KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

QUARTERLY REPORT – JULY–SEPTEMBER 2018
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

DECEMBER 2018

377 MSG/CEI
2050 Wyoming Boulevard SE
Kirtland Air Force Base, New Mexico 87117-5270

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Quarterly Report – July–September 2018
Bulk Fuels Facility
Solid Waste Management Unit ST-106/SS-111
Kirtland Air Force Base, New Mexico

December 2018

Prepared for

U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza Northeast
Albuquerque, New Mexico 87109-3435

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
320 Gold Avenue Southwest, Suite 1300
Albuquerque, New Mexico 87102
Contract No. W912DR-12-D-0006
Delivery Order DM01

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.

Government agencies and their contractors registered with the Defense Technical Information Center should direct requests for copies of this report to: Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22304-6145.

Non-government agencies may purchase copies of this document from: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED *(From - To)***
31-12-2018	Revision 0	01-07-2018 – 30-09-2018

4. TITLE AND SUBTITLE
Quarterly Report – July–September 2018
Bulk Fuels Facility,
Solid Waste Management Unit ST-106/SS-111
Kirtland Air Force Base, New Mexico

5a. CONTRACT NUMBER
W912DR-12-D-0006-DM01

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
EA Engineering, Science, and Technology, Inc., PBC
Sundance Consulting, Inc.

5d. PROJECT NUMBER
62599DM01

5e. TASK NUMBER
1024

5f. WORK UNIT NUMBER
Not applicable

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AND ADDRESS(ES)
EA Engineering, Science, and Technology, Inc., PBC
320 Gold Avenue Southwest, Suite 1300
Albuquerque, New Mexico 87102

8. PERFORMING ORGANIZATION REPORT NUMBER
Not assigned

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers–Albuquerque District
4101 Jefferson Plaza Northeast
Albuquerque, New Mexico 87109-3435

10.SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This Quarterly Report describes activities performed from July 1 through September 30, 2018, and the progress 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, New Mexico. Groundwater, drinking water from proximal 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 extracted and treated 61,523,100 gallons of groundwater through a granular activated carbon filtration system and discharged the treated effluent to the Tijeras Arroyo Golf Course main pond throughout the quarter.

15. SUBJECT TERMS
Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111, Interim Measures, RCRA, groundwater sampling, groundwater treatment system operation, granular activated carbon, ethylene dibromide

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
					Devon Jercinovic
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	ABSTRACT	11,010	**19b. TELEPHONE NUMBER** *(include area code)* 505-715-4248
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED			

Standard Form 298
(Rev. 8-98) **Prescribed by ANSI Std. Z39.18**

40 CFR 270.11
DOCUMENT CERTIFICATION

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.

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, U.S. Air Force
Commander, 377th Air Base Wing

DEC 11 2018
Date

This document has been approved for public release.

Adhana Zuch

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

DEC 11 2018
Date

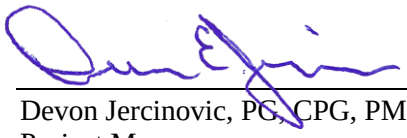
PREFACE

This Quarterly Report – July-September 2018 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 contains data collected by EA itself as well as from other entities/sources that are not under EA's direct control (collectively "non-EA data"). All non-EA data reported herein are displayed in the form they were received from their source entity and EA assumes no liability for the accuracy of any non-EA data in this report.

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 groundwater and drinking water, and operation of the groundwater treatment system were conducted from July 1 through September 30, 2018. Mr. Behnaum Moayyad, PE, is the U.S. Army Corps of Engineers–Albuquerque District Project Manager. The Environmental Restoration Section Chief for this program is Mr. Scott Clark of Kirtland Air Force Base. Ms. Devon Jercinovic is the EA Project Manager.



Devon Jercinovic, PG, CPG, PMP
Project Manager
EA Engineering, Science, and Technology, Inc., PBC

CONTENTS

Section **Page**

APPENDICES

FIGURES

TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	microgram(s) per liter
%	percent
AFB	Air Force Base
BFF	Bulk Fuels Facility
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CFR	Code of Federal Regulations
DO	dissolved oxygen
DP	discharge permit
EA	EA Engineering, Science, and Technology, Inc., PBC
EDB	ethylene dibromide
EFF	effluent
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ft	foot (feet)
GAC	granular activated carbon
GCMP	Golf Course main pond
gpm	gallon(s) per minute
GWM	groundwater monitoring
GWTS	groundwater treatment system
IDW	investigation-derived waste
INF	influent
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
mg	milligram(s)
mg/L	milligram(s) per liter
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
No.	number
ORP	oxidation reduction potential

LIST OF ACRONYMS AND ABBREVIATIONS

psi	pound(s) per square inch
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
RCRA	Resource Conservation and Recovery Act
REI	reference elevation interval
SE	Southeast
SVM	soil vapor monitoring
SWMU	Solid Waste Management Unit
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VA	Veterans Affairs

EXECUTIVE SUMMARY

This Quarterly Report for the third quarter (Q3) of calendar year 2018 summarizes the activities performed from July 1 through September 30, 2018 at Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF), designated as Solid Waste Management Units (SWMU) ST-106/SS-111. These activities are part of the ongoing monitoring for the Resource Conservation and Recovery Act (RCRA) Facility Investigation Addendum and to support the evaluation of the interim measures for soil and groundwater remediation at the BFF site, pursuant to the Hazardous Waste Treatment Facility Operating Permit Number (No.) NM9570024423 (RCRA Permit) (New Mexico Environment Department [NMED], 2010).

This Executive Summary describes the following groundwater monitoring (GWM) and interim measure activities performed at the BFF between July and September 2018, which comprised Q3 2018:

- Installation of six nested GWM wells, each consisting of a water table well and a shallower contingency well (above the current groundwater elevation)
- Sampling the Q3 2018 designated wells in the GWM network
- Sampling the drinking water supply wells located in the vicinity of the dissolved-phase benzene and ethylene dibromide (EDB) plumes
- Operation and maintenance of the groundwater treatment system (GWTS).
- Continuation of Phase 3 of the EDB *in situ* biodegradation pilot study
- Projected activities in the fourth quarter (Q4) 2018.

ES-1 Vadose Zone Monitoring

No soil vapor samples were collected during Q3 2018 in accordance with the soil vapor monitoring (SVM) optimization plan approved on January 4, 2017. SVM is performed in the second quarter (Q2) and Q4 of each monitoring year.

ES-2 Groundwater Monitoring Network Gauging and Sampling

Six new nested GWM wells were installed in Q3 2018 (Figure 3-1) to provide groundwater quality data at the top of the groundwater interface with the vadose zone (NMED, 2018a). Five well nests are located off-Base (KAFB-106240, KAFB-106241, KAFB-106242, KAFB-106243, KAFB-106244). KAFB-106246, a replacement non-nested contingency well for KAFB-106240 is discussed along with KAFB-106240 in this report. One of the newly installed nested wells (KAFB-106245) is located on Kirtland AFB. All the newly installed nested well locations consist of one water table well and one shallower contingency well that are anticipated for future use as the water table continues to rise.

In Q3 2018, 53 Kirtland BFF GWM wells (Figure 3-1) were sampled and depths to groundwater were measured in 152 GWM wells. Depths to groundwater could not be measured in KAFB-106063 and KAFB-106064 due to the presence of dedicated downhole equipment associated with the *in situ* biodegradation pilot test. Findings from the Q3 2018 sampling event include:

- Groundwater levels decreased an average of -0.98 feet (ft) across the GWM network since Q2 2018 (Figures 3-3, 3-4, and 3-5). This seasonal decrease is consistent with previous groundwater levels during Q3.

- Light non-aqueous phase liquid (LNAPL) was measured (at a thickness of 0.05 ft or less) in three wells (KAFB-106079, KAFB-106150-484, and KAFB-106154-484) during gauging. Of the three wells where LNAPL was measured, KAFB-106150-484 and KAFB-106154-484 are screened across the water table. All three wells are either located in or near the BFF source area. The thickest LNAPL was measured in KAFB-150-484 at 0.05 ft (Figure 3-5).

- The project screening levels (PSLs) for this project were selected to satisfy the requirements of the Kirtland AFB RCRA Permit as the lower of:

  1. New Mexico Water Quality Control Commission (NMWQCC) standards per the New Mexico Administrative Code, Title 20.6.2.3103, Standards for Groundwater of 10,000 mg/L Total Dissolved Solids Concentration or Less. For metals, the NMWQCC standard applies to dissolved metals and total mercury.

  2. U.S. Environmental Protection Agency (EPA) National Primary Drinking Water Regulations, maximum contaminant levels (MCLs) and secondary MCLs, and Title 40 Code of Federal Regulations Part 141, 143

  If no MCL or NMWQCC standard existed for an analyte, the PSL used was the EPA Tapwater Regional Screening Level. Additional detail on the PSLs are provided in section 3.5.

- Three of the six newly installed GWM wells were sampled using passive sampling methods in Q3 2018. The other three newly installed GWM wells were not ready for sampling in Q3 2018, however they will be sampled in Q4 2018. EDB was detected at a concentration below the 0.05 micrograms per liter (µg/L) project screening level (PSL) in the sample collected from KAFB-106243-425 (0.04 µg/L); no benzene, toluene, ethylbenzene, and total xylenes (BTEX) were detected in this sample. No EDB or BTEX constituents were detected in either samples collected from KAFB-106240-449 or KAFB-106244-445.

- Fourteen newly added wells were sampled in Q3 2018 (includes the three newly installed wells that were sampled in Q3 2018); newly added wells are subject to four quarters of baseline sampling. EDB was not detected in samples collected from nested wells KAFB-106235 and KAFB-106236. EDB was detected at concentrations below the 0.05 µg/L PSL in the samples collected from KAFB-106041 and KAFB-106152 (0.043 and 0.011 µg/L, respectively). EDB was detected at concentrations above the PSL in samples collected from wells KAFB-106149-484, KAFB-106151-484, and KAFB-106153-484 at concentrations of 7.3, 1.0, and 93 µg/L, respectively. These three wells are located near the source area in the BFF (Figure 3-6).

