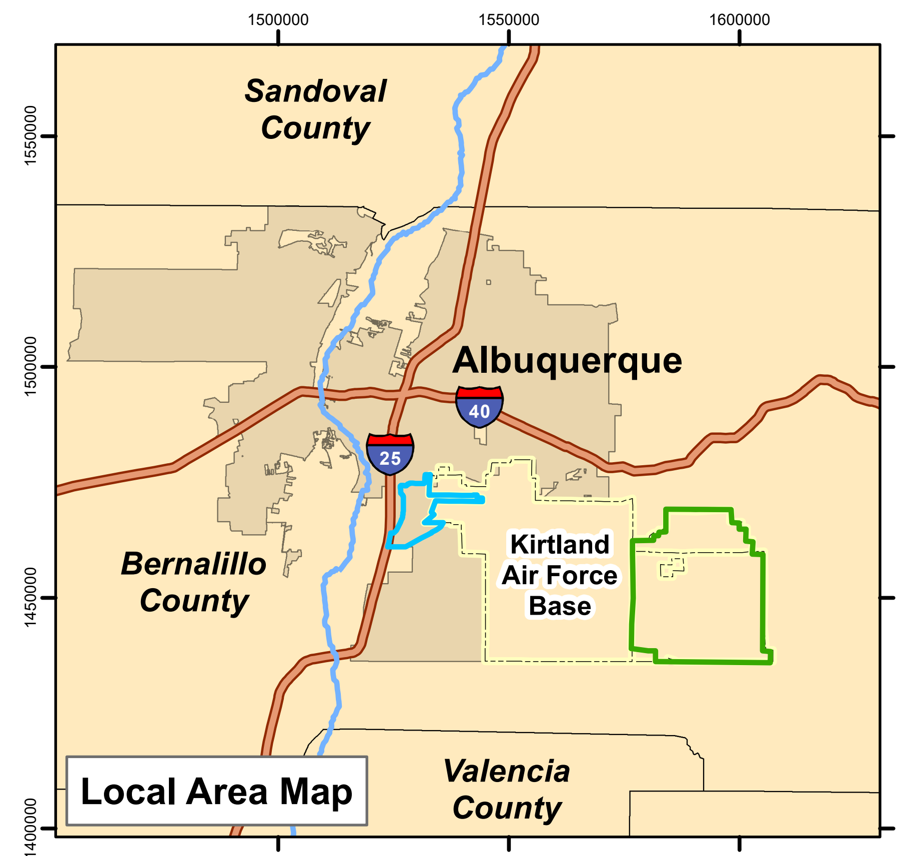
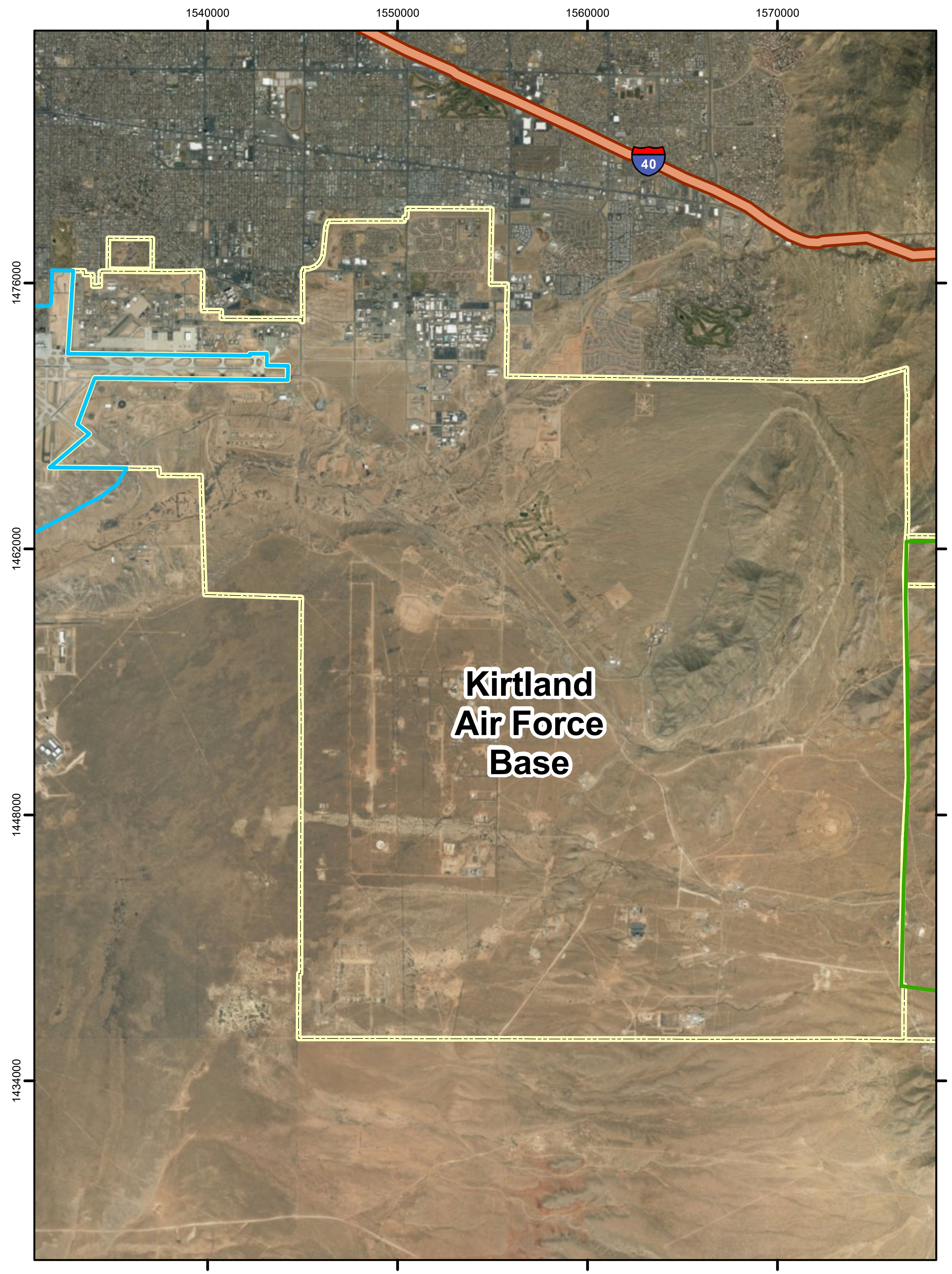
FIGURES





Legend

- Installation Boundary
- USAF Withdrawl Area
- ABQ Sunport Boundary
- Rio Grande
- Interstate
- US Highway
- State/County Highway

Revision Date: 10/17/2019

N

0 2,500 5,000 10,000
Feet

1 inch = 7,193 feet

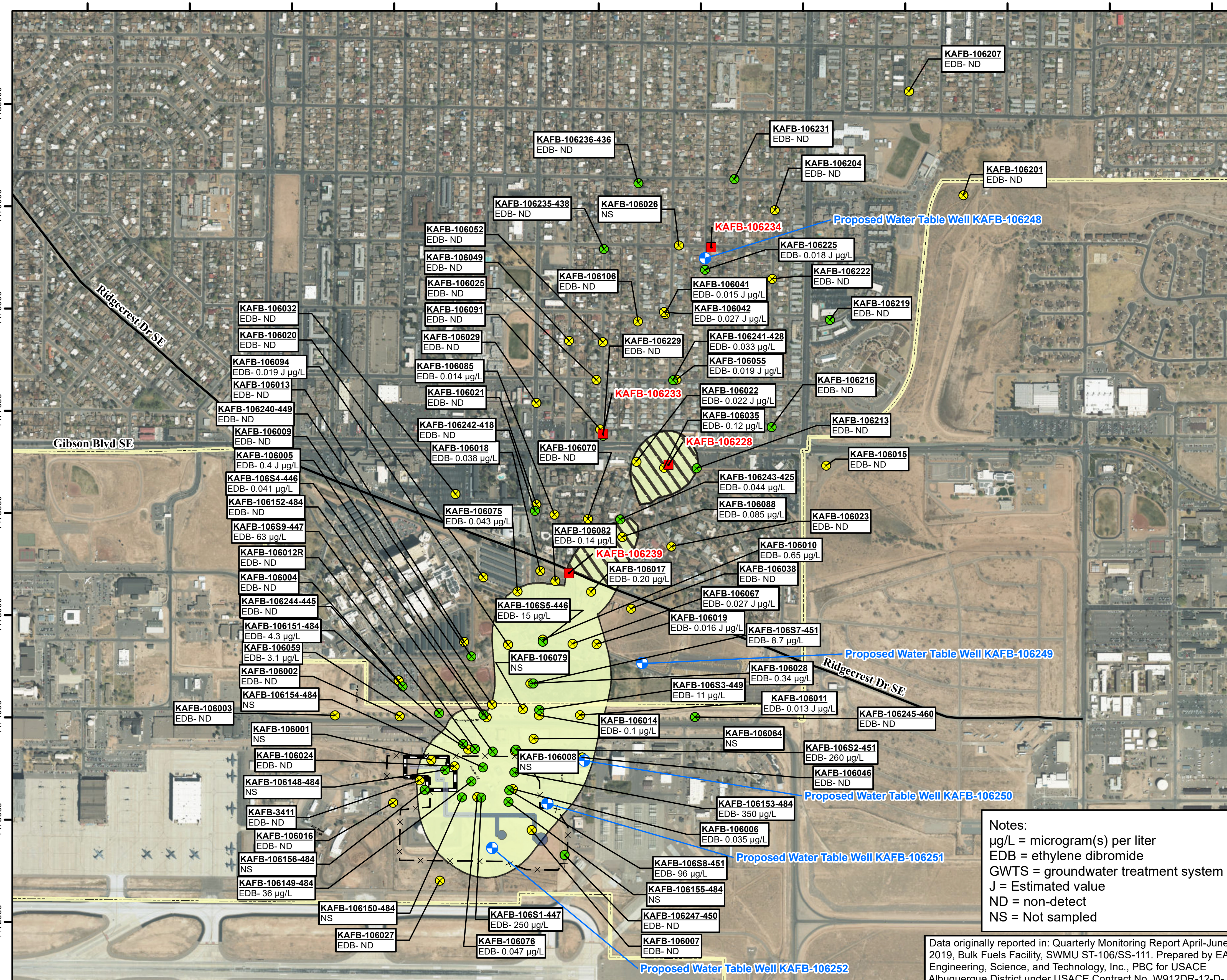
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

DRAFT WORK PLAN FOR DATA GAP MONITORING
WELL INSTALLATION KAFB-106248 TO KAFB-106252
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNITS ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 1-1

SITE VICINITY MAP

Document Path: N:\Kirtland\GIS\GIS_Projects\BFF_new_well_plan\Figure 1. Site Location.mxd

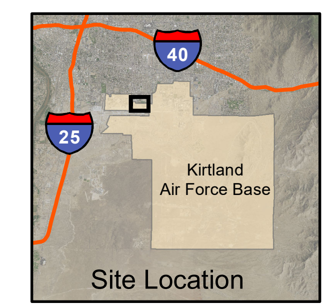


Notes:
µg/L = microgram(s) per liter
EDB = ethylene dibromide
GWTS = groundwater treatment system
J = Estimated value
ND = non-detect
NS = Not sampled

Data originally reported in: Quarterly Monitoring Report April-June 2019, Bulk Fuels Facility, SWMU ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-

Legend

- Proposed Water Table Wells
- Groundwater Monitoring Well (Screen Not Submerged)
- Groundwater Monitoring Well (Screen Submerged)
- Extraction Well
- Ridgecrest Drive
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Former Aboveground Storage Tank
- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- Source Area
- EDB Plume Q2 2019 (>0.05 µg/L)
- EDB Plume Q2 2019 (>0.05 µg/L) within target capture zone of GWTS



Imagery Source: National Agricultural Imagery Program June 2014

Revision Date: 12/13/2019

N

0 250 500 1,000 1,500 2,000
Feet

1 inch = 1,042 feet

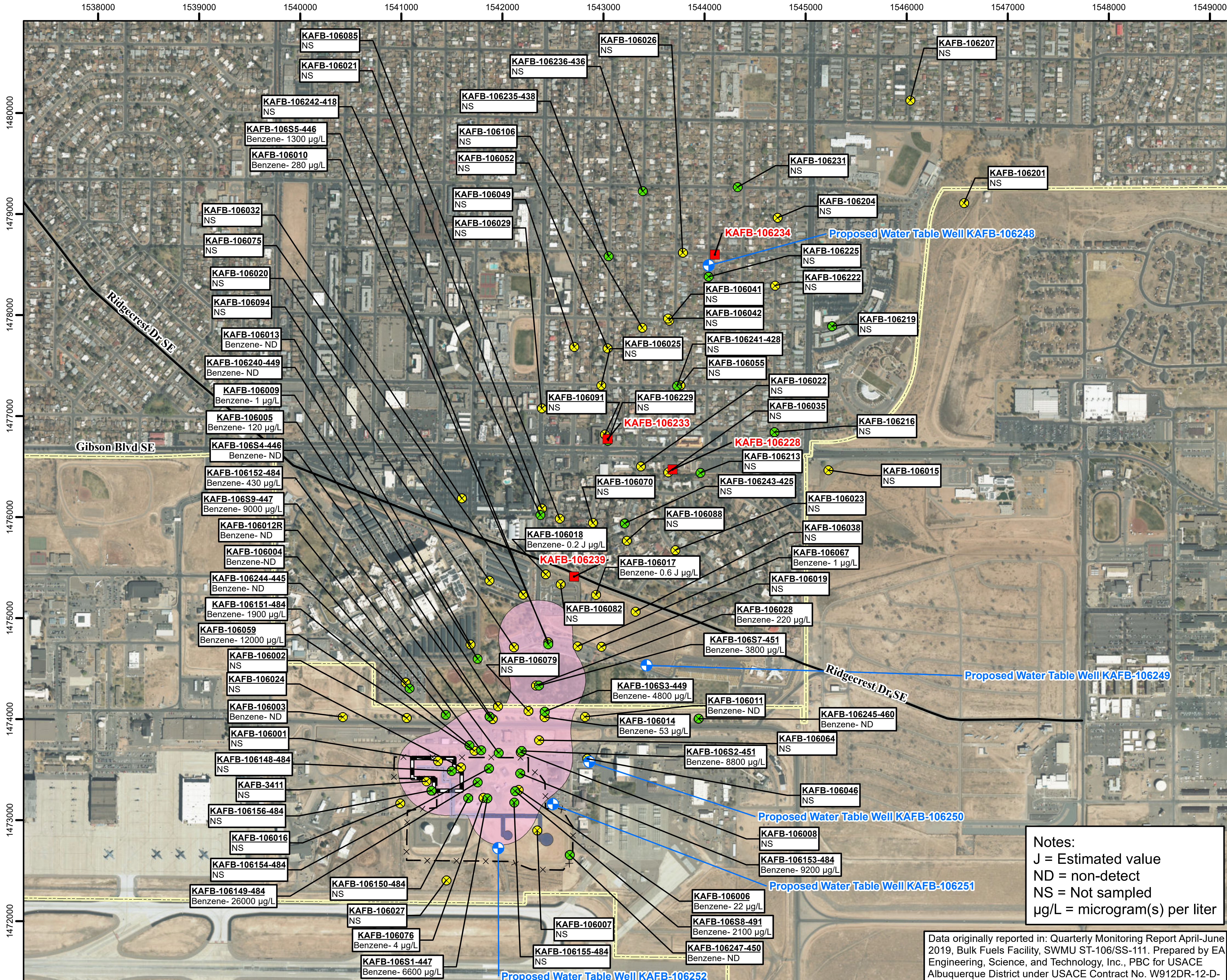
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

WORK PLAN FOR DATA GAP MONITORING
WELL INSTALLATION KAFB-106248 TO KAFB-106252
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNITS ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-1

PROPOSED MONITORING WELL LOCATIONS AND Q2 2019 EDB PLUME MAP

Document Path: N:\Kirtland\GIS\GIS_Projects\BFF_new_well_plan\Figure 2-1. Proposed Wells & Q2 EDB Results2.mxd

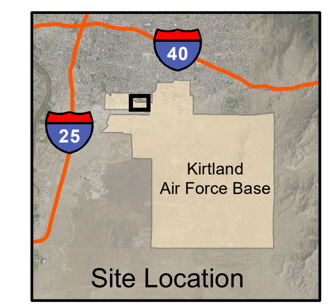


Notes:
J = Estimated value
ND = non-detect
NS = Not sampled
µg/L = microgram(s) per liter

Data originally reported in: Quarterly Monitoring Report April-June 2019, Bulk Fuels Facility, SWMU ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-

Legend

- Proposed Water Table Wells
- Groundwater Monitoring Well (Screen Not Submerged)
- Groundwater Monitoring Well (Screen Submerged)
- Extraction Well
- Ridgecrest Drive
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Former Aboveground Storage Tank
- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- Source Area
- Benzene Plume Q2 2019 (>5.0 µg/L)



Imagery Source: National Agricultural Imagery Program June 2014

Revision Date: 12/13/2019

N

0 250 500 1,000 1,500 2,000
Feet

1 inch = 1,042 feet

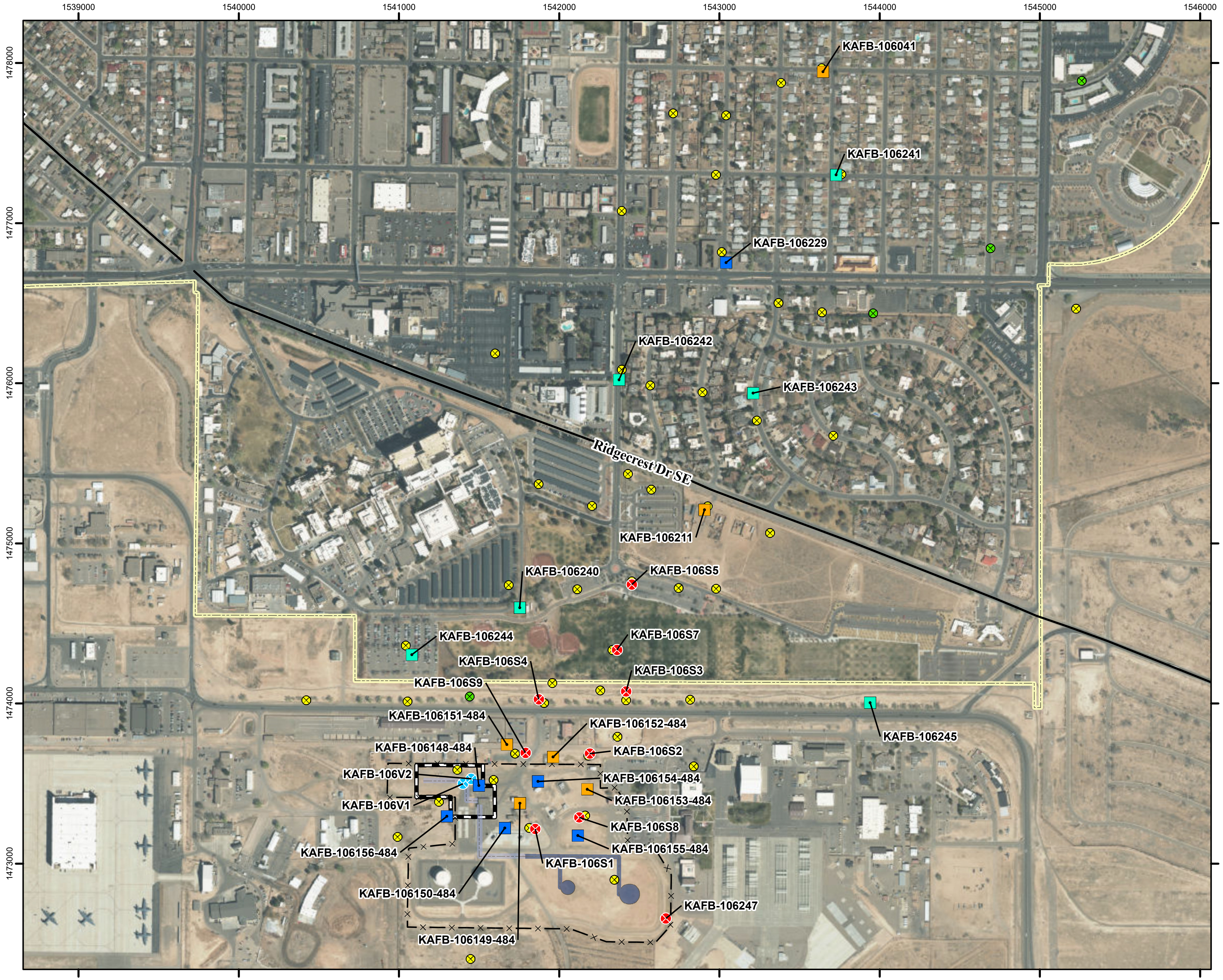
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

WORK PLAN FOR DATA GAP MONITORING
WELL INSTALLATION KAFB-106248 TO KAFB-106252
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNITS ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-2

