UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9
75 Hawthorne Street
San Francisco, CA 94105-3901

October 14, 2016

Catherine Jerrard
Program Manager/BEC
AFCEC/CIBW
706 Hangar Road
Rome, New York 13441

RE: Former Williams Air Force Base ST012 Remedial Action Field Variance Memorandum #5 – Extraction and Treatment System Construction, September 30, 2016

Dear Ms. Jerrard

EPA has reviewed ST012 Remedial Action Field Variance Memorandum 5 – Extraction and Treatment System Construction for the former Williams Air Force Base. EPA requested a containment system because the steam enhanced extraction (SEE) system was terminated prematurely, leaving in the subsurface hot groundwater and light nonaqueous phase liquid (LNAPL). Raising the temperature of liquids lowers their viscosity, and the lower viscosity allows them to migrate more rapidly. The elevated temperatures increase dissolution of jet fuel components, and thus increase the amount of dissolved phase contaminants that will migrate with the hot groundwater. Also, the groundwater level in the subsurface has now risen into the cobble zone, which is believed to be significantly more permeable than the lower zones which are affected by the fuel contamination, and thus risen allow for significantly greater migration of contaminated groundwater and LNAPL.

While it is true that the most recent groundwater concentration data from downgradient sentinel wells have been below maximum concentration levels (MCLs), data collected from the wells U02, W36 and W34 during SEE operations showed increasing benzene concentrations that were well above MCLs. The recent low concentrations were brought about by aggressive groundwater extraction once steam injection was terminated. However, post-SEE groundwater extraction ended in April 2016, and since that time the ambient groundwater gradient to the east/northeast has re-established, as is demonstrated by the groundwater elevation data in Section IV of the Health, Safety, Environmental and Remediation Weekly Reports provided by Amec Foster Wheeler. Thus, without groundwater extraction for containment, benzene concentrations at downgradient wells may be expected to increase rapidly.

According to the field variance memorandum (FVM), the containment system proposed here is based on the groundwater extraction system proposed in the Draft Final Addendum #2, Remedial Design and Remedial Action Work Plan for Operable Unit 2, dated March 15, 2016. Based on a review of the modeling report in Appendix E of Addendum 2, the containment system proposed in the FVM does not appear to be sufficient to contain the hot groundwater and LNAPL plume. Also, the extraction and treatment system proposed in the FVM does not appear to take into account the current temperatures in the subsurface, and this may cause failure of the extraction and above ground treatment system. It is also

noted here that the basic information on the groundwater extraction and treatment system provided in this FVM would not normally be considered a completed design that was ready for construction.

The comments provided below also incorporate comments received from ADEQ. As you are aware the water table has been rising since the shutdown of the Steam Enhanced Extraction System last spring and is currently above the pre SEE baseline. Loss of source zone containment is now a very significant concern and continued recovery of contaminants is necessary to prevent formation of a large groundwater plume which would require an extensive groundwater pump and treat remedy in the future. Therefore, this containment system needs to be installed as expeditiously as possible.

General Comments:

1. According to Section 3.1 of the FV, the proposed containment system is essentially the same as that detailed in Addendum 2. However, the proposed groundwater extraction system in Addendum 2 was not designed for the purpose of containment of the hot groundwater and LNAPL, but to distribute terminal electron acceptor (TEA) (see Section 3.2 of Addendum 2). Modeled TEA injection pathlines shown in Appendix E of Addendum 2 (Figures E-1, E-8, and E-15) clearly show that the proposed pumping for TEA distribution will not contain the TEA at the downgradient side of the site in any of the three zones, and thus this extraction system cannot be expected to contain the hot groundwater and LNAPL plumes.