- All 26 downgradient proximal wells and nine Veterans Affairs proximal wells were sampled in Q3 2018 (35 wells total). Neither EDB nor BTEX was detected in any of the 35 proximal well samples (Figures 3-6 and 3-7).

- EDB was detected in two of the three groundwater samples collected from the source area GWM wells. BTEX constituents were detected in one of the three groundwater samples collected from the source area wells (Figures 3-6 and 3-7).

  - EDB was detected at a concentration above the 0.05 µg/L PSL in the groundwater sample collected from KAFB-106005 (0.54 µg/L).

  - Benzene was detected at a concentration above the 5 µg/L PSL in the groundwater sample collected from KAFB-106005 (260 µg/L).

  - Toluene, ethylbenzene, and xylenes, total were detected in the groundwater sample collected from KAFB-106005 at concentrations below their respective PSLs.

  - Groundwater samples collected from these three wells were also analyzed for inorganic compounds to determine the presence of high concentrations of inorganics that may be related to a suspected sanitary sewer junction manhole leak. A replacement junction manhole was installed in Q4 2017. Inorganic compounds were detected in groundwater samples collected from these wells, with the following PSL exceedances (Figures 3-8 and 3-9). Nitrate/nitrite nitrogen was detected at a concentration of 10.7 milligrams per liter (mg/L) in the groundwater sample collected from KAFB-106009 (slightly exceeding the 10 mg/L PSL). Sulfate was detected in groundwater samples collected from KAFB-106005, KAFB-106009, and KAFB-106012R at concentrations exceeding the 250 mg/L PSL, at concentrations of 519, 357, and 359 mg/L, respectively. Dissolved manganese was detected in the groundwater sample collected from KAFB-106009 at a concentration of 0.247 mg/L (exceeding the 0.2 mg/L PSL). Chloride was detected in the groundwater sample collected from KAFB-106009 at a concentration of 273 mg/L (exceeding the 250 mg/L PSL).

- In Q3 2018, designated wells located north of Ridgecrest Drive Southeast (SE) were sampled using passive sampling methods. All of the wells located south of Ridgecrest Drive SE were sampled using low-flow methods, except for KAFB-106009 and KAFB-106005, which were sampled using passive sampling methods due to poor low-flow pump performance associated with biofouling (Figure 3-11).

- GWM network operation and maintenance activities in Q3 2018 included cleaning wellheads, replacing security bolts and combination locks, and servicing or replacing J-plugs. The dedicated Bennett sampling pump at KAFB-106229 was removed in Q3 2018 (Figure 3-12).

The U.S. Geological Survey monitors and samples 14 sentinel wells located between the Kirtland AFB BFF EDB plume and the Albuquerque Bernalillo County Water Utility Authority water supply wells as a means of providing an independent observation of water quality in the vicinity of the Albuquerque Bernalillo County Water Utility Authority water supply wells. Groundwater samples are collected from these sentinel wells on a quarterly basis and analyzed for BTEX, naphthalene, and EDB. For Q3 2018, BTEX, naphthalene, and EDB were nondetect in the groundwater samples collected from these sentinel wells, however, two results are being verified. A final summary of Q3 2018 sentinel well monitoring data will be included in the Q4 2018 quarterly and annual report.

ES-3 Drinking Water Supply Well Monitoring

Four drinking water supply wells (KAFB-003, KAFB-015, KAFB-016, and ST106-VA-2) are located in the vicinity of the dissolved phase benzene and EDB plumes. These wells were sampled monthly from July to September in Q3 2018 and analyzed for EDB and BTEX. No EDB or BTEX were detected in groundwater samples collected from these four drinking water supply wells (Figure 4-1).

ES-4 Groundwater Treatment System Operation

During Q3 2018, a calculated 6,354 milligrams (mg) of EDB were captured in the lead granular activated carbon vessels. Of this total, 3,276 mg were removed by Treatment Train 1, and 3,078 mg were removed by Treatment Train 2. The GWTS was 97 percent operational from July 1 to September 30, 2018, and 61,523,100 gallons of groundwater was treated during this period. All the treated water was discharged to the Tijeras Arroyo Golf Course main pond (GCMP) throughout the quarter as KAFB-7 was offline pending repairs. All analyte concentrations for effluent samples collected from Trains 1 and 2 during Q3 2018 were below their respective limits of detection.

During Q3 2018, there were multiple, short-term, unscheduled shutdowns due to the installation of the sodium hypochlorite generator, the installation of chlorinated polyvinyl chloride injection headers and valves on the influent conveyance piping, GCMP maintenance activities, rain events, and electrical disruptions. None of these activities resulted in long-term shutdowns, and most shutdowns involved only one or two of the extraction wells, not the full GWTS.

On March 14, 2018, the KAFB-7 V-smart valve hydraulic assembly failed. Since March 14, 2018, all treated effluent has been discharged to the GCMP. KAFB-106228, KAFB-106233, and KAFB-106239 experienced reduced run times during Q3 2018 due to the discharge volume restrictions associated with the GCMP reaching capacity. During Q3 2018, all four extraction wells were operational based on GCMP capacity with the following priority: KAFB-106234 (highest priority), KAFB-106228, KAFB-106239, and KAFB-106233 (lowest priority). Repairs to KAFB-7 are pending.

ES-5 Ethylene Dibromide *In Situ* Biodegradation Pilot Study

The main objective for conducting the *in situ* biodegradation pilot test is to investigate *in situ* anaerobic bioremediation of EDB in groundwater. The passive monitoring portion of Phase 2 of the pilot test, the evaluation of biostimulation in the subsurface after distribution of treatment amendments in recirculated groundwater, was completed in July 2018. Per the Work Plan (U.S. Army Corps of Engineers, 2016c), Phase 3 was to consist of both biostimulation and bioaugmentation; however, after review of field results from both Phase 1 and Phase 2, the Air Force recommended to NMED that a second round of biostimulation would be more beneficial than bioaugmentation. The modified Phase 3 was approved by NMED in a letter dated August 7, 2018 (NMED, 2018b). The active (recirculation) portion of Phase 3 began on July 30, 2018 and was completed on September 9, 2018. The subsequent passive monitoring portion of Phase 3 is currently underway and will continue into Q4 2018. An independent final report summarizing all activities associated with the pilot test will be submitted at the conclusion of the test.

ES-6 Projected Activities

Planned activities for Q4 2018 include:

- Sampling the soil vapor monitoring points
- Sampling the Q4 2018 designated wells in the GWM network beginning in October 2018, including the three remaining newly installed nested wells
- Measure depth to water in all wells in the GWM network to support the second round of plume capture modeling

- Sampling drinking water supply wells for organic compounds on a monthly basis and analyzing inorganic compounds from the October sampling event

- Operating the GWTS and extraction wells KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239 with discharge to the GCMP (pending repairs at KAFB-7)

- Initiating repairs of the KAFB-7 injection well

- Begin the vadose zone coring project.

1. INTRODUCTION

This Quarterly Report for the third quarter (Q3) of calendar year 2018 summarizes the activities performed from July 1 through September 30, 2018, as part of the interim measures for soil and groundwater remediation at Solid Waste Management Units (SWMU) ST-106/SS-111, the Bulk Fuels Facility (BFF) site, at Kirtland Air Force Base (AFB), pursuant to the Hazardous Waste Treatment Facility Operating Permit Number (No.) NM9570024423 (Resource Conservation and Recovery Act [RCRA] Permit) (New Mexico Environment Department [NMED], 2010). The BFF site is located within the northwestern portion of Kirtland AFB, on the southeastern corner of the city of Albuquerque, as shown on the site location map (Figure 1-1). The Phase I RCRA Facility Investigation (U.S. Army Corps of Engineers [USACE], 2017a) provides a detailed site description, history, and conceptual site model. 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.

Groundwater monitoring (GWM) and interim measures for SWMU ST-106/SS-111 were conducted concurrently. The monitoring program was performed in accordance with multiple work plans: (1) groundwater (NMED, 2017a; NMED, 2018a; NMED, 2018b; USACE, 2017b), and (2) drinking water supply wells (NMED, 2017b; USACE, 2017c). Groundwater treatment system (GWTS) operations, sampling, and discharge of treated effluent were performed under the Operations and Maintenance Plan (USACE, 2016a and 2017d).

Appendix A contains key regulatory correspondence for Q3 2018. This Q3 2018 Quarterly Report presents a non-cumulative data report (NMED, 2017a; USACE, 2017b). Non-cumulative data reports are provided for each of first quarter (Q1), second quarter (Q2), and Q3 2018 sampling events, while the fourth quarter (Q4) 2018 Annual Report compiles data collected over the four quarters and provides more detailed data analyses, conclusions, and recommendations for the calendar year. This report provides a streamlined summary of the activities and results during the Q3 2018 Quarterly reporting period.

2. VADOSE ZONE MONITORING

No soil vapor monitoring (SVM) activities were performed during Q3 2018. The SVM program has been optimized to semiannual sampling events performed in Q2 and Q4 of each year (NMED, 2017c). Appendices C and D remain in this report as placeholders; information will be included in these appendices following the semiannual sampling events. The next semiannual SVM event will be performed in Q4 2018.

3. GROUNDWATER MONITORING NETWORK GAUGING AND SAMPLING

Quarterly GWM was conducted as part of the interim measures implemented at the BFF to assess performance of the GWTS, determine changes over time in the distal portion of the EDB plume, and insure that additional contaminants near the source area (including benzene) are not mobilized into the interim measures area north of Ridgecrest Drive SE. At the end of Q3 2018, the BFF GWM well network was comprised of 156 GWM wells (Figure 3-1, Table 3-1); however, only a subset of these wells was sampled in Q3 in accordance with the optimization schedule as shown in Table 3-2.