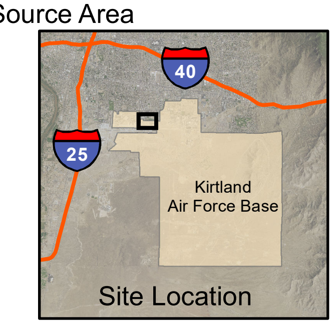
PROPOSED MONITORING WELL LOCATIONS AND Q2 2019 BENZENE PLUME MAP

Document Path: N:\Kirtland\GIS\GIS_Projects\BFF_new_well_plan\Figure 2-2. Proposed Wells & Q2 Benzene Results2.mxd



Legend

- New Monitoring Well in 2018
- Existing Well incorporated for Gauging Only
- Existing Monitoring Well incorporated for Sampling and Gauging
- Coring Locations Completed as SVM Locations
- Coring Locations Completed as GWM Locations
- Groundwater Monitoring Well (Screen Not Submerged)
- Groundwater Monitoring Well (Screen Submerged)
- Ridgecrest Drive
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Former Aboveground Storage Tank
- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- Source Area



Imagery Source: National Agricultural Imagery Program June 2014

Revision Date: 12/13/2019

N

0 250 500 1,000 1,500

Feet

1 inch = 645 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

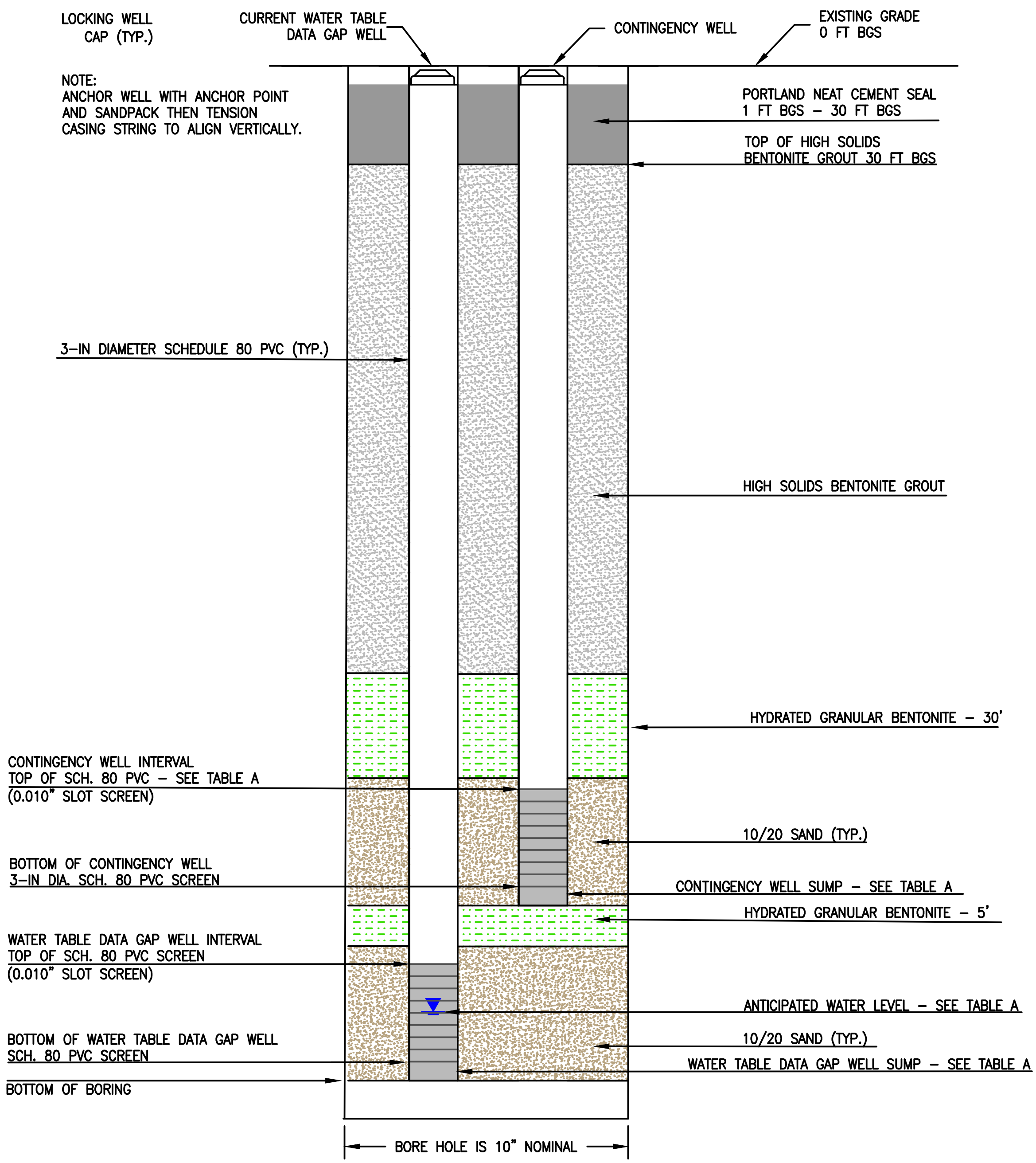
WORK PLAN FOR DATA GAP MONITORING
WELL INSTALLATION KAFB-106248 TO KAFB-106252
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNITS ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-3

PREVIOUS DATA GAP
MONITORING WELL LOCATIONS

Document Path: N:\Kirtland\GIS\GIS_Projects\BFF_new_well_plan\Figure 2-3. Previous Data Gap Locations.mxd

Figure 4-1
Proposed Construction Diagram for Groundwater Monitoring Well with Contingency Well



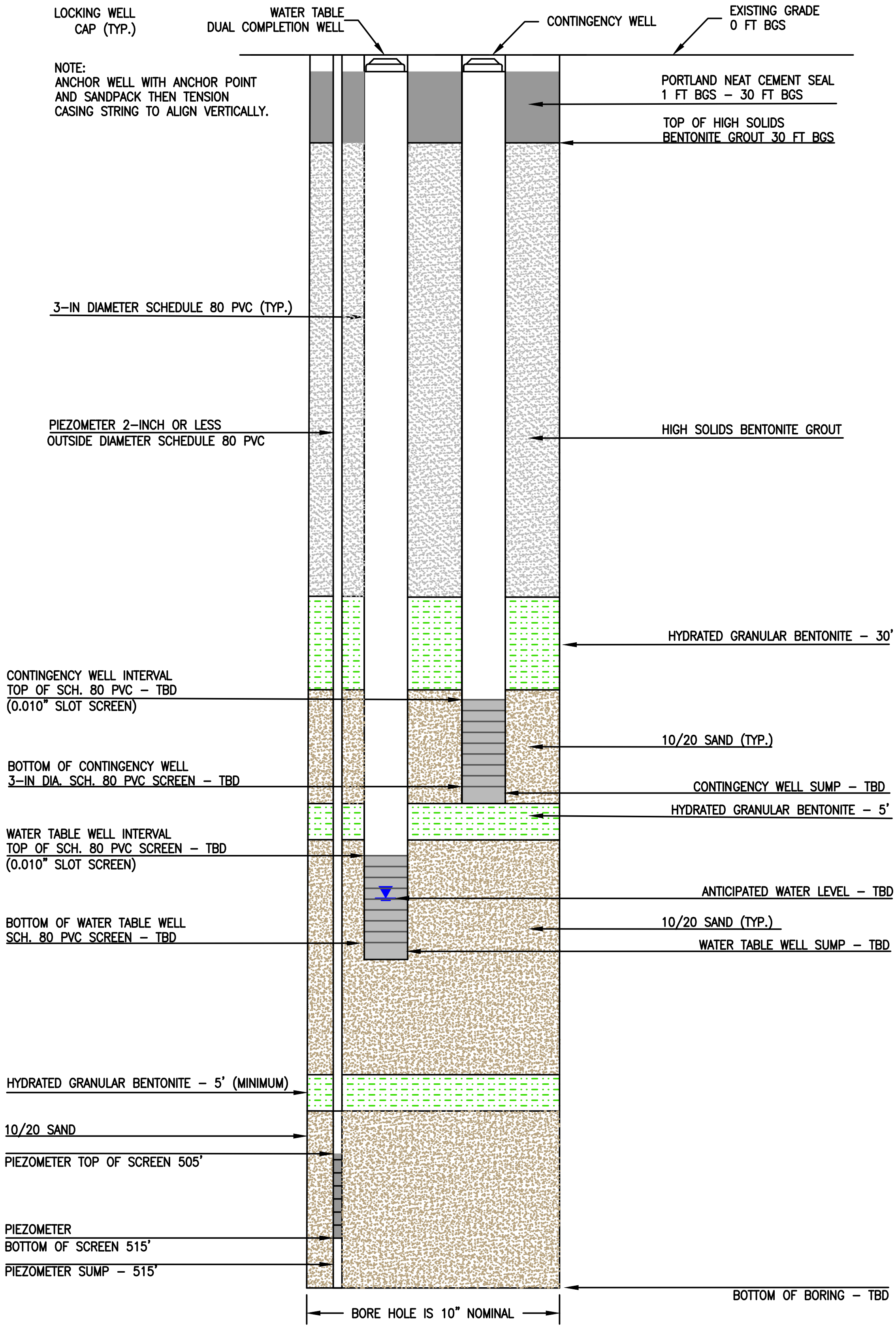
NOTE: APPROXIMATE DEPTH TO WATER DETERMINED FROM Q4 2017 DATA IN SURROUNDING GROUNDWATER MONITORING WELLS
DEPTH INTERVALS MAY BE MODIFIED DURING DRILLING BASED ON OBSERVED CONDITIONS;
WELL SCREENS WILL BE POSITIONED WITH APPROXIMATELY 15' OF WATER COLUMN UPON COMPLETION.

NOT TO SCALE
BGS=BELOW GROUND SURFACE
FT=FEET

	KIRTLAND AIR FORCE BASE		INSTALLATION START DATE/TIME:	INSTALLATION END DATE/TIME:
	PROJECT NO.:	WELL ID:	GEOLOGIST:	DRILLER:

CAD FILE: Y:\Active Projects\62599DM01 Kirtland BFF_USACE\01_Work Plan\19.0 Data Gap Wells WP\Figures\Natives\Nested Monitoring well_KAFB-106240-245.dwg PLOT DATE/TIME: 12/18/2017 – 4:39pm

FIGURE 4-2
Proposed Construction Diagram for Groundwater Monitoring
Well KAFB-106248



NOTE:
TBD = TO BE DETERMINED
DEPTH INTERVALS MAY BE MODIFIED DURING DRILLING BASED ON OBSERVED CONDITIONS;
WELL SCREENS WILL BE POSITIONED WITH APPROXIMATELY 15' OF WATER COLUMN UPON COMPLETION.

NOT TO SCALE
BGS=BELOW GROUND SURFACE
FT=FEET

KIRTLAND AIR FORCE BASE		INSTALLATION START DATE/TIME:	INSTALLATION END DATE/TIME:
PROJECT NO.:	WELL ID:	GEOLOGIST:	DRILLER:

CAD FILE: Y:\Active Projects\62735DM02 Kirtland Vadose Zone\Sundance data gap work plan\Well Completion Diagram–KAFB–106248.dwg PLOT DATE/TIME: 9/26/2019 – 1:03pm

TABLES

Table 4-1. Well Justification and Construction Specifications

Proposed Monitoring Well Location Shown (Figure 3-1)	Location Description (Figure 3-1)	Completion	NAD83 State Plane New Mexico Central ft		Approximate Depth to Water[a]	Depth to Water in Nearby Well[b]	Anticipated Water Table Well Screen Interval[c]	Anticipated Contingency Well Screen Interval[d]	Anticipated Piezometer Well Screen Interval	Justification for Well Location
			(X)	(Y)	(ft bgs)	(ft bgs)	(ft bgs)	(ft bgs)	(ft bgs)	
KAFB-106248	Proximal to extraction well KAFB-106234	Nested - two wells; 3-inch Schedule 80 PVC each and one piezometer well; 1-inch Schedule 80 PVC	1544042.712	1478492.566	451	451.03 (KAFB-106225)	426-466	392-417	505-515	Provides more accurate EDB concentration data to better approximate residual mass. Well should be placed <40 ft away from KAFB-106234 to best represent the EDB concentration collected around the extraction center. Allows for a more accurate drawdown from KAFB-106234 and would help the model in providing a more accurate representation of the groundwater gradients in this area. The well will be placed as close to KAFB-106234 as reasonable to increase the chance of the piezometer intersecting the high permeability gravels seen in the KAFB-106234 logs.
KAFB-106249	Bullhead Park	Nested - two wells; 3-inch Schedule 80 PVC each	1543624.994	1474458.099	480	479.55 (KAFB-106019)	455-495	421-446	NA	Fills plume boundary gap between KAFB-106019 and KAFB-106011. EDB concentrations are decreasing to the east in this area from KAFB-106067 (0.027J ug/l) to KAFB-106019 (0.016J ug/l), however no ND wells to the east. Better control with bounding the benzene plume: KAFB-106067 (1 ug/l) to the north and KAFB-106011 (ND) to the south. Provides data as the water table decreases in depth.
KAFB-106250	East of BFF, adjacent to/north of Air National Guard	Nested - two wells; 3-inch Schedule 80 PVC each	1542861.024	1473577.172	478	477.22 (KAFB-106046)	453-493	419-444	NA	Assesses eastern extent of the on base EDB plume at the water table. Q2 2019 EDB concentrations exceeded the MCL at KAFB-106153-484 and KAFB-106S2-451. KAFB-106046 well screen is submerged.
KAFB-106251	Southeast of BFF in Air National Guard parking Lot	Nested - two wells; 3-inch Schedule 80 PVC each	1542499.573	1473160.013	476	476.22 (KAFB-106S8-491)	451-491	417-442	NA	Assists with bounding southern extent of the EDB plume at the water table. Q2 2019 EDB concentrations exceeded the MCL at KAFB-106S8-491 and KAFB-106S1-447. KAFB-106007 is both submerged
KAFB-106252	In BFF south of former fuel tanks	Nested - two wells; 3-inch Schedule 80 PVC each	1541958.972	1472724.372	470	469.90 (KAFB-106S1-447)	445-485	411-436	NA	Assists with bounding southern extent of the EDB plume at the water table. Q2 2019 EDB concentrations exceeded the MCL at KAFB-106S1-447 and KAFB-106149-484. KAFB-106027 and KAFB-106007 are submerged and there is no other data in this area to help limit the model in this area.

a Approximate depth to water as of the submission of this work plan. Depth to water will likely have changed by the time field activities commence. The well will be installed according to the current water table at the time of drilling.

[b] Depth to water measured April 2019

[c] 40-ft screen, 25 ft above water table, 15 ft below. Depth intervals may be modified during drilling based on observed conditions; water table well screens will be positioned with approximately 15-ft water column upon completion

[d] 25-ft screen, bottom 9 ft above top of water table screen, installed "dry"

µg/L = microgram per liter
BFF = Bulk Fuels Facility
bgs = below ground surface
EDB = ethylene dibromide
ft = feet
MCL = maximum contaminant level
NA= not applicable
ND = non-detect
PVC = polyvinyl chloride
Q2 2019 = second quarter of calendar year 2019

Table 4-2
Groundwater EDB Results from 2017 through 2019 in the Vicinity of KAFB-106234

Location	REI	Project Screening Level[a]	Units	EDB Results															Bottom of Screen Elevation	Top of Screen Elevation
				Q2 2017			Q4 2017			Q2 2018			Q4 2018			Q2 2019				
				Result	Val Qual	LOD	Result	Val Qual	LOD	Result	Val Qual	LOD	Result	Val Qual	LOD	Result	Val Qual	LOD		
KAFB-106041	4857	0.05	µg/L	Not sampled			**0.058**		0.019	0.019	J	0.019	0.013	J	0.0095	0.015	J	0.019	4855	4875
KAFB-106042	4857	0.05	µg/L	ND	U	0.019	0.013	J	0.019	0.017	J	0.02	0.017	J	0.0095	0.027	J	0.019	4841	4855
KAFB-106201	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4837	4867
KAFB-106204	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4840	4870
KAFB-106207	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4841	4871
KAFB-106222	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.02	ND	U	0.019	ND	U	0.019	4845	4875
KAFB-106225	4857	0.05	µg/L	**0.92**		0.38	**0.57**		0.019	**0.12**		0.019	**0.17**		0.019	0.018	J	0.019	4846	4876
KAFB-106231	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4853	4888
KAFB-106236-461	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4855	4880
KAFB-106202	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4823	4838
KAFB-106205	4838	0.05	µg/L	0.041		0.019	ND	U	0.019	0.022	J	0.019	ND	U	0.019	ND	U	0.019	4826	4841
KAFB-106208	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4826	4841
KAFB-106223	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.02	ND	U	0.019	ND	U	0.019	4831	4846
KAFB-106226	4838	0.05	µg/L	ND	U	0.019	**0.33**		0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4832	4847
KAFB-106236-490	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4826	4846
KAFB-106203	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4719	4734
KAFB-106206	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4725	4740
KAFB-106209	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4726	4740
KAFB-106224	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.02	ND	U	0.019	ND	U	0.019	4765	4780
KAFB-106227	4814	0.05	µg/L	0.041		0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4765	4780
KAFB-106232	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4709	4724
KAFB-106236-519	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	ND	U	0.019	4817	4837

[a]EPA National Primary Drinking Water Regulations, MCLs and Secondary MCLs, Title 40CFR Part 141, 143 (May 2018).
EDB = 1,2-dibromoethane (ethylene dibromide)
J = estimated concentration
LOD = limit of detection
ND = nondetect
Q = quarter
REI = reference elevation interval
U = nondetect
Val Qual = validation qualifier
µg/L = micrograms per liter
highlighted cell indicates a detection
bolded text indicates the detected concentration exceeds the project screening level

Table 4-3
Recent EDB and Benzene Results from Groundwater Wells in the Vicinity of Proposed Locations KAFB-106249 through KAFB-106252

		EDB Data								Benzene Data									
				Q4 2018			Q2 2019					Q4 2018			Q2 2019				
Location	REI	Project Screening Level[a]	Units	Result	Val Qual	LOD	Result	Val Qual	LOD	Project Screening Level[a]	Units	Result	Val Qual	LOD	Result	Val Qual	LOD	Is GWM well submerged? Y/N	Proposed well location assoicated with data
KAFB-106010	4857	0.05	µg/L	**2.1**		0.19	**0.65**		0.19	5	µg/L	**2300**		10	**280**		0.5	Y	KAFB-106249
KAFB-106019	4857	0.05	µg/L	**0.079**		0.019	0.016	J	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106249
KAFB-106067	4857	0.05	µg/L	0.018	J	0.019	0.027	J	0.019	5	µg/L	**5**		0.5	1		0.5	Y	KAFB-106249
KAFB-106S5-446	4857	0.05	µg/L	not installed			**15**		1.9	5	µg/L	not installed			**1300**		25	N	KAFB-106249
KAFB-106S3-449	4857	0.05	µg/L	not installed			**11**		2	5	µg/L	not installed			**4800**		50	N	KAFB-106249
KAFB-106245-460	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	ND	U	0.5	N	KAFB-106249, KAFB-106250
KAFB-106046	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106250
KAFB-106064	4857	0.05	µg/L	**0.25**		0.019	not sampled			5	µg/L	**3600**		50	not sampled			Y	KAFB-106250
KAFB-106006	4857	0.05	µg/L	ND	U	0.019	0.035		0.019	5	µg/L	**17**		0.5	**22**		0.5	Y	KAFB-106251
KAFB-106007	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106251
KAFB-106008	4857	0.05	µg/L	**20**		3.8	not sampled			5	µg/L	**5800**		50	not sampled			Y	KAFB-106250
KAFB-106027	4857	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106252
KAFB-106076	4857	0.05	µg/L	0.013	J	0.019	0.047		0.019	5	µg/L	1		0.5	4		0.5	Y	KAFB-106252
KAFB-106S1-447	4857	0.05	µg/L	not installed			**250**		97	5	µg/L	not installed			**6600**		100	N	KAFB-106252
KAFB-106S2-451	4857	0.05	µg/L	not installed			**260**		95	5	µg/L	not installed			**8800**		100	N	KAFB-106250
KAFB-106S8-451	4857	0.05	µg/L	not installed			**96**		19	5	µg/L	not installed			**2100**		100	N	KAFB-106251
KAFB-106247-450	4857	0.05	µg/L	not installed			ND	U	0.019	5	µg/L	not installed			ND	U	0.5	N	KAFB-106251, KAFB-106252
KAFB-106149-484	4857	0.05	µg/L	**34**		9.5	**36**		3.8	5	µg/L	**11000**		50	**26000**		250	N	KAFB-106250, KAFB-106251, KAFB-106252
KAFB-106152-484	4857	0.05	µg/L	0.017	J	0.019	ND	U	0.095	5	µg/L	**71**		0.5	**430**		5	N	KAFB-106250, KAFB-106251
KAFB-106153-484	4857	0.05	µg/L	**300**		39	**350**		95	5	µg/L	**4700**		25	**9200**		100	N	KAFB-106250, KAFB-106251
KAFB-106069	4838	0.05	µg/L	0.044		0.019	0.014	J	0.019	5	µg/L	ND	U	0.5	ND	U	0.5	Y	KAFB-106249
KAFB-106044	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106252
KAFB-106047	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106250
KAFB-106063	4838	0.05	µg/L	**3.6**	J	0.38	not sampled			5	µg/L	**6400**		50	not sampled			Y	KAFB-106250
KAFB-106077	4838	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	ND	U	0.5	Y	KAFB-106252
KAFB-106068	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	ND	U	0.5	Y	KAFB-106249
KAFB-106045	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106252
KAFB-106048	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	not sampled			Y	KAFB-106250, KAFB-106251
KAFB-106062	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	ND	U	0.5	Y	KAFB-106250
KAFB-106078	4814	0.05	µg/L	ND	U	0.019	ND	U	0.019	5	µg/L	ND	U	0.5	ND	U	0.5	Y	KAFB-106252

[a]EPA National Primary Drinking Water Regulations, MCLs and Secondary MCLs, Title 40CFR Part 141, 143 (May 2018).
EDB = 1,2-dibromoethane (ethylene dibromide)
J = estimated concentration
LOD = limit of detection
ND = nondetect
Q = quarter
REI = reference elevation interval
U = nondetect
Val Qual = validation qualifier
µg/L = micrograms per liter
highlighted cell indicates a detection
bolded text indicates the detected concentration exceeds the project screening level

Table 6-1
Groundwater Monitoring Sampling Requirements for Data Gap Wells

Analyte	Analysis	Frequency of Baseline Monitoring[a]	Anicipated Frequency of Post-Baseline Monitoring[a,b]
EDB	EPA Method 8011	Quarterly	Semiannually
BTEX	EPA Method 8260C – BTEX (4 analytes)	Quarterly	None (VOCs to be sampled annually)
Total Metals	EPA Method 6010C (calcium, magnesium, potassium, sodium)	Quarterly	Semiannually
Dissolved Metals	EPA Method 6010C (iron, manganese)	Quarterly	Semiannually
Total Metals	EPA Method 6020A (arsenic, lead)	Quarterly	Semiannually
Anions	EPA Method 300.0A (chloride, bromide, sulfate)	Quarterly	Semiannually
Anions	EPA Method 353.2 (nitrate/nitrite nitrogen)	Quarterly	Semiannually
Alkalinity - Bicarbonate/ Carbonate	Standard Method 2320B	Quarterly	Semiannually
VOCs	EPA Method 8260C	Annually	Annually

[a] Five new wells (KAFB-106248, KAFB-106249, KAFB-106250, KAFB-106251, and KAFB-106252) are proposed to be installed and will be sampled in 2020 following well completion (Figure 3-1).