2. We are learning from the borings and wells that have been installed since the termination of SEE that the LNAPL and dissolved phase plumes extend further to the north and south than was anticipated when the extraction system in Addendum 2 was designed. Thus, there is a much larger area of contamination that requires containment. While this additional LNAPL and dissolved phase is largely outside of the heated area, it has reached the cobble zone and thus will migrate more rapidly than the plumes in the lower less permeable zones have previously. A much more robust extraction system which concentrates on the downgradient side of Site ST012 is required in order to provide containment of the groundwater and LNAPL plumes. Adequate containment can likely be provided using existing SEE wells and/or wells installed for characterization purposes. A revised containment system proposal, which is supported by groundwater modeling that demonstrates capture, should be provided. Capture zone modeling should be applied independently to each of the three zones. Choices of which existing wells to use as extraction wells should also consider where there is the possibility of extracting the most LNAPL.

3. Section 3.1 states that Grundos Model 25S20-11 submersible pumps will be used for extraction. According to the FV, these pumps are designed to operate at 15 gallons per minute (gpm) with a total dynamic head of 250 feet, and were selected for temperature and jet fuel compatibility. However, a specifications sheet for this pump ([HYPERLINK "http://www.geotechenv.com/pdf/total_fluid_dissolved_phase/grundfos_25s_tf_pumps.pdf"]) states that the flow range is 18 to 32 gpm, and does not specify a temperature range that is compatible with the pumps. Temperature measurements from the SEE treatment area obtained on September 2, 2016 show that a large section of the SEE treatment area is still at elevated temperatures, with the TMP11, TMP13, and TMP16 areas approaching the boiling point of water (Health, Safety, Environmental and Remediation Weekly Reports provided by Amec Foster Wheeler for the week ending September 2, 2016). Please confirm that these pumps can provide the desired extraction rates and operate in groundwater with temperatures close to the boiling point of water.

4. The FVM lacks detail regarding how the initial pumping rate will be set for each extraction well and how pumping rates will be adjusted to maintain containment. Please revise the FVM to detail how the initial pumping rate will be set for each extraction well and how pumping rates will be adjusted to maintain containment.

5. The FVM proposes three extraction wells for the CZ, but it is unclear whether three extraction wells will be sufficient to achieve containment in this zone. Please revise the FVM #5 to include additional CZ extraction wells or demonstrate through modeling that ~~to explain why~~ three extraction wells will be sufficient to achieve containment in the CZ.

5. Section 3.1 in the fourth paragraph compares the proposed flow rate for this containment system to the flow rate used for containment before SEE. This comparison is not valid, as SEE targeted a much larger treatment area than had previously been heated during the Thermally Enhanced Extraction (TEE) pilot test. Thus, there is much more hot groundwater and LNAPL over a much larger area that must be contained. Without groundwater modeling to demonstrate that the proposed pumping rate of less than 75 gpm can provide containment, a flow rate closer to 150 gpm is recommended, as that flow rate was demonstrated to be effective for containment during the post-SEE pumping.

6. Section 3.2, in the third paragraph, states, "Water leaving the equalization tank will pass a temperature transmitter, which will shut down the system if the temperature is too high for subsequent treatment equipment and discharge into the City of Mesa sewer." What is the maximum temperature that the downstream treatment equipment can handle? What is the temperature limitation on the City of Mesa sewer discharge permit? The FVM does not describe what would be done to reduce the groundwater temperatures so treatment and discharge could resume. Considering the high temperatures - approaching the boiling point of water - that were measured in the SEE treatment area on September 2, 2016 (Health, Safety, Environmental and Remediation Weekly Reports provided by Amec Foster Wheeler for the week ending September 2, 2016), a heat exchanger is likely needed in the treatment system. Shutdown of the containment system due to high temperatures without a means to cool the water and continue with extraction, treatment and discharge, cannot be tolerated.

7. Section 6 states that the extraction system would operate until enhanced biological remediation (EBR) can be implemented or alternate decision is made. EBR is not a hydraulic containment remedy. This extraction system will be necessary until another remedy is implemented that will eliminate the offsite migration of the plumes.

8. As of the last BCT meeting in September, numerous SEE wells could not be checked for LNAPL accumulations in all three treatment zones because of eductor pumps. The extraction well network for this effort should be re-evaluated based on observations and measurements after the removal of eductor pumps.

Specific Comments:

1. **Section 2.0 Objectives.** The objectives should also include the recovery of accumulated LNAPL and contaminant mass. An assessment of LNAPL recovery is recommended for comparison of treatment rates and costs to those of EBR. Recovery of more accessible LNAPL could significantly reduce the time of remediation for EBR, if significant recovery can be achieved.

