To: Carolyn d'Almeida

From: Eva Davis

Subject: Draft Final Addendum #2 Remedial Design and Remedial Action Work Plan for Operable Unit 2 Revised Groundwater Remedy Site ST012 Former Williams Air Force Base Mesa, Arizona

Dear Carolyn,

I have reviewed the Draft Final Addendum #2 to the Remedial Design and Remedial Action Work Plan for Operable Unit 2, Revised Groundwater Remedy for Site ST012 Former Williams Air Force Base in Mesa, Arizona, dated March 15, 2016. While this revised document contains additional design information for the enhanced biological remediation (EBR) portion of the remedy, as requested in my previous comment letter, important comments on the ability of EBR to meet the remedial goals in the desired time frame have not been adequately addressed. This is not the remedy that I believed that EPA was agreeing to at the time the Record of Decision Amendment (RODA) was signed. I believed that steam enhanced extraction would be used to recover light nonaqueous phase liquid (LNAPL) and EBR would be used only for dissolved phase contamination. It is my belief that the Addendum does not put forward an EBR plan that is likely to meet the remedial goals in the desired time frame.

I would like to re-iterate some of the comments made by Dr. Dan Pope of CSS-Dynamac, an expert in EBR, in his May 17, 2016 memo:

"**it is not clear that the proposed EBR/MNA remedial effort is appropriate**"

"EBR is not a source (e.g., LNAPL) remedy . . . the timeframe for actual removal of a significant mass of source material . . . would likely be far longer than the less-than twenty years remaining in the RODA-specified remedial timeframe"

'it is not clear that sulfate EBR is "*capable of achieving goals in the target timeframes*"

In fact, EBR, as proposed, has substantial probability of making the groundwater at Site ST012 worse than the current conditions, in three ways:

1) Response to EPA comment #16 states, "Sulfate is expected to be consumed by bacteria; however, it is likely that concentrations may exist downgradient that exceed the secondary MCL." Currently the groundwater at the site meets the secondary MCL for sulfate, so this would be a degradation of the downgradient groundwater quality.
2) Response to EPA comment #15, and on page 5-7, states that buildup of hydrogen sulfide, a toxic gas, is possible, and that vapor monitoring will be performed at monitoring wells and vapor purging protocols will be developed for well casings. Many of the new injection wells being installed for EBR are in areas accessible to the public. Figure 4-1 of the Addendum show a concrete vault lid on these wells with a screw cap on the well

itself. It appears that the public could gain access to these wells, and thus potentially could be exposed to hydrogen sulfide in these wells due to the injection of extremely large amounts of sulfate.

3) Page 3-8 states that sodium sulfate contains up to 3 mg/kg of arsenic as an impurity. At the planned sulfate injection concentration of 320 gm/L, the injection water would contain up to 0.96 mg/L of arsenic, which is almost 100 times the drinking water standard for arsenic. It is not clear that injection of this concentration of arsenic is allowed by Arizona state law.

   Based on the amount of sodium sulfate to be used in Phase I, Amec calculated that the concentration of arsenic in the groundwater would be between 8 and 26 µg/l (see Appendix G). Due to the likelihood of needing considerably more sulfate than proposed for Phase I due to the large mass of contaminant remaining at the site, it is likely that higher arsenic groundwater concentrations will be produced. Amec goes on to claim that "The calculation is conservative and does not take into account any of the following expected mechanisms that would be anticipated to decrease arsenic concentrations upon injection: 1. in situ geochemical conditions that would likely lead to precipitation or adsorption, … 3. Consumption of arsenic through biotic and abiotic reactions." However, Ford et al. (Ford, R. G., R. T. Wilkin, & R. W. Puls, Monitored Natural Attenuation of Inorganic Contaminants in Ground Water Volume 2, EPA/600/R-07/140, October 2007) state that reducing chemical environments will cause desorption and dissolution of arsenic. Ford et al. also discuss how arsenic transport via mobile colloids can be enhanced in aquifers impacted by organic contaminants where microbial activity is stimulated resulting in the generation of reducing conditions and/or the production of low molecular weight compounds. Thus, it should be assumed that under the conditions present at this site, the arsenic will remain in the dissolved phase, and may have enhanced mobility via mobile colloids.

