MEMORANDUM

TO: Rick Hutton

FROM: DNAPL Team

DATE: February 27, 2009

DNAPL Team Comments
ISBS Pilot Study Report: Field Performanace Assessment, Cabot Carbon/Koppers Superfund Site in Gainesville, Florida
Adventus Americas, Inc., January 30, 2009

General Comments:

1. It appears from the Adventus ISBS Pilot Study Report (dated January 30, 2009) that the in situ biogeochemical stabilization process used in the North Lagoon pilot test relies on the abiotic chemical conversion of organics and that there is no biological component – but perhaps we are missing something?
2. We did not understand before reading the Adventus report that the stabilization reagent included a silicate and the reliance for chemical stabilization is not on manganese dioxide. This was not made clear in the earlier March 31, 2008 report Adventus needs to provide a detailed description of how the ISBS technology works, including the roles and mechanisms of MnO_2, silicate, and biochemical reactions.
3. Only some of the DNAPL in the contaminated aquifer was contacted by the injectate. See Comment 4.
4. Bench-scale testing in the lab is essential in designing a remedial program but it cannot show how the injection operations will perform in situ. Good sweep of the DNAPL zone requires that the remediation engineers actually simulate how the injectate will migrate in situ and use hydraulic control and extraction wells to direct the injectate through the contaminated aquifer. This does not seem to have been the case in the North Lagoon pilot test because the post-test cores from DVB-2 and DVB-3 show evidence of mobile DNAPL remaining after the test. We believe that this is due to viscous fingering, which is caused by injecting a less viscous fluid (ISBS) into a more viscous fluid (DNAPL). The less viscous injectate fingers through the more viscous DNAPL and by-passes much of it. The same problem occurs when waterflooding oil reservoirs to enhance oil recovery—waterflooding typically leaves >50% of the oil behind.
5. We have some concerns about the data presented in the Adventus ISBS report and the comparison of pre- vs. post-test results. The ACEPD addressed our concerns regarding variability of the data in their February 24 correspondence to EPA.

6. The test appears to show some promise at oxidizing some of the creosote and reducing permeability and leachabilty in those zones into which the RemOx migrates. See Table 8. When it works, the PAH and leachate reductions are in the 90% or higher range – and that is very good. But when it does not work, presumably because the injectant did not contact the creosote, the reductions are minimal.
7. Overall, we believe that if ISBS is implemented throughout the DNAPL source zones, it will probably reduce creosote mobility and dissolved mass discharge out of the DNAPL source zones. However, this technology will succeed in sufficiently reducing migration of contaminants **only if** Adventus can deliver the reagent evenly throughout the target zone. The results of the Pilot Test described in this report are not particularly encouraging in this matter.
8. The largest uncertainties are:
    a. How uniform and consistent will the injections and treatment be?
    b. How many zones will be missed by the treatment?
    c. Will this even matter if the untreated zones are nearly or completely surrounded by treated zones?

    These questions will be challenging to answer, especially with the current lack of information regarding DNAPL distribution in the Suficial and in the Hawthorn.

9. We believe that the area of DNAPL impacts is underestimated and, as a result, the total cost of employing ISBS treatment is greatly underestimated. The proposed remedial plan for the Surficial aquifer would include 196 injection points and cost about $1 million per acre. Presumably this cost would be several times higher per acre for the Upper Hawthorn and several times higher again for the Lower Hawthorn. That makes defining the lateral limits of the DNAPL zones very important from a cost perspective.
10. Beazer needs to complete the DNAPL characterization of all intervals for which ISBS is proposed in the FS. Characterization should be done following the procedure used by GeoTrans in the pilot test and documented in Appendix E.

Specific:

1. As we pointed out in Specific Comment #4 to the Phase 1 ISBS report [letter of July 15, Rick Hutton to Scott Miller - attached], the injectate is denser than the groundwater and will sink to the bottom of the surficial aquifer and then migrate along the top of the UHG clay. It is only following 'preferential flow paths' at the base of the aquifer. In the TIP area (10% solution) only the base of the aquifer is swept by the injectate. In the DIP area, which appears to employ a less-dense injectate (4.5%), there is better sweep efficiency but still only the base of the aquifer is swept. (Overall the shallow sweep was very poor. As the TIP site experiment shows, most of the dense injectate – density ~ 1.1 g/mL – sank to the bottom of the surficial aquifer and moved along the base of the aquifer. Sweep

efficiency would be expected to decrease with increased distance from the injection well. That is why some free-phase DNAPL was not encapsulated only 5 to 7 ft away from one of the DIP wells. See the logs of DVB-2 and DVB-3.)

2. The permanganate reaction is not uniform with depth. The fact that there is 'no HCL reaction' when 'immobile to free product' remains (e.g., DVB-3, 15-17.3 ft and 20-22 ft bgs, sheet 2/2, Appendix E, GeoTrans, April 2, 2008), means that there is no excess injectate to encapsulate the DNAPL. Additional design is needed to ensure that ISBS will adequately degrade and immobilize creosote DNAPL at this site and that it will sufficiently reduce mass flux.
3. Even after the ISBS, logs for DVB-2 (10 ft - 21 ft) (this boring showed very little treatment) and DVB-3 (15 ft - 17 ft) showed evidence of some free product.
4. In 6 days of injection, the radius of influence in the DIP area was only 5 to 7 ft and only 13 ft in the TIP area and it left behind mobile DNAPL just 5 ft from an injection well.