[b] This is the anticipated frequency, which may change based on monitoring results. Baseline sampling results will allow the wells to be categorized in accordance with the approved Work Plan for The Bulk Fuels Facility Expansion of The Dissolved-Phase Plume Groundwater Treatment System Design Revision 2 (KAFB, 2017a). It is anticipated that the wells will be categorized as "groundwater monitoring wells."

BTEX = benzene, toluene, ethylbenzene, and xylenes
EDB = ethylene dibromide
EPA = U.S. Environmental Protection Agency
VOC = volatile organic compound

Table 6-2
Analytical Parameter, Matrix, Method, Sample Container, Preservation, and Holding Time Requirements

Parameter	Matrix	Preparation/ Analysis Method	Bottle Type	Preservative	Preparation Holding Time	Analytical Holding Time
Volatile organic compounds	Water	SW5030B/8260C	3 x 40-mL glass	HCl to pH < 2; Cool ≤6°C	NA	14 days
Volatile Organic Compounds – benzene, toluene, ethylbenzene, xylenes, naphthalene	Water	SW5030B/8260C	3 x 40-mL glass	HCl to pH < 2; Cool ≤6°C	NA	14 days
Ethylene dibromide	Water	SW8011	2 x 40-mL glass	HCl to pH < 2; Cool ≤6°C	NA	14 days
Anions (chloride, bromide, sulfate)	Water	E300.0A	1 x 250-mL glass or HDPE	None; Cool ≤6°C	NA	28 days
Nitrate/Nitrite nitrogen	Water	E353.2	2 x 250-mL glass or HDPE	Sulfuric acid to pH <2; Cool ≤6°C	NA	28 days
Alkalinity – bicarbonate/carbonate	Water	SM2320B	1 x 250-mL glass or HDPE	None; Cool ≤6°C	NA	14 days
Total and dissolved metals	Water	SW3005A/6010C SW3020A/6020A	1 x 250-mL HDPE	Nitric acid to pH <2; Cool ≤6°C	180 days	180 days
Total mercury	Water	SW7470A	1 x 250-mL HDPE	Nitric acid to pH <2; Cool ≤6°C	28 days	28 days
Flashpoint	Water	SW1010A	1 x 250-mL HDPE	None; Cool ≤6°C	NA	NA
pH	Water	SW9040C	1 x 250-mL HDPE	None; Cool ≤6°C	NA	Upon receipt
Volatile organic compounds	Soil	SW5035A/8260C	3 x EnCore/ Terracore samplers; 1 x 4-oz glass	None; Cool ≤6°C	48 hours to preserve or preserved in field	14 days
Semivolatile organic compounds	Soil	SW3546/8270D	1 x 8-oz glass	None; Cool ≤6°C	14 days	40 days
Ethylene dibromide	Soil	SW8011	1 x 8-oz glass	None; Cool ≤6°C	14 days	14 days
Metals	Soil	SW3050B/6010C/ 6020A	1 x 8-oz glass	None; Cool ≤6°C	180 days	180 days
Mercury	Soil	SW7471B	1 x 8-oz glass	None; Cool ≤6°C	28 days	28 days
Ignitability	Soil	40CFR Part 261	1 x 8-oz glass	None; Cool ≤6°C	NA	NA
Reactivity – Cyanide/Sulfide	Soil	40CFR Part 261	1 x 8-oz glass	None; Cool ≤6°C	28 days	28 days
Pesticides	Soil	SW3546/8081B	1 x 8-oz glass	None; Cool ≤6°C	14 days	40 days
Herbicides	Soil	SW3550C/8151A	1 x 8-oz glass	None; Cool ≤6°C	14 days	40 days
Total petroleum hydrocarbon- diesel/residual range	Soil	SW3546/8015D	1 x 8-oz glass	None; Cool ≤6°C	14 days	40 days

Table 6-2
Analytical Parameter, Matrix, Method, Sample Container, Preservation, and Holding Time Requirements

Parameter	Matrix	Preparation/ Analysis Method	Bottle Type	Preservative	Preparation Holding Time	Analytical Holding Time
Total petroleum hydrocarbon- gasoline range	Soil	SW5035A/8015D	1 x 4-oz glass	None; Cool ≤6°C	NA	14 days
Toxicity characteristic leaching procedure	Soil	SW1311	8-oz glass per parameter/method	NA	NA	NA
Particle size-wet sieve analysis including hydrometer analysis	Soil	ASTM International D-422	1 x gallon plastic bag	None	NA	NA

Notes

°C = degrees Celsius
E = EPA Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983 and Updates.
HCl = hydrochloric acid
HDPE = high density polyethylene
mL = milliliter
NA = not applicable
oz = ounce
SM = Standard Methods for Examination of Water and Wastewater, 22nd Edition.
SW = EPA SW846 – Test Methods for Evaluating Solid Waste, 3rd Edition, 1986 and Updates.

Table 6-3
Summary of Investigation-Derived Waste Sampling

Analytical Method	Constituent	Frequency	Sample Location
Water Investigation-Derived Waste from Groundwater Monitoring Activities			
All waste profiling for purge water or excess water from sampling generated during groundwater monitoring activities will be based on historical water quality from the previous two quarters of sample analytical results and/or the sample results from the investigation-derived waste.			
Water Investigation-Derived Waste from Drilling			
EPA Method SW8011[a]	EDB	One per well	Bailer at end of development
EPA Method SW 6010C/7470A	RCRA Metals and Mercury	One per well	Bailer at end of development
EPA Method SW8260C[a]	VOCs	One per well	Bailer at end of development
Soil Investigation-Derived Waste from Installation of Groundwater Monitoring Wells			
EPA Method SW8015D[a]	TPH-DRO/RRO	One per roll-off	5-point composite
EPA Method SW8015D[a]	TPH-GRO	One per roll-off	5-point composite
EPA Method SW8260C[a]	BTEX	One per roll-off	5-point composite

[a] Analytical method per EPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition and Updates, 1986.
BTEX = benzene, toluene, ethylbenzene, and total xylenes
DRO = diesel range organics
EDB = ethylene dibromide (aka 1,2-dibromoethane)
EPA = U.S. Environmental Protection Agency
GRO = gasoline range organics
RCRA = Resource Conservation and Recovery Act
RRO = residual range organics
SW = EPA SW-846-Test Methods for Evaluating Solid Waste, 3rd Edition, 1986 and Updates
TPH = total petroleum hydrocarbons
VOC = volatile organic compound

APPENDICES

APPENDIX A

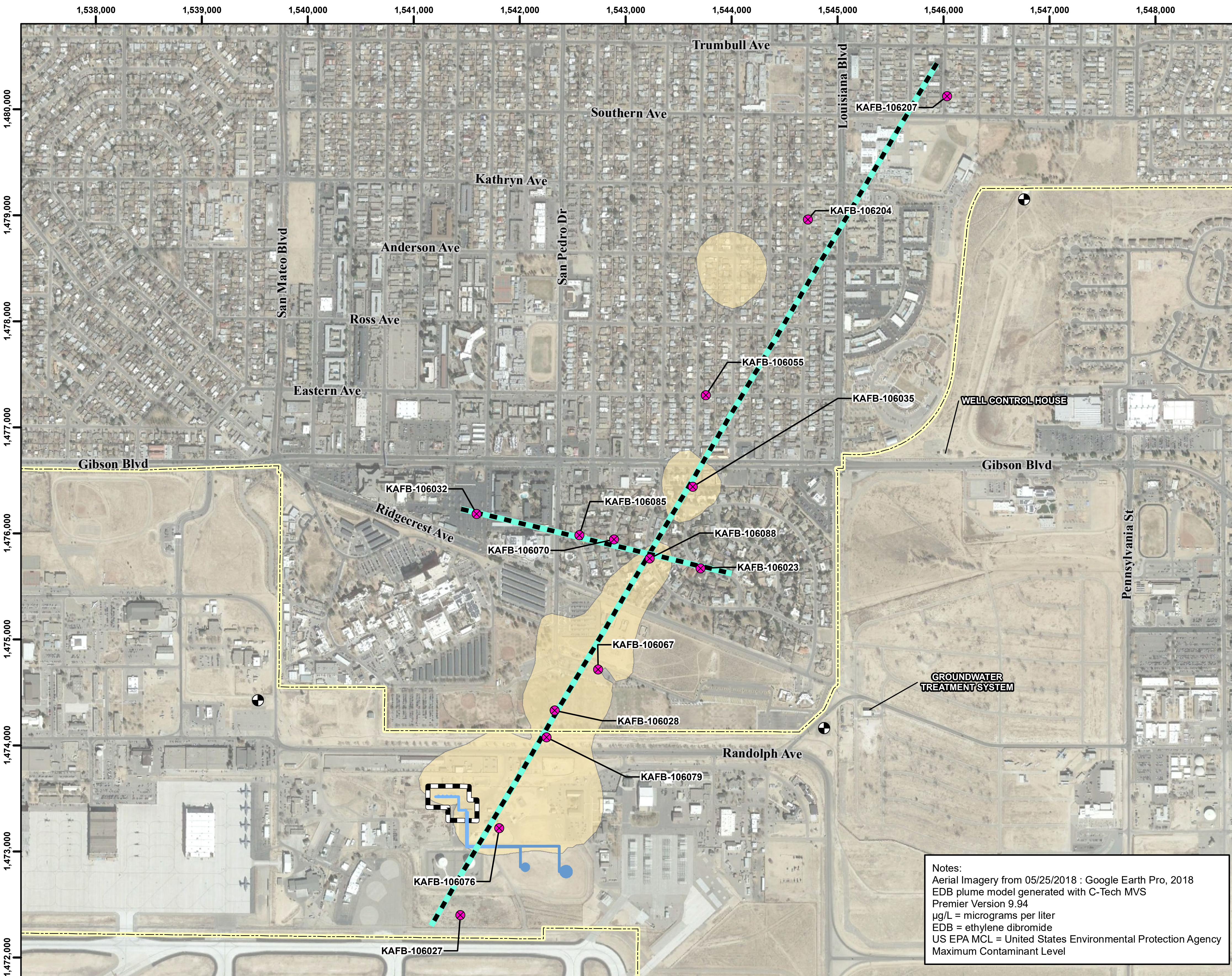
HISTORICAL GROUNDWATER INFORMATION

APPENDIX A-1

WATER-LEVEL HYDROGRAPHS

Material reprinted from Appendix L-2 from the following document:

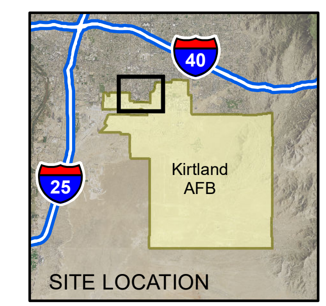
Quarterly Monitoring Report October–December 2018 and Annual Report for 2018, Bulk Fuels Facility, SWMUs ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.



Notes:
Aerial Imagery from 05/25/2018 : Google Earth Pro, 2018
EDB plume model generated with C-Tech MVS
Premier Version 9.94
µg/L = micrograms per liter
EDB = ethylene dibromide
US EPA MCL = United States Environmental Protection Agency
Maximum Contaminant Level

Legend

- Groundwater Monitoring Well Used in Cross Section Profile
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Groundwater Elevation Cross Section
- Installation Fence Boundary
- Q4 2018 EDB Plume with Concentration > 0.05 µg/L (EPA MCL)
- Source Area



N
0 500 1,000 2,000
Feet
1 inch = 1,000 feet
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE L-2-1

GROUNDWATER ELEVATION CROSS SECTION

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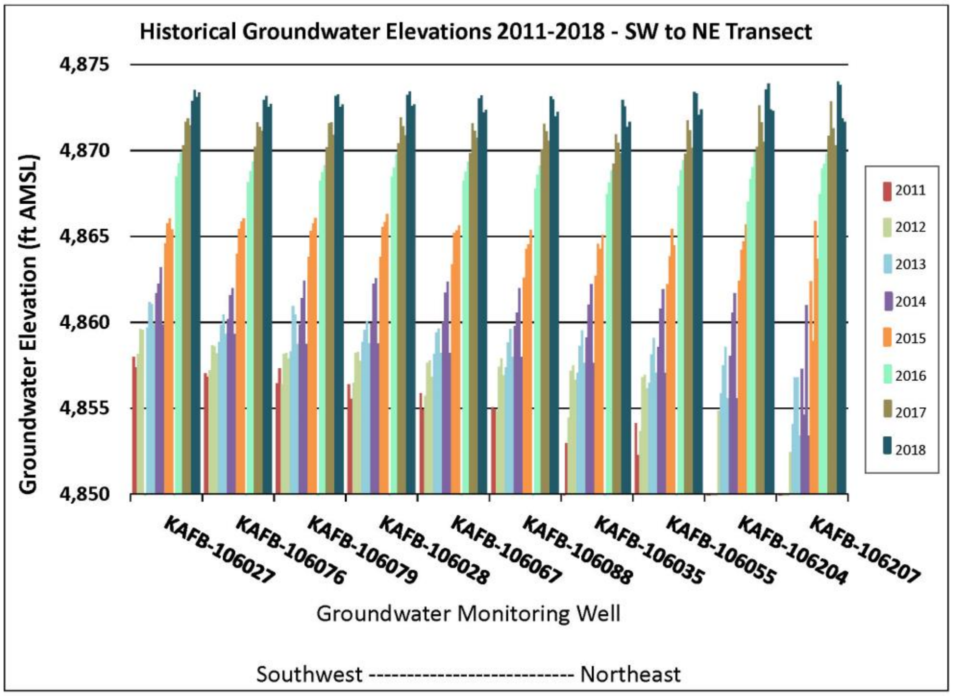
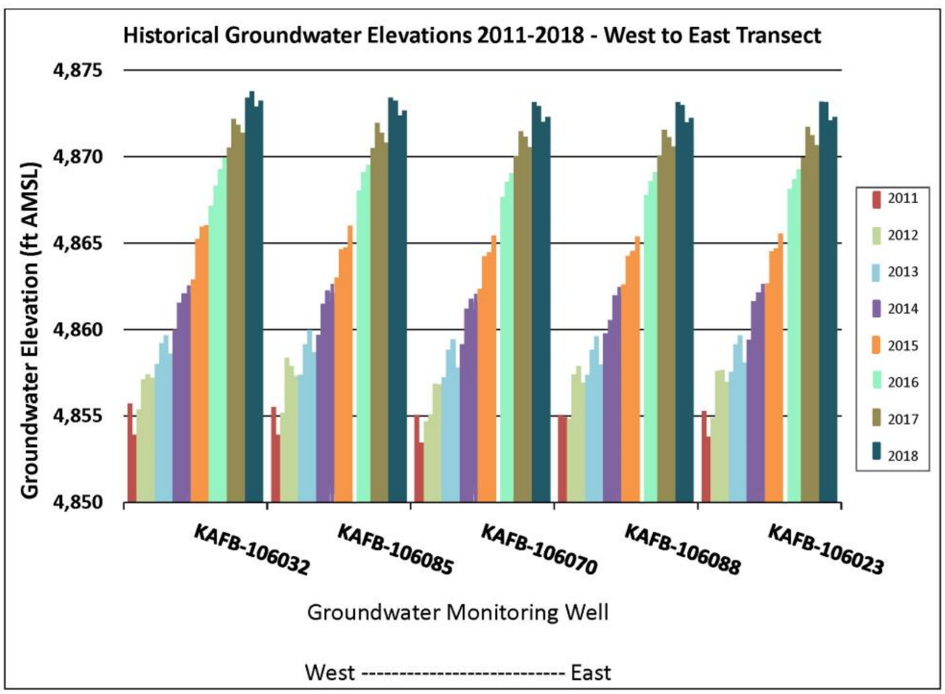
KAFB, 2019a. Quarterly Monitoring Report October–December 2018 and Annual Report for 2018, Bulk Fuels Facility, SWMU ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.

Appendix L-2 Water Level Time-Series Graphs, Q4 2018





Published as Appendix L-2 from:
KAFB, 2019a. Quarterly Monitoring Report October–December 2018 and Annual Report for 2018, Bulk Fuels Facility, SWMU ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.

APPENDIX A-2

HISTORICAL GROUNDWATER PLUME MAPS

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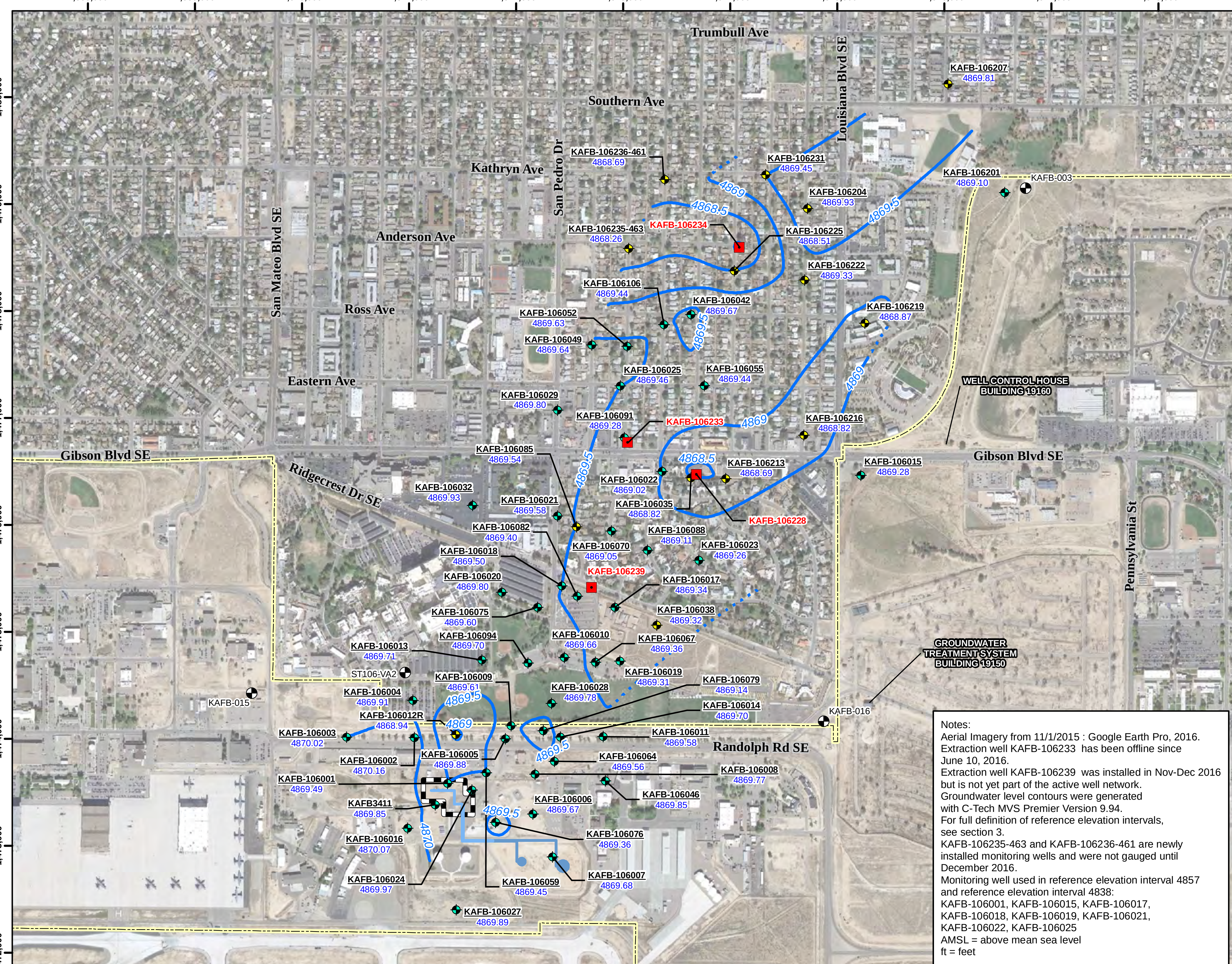
Quarterly Monitoring Report April-June 2017, Bulk Fuels Facility, SWMUs ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.

