ENTERED KAFB Bulk Fuels Spill ST-106 and SS-111 Draft NOD 2nd Quarter 2014 Pre-Remedy Quarterly Monitoring Report

NEW MEXICO ENVIRONMENT DEPARTMENT

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Cabinet Secretary-Designate

BUTCH TONGATE
Deputy Secretary

DRAFT

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

July 6, 2015

Colonel Tom D. Miller
Base Commander
377 ABW/CC
2000 Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

John Pike
Director, Environmental Management Services
377 MSG
2050 Wyoming Blvd. SE, Suite 116
Kirtland AFB, NM 87117-5270

RE: DISAPPROVAL
QUARTERLY PRE-REMEDY MONITORING AND SITE INVESTIGATION REPORT FOR APRIL-JUNE 2014, BULK FUELS FACILITY SPILL, SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111, SEPTEMBER 2014
KIRTLAND AIR FORCE BASE
EPA ID# NM9570024423
HWB-KAFB-14-022

Dear Colonel Miller and Mr. Pike:

The New Mexico Environment Department (NMED) has received the Kirtland Air Force Base (Permittee) *Quarterly Pre- Remedy Monitoring and Site Investigation Report for April- June 2014, Bulk Fuels Facility Spill, Solid Waste Management Units ST-1 06 and SS-111*(Report), dated September 2014. By letter on June 4, 2010, NMED required quarterly reports to be submitted for the investigation and remediation of the Bulk Fuels Facility (BFF) Spill. A pertinent part of that letter states:

> "Each quarterly report shall provide detailed information on all characterization and remediation activities that took place during the period covered by the report, including, but not limited to, as applicable for the reporting period, field and laboratory analytical results for groundwater, soil, and soil gas; graphs showing trends of major contaminants versus time, a table of surveyed well locations;

descriptions of the installation of groundwater and soil-gas monitoring wells; measurements of light non-aqueous phase liquid (LNAPL); table of water levels; water-level map; plume contaminant maps and cross-sections; and geologic and geophysical logs of wells and boreholes. Each quarterly report shall also describe the operation, maintenance, and performance of the four soil-vapor extraction (SVE) systems. Each quarterly report shall also include all field and laboratory quality control data for the reporting period and a discussion of data quality as it relates to accuracy, precision, representativeness, and completeness for each analytical parameter that is to be reported."

NMED has reviewed the Report and hereby issues this Disapproval. The Permittee must address the following comments in a revised report.

General Comments

1. **Conceptual Site Model**
   The Report does not utilize existing data to maximum benefit. Also, as with earlier reports, the Report does not adequately convey the information that is necessary to facilitate a detailed understanding of the geologic, hydrologic, and contaminated conditions of the vadose zone and groundwater, and the degree of success of the soil-vapor extraction (SVE) unit in removing contamination from the vadose zone. In particular, an adequate geologic conceptual site model for such a complex investigation has not been prepared based on the figures provided in the Report, especially for the source area of the contamination where geologic conditions significantly influence the migration of fuel to the water table.

   The report lacks a conceptual-site-model synthesis of the large amount of data that the Permittee had collected. The quarterly reports should be used to continually refine the hydrogeologic site conceptual model. If something was done in the quarter, include it in the report and update the associated cumulative tables. The continued submittal of the databases is the mechanism to correct earlier errors in data. Errors have previously been pointed out to the Permittee (see for example comment 30 in the August 17, 2011, letter from NMED). Each quarterly report must contain a table or text describing data that has been changed, if any.

2. **Previously Identified Deficiencies**
   Many of the following comments concern deficiencies or similar deficiencies that have been previously identified by NMED in comments on quarterly reports on the Bulk Fuels Facility Spill (BFFS), for example those noted in NMED's letters of June 16, 2011; August 17, 2011; February 29, 2012; and February 1, 2013. NMED also provided to the Permittee, in hard copy format, a draft compilation of recurring deficiencies in quarterly reports dated February 13, 2014 at the weekly (at that time) Wednesday afternoon meeting on February 19, 2014. Therefore, the Permittee was aware in advance of the submittal of this Report of many of the deficiencies that have been identified in this Disapproval, but has failed to properly address them. Of further note is that some of the Permittee's unofficial and official responses concerning the deficiencies noted for the quarterly reports indicated that certain information would be added to or would be corrected in the Groundwater and Vadose Zone RFI Reports

that were submitted to NMED prior to submittal of this Report. However, the corrections or additions were not completed, or not adequately completed, in all cases. Because of the latter, certain aspects of the RFI Reports are not technically credible and defensible. The RFI Reports were subsequently withdrawn by the Permittee.

In summary, these deficiencies pertain chiefly to inadequate characterization of the geology, hydrochemistry, hydraulic conditions, and contaminant concentrations and extents of contaminant plumes, and deficient interpretation and presentation of data leading to failure to generate an adequate Conceptual Site Model. Furthermore, the presence of gas bubbles in some water samples calls into question the reliability and accuracy of some investigation results.

3. Field Screening Instrument Data

Throughout the Report, the Permittee utilizes data from field instruments for quantitative calculations, specifically the Horiba MEXA-584L Automotive Emission Analyzer (Horiba). It is inappropriate to use field screening data for quantitative purposes. Field instruments provide qualitative rather than quantitative data. Comparison of data from the Horiba to analytical laboratory data indicates that the Horiba results are neither accurate nor precise and therefore cannot be used to accurately calculate quantitative values.

In addition, the Permittee did not calibrate the instrument per manufacturer's guidance. During the January 20, 2015 CSI meeting at CB&I offices in Albuquerque, when asked how often the Horiba was calibrated, CB&I's field sampling team manager stated that the instrument was calibrated weekly when used regularly and that this frequency was well within the manufacturer's specifications. The *Horiba Automotive Emission Analyzer MEXA 584L Instruction Manual*, page 21, specifically states, "[t]he gas calibration is required at least once per day before measurements."

The Permittee also did not follow sampling protocol specified in the March 2011 *Vadose Zone Investigation Work Plan* (Work Plan). Section 5.3.1, Well Purging, of the Work Plan states, "[f]or each well, the volume (in cubic feet) of casing and any associated piping will be calculated, and the purge pump will be operated long enough to remove three casing/piping volumes before sampling the well." The Permittee has been removing ten casing/piping volumes from all wells prior to sampling. Section 5.3.2, Soil-Gas Sample Collection of the Work Plan states, "[s]amples will be collected after field instrument readings have stabilized within ±10 percent for three consecutive measurements and after the sampling tubing and the soil-gas monitoring well have been purged to remove all stagnant vapor." This protocol was not followed for all wells. For instance, SVMW-04-300, the last three recorded hydrocarbon (HC) measurements all changed by more than 10 percent with a steady decreasing trend.

The Permittee has used Horiba data to calculate CATOX system destruction removal efficiencies, as well as cumulative mass removed by the SVE system since continuous operation began in 2003. The Permittee must remove all calculations based on field screening data from this and all future reports. In addition, provide a description of the calibration procedure and all calibration data for all Horiba field instruments used.

4. Dissolved Oxygen Measurements

For all quarterly sampling events from 2011 to 2014, the Permittee presents various measured dissolved oxygen (DO) values that are above the oxygen solubility limit for the temperatures and pressures that exist at the site. In reviewing field notes over this time period, DO measurements are recorded that are more than three times the solubility limit for site conditions, as well as measurements that are less than zero. Figures 5-31 through 5-33 of the Report present DO values that are well above the solubility limit and up to 11.01 mg/L. Field notes for this quarter record DO values up to 17.38 mg/L, or approximately twice the solubility limit.

Provide an explanation for the collection of erroneous data, the lack of recognition that this data is not valid, and the inclusion this data within a variety of reports. In addition, the Permittee must provide all instrument calibration records for DO and all other field parameters. Remove all invalid DO data from the Report and all subsequent reports. The Permittee must also examine and modify field protocol that has resulted in erroneous measurements of DO.

5. Nomenclature

The nomenclature for the CATOX SVE system inlet sampling port is inconsistent. In Table 2-1 and Table 2-2, it is called CATOX-IN; in Table 2-3, it is Pre CATOX; in Table 2-6, it is CATOX Inlet; in Figure 2-2, it is "prior to the CATOX unit"; in Figure 2-3, it is "prior to the Knock-Out Tank". If these designations all refer to the same sampling location, choose one name and revise all text, figures, and tables to use this name consistently. If some or all of these refer to different locations, explain the differences and use the appropriate designations in the appropriate locations. Similarly, revise the CATOX SVE system outlet nomenclature to be consistent.

