ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

Misael Cabrera
Director

via e-mail

November 23, 2015
FPU16-111

Ms. Catherine Jerrard
AFCEC/CIBW
706 Hangar Road
Rome, NY 13441

RE: WAFB – ADEQ Comments – ST012, *Draft Soil Vapor Extraction System/Steam Enhanced Extraction System Operation and Maintenance 2014 Annual Performance Report, Former Liquid Fuels Storage Area, Site ST012, Former Williams Air Force Base, Mesa, Arizona*; prepared for Air Force Civil Engineer Center AFCEC/CIBW, Lackland AFB, Texas; prepared by Amec Foster Wheeler Environment & Infrastructure, Phoenix, Arizona; document dated October 12, 2015

Dear Ms. Jerrard:

Arizona Department of Environmental Quality (ADEQ) Federal Projects Unit (FPU) and ADEQ contractor UXO Pro, Inc. reviewed the referenced document. General and Specific Comments are provided below.

**General Comments**

1. ADEQ is concerned mobilized contaminants were not captured during the initial SEE operation.

2. ADEQ remains concerned that the contaminant plume is not characterized. An initial quarterly SEE report included: "Benzene concentrations in ST012-W24, ST012-W30, ST012-W34, and ST012-W36 are consistent with historic concentrations and may indicate the presence of residual LNAPL in the vicinity of those wells." Wells beyond the nominal treatment zone and without additional data to indicate LNAPL limits and migration pattern.

3. Please ensure that samples are received at the analytical lab, and initial analyses are conducted, with sufficient time to address any QC issues that may arise before the sample holding time expires. The laboratory notes QC failure, but there is no documentation of attempts to re-extract and re-analyze the sample. Many samples were originally analyzed very close to the holding time expiration date allowing insufficient time for re-extraction/re-analysis within holding time.

4. Please adjust report release timeliness to be less than ten months after reporting interval ends. Releasing an activity report nearly a year after the action may impact timely correcting of ongoing activities and errors, and may negatively impact regulatory agency concurrence to clean up actions.

## Specific Comments

## SEE System Specific Comments

1. Page 2-2, Line 369. Please correct the typographical error.
2. Page 2-4, Lines 427 and 430, *"Vacuum pressure"*

   Delete either vacuum or pressure; the terms are opposite-signed descriptors of the same variable referenced to absolute pressure.

3. Page 2-8, Line 548. The value 1.606 should be 1,606.

4. Page 3-8, Line 994, "*During the restart of operations on 24 December 2014, PID readings indicated an increase in headspace concentrations from the GAC effluent. As a result, steam injection was reduced site-wide and the liquid treatment system was shut down as a proactive measure.*"

   Please replace the term "proactive" with an appropriate descriptor for the measure taken such as "reactive" or "protective."

5. Page 3-9, Line 1025 and Graphs 3-1 and 3-2, *handheld PID and/or FID readings from the wellfield effluent to the thermal accelerator effluent are used to screen the vapor concentrations at several locations in order to measure mass removal relative to time.*"

   Please describe the reference gases or other calibration for the PID and FID readings in ppmv plotted in Graphs 3-1 and 3-2.

6. Page 3-12, Line 1064, "*The wellfield flow rate is calculated by taking the daily average flow rate going to the thermal accelerators and subtracting the effluent flow rate from the air strippers in order to estimate flow coming from the wellfield vapor only. Variation in the flow rates may be amplified as a result of the calculation.*"
   a) Please provide a graph of the flow rate from the air strippers for comparison to the calculated wellfield flow rate to allow the reader to evaluate the uncertainty in the wellfield calculation.
   b) Are estimates available for the vapor extraction rate from individual wells or from the individual zones? For example, is all of the vapor extraction from the Cobble Zone?

7. Page 3-12, Line 1072, "*The cumulative water extraction is calculated based on flow meters installed at each of the 57 extraction wells (accuracy should be considered +/- 20%).*"
   a) Does the cited accuracy apply to the individual flow meters or the calculation of the cumulative water extraction?
   b) If the accuracy applies to the cumulative water extraction by zone, what is the accuracy and range of the individual flow meters?
   c) Do the individual flow meters provide both instantaneous flow rate and total flow?
   d) If so, which values (rate or total) from the educator inlet and outlet are used to calculate the flow rates and cumulative flows presented in Graphs 3-4 and 3-5?

8. Graph 3-4.

   Please provide a graph of the cumulative groundwater extracted from the site as measured at the inlet to the air strippers (or equivalent location) for comparison to the calculated volumes from the individual zones presented in Graph 3-4.