Throughout this report, GWM wells, and their associated groundwater data, are described based on reference elevation intervals (REIs). 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 reference elevation intervals (4857, 4838, and 4814); additional REIs may be added if groundwater rebound continues. A detailed explanation of how the REIs are defined is presented in the Q4 2016 Quarterly and Annual Report (USACE, 2016d).

GWM activities included measuring the depths to groundwater and light non-aqueous phase liquid (LNAPL) (Tables 3-3 and 3-4 and Figures 3-2 through 3-5) and measuring field parameters in wells sampled with low-flow sampling pumps (Table 3-5). Field parameter measurements cannot be accurately obtained from the wells that are sampled using the passive sampling methodology, as discussed in more detail in the Q4 2017 quarterly and annual report (USACE, 2017e). Groundwater samples were collected and submitted for laboratory analysis from all Q3 2018 wells (Tables 3-6 through 3-11 and Figures 3-6 through 3-10).

Appendices pertinent to GWM are listed below:

- E-1 – Daily Quality Control Reports – Groundwater Sampling
- E-2 – Groundwater and LNAPL Measurements
- E-3 – Groundwater Purge Logs and Sample Collection Logs
- E-4 – Groundwater Sample Chain-of-Custody Forms
- E-5 – U.S. Geological Survey (USGS) Sentinel Well Data
- F-1 – Data Quality Evaluation Report – Groundwater Samples
- F-2 – Data Packages – Groundwater Samples.

3.1 New Groundwater Monitoring Activities

Six new data gap well nests were approved for installation in February 2018 (NMED, 2018a). The nested wells consist of one GWM well screened across (partially above and below) the groundwater table and a second well (contingency well) constructed with the well screen above the current water table elevation. The contingency well will be available to monitor the upper zone of the plume in the future as the water table continues to rise. While all six well nests were installed in Q3, only three of the six newly installed GWM wells were ready for sampling in Q3 2018; the other three newly installed wells will be sampled in Q4 2018. In addition to the wells that required sampling as part of the GWM program, KAFB-106229, a well that was installed to support aquifer testing at KAFB-106233, was sampled as it provides an additional water table well location information.

The six new nested GWM wells installed in Q3 2018 are KAFB-106240, KAFB-106241, KAFB-106242, KAFB-106243, KAFB-106244, and KAFB-106245 (Figure 3-1). In addition, KAFB-106246 was

installed as a replacement contingency well for KAFB-106240. All the newly installed well nests, except for KAFB-106240 and KAFB-106246, consist of one water table well and one shallower contingency well that is anticipated for future use as the water table continues to rise. The contingency well at KAFB-106240 was plugged and abandoned due to field failure and thus KAFB-106246 was installed adjacent to KAFB-106240 as the contingency well for this planned nested pair. KAFB-106240, KAFB-106246, and KAFB-106244 were installed on the campus of the Veterans Affairs (VA) Medical Center. KAFB-106242 was installed on San Pedro Drive SE between Gibson Boulevard SE and Ridgecrest Drive SE; KAFB-106243 was installed on Dakota Street SE between Ridgecrest Drive SE and Gibson Boulevard SE; and KAFB-106245 was installed on-Base near the intersection of Randolph Road SE and Ridgecrest Drive SE (Figure 3-1). The well completion reports for the first three completed wells (KAFB-16240, KAFB-106243, and KAFB-106244) are presented in Appendix B-1. KAFB-106240, KAFB-106243, and KAFB-106244 were sampled using passive sampling methods in Q3 2018. Analytical results are provided in Table 3-9. Well completion reports and water quality data for KAFB-106241, KAFB-106242, KAFB-106245, and KAFB-106246 will be provided in the Q4 2018 quarterly and annual report.

KAFB-106229 was sampled using passive methods and analyzed for EDB. Originally installed as an observation well for KAFB-106233, the well is constructed with a 100-foot (ft) screened interval, which has a top of screen above the water table. Although a water table well, the dedicated Bennett sampling pump was set deeper (490 ft below ground surface to monitor the 4814 REI). The Bennett sampling pump was removed on July 24, 2018, so that passive samplers could be placed across the water table interval (4857 REI). KAFB-106229 was also sampled in Q1 and Q2 of 2018; however, analytical data from those sampling events are representative of REI 4814. Though KAFB-106229 is not officially in the GWM program, analytical results will be discussed along with the newly added wells as it provides additional water quality data from the groundwater interface.

3.2 Groundwater and Light Non-Aqueous Phase Liquid Level Measurement

Depth to groundwater were measured in 152 wells between July 23 and 28, 2018 (Table 3-3), using a Solinist Model 122 oil-water interface probe, in accordance with the approved work plan (USACE, 2017b). Each well was also checked for the presence of LNAPL. Depth to water in wells KAFB-106063 and KAFB-106064 could not be measured due to the presence of dedicated downhole equipment related to the Environmental Security Technology Certification Program pilot test project for EDB *in situ* biodegradation. LNAPL was detected in KAFB-106079 (submerged screen), KAFB-106150-484, and KAFB-106154-484 in Q3 2018 (Figure 3-5). All three of these wells had measurable LNAPL in Q2 2018 (Table 3-4).

The interface probe was checked for proper operation and cable integrity prior to each use and was decontaminated before and after gauging each well. If LNAPL was detected using the interface probe, a plastic bailer was used to confirm the presence and thickness of the LNAPL. Depths to LNAPL and groundwater were recorded in the field on Well Gauging Forms (Appendix E-2). The measurement dates, measured depths to LNAPL and groundwater, calculated LNAPL thickness, and groundwater elevations are provided in Table 3-2.

Depth to water in the GWM wells was gauged using three different Solinist Model 122 oil-water interface probes (serial nos. 253053, 253054, and 253056). Depth to water measurements between the three interface probes were calibrated by measuring depth to water with each interface probe in three GWM wells near the source area. Water level interface probe 253054 was designated as the benchmark instrument as it had the least amount of stretch in the measuring tape. Depths measured using interface probe 253056 varied from the benchmark instrument an average of 0.08 ft while values measured using interface probe 253053 varied an average of 0.09 ft. Depth to water measurements were adjusted by the corresponding average differences based on which instrument was used to measure the depth to water in

each well. Appendix Table E-2-1 presents the uncorrected and corrected depth to water measurements for each GWM well and also provides the correction factor applied per well. Tables 3-3 and 3-4 depth to water measurements have been corrected based on the calibration method described above.

Of the 152 GWM wells gauged in Q3 2018, 23 had screens that intersected the current water table while the remaining 130 wells had submerged well screens (Table 3-4). Groundwater levels decreased on average of -0.98 ft from Q2 2018 to Q3 2018. The maximum decrease in groundwater level from Q2 2018 to Q3 2018 was -2.78 ft observed in KAFB-106209. The minimum decrease in groundwater level was -0.42 ft observed in KAFB-106027. Potentiometric surfaces for the three REIs (4857, 4838, and 4814) are provided on Figures 3-2, 3-3, and 3-4, respectively.

3.3 Quarterly Groundwater Sampling

Quarterly groundwater samples were collected from 49 required wells in the GWM network plus four additional wells (KAFB-106229 and three newly installed GWM wells: KAFB-106240-449, KAFB-106243-425, and KAFB-106244-445) between July 9 and August 15, 2018 using dedicated or portable low-flow pump systems or passive sampling methods (Table 3-2). Well locations are shown on Figure 3-1. All groundwater samples collected for the Q3 2018 monitoring event were analyzed for EDB. Groundwater samples collected from the VA proximal wells were analyzed for EDB, benzene, toluene, ethylbenzene, and total xylenes (BTEX). The three groundwater samples collected from the source area wells were analyzed for EDB, BTEX, metals, anions, and alkalinity. Samples collected from all newly added wells were analyzed for EDB, metals, anions, and alkalinity, and the newly installed GWM wells were analyzed for EDB, BTEX, metals, anions, and alkalinity BTEX (Table 3-2). All groundwater samples were analyzed by Eurofins Lancaster Laboratories Environmental, LLC located in Lancaster, Pennsylvania, which maintains current Department of Defense Environmental Laboratory Accreditation Program certification. The groundwater purge and sampling forms are provided in Appendix E-3 and the chain-of-custody forms are provided in Appendix E-4.

For low-flow sampling, well water was purged continuously at a flow rate between 0.5 and 1 liter per minute, while field parameters (turbidity, temperature, dissolved oxygen [DO], specific conductivity, pH, and oxidation reduction potential (ORP) were measured and recorded every 5 minutes. Purging continued until parameters stabilized for three consecutive readings within 10 percent (%) of one another, at which point samples were collected. If stabilization was not attained for any one of the field parameters after 1 hour, samples were collected. Field parameters were recorded on the field forms (Appendix E-3) and are summarized in Table 3-5. To be consistent with previous quarterly sampling events, wells without a dedicated low-flow pump sampling system were designated, based on historical analytical data, as either clean, intermediate, or hazardous. Decontaminated non-dedicated tubing and portable low-flow pumps were used to sample wells designated as clean. The entire sampling assembly was decontaminated following use at each well. Conversely, wells designated as intermediate or hazardous had dedicated tubing that was specific to that well.

Field parameters were not collected from wells that were sampled using passive sampling methods due to the unreliable field parameter data associated with this technology. This is discussed in more detail in the Q2 2017 quarterly report (USACE, 2017f). Field parameters were measured only from wells that were sampled using low-flow technology (Table 3-5).