There is also confusion over the names of wells at KAFB BFF spill. The Permittee utilizes multiple names for the same well in different locations within the Report. For instance, Section 5.1 lists a well as "KAFB-1061" and Section 3.2.7 lists the well as "KAFB-106001". This inconsistency is noticeably apparent in Figure 3-1, where some wells are labeled with the appropriate full designation (e.g., KAFB-106029) and some are labeled with the abbreviated designation (e.g., KAFB-10628). This practice causes confusion and difficulty in review of the Report. The Permittees must use the full well designation in all text, tables, figures, and appendices for each well in this Report and all future submittals.

6. Insufficient subsurface lithologic characterization

The Permittee has provided insufficient information regarding characterization of the subsurface lithology and its relation to contamination.

First, the geologic cross-sections provided in Figures 4-6 through 4-23 report soil classifications documented during well drilling operations. These wells were drilled using air-rotary drilling methods, which utilize air to lift cuttings to the surface. Cuttings collected from the ejected air stream are typically not indicative of actual subsurface conditions based on loss of fines, mixing of materials, and travel time lags from the drill bit depth to the surface.

In addition, where split-barrel sampling was conducted, soils were consistently misclassified on boring logs provided in Appendix D. For fine-grained soils, based on a cursory review of boring logs for wells KAFB-106120 and KAFB-106124, silts classified as "soft" on the boring logs were in actuality "very stiff" or "hard" based on blow counts reported, and silts and clays classified as "stiff" on the boring logs were "hard" based on blow counts reported. A cursory review of the boring log for well KAFB-106108 shows the same inconsistent and inaccurate density classifications for noncohesive soils based on blow counts. In addition, density classifications, primarily "loose", are applied to descriptions where no split-barrel sampling was conducted; all cuttings are loose after being blown through the air-lift system with air rotary drilling methods. These descriptions are not accurate or appropriate on the boring logs.

Borehole logging based on drill cuttings and split-barrel sampling is subjective and dependent on the qualifications and experience of the individual performing the logging. Borehole logging, especially from air-rotary cuttings, regularly provides inaccurate results and should not be considered alone for characterization of the subsurface. Geophysical logging of the boreholes in conjunction with lithologic logging provides a much more reliable source of information for actual subsurface lithology, yet the Permittee appears to have ignored the geophysical data.

Based on geophysical logging of boreholes, the subsurface at the site contains a mostly continuous layer of fine-grained soils, i.e., clays and silts, between 250 and 300 feet (ft) below ground surface (bgs). This fact was detailed in previous reports by the Permittee (e.g., January 30, 2006 *Stage 2 Abatement Plan, Summary and Performance Report for the Soil Vapor Extraction and Treatment System, Bulk Fuels Facility (ST-106) Kirtland Air Force Base*), but has not been acknowledged in more recent reports. In addition, the lithologic layers within the subsurface tend to dip eastward to southeastward. The effect of this fine-grained layer, which extends below the former fuel offloading racks (FFOR), is to retard the downward migration of the fuel contaminants as they move through the subsurface. As the contaminants reached the fine-grained layer, they are likely spread laterally along the layer and generally moved towards the east-southeast.

The geophysical logging data indicate a break in this mostly continuous fine-grained layer between the Pneulog® wells KAFB-106148 and KAFB-106149. Based on these data and the soil gas data logs from these wells, it is likely that the fuel contaminants from the FFOR made their way vertically downward until making contact with the fine-grained layer approximately 270 ft bgs. The fuels then likely spread laterally towards the east-southeast until they reached a break in these fine-grained soils and then further migrated downward through the subsurface. The total VOC vapor plume footprint by elevations maps also support this theory. These maps illustrate that the highest contamination levels in the vadose zone above 250 ft bgs are directly below the FFOR. At 250 ft bgs and below, the highest levels of contamination are located to the east-southeast of the FFOR. The historical location of nonaqueous-phase liquids (NAPL) on the groundwater surface also supports this theory. In addition, data from the SVE pilot tests indicate the highest levels of contaminants being pulled from well 106148 at 199-349 ft bgs and from well 106150 at 355-484 ft bgs supports this theory.

Based on the information above, it is likely that there is a large source of contaminants located at the interface of and adsorbed within the fine-grained layer approximately 270 ft bgs beneath the FFOR. This is also supported by the fact that the highest concentration of TPH found within the historical data for a soil sample was located in SB-26 at 269 ft bgs.

Although the Permittee acknowledges that the contaminants migrated south and east of the FFOR, no discussion of the lithology or potential for highly contaminated soils within the apparent fine-grained lithologic layer at 270 ft bgs was provided. Resolve discrepancies, correct errors, and provide analysis and discussion of all subsurface data, including those that provide important information related to fine-grained soil layers that influence the distribution of vadose zone contamination.

Specific Comments

7. Executive Summary, page ES-1, second paragraph.

Permittee's Statement: "Quarterly pre-remedy monitoring and site investigation reporting presents field and analytical data and information associated with the operation, maintenance, and performance of the interim remedial measures soil-vapor extraction (SVE) and treatment systems; characterization and remediation activities associated with groundwater, vadose zone, and Former Fuel Offloading Rack investigations; and quarterly pre-remedy monitoring for groundwater and soil vapor at the BFF Spill site."

NMED's Comment: The Report lacks a conceptual hydrogeologic model and a synthesis of the information that the Permittee is collecting as described above. A sound conceptual hydrogeologic model is essential for placing groundwater and SVE wells for purposes of characterization and for interim and final remediation measures. It is premature and potentially wasteful to locate wells in such studies without first synthesizing what is known about the geologic setting. NMED has stressed the importance of a sound conceptual hydrogeologic model from the beginning, for example, in its August 6, 2010, letter, NMED required the Permittee to update its "...outdated conceptual model of geologic, hydrologic, and contamination conditions."

It is common, owing to the size or complexity of hydrologic systems, to use numerical models to simulate current or future conditions; such computer models are only as good as the conceptual hydrogeologic models upon which they are based. Thus, it is essential that hydrologic modelers also be able to realistically conceptualize the relationship of the hydrologic system relative to the geologic framework in an area, even with limited information, time, and resources.

8. Executive Summary, page ES-1, third paragraph.

Permittee's statement: "While the major site characterization findings from the quarterly reports are cumulative, the text in this Report reflects investigative findings from the Second

Quarter Calendar year (CY) 2014 only. Cumulative data from past quarters can be found in the appendices of this report."

NMED's Comment: "Cumulative" characterization findings for this site are the data used to compose the Conceptual Hydrogeologic Model upon which any further characterization efforts and all remediation system designs must be based.

9. Executive Summary, page ES-3, last bullet.

Permittee's statement, page ES-3: "Compound-specific isotope analysis for EDB also indicates partial degradation of this compound."

NMED's Comment: According to EPA experts on this subject, the compound-specific isotope analysis data are suspect, and thus, they are not defensible. See Comment 37.

10. Section 1, Introduction, p. 1-3

Permittee's Statement: "Because these new data will lead to revisions of the conceptual site model, Section 7 has been removed from this report for Second Quarter CY 2014."

NMED's Comment: As new data becomes available through additional work, data should be used to refine the existing hydrogeologic conceptual site model. Removing the entire section in the quarterly report is not justified. Include a revised conceptual site model in the Report.

11. Section 2.1.1, Description of SVE System, p. 2-1

NMED's Comment: In a December 10, 2010 letter, NMED instructed the Permittee to prepare an optimization plan for the SVE system. An optimization plan for the SVE system is not included in the Report. The revised Report must include an optimization plan and describe in detail the optimization efforts that were conducted for the SVE system during the reporting period.

12. Section 2.1.1, Description of SVE System, p. 2-1

NMED's Comment: Section 2.1.1 of the June 2014 *Quarterly Pre-Remedy Monitoring and Site Investigation Report for January – March 2014* states, "The SVE system is designed to extract up to 1,600 standard cubic feet per minute of air containing up to 3,450 parts per million by volume (ppmv) total hydrocarbons from the two SVE wells, which results in the removal of over 2,200 pounds of hydrocarbons from the soil per day." Dividing the total mass recovery by the operating time in days in Table 2-4 gives a hydrocarbon recovery rate in pounds per day. Dividing by 2,200 pounds per day gives the percent of design capacity.

