Albuquerque Bernalillo County
Water Utility Authority

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Technical Memo

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From: Diane Agnew, Water Authority, Environmental Manager

CC: Katherine Yuhas, Water Authority, Water Resources Division Manager

Rick Shean, Water Authority, Water Rights Program Manager

Date: 1/14/2020

Re: Kirtland Air Force Base *Source Area Characterization Report for the Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111*, October 2019

The Albuquerque Bernalillo County Water Utility Authority (Water Authority) has reviewed the *Source Area Characterization Report for the Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111* (Report) and related work plan (KAFB, 2017) submitted by Kirtland Air Force Base (KAFB) for the Bulk Fuels Facility (BFF) site. The Report summarizes the findings of soil coring and well installation activities conducted between October 2018 and March 2019 in order to address data gaps in the source area of the site. The Water Authority comments below are based on our review of the Report as well as our understanding of the path forward discussed at the scoping technical working group meetings in 2016, 2017, and 2018 and monthly stakeholder meeting updates.

General Concerns:

- The Report includes a conclusive statement that "the results of this investigation indicate that the presence of fuel has been significantly reduced in the vadose zone by remedial actions and natural processes." The Report lacks any analysis comparing historical source area characterization to the 2018 and 2019 soil, soil vapor, light non-aqueous phase liquid (LNAPL), and groundwater data to support this conclusion.

- The vadose zone model presented in the Report uses soil vapor monitoring data collected during Q2 2019 but ignores/eliminates the soil data collected during the coring work, without explanation. The model should be updated to include the soil concentration data as well as a discussion of the source area data to include soil, soil vapor, LNAPL, and groundwater.

- Water Authority identifies several instances in the Report that the New Mexico Environment Department (NMED) approved Work Plan (KAFB, 2017) was not followed in the performance of the sampling activities. These deviations are identified in the comments below.

Specific Comments:

- *Section 5.2.1*: The Report asserts that detections above the laboratory reporting limits for soil samples collected in the vadose zone were limited to samples collected from KAFB-106V1 and KAFB-106V2. However, there were also detections above the reporting limit for toluene in soil samples collected from KAFB-106S1, KAFB-106S5, and KAFB-106S9. Benzene was detected above the reporting limit in KAFB-106S1 and KAFB-106S9. Fuel-related compounds such as

xylenes, 1,2-dibromide (EDB), and ethylbenzene were detected above the reporting limit at KAFB-106S9, indicating a much broader presence of fuel-related contamination than what is concluded in the Report. Also, more than a third (36.8 percent) of soil samples collected in the vadose zone at the groundwater monitoring well installation sites were not analyzed for volatile organic compounds (VOCs) or EDB, representing a large data gap.

- *Section 5.2.1*: The Report includes a statement that BTEX (benzene, toluene, ethylbenzene, and xylenes), EDB, and total petroleum hydrocarbon (TPH) concentrations increase with depth at KAFB-106V1 and KAFB-106V2 down to a maximum depth of 265 feet below ground surface (bgs). Concentration profiles for these two soil coring locations show that concentrations do not increase with depth, as stated in the Report (Attachment 1); the attached concentration profiles were generated by the Water Authority using data presented in the Report. The soil sample results and resulting concentration profiles indicate that the maximum concentrations of BTEX and EDB occur at 103 feet bgs for KAFB-106V2 and 254 feet bgs for KAFB-106V1.

- *Section 5.2.1*: The "Saturated Zone Summary" states that "the highest concentrations in the saturated zone were located east of the source area (KAFB-106V1 and KAFB-106V2)." This statement is not supported by data; neither KAFB-106V1 or KAFB-106V2 were advanced into the saturated zone and therefore there is an absence of soil coring data in the source area to support this conclusive statement.

