LSS[SM]
Legacy Site Services LLC

4 June 2007

Mr. Matt McClincy
Oregon Department of Environmental Quality
Northwest Region
2020 Southwest 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Subject: Former Arkema Portland Plant
Responses to ODEQ Comments on the Groundwater Treatability Study Work Plan

Dear Matt,

This document provides responses to comments received from the Oregon Department of Environmental Quality (ODEQ) on 26 April 2007 related to the April 2007 *Groundwater Treatability Study Work Plan, Groundwater Source Control Interim Remedial Measures*, prepared by Environmental Resources Management (ERM) for Legacy Site Services, LLC (LSS). Each of the ODEQ comments is provided below in italic font, followed by LSS's response. Attachment 1, provides responses to EPA's comments on the Work Plan.

1. *Please clarify whether Task 3 tests will be conducted using Task 2 effluent or the original (untreated) groundwater sample. Ideally water should move through the tests in the same order proposed for full-scale treatment.*

   Chemical reduction testing (Task 2) using zero-valent iron is being tested as a "stand alone" technology to evaluate whether it can reduce the concentration of chlorate in groundwater as a means to improve the effectiveness of subsequent biological treatment. Chemical precipitation testing (Task 3) is to be conducted using original (untreated) groundwater to assess the performance of subsequent biological treatment under baseline influent conditions, without the benefit of any potential pretreatment via chemical reduction. If chemical reduction testing demonstrates this technology can cost-effectively reduce the concentration of chlorate in groundwater, chemical reduction may be considered as a pretreatment step for the full-scale treatment system. Task 3 effluent will be used for the biological treatment testing.

2. *Figures 1 and 2 suggest that the metal precipitation systems depicted are different. Please clarify.*

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Figure 1 is a hydroxide precipitation treatment process for metals removal and assumes that solids filtration will be used to remove precipitated metals. Figure 2 is an iron co-precipitation treatment process for metals removal and assumes that clarification with associated sludge dewatering equipment (e.g., thickener, filter press) will be required to remove precipitated metals. Larger volumes of metals solids are expected to be generated during iron co-precipitation because this process involves the addition of ferrous sulfate to potentially improve metals removal.

3. *It is not clear that the water starting Task 4 anaerobic treatment will be anaerobic, especially after processing through Task 2 oxidation tests (Figures 1 and 2). What measures will be implemented to maintain anaerobic conditions during Task 4 tests?*

   Perchlorate-respiring bacteria are facultative microorganisms that are capable of utilizing oxygen or perchlorate as terminal electron acceptors. While oxygen is preferentially utilized by these organisms when present, the organic carbon substrate that will be added to influent groundwater will result in oxygen being consumed to biodegrade the substrate, thus creating anaerobic conditions within the bioreactor. The bioreactors will be designed with sufficient residence time and organic carbon substrate feed rates to compensate for oxygen present in the influent and maintain anaerobic conditions in the bioreactor needed for effective perchlorate removal.

4. *Confirm that the fluidized reactor tests will determine the necessary residence time to accomplish treatment objectives.*

   The bioreactor tests are designed to determine the hydraulic retention time, hydraulic loading, and recycle rate necessary to effectively treat groundwater.

5. *The suggestion that elevated chloride levels above 4,000 mg/L could be diluted with water from MWA-23 may have merit, but the effect of diluting other constituents by this action is not clear. For example, a treatment process (such as biodegradation) may not work as well if the dilution has lowered the influent contaminant concentrations.*

   In conventional biological wastewater treatment using an activated sludge process for BOD removal, dilution can affect treatment performance. In this case, the effects of dilution and associated lowering of influent perchlorate concentrations may be addressed by adjusting the operating conditions (recycle rate, residence time) and maintaining the desired organic substrate feed rate.

