KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

QUARTERLY REPORT – JULY-SEPTEMBER 2016
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

December 2016

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Solid Waste Management Unit ST-106/SS-111
Kirtland Air Force Base, New Mexico

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Prepared for
U.S. Army Corps of Engineers
Albuquerque District
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NOTICE

This report was prepared for the U.S. Army Corps of Engineers by EA Engineering, Science, and Technology, Inc., PBC for the purpose of documenting the progress of an Interim Action being implemented by the U.S. Air Force Environmental Restoration Program (ERP) at Kirtland Air Force Base. As the report relates to actual or possible releases of potentially hazardous substances, its release prior to a final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the ERP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known that may make this report premature or inaccurate.

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14. ABSTRACT

This Quarterly Report summarizes the activities performed from July 1 through September 30, 2016 as part of the Resource Conservation and Recovery Act interim measures for soil and groundwater remediation at Solid Waste Management Unit ST-106/SS-111, the Bulk Fuels Facility site, at Kirtland Air Force Base (AFB), New Mexico. Quarterly source area soil vapor, groundwater, drinking water at proximal water supply wells, and groundwater treatment system (GWTS) samples were collected and analyzed for contaminants of concern and other relevant field and laboratory parameters. The GWTS treated approximately 32,320,000 gallons of extracted groundwater through a granular activated carbon filtration system and discharged the treated effluent to the Kirtland AFB golf course main pond. Concentrations in all treated effluent samples were below regulatory standards before discharge.

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ERIC H. FROEHLICH, Colonel, U.S. Air Force
Commander, 377th Air Base Wing

This document has been approved for public release.

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KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

PREFACE

This Quarterly Report – July-September 2016 has been prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) for the U.S. Army Corps of Engineers, under Contract Number W912DR-12-D-0006, Delivery Order DM01 and pertains to the Base Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS 111, located in Albuquerque, New Mexico. This report was prepared in accordance with applicable federal, state, and local laws and regulations, including the New Mexico Hazardous Waste Act, New Mexico Statutes Annotated 1978, New Mexico Hazardous Waste Management Regulations, Resource Conservation and Recovery Act, and regulatory correspondence between the New Mexico Environment Department Hazardous Waste Bureau and the U.S. Air Force, dated March 25 and May 20, 2016.

Quarterly monitoring of soil vapor, groundwater, and drinking water supply and operation of the groundwater treatment system were conducted from July 1 through September 30, 2016. Mr. Trent Simpler, PE, is the U.S. Army Corps of Engineers–Albuquerque District Project Manager. The Environmental Restoration Section Chief for this program is Mr. Ludie W. Bitner of Kirtland Air Force Base. Ms. Devon Jercinovic is the EA Project Manager.

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
µg/L	microgram(s) per liter
µS/cm	microsiemens per centimeter
AFB	Air Force Base
BFF	Bulk Fuels Facility
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CFR	Code of Federal Regulations
CO_2	carbon dioxide
DMS	dual-membrane sampler
DO	dissolved oxygen
DoD	Department of Defense
EA	EA Engineering, Science, and Technology, Inc., PBC
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
ERDC	Engineering Research and Development Center
ft	foot (feet)
GAC	granular activated carbon
gpm	gallon(s) per minute
GWM	groundwater monitoring
GWTS	groundwater treatment system
HC	total hydrocarbon
Horiba	Horiba MEXA 584L auto emissions analyzer
ID	identification
IDW	investigation-derived waste
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
mg/L	milligram(s) per liter
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
No.	number
NTU	nephelometric turbidity units

LIST OF ACRONYMS AND ABBREVIATIONS (CONCLUDED)

O_2	oxygen
ORP	oxidation reduction potential
PDB	passive diffusion bag
ppmv	parts per million by volume
PSL	project screening level
Q1	first quarter of the year, January 1 through March 31
Q2	second quarter of the year, April 1 through June 30
Q3	third quarter of the year, July 1 through September 30
Q4	fourth quarter of the year, October 1 through December 31
QC	quality control
RPD	relative percent difference
SV	soil vapor
SVM	soil vapor monitoring
SVMP	soil vapor monitoring point
SWMU	Solid Waste Management Unit
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
VA	U.S. Department of Veterans Affairs
VOC	volatile organic compound

EXECUTIVE SUMMARY

Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) is Solid Waste Management Unit (SWMU) ST-106/SS-111 and became a cleanup site in November 1999 after fuel was observed day lighting from the ground surface near the BFF fuel off-loading rack. Subsequent pressure testing identified three leaks from lines that transferred aircraft fuel from the fuel off-loading rack to the Pump House at the BFF. The leaking lines were immediately taken off-line and a temporary alternate off-loading rack was installed and used until construction of a new state-of-the-art BFF was brought online in April 2011. The ongoing investigation and cleanup activities of the BFF site began in 1999 by characterizing the extent of the contamination along with removing contaminated soil, vapors from the vadose zone, and contaminated groundwater. These cleanup efforts are ongoing.

This Executive Summary describes soil vapor monitoring (SVM), groundwater monitoring (GWM), and interim measure activities performed at the BFF between July and September 2016, which comprised the third quarter (Q3) of calendar year 2016 (herein referred to as Q3 2016). The activities consisted of the following:

- Sampling the entire SVM network
- Sampling the Q3 2016 designated wells in the GWM network
- Continuing the passive sampling evaluation
- Sampling the drinking water supply wells located in the vicinity of the dissolved benzene and ethylene dibromide (also known as 1,2-dibromoethane [EDB]) plumes
- Operation, maintenance, and expansion of the EDB groundwater treatment system (GWTS).

ES-1 Vadose Zone Monitoring

Soil vapor (SV) samples were collected from 56 SVM locations (comprised of a total of 284 individual SVM points [SVMPs]) for field parameter measurements and laboratory analyses. Each SVM location is comprised of up to six SVMPs. These monitoring points are screened at discrete intervals ranging from approximately 25 to 450 feet (ft) below ground surface (bgs). Each SVMP has a unique database identification (ID). Included in the database ID is the SVM location followed by a number identifying the approximate depth of the screened interval associated with an individual SVMP (example given, SVMW 04-250 is located at SVMW-04 and is screened at approximately 250 ft bgs).

SVM locations were separated into three areas of interest to evaluate SV concentrations in Q3 2016. These areas include off-Base SVM locations, on-Base SVM locations outside of the source area, and on-Base SVM locations inside of the source area. The source area is defined as a 100-ft buffer zone around the original jet fuel pipeline that was the source of the BFF releases. Within each area of interest, EDB, benzene, and total hydrocarbon (HC) concentrations were evaluated to determine areas of relative higher or lower contamination. Percent oxygen (O_2) along with carbon dioxide (CO_2) at each SVMP were also evaluated as an indicator of aerobic HC biodegradation.

The off-Base SVM area of interest includes 28 SVMPs ranging in depth from approximately 25 to 450 ft bgs. All EDB, benzene, and HC concentrations in this area were below the three comparison concentrations of 0.5, 1, and 1,000 parts per million by volume (ppmv), respectively. The comparison concentrations used in this report were determined by historical maximum and minimum SV concentrations to show which SVMPs had relatively high or low concentrations. The highest concentration of EDB (0.0018 ppmv) in off-Base wells was detected at KAFB-106028-450. The highest concentration of benzene (0.018 ppmv) was detected in 106142-450. The highest HC concentration (5 ppmv) was detected at KAFB-106141-250.

There are 224 SVMPs in the on-Base area of interest outside of the source area. Sixty-three percent of the SVMPs were non-detect for EDB in this area, 23 percent were non-detect for benzene, and 96 percent had measured HC concentrations less than 1,000 ppmv. SVMPs with EDB concentrations greater than 0.5 ppmv, benzene concentrations greater than 1 ppmv, or HC concentrations greater than 1,000 ppmv were screened at depths ranging from approximately 100 to 450 ft bgs. The highest concentrations of EDB and HC (1.4 and 5,870 ppmv, respectively) were detected at KAFB-106128-450. The maximum detected concentration of benzene (130 ppmv) in wells on-Base outside the source area was at SVMW-06-252.

There are 32 SVMPs inside the source area. The source area had the highest EDB, benzene, and HC concentrations when compared to the other areas of interest. All SVMPs with EDB concentrations greater than 0.5 ppmv, benzene concentrations greater than 1 ppmv, or HC concentrations greater than 1,000 ppmv were detected at depths ranging from approximately 50 to 300 ft bgs. The highest detection of EDB within the source area was 21 ppmv at SVMW-11-100. The highest concentrations of benzene and HC (660 and 32,760 ppmv, respectively) within the source area were detected at SVMW-11-100.

At fuel release sites, microbial activity causes aerobic biodegradation of the fuel constituents, which consumes O_2 and produces CO_2. Field measured O_2 levels in SVMPs with HC concentrations greater than 1,000 ppmv ranged from 0.06 to 19.59 percent. The lowest O_2 level of 0.06 percent was measured in SVMW-11-260, located within the source area. Twenty SVMPs had less than 5 percent O_2, which is considered less than optimal for aerobic microbial activity to degrade HC.