- *Section 5.2.1*: The text concludes that "concentrations of BTEX, TPH, and EDB decrease significantly in wells located off-base." However, the Water Authority's one-way analysis (Table 1) of variance (ANOVA) for EDB and BTEX collected in the saturated zone (samples at depths greater than or equal to 475 feet bgs) shows no statistically significant difference in mean concentration levels. The null hypothesis for the Water Authority's analysis is "no difference in mean concentration levels for BTEX and EDB samples on- and off-base, respectively." Since the p-value of the analysis is greater than 0.05 for all cases, the null hypothesis is accepted. KAFB should complete statistical analysis of data trends to support statements about concentrations both on- and off-base in order to support development of the source area conceptual model.

Table 1

Response		Degrees of Freedom	Sum of Squares	Mean of Squares	F Value	Pr(>F)
BTEX	*Between groups*	1	204.63	204.63	8.26×10^{-3}	0.928
	Within groups	23	$5.70 \times 10^{+5}$	$2.48 \times 10^{+4}$	NA	NA
EDB	*Between groups*	1	1.46×10^{-3}	1.46×10^{-3}	0.360	0.554
	Within groups	23	9.30×10^{-2}	4.04×10^{-3}	NA	NA

NA: not applicable

- *Section 5.2.4:* The Air Force previously collected continuous cores as part of the In-Situ Bioremediation Recirculation Pilot test. Microbial analysis was completed on the soil cores but those results are not included in the discussion of the source area conceptual model. The microbial data from previous sampling efforts should not be omitted from the source area CSM without discussion, particularly if it is being excluded due to data quality concerns.

- While a lab report for the microbial analysis is included in Appendix G, the complete results have been omitted from the Report. The Report should be amended to include this data. The Water Authority suggests that the data be presented in a summary table in order to more easily review what was detected, degraded, and the results of the analyses. For example, the Report could be updated

with a table that has column headers of "Sample ID," "Date Collected," Bacterial/Bacterial Gene," "Produce Degraded," and "Result."

- *Figures 5-8 through 5-15* only present soil vapor, LNAPL, and groundwater data and do not incorporate the soil concentration data. The Report does not discuss why this dataset was omitted and appears to indicate that the soil sample results are not sufficient to inform the conceptual model for the site and complete characterization of the remaining contamination in the source area.

- *Figures 5-8 and 5-11*: Both figures are missing soil vapor data from Q2 2019. For example, Q2 2019 soil vapor data from soil vapor monitoring point SVMW-09-266 shows a BTEX concentration of 3,398,000 parts per billion (ppb). This concentration is not depicted on either figure.

- *Figure 5-11*: It is not clear what measurements (e.g., Q2 2019) were used to generate the LNAPL shown in the figure.

- *Figure 5-12*: The title and color gradient bar in the legend indicate that the map is showing dissolved benzene in the saturated zone. The text in the legend, however, states that the data are soil vapor data from Q2 2019. It is not clear what data are being illustrated in this figure and should be updated to clarify.

- *Figure 5-13*: The map is showing BTEX concentrations in soil vapor, using Q2 2019 soil vapor data but does not include the soil vapor monitoring points used to generate the soil vapor plume illustrated. The soil vapor monitoring points used for contouring the BTEX concentration plume in soil vapor should be added to the figure for clarity. Additionally, the Q2 2019 report indicates that benzene was detected in soil vapor north of the KAFB installation boundary which indicates that this figure is showing a limited database of BTEX concentrations in soil vapor.

- *Figure 5-14*: The figure combines groundwater data and soil vapor data on the same color spectrum. making it impossible to distinguish in the map.

- *Table 4-1:* There is a typo in the "Depth" column for KAFB-106S8. A value of "70.4" appears between depths of 440 and 460 feet bgs; table should be updated with the correct depth of the measurement.

Field Screening and Soil Coring Concerns

- It is unclear what metrics were used to determine that there was not sufficient LNAPL present in a core to sample for LNAPL properties. The Report indicates that the ultraviolet (UV) screening was used to determine if a sample was collected but the report does not describe what criteria were used. Moreover, the approved work plan does not indicate that UV screening would be used for determining the collection of soil samples (Sections 3.1.1.2 and 3.1.1.3 of the Work Plan [KAFB, 2017]) . The work plan cites the use of photoionization detector (PID) readings and/or odor in the field but did not include the UV screening. There is no document in the administrative record to indicate the variance from the work plan or the criteria to be used for defining sampling collection intervals.