Sincerely,

Todd Slater
Legacy Site Services LLC

cc: Tom Grainger, DEQ NWR
Claudia Powers, Ater Wynne

Erik Ipsen, ERM
Larry Patterson

Attachment 1

Responses to EPA Comments

1. *It is not clear why ERM is proposing to test the EHC-M proprietary nutrient from Adventus, when non-proprietary nutrients such as ethanol, lactate, and acetate have already successfully been used to treat perchlorate and chlorate in FBRs. All full scale bioreactors currently treating perchlorate and chlorate are FBRs and not PBRs, which have a higher propensity to biofoul. Also, recent research has shown that ZVI alone does not effectively treat perchlorate in groundwater.*

   The EHC-M testing is part of a potential alternative treatment train approach as shown on Figure 3 of the Treatability Study Work Plan. EHC-M is not intended to be used as a substitute for conventional carbon sources used as electron donors in the FBR (see response to ODEQ comment #3). The primary purpose of the ZVI testing is not for its capability to remove and/or treat perchlorate, it is for its ability to remove chlorate which will reduce the chlorate loading to the biological treatment units (see response to ODEQ comment #1). Chlorate competes with and/or is preferentially degraded in biological treatment units over perchlorate.

2. *The area where they need to focus is testing FBRs using salt tolerant microbial consortia that have demonstrated the ability to degrade perchlorate and nitrate in chloride levels as high as 3% to 6% (30,000 ppm to 60,000 ppm). If these consortia are capable of degrading perchlorate at the ambient levels of chloride that exist at Arkema (9,269 ppm avg, +/- 29,179 ppm), then it could potentially eliminate the need to do desalinization.*

   As stated in the Work Plan, the FBR treatability studies have been designed to test a minimum of two chloride influent conditions - the first being the "expected" blended concentrations and the second representing a potential high blended chloride concentration (~15,000 mg/L). The results of the recently acquired blended sample indicate the actual blended chloride level is 1,600 mg/L. The consortia being used to seed the reactor have been obtained from the site aquifer material. Should these bacteria be unable to degrade the perchlorate in the reactor, alternative consortia will be evaluated at that time. Desalinization is not considered to be technically practicable or necessary based on the results of the expected blended sample.

3. *For the ion exchange resin tests, the three primary ones that should be evaluated are: 1) styrenic strong base anion (SBA) resins, 2) nitrate specific resins, and 3) bifunctional perchlorate specific resins.*

Ion exchange testing, if determined to be necessary, will evaluate two resins considering the above recommendations, literature review, and manufacturer's recommendations. Perchlorate-specific and bi-functional resins will be evaluated for use in the testing. Manufacturer's to be contacted include Purolite, Sybron, and Rohm and Haas based literature references identifying these manufacturers as offering these resin types. Ion exchange is only be considered as a polishing step following anaerobic biological treatment in the event anaerobic biological treatment cannot achieve sufficient effluent concentrations on its own. If bench-scale testing demonstrates anaerobic biological treatment can achieve sufficient effluent concentrations, no ion exchange testing will be performed.

4. *Actual performance standards are needed for the hydraulic containment. From the preamble language, it seems pretty much anything would qualify as hydraulic control. "The proposed Groundwater Source Control IRM consists of hydraulic containment coupled with a low permeability barrier along the Willamette River to reduce migration of contaminants in groundwater to the river."*

   Performance standards and/or performance monitoring of the IRM will be discussed in the Focused Feasibility Study and finalized with ODEQ.

5. *It seems that clean groundwater will be used to dilute perchlorate to the point that bioremediation will work. It may be optimistic for bioremediation to work ex-situ even with diminished salt levels. Discussion should be added regarding engineering of a desalinization plant should bioremediation of perchlorate/salt influent prove ineffective.*

   The work plan states that if the results of the blended sample indicate that chloride is over 4,000 mg/l, then dilution water would be added to bring the blended to reduce chloride to less than 4,000 mg/L prior to testing the FBR for perchlorate removal. As stated above, the results of the initial blended sample indicate chloride is 1,600 mg/l, therefore no dilution water is necessary. A desalinization plant is considered technically impracticable.

6. *The ion-exchange discussion should discuss pertinent salt clogging issues relating to acceptable dissolved constituent levels in influent.*

   The potential for resin clogging due to solids formation within the resin columns will be evaluated as part of the ion exchange bench-scale testing, if such testing is determined to be necessary pending the anaerobic biological treatment testing. However, evaluating such clogging potential on a bench-scale can often be difficult considering the hydraulics are difficult to simulate on a bench scale and mass loadings of constituents in ground water are low. If ion exchange is determined to be required as a polishing step following anaerobic biological treatment, clogging potential will be more effectively evaluated on a pilot scale.