Quarter	Total Mass Recovery (lb/period)	pounds/day	% efficiency
3/15/13 - 3/31/13	19,385	1140	52%
4/1/13 - 6-30/13	59,159	1023	47%
7/1/13 - 9/30/13	76,540	920	42%
10/1/13 - 12/31/13	53,647	1074	49%
1/1/14 - 3/31/14	111,521	1464	67%
4/1/14 - 6/30/14	93,485	1292	59%

As shown by the above table, the CATOX SVE system has not been operating anywhere near the design capacity. Provide an explanation for the low efficiency of the CATOX SVE system.

13. Section 2.1.1, Description of SVE System, p. 2-2

Permittee's Statement: "During Second Quarter CY 2014, valves at various extraction wells and various depths were adjusted to optimize the vapor concentration in the extracted vapor."

NMED's Comment: Appendix E of the Permittee's February 2014 *Soil-Vapor Extraction System Pilot Test Report* (Pilot Test Report) states, "the following three Pneulog® wells will be permanently piped into the existing SVE treatment system (Figure E-1):

- Kirtland Air Force Base (KAFB)-106149 (middle screened interval, 200 feet to 350 feet bgs)- replaces ambient dilution air and increases ROI at 350 foot level of vadose zone.
- KAFB-106150 (bottom screened interval, 350 feet to 480 feet bgs)- produces soil vapor with high ethylene dibromide (EDB) concentrations, and will increase the radius of influence at this depth.
- KAFB-106154 (middle screened interval, 200 feet to 350 feet bgs)- replaces ambient dilution air and increases ROI at 350 foot level of vadose zone."

The Permittee's statement suggests that the system is not configured as was described in the Pilot Test Report. Provide a detailed description of the expanded extraction well system, including why the system is not being operated as described above, how the valving system is set up on the Pneulog® wells to allow the different screens to be turned on and off, and how each individual screen is sampled.

Table 2-7 indicates that certain screened intervals in the Pneulog® extraction wells were not used (KAFB-106149 at 484 feet, KAFB-106150 at 200 feet, and KAFB-106154 at 484 feet), while KAFB-106154 at 200 feet was sampled for less than a week and turned off. Explain why the former two screens were not sampled, and why the latter screen was sampled so few times. Also discuss why KAFB-106150 at 484 feet has the highest hydrocarbon

concentration, yet a very low flow rate. The table also suggests that the system is not configured as described in the Pilot Test Report.

14. Sections 2.1.2, Vapor Monitoring and Sampling, p. 2-2, and 2.1.3 Calculation of Destruction Removal Efficiency, p. 2-3

Permittees Statement: "During the reporting period, quarterly vapor samples from vapor extraction wells KAFB-106160 and KAFB 106161, SVM wells, and SVE system inlet and exhaust ports were collected for laboratory analysis."

NMED's Comment: Table 2.1 and Table 2.2 shows that the Total Lab VOC (with C5 – C12 DRO) value is similar to the field hydrocarbon measurement for KAFB-106160, over two orders of magnitude below the field hydrocarbon measurement value for KAFB-106161, and off by a factor of two from the field hydrocarbon measurement for the CATOX inlet and outlet. Explain the discrepancies. Describe how the Horiba emissions analyzer is calibrated and provide calibration records in the revised Report. See Comment 3.

15. Sections 2.1.2, Vapor Monitoring and Sampling, p. 2-2, and 2.1.3 Calculation of Destruction Removal Efficiency, p. 2-3

NMED's Comment: There is no description or figure in the text that describes the SVE extraction well sampling locations or the CATOX SVE inlet and outlet sampling locations. Nor is there a description of field sampling method protocols or the laboratory sample collection method for vapor. The Permittee must include both field and laboratory vapor sampling method protocols in an appendix, as it is difficult to determine potential reasons for differences in sampling results without knowing the sampling method.

16. Sections 2.1.2, Vapor Monitoring and Sampling, p. 2-2, and 2.1.3 Calculation of Destruction Removal Efficiency, p. 2-3

NMED's Comment: Field data should be used for screening and as an interim check of lab data, not for calculation of hydrocarbon removal or SVE efficiency. It is unclear how many laboratory samples were collected from the two extraction wells and the inlet and outlet of the CATOX SVE system. Table 2-2 lists only one sample collected on June 18, 2014. Field data are not correlated with lab data and it appears that no verification or validation of field data has occurred. The Work Plan must describe sampling protocol, how often field and laboratory samples are collected, when resampling should occur, and other operational issues. See Comment 3.

17. Section 2.1.3, Calculation of Destruction Removal Efficiency:

Permittees Statement: "However, the average DRE [destruction removal efficiency] value based on field measurements for the quarter is estimated to be approximately 88% (Table 2-3)."

NMED's Comment: DRE values calculated based on field measurements are not valid. See Comment 3. The true DRE value must be based on analytical laboratory data, which Table 2-3 indicates is actually 56.7%. Section 2.1, Phase II Remediation Interim Measure, of the December 2013 *Phase II Remediation Interim Measures Plan Soil-Vapor Extraction Treatment System Design*, states, "The CATOX is a natural gas-fired unit designed for 98 percent destruction of hydrocarbons." Provide an explanation as to why the destruction efficiency of the CATOX is less than 57% in the revised Report.

18. Section 2.1.6, SVE Tracking, p. 2-5

Permittee's Statement: "Figure 2-3 shows the flow rate and vacuum pressure measured at the CATOX unit during Second Quarter CY 2014. Figure 2-2 shows the total hydrocarbons measured at the CATOX unit."

NMED's Comment: When referencing figures, also reference the relevant table or tables. Provide a reference for the table or tables with measured flow rate, vacuum pressure, and hydrocarbon concentration for the CATOX inlet. The average flow rate and hydrocarbon concentration calculated on the tables should match the values of Table 2-4. Also, include the calculation used to determine hydrocarbon recovery rates in the text.

19. Section 2.3 Waste Generation, p 2-6

Permittee's Statement: "Approximately 270 gallons of condensate were disposed of offsite as hazardous waste on April 8, 2014 by Advanced Chemical Transport, Inc. During First Quarter CY 2014, 2,455 gallons of condensate waste were generated."

NMED's Comment: Describe how and where the remaining condensate waste is being stored and the eventual fate of the waste in the revised Report.

20. Section 3.0, Site Investigation, p 3-1

NMED's Comment: In previous letters, NMED expressed concern that the Permittee was not fully integrating geophysical and geologic data into the conceptual geologic model or cross-sections and that the Permittee should include data from other KAFB wells, the Veteran's Administration well, and the Water Utility Authority (WUA) wells on cross-sections, wherever possible, to provide additional information for preparation of the geologic cross-sections. Also, because the production wells in the area are deeper than the monitoring wells, these wells may be the only source for geologic information for deeper parts of the aquifer (geophysical logs are available for many of these wells). Instead of including this data and updating the model, the Permittee has elected to forgo any discussion of their conceptual site hydrogeologic model. Provide and discuss an updated conceptual site geologic mode and an updated conceptual site hydrogeologic model in the revised Report.

21. Section 3.2.1 Installation of Air Sparge and SVE Well, p. 3-2

NMED's Comment: Provide a brief summary of the rationale for the location of the air sparge and SVE system, as well as a reference for the well log for KAFB-106221 in the text. Provide a figure showing the location of the new well, the GAC system, nearby groundwater and soil vapor monitoring wells, and supply wells. Discuss the results of the vertical permeability testing and compare these with ranges of conductivity and permeability for similar materials as shown in the lithologic log at the same depths.

22. Section 3.2.3 Well Installation, p. 3-4

Permittee's Statement: "Appendix D-4 includes paperwork documenting how KAFB-10612 became inoperable."

NMED's Comment: Provide a summary of how KAFB-10612 became inoperable in the Report text, so the reader does not have to refer to the appendix and interpret scanned handwritten documents.

23. Section 3.2.3 Well Installation, p. 3-4

Permittee's Statement: "The primary function of well KAFB-106210 was to provide material for the bench scale treatability tests for upcoming interim measures. This well will not be included in the quarterly groundwater monitoring network, and no groundwater sample was collected at KAFB-106210 during Second Quarter CY 2014."

NMED's Comment: Describe the location of KAFB-106210 and include a figure showing the location of KAFB-106210 for reference.

Provide an explanation as to why well KAFB-106210 was installed and developed rather than plugged and abandoned, if the well will not be sampled. Quarterly groundwater samples and monthly water level measurements should be collected as it will provide additional useful data on the contaminant plume. If there are future plans to inject chemicals into this well in order to augment abiotic/biotic degradation of EDB and LNAPL, groundwater samples must be collected and analyzed to establish baseline concentrations of groundwater constituents.