Field parameter measurements for the samples collected during Q3 2018 ranged as follows: temperature from 19.9 to 24.2 degrees Celsius, pH from 7.66 to 9.3 standard units, specific conductivity from 330.7 to 1,589 microSiemens per centimeter, DO from 2.46 to 7.56 milligrams per liter (mg/L), ORP from -0.9 to 151.8 millivolts, and turbidity from 0.56 to 5.78 nephelometric turbidity units.

3.3.1 Sampling Deviations

- Two attempts were made to collect a complete sample from well KAFB-106153-484. In both attempts the passive sampler bags had failed while being deployed, resulting in insufficient sample volume to analyze for alkalinity and dissolved metals. All other analytes were successful analyzed.

- Well KAFB-106005 was sampled using passive sampling methods, rather than portable low-flow methodology, due to biofouling that clogged the pump intake repeatedly. Biofouling was confirmed with a video inspection.

3.4 Data Review and Usability Results

The Q3 2018 groundwater analytical data underwent U.S. Environmental Protection Agency (EPA) Level 3 data validation by an independent third-party subcontractor. Subsequent to performing data validation, the 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 the project data quality objectives in Q3 2018. All groundwater data presented and discussed in this report are final validated data. The Environmental Resources Program Information Management System data deliverable is scheduled for submittal on December 12, 2018. The Data Quality Evaluation Report for groundwater samples collected in Q3 2018 is provided in Appendix F-1, and the final laboratory data reports are included in Appendix F-2.

3.5 Project Screening Levels

The project screening levels (PSLs) were selected to satisfy the requirements of the Kirtland AFB RCRA Permit (NMED, 2010) as the lower of:

1.) New Mexico Water Quality Control Commission (NMWQCC) standards per the New Mexico Administrative Code, Title 20.6.2.3103, Standards for Groundwater 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, 2017).

If no MCL or NMWQCC standard existed for an analyte, the PSL used was the EPA Tapwater Regional Screening Level (EPA, 2017).

The analytical method utilized to analyze for total nitrate/nitrite nitrogen concentrations (Method 353.2) 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). 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 report.

Groundwater PSLs for all analytes are provided in the groundwater analytical data tables included in this report.

3.6 Groundwater Quality Data

All groundwater samples collected for the Q3 2018 monitoring event 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 (bromide, chloride, sulfate, and nitrate/nitrite nitrogen), and alkalinity (Table 3-2). Alkalinity, sulfate, dissolved iron, and dissolved manganese concentrations provide direct and indirect evidence of anaerobic conditions and thus are important indictors of bioremediation (Section 3.6.6 – not assessed in Q1 and Q3 due to the limited dataset). Contaminant concentrations were compared to their respective PSLs and are discussed in the following sections. The analytical results for field duplicate samples are presented in the tables and are used to assess field and laboratory analytical precision. However, field duplicate results are not discussed in this text for comparison purposes unless otherwise noted and duplicate data are not provided on figures. The results for the duplicate sample analyses are included in the Data Quality Evaluation Report (Appendix F-1).

Data tables are provided in each section for the wells based on their designation within the optimized monitoring program (Tables 3-6, 3-7, 3-9, and 3-10). Concentrations for various compounds are depicted on figures as listed below.

- EDB on Figure 3-6
- Benzene on Figure 3-7
- Toluene on Figure 3-7
- Ethylbenzene on Figure 3-7
- Total xylenes on Figure 3-7
- Nitrate/nitrite nitrogen on Figure 3-8
- Sulfate on Figure 3-8
- Total alkalinity on Figure 3-9
- Bromide on Figure 3-9
- Dissolved iron on Figure 3-9
- Dissolved manganese on Figure 3-9
- DO on Figure 3-10
- ORP on Figure 3-10.

Figure 3-11 shows the GWM well network displayed per the sample methods used in Q3 2018.

3.6.1 Sample Results for "Downgradient" Proximal and Veterans Affairs Proximal

The purpose of sampling the 35 wells originally designated as "downgradient" and the VA proximal wells is to ensure protectiveness of the drinking water supply wells, which were historically downgradient of the EDB plume when the regional gradient was from the southwest to northeast. Due to the changing regional gradient (Q2 2018 Quarterly Monitoring Report [USACE 2018]), future well designations will require modification to reflect dynamic gradients at the BFF site. Analytical results for VA and "downgradient" well samples for Q3 2018 are presented in Tables 3-6 and 3-7, respectively.

3.6.1.1 Organic Compound Analytical Results

Of the 35 combined "downgradient" proximal and VA proximal wells, no organic compounds (EDB and BTEX) were detected at concentrations above their respective PSLs during Q3 2018.

3.6.2 Sample Results for Newly Added Wells

All newly added GWM wells require a minimum of four consecutive quarters of baseline sampling. Newly added wells can include both existing wells that are added to the GWM network as well as newly installed wells. Groundwater samples collected from these wells were analyzed for the following suites of analytes: EDB, select total and dissolved metals, anions, and alkalinity. Table 3-8 provides the status of these newly added wells. Q3 2018 analytical results for the newly added wells are provided in Table 3-9 and are summarized below.

3.6.2.1 Organic Compounds Analytical Results

Organic compound detections are noted as follows:

- EDB was detected in groundwater samples collected from KAFB-106149-484 (7.3 µg/L), KAFB-106151-484 (estimated concentration of 1.0 µg/L), and KAFB-106153-484 (93 µg/L), all located in the source area, at concentrations above the PSL of 0.05 µg/L.

- EDB was detected in the groundwater samples collected from KAFB-106152-484 (estimated concentration of 0.011 µg/L) and KAFB-106243-425 (0.04 µg/L) at concentrations below the PSL of 0.05 µg/L. EDB concentrations are presented on Figure 3-6. BTEX analyses were not required for these wells in Q3.

3.6.2.2 Inorganic Compounds Analytical Results

No inorganic compounds were detected at concentrations above their respective PSLs for any of the newly added wells except for those noted as follows:

- Dissolved manganese was detected in groundwater samples collected from KAFB-106152-484 at a concentration above the PSL of 0.2 mg/L (2.48 mg/L). Dissolved manganese concentrations are presented on Figure 3-9.

- Sulfate was detected in groundwater samples collected from KAFB-106151-484 and KAFB-106244-445 at concentrations above the PSL of 250 mg/L (401 and 327 mg/L, respectively). Sulfate concentrations are presented on Figure 3-8.

3.6.3 Sample Results for Source Area Wells

During Q3 2018 sampling, three source area wells (KAFB-106005, KAFB-106009, and KAFB-106012R) were sampled as part of the optimized monitoring schedule. Groundwater samples collected from these wells were analyzed for BTEX, EDB, select total and dissolved metals, anions, and alkalinity. Analytical results for the source area wells are presented in Tables 3-10 and 3-11 and summarized below.

3.6.3.1 Organic Compounds Analytical Results

Organic compound detections are noted as follows:

- EDB was detected in the groundwater sample collected from KAFB-106005 (0.54 µg/L) at an estimated concentration above the PSL of 0.05 µg/L. EDB was detected in the groundwater sample collected from KAFB-106009 (0.026 µg/L), at an estimated concentration below the PSL of 0.05 µg/L. EDB concentrations are presented on Figure 3-6.

- Benzene was detected in the groundwater sample collected from KAFB-106005 (260 µg/L) at a concentration above the PSL of 5.0 µg/L. Benzene concentrations for the source area wells are presented on Figure 3-7.

- Toluene was detected in the groundwater sample collected from KAFB-106005 (5 µg/L) at a concentration below the PSL of 750 µg/L. Toluene concentrations for the source area wells are presented on Figure 3-7.

- Ethylbenzene was detected in groundwater samples collected from KAFB-106005 (30 µg/L) at concentrations below the PSL of 700 µg/L. Ethylbenzene concentrations for the source area wells are presented on Figure 3-7.

- Total xylenes were detected in groundwater samples collected from KAFB-106005 (79 µg/L) at concentrations below the PSL of 620 µg/L. Total xylene concentrations for the source area wells are presented on Figure 3-7.

3.6.3.2 Inorganic Compounds Analytical Results

Inorganic compound detections are noted as follows:

- Chloride was detected in groundwater samples collected from all three source area wells; the concentrations in KAFB-106009 (273 mg/L) exceeded the 250 mg/L PSL. Chloride concentrations for the source area wells are presented on Figure 3-8.

- Nitrate/nitrite nitrogen was detected in groundwater samples collected from all three source area wells; the estimated concentrations in KAFB-106009 (10.7 mg/L) exceeded the 10 mg/L PSL. Nitrate/nitrite nitrogen concentrations for the source area wells are presented on Figure 3-8.

- Sulfate was detected in groundwater samples collected from all three source area wells; all three wells had concentrations that exceeded the 250 mg/L PSL (ranging from 357 to 521 mg/L). Sulfate concentrations for the source area wells are presented on Figure 3-8.

- Bromide was detected in all three source area groundwater samples; however, there is no PSL for bromide. Bromide concentrations for the source area wells ranged from 2.4 to 3.9 mg/L and are presented on Figure 3-9.

- Dissolved iron was detected in the groundwater sample collected from KAFB-106005 (0.377 mg/L), at a concentration below the PSL of 1.0 mg/L. Dissolved iron concentrations for the source area wells are presented on Figure 3-9.

- Dissolved manganese was detected in all three source area wells; the estimated concentrations in the groundwater sample collected from KAFB-106009 (0.247 mg/L) exceeded the PSL of 0.2 mg/L. Dissolved manganese concentrations for the source area wells are presented on Figure 3-9.

3.6.4 Sample Results for Groundwater Monitoring Network Wells

In accordance with the optimized monitoring program, no GWM network wells were sampled in Q3 2018.

3.6.4.1 Organic Compounds Analytical Results

In accordance with the optimized monitoring program, no GWM network wells were sampled in Q3 2018.