ES-2 Groundwater Monitoring Network Gauging and Sampling

In Q3 2016, the depth to groundwater and light non-aqueous phase liquid (LNAPL) thickness were measured in 132 of 134 GWM wells, as two of the wells have been removed from the monitoring program due to safety concerns. Groundwater samples were collected from 40 of these GWM wells (32 wells that are part of the Q3 2016 sampling, one well that was deferred from the second quarter (Q2 2016), and an additional seven wells that are part of the passive sampling evaluation study), and the samples were analyzed for field parameters and submitted for laboratory analyses. The following are the findings of the field sampling event:

- Groundwater levels continued to rise across the GWM network an average of 0.72 ft since Q2 2016.
- All 132 GWM wells gauged were evaluated for floating fuel on the water table (i.e., LNAPL). Only three GWM wells (KAFB-106005, KAFB-106008, and KAFB-106076) had measurable LNAPL thicknesses of approximately 0.01, 0.04, and 0.01 ft, respectively.
- Monitoring of wells KAFB-106026 and KAFB-106230 ceased due to safety concerns, as approved by the New Mexico Environment Department (NMED) (NMED, 2016a).
- Field parameters were measured for groundwater samples collected from all 40 GWM wells and ranged as follows: temperature from 18.7 to 26.4 degrees Celsius (°C), pH from 6.87 to 8.62 standard units, conductivity from 264.6 to 2,193 microsiemens per centimeter (µS/cm), dissolved oxygen (DO) from 0.14 to 9.52 milligrams per liter (mg/L), oxidation reduction potential (ORP)

from -313.9 to 198.4 millivolts, and turbidity from 0.19 to 21.6 nephelometric turbidity units (NTUs). DO and ORP measurements indicated aerobic conditions in most wells, while shallow wells associated with the source area generally had lower DO and ORP measurements.

- In addition to the standard GWM activities, a passive dual-membrane sampler (DMS) evaluation was completed on eight wells along the longitudinal axis of the EDB plume. One of these wells was part of the Q3 2016 monitoring program; in addition, seven GWM wells were sampled in Q3 2016 using both Bennett pump systems as well as using passive sampling systems for this study. The purpose of this evaluation was to assess if the quality of the analytical data for samples collected using passive DMS was viable and comparable to that of analytical results for groundwater samples collected using Bennett sampling pumps. This evaluation is provided in Section 3.7.6 and Appendix E-1.

- Twenty-seven sentinel wells (18 downgradient proximal wells and nine U.S. Department of Veterans Affairs [VA] proximal wells) were sampled in Q3 2016. EDB was detected in one downgradient proximal well. EDB was detected in KAFB-106205 at an estimated concentration of 0.016 micrograms per liter (µg/L), which is below the 0.05 µg/L project screening level (PSL) for EDB. Benzene, toluene, ethylbenzene, and total xylenes (BTEX) were not detected in VA proximal wells.

- Groundwater samples collected from three source area wells were also analyzed for EDB, which was detected above the 0.05 µg/L PSL in one shallow well (KAFB-106005) and one intermediate (KAFB-106083) GWM well.

- Groundwater samples collected from 19 GWM wells were analyzed for BTEX. Seven of the 19 wells were sampled as part of the passive sampling evaluation. Benzene was detected above the 5 µg/L PSL in a sample from one scheduled source area well (KAFB-106005). In addition, samples were collected for benzene analysis from seven additional wells as part of the DMS evaluation. Benzene was detected above the 5 µg/L PSL in a sample from one source area well (KAFB-106059) as part of the passive evaluation. Toluene, ethylbenzene, and total xylenes were detected at concentrations above their 750, 700, and 620 µg/L PSLs, respectively, in only one well (KAFB-106059).

- Groundwater samples collected from 13 GWM wells were analyzed for select metals, anions, and alkalinity. Of the six scheduled wells, dissolved manganese exceeded the 0.2 mg/L PSL in two of six wells. Lead and arsenic concentrations were below their 0.015 and 0.01 mg/L PSLs, respectively, in all samples. Chloride exceeded the 250 mg/L PSL in KAFB-106009. Sulfate exceeded the 250 mg/L PSL in two wells (KAFB-106009 and KAFB-106012R). Nitrate/nitrite nitrogen exceeded the 10 mg/L PSL for nitrate in KAFB-106009 only. Total alkalinity as calcium carbonate ranged from 76.7 to 359 mg/L. Of the seven exclusive passive evaluation wells, dissolved iron exceeded the 1.0 mg/L PSL in samples from one well (KAFB-106059) and dissolved manganese exceeded the 0.2 mg/L PSL in three of the seven wells (KAFB-106059, KAFB-106082, and KAFB-106083).

ES-3 Drinking Water Supply Well Monitoring

Drinking water supply well samples were collected in July, August, and September 2016. Four drinking water supply wells are located in the vicinity of the benzene and EDB plumes: KAFB-003, KAFB-015, KAFB-016, and ST106-VA-2. KAFB-003 and ST106-VA-2 were sampled monthly for BTEX and EDB in Q3 2016. KAFB-016 was not sampled in Q3 2016 due to ongoing repairs. KAFB-015 was not sampled in July and August 2016 due to ongoing repairs, which were completed in August. KAFB-015 was sampled in September for BTEX and EDB. There were no analyte detections in samples collected at KAFB-003 or ST106-VA-2 in Q3 2016. The sample collected from KAFB-015 in September 2016 was non-detect for all constituents analyzed with the exception of an estimated (J) detection of total xylenes at 0.16 µg/L, which is below the PSL of 620 µg/L. This detection was most likely related to the repairs and replacement of surface infrastructure performed prior to September 2016.

ES-4 Groundwater Treatment System Operation

The GWTS was 85 percent operational from July 1 to September 30, 2016 and treated 32,320,000 gallons of groundwater, all of which were discharged to the Kirtland AFB golf course main pond. All concentrations in effluent samples collected during Q3 2016 were below their respective limits of detection and below the discharge permit acceptable limits (NMED, 2016b). The pump motor for extraction well KAFB-106228 was replaced and a sacrificial anode was added to the drop pipe. Several unplanned shutdowns occurred due to the following issues: heavy rains activating high water alarms, overheating of the well-control house, and issues with flowmeters installed at KAFB-106228 and on the influent pump skid. The pump in KAFB-106233 remained off-line for the entirety of Q3 2016.

ES-5 Projected Activities

Planned activities for fourth quarter (Q4) 2016 include the following:

- Perform vadose zone monitoring between October 3 and October 21, 2016
- Perform GWM from October 1 through December 31, 2016
- Continue vertical profile evaluation with passive diffusion bag (PDB) samplers in a subset of GWM wells to determine the vertical extent and vertical plume dynamics
- Perform monthly drinking water supply well monitoring for October, November, and December 2016
- Perform semiannual sampling for the analysis of inorganic compounds at the drinking water supply wells
- Continue operating the GWTS and both extraction wells (KAFB-106228 and KAFB-106234)
- Install new extraction well KAFB-106239 along Ridgecrest Drive
- Install two new data gap wells on the northwest portion of the EDB distal plume (KAFB-106235 and KAFB-106236)
- Plan activities for rehabilitation of extraction well KAFB-106233
- Continue the construction phase of the second treatment train at the GWTS.

1. INTRODUCTION

This Quarterly Report for Q3 2016 summarizes the activities performed from July 1 through September 30, 2016, as part of the interim measures for soil and groundwater remediation at SWMU ST-106/SS-111, the BFF site, at Kirtland AFB, pursuant to the Hazardous Waste Treatment Facility Operating Permit Number (No.) NM9570024423 (Permit; NMED, 2010). The BFF site is located within the northwestern portion of Kirtland AFB on the southern end of the City of Albuquerque as shown on the Site location map (Figure 1-1). Vadose zone and groundwater investigation and remediation activities are required to address the potential impact of fuels that were released from leaking pipelines at the Former Fuel Off-Loading Rack.

GWM, SVM, and interim measures for SWMU ST-106/SS-111 were conducted concurrently. The monitoring program was performed in accordance with multiple Work Plans: (1) SV (NMED, 2016c; U.S. Army Corps of Engineers [USACE], 2016a), (2) groundwater (NMED, 2016d; USACE, 2016b), and (3) drinking water supply wells (NMED, 2016c; USACE, 2016a). GWTS operations were performed under the Operations and Maintenance Plan (USACE, 2016c) and permission to discharge treated effluent (NMED, 2016b). Appendix A contains key regulatory correspondence. This Q3 2016 Report is prepared as a non-cumulative data report (NMED, 2016d; USACE, 2016b). Non-cumulative data reports are provided for each of the first quarter (Q1), Q2, and Q3 2016 sampling events, while the Q4 2016 Annual Report is a compilation of the data collected over the four quarters with more in-depth data analysis, conclusions, and recommendations for that calendar year. The Q3 2016 Report provides a streamlined, clear, and concise structure that focuses on the results of activities completed during the reporting period.

2. VADOSE ZONE MONITORING

This Section describes the field activities, analyses, and results for the Q3 2016 monitoring of 56 SVM locations at Kirtland AFB (Figure 2-1). Quarterly SV sampling is conducted to characterize and monitor vadose zone contaminant concentrations.

Each SVM location is comprised of up to six SVMPs, each screened at discrete intervals ranging from approximately 25 to 450 ft bgs. Each SVMP has a unique database ID. Included in the database ID are the SVM location followed by a number identifying the approximate depth of the screened interval associated with an individual SVMP (example given, SVMW-04-250 is located at SVMW-04 and is at approximately 250 ft bgs). Table 2-1 lists each SVM location, its associated SVMPs, the screened intervals of each, and the pre-calculated purge volume.

Samples collected in Q3 2016 represent the vadose zone without the influence of artificially induced airflow. All SVMPs are sealed to atmospheric air, which minimizes the exchange with the atmosphere during “inhalation” and “exhalation” cycles driven by barometric pressure fluctuations. In addition, there is no SV extraction system currently operational at SWMU ST-106/SS-111.

2.1 Vadose Zone Data Collection

Field parameters and SV laboratory samples were collected from all SVMPs during Q3 2016. The condition of the vault and the pneumatic quick connect fittings at each SVMP was documented on the associated purge log (Appendix C-1) to ensure sample representativeness.

2.1.1 Field Soil Vapor Data

Field parameters including HC concentration (in ppmv), percent O_2, and percent CO_2 were measured and recorded at each SVMP using a Horiba MEXA 584L auto emissions analyzer (Horiba). Differential air pressure (inches of water column) readings were measured and recorded for pre-purging and post-purging conditions of each well using an electric manometer. SVMP data were recorded on purge logs (Appendix C-1). Horiba calibration and sample system leak tests were performed. Daily quality control (QC) reports are included in Appendix C-2. SV field data are listed in Table 2-2.