- Section 3.1.1.1 of the Work Plan (KAFB, 2017) states that the Air Force would implement one or more mitigation strategies to maintain a core temperature between 20 and 22 degrees Celsius. In all cases, the average core temperature exceeded this threshold with the average core temperatures range from 27.7 to 69.9 degrees Celsius. In the case of KAFB-106S9, core temperatures exceeded 200 degrees Celsius, far outside the tolerance for core temperatures. While some of the coring temperature logs note when small volumes of water were added to cool the core barrels, there is no note of a change in implementing any of the other three strategies (e.g., slowing the speed of coring in order to minimize vibration).

- Section 4.1.1 of Report states that temperature regulation of the soil cores only occurred in coring intervals to be sampled. However, the sampling should have been based on field PID readings in compliance with the approved work plan. PID readings could be affected by temperature of the core

and therefore temperature regulation should have occurred throughout the length of soil coring. Using predefined soil sampling intervals could have resulted in "missing" impacted soils and the lack of temperature regulation of the cores could bias the PID readings low, resulting in the omission of data on the presence of contamination.

- Per Section 3.1.1.3 of the NMED approved Work Plan (KAFB, 2017) for the soil coring work, soil samples were to be collected and analyzed from intervals with PID readings greater than 1,000 ppm. In reviewing Tables 3-1 and 4-1, not all depths with PID readings greater than 1,000 ppm were sampled. In boreholes KAFB-106S2, KAFB-106S7, and KAFB-106S8 samples were collected where PID readings were below the field screening threshold and no samples were collected where PID readings were greater than the field screening threshold of 1,000 ppm.

  As a result, the soil samples that were collected for the 450 – 500 foot bgs depth intervals at these three coring locations were biased to low PID readings and most likely missed zones of concentrated hydrocarbons. Additionally, within a given 50-foot interval at all coring locations, the soil samples collected were not from the depth of maximum PID reading. In some instances, the missed PID maximums were significantly higher than the PID readings for the sampled interval, as shown in Table 2 below.

Table 2

Coring Location	Depth Interval	Soil Sample		PID Maximum	
		PID	Depth	PID (ppm)	Depth
KAFB-106S2	450 – 500 feet bgs	90.2 ppm Unknown	474 ft bgs 499 ft bgs	3,826 ppm	494 ft bgs
KAFB-106S7	450 – 500 feet bgs	46.8 ppm Unknown Unknown	485 ft bgs 495 ft bgs 196 ft bgs	1,499 ppm	490 ft bgs
KAFB-106S8	450 – 500 feet bgs	54.1 ppm 8.1 ppm	475 ft bgs 499 ft bgs	1,498 ppm	490 ft bgs
KAFB-106V1	200 – 250 feet bgs	2,647 ppm	216 ft bgs	6,831 ppm	240 ft bgs
KAFB-106V2	100 – 150 feet bgs	1,778 ppm 2,075 ppm	103 ft bgs 117 ft bgs	2,230 ppm	140 ft bgs
	150 – 200 feet bgs	2,040 ppm	159 ft bgs	2,706 ppm	170 ft bgs
	200 – 250 feet bgs	3,023 ppm	215 ft bgs	3,633 ppm	230 ft bgs

- Sample depth intervals were not consistently sampled across the boring locations. Critically, KAFB-106247, that was intended to provide "background" data for use in the study, was only sampled at 5 of the 11 depth intervals defined by KAFB. Without consistent sampling of intervals across the source area, there will be a need for relying on data interpolation and modeling instead of the soil coring data that was intended to fill the source area characterization data gap.