24. Section 3.2.2 Geophysical Logging, p. 3-3

Permittee's Statement: "No geophysical logging was conducted during Second Quarter CY 2014."

NMED's Comment: There is no discussion of the results of geophysical logging methods, either individually (electric, gamma, neutron) or as a whole. The Permittee has also neglected to improve the conceptual site model geology based on both the Permittee's geophysical logs and other geophysical logs from nearby wells, such as KAFB production wells, the Veteran's Administration well, Ridgecrest #3 and #5, and the ABCWUA Trumbull wells. Because the

production wells and the ABCWUA wells in the area are deeper than the monitoring wells, these wells may be the only source for geologic information for the deeper portions of the aquifer. Provide and discuss the geophysical logging results for all local wells, an updated conceptual site geologic model, and an updated conceptual site hydrogeologic model in the revised Report.

25. Section 3.2.7, Quarterly Groundwater Sampling Field Activities, p. 3-9

Permittee's Statement: "Field alkalinity data and water level were also recorded when applicable."

NMED's Comment: Field alkalinity and water level measurements are always applicable. The table *Final Groundwater Water Quality Field Parameter Measurements Prior to Sampling* in Appendix G-2, 2014, shows that water levels were not measured in water supply wells 2819-R-CRT, KAFB-003, KAFB-015, KAFB-016, and ST106-VA2. The Permittee must measure water levels in all wells in order to generate an accurate potentiometric map.

26. Section 3.2.8, Quarterly Soil-Vapor Sampling Field Activities, p. 3-12

Permittee's Statement, page 3-12, first paragraph: "Field purge data for each well sampled during Second Quarter CY 2014 are included in Appendix G-1."

NMED's Comment: Soil vapor field data are found in Appendix G-3. Correct the reference.

27. Section 3.2.8, Quarterly Soil-Vapor Sampling Field Activities, p. 3-12

Permittee's Statement: "...and associated sample delivery group (column labeled "SDG")..."

NMED's Comment: SDG designations are not in columns; rather, they are headings on each page of the table. Correct the reference.

28. Section 4.1, Soil Sampling Results, p. 4-1

Permittee's Statement: "With the exception of FFOR samples, the soil sampling activities were completed by the end of Third Quarter CY 2011; therefore, results and conclusions from previous soil sampling activities are presented in the Third Quarter CY2011 quarterly report (USACE, 2011f)."

NMED's Comment: The third quarter 2011 report states "For 3D spatial analysis of soil analytical data, the 2011 soil boring data were combined with historical data from 2007 – 2010 into a comprehensive data set." Since many soil boring samples were collected prior to 2007 (ST106-SB22 through 34, for example), ensure all pertinent soil data is used for soil contamination analyses, including data from ST-341. Revise all soil TPH contamination maps to include all pertinent soil data regardless of when it was produced.

29. Section 4.2, Vadose Zone Vapor Monitoring Results, p. 4-2

Permittee's Statement: "The soil vapor monitoring/remediation system currently consists of 285 individual vapor wells (SVM wells and SVE wells)."

NMED's Comment: Provide a comprehensive table listing each well, its location, screened interval, diameter, and specify if it is a monitoring or extraction well. This may be accomplished by adding columns to Table 4-1.

30. Section 5, Groundwater Monitoring, p. 5-1

Permittee's Statement: "Groundwater monitoring consists of collecting quarterly liquid-level groundwater elevation and NAPL measurement data, and performing quarterly groundwater sampling for field chemical parameters and off-site laboratory analysis."

NMED's Comment: For monitoring wells sampled with portable pumps, describe where pumps are located when samples are collected, e.g., middle of screen, or five feet below water table. Provide a table of all wells containing depth and elevation of the top and bottom of screen and locations and depths of dedicated pumps, for all wells so equipped. Also, provide a description of how water levels are measured in wells with dedicated pumps.

31. Section 5, Groundwater Monitoring, p. 5-1

Permittee's Statement: "In the following discussions, the SWMU SS-111 aquifer has been classified into the following four zones for purposes of data analysis."

NMED's Comment: Clarify how the current groups of "shallow", "intermediate", and "deep" monitoring wells will be described as the water table continues to rise and "shallow" wells become "intermediate" based on the location of the screen in relation to the water table depth. In addition, analyze the effect of the rising water table on groundwater sampling quality results. If contaminants rise along with the water table and samples are collected at continuously greater depths below the water table, contaminant concentrations may become biased low relative to historic detections.

32. Section 5.1 Quarterly Pre-Remedy Groundwater Monitoring, p. 5-1

Permittee's Statement: "During Second Quarter CY 2014, groundwater sampling was conducted at the following groundwater wells (Figure 5-1)."

NMED's Comment: Explain why the following wells are not sampled for inorganic constituents: KAFB-0118, KAFB-0119, KAFB-0121, KAFB-0510-MW, KAFB-0519, and KAFB-0524.

33. Section 5.2 Liquid-Level Data, p. 5-5

Permittee's Statement: "Beginning with First Quarter CY 2012, liquid levels were measured on a quarterly basis as opposed to a monthly basis in accordance with the BFF Spill QAPjP (USACE, 2011g), which was accepted by the NMED letter dated August 27, 2012."

NMED's Comment: Describe how water levels in monitoring wells are measured. If measuring tapes are used (e.g., steel, fiberglass, kevlar), the Permittee must describe how they were calibrated. NMED did acknowledge the QA plan was complete in its letter of August 27, 2012; however, it did not approve the change from monthly to quarterly water level measurements. Any such change in the frequency of water level measurements should have been proposed as a revision to the Groundwater Investigation Work Plan.

34. Section 5.2 Liquid-Level Data, p. 5-5

Permittee's Statement: "During Second Quarter CY 2014, liquid-level measurements were conducted at the following groundwater monitoring wells (Table 5-3)..."

NMED's Comment: The groundwater contour maps provided do not incorporate measurements from any supply wells, nor the wells in Table 5-3 with a "not designated" aquifer zone. Designate all "not designated" wells as shallow, intermediate, or deep based on the location of the well screen with respect to the water table and other shallow, intermediate, and deep monitoring well screens, and expand the potentiometric maps to include these wells, Kirtland supply wells, and all other wells where contemporaneous water-elevation data are available.

35. Section 5.2 Liquid-Level Data, 3rd bullet, p. 5-6

Permittee's Statement: "Field technicians measure liquid levels and field-check to verify that measurements within a given cluster are within plus or minus 0.5 foot, or are similar to previous quarterly measurements."

NMED's Comment: The Permittees have altered this procedure from previous documents by adding the "or are similar to previous quarterly measurements" clause. The Permittee must provide an explanation for any change to established protocols. Prior to making changes to procedures for water level measurements, propose and obtain approval to revise the Groundwater Investigation Work Plan.

36. Section 5.2 Liquid-Level Data, 5h bullet, page 5-6 and first paragraph, page 5-7

Permittee's Statement: "Additionally, the Field Sampling Coordinator compares the measurements against the measurements from the preceding quarter. If any measurements fail a plus or minus 1.0-foot check, they are marked and measured again the following day. This QC evaluation is documented on the liquid-level measurement field form."

and
"CB&I field personnel did not re-measure all wells that were more than 1.0 foot different from previous quarters; however, water levels in these wells were within 0.5 feet of the other wells in the cluster."

NMED's Comment: Table App_E-2 Q1, 2014 of Appendix E shows that six out of 122 wells were field rechecked, while 96 out of 122 wells had greater than one foot difference from the previous quarterly measurements. Prior to making changes to procedures for water level measurements, the Permittee must propose and obtain approval to revise the Groundwater Investigation Work Plan. Correct this discrepancy and follow established sampling procedures for future sampling events and explain the process for choosing which groundwater elevation to use when multiple groundwater depths for a well are recorded on the Quarterly Water Level Field Measurements form.

37. Section 5.3.2.1 Compound-Specific Isotope Analysis and Biological Parameter Sampling, p. 5-18

NMED's Comment: This section discusses the CSIA analysis. According to EPA experts on this subject, the CSIA data are suspect, and thus, they are not defensible. After comparing the standard operating procedure (SOP) that was used for the KAFB CSIA analysis of EDB and benzene to the recommendations in the EPA guide for analysis of stable isotopes (Hunkeler et al., 2008), EPA found that insufficient information was available in the SOP to determine whether appropriate analytical methods were used for the CSIA sampling.