9. Page 3-14, Line 1086, "*PID measurements in the liquid headspace of samples from the GAC vessels, air stripper influent, extraction manifolds, and at individual MPE wells were checked on a weekly basis. The primary use of this data was to screen for unusual changes such as large increases in readings that may reflect upset conditions. System operators indicate readings for the reporting period did not reflect unusual conditions that directly caused them to change system operation, however, the logbook with the recorded readings has been misplaced and the values are not available to report.*"

   a) This paragraph states system operators did not note unusual changes or upset conditions; however, the extraction system was shut down on 24-Dec-14 because "PID readings indicated an increase in headspace concentrations from the GAC effluent." These statements are inconsistent. Please resolve.
   b) In addition, a floating layer and petroleum odor were observed at the downstream municipal wastewater lift station indicating the PID head space readings were inadequate monitors for unusual conditions or upset conditions. A continuous, automated monitoring system is recommended for the GAC effluent.

10. Page 3-14, Line 1100, "*Beginning the first quarter of 2015, recovered LNAPL will be sampled on a monthly basis to determine suitability for combustion in the SEE system boilers and thermal accelerators.*"

    Are any analyses available for the composition of the recovered NAPL? If so, please provide in the report.

11. Page 3-15, Line 1107, "*Steam injection rates are tracked by individual SIW.*"

    a) What is the accuracy of the individual steam flow meters?
    b) Do they record both instantaneous rate and total?
    c) If both, which value is graphed?
    d) Are the steam injection values presented in Graphs 3-7 and 3-8 validated or correlated with measures of water usage in the boilers?

12. Graph 3-10.

    What is the explanation for a significant temperature response recorded in the UWBZ/CZ of TMP-6 on 30-Oct-14? No active SIW was in its vicinity.

13. Graph 3-11.

    a) What is the explanation for the continued temperature response recorded in the UWBZ/CZ of TMP-6 on 28-Nov-14? No active SIW was in its vicinity and all steam injection was solely in the LSZ.
    b) What is the explanation for the steam zone indicated in the LPZ and lower UWBZ recorded at TMP-3 on 28-Nov-14? At this time, steam injection was solely in the LSZ.

14. Graph 3-12.

    What is the explanation for the temperature profile recorded in TMP-13 from about 160 to 230 ft. below ground surface (bgs)? The profile is inconsistent with the profile presented for 28-Nov-14 in that preferential steam flow is absent in the LSZ, heating appears to extend uniformly across the LPZ and into the UWBZ, and values are below steam temperature.

15. Graph 3-16.

    The data include readings beyond the reporting period and should be removed.

16. Page 3-39, Line 1270, "*Based on operational testing following startup, the eductor motive water pressures and flows were optimized. As part of this optimization, the operational strategy of the eductor skids was changed from all operating to cycling the eductor skids on a daily basis such that typically four eductor skids are operating.*"

    What specific optimization led to the cycling of eductor pumps rather than constant, site-wide extraction?

17. Page 3-43, Line 1324, "*During the week of 10 November 2014, ST012-TMP06, ST012-TMP13, ST012-TMP14, ST012-TMP16, and ST012-TMP17 demonstrated heating within the LSZ.*"

    a) Please explain the inconsistent temperature response in TMP06. TMP06 is located close to steam injection well ST012-LSZ20-SIW where injection was initiated around 3-Nov-14. As indicated in Figure 8 no temperature response was observed in TMP06 on 11/9/14. Figure 8 from 11/16/14 indicated increases to near 100 °C in the LSZ yet temperatures remained below steam temperature for the LSZ through the reporting period as illustrated in Figure 8 from 12/29/14. The temperature response at TMP06 is inconsistent with the locations of TMP06 and ST012-LSZ20-SIW suggesting the temperature readings are unreliable.
    b) Similarly, as commented on Graph G-12, the readings from TMP13 are likely unreliable. Please provide a plausible explanation for the vertically expansive uniform profile.

18. Page 3-43, Line 1330, "*Heating in the UWBZ was first observed starting the week of 03 November 2014 at ST012-TMP03.*"

    Please explain why steam was detected at TMP03 in the UWBZ one month before steam injection was initiated in the UWBZ (4 Dec 14) and after only two weeks of steam injection in the LSZ. Figure 8 from the weekly progress reports in Appendix F reveal an abrupt heating at TMP03 between 2 Nov 14 and 9 Nov 14 suggesting the readings are not reliable.

19. Page 3-43, Line 1341, "*ST012-LSZ11 measured higher than ambient temperatures starting the week of 05 December 2014.*"

    Please explain why the temperature readings in LSZ11 and LSZ20 plotted in Appendix L indicate near steam temperatures 1 Oct 14 before steam injection was initiated.