- It is unclear what field screening criteria was used to determine when a sample would be collected. For example, a sample was collected from the depth interval of 100-150 feet bgs where the highest PID reading was 6.6 ppm. At KAFB-106S3, however, no sample was collected from the same interval (100-150 feet bgs) despite a comparable maximum PID reading of 6.0 ppm. In a comparison of field PID readings to sample intervals, the percentage of samples representing the maximum PID screening value for a given interval ranges from 0 to 80% (Table 3):

Table 3

Coring Location	Percentage of samples representing maximum PID field screening value
KAFB-106S1	36%
KAFB-106S2	55%
KAFB-106S3	36%
KAFB-106S4	27%
KAFB-106S5	36%
KAFB-106S7	0%
KAFB-106S8	0%
KAFB-106S9	45%
KAFB-106V1	80%
KAFB-106V2	20%

Data Quality Concerns

- All of the soil cores have sample results reported where the reported concentration is below the limit of detection (LOD) but does not have a data qualifier in Table 5-1 in the Report. Additionally, some of the samples were analyzed outside of the holding time and the laboratory reports document data concerns with their ability to quantify results; these concerns and qualifiers from the laboratory do not appear in Table 5-1.

- Multiple samples have LODs greater than the Environmental Protection Agency (EPA) Regional Screening Levels (RSL) for benzene (e.g., KAFB-106S1, KAFB-106S9, KAFB-106V1, KAFB-106V2).

- The Report indicates that there were no bacteria or functional genes detected that are associated with BTEX or EDB biodegradation. The Report also states that there could potentially be a substance in the samples that would inhibit the polymerase chain reaction (PCR). The Report does not discuss what the potential and/or likely PCR inhibitors could be that would bias the results low. The most common PCR inhibitors for soil and sediment samples are compounds that would not be expected to occur at depth (e.g., humic substances and plant material) and could potentially be an indication of cross-contamination of samples.

- The Report seems to conclude that PCR inhibitors impacted the results of the microbial analysis which puts into question the analytical method being used to determine microbial populations in the soil. Additionally, the PCR inhibitors indicate poor data quality and therefore the results should not be used to make statements on microbial degradation of fuel compounds (Section 5.4.4).

- It is unclear from the report if LNAPL thickness measurements were collected from the groundwater monitoring well completions at the soil core location. For example, Figure 5-7 uses unique well symbols to indicate whether or not there was measurable LNAPL at existing groundwater monitoring wells but there is no data on what was measured in the newly installed wells.

The Water Authority does not believe data collected and summarized in the Report adequately addresses outstanding source area data gaps and the Report lacks the robust analysis necessary to revise/update the source area conceptual site mode.. Statistical analysis of concentration trends in the source area should be completed to support development of the conceptual site model and to understand the significance of observed trends in the dataset. Additionally, the reporting of data without qualification for samples that were analyzed outside of their holding times and with LOD greater than the reported results raises concerns about the use of the data from the Report for making definitive statements about the remaining fuel contamination. The Water Authority did not review the entirety of the laboratory results and recommends that this be completed by NMED and the Air Force to understand the scope of the data quality problems. Finally, the high core temperatures reported for all soil core temperatures, the failure to collect soil samples in accordance with the PID threshold, and the lack of consistent sampling across depth intervals likely biases the data towards lower/reduced concentrations of fuel contaminants at the site.