2.1.2 Laboratory Soil Vapor Analytical Data

Q3 2016 SV samples were collected between July 12 and August 3, 2016. Two hundred and eighty-four SVMP field samples and 29 field duplicates were collected using certified pre-evacuated Bottle-Vac™ canisters fitted with a specialized female pneumatic connector that allowed only the vapor from the SVMP to enter the bottle. All samples were recorded on sample collection logs included in Appendix C-1. Chain-of-custody records are included in Appendix C-3. After collecting samples, each bottle was immediately placed into protective packaging, and then shipped to ALS Environmental in Simi Valley, California, for analyses of the following SV analytical suite:

- Volatile organic compounds (VOCs) by U.S. Environmental Protection Agency (EPA) Method TO-15
- Air-phase petroleum HCs by Method Massachusetts Department of Environmental Protection Air-Phase Petroleum Hydrocarbons 1.0

- Fixed gases (hydrogen, carbon monoxide, CO_2, nitrogen, methane, and O_2/argon by Method E3C)
- EDB by EPA Method California Air Resources Board 422.

Four trip blanks were analyzed for VOCs by EPA Method TO-15 to monitor and assess sample preservation, packing, shipping, and storage conditions. The Data Quality Assessment Report is included in Appendix D-1. Analytical results are reported in the ALS Environmental Laboratory Report (Appendix D-2). SV analytical data were validated by Laboratory Data Consultants, Inc., Carlsbad, California. Data validation reports are included in Appendix D-2. SV analytical results are listed in Table 2-3.

2.2 Data Review and Usability

Laboratory Data Consultants, Inc. performed 100 percent Level III data validation of Q3 2016 SV analytical data. All data met the criteria that validated the data as usable, and no data qualified as rejected. The technical data completeness was 100 percent. The data met data quality objectives and were appropriate for use in project decision-making. Some laboratory results yielded an estimated (J) detection, in which the J qualifier denotes the analyte was positively identified but the associated numerical value was estimated. The results of the QC parameter and data quality indicator (precision, bias [accuracy], representativeness, comparability, completeness, and sensitivity) evaluation are provided in the Data Validation Reports included in Appendix D-2, and Data Quality Assessment Report included in Appendix D-1. Validated SV data are presented in Table 2-3.

2.3 Soil Vapor Data Evaluation

The Q3 2016 analytical results and field data from the 284 SVMPs were used to generate two-dimensional plan-view maps (Figures 2-2 through 2-8) that depict benzene, EDB, and HC concentrations at depths of 25, 50, 100, 150, 250, 350, and 450 ft bgs.

The SVM locations have been categorized into three areas of interest: off-Base SVM locations, on-Base SVM locations outside of the source area, and on-Base SVM locations inside of the source area. SV analytical data are discussed in relation to each area. The source area (delineated by the black and white line on Figures 2-1 through 2-8) is defined as a 100-ft buffer zone around the original jet fuel pipeline that was the source of the BFF releases. That pipeline has since been removed.

EDB and benzene were evaluated based on the laboratory results; HC concentrations and percent O_2 concentrations were evaluated based on field-measured data as discussed in Section 2.4.4. The Kirtland AFB Resource Conservation and Recovery Act Permit does not specify cleanup screening values for SV. All EDB, benzene, and HC concentrations are compared to the concentrations of 0.5, 1, and 1,000 ppmv, respectively. The comparison concentrations used in this report were determined by historical maximum and minimum SV results to show which SVMPs had relatively high or low concentrations.

Of the three areas of interest identified to evaluate SV concentrations from Q3 2016, the off-Base SVMPs had the highest percentage of non-detects for EDB and benzene (25 of 28 SVMPs [89 percent] and 13 of 28 SVMPs [46 percent], respectively), and the lowest average EDB and benzene detected concentrations (0.0011 and 0.0019 ppmv, respectively). O_2 concentrations in these SVMPs were generally close to atmospheric levels (>17 percent), which suggests the native bacteria's aerobic activity is not limited and the native bacteria can degrade residual fuel constituents present. In the SVMPs located on-Base but outside of the source area, EDB, benzene, and HC had average detected concentrations of 0.050, 1.9, and

167 ppmv, respectively. The areas with higher concentrations (EDB greater than 0.5 ppmv, benzene greater than 1 ppmv, and HC greater than 1,000 ppmv) were located at depths between approximately 100 and 450 ft bgs. The highest SV EDB, benzene, and HC concentrations for Q3 2016 were within the source area, with maximums of 21, 660, and 32,760 ppmv, respectively. This area of interest also had the highest percentage of detections for both EDB and benzene (31 of 32 SVMPs [97 percent]), and the highest average of detected concentrations of EDB and benzene of 2.5 and 130 ppmv, respectively. Twenty of the total 284 SVMPs had O_2 concentrations less than 5 percent, and these SVMPs suggest rate limiting aerobic microbial activity (i.e., native bacteria need more O_2 to degrade residual fuel constituents).

2.3.1 Off-Base Soil Vapor Monitoring Points

Figures 2-2 through 2-8 show the off-Base SVMPs, which are all located north of the Kirtland AFB installation boundary. There are five SVM locations off-Base, with the furthest location approximately 1,200 ft north of Kirtland AFB. The off-Base SVM locations consist of 28 SVMPs, which are screened at intervals from approximately 25 to 450 ft bgs.

Twenty-five of the 28 off-Base SVMPs (89 percent) had no EDB detections reported in Q3 2016. Of the three remaining SVMPs, two had J detections. The one remaining SVMP with a measured detection was screened at approximately 450 ft bgs. The highest EDB concentration was 0.0018 ppmv at KAFB-106028-450.

Thirteen of the 28 off-Base SVMPs (46 percent) had no benzene detections reported in Q3 2016. Of the remaining 15 SVMPs, 12 had J detections. The remaining three SVMPs with measured detections were screened between approximately 350 and 450 ft bgs. The highest benzene concentration was 0.018 ppmv at KAFB-106142-450.

HC concentrations in the 28 off-Base SVMPs ranged between 0 and 5 ppmv. O_2 levels were between 17.38 and 20.79 percent.

Monitoring of the off-Base SVMPs demonstrated EDB concentrations below 0.0019 ppmv, benzene concentrations below 0.019 ppmv, and HC concentrations below 6 ppmv in Q3 2016. Percent O_2 in the off-Base SVMPs was close to atmospheric levels, which suggests aerobic microbial activity is not limited (i.e., native bacteria can degrade residual fuel constituents present).

2.3.2 On-Base Soil Vapor Monitoring Points Outside of Source Area

Figures 2-2 through 2-8 show the locations of the 224 SVMPs located on Kirtland AFB property, but outside of the source area boundary. Those SVMPs are screened at intervals from approximately 25 to 450 ft bgs. SVM location KAFB-106135 is the furthest away from the source area at approximately 1,400 ft to the northeast.

EDB was not detected in 140 of the 224 (62 percent) SVMPs located on-Base but outside of the source area. EDB results were qualified as J in 14 percent of the SVMPs, and detected in 24 percent of the SVMPs. EDB concentrations were greater than 0.5 ppmv in two SVMPs: KAFB-106128-450 and SVMW-02-100 at 1.4 and 0.53 ppmv, respectively. The sample containing the highest EDB concentration of 1.4 ppmv was collected approximately 75 ft southeast of the source area.
For on-Base SVMPs outside the source area, benzene was not detected in 52 of 224 (23 percent) SVMPs, qualified as J in 19 percent, and detected in 58 percent of SVMPs. Twenty-one on-Base outside the

source area SVMPs (9 percent) had benzene concentrations greater than 1 ppmv. The highest detection (130 ppmv) was measured at SVMW-06-252, located approximately 200 ft east of the source area.

Two hundred and sixteen out of 224 SVMPs (96 percent) located on-Base, but outside of the source area, had HC concentrations below 1,000 ppmv. The eight SVMPs with concentrations greater than 1,000 ppmv were screened from approximately 100 to 450 ft bgs. The highest concentration of HC for these SVMPs was 5,870 ppmv at KAFB-106128-450, which is approximately 75 ft to the southeast of the source area.

Percent O_2 in the on-Base outside of the source area SVMPs ranged from 4.06 to 21.01 percent. O_2 levels greater than 15 percent were measured in 210 out of 224 SVMPs (94 percent). The lowest O_2 level (4.06 percent) was recorded at KAFB-106117-450, located approximately 100 ft east of the source area, which had an EDB concentration of 0.39 ppmv, a benzene concentration of 13 ppmv, and an HC concentration of 4,130 ppmv.

The highest concentrations of EDB (greater than 0.5 ppmv), benzene (greater than 1 ppmv), and HC (greater than 1,000 ppmv) were measured at on-Base SVMPs, outside of the source area, and located within 900 ft of the source area, toward the southeast and northeast. SVMP screened intervals showing these concentrations ranged in depths between approximately 100 and 450 ft bgs. O_2 levels were less than 15 percent at 14 SVMPs. O_2 concentrations above 5 percent, but lower than atmospheric levels suggest that aerobic microbial activity was not rate limited in these areas, but that consumption of O_2 to biodegrade fuel constituents was occurring. At KAFB-106117-450, O_2 levels were below 5 percent, which likely represented aerobic microbial activity rate limiting conditions at this SVMP.

2.3.3 Source Area Soil Vapor Monitoring Points

Figures 2-2 through 2-8 show the 32 source area SVMPs located within 100 ft of the original location of the underground jet fuel pipeline and screened from approximately 25 to 450 ft bgs.