Quarterly Monitoring Report October–December 2017 and Annual Report for 2017, Bulk Fuels Facility, SWMUs ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.

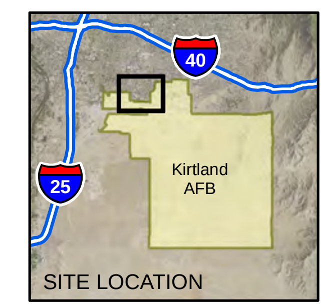
Quarterly Monitoring Report April-June 2018, Bulk Fuels Facility, SWMUs ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.

Quarterly Monitoring Report October–December 2018 and Annual Report for 2018, Bulk Fuels Facility, SWMUs ST-106/SS-111. Prepared by EA Engineering, Science, and Technology, Inc., PBC for USACE Albuquerque District under USACE Contract No. W912DR-12-D-006.



Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Groundwater Level Contour (ft AMSL)
- Inferred Groundwater Level Contour (ft AMSL)
- Installation Boundary
- Source Area



N

0 500 1,000 2,000

Feet

1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

Notes:
Aerial Imagery from 11/1/2015 : Google Earth Pro, 2016.
Extraction well KAFB-106233 has been offline since June 10, 2016.
Extraction well KAFB-106239 was installed in Nov-Dec 2016 but is not yet part of the active well network.
Groundwater level contours were generated with C-Tech MVS Premier Version 9.94.
For full definition of reference elevation intervals, see section 3.
KAFB-106235-463 and KAFB-106236-461 are newly installed monitoring wells and were not gauged until December 2016.
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025
AMSL = above mean sea level
ft = feet

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FIGURE 3-3

POTENTIOMETRIC SURFACE MAP OF REFERENCE ELEVATION INTERVAL 4857, OCTOBER 3-6, 2016

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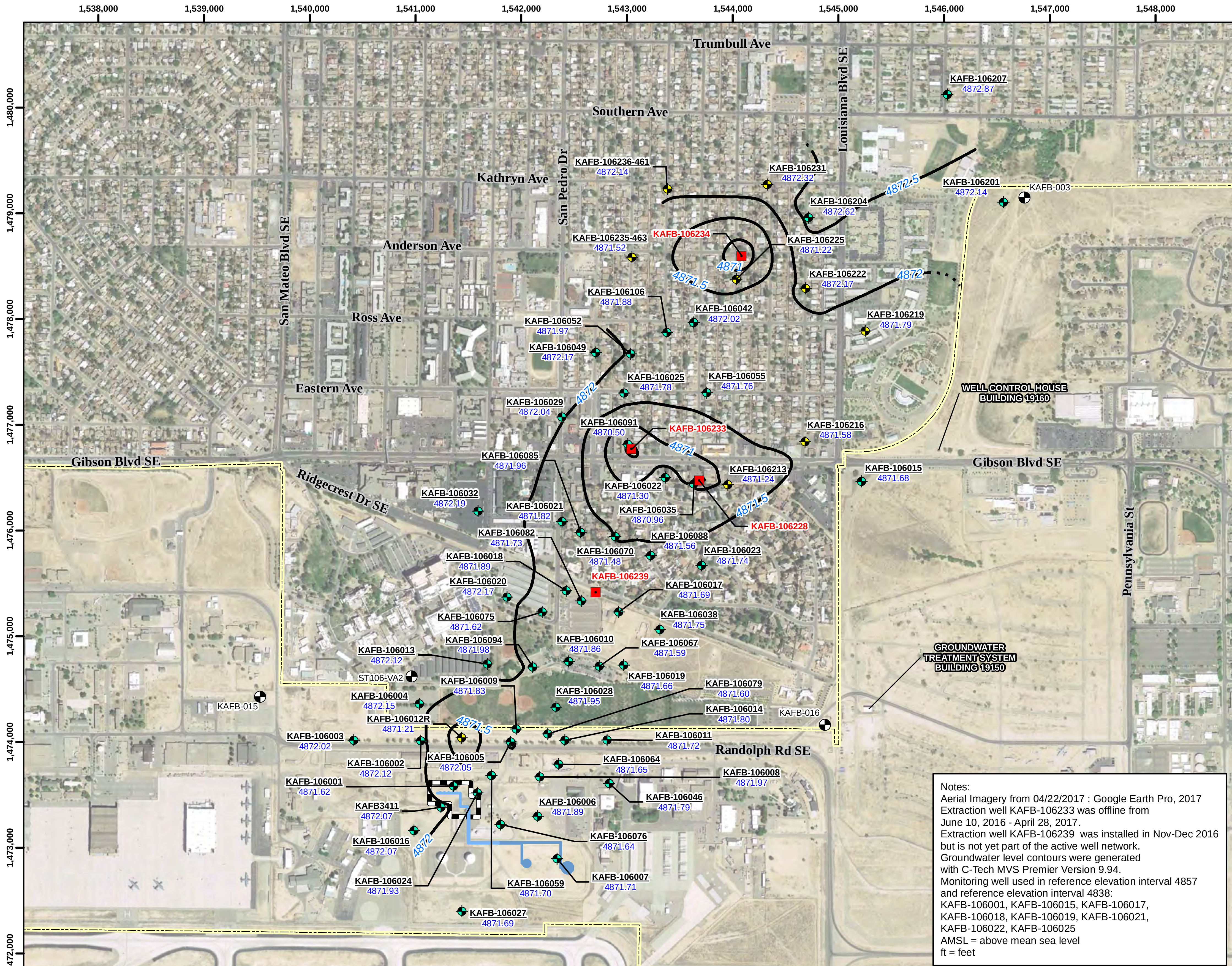
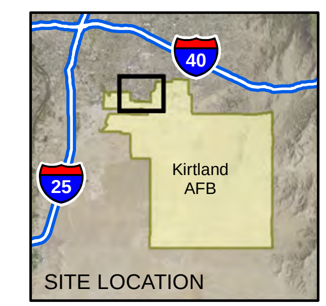


Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Groundwater Level Contour (ft AMSL)
- Inferred Groundwater Level Contour (ft AMSL)
- Installation Boundary
- Source Area



N

0 500 1,000 2,000

Feet

1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

Notes:
Aerial Imagery from 04/22/2017 : Google Earth Pro, 2017
Extraction well KAFB-106233 was offline from June 10, 2016 - April 28, 2017.
Extraction well KAFB-106239 was installed in Nov-Dec 2016 but is not yet part of the active well network.
Groundwater level contours were generated with C-Tech MVS Premier Version 9.94.
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025
AMSL = above mean sea level
ft = feet

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FIGURE 3-3

POTENTIOMETRIC SURFACE MAP OF REFERENCE ELEVATION INTERVAL 4857, MAY 8-11, 2017

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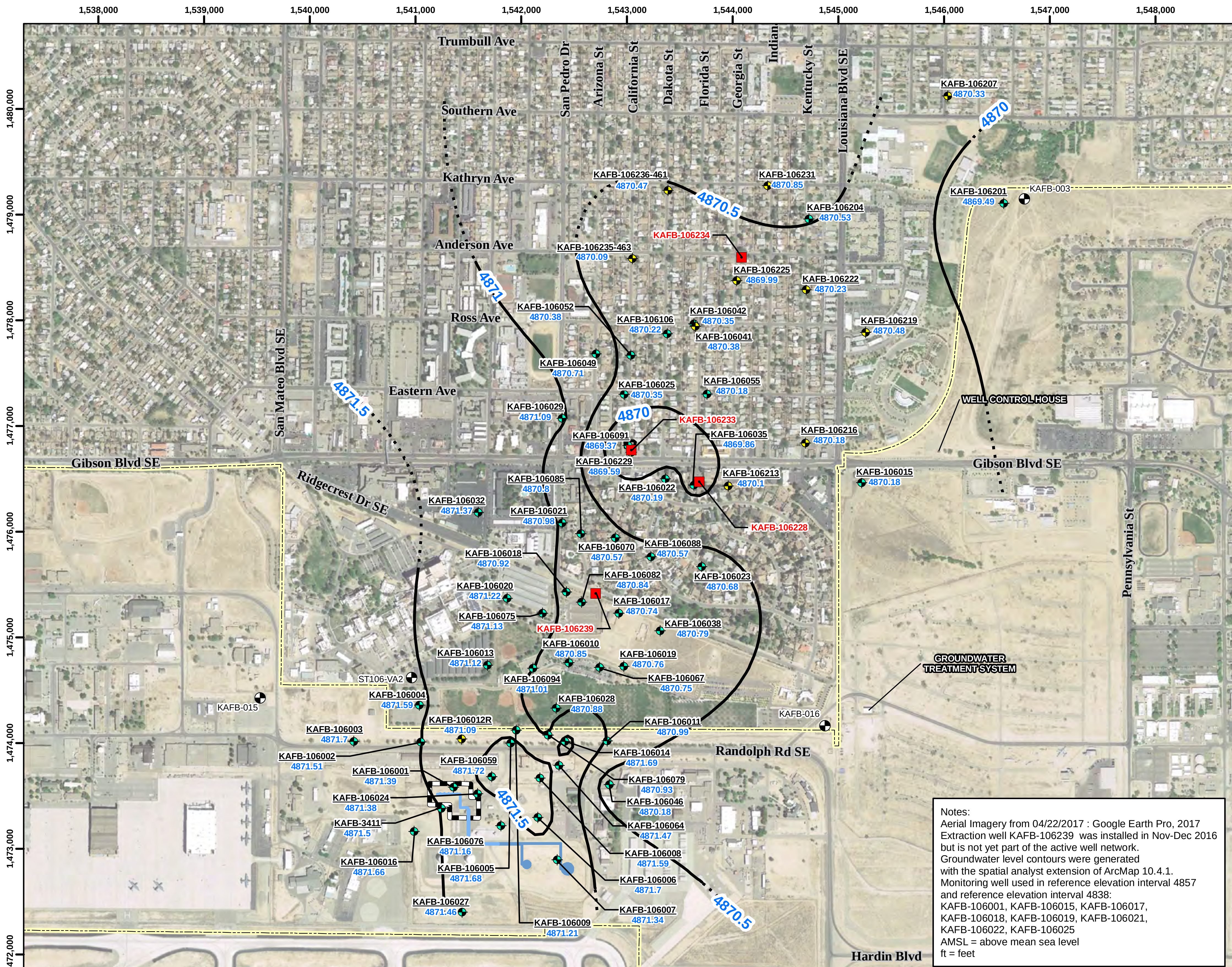
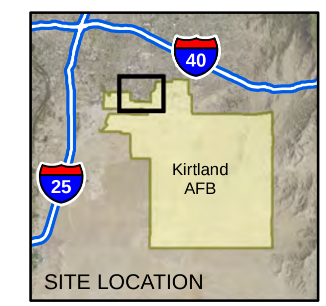


Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Groundwater Level Contour (ft AMSL)
- Inferred Groundwater Level Contour (ft AMSL)
- Installation Boundary
- Source Area



N

0 500 1,000 2,000

Feet

1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-3

POTENTIOMETRIC SURFACE MAP OF REFERENCE ELEVATION INTERVAL 4857, OCTOBER 16-24, 2017

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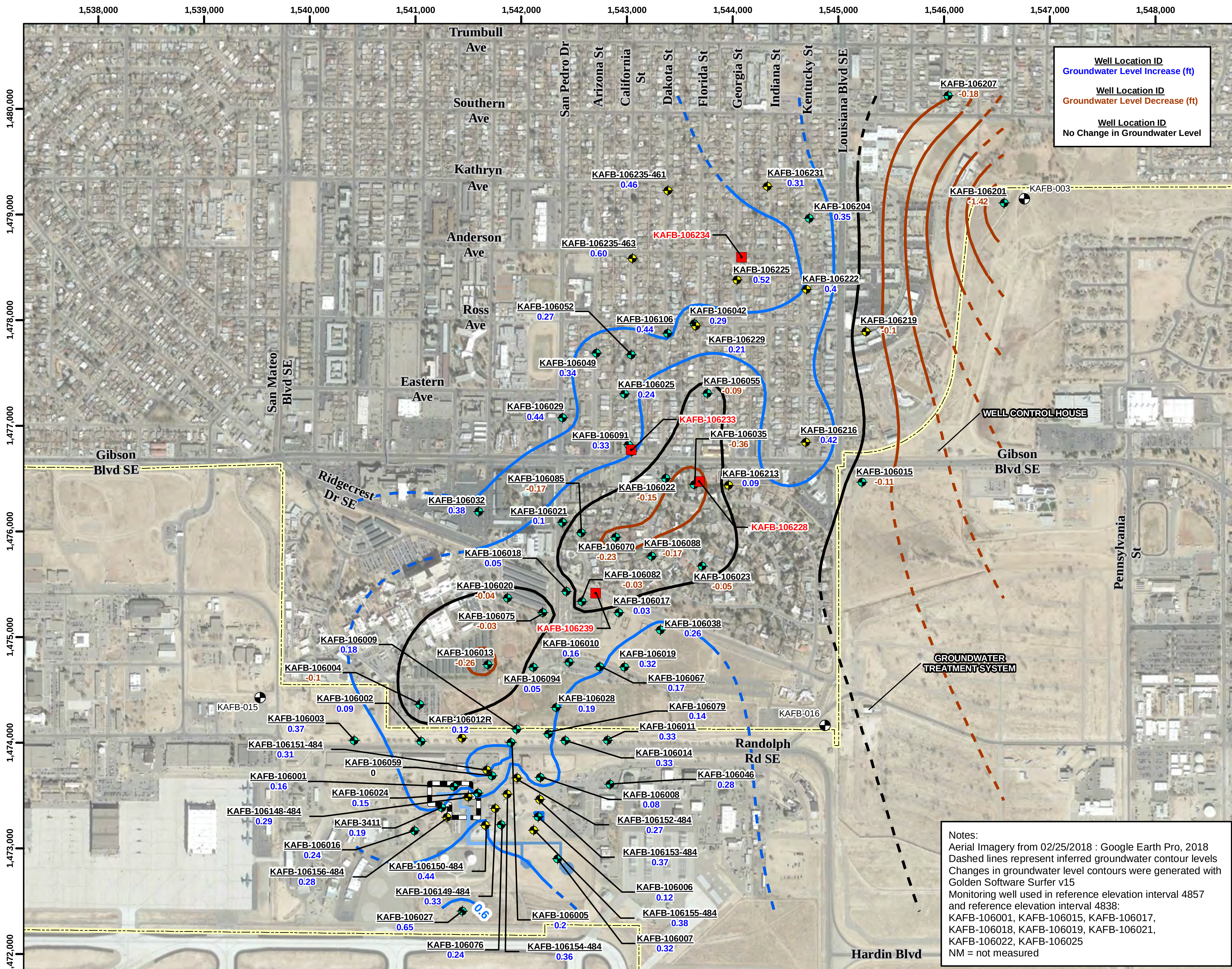
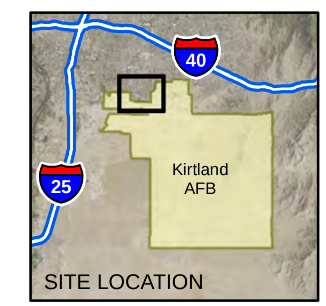


Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- Groundwater contour indicating water table increase from previous quarter
- Groundwater contour indicating water table decrease from previous quarter
- Groundwater contour indicating no change in water table from previous quarter
- Source Area



N 0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

Notes:
Aerial Imagery from 02/25/2018 : Google Earth Pro, 2018
Dashed lines represent inferred groundwater contour levels
Changes in groundwater level contours were generated with Golden Software Surfer v15
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025
NM = not measured

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FIGURE 3-3

CHANGES IN POTENTIOMETRIC SURFACE OF REFERENCE ELEVATION INTERVAL 4857, Q1 2018 - Q2 2018

P:\gis\Projects\Kirtland\Figures\BFF Quarterly Report\2018_Q2\Section 3\3-3 Interval 4857 ChangePotentiometricSurface.mxd 8/15/2018 EA eomalia

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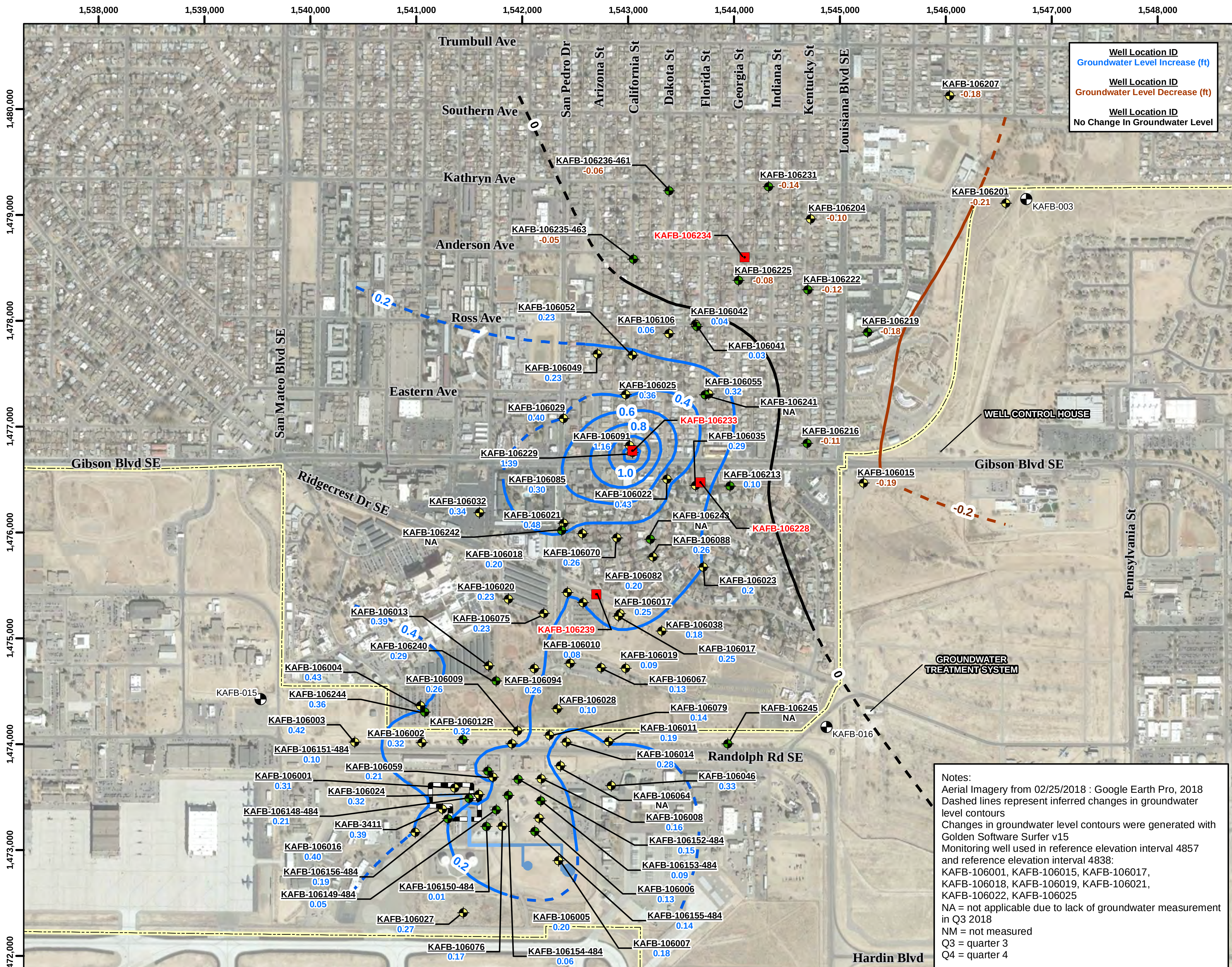
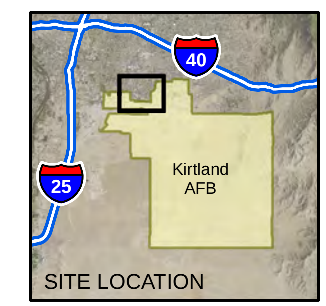
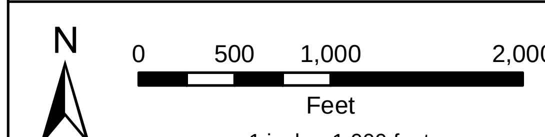