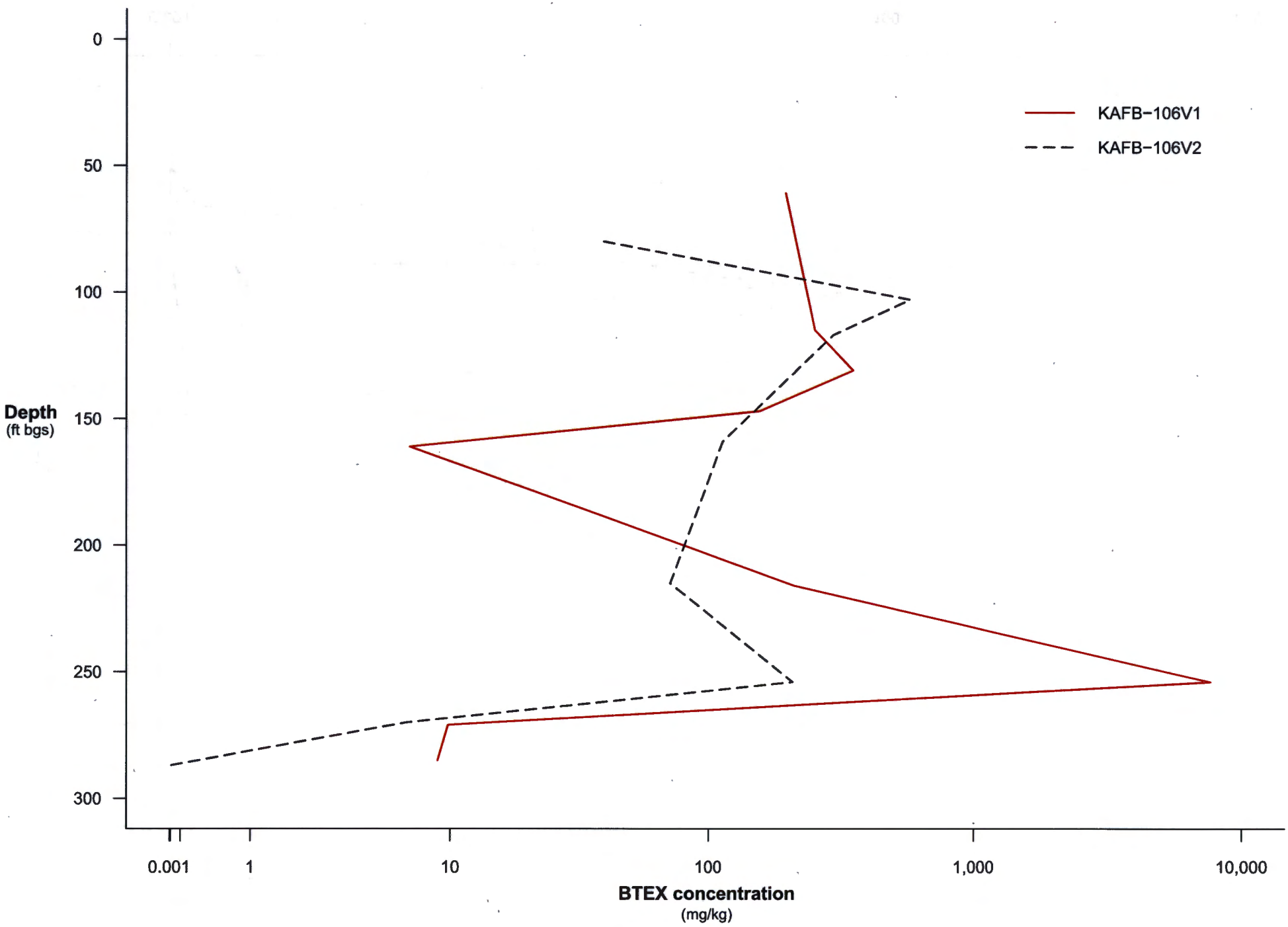
Understanding the source area and the remaining contamination is a critical component for a robust Corrective Measures Evaluation. Our primary concern with this Report is that it concludes that the source area has been adequately characterized, with the resulting conceptual site model diverges from what previous characterization data has indicated. Failure to delineate the extent of remaining fuel contamination could result in a persistent source to groundwater and increase the amount of time it will take to clean-up the impacted groundwater source. Protection of our drinking water and aggressive cleanup of the remaining contamination remains a priority of the Water Authority and we believe a technically robust characterization of the source area is key to that objective.