No SVMPs sampled in the source area were non-detect for EDB and one out of 32 points sampled (3 percent) contained a J detection. The highest detected EDB concentration was 21 ppmv at SVMW-11-100. Benzene was not detected in one out of 32 SVMPs (3 percent) and there were no J detections. The highest benzene concentration (660 ppmv) and EDB concentration (21 ppmv) were both detected at SVMW-11-100.

The higher concentrations (EDB greater than 0.5 ppmv or benzene greater than 1 ppmv) were located at depths between approximately 50 and 300 ft bgs.

Ten out of 32 of the source area SVMPs (31 percent) had HC concentrations less than 1,000 ppmv. The highest concentration was 32,760 ppmv at SVMW-11-100. HC concentrations above 1,000 ppmv were located from approximately 50 to 300 ft bgs. Twenty-seven SVMPs had percent O_2 below 15 percent; of those, 19 were measured with a percent O_2 less than 5 percent. The SVMPs with O_2 below 15 percent ranged from depths of approximately 50 to 300 ft bgs. These conditions support that biodegradation is ongoing and is not rate limited by O_2 in these areas.

The highest concentrations of EDB (greater than 0.5 ppmv), benzene (greater than 1 ppmv), and HC (greater than 1,000 ppmv) at source area SVMPs were measured at depths ranging from approximately 50 to 300 ft bgs. Generally, reduced O_2 concentrations corresponded with higher EDB, benzene, and HC concentrations (Table 2-2), suggesting that microbial degradation of fuel compounds may be taking place. Some SVMPs showed low percent O_2 corresponding with low EDB, benzene, and HC concentrations; however, the SVMP above or below those SVMPs at the same SVM location had higher VOC concentrations. Percent O_2 was less than 5 percent at 19 SVMPs ranging in depth from approximately 50 to 300 ft bgs. Aerobic microbial activity was likely rate limited at these locations due to the lack of O_2 available to degrade HC.

2.3.4 Comparison of Field Parameters with Laboratory Analytical

The field-measured percent O_2 (listed in Table 2-2) was compared with the fixed-gas laboratory analyses for percent O_2. The laboratory percent O_2 results were, on average, greater in value by 0.89 percent than the field-measured percent O_2. Laboratory percent O_2 was higher than atmospheric percent O_2 (21 percent) in 64 samples. These factors suggest the field-measured O_2 concentrations were a better representation of vadose zone conditions than laboratory analysis of percent O_2.

Hydrocarbon data were used to assess total VOCs in Q3 2016. An evaluation of HC concentrations in comparison to laboratory total petroleum hydrocarbon (TPH) concentrations was performed in the *Quarterly Pre-Remedy Monitoring and Site Investigation Report for October-December 2015 and Annual Report for 2015* (USACE, 2016d). That evaluation determined that HC data were higher in comparison to laboratory TPH data, and represented a more conservative estimate of total VOCs in SV. A comparison of the Q3 2016 data supported this conclusion. As a result, no laboratory TPH data were used in this report to assess total VOC concentrations because laboratory TPH data did not exceed the Horiba's saturation limit of 32,760 ppmv.

2.4 Vapor Concentrations over Time (Q4 2016 Annual Report Only)

To be provided in the Q4 2016 Annual Report.

3. GROUNDWATER MONITORING NETWORK GAUGING AND SAMPLING

Quarterly GWM was conducted as part of the interim measures implemented at the BFF to assess system performance of the GWTS and determine contaminant plume changes over time. As of Q3 2016, the BFF GWM well network was comprised of the 132 GWM wells (Figure 3-1). GWM includes measuring depths to groundwater, gauging LNAPL thickness, and collecting groundwater samples for field measurements and laboratory analysis.

To characterize the distribution of the dissolved-phase contaminants in the shallow, intermediate, and deep groundwater zones, the BFF monitoring wells are classified into those three categories based on their screened intervals. No GWM wells installed in the regional aquifer zone are included in this GWM network; however, regional wells have been installed and are monitored by the U.S. Geological Survey. The groundwater zones and well screen intervals for the entire GWM network, if applicable, are summarized below:

- ***Shallow Aquifer,*** as defined in this report, extends from the water table to 200 ft below the water table. GWM of this shallow aquifer is performed in the following zones based on monitoring well screened intervals:

  - ***Shallow Zone*** is monitored by GWM wells with screens that extended from the water table to 15 ft below the water table measured at the time of well installation. Sixty GWM wells are installed in this zone. These wells were designed as water table wells with screens that were partially submerged; however, only 15 shallow zone wells remain with partially submerged screens due to rising groundwater elevations.

  - ***Intermediate Zone*** is monitored by GWM wells with screens that extend from 15 to 30 ft below the water table measured at the time of well installation. Thirty-seven GWM wells are installed in this zone.

  - ***Deep Zone*** is monitored by GWM wells with screens that extended from 30 to 130 ft below the water table measured at the time of well installation. Thirty-seven GWM wells are installed in this zone. Deep zone GWM wells installed starting in Q2 2011 were screened from 45 to 60 ft, from 85 to 100 ft, or from 115 to 130 ft below the water table measured at the time of well installation.

- ***Regional Aquifer*** contains most of the drinking water supply wells with screens 500 ft or more below the current water table. This aquifer does not contain any wells included in this GWM network.

Appendices pertinent to groundwater monitoring are listed below:

- E-1 Passive Sampling Evaluation
- E-2 Daily Quality Control Reports – Groundwater Sampling
- E-3 Groundwater and LNAPL Measurements
- E-4 Groundwater Purge Logs and Sample Collection Logs
- E-5 Groundwater Sample Chain-of-Custody Forms
- F-1 Data Quality Evaluation Report – Groundwater Samples
- F-2 Data Packages – Groundwater Samples.

3.1 New Groundwater Monitoring Activities

In addition to the standard GWM activities, a passive sampler evaluation was completed on eight wells selected along the longitudinal axis of the dissolved-phase EDB plume, including a background well. The purpose of this evaluation was to assess if the quality of the analytical data for samples collected using DMS for inorganic compounds and PDB samplers for organic compounds is comparable and a viable alternative sampling method when compared to the current sampling method using Bennett pumps and their analytical results. The GWM wells included in this study are KAFB-106009, KAFB-106015, KAFB-106021, KAFB-106059, KAFB-106082, KAFB-106083, KAFB-106084, and KAFB-106105. KAFB-106009 was part of the Q3 2016 monitoring program; however, the other seven GWM wells were sampled out of quarter using Bennett pumps for comparison to the passive sampler system. This evaluation seeks to determine if passive sampling is a viable alternative to replace the failing Bennett pump systems. A review of the evaluation is provided in Section 3.7.6 of this report and in Appendix E-1.

KAFB-106020 was not sampled as scheduled in Q2 2016 due to the need for pump removal and inspection. It was determined that the well would be sampled in Q3 2016 after rehabilitation was completed. Consequently, this well was cleaned on July 6, 2016 by brushing the well screen for approximately 30 minutes, followed by swabbing the well screen for 20 minutes. Once these activities were completed, KAFB-106020 was developed by bailing 21 times to remove the majority of the solids liberated by cleaning the screen. After bailing, development continued using a 5SQ Grundfos submersible pump that was set down the well to approximately 505 ft bgs and used to pump water from the well for 1.5 hours; during this time, the turbidity decreased from greater than 1,000 to 9.85 NTUs. A total of 160 gallons of water was extracted from KAFB-106020. A video survey was performed on July 7, 2016, which showed no evidence of damage to the well screen. KAFB-106020 will be monitored per the sampling program as part of the GWM network starting in Q4 2016.

The entire GWM well network was resurveyed by the U.S. Geological Survey in Q2 2016 for top-of-casing elevations with controlled benchmarks. The resurveyed elevations were not available at the time this report was prepared but they will be utilized for revising the calculations of groundwater elevations for the network as soon as they become available.

3.2 Groundwater Monitoring Network Optimization

Table 3-1 lists the network GWM wells and their optimized sampling and analysis requirements. In addition to quarterly sampling of select wells, water level and LNAPL measurements were performed across the entire GWM network. The activities performed are described on the Daily QC Reports for groundwater sampling (Appendix E-2). The following sections describe Q3 2016 field GWM well monitoring activities and present the analytical data for the samples collected.

3.3 Groundwater and Light Non-Aqueous Phase Liquid Level Measurement

Depths to LNAPL and groundwater were measured in all 132 wells between July 11 and July 14, 2016 and groundwater elevations were calculated, accounting for the presence of LNAPL in three wells. The measurement dates, measured depths to LNAPL and groundwater, calculated LNAPL thicknesses, and groundwater elevations are provided in Table 3-2. Forms used to record the depth to groundwater and LNAPL measurements are provided in Appendix E-3. Potentiometric surface maps for the shallow, intermediate, and deep zones of the aquifer are provided on Figures 3-2, 3-3, and 3-4, respectively.

Solinst Model 122 oil-water interface probes were used to measure the depth to LNAPL and depth to

groundwater at all locations. Prior to each use, the probes were checked for proper operation and cable integrity. Depths to LNAPL and groundwater measurements were recorded in the field on Well Gauging Forms, which are provided in Appendix E-3. The probes were decontaminated between wells.
Out of the 59 shallow wells gauged in Q3 2016, the water level in only 14 wells was present within the screened intervals (Table 3-3). Since Q2 2016, no additional well screens have become submerged; the screen for well KAFB-106026 was submerged in Q2 2106; however, this could not be confirmed because it was not gauged during Q3 2016.

As shown in Table 3-2, LNAPL was detected in shallow source area GWM wells KAFB-106005 (0.01 ft), KAFB-106008 (0.04 ft), and KAFB-106076 (0.01 ft). These wells are located in the source area and had historically exhibited elevated concentrations of EDB and BTEX. LNAPL thickness decreased by 0.01 ft in KAFB-106008 since Q2 2016 (Table 3-3).