3.6.5 Sampling Results for U.S. Geological Survey Monitored Sentinel Wells

The USGS monitors 14 sentinel wells between the Kirtland AFB BFF EDB plume and the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) water supply wells as a means of providing independent observation of water quality in the vicinity of ABCWUA water supply wells. Samples are collected from these sentinel wells quarterly. For Q3 2018, these samples were collected using dual membrane samplers during the time period of July 9–12, 2018, and analyzed for volatile organic compounds (using EPA Method SW8260A) by RTI Laboratories in Livonia, Michigan and EDB (using EPA Method SW8011) by ELLE in Lancaster, Pennsylvania. BTEX, naphthalene, and EDB were nondetect in the groundwater samples collected from these sentinel wells, however, two results are being verified. A final summary of Q3 2018 sentinel well monitoring data will be included in the Q4 2018 quarterly and annual report. Additionally, the USGS implemented a rehabilitation program which included redevelopment of the sentinel wells, well video logging, and hydraulic slug tests to determine well performance. The USGS transmittal letter, data results, and rehabilitation memorandum are provided in Appendix E-5.

3.6.6 Bioremediation Indicators

Bioremediation indicators are not assessed in Q1 and Q3 due to the limited dataset.

3.7 Groundwater Monitoring Well Network Operation and Maintenance

The GWM well network was inspected between August 7 and September 19, 2018 to ensure that the condition of all protective covers and wellheads met the intended requirements for performance and security. During the inspection period, the necessary cleaning and maintenance were performed and all GWM wells were deemed as fully serviceable.

One dedicated Bennett pump (KAFB-106229) was removed during Q3 2018. As of the end of Q3 2018, EA had removed 86 dedicated Bennett pumps from the GWM well network. Although several wells are sampled using portable Bennett pumps, ongoing issues with this low-flow sampling system continue to arise as a result of corrosion of components and mechanical failure due to aging parts.

4. DRINKING WATER SUPPLY WELL MONITORING

Three drinking water supply wells (KAFB-003, KAFB-015, and KAFB-016) provide drinking water to on-Base employees and tenants and the tenants of Maxwell Housing, which is located off-Base. One drinking water supply well (ST106-VA-2) provides drinking water to VA Medical Center patients, employees, and visitors. As part of the monitoring associated with the BFF site, these wells are sampled monthly and analyzed for EDB and BTEX due to their proximity to the dissolved-phase EDB and benzene plumes.

4.1 Drinking Water Supply Well Sampling and Analysis Procedures

All field measurements, sample collection, packaging, shipping, and analyses were performed in accordance with the Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling Work Plan and associated Quality Assurance Project Plan (USACE, 2017c). Field DO, pH, ORP, conductivity, and temperature measurements were measured using an YSI Professional Plus multiparameter water quality probe; turbidity was measured using a Hach 2100Q. Instrument calibrations were performed at the start of each day of the sampling event to ensure accurate readings. The sample port at each drinking water well head was opened for 60 seconds prior to sampling to purge any entrained sediment. Volatile organic analysis samples were collected first prior to collecting inorganic parameter samples. Upon filling, the sample containers were immediately sealed, checked for headspace bubbles, labeled, and put into an iced cooler. Daily quality control reports are presented in Appendix G-1. Completed sample collection logs and chain-of-custody forms are presented in Appendix G-2.

Drinking water supply samples were collected and submitted for the following analyses:

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

Samples were submitted to TestAmerica Laboratories in Savannah, Georgia, for analytical testing. Analytical results were validated by Environmental Data Services, Inc. The Data Quality Evaluation Reports are included in Appendix H-1. The TestAmerica Laboratories Analytical Reports for July, August, and September 2018 are included in Appendix H-2.

4.2 Data Review and Usability

Environmental Data Services, Inc., performed a 100% Level 3 data validation for Q3 2018 organic and inorganic compound analytical data. All data complied with necessary criteria that determined the data valid, with no data qualified as rejected. The technical data completeness was 100%. The data met data quality objectives and were appropriate for use in project decision-making. The quality control parameter and data quality indicators (precision, bias [accuracy], representativeness, comparability, completeness, and sensitivity) evaluation results are provided in the Data Quality Evaluation Report and Data Validation Report presented in Appendix H-1 for organic compounds. Final validated data are presented in Table 4-1.

4.3 Drinking Water Supply Well Water Quality for Q3 2018

All four wells had no detectable concentrations of EDB or BTEX in the drinking water that is supplied to Kirtland AFB employees and tenants, and VA Medical Center patients, employees, and visitors. Analytical results for July, August, and September 2018 are presented in Table 4-1, Figure 4-1, and Appendix H-2. The MCLs for drinking water supply wells were based on EPA National Primary Drinking Water Regulations, MCLs, and Secondary MCLs, Title 40 CFR Part 141, 143 (EPA, 2017).

5. GROUNDWATER TREATMENT SYSTEM OPERATION AND PERFORMANCE

This section presents Q3 2018 operations, performance metrics, system expansion activities, maintenance activities of the GWTS, and plume capture evaluation.

5.1 Groundwater Treatment System Operation

The GWTS was operated during Q3 2018 to treat groundwater extracted from the distal portion of the EDB plume. The GWTS is comprised of four extraction wells (KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239), conveyance piping, a dual train 800-gallon per minute (gpm) capacity carbon treatment system located within the GWTS building, and effluent conveyance lines discharging to either the Tijeras Arroyo Golf Course main pond (GCMP) or gravity-fed injection well KAFB-7 (Figure 5-1).

In addition to the operational procedures outlined in the Operations and Maintenance Plan (USACE, 2016a and 2017c), the GWTS is also subject to the terms of RCRA Operating Permit No. NM9570024423 (NMED, 2010) and a Class V Underground Injection Control Well Discharge Permit (DP) No. 1839 (NMED, 2017b) for injecting treated groundwater to KAFB-7. The DP became effective on April 28, 2017. The requirements associated with the conditions of the DP and the location of reporting requirements in this report are summarized in Table 5-1.

5.1.1 Groundwater Treatment System Treatment Volumes and Percentage Run Time

During Q3 2018, the GWTS treated 61,523,100 gallons of groundwater that was discharged to GCMP throughout the quarter as injection well KAFB-7 was offline pending repairs. Table 5-2 provides a cumulative summary of groundwater quantities extracted, treated, and discharged. During Q3 2018, Trains 1 and 2 treated 36,528,500 and 24,994,600 gallons, respectively.

For the purpose of run-time evaluation, GWTS operation is defined as the time when groundwater was being pumped from at least one extraction well and was subsequently treated and discharged. Table 5-3 provides a monthly and quarterly summary of the extraction well performance that includes individual extraction well run times.

From July 1 through September 30, 2018, the GWTS was operational 97% of the time (Table 5-3), representing a 1% increase relative to Q2 2018. Planned and unplanned system shutdowns affecting GWTS overall run time during Q3 2018 are described in Sections 5.3.1 and 5.3.3.

5.1.2 Extraction Well Performance Metrics

The following subsections provide a summary of the performance metrics for the four extraction wells. Quarterly injection well performance data required for DP reporting compliance are provided in Table 5-4. The injection well KAFB-7 remained offline throughout the entirety of Q3 2018. Average operational extraction flow rates do not include flow rates during downtime. Well performance figures are provided in Appendix I-1.

5.1.2.1 Quarterly Extraction Rates

KAFB-106228, KAFB-106233, and KAFB-106239 experienced reduced run times during Q3 2018 due to the V-smart valve hydraulic assembly failure at KAFB-7 and discharge volume restrictions associated with the GCMP reaching capacity. During Q3 2018, all four extraction wells were operational based on GCMP capacity with the following priority: KAFB-106234 (highest priority), KAFB-10228, KAFB-106239, and KAFB-106233 (lowest priority).

Groundwater was extracted from KAFB-106228 during Q3 2018 at an average operational flow rate of 139.5 gpm with a run time of 89% (Table 5-3).

Groundwater was extracted from KAFB-106233 during Q3 2018 at an average operational flow rate of 154.8 gpm with a run time of 78% (Table 5-3).

Groundwater was extracted from KAFB-106234 during Q3 2018 at an average operational flow rate of 163.8 gpm with a run time of 96% (Table 5-3).

Groundwater was extracted from KAFB-106239 during Q3 2018 at an average operational flow rate of 74.1 gpm with a run time of 88% (Table 5-3).

5.2 Groundwater Treatment System Performance Monitoring and Ethylene Dibromide Removal

GWTS performance monitoring is performed in conformance with the most recently approved Work Plan (USACE, 2017a) as well as Appendix L of the Operations and Maintenance Plan, Sampling and Analysis Plan, and any subsequent revisions (USACE, 2016a and 2017c). DP-1839 provides additional sampling criteria. Table 2 of DP-1839 provides a list of the constituents of concern that are most frequently monitored at the GWTS (NMED, 2017d). Q3 2018 GWTS analytical performance metrics and EDB mass removal are discussed in the following sections.

5.2.1 Quarterly Sampling and Analysis

For both Train 1 and Train 2, GWTS samples were collected monthly from the untreated influent (GWTS-BFF-INF1 and GWTS-BFF-INF2), at ports located after the lead granular activated carbon (GAC) vessel (GWTS-BFF-GAC1 and GWTS-BFF-GAC2), and from the treated effluent (GWTS-BFF-EFF1 and GWTS-BFF-EFF2) in Q3 2018. These samples were analyzed for EDB, BTEX, and dissolved metals (iron and manganese). Samples were collected from both Train 1 and Train 2 to satisfy annual influent and effluent sampling requirements as provided in Table 3 of the DP. The samples were analyzed for semivolatile organic compounds, anions (chloride, sulfate, nitrate, and nitrite), and total phenol, in addition to the routine monthly analytes. EDB concentrations and mass removal for Q3 2018 are summarized in Table 5-5. Sample results and effluent discharge limits are provided in Table 5-6 for Train 1, Table 5-7 for Train 2, and Table 5-8 for extraction wells. Results for the annual samples collected from both trains in July are provided in Tables 5-9. GWTS performance sample collection logs are provided in Appendix I-3.