Notes:
Aerial Imagery from 02/25/2018 : Google Earth Pro, 2018
Dashed lines represent inferred changes in groundwater level contours
Changes in groundwater level contours were generated with Golden Software Surfer v15
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017,
KAFB-106018, KAFB-106019, KAFB-106021,
KAFB-106022, KAFB-106025
NA = not applicable due to lack of groundwater measurement in Q3 2018
NM = not measured
Q3 = quarter 3
Q4 = quarter 4

Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Fence Boundary
- Groundwater contour indicating water table increase from previous quarter
- Groundwater contour indicating water table decrease from previous quarter
- Groundwater contour indicating no change in water table from previous quarter
- Source Area





1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-3

CHANGES IN POTENTIOMETRIC SURFACE OF REFERENCE ELEVATION INTERVAL 4857, Q3 2018 - Q4 2018

P:\gis\Projects\Kirtland\Figures\BFF Quarterly Report\2018_Q4\Section 3\3-3 Interval 4857 PotentiometricSurfaceChange_R1.mxd 3/8/2019 EA eomalia

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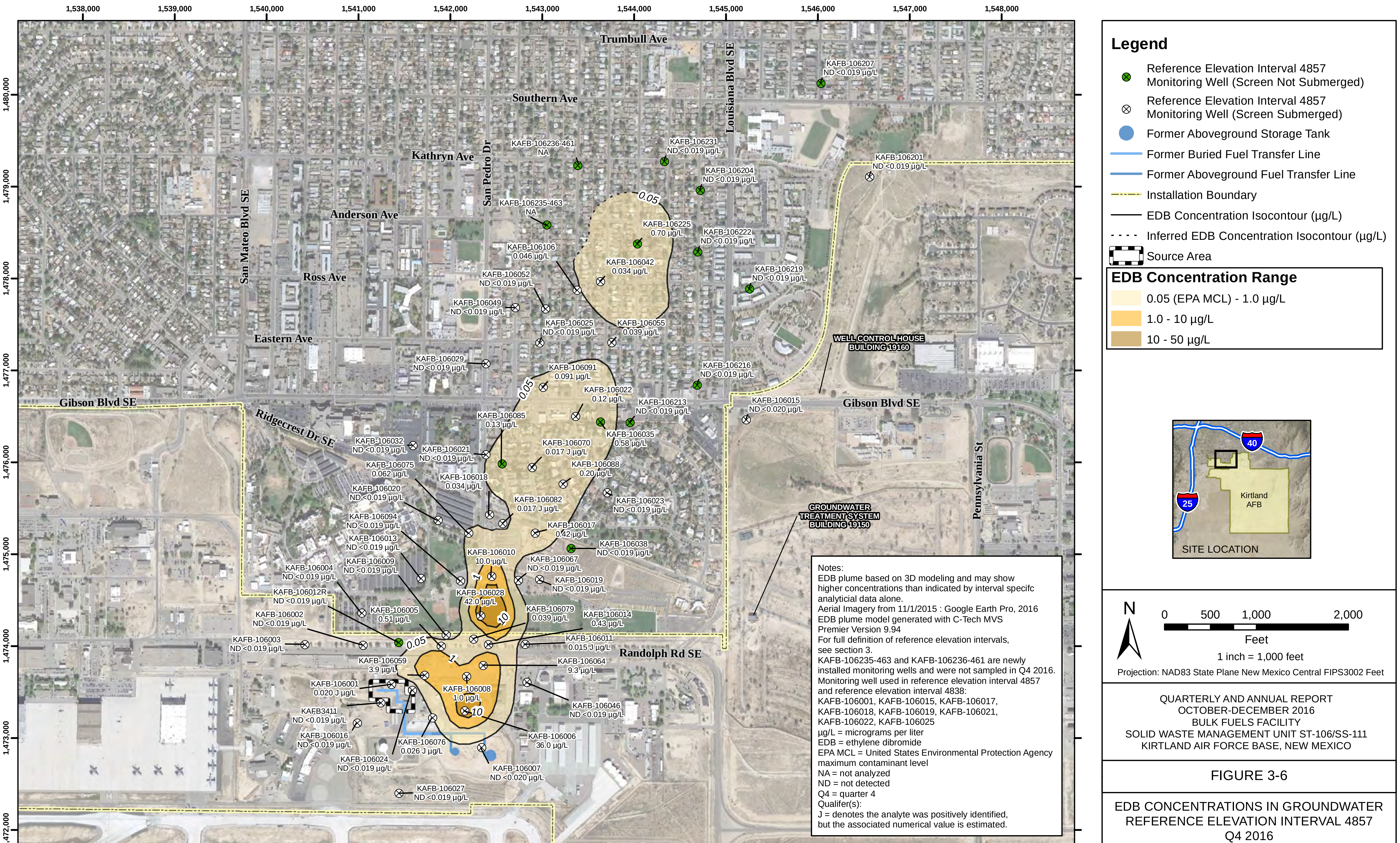

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FIGURE 3-6

EDB CONCENTRATIONS IN GROUNDWATER
REFERENCE ELEVATION INTERVAL 4857
Q4 2016

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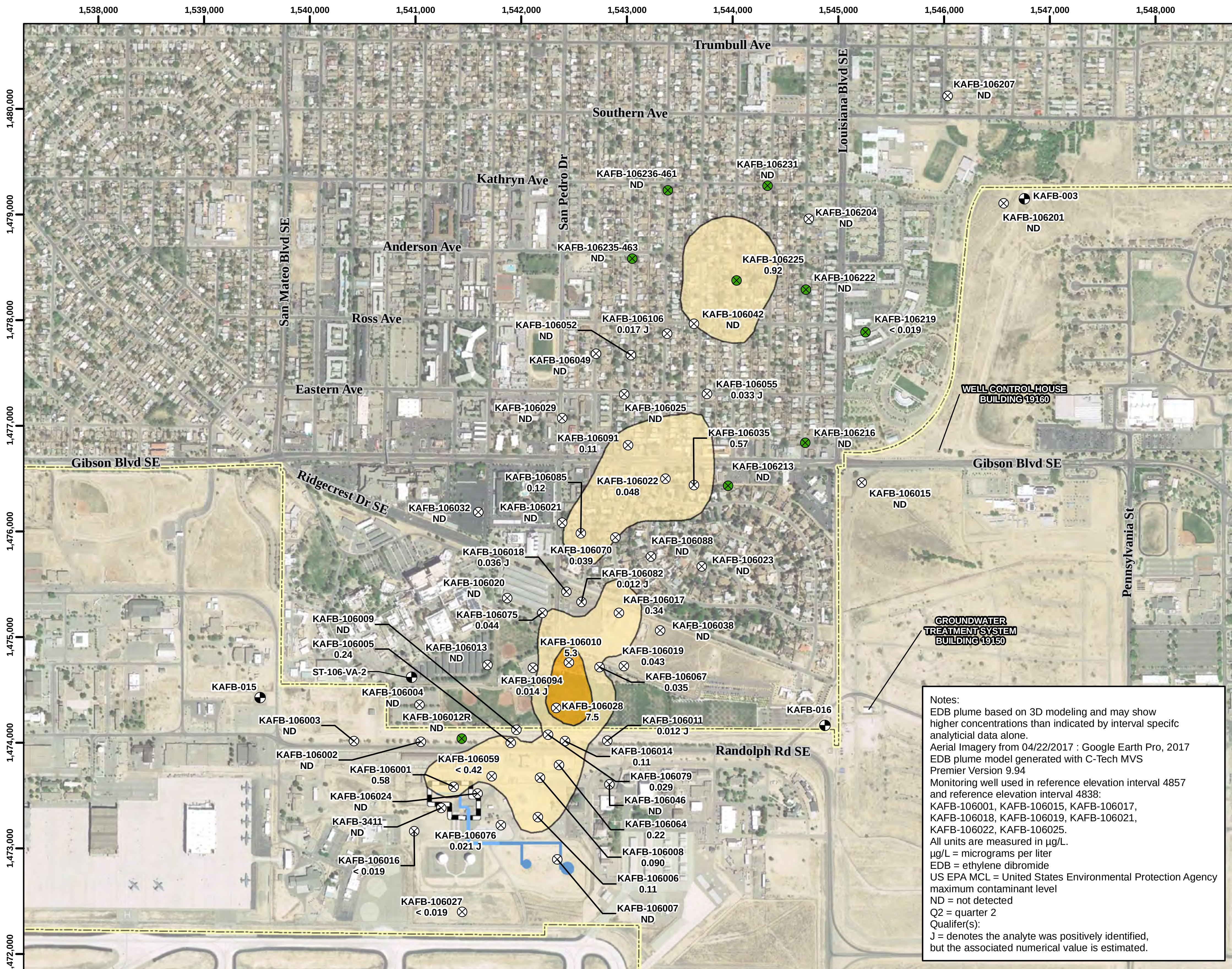


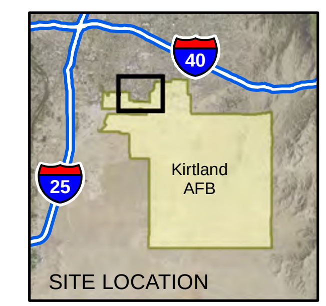
Notes:
EDB plume based on 3D modeling and may show higher concentrations than indicated by interval specifc analyticial data alone.
Aerial Imagery from 04/22/2017 : Google Earth Pro, 2017
EDB plume model generated with C-Tech MVS Premier Version 9.94
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025.
All units are measured in µg/L.
µg/L = micrograms per liter
EDB = ethylene dibromide
US EPA MCL = United States Environmental Protection Agency maximum contaminant level
ND = not detected
Q2 = quarter 2
Qualifer(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- EDB Concentration Isocontour (µg/L)
- Inferred EDB Concentration Isocontour (µg/L)
- Source Area

EDB Concentration Range

- 0.05 (EPA MCL) - 1.0 µg/L
- 1.0 - 10 µg/L



N
0 500 1,000 2,000
Feet
1 inch = 1,000 feet
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-6

EDB CONCENTRATIONS IN GROUNDWATER REFERENCE ELEVATION INTERVAL 4857, Q2 2017

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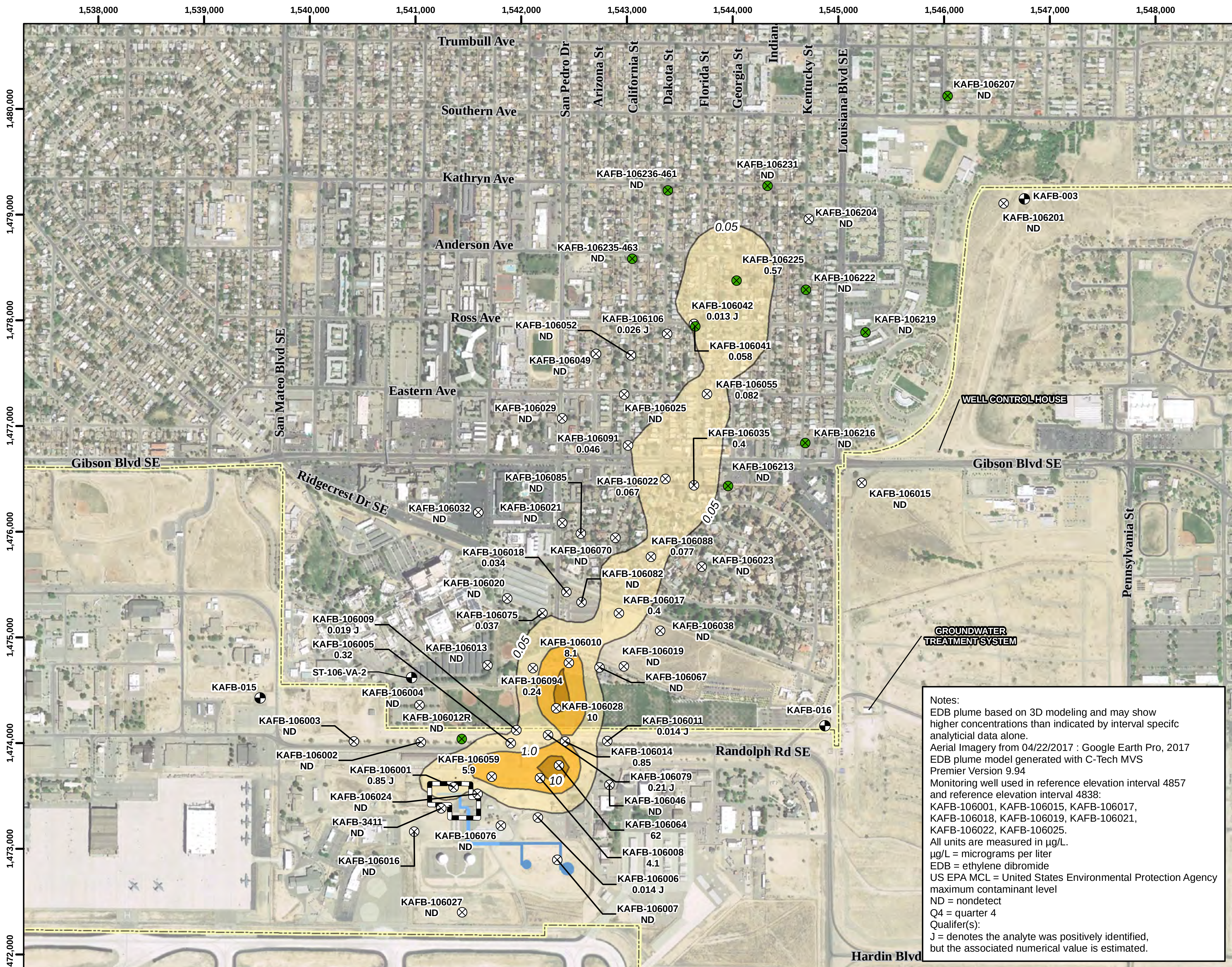


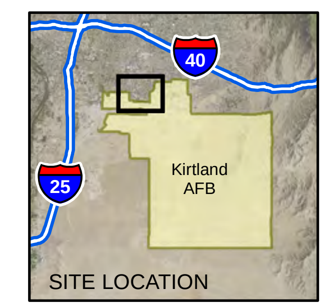
Notes:
EDB plume based on 3D modeling and may show higher concentrations than indicated by interval specifc analyticial data alone.
Aerial Imagery from 04/22/2017 : Google Earth Pro, 2017
EDB plume model generated with C-Tech MVS Premier Version 9.94
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025.
All units are measured in µg/L.
µg/L = micrograms per liter
EDB = ethylene dibromide
US EPA MCL = United States Environmental Protection Agency maximum contaminant level
ND = nondetect
Q4 = quarter 4
Qualifer(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- EDB Concentration Isocontour (µg/L)
- Inferred EDB Concentration Isocontour (µg/L)
- Source Area

EDB Concentration Range

- 0.05 (EPA MCL) - 1.0 µg/L
- 1.0 - 10 µg/L
- 10 - 50 µg/L



N
0 500 1,000 2,000
Feet
1 inch = 1,000 feet
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-6

EDB CONCENTRATIONS IN GROUNDWATER REFERENCE ELEVATION INTERVAL 4857, Q4 2017

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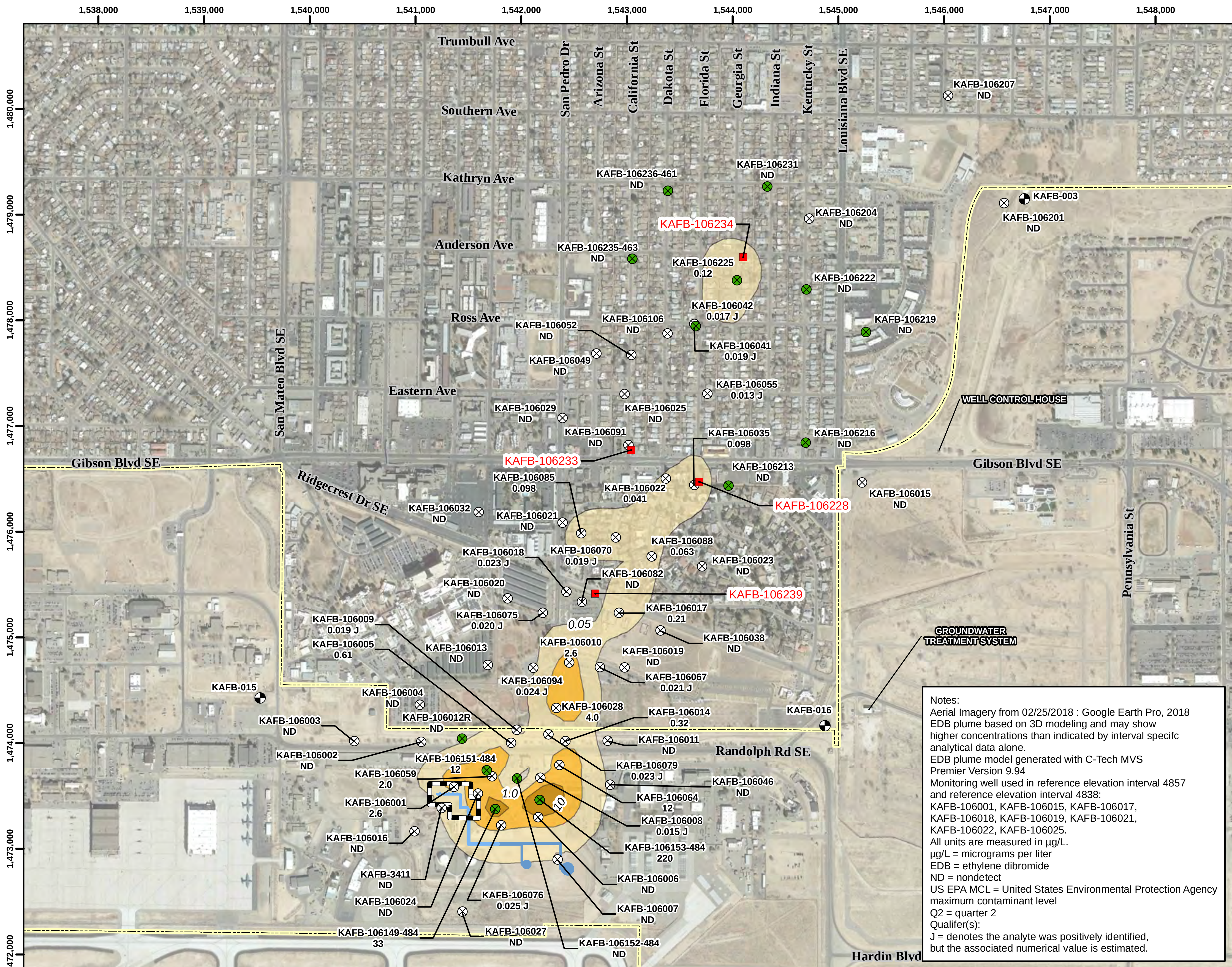

Notes:
Aerial Imagery from 02/25/2018 : Google Earth Pro, 2018
EDB plume based on 3D modeling and may show higher concentrations than indicated by interval specifc analytical data alone.
EDB plume model generated with C-Tech MVS Premier Version 9.94
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025.
All units are measured in µg/L.
µg/L = micrograms per liter
EDB = ethylene dibromide
ND = nondetect
US EPA MCL = United States Environmental Protection Agency maximum contaminant level
Q2 = quarter 2
Qualifer(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

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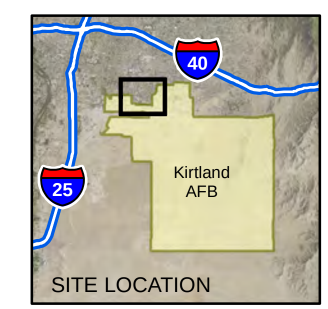
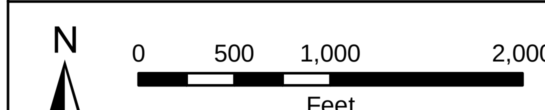
Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- EDB Concentration Isocontour (µg/L)
- Source Area