KAFB-106005, KAFB-106008, and KAFB-106076 were inspected for LNAPL using clear bailers following completion of quarterly sampling efforts. Both KAFB-106005 and KAFB-106076 yielded small quantities of LNAPL on the first bailing attempt, but were unable to produce enough LNAPL for sample collection. KAFB-106008 yielded enough LNAPL that a sample was obtained and submitted for hydrocarbon finger printing analysis at Alpha Analytical, Inc. laboratory in Mansfield, Massachusetts. Analytical results from the hydrocarbon finger printing analyses are provided in Appendix F-2 and identify the LNAPL present to be jet propellant 4.

3.4 Quarterly Groundwater Sampling

Quarterly groundwater samples were collected using Bennett pump systems between July 11 and August 29, 2016. Samples were collected from 40 GWM wells, 32 mandated under the optimized monitoring program, one well (KAFB-106020) was sampled in Q3 2016 instead of Q2 2016, and seven wells were sampled as part of the passive sampling evaluation. Sampling of KAFB-106230 was suspended in Q3 2016 due to safety concerns (NMED, 2016a). Table 3-4 presents the GWM wells sampled in Q3 2016 and their respective groundwater zones. Well locations are shown on Figure 3-1.

GWM well sampling was performed using either a dedicated or a portable sampling system both utilizing a Bennett pump as indicated in Table 3-4. Portable Bennett sampling systems were decontaminated prior to deployment in each well. For portable pumps, new polyethylene tubing was purchased for each well not sampled in a previous quarter; the tubing measured for each well was specific to the screen depth and will be dedicated to that well for the future. A minimum of one well volume was purged from each well prior to sample collection except for wells KAFB-106084, KAFB-106099, KAFB-106102, and KAFB-106232 (these exceptions are discussed below) at a purge rate that ranged from 0.8 to 4.8 liters per minute. The depth to water was monitored the entire time of the purge to ensure that the drawdown was within the specifications. During purging, the following water quality parameters were measured and recorded on the field forms (Appendix E-4): temperature, pH, DO, turbidity, ORP, and specific conductivity. After reaching stabilization of the water quality parameters and removal of at least one well volume, the purge rate was reduced to approximately 1.0 liter per minute to collect groundwater samples for the required analyses.

Prior to sample collection, the field parameter measurements ranged as follows: temperature from 18.7 to 26.4 °C, pH from 6.87 to 8.62 standard units, specific conductivity from 264.6 to 2,193 µS/cm, DO from 0.14 to 9.52 mg/L, ORP from -313.9 to 198.4 millivolts, and turbidity from 0.19 to 21.6 NTUs. DO and ORP measurements indicated aerobic conditions in most wells except shallow wells associated with the source area, which generally had lower DO and ORP. The field parameters measured prior to sample collection are summarized in Table 3-5.

Purging and sampling conformed to the requirements, with minor exceptions (USACE, 2016b).

- Stabilization of all water quality parameters was not achieved at seven wells prior to sample collection, as follows:
  - The DO measurements at GWM wells KAFB-106009, KAFB-106059, and KAFB-106083 did not achieve stabilization as the DO concentrations were close enough to zero that the 10 percent difference was too small to obtain three consecutive readings within a reasonable amount of time. Initially, DO was not believed to have been stabilized prior to sampling well KAFB-106012R; however, inspection of the sample collection log shows that the DO concentration was filled in with a DO saturation percentage rather than the DO concentration during the final reading.
  - The ORP measurement at KAFB-106208 was not stabilized due to the narrow range of values acceptable for parameter variation. ORP at KAFB-106051 and KAFB-106203 was not stabilized and this was identified as an unintentional variance by field staff.
  - All other parameters were stabilized in seven situations and a comparison of the analytical results to previous quarterly data reveals that the data are consistent with previous findings. These factors indicate that the lack of a single field parameter stabilization did not have an impact on the data quality for the samples.
- Four wells (KAFB-106084, KAFB-106099, KAFB-106102, and KAFB-106232) were sampled this quarter without completing the required purge of one well volume, as the dedicated pumps at these wells experienced failure or near-failure while operating. However, the water quality parameters were stabilized at each well prior to sampling as per the preliminary approval for well stabilization in lieu of well purge volume requirements at the July 13, 2016 Hydrogeology Working Group meeting. A comparison of the analytical results from the four wells to previous quarterly data revealed that the data are consistent with previous findings. This indicates that well stabilization in lieu of well purge volume requirements did not have an impact on the data quality for the affected samples.

Groundwater samples were analyzed for the suites presented in Table 3-4 by Eurofins Lancaster Laboratories Environmental, LLC in Lancaster, Pennsylvania. Eurofins Lancaster Laboratories Environmental, LLC maintains current Department of Defense (DoD) Environmental Laboratory Accreditation Program certification. The groundwater purge and sampling forms are provided in Appendix E-4 and the chain-of-custody forms are provided in Appendix E-5.

3.5 Data Review and Usability Results

The Q3 2016 groundwater analytical data underwent EPA Stage 3 data validation by an independent third-party subcontractor. Subsequent to validation, data qualifiers were uploaded to the EQuIS® project database. Data were further assessed for accuracy, precision, representativeness, comparability, completeness, and sensitivity and determined to achieve project data quality objectives and were deemed usable for their intended purpose. No Q3 2016 project data were rejected. All groundwater data presented and discussed in this Report are final validated data. The Environmental Resources Program Information Management System submittal is scheduled for submittal on October 19, 2016. The Data Quality Evaluation Report for groundwater samples collected in Q3 2016 is provided in Appendix F-1 and the final laboratory data reports are included in Appendix F-2.

3.6 Project Screening Levels

The PSLs were selected to satisfy the requirements of the Kirtland AFB Permit (NMED, 2010) as the lowest of:

1. New Mexico Water Quality Control Commission (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 (New Mexico Administrative Code, 2004). For metals, the NMWQCC standard applies to dissolved metals and total mercury.

2. EPA National Primary Drinking Water Regulations; Maximum Contaminant Levels (MCLs) and Secondary MCLs; and Title 40 Code of Federal Regulations (CFR) Part 141, 143 (EPA, 2015).

If no MCL or NMWQCC standard existed for any analyte, the PSL was the EPA Tapwater Regional Screening Level (EPA, 2015).

The analytical method utilized to analyze for total nitrate/nitrite nitrogen concentrations cannot identify individual nitrate and nitrite concentrations without modification. Typically, in highly oxidizing and near neutral aquifers, nitrate is the primary nitrogen species found in groundwater (Langmuir, 1997) and previous studies in the Albuquerque Basin have used total nitrate/nitrite nitrogen concentrations as equivalent to nitrate nitrogen concentrations (Longmire, 2016; Anderholm et al., 1995). Therefore, total nitrate/nitrite nitrogen concentrations were compared to the 10 mg/L MCL for nitrate in this text.

PSLs for groundwater samples are provided in all groundwater data tables included in this report.

3.7 Groundwater Quality Data

Samples collected in Q3 2016 were analyzed for EDB. A subset of the samples was also analyzed for BTEX, total metals (arsenic, lead, calcium, magnesium, potassium, and sodium), dissolved metals (iron, manganese), anions (ammonia nitrogen, bromide, chloride, sulfate, nitrate/nitrite nitrogen, sulfide), and alkalinity (Table 3-4). Contaminant concentrations were compared to their respective PSLs, and the results of this comparison are discussed in the sections below. Of note, the analytical results for field duplicate samples are presented in the tables, and are used to assess field and laboratory analytical precision. Duplicate samples are not discussed in this text for comparison unless otherwise noted. The results for the duplicates are included in the Data Quality Evaluation Report in Appendix F-1.

Concentrations for the following analytes are depicted on figures, as follows:

- Figure 3-5 EDB Concentrations, Q3 2016
- Figure 3-6 BTEX Concentrations, Q3 2016
- Figure 3-7 Nitrate/Nitrite Nitrogen, Sulfate, and Chloride Concentrations, Q3 2016
- Figure 3-8 Total Alkalinity as Calcium Carbonate, Bromide, and Dissolved Iron and Manganese Concentrations, Q3 2016
- Figure 3-9 Dissolved Oxygen Concentrations and Oxygen Reduction Potential, Q3 2016.

3.7.1 Sample Results for Sentinel Wells

The purpose of sampling the 27 sentinel wells (nine VA and 18 downgradient proximal GWM wells) is to ensure protectiveness of downgradient drinking water supply wells. Data from these wells serve to trigger actions in the event that contaminants of concern exceed pre-determined concentrations (i.e., MCLs). Q3 2016 analytical results for VA proximal wells are provided in Table 3-6, and for downgradient proximal wells in Table 3-7.

Samples from all 27 sentinel GWM wells were analyzed for EDB. In addition, the nine samples from the VA proximal wells were also analyzed for BTEX. EDB was the only organic compound detected in the samples. The only EDB detection was below the 0.05 µg/L MCL at a concentration of 0.016J µg/L in KAFB-106205 (Figure 3-5).

3.7.2 Sample Results for Newly-Installed Wells

NMED requires four quarterly sampling events for newly-installed monitoring wells prior to implementing the approved optimized monitoring program. Three newly-installed GWM wells (KAFB-106230, KAFB-106231, and KAFB-106232) are currently in this quarterly program (Table 3-8). Groundwater analytical results from Q3 2016 for two newly-installed wells are provided in Table 3-9. KAFB-106230 was not sampled in Q3 2016 due to safety concerns that are noted from NMED (NMED, 2016a). The aquifer zone where the wells are screened is also shown in Table 3-9.

3.7.2.1 Organic Compounds Analytical Results

EDB was not detected in either KAFB-106231 or KAFB-106232.

3.7.2.2 Inorganic Compounds Analytical Results

Inorganic analytes consisted of metals, anions, and alkalinity and were detected in both samples collected from newly-installed wells; however, no newly-installed GWM wells exceeded the PSL for inorganic analytes.