Additionally, based on review of the KAFB CSIA SOP and the KAFB CSIA analytical data reports, EPA stated that it is unlikely that EDB was separated from the other fuel components by two-dimensional gas chromatography, which is the method outlined in Wilson et al. (2008) to attain complete separation of EDB from the petroleum hydrocarbons. If the compounds are not separated, the values determined for the stable isotope ratio of EDB will be in error.

EPA also found, based on their review of the CSIA analytical reports, that there were problems with the CSIA analysis when petroleum hydrocarbons are present in the samples. That is, all of the CSIA data reviewed with high concentrations of EDB and high concentrations of petroleum hydrocarbons were flagged with either a J-code (estimated, less than optimal reproducibility) or a U-code (a ratio could not be determined).

EPA recommended that the wells be resampled and analyzed again for CSIA before any decision is made regarding the contribution of natural biodegradation of EDB.

EPA also recommended that the standard operating procedures (SOP) for CSIA analysis of EDB and benzene be examined and revised as needed to provide adequate documentation of data quality for CSIA analysis. The SOP should be examined to determine if it provides baseline separation of EDB from the petroleum hydrocarbons for each sample that is analyzed (See Figure 2.2 of Hunkeler et al. (2008) for an example of the necessary baseline separation).

Furthermore, as described in Section 2.4.3 of Hunkeler et al. (2008), a series of working standards with decreasing concentrations should be analyzed to determine the concentration threshold or working limit for EDB when analysis is done using the SOP. If the concentration threshold or working limit is higher than 0.05 µg/L, it is recommended that the SOP be modified to attain a concentration threshold or working limit of 0.05 µg/L. The Permittee shall address all of EPA's concerns and recommendations concerning CSIA and the revise the Report accordingly.

In addition, the Permittee should include a statement acknowledging that no additional compound-specific isotope analysis or biological parameter analysis was performed during this quarter.

38. Section 5.3.4 Piper and Stiff Diagram Inorganic Chemistry Evaluation, p. 5-20

Permittee's Statement: "The major inorganic ion Piper and Stiff diagrams are presented on Figures 5-55 through 5-68. The diagrams are grouped by well location with respect to the NAPL area, and color-coded by Shallow, Intermediate, Deep, and Regional Zones of the aquifer."

NMED's Comment: There is no figure that provides a plan view of the groups of wells; therefore, it is difficult to determine what areas encompass the groups designated the "NAPL area", "Near and Far Downgradient", "Nondetect", and "Upgradient, Regional". The "Nondetect" group is most difficult to discern; state what constituent is not detected. Include figures showing the various groups of wells so that a reader may better understand the trends shown in the Piper and Stiff diagrams and also include figures that include the Stiff diagrams and Piper diagrams on a map of the wells so that a reader may see a complete spatial distribution of constituents.

39. Section 5.5.1 Groundwater Levels, page 5-22

Permittee's Statement: "The [100 ft thick] smear zone explains why the highest soil and vapor concentrations (and presumably most of the contaminant mass) are primarily found at depths greater than 400 ft bgs."

NMED's Comment: Based on the mass estimates presented in Table 3, Appendix I, of the Permittee's now withdrawn *Resource Conservation and Recovery Act Facility Investigation Report, Groundwater Zone, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, March 2014*, the majority of fuel contamination exists as LNAPL situated at the water table (the LNAPL is now mostly submerged below the water table). The LNAPL mass, as estimated by KAFB, is about 8 times that in the vadose zone (as the total of the mass adsorbed to soil and as vapor). However, such a condition is unlikely and it is probable that more mass is present in the vadose zone than has been determined through site characterization. Drilling and sampling completed thus far is believed to have successfully located where the plume lies within the vadose zone in the vicinity of the source area of the BFFS site. But characterization of the core of the plume, where soil and soil vapor contaminants would be expected to be present at their highest concentrations, is inadequate

as indicated by the typically low levels of contaminants detected and reported for these media. Thus, additional characterization of the core of the contaminant plume is necessary to more accurately estimate the amount of contamination that is present in the vadose zone. This deficiency will be addressed in more detail by NMED comments on the vadose zone investigation with regard to additional site characterization.

40. Section 7, Projected Activities and Recommendations, p. 7-1

NMED's Comment: Include all applicable projected activities, not only those to be done in the next quarter. These may include:

- a timeline for completion of geophysical logging for wells that have not yet been logged;
- a timeline to relog those wells that were logged with improper equipment or improperly calibrated equipment;
- a timeline to complete Pneulog® testing of Pneulog® wells;
- a time line to use geophysical logs to improve the conceptual site model geology based on both the Permittee's geophysical logs and other geophysical logs from nearby wells, such as KAFB production wells, the Veteran's Administration well, Ridgecrest #3 and #5, and the ABCWUA Trumbull wells;
- a proposal for a new constant discharge aquifer test, using the slug test results and the previous failed pump test results to inform more realistic pump test rates and proper pump test procedures;
- a monitoring well location proposal and timeline, with a written description of the locations and a map showing the proposed locations, groundwater flow direction, and most recent EDB concentrations of nearby wells;
- a soil vapor monitoring well installation proposal with a written description of the locations and a map showing the proposed locations, and most recent VOC and benzene concentrations of nearby wells; and
- a description of the existing air sparging system and a description of ongoing monitoring and reporting expected for the system.

Figures

41. Figures 2-2, Vapor Concentrations Measured at the SVE Wellheads and CATOX Unit Second Quarter CY 2014, and 2-3, Vacuum Pressure and Flow Rates at the SVE Wellheads and CATOX Unit Second Quarter CY 2014

NMED's Comment: Figure 2-2 and 2-3 are crowded with data making review difficult. Increase the number of figures and reduce the amount of data per figure. For example, split Figure 2-2 into a figure showing hydrocarbon concentrations, a figure for oxygen concentrations, and a figure for carbon dioxide concentrations.

42. Figures 2-4 through 2-6, Second Quarter 2014 Vacuum Readings (various depths)

NMED's Comment: Provide an explanation as to why the vacuum pressures for wells KAFB-106160 and KAFB-106161 are consistent between figures, but the vacuum pressures for wells KAFB-106149 and KAFB-106150 change between figures. In addition, provide an explanation as to why well KAFB-106154 is not depicted as a "Pneulog® Currently in Use" on Figure 2-6. Also, many of the contour lines depicted on the figures have no bounding wells which are necessary to accurately define the contours. Provide revised figures that correct these discrepancies in the Report.

43. Figure 2-7, SVE Cumulative Mass Recovery Over Time October 2007 through Second Quarter CY 2014

NMED's Comment: Figure 2-7 indicates that the CATOX SVE system has recovered over 500,000 "pounds equivalent" of hydrocarbons. Table 2-4 shows that the CATOX SVE system total mass recovery is 410,737 pounds. Provide an explanation for, or correct, the discrepancy. For both Figure 2-7 and the Table 2-4, the mass recovery must only be based on analytical laboratory data. Field instrument data is for screening purposes only; its data is qualitative, not quantitative, and must not be used for any calculations. Revise Figure 2-7 and Table 2-4 using only analytical laboratory data. See Comment 3.

Also, in order to make Figure 2-7 more meaningful, include the total hours of units operation by period, so that for example, turning off the units for ROI testing and mechanical breakdown/maintenance are not interpreted as a decrease in mass recovery efficiency.

44. Figures 4.3, 4-4, and 4-5, Soil-Vapor Data Evaluation

NMED's Comment: Figures 4-3, 4-4, and 4-5 show plan view VOC, benzene, and EDB concentrations at various depths. At multiple locations, the data related to specific concentration values do not appear to match the color coded ranges. Additionally, some of the smaller sized concentration rings are hidden behind large well symbols. In order to aid clarity, color-code each well symbol by concentration. All computer generated cross-sections and maps should also be checked and corrected for accuracy. Computer generated contouring programs must not be allowed to change actual analytical values at known points based on modeled results. Provide revised figures in the Report.