EDB Concentration Range

- 0.05 (EPA MCL) - 1.0 µg/L
- 1.0 - 10 µg/L
- 10 - 500 µg/L





1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-7

EDB CONCENTRATIONS IN GROUNDWATER
REFERENCE ELEVATION INTERVAL 4857,
Q2 2018

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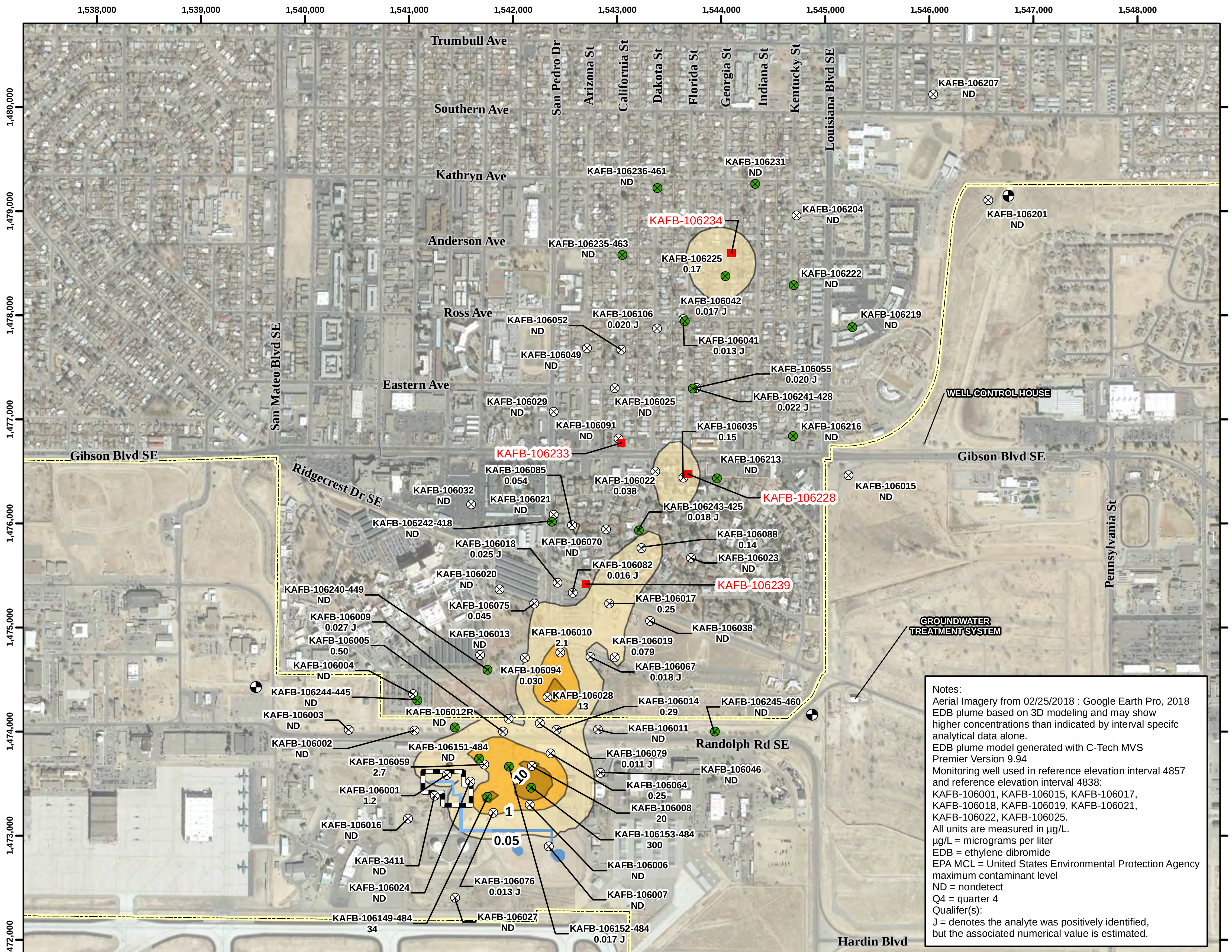


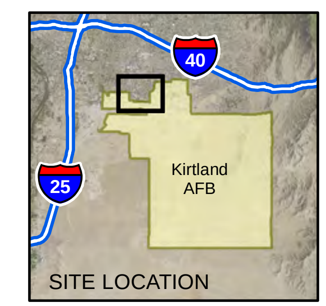
Notes:
Aerial Imagery from 02/25/2018 : Google Earth Pro, 2018
EDB plume based on 3D modeling and may show higher concentrations than indicated by interval specifc analytical data alone.
EDB plume model generated with C-Tech MVS Premier Version 9.94
Monitoring well used in reference elevation interval 4857 and reference elevation interval 4838:
KAFB-106001, KAFB-106015, KAFB-106017, KAFB-106018, KAFB-106019, KAFB-106021, KAFB-106022, KAFB-106025.
All units are measured in µg/L.
µg/L = micrograms per liter
EDB = ethylene dibromide
EPA MCL = United States Environmental Protection Agency maximum contaminant level
ND = nondetect
Q4 = quarter 4
Qualifier(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

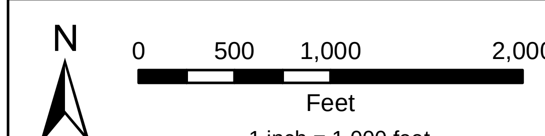
Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Extraction Well
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Fence Boundary
- EDB Concentration Isocontour (µg/L)
- Source Area

EDB Concentration Range

- 0.05 (EPA MCL) - 1.0 µg/L
- 1.0 - 10 µg/L
- 10 - 500 µg/L





1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-7

EDB CONCENTRATIONS IN GROUNDWATER REFERENCE ELEVATION INTERVAL 4857, Q4 2018

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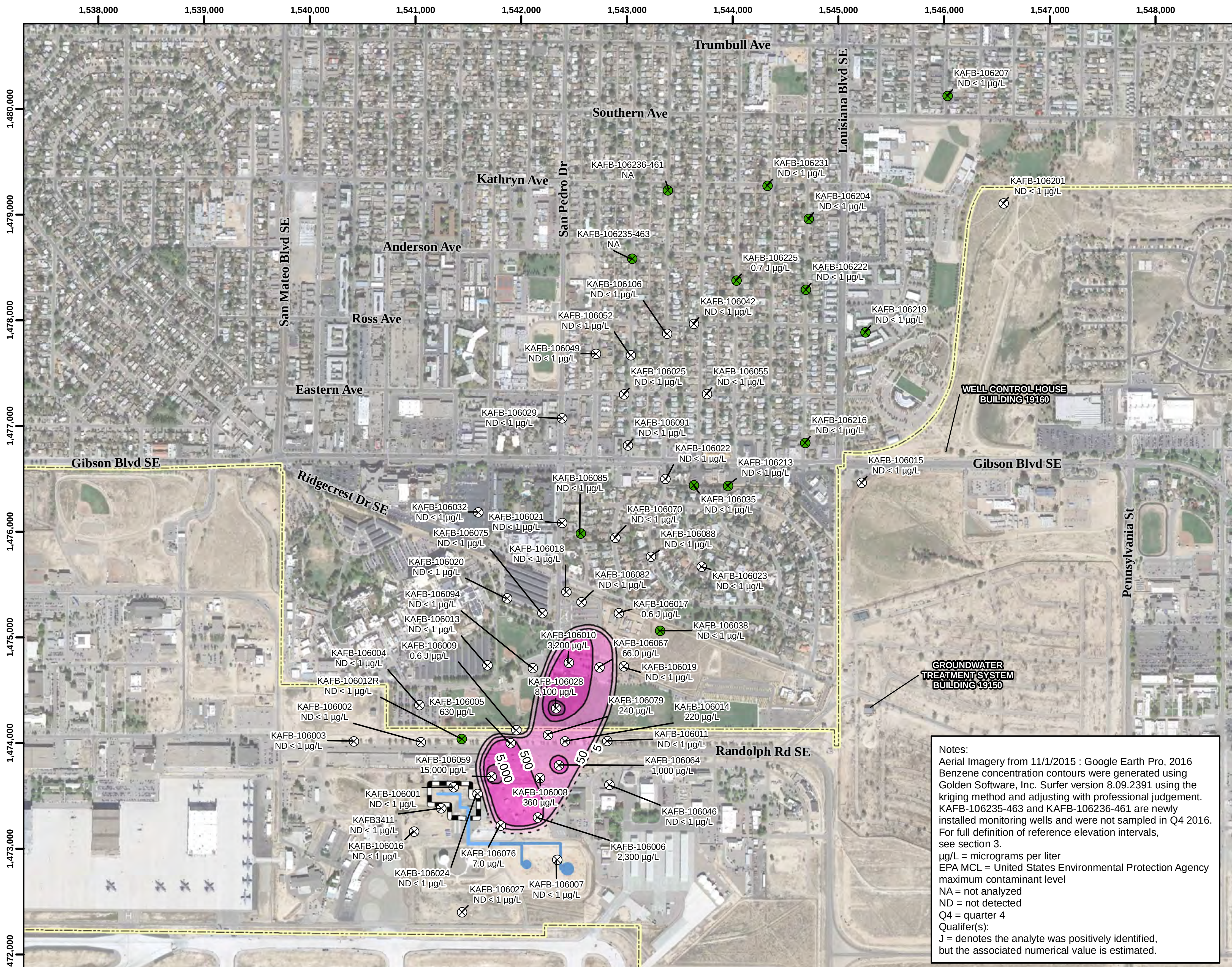
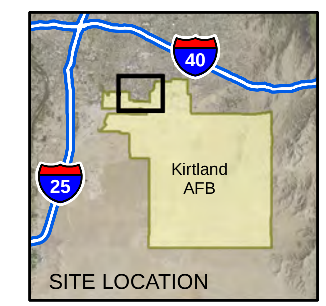


Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- Benzene Concentration Isocontour (µg/L)
- Inferred Isocontour (µg/L)
- Source Area

Benzene Concentration Range

- 5.0 (EPA MCL) - 50 µg/L
- 50 - 500 µg/L
- 500 - 5,000 µg/L
- 5,000 - 15,000 µg/L



N

0 500 1,000 2,000

Feet

1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

Notes:
Aerial Imagery from 11/1/2015 : Google Earth Pro, 2016
Benzene concentration contours were generated using Golden Software, Inc. Surfer version 8.09.2391 using the kriging method and adjusting with professional judgement.
KAFB-106235-463 and KAFB-106236-461 are newly installed monitoring wells and were not sampled in Q4 2016.
For full definition of reference elevation intervals, see section 3.
µg/L = micrograms per liter
EPA MCL = United States Environmental Protection Agency maximum contaminant level
NA = not analyzed
ND = not detected
Q4 = quarter 4
Qualifer(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

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FIGURE 3-9

BENZENE CONCENTRATIONS IN GROUNDWATER REFERENCE ELEVATION INTERVAL 4857, Q4 2016

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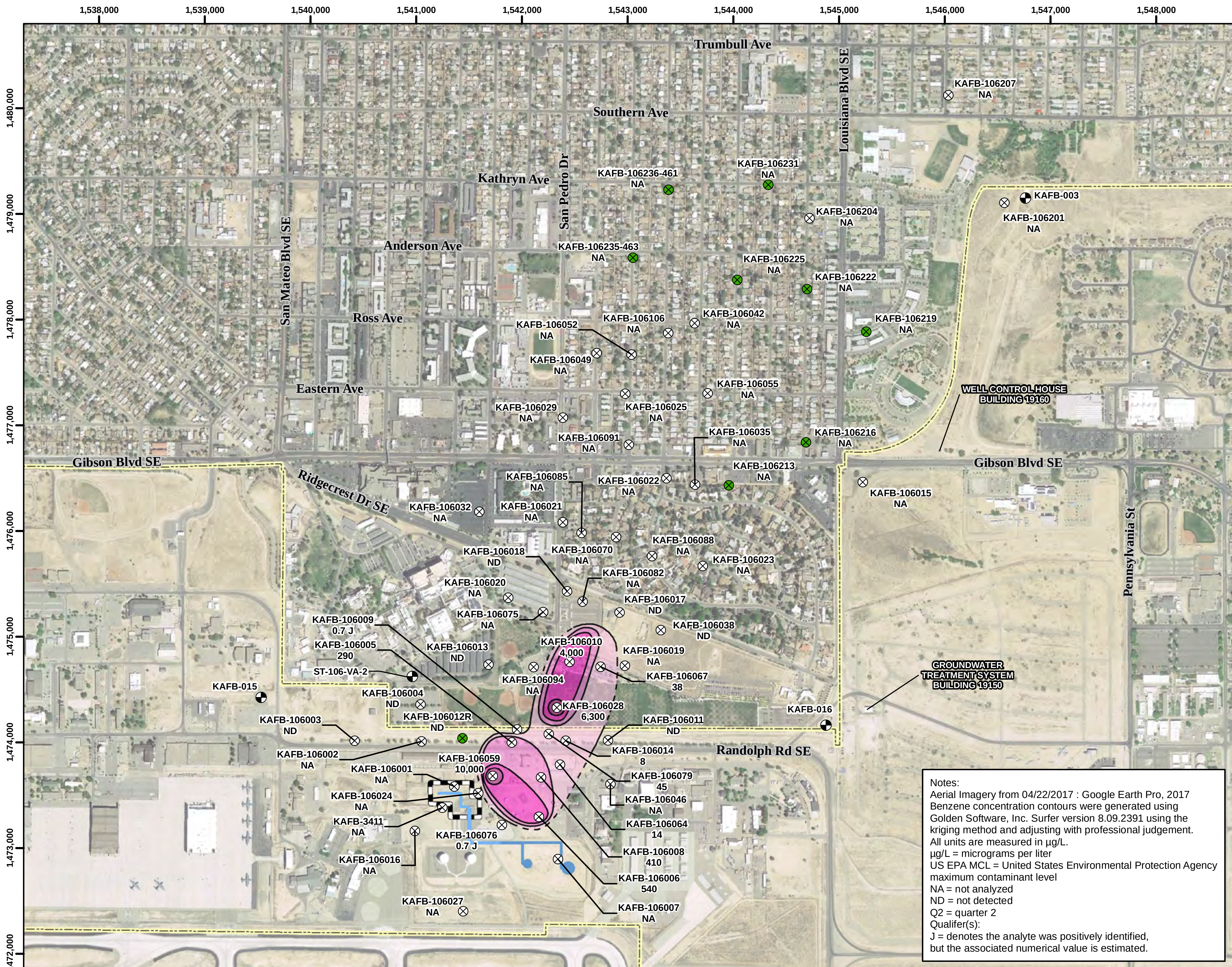


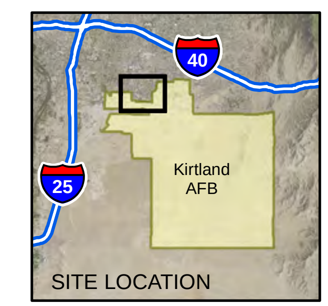
Notes:
Aerial Imagery from 04/22/2017 : Google Earth Pro, 2017
Benzene concentration contours were generated using Golden Software, Inc. Surfer version 8.09.2391 using the kriging method and adjusting with professional judgement.
All units are measured in µg/L.
µg/L = micrograms per liter
US EPA MCL = United States Environmental Protection Agency maximum contaminant level
NA = not analyzed
ND = not detected
Q2 = quarter 2
Qualifer(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- Benzene Isocontour (µg/L)
- Inferred Isocontour (µg/L)
- Source Area

Benzene Concentration Range

- 5.0 (EPA MCL) - 50 µg/L
- 50 - 500 µg/L
- 500 - 5,000 µg/L
- 5,000 - 15,000 µg/L



N

0 500 1,000 2,000
Feet
1 inch = 1,000 feet

Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-9

BENZENE CONCENTRATIONS IN GROUNDWATER REFERENCE ELEVATION INTERVAL 4857, Q2 2017

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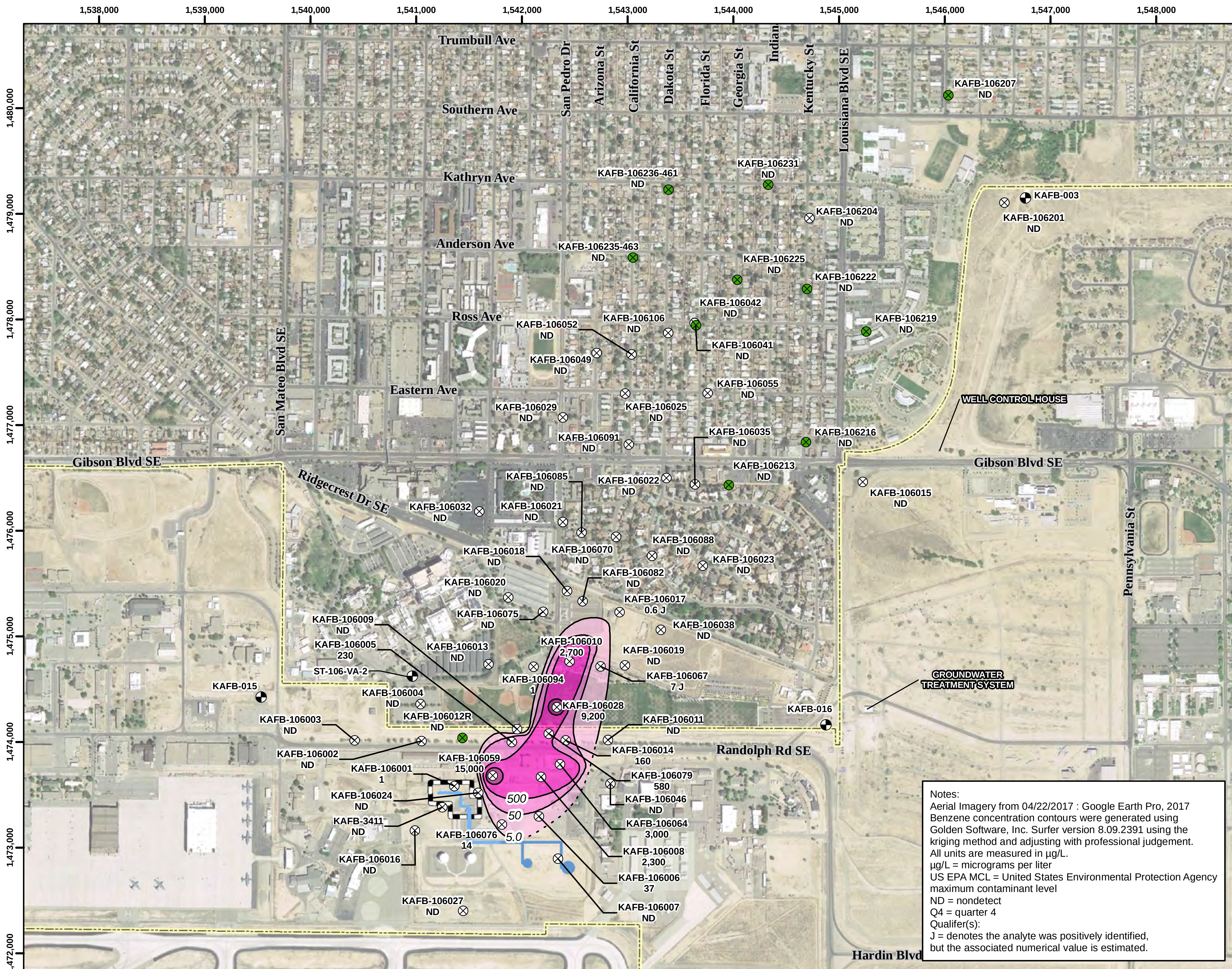


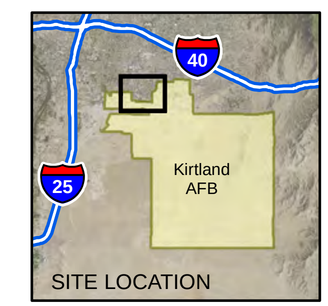
Notes:
Aerial Imagery from 04/22/2017 : Google Earth Pro, 2017
Benzene concentration contours were generated using Golden Software, Inc. Surfer version 8.09.2391 using the kriging method and adjusting with professional judgement.
All units are measured in µg/L.
µg/L = micrograms per liter
US EPA MCL = United States Environmental Protection Agency maximum contaminant level
ND = nondetect
Q4 = quarter 4
Qualifer(s):
J = denotes the analyte was positively identified, but the associated numerical value is estimated.