3.7.3 Sample Results for Source Area Wells

Three GWM wells (KAFB-106005, KAFB-106009, and KAFB-106012R) located in the source area (Figure 3-1) were sampled during Q3 2016 and sample analytical results are provided in Table 3-10 and summarized below. KAFB-106059 is not part of the Q3 2016 sampling program but was sampled for the analytical comparison between passive sampling system and active Bennett pump system.

3.7.3.1 Organic Compounds Analytical Results

Organic compounds, including EDB and BTEX compounds, were detected in samples collected from source area GWM wells except in KAFB-106012R. PSL exceedances were noted as follows:

- EDB was detected above the 0.05 µg/L PSL in the sample from KAFB-106005 with a concentration of 0.74J µg/L (Figure 3-5). The J-flagged (estimated) EDB result exceeding the PSL is due to interference with the method QC sample (laboratory control spike) causing the recovery to be outside of the control limit. This interference is caused by the elevated analyte concentration in the well sample.

- Benzene was detected in two of the three samples, and exceeded the 5.0 µg/L PSL in samples from KAFB-106005 with a concentration of 1,300 µg/L (Figure 3-6).

3.7.3.2 Inorganic Compounds Analytical Results

Inorganic analytes consisted of metals, anions, and alkalinity and were detected in most samples collected from source area GWM wells. PSL exceedances were noted as follows:

- Chloride was detected in all three samples, with only one exceedance of the 250 mg/L PSL in the sample from KAFB-106009 at 367 mg/L (Figure 3-7).
- Sulfate was detected in all three samples, with exceedances of the 250 mg/L PSL in samples from KAFB-106009 and KAFB-106012R; the highest concentration was 446 mg/L, measured in the sample from KAFB-106009 (Figure 3-7).
- Nitrate/nitrite nitrogen was detected in the three wells sampled (KAFB-106005, KAFB-106009, and KAFB-106012R). The highest concentration (13.5J mg/L) was measured in the sample from KAFB-106009 and was the only detection above the 10 mg/L PSL established for nitrate (Figure 3-7).
- Dissolved manganese was detected in samples from two of the three wells and all concentrations exceeded the 0.2 mg/L PSL; the highest concentration was 1.82J mg/L in the sample collected from KAFB-106009 (Figure 3-8).

The J-flagged (estimated) dissolved manganese and nitrate/nitrite nitrogen results exceeding the PSL are due to interference with the method QC sample (matrix spike) causing the recovery to be outside of the control limit. This interference is caused by the elevated analyte concentration in the well sample.

3.7.4 Sample Results for Groundwater Monitoring Network Wells

One GWM well (KAFB-106020) was rehabilitated and sampled in Q3 2016 because it could not be sampled in Q2 2016. No concentrations exceeded the PSLs. Sample analytical results are provided in Table 3-11 and are depicted on Figures 3-5, 3-7, 3-8, and 3-9.

3.7.5 Groundwater Trends of the Analysis Performed

Aerobic microorganisms require the presence of DO to effectively break down organic compounds found in the environment. Decreased DO and ORP can be indicators of microbial degradation in a subsurface environment as increased microbial activity can result in anaerobic conditions. These conditions are often associated with microbial growth and the subsequent degradation of organic compounds in an environment. Field measurements for DO and ORP (Figure 3-9) appeared to be higher outside of the distal EDB plume area and lower close to and just downgradient of the source area. This indicates that aerobic microbial degradation of the fuel constituents is occurring within the benzene and EDB plumes based on the DO and ORP.

Higher alkalinity and dissolved metals concentrations can often be associated with microbial activity as increased microbial activity can cause the dissolution of minerals found in the saturated subsurface. The dissolution of minerals is associated with excess respiration of CO_2 and subsequent drop in pH caused by high rates of microbial activity. The highest total alkalinity measurements are present within the benzene plume with the highest detection in KAFB-106059. Wells situated outside of the benzene plume have similar concentrations of total alkalinity (Figure 3-8). The five PSL exceedances for dissolved manganese and the only exceedances for dissolved iron were detected in samples collected in the vicinity of the benzene plume (Figure 3-8). The elevated alkalinity and dissolved metal concentrations along with lower DO and ORP measurements within the benzene and EDB plumes indicates the native aerobic microbial community is biodegrading the fuel constituents present in the groundwater.

Decreased concentrations of nitrate/nitrite nitrogen and sulfate are often associated with microbial activity. Nitrogen is incorporated into microbial biomass and sulfate can be used as an energy source by some microorganisms. The highest nitrate/nitrite nitrogen and sulfate concentrations occurred in source area well KAFB-106009 (Figure 3-7). Additionally, the only exceedance of the chloride PSL was found in the sample from KAFB-106009. These findings are consistent with an extraneous source of nitrate/nitrite nitrogen and sulfate in the vicinity of KAFB-106009 such as a leaking sewer line. Investigation of over 1,000 ft of newer sewer line located in Randolph Street was initiated by the Kirtland AFB in December 2015 with camera surveys and indicated that the sewer line was intact. Additional investigations are ongoing into the manholes and other possible sources of leakage.

Degradation of EDB can result in elevated concentrations of bromide in the subsurface as bromide ions can be liberated from EDB during decomposition. The highest bromide concentration was detected in the sample from KAFB-106009 (Figure 3-8).

Increasing ORP levels and anion and cation concentrations have been observed at three on-Base source area wells screened in the shallow zone: KAFB-106005, KAFB-106009, and KAFB-106012R. The anions included chloride, sulfate, and nitrate/nitrite nitrogen and the cations included calcium and sodium. As a consequence, these source area wells were monitored during Q3 2016 and samples were analyzed for BTEX, EDB, select metals, anions, and alkalinity. Water quality parameters, including ORP, were measured in the field prior to sample collection; chloride, sulfate, nitrate/nitrite nitrogen, calcium, and sodium were analyzed in samples sent to the off-Site laboratory. Table 3-12 presents the ORP and laboratory results for the three shallow zone wells. A thorough discussion of the data trends at these three wells will be provided in the Q4 2016 Annual Report.

3.7.6 Dual-Membrane Sampler Evaluation

The purpose of this evaluation was to assess if the quality of the analytical data for samples collected using DMS for inorganic compounds and PDBs for organic compounds was comparable to that of analytical results for samples collected using portable Bennett pump systems (Appendix E-1). The evaluation will ultimately conclude if DMS and PDB samplers are a viable alternative to replace the failing Bennett sampling pump systems.

A passive sampling evaluation utilizing DMS and PDB samplers was conducted on eight wells (KAFB-106009, KAFB-106015, KAFB-106021, KAFB-106059, KAFB-106082, KAFB-106083, KAFB-106084, and KAFB-106105) located along the longitudinal axis of the EDB plume, including a background well (Figure 3-10). Of these eight wells, only one was included in Q3 2016 sampling; however, the analytical suites were expanded to include all of the analytes included in the DMS evaluation (see below).

Evaluation samples collected in Q2 and Q3 2016 were analyzed for EDB, BTEX, total metals (arsenic, lead, calcium, magnesium, potassium, and sodium), dissolved metals (iron and manganese), anions (ammonia nitrogen, bromide, chloride, sulfate, nitrate/nitrite nitrogen, and sulfide), and alkalinity (Table 3-13). In wells with shorter screened intervals where only six of the eight passive samplers could be deployed, the samplers for ammonia nitrogen analysis were not deployed.

Since the DMS utilized for EDB collection in the first round of sampling were located at the highest level of the screened interval, a decision was made to deploy PDBs to collect samples for the analysis of organic compounds (EDB and BTEX) from the top position on the tethers during Q3 2016. This replacement was meant to assess if sample collection using PDBs could achieve lower relative percent differences (RPDs) for volatile organic compounds (VOCs) than when collected using DMS, as PDBs are specifically designed for the collection of samples for analysis of VOCs.

The acceptable RPD for duplicate groundwater samples is ± 35 percent (USACE, 2016b) and is calculated as follows:

$$RPD = \left(\frac{R_B - R_D}{\left[\frac{R_B + R_D}{2} \right]} \right) * 100$$

where:

R_B = Result from sample obtained using Bennett sampling system.
R_D = Result from sample obtained using passive sampling system.

The majority of the organic and inorganic analytical results from samples collected using the Bennett pump systems and DMS/PDB were similar, with RPDs generally less than 20 percent in Q3 2016 (as well as Q2 2016 (Table 3-13). Of the RPDs obtained through Q2 and Q3 2016, 17 of the 153 RPDs calculated (11 percent) exceeded the acceptable 35 percent for duplicate groundwater samples. PDBs appeared to have similar RPDs for EDB and BTEX with Bennett samples compared to DMS with Bennett samples. Further analysis of these results is presented in Appendix E-1.

3.8 Time-Series Analysis of Groundwater Elevations and Light Non-Aqueous Phase Liquid Thicknesses (Q4 2016 Annual Report Only)

This section will be provided in the Q4 2016 Annual Report.

3.9 Time-Series Analysis of Concentrations in Groundwater (Q4 2016 Annual Report Only)

This section will be provided in the Q4 2016 Annual Report.

3.10 Groundwater Monitoring Well Network Operation and Maintenance

The GWM wells were inspected between August 15 and August 19, 2016 for integrity and security. These inspections were performed to ensure that the condition of all protective covers and wellheads met the intended requirements for performance and security. Following the inspections, GWM wells requiring maintenance were serviced and additional information on GWM network maintenance is provided in the GWM Well Network Maintenance Report (USACE, 2016e).

Dedicated sampling systems were removed during Q3 2016 from the following wells: KAFB-106014, KAFB-106035, KAFB-106036, KAFB-106063, KAFB-106099, KAFB-106102, KAFB-106207, KAFB-106212, KAFB-106226, and KAFB-106232 (Figure 3-11) because the Bennett pumps underwent failure, were near failure, or they needed to be removed for the vertical passive sampling profile demonstration in Q3 2016. Portable Bennett pump systems will be used to sample these wells in the future.