45. Figures 4.6 through 4-23, Lithology and Vapor Cross-Sections

NMED's Comment: It is a basic tenant of contaminant-plume mapping wherein contaminant concentrations are represented as ranges (e.g., 0-10 ppmv, 10-100 ppmv, and 100-1,000 ppmv) that vapor concentrations cannot go from 100-1,000 ppmv to 0-10 ppmv without dropping through the 10-100 ppmv range as indicated in Figure 4-6, VOC Vapor Cross-Section F-F′. Also, it is highly unlikely that concentration ranges (e.g., 100-1,000 ppmv zone in Figure 4-6, VOC Vapor Cross-Section F-F′) truncate in vertical planes in the absence of vertical barriers, which are not identified on the figures. All computer generated cross-sections and maps must be checked and corrected for veracity and accuracy.

46. Figures 4.6 through 4-23, Soil-Vapor Data Evaluation

Permittee's Statement: "In past quarters, analytical results from any SVM well within 50 feet of a given cross-section line were shown on the cross-sections, but this would result in confusion, as the sample results at the actual well location often varied from the modeled concentrations at the cross-section line."

NMED's Comment: The lithology and contaminant of concern (CoC) vapor cross sections shown in Figures 4-6 through 4-23 depict a lithologic cross section with wells/boreholes from which lithologic and soil-vapor data were collected, and, below, the same section with plots of the various CoC vapor concentrations devoid of wells/boreholes and corresponding sample analysis results from which the plot was generated. This is a marked change from past reports wherein wells/boreholes and corresponding lab data were included and makes these interpretations far less verifiable and, thus, far less useful. While the map notes explain that showing analytical results resulted in confusion, the current presentation is less clear. The amorphous blobs of color in the vapor cross sections are much more confusing absent the wells and analytical results. Revise the figures to include the wells and analytical results as presented in previous quarterly reports.

47. Figure 5-2, Shallow Groundwater Contours April 2014

NMED's Comment: The groundwater potentiometric surface map (Fig. 5-2) does not cover a sufficiently large area. Add wells KAFB-510, KAFB-0519, KAFB-0118, KAFB-0119, KAFB-0121, KAFD-015, KAFB-016, KAFB-003, VA Hospital, Ridgecrest 3, and Ridgecrest 5 to the map. The groundwater elevations from the water supply wells (and KAFB-0519) should not be used for contouring, but the elevation data must be depicted on the map.

Tables

48. Tables 2-1, Field Measurements for Soil Vapor Extraction System January 2013 – June 2014, and 2-2, SVE System Laboratory and Field Analytical Data April – June 2014

NMED's Comment: In Table 2-1 and Table 2-2, explain why there are no entries for the Pneulog® extraction wells (KAFB-106149 (200'), KAFB-106149 (350'), KAFB-106149 (484'), KAFB-106150 (200'), KAFB-106150 (350'), KAFB-106150 (484'), KAFB-106154 (200'), KAFB-106154 (350'), or KAFB-106154 (484')).

49. Table 2-2, SVE System Laboratory and Field Analytical Data April – June 2014

NMED's Comment: Describe how values in the row titled "Total Lab VOC (no C8-C12 GRO)" were calculated. The GRO fractions from the analytical laboratory are reported as C5-C8 Aliphatic hydrocarbons, C9-C10 Aromatic hydrocarbons, and C9-C12 Aliphatic hydrocarbons. Explain how C8 hydrocarbons were removed from the reported values. In addition, the Permittee must provide the calculations utilized to convert laboratory results from $\mu g/m^3$ to ppmv.

Destruction removal efficiency for the CATOX system must only be reported based on analytical laboratory data. For instance, the June 18, 2014 CATOX-IN sample shows field results approximately triple the value of analytical laboratory results (TO-15 modified $\mu g/m^3$ to ppmv conversion based on the molecular weight of hexane), while the CATOX-POSTC1 sample shows field results below the analytical laboratory results, which results in a grossly exaggerated destruction removal efficiency. Analytical laboratory data indicates that the destruction removal efficiency for the CATOX system on June 18, 2014 was 57%. Remove all calculations within this and all future quarterly reports that are based on field instrument data. As previously stated, field instruments provide qualitative rather than quantitative data. See Comment 3.

Notes: b. states, "Gasoline Range Organics (GRO) including butane, pentane, hexane, heptane, and other higher carbon compounds for other sampling periods." This sentence is confusing. Explain to what "other higher carbon compounds for other sampling periods" refers.

50. Table 2-3, Summary of Destruction Removal Efficiency April – June 2014

NMED's Comment: Data from field instruments are qualitative by nature and cannot be used to calculate destruction removal efficiency. Recalculate destruction removal efficiency based only on analytical laboratory data. See Comment 3.

Also, there is a "b" in the "Notes:" following the table that is not referenced within the table. Correct the discrepancy.

51. Table 2-4, Summary of Vapor-Operating Data Collected from SVE System March 2013 – June 2014

NMED's Comment: Mass Recovery from the SVE system must only be calculated using analytical laboratory data. Data from field instruments are qualitative by nature and cannot be used to calculate mass recovery. Recalculate mass recovery based only on analytical laboratory data. See Comment 3.

52. Table 2-6, CATOX Unit Readings April 2013 – June 2014

NMED's Comment: Add a column in Table 2-6 to show natural gas usage in standard cubic feet per day. Explain the purpose of the LEL Meter column. Also, explain why natural gas usage is elevated when the CATOX SVE system should use very little natural gas when total extracted hydrocarbon concentrations are above 1500 ppmv.

53. Table 2-7, SVE Monitoring Data

NMED's Comment: The data in Table 2-7 are inefficiently formatted. Rearrange the tables by parameter, then well, then date, rather than by date. Include the CATOX SVE inlet flow rate and hydrocarbon concentration values in this table. Also, add a copy of Table 2-7 in

excel format to the electronic copy of the Report so that the data may be manipulated to facilitate evaluation.

54. Table 2-7, SVE Monitoring Data

NMED's Comment: Table 2-7 states that flow rates are calculated. Provide an explanation of the calculations used to determine flow rates.

Table 2-7 indicates that field values of total hydrocarbons for KAFB-106160 and KAFB-106161 (extraction wells with the highest flow rates) average over 3,400 ppm, while Table 2-3 reports that field values of total hydrocarbons for pre CATOX range from 2,130 to 2,410 ppmv. With the caveat that these measurements were not made on the same days, explain why the CATOX influent vapor is over-diluted and the difference in units.

Explain the difference between vacuum measurements and differential pressure measurements on Table 2-7. Include at least one example of the calculation of a "corrected observed vacuum" from a "measured vacuum" in Table 2-7. This example may be presented in Appendix L. Also, include a table of all "corrected observed vacuum" values as a reference for Figures 2-4 through 2-6.

55. Table 5-3, Second Quarter CY 2014 Liquid Levels

NMED's Comment: Table 5-3 has measurement data for KAFB-0519 from July 23, 2004, along with "Note 'a'" that states, "No groundwater level measurements can be collected at this well due to the presence of a dedicaded (sic) Barcad pump." Remove the 2004 data from the table so as to avoid confusion.

Appendices

56. Appendix D-1 Well Logs, Completion Diagrams, WDRs

NMED's Comment: The well completion diagram for KAFB-106209, Appendix D1 lists the Bottom of Sump at 622 ft BGS while the Bottom of Hole is listed as 618 ft BGS. The Bottom of Hole must be lower than the Bottom of Sump. Correct the diagram as appropriate.

The Report is missing many well boring logs and construction diagrams. Add well boring logs and construction diagrams for KAFB-106001 through 106028 and KAFB-3411 in Appendix D-1.

57. Appendix E-1, GW, Soil, and SV Historical Data

NMED's Comment: The continued submittal of the databases (Appendices E-1 and E-2) is the mechanism to correct earlier mistakes in data. Mistakes have previously been identified by NMED (see for example comment 30 in the August 17, 2011, letter from NMED). Each quarterly report should contain a table listing and text describing data that have been corrected, if any.

The data tables appear to have been cut, with data from 2011 to current on one table, and 2010 data and older in a separate "historical" table. Include a summary of changes to data formats on a separate page when making these kinds of changes so as to avoid confusion.

58. Appendix E-2, Table App_E-2 Q2, 2014

NMED's Comment: There is confusion about well KAFB-0510-MW (also designated as KAFB-510MW, KAFB0510MW, KAFB-510). Table App_E-2 Q2, 2014 of the Report contains data that conflicts with Table App_E-2 Q1, 2014 of the *January – March 2014 Quarterly Pre-Remedy Monitoring and Site Investigation Report*. Though the tables provide information for what should be the same well, there are differences in names, groundwater elevations, easting and northing coordinates, and the measuring point at the top of casing elevation. There is nothing in the text or appendices to explain the differences for the well in each table or the differences between the two tables. Additionally, "SL" listed under "Location Type" for measurement date 2014-03-20 is not defined in the APPENDIX E-1 and E-2 guidance.