Legend

- Reference Elevation Interval 4857 Monitoring Well (Screen Not Submerged)
- Reference Elevation Interval 4857 Monitoring Well (Screen Submerged)
- Drinking Water Supply Well
- Former Aboveground Storage Tank
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Installation Boundary
- Benzene Isocontour (µg/L)
- Inferred Isocontour (µg/L)
- Source Area

Benzene Concentration Range

- 5.0 (EPA MCL) - 50 µg/L
- 50 - 500 µg/L
- 500 - 5,000 µg/L
- 5,000 - 15,000 µg/L



N
0 500 1,000 2,000
Feet
1 inch = 1,000 feet
Projection: NAD83 State Plane New Mexico Central FIPS3002 Feet

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FIGURE 3-9

BENZENE CONCENTRATIONS IN GROUNDWATER REFERENCE ELEVATION INTERVAL 4857, Q4 2017

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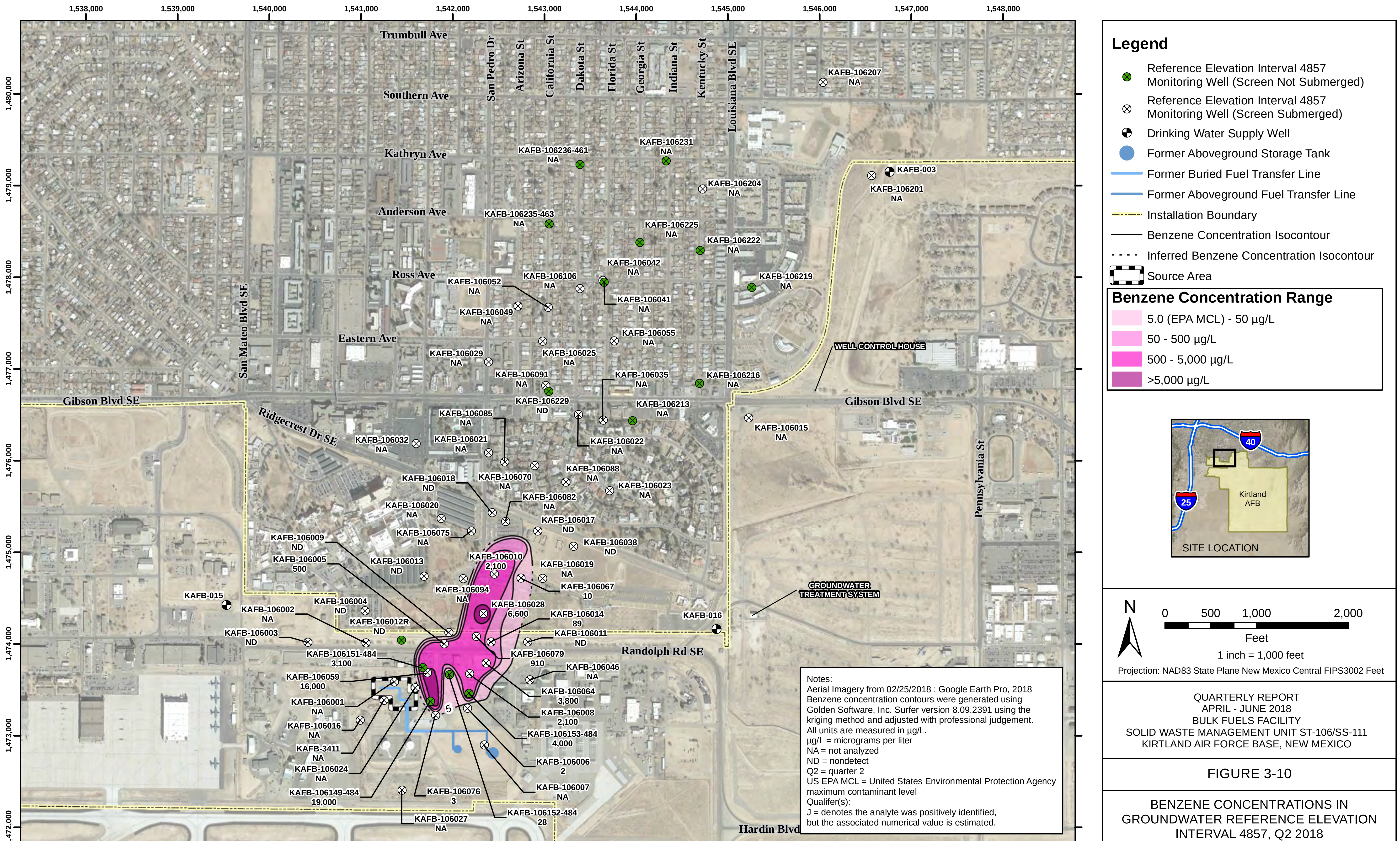

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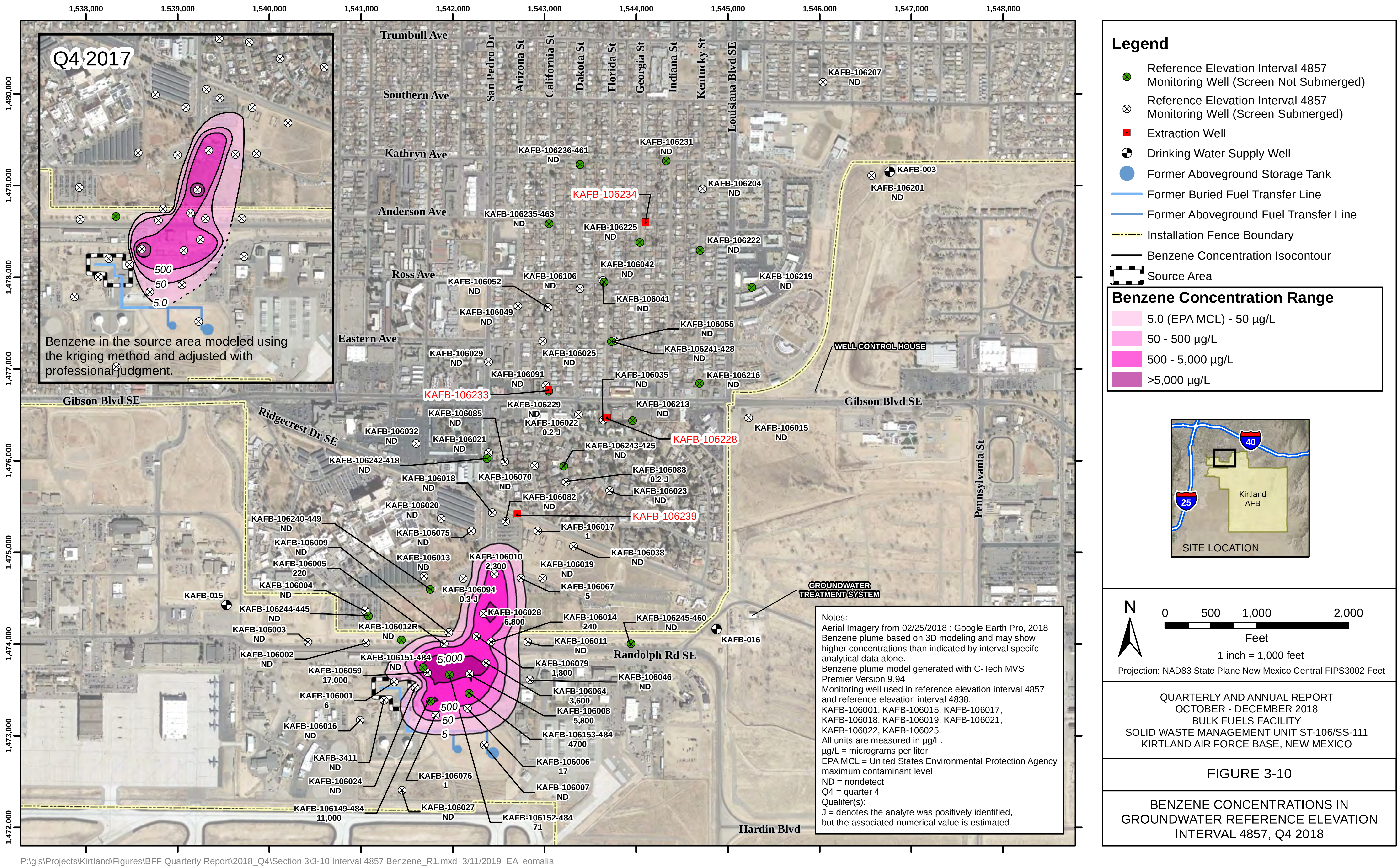

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APPENDIX B

FIELD FORMS

BORING/WELL CONSTRUCTION LOG

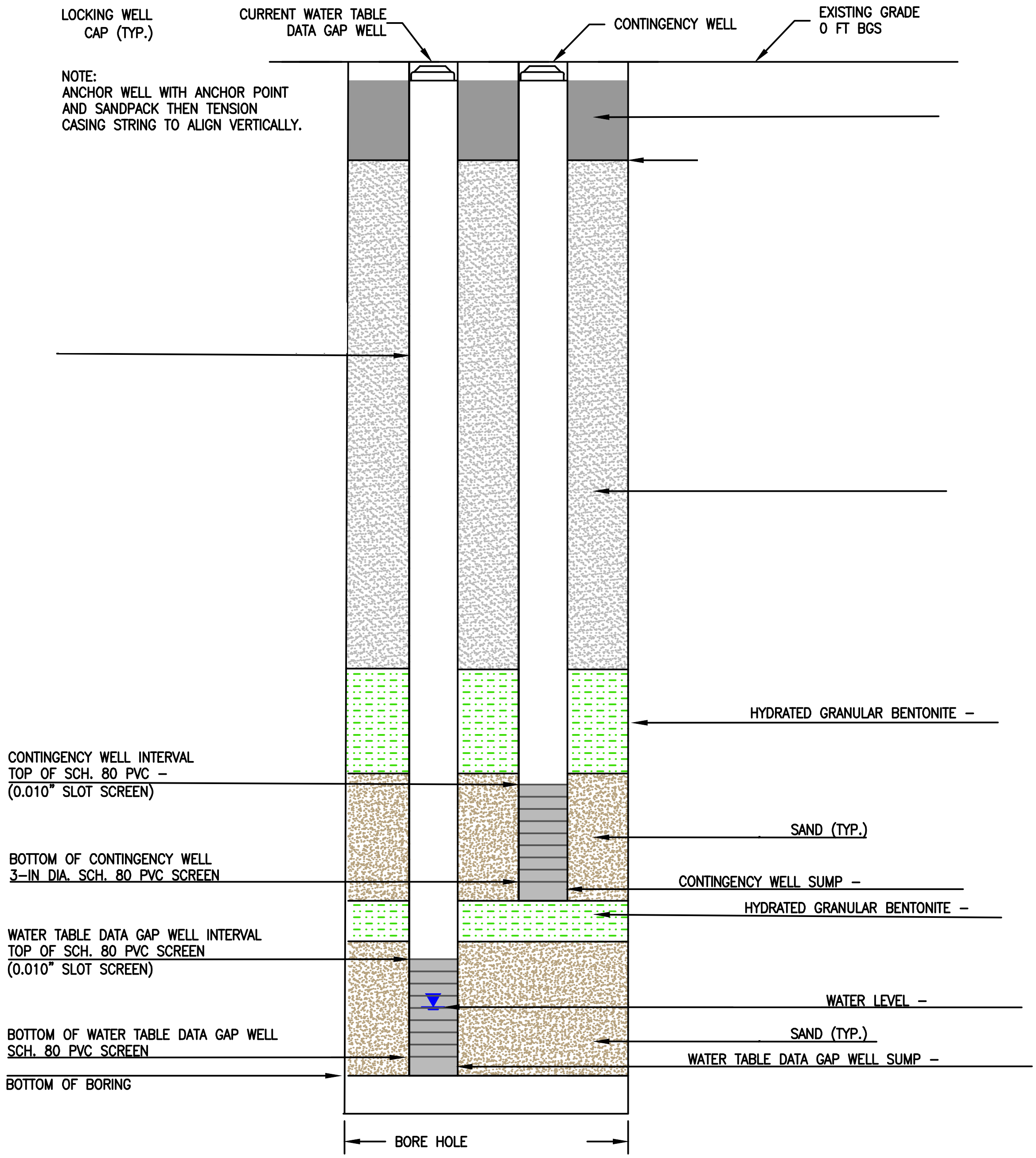
Project: **Kirtland BFF**	Project Number:
Drilling Company:	Start Time/Date:
Lead Driller:	Completion Time/Date:
Drilling Method:	Final Depth:
Casing Diameter OD:	Bit Type and Outer Diameter
Boring/Well ID:	Logged By: Page ___ of ____

		SAND		GRAVEL				
USCS Soil Type	**PID Reading (ppm)**	**Grain Size %(fine, medium, coarse)**	**Mineralogy %(Quartz, Feldspar, Lithic)**	**Angularity, Roundness (R,SR,SA,A)**	**Mineralogy %(Quartz, Feldspar, Lithic)**	**Depth, ft bgs**	**Soil Description** (sample interval, soil type, color, plasticity, moisture, other)	**Well Details**

Additional Comments:

R=Rounded, SR=Subrounded, SA=Subangular, A=Angular

Well Completion Diagram with Contingency Well



NOTE: APPROXIMATE DEPTH TO WATER DETERMINED FROM Q4 2017 DATA IN SURROUNDING GROUNDWATER MONITORING WELLS
DEPTH INTERVALS MAYBE MODIFIED DURING DRILLING BASED ON OBSERVED CONDITIONS;
WELL SCREENS WILL BE POSITIONED WITH APPROXIMATELY 15' OF WATER COLUMN UPON COMPLETION.

NOT TO SCALE
BGS=BELOW GROUND SURFACE
FT=FEET

KIRTLAND AIR FORCE BASE		INSTALLATION START DATE/TIME:	INSTALLATION END DATE/TIME:
PROJECT NO.:	WELL ID:	GEOLOGIST:	DRILLER:

CAD FILE: Y:\Active Projects\62599DM01 Kirtland BFF_USACE\01_Work Plan\19.0 Data Gap Wells WP\Figures\Natives\Nested Monitoring well_KAFB-106240-245.dwg   PLOT DATE/TIME: 12/18/2017 – 4:39pm

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date/Time:
EA Personnel:	Development Method:	
Equipment Used:		Equipment Calibrated: Y N
Weather/Temperature/Barometric Pressure:		Date/Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth To Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal)[C*D]:
C. Water Column Height (ft):	F. Five Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH (Δ<0.2)						
Temperature (°F) (Δ<10%)						
Conductivity (μmhos/cm) (Δ<10%)						
Turbidity (NTU) (<10 NTU*)						
Parameter	**6 Volumes**	**7 Volumes**	**8 Volumes**	**9 Volumes**	**10 Volumes**	**End**
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH (Δ<0.2)						
Temperature (°F) (Δ<10%)						
Conductivity (μmhos/cm) (Δ<10%)						
Turbidity (NTU) (<10 NTU*)						

NOTE: NTU = Nephelometric turbidity unit.
ORP = Oxidation-reduction potential.
* = If <10 NTU is not able to be achieved, <100 NTU is acceptable

Parameter stabilization requires four consecutive readings [four consecutive differences (Δ)] to meet parameter stabilization requirements listed.

COMMENTS AND OBSERVATIONS: ______________________________

Kirtland AFB BFF
Groundwater Well Inspection Form

Well ID: ____________________ **PID:** __________ ppm **Date:** __________

Stick up: ☐ **Flush Mount:** ☐

Well Pad Condition:	Below Grade	☐	Functional	☐	Repair Required	☐
Bollards:	Not Applicable	☐	Functional	☐	Repair Required	☐
Protective Casing:	Not Applicable	☐	Functional	☐	Repair Required	☐
Lock/Cover Bolt:	Not Applicable	☐	Functional	☐	Replacement Required	☐
Vault Threads:	Not Applicable	☐	Functional	☐	Cleaning Required	☐
Vault Cover:	Not Applicable	☐	Functional	☐	Repair Required (Excessive Corrosion on Threads)	☐
Vault Seal:	Missing	☐	Functional	☐	Replacement Required (Excessive Corrosion at Seal Surface)	☐
Water in Vault:	Yes	☐	No	☐	***If yes, Depth of Water:*** __________ Ft.	
Debris in Vault:	Yes	☐	No	☐	***If yes, Type of Debris:*** __________	
Pump Present:	Yes	☐	No	☐	***If no pump, J-Plug Present:*** Yes ☐ No ☐	

Bennett Pump Inventory:

Drop Pipe Plug:	Missing	☐	Functional	☐	Replacement Required	☐
Exhaust Line Plug:	Missing	☐	Functional	☐	Replacement Required	☐
Pump Line Plug:	Missing	☐	Functional	☐	Replacement Required	☐
Well Sounder Plug:	Missing	☐	Functional	☐	Replacement Required	☐

Additional Comments: ______________________________

____

____

____

____

Work Performed: ______________________________

____

____

Photographs of Damaged/Missing Parts Taken: Yes ☐

Recorded By: ______________________________

For serious problems, contact Earl Morse at (505) 238-4410

	Well Gauging Form					Total Wells		Year
	Project: Kirtland AFB BFF ST-106/SS-111							Quarter :
Well ID	Previous DTW (ft MRP)		Date	PID (ppm)	Depth to NAPL (ft MRP)	DTW (ft MRP)	Initials	Reference Point
	Depth to NAPL	DTW						
								TWV
								TWV
								TWV
								TWV
								TWV
								TWV
								TWV
								TWV
								TWV
								TWV
								TOPC
								TWV

Ground Water Sampling Data Sheet

Year:
Quarter:
Sample ID:

Well Location ID: ____________ ***Deployment***

Well Information

Screen Interval Length (ft):

Previous Depth to Water (MRP):

Well Depth: ________ ft MRP
Top of Screen: ________ ft MRP
Bottom of Screen: ________ ft MRP

Deployment Team: ______________________

Date Deployed: ____________ **Time Deployed:** ____________

PID: **MiniRAE 3000** **Serial No:** ____________

Water Level Meter: **Solinst 500 ft** **Serial No:** ____________

PID Reading: ____________ **ppm**

Depth to Water: ____________

DMS Tether and Reel ID match Well ID? ☐ *Check box to confirm*

QC sample notes.
(If blank, no QC samples required):

Sampler Number:	**Top of Sampler Depth (MRP)**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Underlined depths represent submerged samplers during previous deployment

Notes: ______________________

Reviewed by: ____________ Initials: ________ Review Date: ____________

Primary Samples
(3 DMS)

DMS1:
VOCs, EDB, Metal (Dissolved)
120 mL + 80 mL + 250 mL = 450

DMS 2:
Metal (Total), Alkalinity
250 mL + 250 mL = 500 mL

DMS 3:
Anions and Nitrate/Nitrite Nitrogen
80 mL + 250 mL = 330 mL

220 mL Spare

Primary and Duplicate Samples
(6 DMS)

DMS1:
VOCs and EDB + dup
240 mL + 160 mL = 400

DMS 2:
Metals (Total and Dissolved)
250 mL + 250 mL = 500 mL

DMS 3:
Metals (Total and Dissolved)
250 mL + 250 mL = 500 mL

DMS4:
Anions and Nitrate/Nitrite Nitrogen
80 mL + 250 mL = 330 mL

DMS 5:
Anions and Nitrate/Nitrite Nitrogen
80 mL + 250 mL = 330 mL

DMS 6:
Alkalinity + dup
250 mL + 250 mL = 500 mL

440 mL Spare

Primary and MS/MSD Samples
(6 DMS)

DMS1:
VOCs + MS/MSD
360 mL

DMS 2:
EDB + MS/MSD
240 mL

DMS 3:
Dissolved Metals
250 mL + 250 mL = 500 mL

DMS 4:
Metals (Total and Dissolved)
250 mL + 250 mL = 500 mL

DMS 5:
Total Metals
250 mL + 250 mL = 500 mL

DMS 6:
Alkalinity and Nitrate/Nitrite Nitrogen
250 mL + 250 mL = 500

320 mL Spare

Ground Water Sampling Data Sheet

Well Location ID: ______ ***Sampling***

Year:
Quarter:
Sample ID:

Date Sampled: ______ **Time Sampled:** ______ **Sampling Team:** ______

PID Reading: ______ **DMS Tether and Reel ID match Well ID?** ☐ *Check box to confirm*

Type of Analysis (circle appropriate)

Sampler Number:
(shallow to deep)

Choose only one (VOCs / BTEX (N))

Document in notes

Sampler Number									Dup?	MS/MSD?
1	**Metals (Total)**	**Metals (Dissolved)**	**Anions**	**Nitrate / Nitrite**	**VOCs**	**BTEX (N)**	**EDB**	**Alkalinity**	☐	☐
2	**Metals (Total)**	**Metals (Dissolved)**	**Anions**	**Nitrate / Nitrite**	**VOCs**	**BTEX (N)**	**EDB**	**Alkalinity**	☐	☐
3	**Metals (Total)**	**Metals (Dissolved)**	**Anions**	**Nitrate / Nitrite**	**VOCs**	**BTEX (N)**	**EDB**	**Alkalinity**	☐	☐
4	**Metals (Total)**	**Metals (Dissolved)**	**Anions**	**Nitrate / Nitrite**	**VOCs**	**BTEX (N)**	**EDB**	**Alkalinity**	☐	☐
5	**Metals (Total)**	**Metals (Dissolved)**	**Anions**	**Nitrate / Nitrite**	**VOCs**	**BTEX (N)**	**EDB**	**Alkalinity**	☐	☐
6	**Metals (Total)**	**Metals (Dissolved)**	**Anions**	**Nitrate / Nitrite**	**VOCs**	**BTEX (N)**	**EDB**	**Alkalinity**	☐	☐

6mm ______

pH, Conductivity, ORP, DO, Temperature	YSI Professional Plus	Serial No: ______	Water Level Meter:	Solinst 500 ft	Serial No: ______
PID:	MiniRAE 3000	Serial No: ______	Turbidity Meter:	Hach 2100Q	Serial No: ______

IDW will be taken to:

Sample ID: ______

Duplicate ID:
(if applicable) ______

COC#: ______

Notes: ______

______

Reviewed by: ______ Initials: ______ Review Date: ______

Primary Samples (3 DMS)	Primary and Duplicate Samples (6 DMS)	Primary and MS/MSD Samples (6 DMS)
DMS1: VOCs, EDB, Metal (Dissolved) 120 mL + 80 mL + 250 mL = 450	DMS1: VOCs and EDB + dup 240 mL + 160 mL = 400	DMS1: VOCs + MS/MSD 360 mL
DMS 2: Metal (Total), Alkalinity 250 mL + 250 mL = 500 mL	DMS 2: Metals (Total and Dissolved) 250 mL + 250 mL = 500 mL	DMS 2: EDB + MS/MSD 240 mL
DMS 3: Anions and Nitrate/Nitrite Nitrogen 80 mL + 250 mL = 330 mL	DMS 3: Metals (Total and Dissolved) 250 mL + 250 mL = 500 mL	DMS 3: Dissolved Metals 250 mL + 250 mL = 500 mL
220 mL Spare	DMS4: Anions and Nitrate/Nitrite Nitrogen 80 mL + 250 mL = 330 mL	DMS 4: Metals (Total and Dissolved) 250 mL + 250 mL = 500 mL
	DMS 5: Anions and Nitrate/Nitrite Nitrogen 80 mL + 250 mL = 330 mL	DMS 5: Total Metals 250 mL + 250 mL = 500 mL
	DMS 6: Alkalinity + dup 250 mL + 250 mL = 500 mL	DMS 6: Alkalinity and Nitrate/Nitrite Nitrogen 250 mL + 250 mL = 500
	440 mL Spare	320 mL Spare

YSI Professional Plus Log

Serial # (WH0001)

Year:

Project: Kirtland AFB BFF ST-106/SS-111

Quarter : _

Date	Cal or Bump	pH 4.00	pH 7.00	pH 10.00	ORP (220 mV)	Conductivity (1413 µS/cm)	Measured DO (% Sat)	Barometer (mm Hg)	100% DO Sat Adjusted for Barometric Pressure	Initials
Calibration Tolerances:		+/- 0.2 pH Units			+/- 20 mV Standard	+/- 0.5% of Standard	+/- 2% of the Adjusted DO Value	N/A	N/A	N/A

* Calibrate all parameters weekly. Bump check all parameters daily and re-calibrate if values are out of tolerance.