4. DRINKING WATER SUPPLY WELL MONITORING

Four drinking water supply wells (KAFB-003, KAFB-015, KAFB-016, and ST106-VA-2) provide drinking water to Kirtland AFB employees and tenants, and VA Medical Center patients, employees, and visitors. Monthly organic compound sampling and analyses were performed during Q3 2016 at drinking water supply wells KAFB-003 and ST106-VA-2 as part of the monitoring associated with the BFF site. Repairs were ongoing at KAFB-015 during the first part of Q3 2016, and were completed in August 2016. This drinking water supply well was sampled during the September 2016 event. The samples were analyzed for EDB and BTEX due to the proximity of these wells to the dissolved-phase EDB and benzene plumes. KAFB-016 was not operational due to ongoing maintenance and, therefore, was not sampled in Q3 2016.

4.1 Drinking Water Supply Well Sampling and Analysis Procedures

Field DO, pH, ORP, conductivity, turbidity, and temperature measurements were made using a Yellow Springs Instrument 556 multi-probe system. Instrument calibration was performed daily for QC to ensure accurate readings. Field measurements were obtained prior to the collection of drinking water samples. The sample port at each drinking water wellhead was opened for 30 seconds prior to sampling or obtaining measurements to purge any entrained sediment. After field data were obtained, sample containers were filled. Upon filling, the sample containers were immediately sealed, labeled, and put into a cooler. Daily field activity logs and calibration logs are included in Appendix G-1. Completed sample collection logs and chain-of-custody forms are included in Appendix G-2.

Drinking water supply samples were collected for the following analyses:

- EDB using EPA Method 504.1
- BTEX using EPA Method 524.2.

Samples were submitted to TestAmerica Laboratories, Inc. in Savannah, Georgia for analytical testing. Analytical results were validated by Laboratory Data Consultants, Inc. The Data Quality Evaluation Report is included in Appendix H-1. TestAmerica Laboratories Inc. reports for July, August, and September 2016 are included in Appendix H-2.

4.2 Data Review and Usability

Laboratory Data Consultants, Inc. performed a 100 percent Level 3 data validation for Q3 2016 organic compound analytical data. All data were usable, and no data were qualified as rejected. The data met data quality objectives and were appropriate for use in project decision-making. The QC parameter and data quality indicator (precision, bias [accuracy], representativeness, comparability, completeness, and sensitivity) evaluation results are provided in the Data Quality Assessment Report and Data Validation Report included in Appendix H-1 for organic compounds. Final validated data are presented in Table 4-1.

4.3 Drinking Water Supply Well Water Quality

Analytical results for July, August, and September 2016 are presented in Table 4-1 and Appendix H-2, and presented in Figure 4-1. PSLs for drinking water supply wells were the lower of either the EPA MCLs or NMWQCC screening levels, as discussed in Section 3.5. There were no EDB or BTEX detections above the limit of detection at drinking water supply wells KAFB-003 or ST106-VA-2 sampled in July, August, or September 2016. This indicated that both wells had no detectable concentrations of EDB and BTEX in the drinking water that is supplied to Kirtland AFB employees and tenants, and VA Medical Center patients, employees, and visitors. KAFB-015 was sampled in September 2016 after ongoing repairs were completed. The analyses for this well showed no detections for all constituents with the exception of total xylenes, which had a J detection of 0.16 µg/L, substantially below the 10,000 µg/L total xylene PSL. This detection was most likely related to the repairs and replacement of surface infrastructure performed at KAFB-15 prior to September 2016, and not representative of groundwater concentrations at the well location.

5. GROUNDWATER CAPTURE AND TREATMENT SYSTEM OPERATION

The GWTS was operated during Q3 2016 to treat groundwater extracted from the distal portion of the EDB plume. The current GWTS is comprised of three extraction wells (KAFB-106228, KAFB-106233, and KAFB-106234), conveyance piping, and a 400-gallon per minute (gpm) capacity carbon treatment system (Figure 5-1). The pump in KAFB-106233 remained off-line for the entirety of Q3 2016 to prevent biofouling and clogging of the GWTS. During Q3 2016, the GWTS treated 32,320,000 gallons of groundwater with all treated water discharged to the Kirtland AFB golf course main pond (Figure 5-1). Table 5-1 provides a summary of groundwater quantities extracted, treated, and discharged. The sections below discuss plume capture evaluation, system evaluation metrics, and issues encountered throughout Q3 2016. Supporting documentation for GWTS performance is located in Appendix I-1. New Mexico 811 line location tickets are located in Appendix I-2.

5.1 Plume Capture and Reduction

Figure 5-2 presents the shallow zone aquifer groundwater potentiometric surface map in conjunction with the Q2 2016 shallow EDB contour map (USACE, 2016f) and shows the continued capture of the distal EDB plume. A more thorough evaluation of plume capture and EDB mass reduction will be presented in Q4 2016.

5.2 Groundwater Treatment System Operation

Overall system performance is evaluated by looking at multiple performance metrics: system run time metrics, several extraction well performance metrics, and changes in analyte concentrations. Brief discussions of these performance metrics along with comparison of the values from Q3 2016 with Q2 2016 follow.

5.2.1 System Operation and Percentage Run Time

For the purpose of run time evaluation, GWTS operation is defined as water being pumped from at least one extraction well and water being treated and discharged. From July 1 through September 30, 2016, the GWTS was operational 85 percent of the time, which is a 7 percent reduction relative to Q2 2016. This decrease in operational run time stems from planned and unplanned system shutdowns, which are further described in Section 5.3.3.

5.2.2 Well Performance Metrics

5.2.2.1 Extraction Rates

Average extraction rates from each well include downtime for a conservative estimate of pump performance. Water was extracted from KAFB-106228 from July 11 through September 30, 2016 at an average rate of 108.0 gpm, an 18.4 gpm increase from Q2 2016. Water was not extracted from KAFB-106233 for the entirety of Q3 2016 due to fouling concerns under investigation by the USACE Engineer Research and Development Center (ERDC) (Appendix I-1). The pump in KAFB-106234 was functional from July 1 through September 30, 2016 at an average of 125.5 gpm, a 39.5 gpm decrease from the Q2 2016 average. Table 5-2 provides a summary of monthly performance of the extraction wells.

5.2.2.2 Specific Capacity

The specific capacity for KAFB-106228 was between 2.72 and 2.76 gpm/ft for the 14 days that it pumped after being restarted on July 11, 2016. On August 2, 2016, there was an increase in specific capacity to 5.12 gpm/ft; however, overall specific capacity showed a decreasing trend throughout the quarter to 4.62 gpm/ft on September 30, 2016.

The specific capacity for KAFB-106234 showed a slight increase between the beginning (30.54 gpm/ft) and end of the quarter (34.63 gpm/ft), indicating that the well may still be undergoing development. Specific capacity in KAFB-106234 appears to show several instances where the water level transducer may have recorded incorrect readings as there are large peaks in the well's specific capacity. Specific capacity measurements will continue to be monitored and the transducer performance will be assessed in Q4 2016. Specific capacities for each extraction well were plotted over time and are included in Appendix I-1 under well performance figures.

5.2.3 Analytical Metrics and Ethylene Dibromide Removal

Monthly GWTS samples were collected from the untreated influent, post-granular activated carbon (GAC) 1, and the treated effluent (post-GAC 2) sample ports. GWTS performance sample collection logs are located in Appendix I-3. Samples were analyzed for EDB, BTEX, and dissolved metals (iron and manganese). GWTS effluent discharge limits are provided as PSLs in Table 5-3. All analyte concentrations for effluent samples collected during Q3 2016 were below their respective limits of detection (Table 5-3).

The Q3 2016 GWTS analytical data underwent EPA Stage 3 data validation by an independent third party. Additionally, the data were assessed for accuracy, precision, representativeness, comparability, completeness, and sensitivity to determine if the project data quality objectives were achieved and usable for their intended purpose. No Q3 2016 GWTS data were rejected. The results of the validation are included in the Data Quality Evaluation Report provided in Appendix I-4, and the final laboratory data reports are included in Appendix I-5.

From July 1 through September 30, 2016, an estimated 10,080 milligrams of EDB was captured in the lead GAC vessel by taking the sum of each monthly influent concentration multiplied by the respective total monthly treated volume (Table 5-4). Flow measurements were collected weekly and, therefore, measurement dates often did not correspond with the beginning and end dates of each month. Monthly treated volumes were calculated using weekly flow measurements and, in instances where weekly flow measurements included dates outside of the month, weekly treated volumes were interpolated to correspond with the monthly start and end dates.

5.3 Groundwater Treatment System Maintenance and Expansion

5.3.1 Routine Maintenance Activities

Significantly less frequent bag filter change-out was required during Q3 2016 as compared with Q2 2016. This was because the pump in KAFB-106233, which produced water that was biofouled and clogged the influent bag filters approximately every three days when operational during Q2 2016, was off-line as of June 17, 2016.

During Q3 2016, bag filters were only changed out twice, on August 26 and September 30, 2016. Effluent bag filters were changed out and the Y-strainer was cleaned on September 30, 2016. Differential pressures in the lead and lag GAC vessels showed only small increases (2.2 and 1.3 pounds per square inch, respectively) throughout the quarter. No maintenance was required or performed on either GAC vessel.

The GWTS routine maintenance schedule is provided as Table 5-5. During Q3 2016, non-routine system operational issues were encountered; these are discussed in Section 5.3.3.

5.3.2 Conveyance Line Security and Administrative Controls

Kirtland AFB is registered as a line-owner with New Mexico 811 for the off-Base portion of the conveyance lines. Permits are required for all on-Base excavation projects. During Q3 2016, Kirtland AFB responded to 18 off-Base tickets requested through New Mexico 811 (Appendix I-2).