Previously, in the quarterly report for July-September 2012 (dated December 2012), Table 3-7 in Appendix E-3, lists the coordinates for KAFB-0510 as 1545111.00E, 1472790.42N, elevation 5370.0 ft. In the quarterly report for January-March 2012 (dated June 2012), the Well Construction Database in Appendix E-1 lists a well designated KAFB-510 at 1545110.841 E, 1472791.276 N, elevation 5,357 ft (with no measuring point), and another well named KAFB-510MW at 1545235.841 E, 1472788.945 N, elevation 5,262.18 ft (with a measuring point elevation of 5,262.18 ft). These latter two locations are separated by approximately 120 ft horizontally and 105 ft vertically.

NMED is aware of only one well in this vicinity and the topography is essentially flat. This discrepancy was pointed out to the Permittee by email on March 9, 2012. The Permittee responded by email on March 12, 2012 stating that they would resurvey the location. NMED has not received the correct coordinates for the well.

Additionally, NMED notes that KAFB-0510 was listed as being at 404990.22 N and 1472725.67 E, elevation 5262.18 ft (with a measuring point elevation of 5,364.43 ft) in the February 2002 Kirtland AFB Biannual Groundwater Monitoring Report, page 2-8, Table 2-5. The horizontal location, when converted from NAD 27 to NAD 83, corresponds to the location listed for the well named KAFB-510MW and the same elevation (if you assume there is a typographical error for the elevation in the 2002 report), but the measuring point is different.

The hydrograph submitted in the July-September 2012 quarterly report (dated December 2012), Appendix F-1, Water Level Hydrographs, page F1-4, Well ID KAFB0510MW, shows the water level at about 4856.5 ft elevation for January 2012. Appendix G-6, Water Level Measurement Field Forms, the Quarterly Water Level Field Measurements, 1st Quarter 2012 form, page 18 of 20, shows a depth to water of 513.41 ft on 1/5/12 at KAFB-0510-MW. This would imply a measuring point of approximately 5,370 ft, about 4.5 ft higher than the

surveyed measuring point listed in the 2002 Report or the measuring point listed in Appendix E-1 of the April-June quarterly report, dated October 2012.

In the April-June 2012 quarterly report, well KAFB-051 0MW is listed as having a groundwater elevation of 4750.88 ft in Appendix E-2 for the second quarter 2012, which would plot about 100 ft below the hydrograph of the well presented in Appendix F-1 of this report. The measuring point listed in Appendix E-2 is listed as 5262.18 ft, which is appreciably below actual ground elevation.

Revise the Report to correct the information, including the name(s) for the well or wells, supply accurate horizontal and vertical coordinates, and provide an accurate elevation of the measuring point and the groundwater potentiometric surface. Additionally, explain why water elevation data from this well is not used in generating water level maps for the BFF Spill. Also, define all abbreviations used in the tables and use only one designated well designation for each well in all future work plans and reports. See Comment 5.

59. Appendix F-1, Hydrographs

NMED's Comment: The combined hydrographs facilitate review; however, many wells are missing. Include KAFB-3, KAFB-15, KAFB-16, KAFB-0118, KAFB-0119, KAFB-0121, KAFB-0510-MW, KAFB-0519, KAFB-0524, and KAFB-10628-510 in the hydrographs. If KAFB-10628 is actually KAFB-10628-510, state as such. All hydrographs must show all available data for each well.

60. Appendix G-1, Groundwater Purge Logs

NMED's Comment: Provide a description and frequency of calibration procedures for field measurement devices and provide calibration records for each instrument. See Comments 3 and 4.

61. Appendix G-5, Survey Plates

NMED's Comment: In Appendix G-5, on the survey plat dated April 20, 2011, Sheet 1 of 2, there are a number of symbols to the south and west of newly surveyed well 106116 that seemingly indicate newly surveyed monitoring wells, but are not labeled. Specify the name of the wells for the unlabeled symbols.

62. Appendix G-6 Water Level Measurements Field Forms

NMED's Comment: In Appendix G-6 Water Level Measurements Field Forms, the value listed for KAFB-106207 in the column labeled "AS BUILT DEPTH TO BOTTOM (CH2MHILL OR COMPLETION DATA, BGS)" is 530.00, which is Bottom of Hole and the value listed for KAFB-106208 is 523.00 which is Bottom of Sump. Specify in the column heading if Bottom of Hole or Bottom of Sump is to be used and correct erroneous entries for this cluster and any other wells as appropriate.

63. Appendix H. Slug Test Results

NMED's Comment: The U. S. Environmental Protection Agency (EPA) and the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) have provided comments to NMED on the, since withdrawn, 2014 Groundwater Zone RFI Report. Due to the expertise of these organizations with respect to technical issues concerning groundwater contamination and remediation, their comments carry considerable weight with the Department.

EPA provided comments (dated July 11, 2014) on groundwater issues that were attached to a July 11, 2014, email from Ms. Laurie King to Mr. John Kieling. EPA expressed concern that hydraulic conductivity estimates for the BFFS project are based only on slug test data, which alone are not adequate, and that aquifer tests with "multiple properly located and spaced observation wells should be performed." EPA also expressed concern that the rising water table could have a future effect on contaminant concentrations and should be evaluated. EPA also commented that concerns and discrepancies were identified regarding the geophysical logs and that the Permittee should take steps to resolve the issues with the logs. Additionally, EPA commented that in order to provide a defensible dataset supporting biological or abiotic degradation of EDB and benzene (the CSIA analysis) the Permittee should proceed with recommendations made by EPA's National Risk Management Research Laboratory.

EPA also provided additional comments (dated August 8, 2014) on groundwater issues that were attached to an August 8, 2014, email from Ms. Laurie King to Mr. Tom Blaine and Mr. Dave Cobrain. In addition to the aforementioned recommendations concerning the EPA's National Risk Management Research Laboratory and the CSIA , in this later set of comments, EPA expressed concerns about the shortcomings of the local groundwater model, and expanded on their earlier comments on issues related to slug tests. In particular, EPA emphasized that "slug tests provide very limited information on hydraulic properties" and opined again that additional aquifer characterization is needed via pumping tests.

The ABCWUA comments (dated July 25, 2014) were attached to a July 31, 2014, email from Mr. Rick Shean to Mr. Tom Blaine. ABCWUA expressed concern that the horizontal and vertical extents of dissolved-phase EDB and benzene contamination have not been determined, that EDB concentrations have not been adequately characterized in the core of the dissolved phase plume, and the nature, concentrations, and the vertical and lateral extent of the LNAPL smear zone have not been determined. ABCWUA also expressed concern that no successful aquifer tests have been completed to better characterize critical aquifer properties (hydraulic conductivity and transmissivity), that the CSIA analysis is flawed as indicated by the EPA, that the local groundwater model is based on an incorrect conceptual site model, that other sources of dissolved-phase contamination are being overlooked (those sources being LNAPL draining through the vadose zone to the water table, and that in the smear zone), and that some shallow wells no longer monitor the higher concentration upper parts of the contaminant plumes due to water levels rising above the tops of the well screens in the shallow wells (July 25 and July 28, 2014 technical memos). It is clear that, at least on a fundamental level, many of the concerns expressed by the EPA and ABCWUA are the same.

NMED agrees with the major concerns noted by both the EPA and ABCWUA. As such, similar or essentially identical concerns are documented in this Disapproval.

64. Appendix H-3. Individual Slug Test Analysis Sheets

NMED's Comment: It appears that the analysis sheets for KAFB-106074 P4, KAFB-10619 OUT, and KAFB-10620 IN are in Appendix H-3 and summarized in Table 5-9, but were left off of the Appendix H-3 index. Add all analyses to the Appendix H-3 index. In addition, there is no discussion in the text about the parameters on the data sheets. The Permittee must discuss the significance and source of input data for the aquifer and well, whether it came directly from existing and measured data (such as well logs or transducer measurements), if it was calculated from existing and measured data, if it estimated by the Permittee (user input), or if it was generated by the modeling software. This includes the anisotropy ratio, saturated thickness, total well penetration depth, casing radius, well radius, well skin radius, and gravel pack porosity. The Permittee must also discuss the significance of solution parameters "y0", "Ss vs Ss'", "Kr vs Kr'", "Kz/Kr vs Kz/Kr'", and "Le".