Despite the concerns that EPA has expressed about apply this remedy to the large quantity of remaining LNAPL, Amec has proceeded with installing wells to initiate EBR. Several of the installed wells have already shown that LNAPL exists outside of the modeled area believed to contain LNAPL. Slide 22 from the May 19, 2016 conference call shows that LNAPL was encountered at 215 feet below ground surface (bgs) at boring LSZ47, which is approximately 60 feet south of where Amec believed LNAPL to exist in the lower saturated zone (LSZ) (see Figures 2-6, B-6 and B-7). Also, the LNAPL found in boring UWBZ33 at 175 and 190 feet bgs is right at the edge of the modeled LNAPL extent for these depth ranges (see Figures 2-2 and B-3), indicating that LNAPL extends beyond the modeled extent. The LNAPL detected in boring LSZ50, as described by Steve Willis (memo of May 18, 2016), indicates that the conservative estimate of LNAPL extent is more appropriate for the 210 to 230 foot depth range. Strong odors at 200 to 212 feet bgs and a positive dye test in boring LSZ46 (Steve Willis memo of June 6, 2016) indicate that LNAPL extends approximately 100 feet further to the south in this area then conservatively modeled in Figure B-6. Thus, it is likely that current estimates of remaining LNAPL are not conservative, but are low. This would indicate that the planned sulfate injections, which are based on minimum mass estimates, are low. **This recent data re-inforces the importance of understanding where the LNAPL is and how much there is before making decisions on the appropriate remedial technology to use and determining the**

implementation strategy. Complete delineation of the LNAPL and dissolved phase plume should be the first step in determining the appropriate remedial strategy for the remaining LNAPL.

In response to previous EPA comments, some contingency planning has been incorporated into the Addendum. However, there are no clear protocols or criteria for determining when the contingencies identified will be implemented. The Addendum only states that contingencies 'will be considered". This does not provide EPA with assurance that differing field conditions will be responded to in the appropriate manner – or responded to at all. I do not consider this to be adequate contingency planning.

Section 4.2.5, on page 4-11, #4, states, "If mobile LNAPL is observed in a new or existing injection well, the LNAPL will be removed to the extent practical prior to injections. If sustained recovery of LNAPL is possible, TEA injection at that location will be delayed." This is an admission by Amec that EBR is not an appropriate remedial technology for areas with mobile LNAPL. Well W-37 has been continually producing LNAPL since 2013, and approximately ten gallons were recovered as recently as April 29, 2016. Well W-11 has had a fairly stable amount of LNAPL in it for at least the month of April. Both of these wells are currently slated to be injection wells, however, by this contingency criteria, it is not appropriate to use them for that purpose. Thus, there is currently no remediation being contemplated for these two highly contaminated areas beyond occasional removal of LNAPL from the wellbore.

It appears that dispersion is to be relied on to distribute sulfate throughout the area to be treated, as groundwater flow lines for the injected sulfate solution shown in Figures E-1, E-8, and E-15 do not cover most of the areas on known LNAPL contamination.. The series of model results presented in Figure E-2 to E-7, E-9 to E-14, and E-16 to E-21 show the sulfate distribution (above background concentrations) for each of the vertical treatment zones, and appears to show that the sulfate is expected to move almost the same distance laterally via dispersion as toward the extraction wells while the extraction wells are being pumped. This does not seem reasonable or believable. Considering the significant uncertainty in the pilot test results, as documented by Dr. Pope in his May 17, 2016 memo, it is likely that dispersivity values determined from the same test are also highly uncertain. These figures do not provide confidence that the sulfate can be adequately distributed with the planned injection system.

If you would like to discuss these comments, I would be happy to do so. I can be reached at (580) 436-8548 or davis.eva@epa.gov.