In Q3 2018, an estimated 6,354 milligrams (mg) of EDB was captured in the lead GAC vessels. Of this total, 3,276 mg was removed by Train 1 and 3,078 mg was removed by Train 2. These quantities of mass were calculated by taking the sum of each monthly influent concentration multiplied by the respective total weekly treated volume (Table 5-5).

EDB in the influent sample of Train 1 was detected at concentrations of 0.042, estimated (J-flag) 0.017, and estimated (J-flag) 0.016 µg/L in July, August, and September 2018, respectively (Table 5-6). EDB in the influent samples of Train 2 was detected at concentrations of 0.046, estimated (J-flag) 0.032, and estimated (J-flag) 0.026 µg/L in July, August, and September 2018, respectively (Table 5-7). BTEX and dissolved iron were not detected in any influent samples collected from either train during Q3 2018. Dissolved manganese was detected below the PSL in all monthly influent samples collected from Train 2 (Tables 5-6 and 5-7). Influent EDB concentrations continue to decrease monthly.

EDB, BTEX, dissolved iron, and manganese were nondetect in all post-GAC and effluent monthly samples collected from either train during Q3 2018.

All four extraction wells (KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239) were sampled in July 2018 for EDB, BTEX, dissolved iron, and dissolved manganese. The concentration of EDB was detected at concentrations above the PSL (0.070 µg/L) only in the sample from KAFB-106228 (Table 5-8). BTEX and dissolved iron were not detected in any extraction well samples. Dissolved manganese was detected below the PSL only in the sample from KAFB-106239 at a concentration of 0.150 mg/L.

Annual samples were collected in July 2018 from the GWTS influent and effluent. Results for the annual samples are provided in Table 5-9. Influent and effluent samples collected for annual analysis had detectable anions (chloride, sulfate and nitrite-nitrates) at concentrations below the respective PSLs (Table 5-9) from both treatment trains. Volatile organic compounds, semivolatile organic compounds, and phenols were not detected in any of the samples collected.

5.2.2 Data Validation

All Q3 2018 GWTS analytical data underwent EPA Stage 3 data validation by Environmental Data Services, Inc. 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. The data validation results are included in the Data Quality Evaluation Report provided in Appendix I-4 and the final laboratory data reports included in Appendix I-5.

5.3 Groundwater Treatment System Maintenance and Expansion Activities

GWTS maintenance activities throughout Q3 2018 were performed in accordance with the Operations and Maintenance Plan (USACE, 2016a and 2017c). All Q3 2018 GWTS maintenance activities are provided in the following sections.

5.3.1 Routine Maintenance Activities

Routine maintenance is any activity described as such in the GWTS Operations and Maintenance Plan (USACE, 2016a and 2017c). A summary of routine maintenance activities is provided below.

During Q3 2018, influent or effluent bag filters were not changed out for either Train 1 or Train 2. The differential pressure along the lead GAC vessel on Train 1 was 7.1 pounds per square inch (psi) on July 2, 2018; and, on September 29, 2018, the differential pressure was also 7.1 psi (Appendix I-1) showing no change in lead GAC vessel differential pressure throughout the quarter without the need to skim or backwash the GAC. On July 2, 2018, the differential pressure along the lead GAC vessel of Train 2 was 7.6 psi. The differential pressure in the lead GAC of Train 2 was 7.9 psi as of September 29, 2018.

Sand filters were installed to pretreat groundwater (remove biologic material and solids) prior to entering the GAC treatment trains.

The influent Y-strainers were cleaned 11 times for both Train 1 and Train 2 throughout Q3 2018. Y-strainers were cleaned to maintain equalization of the influent tanks and prevent cavitation at the influent pump intakes.

The GWTS routine maintenance schedule is provided in Table 5-10 and non-routine maintenance activities that were performed during Q3 2018 are discussed in Section 5.3.3 and in Table 5-11.

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. U.S. Air Force 103 permits are required for all on-Base excavation projects. During Q3 2018, Kirtland AFB responded to 33 off-Base tickets requested through New Mexico 811 (Appendix I-2). There were no conveyance line breaches and all off-Base conveyance lines remained intact.

On September 27, 2018, the controls conduit for KAFB-106228 was struck by a contractor performing excavation near the KAFB-106228 conveyance line, which resulted in the shutdown of the well for less than 24 hours. GWTS personnel responded to the line damage ticket per NM811 requirements. The conduit was replaced, the wires landed, and all controls tested for KAFB-106228 on September 28, 2018. KAFB-106228 was returned to service on the same day (September 28, 2018).

5.3.3 Non-Routine Maintenance Activities

Non-routine maintenance activities are defined as maintenance items that fall outside of the scope of the GWTS Operations and Maintenance Plan (USACE, 2016a and 2017c) but need to be addressed in order to maintain consistent GWTS operation. A summary of shutdowns associated with non-routine maintenance activities occurring during Q3 2018 is provided on Table 5-11. Major non-routine maintenance performed in Q3 is listed below.

Repairs to the KAFB-7 injection well plumbing, flow control, and metering are underway. The failed V-Smart valve was removed from KAFB-7 in August 2018 and the well was inspected by video camera (see Appendix I-1a). Repairs to the injection system are substantially completed and effluent discharge to KAFB-7 was resumed starting November 12, 2018. Final wellhead valve repairs are pending. Documentation of final repairs and well maintenance will be presented in future quarterly reports.

The entire system was offline for approximately 5 hours on September 4, 2018 to install breakers for the sodium hypochlorite generator. Repairs of a minor leak associated with the Train 1 sodium hypochlorite injection saddle were performed on September 7, 2018. Extraction wells KAFB-106228, KAFB-106233, and KAFB-106239 were offline for approximately 40 hours beginning on September 6, 2018 following the failure of an air relief valve associated with the Tijeras Arroyo Golf Course irrigation system.

Installation of a fiber optic line near the off-Base influent conveyance pipeline for KAFB-106233 and KAFB-106234 was performed on September 11, 2018. As a result, GWTS personnel shut down KAFB-106233 and KAFB-106234 for approximately 3.5 hours to mitigate potential risks associated with the excavation.

The entire system was offline for approximately 5 hours on September 20, 2018 in conjunction with the installation of chlorinated polyvinyl chloride injection headers and valves on the influent conveyance piping.

The GWTS was offline for approximately 2.5 hours on September 28, 2018 during repairs to the KAFB-106228 communications line. The communications line was damaged during excavation activities associated with the installation of a protective cap over the lines on September 27, 2018 (Section 5.3.2).

The GWTS was shut down several times due to GCMP maintenance activities, rain events, and electrical disruptions throughout Q3 2018.

5.3.4 Effluent Conveyance Line Integrity

No effluent line testing was performed during Q3 2018.

5.4 Ethylene Dibromide *In Situ* Biodegradation Pilot Test

The EDB *in situ* biodegradation pilot test has been ongoing on Kirtland AFB. It is being performed directly south of Randolph Avenue, near the BFF groundwater source area. The main objective of the pilot test is to investigate *in situ* anaerobic bioremediation of EDB in groundwater. This pilot test is being completed under an NMED-approved work plan titled *EDB In Situ Biodegradation Pilot Test Work Plan* (USACE, 2016c).

Several new wells and existing monitoring wells KAFB-106064 and KAFB-106063 are being utilized for this pilot test. The new wells include extraction wells KAFB-106EX1 and KAFB-106EX2; injection well KAFB-106IN1; and nested monitoring wells KAFB-106MW1-S, KAFB-106MW1-I, KAFB-106MW2-S, and KAFB-106MW2-I. Underground conveyance piping was also constructed to carry groundwater between the extraction and injection wells, directing the flow through an aboveground installation where amendments and/or tracers are introduced to the recirculated groundwater.

The pilot test was to be implemented in four phases, each briefly described below:

- ***Phase 1***—Evaluate baseline conditions and the distribution of recirculated water using tracer amendments.
- ***Phase 2***—Evaluate biostimulation in the subsurface after distribution of treatment amendments in recirculated groundwater.
- ***Phase 3***—Evaluate bioaugmentation in the subsurface after distribution of treatment amendments and dehalogenating bacteria in recirculated groundwater.
- ***Phase 4***—Continued monitoring with no active extraction/injection.

Per the Work Plan (USACE, 2016c), Phase 3 was to consist of both biostimulation and bioaugmentation; however, after review of field results from both Phase 1 and Phase 2, it was determined that bioaugmentation was not warranted. Due to the success of biostimulation during Phase 2, Phase 3 was modified to further evaluate biostimulation. The modified Phase 3 was approved by NMED in a letter dated August 7, 2018 (NMED, 2018b).

Phase 2 was completed in July 2018. The recirculation system was restarted, and Phase 3 began on July

30, 2018. The amendments that were introduced to groundwater during Phase 3 included a fermentable sodium lactate-based substrate with nutrients (WilClear Plus®) and additional nutrients (diammonium phosphate). While the recirculation system was operated during Phase 3 (July 30 – September 9, 2018) 340 gallons of WilClear Plus® and 143 kilograms of diammonium phosphate were added to the subsurface; no tracers were used.

Following the active portion of Phase 3, a passive monitoring period without recirculation was started and will continue into Q4 2018. During this time, groundwater samples will be collected on a monthly basis at extraction, injection, and monitoring wells to evaluate the effectiveness of biostimulation.

An independent final report summarizing all activities associated with the pilot test will be submitted at its conclusion.

6. INVESTIGATION-DERIVED WASTE

During Q3 2018, non-hazardous and hazardous investigation-derived waste (IDW) was generated. Non-hazardous IDW consisted of both liquid and solids that were sourced from GWM and monitoring well drilling operations. Liquid hazardous waste was generated strictly from GWM operations.