* 100% DO Sat =100 x (Barometric Pressure in mmHg/760)

Rae Systems MiniRAE 3000 PID Log

Serial # (WH0004)

Year:

Project: Kirtland AFB BFF ST-106/SS-111

Quarter : _

Date	Cal or Bump	0 ppm	100 ppm	Initials
Calibration Tolerances:		+/- 3% of standard value		N/A

* Calibrate all parameters weekly. Bump check all parameters daily and re-calibrate if values are out of tolerance.

Hach 2100Q Portable Turbidimeter Log

Serial # **(WH0007)** Year:

Project: Kirtland AFB BFF ST-106/SS-111 Quarter : _

Date	Bump or Cal	20 NTU	100 NTU	800 NTU	10 NTU	Initials
Calibration Tolerance:		+/- 10% of Standard Value				N/A

*Calibrate Instrument every three months, bump check weekly and re-calibrate if values are out of tolerance.

CHAIN-OF-CUSTODY RECORD

	CHAIN-OF-CUSTODY RECORD			COC NUMBER
PROJECT NAME: **Kirtland AFB Bulk Fuels Facility**	PROJECT NUMBER:	LABORATORY NAME AND CONTACT:	FAX AND MAIL REPORTS/EDD TO:	YEAR:
			FAX AND MAIL REPORTS/EDD TO:	QUARTER:
PROJECT SITE AND PHASE: ST106/SS110		LAB PO NUMBER:	LAB CONTACT:	

ITEM	SAMPLE IDENTIFIER	DATE COLLECTED	TIME COLLECTED	ANALYSIS REQUIRED (Specify number of bottles): Total Number of Bottles	VOCs (8260C)	BTEX (8260C)	BTEXN (8260C)	EDB (8011)	Total As,Pb,Ca,K,Na,Mg (6020A/6010C)	Dissolved Fe, Mn (6010C)	Chloride, bromide, sulfate (300.0)	Nitrate-Nitrite (353.2)	Alkalinity (SM2320B)	COMMENTS
1										*				
2														
3														
4														
5														
6														

COMMENTS: *Dissolved Fe, Mn aliquot was field filtered.

SAMPLER(S):	COURIER AND SHIPPING NUMBER:

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
Printed Name and Signature:			Printed Name and Signature:		
Printed Name and Signature:			Printed Name and Signature:		
Printed Name and Signature:			Printed Name and Signature:		
Printed Name and Signature:			Printed Name and Signature:		

SAMPLE COOLER

SHIPPING CHECKLIST

Site Name: Kirtland BFF (62599DM01) **Date: ________________________**

Fedex Tracking Number: ____________________

Matrix: Groundwater **Lab:** Eurofins (Lancaster, PA)

Cooler Sealed: ____________ (Time) **Delivered to FedEx:____________(Time)**

Sampler 1 (Initials)		Sampler 2 (Initials)
☐	**Two (2) Plastic Bag Liners Included**	☐
☐	**Temperature Blank Included at Bottom of Cooler Surrounded by Ice**	☐
☐	**Trip Blank Included (2 for EDB, 2 for BTEX if present)**	☐
☐	**Samples Checked Against Chain of Custody**	☐
☐	**Chain of Custody Originals Included**	☐
☐	**All Void Space in Cooler filled with Ice**	☐
☐	**Custody Seals On Plastic Bag Liner And Outside Of Cooler**	☐

(Print)Name:____________________________ **(Print)Name:____________________________**

Signature:______________________________ **Signature:______________________________**

Date/Time:_____________________________ **Date/Time:_____________________________**

COC's in Cooler:

____

____

____

____

APPENDIX C

EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL LLC

METHOD REPORTING LIMITS AND SCREENING CRITERIA

Method Reporting Limits and Screening Criteria for Water

Analyte	Analytical Method	CASRN	Units	NMWQCC[1]	EPA MCL[2]	EPA Tapwater		Project Screening Level[4]	Achievable Laboratory Limits[5]		
						RSL[3]	c/nc		LOQ	LOD	DL
Volatile Organic Compounds/BTEX/Naphthalene											
1,1,1,2-Tetrachloroethane	SW8260C	630-20-6	µg/L	NS	NS	5.7	c	5.7	1.0	0.5	0.2
1,1,1-Trichloroethane	SW8260C	71-55-6	µg/L	200	200	8000	nc	200	1.0	0.5	0.3
1,1,2,2-Tetrachloroethane	SW8260C	79-34-5	µg/L	10	NS	0.76	c	10	1.0	0.5	0.2
1,1,2-Trichloroethane*	SW8260C	79-00-5	µg/L	5	5	2.8	c	5.0	1.0	0.5	0.2
1,1-Dichloroethane	SW8260C	75-34-3	µg/L	25	NS	28	c	25	1.0	0.5	0.2
1,1-Dichloroethene	SW8260C	75-35-4	µg/L	7	7	280	nc	7.0	1.0	0.5	0.2
1,1-Dichloropropene	SW8260C	563-58-6	µg/L	NS	NS	NS	-	NS	5.0	0.5	0.2
1,2,3-Trichlorobenzene	SW8260C	87-61-6	µg/L	NS	NS	7.0	nc	7.0	5.0	1.0	0.4
1,2,3-Trichloropropane	SW8260C	96-18-4	µg/L	NS	NS	0.0075	c	0.0075	5.0	0.5	0.2
1,2,4-Trichlorobenzene	SW8260C	120-82-1	µg/L	70	70	12	c	70	5.0	1.0	0.3
1,2,4-Trimethylbenzene	SW8260C	95-63-6	µg/L	NS	NS	56	nc	56	5.0	2.0	1.0
1,2-Dibromo-3-chloropropane	SW8260C	96-12-8	µg/L	NS	0.2	0.0033	c	0.2	5.0	1.0	0.3
1,2-Dibromoethane (EDB)*	SW8011	106-93-4	µg/L	0.05	0.05	0.075	c	0.05	0.03	0.02	0.01
1,2-Dichlorobenzene	SW8260C	95-50-1	µg/L	600	600	300	nc	600	5.0	0.5	0.2
1,2-Dichloroethane*	SW8260C	107-06-2	µg/L	5	5	1.7	c	5.0	1.0	0.5	0.3
1,2-Dichloropropane	SW8260C	78-87-5	µg/L	5	5	8.5	c	5.0	1.0	0.5	0.2
1,3-Dichloropropane	SW8260C	142-28-9	µg/L	NS	NS	370	nc	370	1.0	0.5	0.2
1,3-Dichlorobenzene	SW8260C	541-73-1	µg/L	NS	NS	NS	-	NS	5.0	0.5	0.2
1,3,5-Trimethylbenzene*	SW8260C	108-67-8	µg/L	NS	NS	130	nc	130	5.0	1.0	0.3
1,4-Dichlorobenzene	SW8260C	106-46-7	µg/L	75	75	4.8	c	75	5.0	0.5	0.2
2-Butanone (Methyl Ethyl ketone)*	SW8260C	78-93-3	µg/L	NS	NS	5600	nc	5600	10	1.0	0.3
2-Chlorotoluene*	SW8260C	95-49-8	µg/L	NS	NS	240	nc	240	5.0	0.5	0.2
2,2-Dichloropropane	SW8260C	594-20-7	µg/L	NS	NS	NS	-	NS	1.0	0.5	0.3
2-Hexanone*	SW8260C	591-78-6	µg/L	NS	NS	38	nc	38	10	1.0	0.3
4-Chlorotoluene	SW8260C	106-43-4	µg/L	NS	NS	250	nc	250	5.0	0.5	0.2
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)*	SW8260C	108-10-1	µg/L	NS	NS	6300	nc	6300	10	1.0	0.5
Acetone*	SW8260C	67-64-1	µg/L	NS	NS	14000	nc	14000	20	2.0	0.7
Acrolein	SW8260C	107-02-8	µg/L	NS	NS	0.042	nc	0.042	100	5.0	2.0
Acrylonitrile	SW8260C	107-13-1	µg/L	NS	NS	0.52	c	0.52	20	1.0	0.3
Benzene*	SW8260C	71-43-2	µg/L	5	5	4.6	c	5.0	1.0	0.5	0.2
Bromobenzene	SW8260C	108-86-1	µg/L	NS	NS	62	nc	62	5.0	0.5	0.2
Bromochloromethane	SW8260C	74-97-5	µg/L	NS	NS	83	nc	83	5.0	0.5	0.2
Bromodichloromethane[6]	SW8260C	75-27-4	µg/L	NS	80	1.3	c	80	1.0	0.5	0.2
Bromoform[6]	SW8260C	75-25-2	µg/L	NS	80	33	c	80	4.0	2.0	1.0
Bromomethane	SW8260C	74-83-9	µg/L	NS	NS	7.5	nc	7.5	1.0	0.5	0.3
Carbon Disulfide*	SW8260C	75-15-0	µg/L	NS	NS	810	nc	810	5.0	0.5	0.2
Carbon Tetrachloride	SW8260C	56-23-5	µg/L	5	5	4.6	c	5.0	1.0	0.5	0.2
Chlorobenzene	SW8260C	108-90-7	µg/L	NS	100	78	nc	100	1.0	0.5	0.2
Chloroethane (Ethyl Chloride)	SW8260C	75-00-3	µg/L	NS	NS	21000	nc	21000	1.0	0.5	0.2
Chloroform[6]	SW8260C	67-66-3	µg/L	100	80	2.2	c	80	1.0	0.5	0.2
Chloromethane*	SW8260C	74-87-3	µg/L	NS	NS	190	nc	190	1.0	0.5	0.2
cis-1,2-Dichloroethene	SW8260C	156-59-2	µg/L	70	70	36	nc	70	1.0	0.5	0.2
cis-1,3-Dichloropropene	SW8260C	10061-01-5	µg/L	NS	NS	NS	-	NS	1.0	0.5	0.2
Dibromochloromethane[6]	SW8260C	124-48-1	µg/L	NS	80	8.7	c	80	1.0	0.5	0.2
Dibromomethane	SW8260C	74-95-3	µg/L	NS	NS	8.3	nc	8.3	1.0	0.5	0.2
Dichlorodifluoromethane*	SW8260C	75-71-8	µg/L	NS	NS	200	nc	200	1.0	0.5	0.2
Ethylbenzene*	SW8260C	100-41-4	µg/L	700	700	15	c	700	1.0	0.8	0.4
Hexachlorobutadiene	SW8260C	87-68-3	µg/L	NS	NS	1.4	c	1.4	5.0	4.0	2.0
Isopropylbenzene (Cumene)*	SW8260C	98-82-8	µg/L	NS	NS	450	nc	450	5.0	0.5	0.2
Methyl tert-Butyl Ether*	SW8260C	1634-04-4	µg/L	NS	NS	140	c	140	1.0	0.5	0.2
Methylene Chloride*	SW8260C	75-09-2	µg/L	5	5	110	c	5.0	1.0	0.5	0.3
n-Butylbenzene*	SW8260C	104-51-8	µg/L	NS	NS	1000	nc	1000	5.0	0.5	0.2
n-Propylbenzene*	SW8260C	103-65-1	µg/L	NS	NS	660	nc	660	5.0	0.5	0.2
Naphthalene*[7]	SW8260C	91-20-3	µg/L	30	NS	1.7	c	30	5.0	2.0	1.0
p-Isopropyltoluene*	SW8260C	99-87-6	µg/L	NS	NS	NS	-	NS	5.0	0.5	0.2
sec-Butylbenzene*	SW8260C	135-98-8	µg/L	NS	NS	2000	nc	2000	5.0	0.5	0.2
Styrene	SW8260C	100-42-5	µg/L	100	100	1200	nc	100	5.0	0.5	0.2
tert-Butylbenzene*	SW8260C	98-06-6	µg/L	NS	NS	690	nc	690	5.0	1.0	0.3
Tetrachloroethene	SW8260C	127-18-4	µg/L	5	5	110	c	5.0	1.0	0.5	0.2
Toluene*	SW8260C	108-88-3	µg/L	1000	1000	1100	nc	1000	1.0	0.5	0.2
trans-1,2-Dichloroethene	SW8260C	156-60-5	µg/L	100	100	360	nc	100	1.0	0.5	0.2
trans-1,3-Dichloropropene	SW8260C	10061-02-6	µg/L	NS	NS	NS	-	4.7	1.0	0.5	0.2
Trichloroethene*	SW8260C	79-01-6	µg/L	5	5	4.9	c	5.0	1.0	0.5	0.2
Trichlorofluoromethane*	SW8260C	75-69-4	µg/L	NS	NS	5200	nc	5200	1.0	0.5	0.2
Vinyl Acetate	SW8260C	108-05-4	µg/L	NS	NS	410	nc	410	10.0	2.0	0.7
Vinyl Chloride	SW8260C	75-01-4	µg/L	2	2	0.19	c	2	1.0	0.5	0.2
m,p-Xylene*	SW8260C	179601-23-1	µg/L	NS	10,000	190	nc	10,000	5.0	2.0	1.0
o-Xylene*	SW8260C	95-47-6	µg/L	NS	10,000	190	nc	10,000	1.0	0.8	0.4
Xylene (Total)*	SW8260C	1330-20-7	µg/L	620	10,000	190	nc	620	6.0	2.0	1.0
Metals - Total											
Arsenic	SW6020A	7440-38-2	mg/L	0.01	0.01	0.00052	c	0.01	0.002	0.0016	0.00068
Calcium	SW6010C	7440-70-2	mg/L	NS	NS	NS	-	NS	0.2	0.1502	0.096
Lead	SW6020A	7439-92-1	mg/L	0.015	0.015	0.015	nc	0.015	0.0005	0.00025	7.1E-05
Magnesium	SW6010C	7439-95-4	mg/L	NS	NS	NS	-	NS	0.1	0.0751	0.04
Potassium	SW6010C	7440-09-7	mg/L	NS	NS	NS	-	NS	0.5	0.3754	0.204
Sodium	SW6010C	7440-23-5	mg/L	NS	NS	NS	-	NS	1	0.5	0.239
Metals - Dissolved											
Iron	SW6010C	7439-89-6	mg/L	1.0	0.3	14	nc	0.3	0.2	0.1	0.04
Manganese	SW6010C	7439-96-5	mg/L	0.2	0.05	0.43	nc	0.05	0.01	0.005	0.003
Miscellaneous											
Alkalinity - Bicarbonate/Carbonate	SM 2320B	NS	mg/L	NS	NS	NS	-	NS	8	6	2.6
Ammonia Nitrogen	SM 4500NH3B/C	7664-41-7	mg/L	NS	NS	NS	-	NS	0.75	0.6	0.25
Bromide	E300.0A	24959-67-9	mg/L	NS	NS	NS	-	NS	2.5	2	1.25
Chloride	E300.0A	16887-00-6	mg/L	250	250	NS	-	250	2	1.5	1
Flashpoint[9]	SW-846 1010A	NS	degrees F	NS	NS	NS	-	<140	50	50	50
Nitrate/Nitrite Nitrogen[10]	E353.2	NS	mg/L	10[10]	10[10]	NS	-	10.00	1	0.09	0.04
pH	SW-846 9040C	NS	S.U.	6-9	6.5-8.5	NS	-	6.5-8.5	0.01	0.01	0.01
Sulfate	EPA 300.0A	18785-72-3	mg/L	600	250	NS	-	250	5	4.5	1.5
Sulfide	SM 4500S2F	18496-25-8	mg/L	NS	NS	NS	-	NS	2	1.5	0.7

[1] NMWQCC standards per the New Mexico Administrative Code Title 20.6.2.3101A, Standards for Ground Water of 10,000 mg/L Total Dissolved Solids Concentration or Less (NMAC 2018). For metals, the NMWQCC standard applies to dissolved metals and total mercury.

[2] EPA National Primary Drinking Water Regulations, Maximum Contaminant Levels and Secondary Maximum Contaminant Levels, Title 40CFR Part 141, 143 (June, 2019)).

[3] EPA Regional Screening Levels for Tapwater (Novmeber 2017) for hazard index = 1.0 for noncarcinogens and a 10^{-5} cancer risk level for carcinogens.

[4] The project screening level was selected to satisfy the requirements of the Kirtland AFB Hazardous Waste Permit No. NM9570024423 as the lowest of 1) NMWQCC standard or 2) EPA MCL. If no MCL or NMWQCC standard exists for any analyte, then the project screening level will be the EPA Tapwater RSL. Project screening levels below the LOD are highlighted and the screening level is set at the LOQ.

[5] Achieveable laboratory limits are for Eurofins Lancaster Laboratories Environmental, LLC, Lancaster PA.

[6] The EPA RSL and MCL for tapwater is for total trihalomethanes.

[7] NMWQCC specifies a standard for the sum of naphthalene and mononaphthalenes (1-methylnaphthalene and 2-methylnaphthalene). Conservatively, this standard is shown for each of the three compounds.

[8] MCL for nitrite is listed; the MCL for nitrate is 10 mg/L.

[9] The project screening level for flashpoint is based on RCRA hazardous waste criteria.

[10] Based on the geochemical equilibrium of the site groundwater and previous site data nalyses, nitrat/nitrite results represent nitrate concentrations

* VOCs included in the Bulk Fuels Facility network groundwater monitoring and treatment system monitoring.

µg/L = Microgram(s) per liter.
AFB = Air Force Base.
BTEX = Benzene, toluene, ethylbenzene, and total xylenes.
c = Carcinogenic.
CASRN = Chemical Abstracts Service Registry Number.
DL = Detection limit.
EPA = U.S. Environmental Protection Agency.
LOD = Limit of detection.
LOQ = Limit of quantitation.
mg/L = Milligram(s) per liter.
MCL = Maximum Contaminant Level.
nc = Noncarcinogenic.
NMAC = New Mexico Administrative Code.
NMWQCC = New Mexico Water Quality Control Commission
NS = Not specified.
RCRA = Resource Conservation and Recovery Act.
RSL = Regional Screening Level.
S.U. = Standard units
VOC = Volatile organic compound.
Cell highlight indicates the LOQ is higher than the project screening level.