20. Page 3-43, Line 1349, "*At the end of the reporting period, the SEE system had been operating for 91 days. When comparing the projected UWBZ and LSZ layer temperatures with actual temperatures measured at the TMPs (as shown in Graph 3-13) at the end of the 91-day period, subsurface heat up exceeded the expected progress as modeled for the reporting period.*"

    a) Please explain why graph 3-13 shows an LSZ average temperature of ~28 °C at the start of

injection and ~69 °C after 91 days of injection yielding an average temperature increase of ~41 °C while the model results given in Graph 3-18 for Layers 6 and & 7 (LSZ) show an average LSZ temperature of ~80 °C after 91 days of LSZ injection and an initial temperature of 18 °C yielding a temperature increase in the LSZ exceeding 60 °C.

b) Similarly, the UWBZ steam injection started on 4-Dec-14 spanning 25 days in the reporting period and Graph 3-18 projects a temperature increase of ~12 °C (Layers 3 & 4) while Graph 3-13 indicates an increase of ~11 °C. If no explanation exists for these discrepancies, please rephrase to read, "*Subsurface heat up lagged the expected progress as modeled for the repor ting period.*"

21. Page 3-44, Line 1367, "*A correction factor is applied to the PID and FID readings based on corresponding analytical data. Given that new analytical data is not available as frequently as the PID and FID readings, the same correction factor that corresponds to the most recent analytical data is applied until new analytical data is available and a new correction factor is applied beginning with the date the respective analytical sample was taken.*"

    Please include the analytical data and associated PID and FID readings used to determine each correction factor and the timeframe of application.

22. Page 3-47, Line 1401, "*In accordance with the RD/RAWP, as results approach the target, extracted groundwater samples will be collected from specific areas and wells at the site.*"

    If air stripper influent benzene concentrations reflect average groundwater concentrations from all combined operating MPE wells, are the benzene concentrations measured in the air stripper influent the preferred "trigger" for more detailed groundwater sampling as indicated by the cited text and the referenced transition criteria?

23. Section 3.3.2.1 Water Balance.

    Could steam, groundwater, and NAPL be pushed outside the defined perimeter given the following contexts?

    a) Assume the water balance is insufficient to demonstrate containment of injected flow to the defined treatment zone (TTZ) and larger heated zone (HZ).
    Assume the reported water balance is a mass balance and lacks the associated energy balance to provide the applicable volume balance associated with phase change.
    Assume uncondensed steam zones, intended and known, in the subsurface containing small water mass compared to the large water mass displaced by the vapor.
    Then not accounting for this phase change and volume balance could result in the flow of displaced, contaminated groundwater and potentially mobilized NAPL beyond the perimeter extraction wells.
    b) Assume the simple mass balance includes a momentum (i.e., pressure) balance to account for soil heterogeneity and well placement.
    Then a significant fraction of condensed steam and displaced groundwater can be pushed outside the defined volume in some areas of the site while preferential recovery may occur in other areas drawing in excessive periphery groundwater.

24. Graph 3-22.

    To assess containment, the net liquid extraction should be calculated starting with the steam injection and not prior as shown in Graph 3-22. The initial ~2,000,000 gallons of extracted groundwater do not contribute to containment. Please change the start date in Graph 3-22.

25. Page 3-49, Line 1436, "*During operation, groundwater elevation rises have been observed in perimeter wells following increases in steam injection; however, these rises are temporary (typically a few days) and overall groundwater elevations at perimeter wells have been maintained below baseline indicating hydraulic control around the perimeter of the site.*"

    a) The groundwater elevation data presented in Table 3-5 shows levels above the corrected base line persisting from 11/10/14 to 12/12/14 in ST012-W30 to the west and ST012-W36 to the northwest. Please add text for this exception to the general statement, "typically a few days" and also add to the last sentence, "… at most locations."

26. Page 3-49, Line 1451, "*LNAPL has been measured in two perimeter groundwater monitoring wells during SEE; ST012-W11 and ST012-W37. At both of these locations, LNAPL was detected prior to SEE startup. LNAPL accumulating in these wells during treatment is the result of changes in hydraulic gradients caused by SEE. Groundwater elevations and temperature monitoring indicate that the LNAPL present at these wells is not a result of steam mobilization.*"

    The last two statements are unsubstantiated and should be deleted. The cited statements imply that NAPL accumulations cannot be used to support containment because NAPL may or may not already be in the vicinity of the wells. Hydraulic gradients caused by SEE existed for two months before NAPL accumulations increased in W11 and W37, but there is no explanation for the delay. A coalesced bank of mobile NAPL does not require heat for migration and responds differently to subsurface pressures than water because of lesser density and lesser viscosity.

27. Section 3.3.2.5 Perimeter Benzene Concentrations.

    The discussion of perimeter benzene concentrations in this paragraph does not describe the relevance to assessing containment and implies such benzene monitoring cannot be interpreted as NAPL may or may not be in the vicinity of the wells and skew results. Please provide relevance to containment or delete the paragraph.