The Anisotropy Ratio in the Aquifer Data section of each data sheet is confusing. Presumably, the Permittee could not have calculated an anisotropy ratio from existing data, so it is likely that it came from user input. Values range from 1 to $1x10^{-7}$, with most tests having a value of 0.1. Explain the variation in the anisotropy ratio and how these ratios were determined.

Table 5-9 contains columns for casing radius and boring radius, which are analogous to the casing radius and well radius on the Appendix H-3 data sheets. However, the data sheets' casing radius and well radius values are equal in value for each well, with the exception of wells KAFB-106160, KAFB -106161 and KAFB-106201 through KAFB-106209. Use of the boring radius as the well radius is the accepted industry standard for wells with filter packs (Butler, 1997). For the KGS model with skin effect, the well skin radius was set equal to the borehole radius, which is appropriate. Correct the well radius and well skin radius values and recalculate all conductivities or explain why the values are correct as written. (Butler J.J. Jr., 1997, The Design, Performance, and Analysis of Slug Tests, Lewis Publishers).

The Bouwer-Rice solution for all of the wells seems to use data from very early in the slug test (around the first 10 seconds). NMED is concerned that using this early data, rather than later data (from around 20-40 seconds), would cause the calculated conductivity values to be characteristic of the well filter pack rather than the surrounding aquifer. Justify the basis for using early data rather than later data.

The KAFB-106209 tests appear to have an oscillatory response, yet the solution curves do not show this response. Include additional discussion of the results of this particular test.

65. Appendix J-1, Plate J-10, TPH Soil Concentrations for Geologic Cross Section A-A'

NMED's Comment: Plate J-10 indicates the presence of soil contamination at approximately 150 feet below the water table at well KAFB-106081. Explain how soil

contamination reached that depth below the water table and discuss the ramifications of contamination at that depth.

66. Appendix J-2, Plate Appendix J2-10, Lithology and TPH Soil East-West Cross-Sections F-F'

NMED's Comment: Plate Appendix J2-10 reports soil contamination in the 100-1,000 mg/kg range approximately 150 feet below the water table. Explain how soil contamination reached that depth below the water table and discuss the ramifications of contamination being present at that depth.

67. Appendix J-2, Plate Appendix J2-11, Lithology and TPH Soil East-West Cross-Sections G-G'

NMED's Comment: Plate Appendix J2-11 provides no soil chemical analytical data from beneath the former fuel offloading rack (FFOR) and indicates that the soils in the vicinity of the FFOR exhibit little TPH contamination. This is misleading. Previous reports submitted by the Permittee present much higher levels of TPH in the soil beneath the FFOR (e.g., Figure 2-2 of the *Stage 2 Abatement Work Plan for the Soil Vapor Extraction Pilot Test at the Bulk Fuels Facility* (ST-106), December 11, 2002). Provide an explanation as to why this data was not included. The Permittee must utilize all available analytical laboratory data for site characterization no matter which contractor collected the data. Provide updated plates that utilize all data in the revised Report.

68. Appendix K1, PTS Lab Soil and NAPL Analysis Results

NMED's Comment: Appendix K1, PTS Lab Soil and NAPL Analysis Results, Sieve Analysis results #41516, third page, lists the USCS/ASTM description of the grain-size analysis sample for KAFB-106030 at 475ft depth as gravel. Because more than 50% of the sample is sand, the USCS/ASTM classification would not be gravel. Other such examples exist. Describe the classification system used and why the standard USCS description was not used. Provide corrected soil classifications in the revised Report.

In addition, the methodology used, EPA 9100, is inappropriate to estimate hydraulic conductivity in the subsurface. This method is specifically designed to determine hydraulic conductivity for "disturbed coarse grain soils" that will be utilized for landfill liners. These data are not appropriate for subsurface soils and must be removed from the Report and all future work plans or reports for this site.

69. Appendix M1, Geophysical Calibration Logs

NMED's Comment: In Appendix M1, Geophysical Calibration Logs, the standard unit of calibration for the induction logs should be mmhos/m and not mmhos/cm. Also, gamma log calibrations should be reported in API units, not mmhos/m. Given that the quality control documentation forms are erroneous, doubt is cast on the credibility of the data. Review the quality assurance procedures.

70. Appendix M1, Geophysical Calibration Logs

NMED's Comment: Appendix M-1 presents geophysical logging calibration data. NMED notes that for the gamma logs (on the induction tool), the shop, pre-log field, and post-log field calibrations do not always correlate well. For example, only one of the field calibrations agrees with the shop calibration (5/1/11), both field calibrations agree with each other but not with the shop calibration (9/16/11), or none of the three agree with each other (9/13/11). At times they vary by as much as 25%. Explain the accuracy specifications for the gamma pre- and post-logging calibrations in comparison to the shop calibration.

NMED is under the impression that the geophysical subcontractor, Jet West, uses an Advanced Logic Technologies DIL45 for induction logging (Jet West website http://www.jetwestgeophysical.com/files/ALT-DIL45.pdf). The DIL45 Operation Manual refers to a 606 mmhos /m calibration standard. The calibration logs submitted in the Report, Appendix Ml, indicate that the induction logs are calibrated to 606 mmhos/cm. Verify the value of the induction log standard actually used to generate logs for wells installed for the Bulk Fuels Facility Spill.

71. Appendix N. Pneulog® Evaluation Report, Praxis Environmental Technologies, Inc.

NMED's Comment: There are numerous issues with both the Pneulog® testing design and the conclusions based on data collected during the testing. Based on the fact that there was no observed flow at the bottom of eight of the nine screened intervals tested, and the interpreted low effective permeability in the bottom of each of the eight intervals compared to the interpreted high effective permeability in the top of each subsequent interval do not correlate, it is highly likely that the applied vacuum at the wellhead was not sufficient to induce flow at the bottom of the screened intervals. There was no mention of this issue in the Pneulog® Evaluation Report, nor any discussion or correction for pressure differential within the screened intervals based on depth.

In addition, the TVPH soil gas sampling does not provide an accurate representation of concentrations within the vadose zone at specific depths. Based on the description of the sampling in the Pneulog® Evaluation Report, the samples are collected within an open borehole that is under flowing conditions induced by vacuum extraction. While this data may provide a reasonable relative trend in areas that produce flow, the samples are highly mixed and will be positively biased to higher permeability zones or negatively biased where there is little or no flow from the formation, as is the case near the bottom of most screened intervals. One example of the issues with this measurement procedure is that the deepest sample in the middle screened interval of well 106149 at 345 ft bgs had a measured TPH concentration of 7294 ppmv, whereas the shallowest sample of the deep screened interval of well 106149 at 345.1 ft bgs had a reported TPH concentration of 14356 ppmv. This suggests that the TPH concentration doubles over a distance of a tenth of a foot.

The Permittee has not indicated that there are any limitations related to this sampling and analysis method, nor have they provided any recommendations on the appropriate usage of these data. Provide a detailed discussion of the issues and limitations inherent in this

sampling and analysis protocol, as well as recommendations on the appropriate use of the data.

72. Additional Data Request

NMED is aware that pumping test data and geophysical logs have been generated for at least some Kirtland production wells, and construction logs likely exist for all of the production wells. Submit all such available data for production wells KAFB-1 KAFB-2 KAFB-3, KAFB-7, KAFB-14, KAFB-15, KAFB-16, and KAFB-20.

The Permittee committed to correct many of the deficiencies identified in this report based on emailed general comments sent by former Division Director Tom Blaine to the Air Force in February 2014. These deficiencies were not corrected in this Report nor in the Groundwater and Vadose Zone RFI Reports that were submitted in March 2014 and subsequently withdrawn by the Air Force in September 2014.

The Permittee must submit a revised Report that corrects all of the deficiencies noted in this Disapproval no later than **March 31, 2016**. The revised Report must be accompanied by a response letter that details where the Disapproval comments were addressed that cross-references NMED's numbered comments. The Permittee must also submit an electronic redline-strikeout version of the Report that shows where all changes were made. In addition, these comments apply to all future reports, and reports that have already been submitted must be revised to incorporate these comments.

Should you have any questions, please contact Mr. Ben Wear of my staff at (505) 476-6041.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: K. Roberts, Director, NMED RPD
D. Cobrain, NMED HWB
W. Moats, NMED HWB
W. McDonald, NMED HWB
N. Davidson, NMED HWB
B. Faris, AEHD
F. Shean, ABCWUA
L. King, EPA-Region 6 (6PD-N)

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