5.3.3 Non-Routine Maintenance Activities

5.3.3.1 Extraction Well KAFB-106228 Pump Motor Replacement and Restart

Extraction well KAFB-106228 was shut down from April 19 through July 11, 2016 and the pump was replaced on July 7, 2016. The submerged portion of the drop pipe was also replaced and a sacrificial anode was installed to mitigate future oxidation of the drop pipe or pump. The new pump was started on July 11, 2016, and was only taken off-line for scheduled or temporary and unscheduled shutdowns not pertaining to issues with the pump in this well.

5.3.3.2 Operational Issues

During Q3 2016, multiple unscheduled system shutdowns occurred. On several occasions, the system shut down due to heavy rain that caused flooding in well vaults, which triggered high water alert alarms. The next day following high water alert alarms, the vaults were drained of rainwater if it was necessary and the vaults were cleaned and inspected.

<u>Extraction Well KAFB-106228 Operational Issues</u>

On September 3, 2016, the flowmeter at KAFB-106228 began reading negative flow rates while the pump was running. On September 5, 2016, the flowmeter at KAFB-106228 was inspected and found to be corroded. The incorrect communication of flow rate to the human machine interface in turn resulted in delayed system-wide shutdowns until the corroded components were replaced and the system was restarted on September 6, 2016.

<u>Extraction Well KAFB-106233 Operational Issues</u>

The pump at KAFB-106233 shut down in June 10, 2016, and remained off-line during the entirety of Q3 2016. Resuming operation is pending well rehabilitation and installation of sand filters at the GWTS. USACE ERDC provided a final report (Appendix I-1) on the biofouling issues tested in Q2 2016 and recommended installation of sand filters prior to the bag filters at the GWTS to mitigate any future downstream fouling issues. Rehabilitation and restarting of KAFB-106233 are scheduled for Q1 2017.

Extraction Well KAFB-106234 Operational Issues

KAFB-106234 experienced sporadic shutdowns beginning the week of July 20, 2016. The shutdowns were determined to be the result of two primary issues. The first cause of sporadic shutdowns was clogging of the influent flowmeter measurement ports on the skid pump by biofouled water, which resulted in the transmission of erroneous readings to the human machine interface. This resulted in several full system shutdowns prior to replacement of the flowmeter. The flowmeter was taken off-line on July 29, 2016 and replaced with a temporary strap-on flowmeter to correct the problem. The system operated utilizing the temporary strap-on flowmeter through the end of the quarter. Replacement of the temporary flowmeter with a permanent flowmeter will occur during the GWTS expansion in Q4 2016.

The second cause of shutdowns occurred due to overheating of the new variable frequency drive transformers in the well-control house. When the variable frequency drive transformer for KAFB-106234 overheated, it would cause an unalarmed shutdown of the pump in KAFB-106234, which resulted in a delayed system-wide shutdown. Shutting down KAFB-106234 for approximately four hours during the hottest part of each day provided a temporary solution to the overheating problem. This issue was resolved long-term by installing an air conditioning unit in the well-control house.

5.3.4 Expansion Activities

Expansion efforts began at the GWTS during Q3 2016. Below is a summary of work performed as part of the GWTS expansion. The daily reports associated with GWTS expansion are provided in Appendix I-1.

On September 22, 2016, wiring from the GWTS dust suppression system was connected to the human machine interface and the emergency stop button sign was installed.

On September 23, 2016, two overhead lights were removed in preparation for the addition of another GAC treatment train.

On September 27, 2016, all locations for new equipment planned for installation in the GWTS were marked and extensions were added to vault air release valve drop pipes.

On September 28, 2016, two GAC vessels, two influent tanks, and two pump skids were delivered and set inside of the GWTS. Further installation of delivered equipment will occur beginning in Q4 2016.

6. INVESTIGATION-DERIVED WASTE

During Q3 2016, investigation-derived waste (IDW) was generated during operations at the BFF site consisting of liquid and non-liquid IDW. Some IDW generated during Q2 2016 was held for disposal in Q3 2016. Liquid IDW was associated with groundwater sampling and equipment decontamination activities. Solid IDW consisted of passive sampling equipment, bag filters, and dedicated sampling system equipment.

6.1 Liquid Investigation-Derived Waste

Liquid IDW generated during Q3 2016 consisted of purge water associated with GWM well sampling and decontamination water generated from cleaning non-dedicated sampling equipment. Disposal of liquid IDW to the GWTS was evaluated by comparing historical data to the discharge limits. Liquid IDW was not to be discharged if it would cause the GWTS effluent to exceed the following concentration limits: 0.05 µg/L EDB, 5 µg/L benzene, 750 µg/L toluene, 700 µg/L ethylbenzene, 620 µg/L total xylenes, 1 mg/L dissolved iron, and 0.2 mg/L dissolved manganese.

The distinction between hazardous and non-hazardous liquid IDW was made prior to sampling the GWM network in Q3 2016 by considering historical data available for each GWM well and identifying the liquid IDW originating from each well as hazardous if the concentration of benzene exceeded 500 µg/L in any of the previous four quarters. Decontamination water was considered non-hazardous due to the low potential of it carrying residual contamination from the GWM water and was added to the GWM purge water sampled prior to decontamination. This ensured the decontamination water was handled and treated to the same extent as the water that created the need for decontamination to occur.

6.1.1 Non-Hazardous Liquid Investigation-Derived Waste

Liquid IDW was collected in 55-gallon plastic drums that were sealed with plastic covers with locking-ring steel collars and 275-gallon plastic totes with threaded caps. Liquid IDW from individual wells was segregated into separate drums and totes, which were labeled with vinyl non-hazardous waste labels, and transferred to the designated IDW storage yard located on Kirtland AFB.

A total of 73 drums containing 2,807 gallons and five, five-gallon buckets containing 13 gallons of non-hazardous liquid IDW were generated during Q3 2016. Non-hazardous purge water was batch fed through the GWTS between July 11 and September 26, 2016. Six drums containing 245 gallons of Q2 2016 decontamination water were batch fed through the GWTS on September 26, 2016 following receipt of analytical data supporting its non-hazardous status. Table J-1-1 (Appendix J-1) provides well-specific purge water details. All GWTS effluent exhibited concentrations of dissolved iron and manganese below permit discharge limits.

Non-hazardous liquid IDW generated in Q2 and Q3 2016 that contained concentrations of dissolved iron and manganese above the permit discharge limits was retained in the IDW pending disposal yard waiting off-Site disposal. A summary of all non-hazardous liquid IDW pending analysis and temporarily stored in the IDW yard is provided in Table J-1-1 (Appendix J-1).

6.1.2 Hazardous Liquid Investigation-Derived Waste

Hazardous purge water collected from KAFB-106005, KAFB-106008, KAFB-106010, KAFB-106014, KAFB-106028, KAFB-106059, KAFB-106064, and KAFB-106076 in Q2 2016 was removed from the 90-day accumulation area on August 8, 2016 by Advance Chemical Transport, Inc. for disposal, as summarized in Table J-2-1. Total IDW included 15 drums and approximately 625 gallons of hazardous (DO018) liquid IDW. Waste profiles and supporting analytical data are provided in Appendix J-2.

During the Q3 2016 sampling event, purge water was stored from KAFB-106005 and KAFB-106059 known historically to have contained benzene concentrations above the characteristic hazardous waste toxicity criteria (40 CFR Part 261.24). Purging these wells generated two drums and approximately 125 gallons of hazardous (DO18) liquid IDW. The drums were labeled as hazardous waste (DO018) and placed in the Kirtland AFB 90-day accumulation area pending analytical results, as summarized in Appendix J-2.

6.2 Non-Liquid Investigation-Derived Waste

Two drums containing non-liquid waste were held in the IDW pending analysis yard prior to off-Site disposal. One drum contained GAC that was removed from the lead GAC vessel of the GWTS on June 17, 2016. This drum was removed by Advance Chemical Transport, Inc. on August 31, 2016 and disposed of as non-hazardous solid waste. The second drum contained equipment solid waste associated with passive sampling of eight wells during Q2 2016. The passive sampling equipment and bag filters were disposed of as municipal solid waste. Table J-3-1 (Appendix J-3) provides specific details on the solid waste being held in the pending analysis yard. The waste profiles and supporting analytical data for all solid wastes managed this quarter are provided in Appendix J-3.

7. PROJECTED ACTIVITIES

Q4 2016 will comprise the period between October 1 and December 31, 2016. Planned Q4 2016 activities are summarized below.

Vadose Zone Monitoring

- Vadose Zone monitoring will be performed between October 3 and October 21, 2016.

Groundwater Monitoring

- GWM will be performed between October 1 and late November 2016.
- Two new data gap wells will be installed on the northwest portion of the EDB distal plume (KAFB-106235 and KAFB-106236).
- The vertical profiling evaluation will continue with passive sampling equipment.

Drinking Water Supply Well Monitoring

- Drinking water supply well monitoring will be performed monthly for organic compound analysis.
- Additional semi-annual monitoring will be performed for inorganic compound analysis on October 3, 2016.

Groundwater Treatment System Operation

- One new extraction well (KAFB-106239) will be installed along Ridgecrest Drive.
- The second treatment train with an additional capacity of 400 gpm will be constructed in the GWTS.
- GWTS operation and maintenance will continue.
- Planning activities will proceed for the rehabilitation of extraction well KAFB-106233.

Reporting

An annual report will be prepared to detail the activities conducted during the quarter. In addition, the annual report will include in-depth analyses of the data collected during the four quarters of 2016. The report will discuss trends observed relative to remediation progress, draw conclusions relative to the effectiveness of the interim measures, and provide recommendations for optimizing remedial performance in 2017.

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