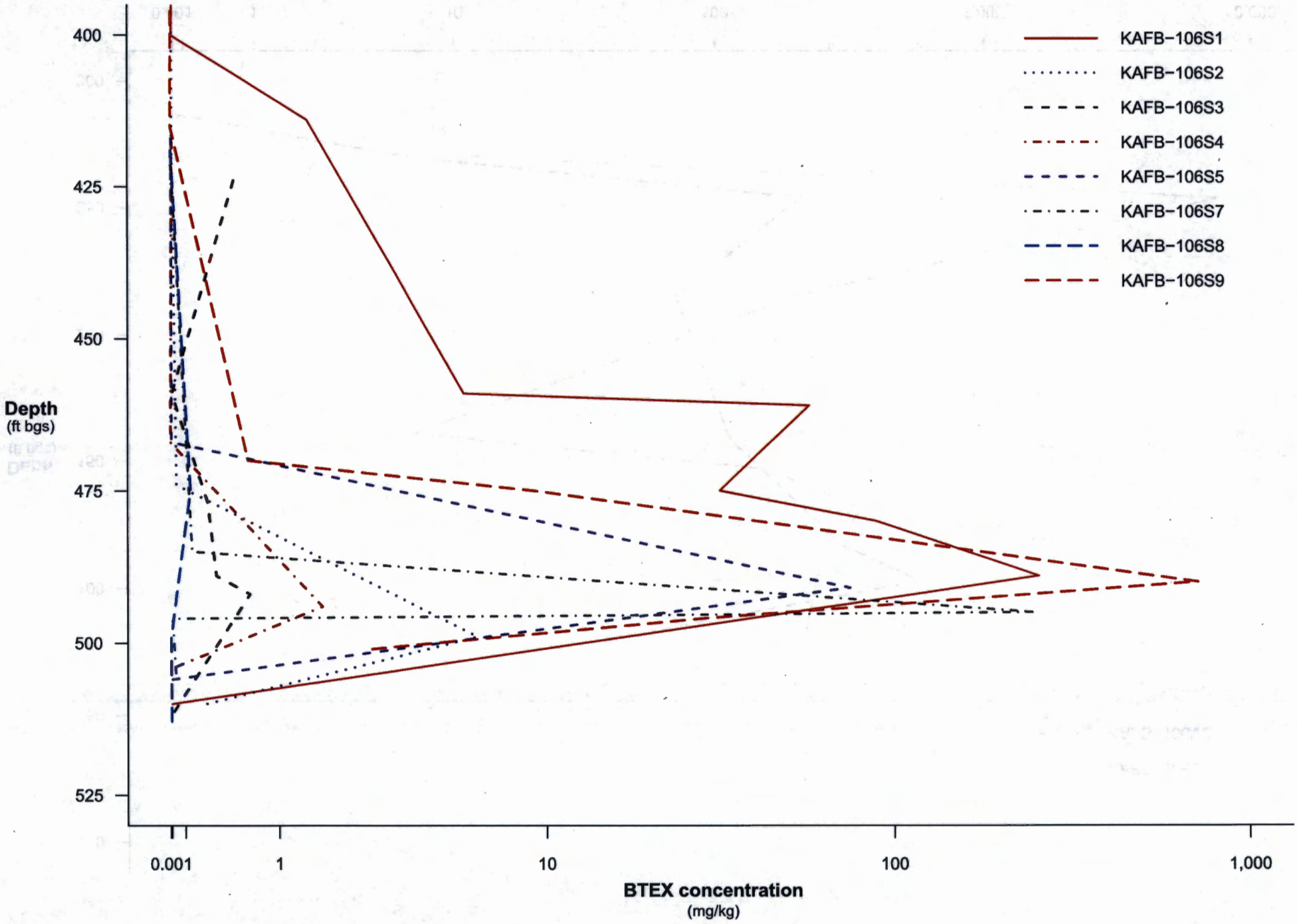
References

Kirtland Air Force Base (KAFB), 2017. *Work Plan for Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111, Revision 1.* Prepared by EA Engineering, Science, and Technology, Inc. Albuquerque. December.

KAFB. 2019. *Source Zone Characterization Report for the Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111.* Prepared by EA Engineering, Science, and Technology, Inc. Albuquerque. October.

ATTACHMENT 1


KAFB-106V1
KAFB-106V2
Depth
(ft bgs)
0
50
100
150
200
250
300
0.001
1
10
100
1,000
10,000
BTEX concentration
(mg/kg)


400
425
450
475
500
525
Depth
(ft bgs)
0.001
1
10
100
1,000
BTEX concentration
(mg/kg)
KAFB-106S1
KAFB-106S2
KAFB-106S3
KAFB-106S4
KAFB-106S5
KAFB-106S7
KAFB-106S8
KAFB-106S9