In addition to the IDW generated specifically during Q3 2018, additional non-hazardous IDW generated during Q2 2018 was stored and managed during Q3 2018. This section discusses the details of waste generated and managed during the quarter.

6.1 Non-Hazardous Investigation-Derived Waste

Non-hazardous IDW liquids and solids comprised the majority of waste volume generated during the quarter. This waste was generated from both the quarterly GWM sampling event and drilling of monitoring wells during the quarter. Appendices J-1 and J-2 provide specific information regarding the non-hazardous liquid and solid IDW waste generated and disposed of during Q3 2018. For Q3 2018, a total of 323.5 gallons of non-hazardous liquid IDW from groundwater monitoring and new well installation and development were also processed through the GWTS. A total of 168.5 cubic yards of non-hazardous solids were disposed of at the Kirtland AFB Construction and Demolition Landfill and an offsite construction landfill in Q3 2018.

6.1.1 Groundwater Monitoring Liquid Waste

Non-hazardous, IDW purge water collected from the monitoring wells was placed in 55-gallon plastic (poly) drums. The drums were sealed with matching plastic lids with steel, locking-ring collars, labeled with vinyl non-hazardous waste labels, and transferred to the designated non-hazardous IDW storage yard located on Kirtland AFB. Small volumes of IDW water, typically generated from the sampling of drinking water wells, were placed in labeled, 5-gallon plastic buckets with sealing lids.

Eligibility for discharge of non-hazardous liquid IDW to the GWTS was determined by comparing historical, well-specific data from the previous two quarters to the acceptance criteria of the GWTS. Liquid IDW from monitoring wells that had historically met the GWTS acceptance criteria was discharged to the facility without further review. Liquid IDW sourced from wells with historical data from the previous two quarters that exceeded the GWTS acceptance criteria was held for further evaluation.

For Q3 2018, a total of 170.5 gallons of non-hazardous groundwater monitoring purge water and equipment decontamination water met the GWTS acceptance criteria and were processed through the GWTS. All IDW water processed through the GWTS was discharged to the Tijeras Arroyo GCMP (Table J-1-1).

Any liquid IDW that is collected, but not yet processed through the GWTS, is temporarily stored in the "Pending Disposal" area of the IDW yard. Typically, this category includes non-hazardous purge water collected during the quarter that meets GWTS acceptance criteria, but was held due to GWTS discharge limitations, construction activities that delayed discharge, or operation and maintenance activities. By the end of Q3 2018, no groundwater monitoring purge water was being held in the "Pending Disposal" category (Table J-1-2a).

Any liquid IDW that is collected, but held pending receipt and evaluation of analytical data, is placed in the "Pending Analysis" area of the IDW yard. By the end of Q3 2018, a total of 7 gallons of IDW water were held in this category (Table J-1-2b).

6.1.2 Well Development and Drilling Liquid Investigation-Derived Waste

During Q3 2018, the "Data Gap" monitoring well drilling project was in progress. As a result, liquid IDW was generated from the well construction activities. As of the end of September 2018, approximately 409 gallons of development water was generated and managed during Q3. The development water was sourced from monitoring wells KAFB-106240, KAFB-106241, KAFB-106242, KAFB-106243, KAFB-106244, and KAFB-106245 (Tables J-1-1, J-1-2a). A total of 153 gallons of development water met GWTS acceptance criteria and were processed through the GWTS in Q3 2018 (Table J-1-1). The remaining 256 gallons of development water were held in the "Pending Disposal" area of the IDW yard at the end of Q3 (Table J-1-2a).

Water that is generated during the construction of monitoring wells and decontamination of drilling equipment are placed in roll-off bins and held in the IDW yard pending analyses. Once analyses are obtained and authorization is given, the liquid fraction of the waste is processed at the GWTS. In Q3 2018, a total of 4,485 gallons of drilling and decontamination water was disposed (Table J-1-3).

6.1.3 Well Drilling Non-Hazardous Solid Investigation-Derived Waste

Approximately 225 cubic yards of non-hazardous, non-liquid IDW was managed during Q3 2018. This IDW includes both soil and mud associated with the drilling of "Data Gap" monitoring wells and associated well construction concrete waste. The dry soils (drill cuttings) composed the majority of the volume of the waste disposed during the quarter (168.5 cubic yards). Upon approval by the Kirtland Solid Waste Program Manager, the soil was disposed of at the Kirtland AFB Construction and Demolition Landfill. Table J-2-1 (Appendix J-2) provides a list of all solid IDW disposed of in Q3 2018.

Additional soil and mud waste generated from well drilling activities were stored at the non-hazardous IDW yard during Q3 2018. A total of 56 cubic yards of material was held at the IDW yard as of September 30, 2018. Table J-2-2 provides a list of all non-hazardous drilling IDW pending disposal at the end of Q3.

In addition to drilling waste routine, disposable, non-hazardous solid wastes that were generated during GWM activities included single-use dual membrane samplers, disposable in-line filters, nitrile gloves, and paper trash. These items were disposed of as municipal solid waste and volumes were not tracked.

6.2 Hazardous Investigation-Derived Waste

Prior to the start of each quarterly GWM sampling event, a preliminary evaluation is made to identify monitoring wells that are anticipated to generate hazardous liquid IDW for initial waste segregation purposes. Based on historical analytical data available for each well, the water is suspected hazardous if the concentration of benzene exceeded 500 µg/L (per 40 CFR Part 261.24) in either of the previous two sampling events. Liquid IDW from these wells is managed as a potentially hazardous waste pending confirmation from laboratory analytical results. The hazardous waste classification code for benzene is D018.

Hazardous or suspected hazardous IDW waste is stored in the Kirtland AFB BFF RCRA less than 90-day accumulation area pending analytical results. Purge water is placed in 55-gallon steel drums with steel

tops and locking rings. All waste containers are properly labeled, sealed, and placed on secondary containment pallets located in the secured less than 90-day accumulation area. The accumulation area and waste containers are inspected on a weekly basis by trained personnel as required under 40 CFR 262.34.

Upon receipt of analytical data, the IDW will continue to be managed in the less than 90-day accumulation area if confirmed to be a hazardous waste. If the IDW is determined to not meet hazardous criteria based on analytical data, the non-hazardous waste is transferred to the "Pending Disposal" area of the non-hazardous IDW yard.

All hazardous waste must be removed from Kirtland AFB and properly disposed of off-Base within the required 90-day holding timeframe. Hazardous waste is transported off Kirtland AFB after it is properly profiled, manifested, and approved for transport by the Kirtland AFB Hazardous Waste Management Group. Waste is transported by a licensed hazardous waste hauler to a permitted treatment, storage, disposal facility.

Due to the small volume of waste generated during passive monitoring well sampling and pneulog well sampling, the hazardous purge water was consolidated. A hazardous waste storage and disposal summary is provided in Table J-3-1 (Appendix J-3).

During Q3 2018, only one drum (containing approximately 1 gallon) of hazardous purge water waste was generated from GWM activities and placed in the less than 90-day accumulation area. The RCRA less than 90-day accumulation area deadline for disposal of this waste was October 6, 2018. However, the volume of sample required to fully characterize the waste consumed 100% of the waste volume. Consequently, the disposal date for this waste is listed as the sampling date of August 7, 2018. Additionally, there was not a manifest number generated for disposal of this waste.

No hazardous waste managed during Q3 2018 was out of compliance with the RCRA hazardous waste less than 90-day accumulation area, transportation, or disposal requirements.

6.2.1 2018 Hazardous Investigation-Derived Waste Volume Summary

As of the end of Q3 2018, the total cumulative volume of hazardous IDW purge water generated from GWM activity at the Kirtland BFF project during 2018 is 130 gallons. The cumulative total for the year will be updated with the Q4 2018 results.

7. PROJECTED ACTIVITIES

Q4 2018 will comprise the period between October 1 and December 31, 2018. Planned Q4 2018 activities are summarized below.

Vadose Zone Monitoring

- Perform semiannual SVM in Q4 2018
- Begin vadose zone coring project and well installation.

Groundwater Monitoring

- Perform quarterly GWM in Q4 2018 and complete sampling of the remaining three newly installed nested wells
- Report quarterly monitoring of USGS sentinel wells (by USGS).

Drinking Water Supply Well Monitoring

- Perform drinking water supply well monitoring monthly for organic compound analysis and inorganic analysis for the October sampling event.

Groundwater Treatment System Operation

- Continue operating the GWTS and extraction wells KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239 with discharge directed to the GCMP until repairs are performed at KAFB-7
- Initiate repairs at KAFB-7
- Complete performance assessment of the GWTS extraction system.

Reporting

A quarterly and annual report will be prepared to detail the activities conducted during the quarter, and to summarize the activities, GWM data, and performance assessment for the entire year. The report will include the semiannual sampling data collected for the full GWM network as well as the vadose zone. The report will provide results of the performance assessment to evaluate the effectiveness of the interim measures.

8. REFERENCES

Anderholm, S.K., M.J. Radell, and S.F. Richey. 1995. *Water-quality Assessment of the Rio Grande Valley Study Unit, Colorado, New Mexico, and Texas – Analysis of Selected Nutrient, Suspended-sediment, and Pesticide Data.* U.S. Geological Survey. 167 p.

EPA. 2017. Regional Screening Levels Master Table. Available online at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017. June.

Langmuir, D. 1997. *Aqueous Environmental Geochemistry*. Prentice-Hall, Upper Saddle River, New Jersey. 600 p.

Longmire, D. 2016. *Application of PHREEQC for Evaluating Precipitation of Reactive Phases During Injection of Treated Effluent Water at Well KAFB-7, Kirtland Air Force Base, Albuquerque, New Mexico.* NMED. 9 p. February 2.