2. **Section 3.0 Scope of Work.** The introductory list of unit processes should be edited to read: "6. Air Stripping and Effluent Vapor Treatment; and"

3. The FVM lacks detail regarding how the initial pumping rate will be set for each extraction well and how pumping rates will be adjusted to maintain containment. Please revise the FVM #5 to detail how the initial pumping rate will be set for each extraction well and how pumping rates will be adjusted to maintain containment.

Commented [DE1]: This is a repeat of #4 on page 3.

4. **Section 3.1 Groundwater Extraction Well and Pump Network.**
   a. Please consider operating for an evaluation period in each zone at higher extraction rates (e.g., 10 to 12 gpm from each extraction well) and deeper drawdown to assess the potential for mass recovery via simple physical methods augmented by the residual heat from SEE. If successful, such mass reductions will contribute to a reduction in time of remediation. The average pre-SEE extraction rate of 15-20 gpm was operated under significantly different conditions when biological processes and contaminant transport were in a pseudo-equilibrium at ambient temperatures and such an equilibrium has not been re-established. The total extraction rate closer to that of SEE (or more) is recommended until the mass recovery rate diminishes to a low level and containment is demonstrated via groundwater sampling and analyses.
   b. Containment should not be based solely on monitoring of groundwater levels. Hydraulic control based on groundwater elevation monitoring is complicated by variations in groundwater temperature. A more detailed capture zone analysis is required.

5. **Table 3-1.** Please add a column that lists the design extraction rate for each well (i.e., the estimated initial extraction rate).

6. **Section 3.2, Groundwater Treatment System Installation, Pages 4 and 5:** Section 3.2 discusses the use of a chemical feed system, but the chemical(s) that will be used are not specified. Please revise FVM #5 to specify the chemical(s) that will be used.

7. **3.2 Groundwater Treatment System Installation** Page 5, paragraph 4 should be edited to read, "All process air produced by the air stripper will be treated by the SVE thermal oxidizer." Please describe how the air stripper effluent air will be integrated with the extracted vapors from the SVE wells. Will the SVE well rate be significantly diminished by the flow from the air stripper? Will the air stripper effluent air serve as dilution air or combustion air in the thermal oxidizer?

8. **Figure 3-1, Treatment System Process Flow Diagram:** The Treatment System Process Flow Diagram should indicate rates of various process flows including both anticipated and maximum rates. The diagram should indicate the production and treatment of air used in the air stripper. The treatment system should have sampling ports (e.g., between granular activated carbon [GAC] vessels, at a point before discharge to the sewer system, etc.), but the location of sampling ports are not shown on Figure 3-1. Please revise Figure 3-1 of FVM #5 to indicate the location of sampling ports

9. **Figure 3-2.** Please add ST012-CZ01 or ST012-CZ08 to the monitoring well network.

10. **Figure 3-3.** Please add ST012-UWBZ28 to the monitoring well network. Consider additional extraction and monitoring wells in the UWBZ thermal treatment zone pending the outcome of

observations and measurements in former SEE extraction wells after the removal of 4 eductor pumps.

11. **Figure 3-4.** Please add ST012-LSZ43 to the monitoring well network. Consider additional extraction and monitoring wells in the LSZ thermal treatment zone pending the outcome of observations and measurements in former SEE extraction wells after the removal of 11 eductor pumps.

12. **Section 4.0 Performance Monitoring**. Performance monitoring should include volume of LNAPL collected in the oil water separator.

13. **Table 4-1.** Performance monitoring should include air flow rates into the air stripper and sampling of VOCs in the air effluent before its treatment.

14. **Section 6.0 Schedule.** Fine tuning of active containment GWETS operation should include optimizing recovery of mobile LNAPL and contaminant mass.

Please don't hesitate to call me at (415) 972-3150 if you have any questions about this letter

Sincerely,

Carolyn d'Almeida
Remedial Project Manager

cc: Wayne Miller, ADEQ