28. Appendix N does not include lab reports in Attachment B.

29. Appendix J does not include the associated soil sample analytical reports.

*Continued next page with Laboratory Specific Comments*

## Laboratory Specific Comments

Appendix C SVE Data Validation Narratives and Appendix H SEE Data Validation Reports

1. Please note in the appropriate Data Validation Narratives/Reports that ALS does not have DoD-ELAP or AIHA-LAP accreditation for EPA Method TO-17 analyses.
2. **TestAmerica reports 280-61736, 280-63008, and 280-63944.** The Case Narratives for these reports state that samples formed emulsions during extraction, and that the emulsions were "broken up using pour backs." Please include this information in the associated Data Validation Reports, explain the process described as "pour backs", and discuss the possible effects on data quality.
3. **ALS report P1404205:** The data validation report provided in Appendix H for this sample group includes the following statements:
   a) Section 3.0 Sample Integrity: "Based on the information provided on the cooler receipt forms, samples arrived at the laboratory within temperature and preservation requirements."
   b) Section 4.0 Sample Identification: "This SDG contains the following groundwater and quality control samples."
   c) Section 8.3 Representativeness: "All samples were properly stored and preserved in the field and at the laboratories."

   The ALS Sample Acceptance Form indicates the temperature of the cooler upon receipt was 31° C, which is well above the Method TO-17 requirement of 4° C. Please review the data validation report for this sample delivery group, as it appears the stated conclusion that "the analytical results indicate sample data are representative of the Site operating conditions" may be inappropriate for these samples.

   In addition, according to the chain of custody and the ALS lab report, the samples submitted were air samples, not groundwater samples.
4. **Test America report 280-62081.** The Data Validation Report indicates the samples were received at the lab expired or close to the holding time expiration, and that the samples were analyzed past the holding time with results flagged as estimated. Please indicate that, because the samples were analyzed past the holding time, results should be considered biased low.
5. **Test America report 280-60820.** All three VOC vials for GAC MIDFLUENT were submitted with significant headspace. This should be included in the Data Validation Report for this Sample Delivery Group along with a discussion of possible impacts to data quality.
6. **Test America report 280-61736.** The sample temperatures upon receipt in the report case narrative (1.6°C, 0.3°C, and 0.3°C) do not match what is recorded at the bottom of the chain of custody (2.7°C, 5.9°C, and 2.3°C). It appears the samples were subcontracted from one TestAmerica lab to another, but this is not documented.
7. Please include a discussion of the following chain of custody issues in the Data Validation Narratives/Reports. In numerous instances, there are date and time gaps in the sample handling chain, missing documentation, and strikethroughs that weren't initialed. Since chain of custody documentation directly affects the data validity and usability, these issues should be discussed in the reports and corrected if possible.
   a) **Test America report 280-61454.** The times are missing on the 1st row of the Relinquished By/Received By on the chain of custody.

b) **Test America report 320-9895.** The chain of custody lists both air and water samples. According to the laboratory report case narrative, only methods TO-15 and TO-3 air canisters were received at the lab. All other samples and analyses on the chain of custody were not received. Laboratory reports for the missing water samples could not be found.

c) **ALS report P1404057.** The chain of custody included with this ALS lab report is a TestAmerica chain of custody with a TestAmerica project number (280-36173-14704) and Project Manager referenced. Please clarify if these samples were initially submitted to TestAmerica and sub-contracted to ALS, and include a copy of the original chain of custody if necessary.

d) **Test America report 280-62081.**

   i. The chain of custody checklist indicates that information was missing from the chain of custody record. There are several notes in the case narrative indicating discrepancies on the chain of custody had to be corrected regarding labeling and collection times.

   ii. The sample handling chain is not complete, and the Case Narrative indicates that TestAmerica Phoenix did not properly relinquish the samples.

e) **Test America report 280-63008.**

   i. The "Relinquished By" and "Received By" sample dates and times contain strikethroughs that are not initialed and that make the sample handling chain difficult to interpret.

   ii. The listed samples contain a strikethrough that is not initialed.

**Closure**

ADEQ may add or amend comments if evidence to the contrary of our understanding is discovered at the referenced location; if received information is determined to be inaccurate; if any condition was unknown to ADEQ at the time this document was signed; or if complementary regulatory agencies bring valid and proven concerns to our attention.

Thank you for the opportunity to comment. Should you have any questions regarding this correspondence, please contact me by phone at (602) 771-4121 or e-mail miller.wayne@azdeq.gov.

Sincerely,

Wayne Miller
ADEQ Project Manager, Federal Projects Unit
Remedial Projects Section, Waste Programs Division

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