New Mexico Administrative Code. 2004. *State of New Mexico, Title 20.6.2 Ground and Surface Water Protection.*

New Mexico Environment Department (NMED). 2010. Hazardous Waste Treatment Facility Operating Permit, EPA ID No. NM9570024423, Issued to U.S. Air Force for the Open Detonation Unit Located at Kirtland Air Force Base, Bernalillo County, New Mexico, by the NMED Hazardous Waste Bureau. July.

NMED. 2017a. Correspondence from Juan Carlos Borrego, Deputy Secretary, Environment Department to Colonel Eric H. Froehlich, Base Commander, Kirtland AFB, New Mexico, and Lieutenant Colonel Wayne J. Acosta, Civil Engineer Office, Kirtland AFB, New Mexico, regarding the Work Plan for Bulk Fuels Facility Expansion of the Dissolved-Phase Plume Groundwater Treatment System Design Revision 2, Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, EPA ID No. NM9570024423, HWB-KAFB-13-MISC. May 31.

NMED. 2017b. Correspondence from Mr. Juan Carlos Borrego, Deputy Secretary Environment Department, to Colonel Richard W. Gibbs, Base Commander, 377 ABW/CC, Kirtland AFB, New Mexico and Mr. Chris Segura, Chief, Installation Support Section, AFCEC/CZOW, Kirtland AFB, New Mexico, re: Work Plan for Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling, Revision 2, Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, New Mexico, EPA ID No. NM9570024423, HWB-KAFB-13-MISC. February 23.

NMED. 2017c. Correspondence from Kathryn Roberts, Director, Resource Protection Division to Colonel Eric. H. Froehlich, Base Commander, Kirtland AFB, New Mexico, and Lieutenant Colonel Wayne J. Acosta, Civil Engineer Office, Kirtland AFB, New Mexico, regarding Technical Memo Requesting the Optimization of Soil Vapor Monitoring, Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, EPA ID No. NM9570024423, HWB-KAFB-13-MISC. January 4.

NMED. 2017d. Discharge Permit Issuance DP-1839, Kirtland Air Force Base, Bernalillo County, New Mexico, by the New Mexico Environment Department Groundwater Quality Bureau. April.

NMED. 2018a. Correspondence from Mr. Juan Carlos Borrego, Deputy Secretary Environment Department, to Colonel Richard W. Gibbs, Base Commander, 377 ABW/CC, Kirtland AFB, New

Mexico and Mr. Chris Segura, Chief, Installation Support Section, AFCEC/CZOW, Kirtland AFB, New Mexico, re: Work Plan for Data Gap Monitoring Well Installation, Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, New Mexico, EPA ID No. NM9570024423, HWB-KAFB-13-MISC. February 28.

NMED, 2018b. Correspondence from Mr. Juan Carlos Borrego, Deputy Secretary, Environment Department, to Colonel Richard W. Gibbs, Base Commander, 377 AB/CC, Kirtland AFB, NM and Mr. Chris Segura, Chief, Installation Support Section, AFCEC/CZOW, Kirtland AFB, NM, *re:* Phase 3 Ethylene Dibromide *In Situ* Biodegradation Pilot Test, Notification letter, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-11, Kirtland Air Force Base, EPA ID# NM9570024423, HWB-KAFB-13-MISC. August 7.

U.S. Army Corps of Engineers (USACE). 2016a. *Operations and Maintenance Plan, Groundwater Treatment System, Bulk Fuels Facility, SWMU ST-106/SS-111, Kirtland Air Force Base, New Mexico.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912DR-12-D-0006. August.

USACE. 2016c. *Ethylene Dibromide In Situ Biodegradation Pilot Test Work Plan*. Prepared by CB&I Federal Services for the USACE Omaha District under USACE Contract No. W9128F-12-D-0003. December 22.

USACE. 2016d. *Quarterly Monitoring Report October-December 2016 and Annual Report for 2016, Bulk Fuels Facility, SWMU ST-106/SS-111.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912WR-12-D-0006. March 31.

USACE. 2017a. *RCRA Facility Investigation Report, Bulk Fuels Facility Releases, Solid Waste Management Unit ST-106/SS-111*. Prepared by Sundance Consulting, Inc. for the USACE Albuquerque District under USACE Contract No. W912PP-16-C-0002. January 31.

USACE. 2017b. *Work Plan for Bulk Fuels Facility Expansion of the Dissolved-Phase Plume Groundwater Treatment System Design Revision 2, Solid Waste Management Unit ST-106/SS-111*. Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912WR-12-D-0006. May.

USACE. 2017c. *Work Plan for Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling Revision 1, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for U.S. Army Corps of Engineers–Albuquerque District under Contract W9128F-13-D-0006 DM02. December.

USACE. 2017d. *Operations and Maintenance Plan, Groundwater Treatment System, Bulk Fuels Facility, SWMU ST-106/SS-111, Kirtland Air Force Base, New Mexico.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912DR-12-D-0006. September.

USACE. 2017e. *Quarterly Monitoring Report October-December 2017 and Annual Report for 2017, Bulk Fuels Facility, SWMU ST-106/SS-111.* Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912WR-12-D-0006. March 31.

USACE. 2017f. *Quarterly Monitoring Report April-June 2017, Bulk Fuels Facility, SWMU ST-106/SS-111*. Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912WR-12-D-0006. September.

USACE. 2018. *Quarterly Monitoring Report April-June 2018, Bulk Fuels Facility, SWMU ST-106/SS-111*. Prepared by EA Engineering, Science, and Technology, Inc., PBC for the USACE–Albuquerque District under USACE Contract No. W912WR-12-D-0006. September.

FIGURES

TABLES

APPENDICES

LIST OF APPENDICES

J Waste Disposal Documentation

J-1 Non-Hazardous Liquid Investigation-Derived Waste Profiling and Disposal Documentation
J-2 Non-Hazardous Solid Investigation-Derived Waste Profiling and Disposal Documentation
J-3 Hazardous Investigation-Derived Waste Profiling and Disposal Documentation

APPENDIX A

REGULATORY CORRESPONDENCE

APPENDIX B

NEW ACTIVITIES SUPPORTING INFORMATION

APPENDIX B-1

COMPLETION REPORT FOR GROUNDWATER MONITORING WELLS KAFB-106240, KAFB-106243, AND KAFB-106244

APPENDIX C

SOIL VAPOR FIELD SAMPLING RECORDS (NOT INCLUDED IN Q3 2018)

APPENDIX D

SOIL VAPOR DATA QUALITY EVALUATION REPORTS AND DATA PACKAGES (NOT INCLUDED IN Q3 2018)

APPENDIX E

GROUNDWATER MONITORING NETWORK FIELD SAMPLING DATA AND RECORDS

APPENDIX E-1

DATA QUALITY CONTROL REPORTS – GROUNDWATER SAMPLING

APPENDIX E-2

GROUNDWATER AND LIGHT NON-AQUEOUS PHASE LIQUID MEASUREMENTS

APPENDIX E-3

GROUNDWATER PURGE LOGS AND SAMPLE COLLECTION LOGS

APPENDIX E-4

GROUNDWATER SAMPLE CHAIN-OF-CUSTODY FORMS

APPENDIX E-5

U.S. GEOLOGICAL SURVEY SENTINEL WELL DATA

APPENDIX F

GROUNDWATER MONITORING NETWORK SAMPLE DATA QUALITY EVALUATION REPORTS AND DATA PACKAGES

APPENDIX F-1

DATA QUALITY EVALUATION REPORT – GROUNDWATER SAMPLES

APPENDIX F-2

DATA PACKAGES – GROUNDWATER SAMPLES

APPENDIX G

DRINKING WATER SUPPLY WELL SAMPLING DOCUMENTATION

APPENDIX G-1

DAILY QUALITY CONTROL REPORTS – DRINKING WATER SUPPLY WELL SAMPLING

APPENDIX G-2

DRINKING WATER SAMPLE COLLECTION LOGS AND CHAIN-OF-CUSTODY FORMS

APPENDIX H

DRINKING WATER SUPPLY WELL DATA QUALITY EVALUATION REPORTS AND DATA PACKAGES

APPENDIX H-1

DATA QUALITY EVALUATION REPORT – DRINKING WATER SUPPLY WELL SAMPLES

APPENDIX H-2

DATA PACKAGES – DRINKING WATER SUPPLY WELL SAMPLES

APPENDIX I

GROUNDWATER TREATMENT SYSTEM MONITORING AND PERFORMANCE EVALUATION

APPENDIX I-1

GROUNDWATER TREATMENT SYSTEM PLANT OPERATION AND MAINTENANCE DOCUMENTATION

APPENDIX I-2

NEW MEXICO 811 LINE LOCATE TICKETS

APPENDIX I-3

GROUNDWATER TREATMENT SYSTEM PERFORMANCE SAMPLE COLLECTION LOGS

APPENDIX I-4

GROUNDWATER TREATMENT SYSTEM DATA QUALITY EVALUATION REPORT JULY–SEPTEMBER 2018

APPENDIX I-5

DATA PACKAGES – GROUNDWATER TREATMENT SYSTEM SAMPLES

APPENDIX I-6

GROUNDWATER TREATMENT SYSTEM PERFORMANCE ASSESSMENT (NOT INCLUDED IN Q3 2018)

APPENDIX J

WASTE DISPOSAL DOCUMENTATION

APPENDIX J-1

NON-HAZARDOUS LIQUID INVESTIGATION-DERIVED WASTE PROFILING AND DISPOSAL DOCUMENTATION

APPENDIX J-2

NON-HAZARDOUS SOLID INVESTIGATION-DERIVED WASTE PROFILING AND DISPOSAL DOCUMENTATION

APPENDIX J-3

HAZARDOUS INVESTIGATION-DERIVED WASTE PROFILING AND DISPOSAL DOCUMENTATION