



MARYLAND DEPARTMENT OF THE ENVIRONMENT

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October 17, 2013

Mr. Scott Burleson
Site Executive
Shore Regional Health – Chestertown
100 Brown Street
Chestertown MD 21620

RE: GROUNDWATER REMEDIATION 2013 ACTION PLAN APPROVAL

Case No. 1987-2534-KE

Chester River Hospital Center

100 Brown Street, Chestertown

Kent County, Maryland

Facility I.D. No. 3168

Dear Mr. Burleson:

On July 22, 2013, the Chester River Hospital Center (CRHC) submitted a draft version of the referenced plan for the Maryland Department of the Environment (MDE) to review and comment on. The plan called for the injection of a surfactant solution, Ivey-sol, to assist in “dissolving” the residual adsorbed / absorbed petroleum hydrocarbons into the shallow groundwater formation. A “Push-Pull” method would be employed to assist in the distribution efforts. The “dissolved” petroleum hydrocarbons will then be available for extraction and ex situ treatment.

The Department completed an initial review of the draft plan and provided comments to CRHC on August 2, 2013 (enclosed). On August 22, 2013, an email from the CRHC’s consultant was received with various attachments for the Department to review in anticipation of the upcoming technical meeting (enclosed). On August 26, 2013, the technical meeting was held at the MDE’s office with representatives of the CRHC and MDE to discuss the proposed plan.

On September 13, 2012, the Department received the revised *Groundwater Remediation 2013 Action Plan*. The Department has reviewed the plan and agrees that the technology can be successful in making more petroleum hydrocarbons available for recovery and treatment. The following is a review of the initial concerns noted by the Department and how each was addressed. The Department’s final comments on each concern are presented in italics. Additionally, the Department’s conditional approval follows at the end of the letter.

Review of MDE's August 2, 2013 Comments and Responses

- The plan is conceptual in nature and does not detail where the injection and extraction points will be located. The treatment should be focused on the area of greatest residual source mass. This area is generally defined by the areas exhibiting the highest concentrations of total petroleum hydrocarbons – diesel range organics (TPH-DRO) and measurable free product. Treating areas that are downgradient from the source area will not provide for long term or sustained remediation.

CRHC Response: We agree with the areas to be targeted for the lvey-sol “Push-Pull” application. The plan will include treatment of the areas exhibiting the greatest residual source mass to include:

- Wells with measurable free product
 - MW-47 (May, June, 2013)
 - RW-3b (June, 2013)
- Wells with highest concentration of TPH-DRO
 - MW-14 (410 mg/L)
 - MW-41 (410 mg/L)

MDE Response: *The plan is aggressive with proposed injection and extraction points located all over the site. Although wells with measurable free product (MW47 and RW3B) and wells with the highest concentrations (MW14 and MW41) are targeted, the proposal to utilize up to 19 existing wells and 5 new wells across the defined monitoring zone and outside of the documented capture zone could result in the liberation of liquid phase hydrocarbons (LPH) or high dissolved phase concentrations without an ability to recapture. Additionally, it is still not clear as to the depth of the targeted injections or extraction events.*

The Department has prepared the enclosed map to indicate the approximate LPH footprint at the site. The footprint was determined based upon the existing well gauging data showing where LPH have been detected. The LPH footprint will generally represent the area where residual (adsorbed and entrained) LPH are likely to be encountered and is the general area where the surfactant injection efforts should be focused. Based on the identified LPH footprint and the existing pump and treat system, the Department is approving a limited initial implementation of the surfactant and use of the pump and treat system to maintain hydraulic control. This requirement is further detailed later in the letter.

- The existing smear zone should be identified to determine the depths of residual hydrocarbons. This can be accomplished through review of previously collected boring logs (if sufficient detail exists) and previously collected soil data. The point of this exercise is to identify the general geometry of the residual mass so that the injections are targeted. By not completing this exercise and relying on “pouring” the surfactant solutions into existing wells, the solution will generally not distribute vertically to any significant degree. Using the existing recovery wells to influence the local hydraulics can assist with vertical distribution to a degree. However, it is often beneficial to install appropriately constructed injection wells to target the residual mass and better guarantee contact with the source area.

CRHC Response: We agree and EBA will review existing data with Earth Data to provide further insight regarding the existing smear zone characteristics, which will be discussed with MDE at our proposed August 26, 2013 meeting. At that time we will outline what we believe to be the smear zone and discuss further with MDE regarding the process and procedure for implementing the Ivey-sol application.

MDE Response: *The presented tables and graphs do not identify the smear zone relative to well construction and screen intervals. Screen intervals are a very important factor when determining delivery mechanisms, extraction options, and calculating radius of influence. It is not readily apparent what the relationship is between the smear zone, the existing well screens, and the pumping and non-pumping water levels at the site.*

- Because the technology does make additional hydrocarbons available for migration in the groundwater, demonstrating adequate hydraulic control is a critical component to the MDE approving this plan. CRHC must demonstrate this through presentation of past hydrogeologic work (e.g., presenting of past pumping tests, established cones of depression) and presentation of updated information if new recovery wells are installed.

CRHC Response: We have been in discussion with Earth Data regarding hydraulic control and will be discussing this further with you at the August 26, 2013 meeting. We understand that the soils at the site are sands and silty sands. Based upon extensive Ivey-sol experience on various sites with similar soils and utilizing 4-Inch diameter Injection Wells (IW) that the injection diffusion radius would likely be between 10 and 20 feet. We will continue to review the available information to locate injection wells optimally so as to promote and maximize the results of the Ivey-sol application

MDE Response: *This comment has not been sufficiently addressed. While injection radius is an important design factor with regard to plan implementation, the more important factor is hydraulic control. As the technology is designed to mobilize otherwise immobile hydrocarbons, there must be a predictable means of recovering the mobilized hydrocarbons. The existing pump and treat system has demonstrated sufficient hydraulic control for the areas to the north of Brown Street. The proposed "Push-Pull" methods discussed are generic in presentation and simply rely on "available methods" for the "Pull" or extraction piece. While there is not sufficient detail presented to allow the Department to approve the plan as presented, the Department will approve a limited initial implementation as described below.*

- The plan must include the specific wells to be used for 1) monitoring, 2) injection, and 3) extraction. Any new wells proposed to be installed for these purposes must also be identified and the installation details presented.

CRHC Response: Our Team will provide a map with proposed locations of new wells and will be prepared to discuss further at the August 26, 2013 meeting.

***MDE Response:** The following existing points were proposed to be used as injection and extraction points: RW3; RW5; MW14; MW15; MW16; MW19; MW20; MW22; MW24; MW33; MW34; MW35; MW40; MW41; MW42; MW47; MW48; MW49; and MW50. Five additional 4-inch diameter injection/extraction points were also proposed: MW8R; MW51; MW52; MW53; and MW54.*

All injections are proposed as "Push-Pull" where there is an injection and extraction from the same point, not a "Push" of the material into one well and a "Pull" of the material through the formation for recovery at an extraction point. It is unclear as to how treatment of the formation will be distinguished from localized treatment of the injection/extraction wells.

Prior to system shut-down and surfactant injection, the following wells are proposed to be gauged and sampled: MW15; MW16, MW19, MW20; MW24; MW33; MW34; MW35; MW48; MW49; and MW50.

- It is not clear from the plan if the intention is to use the same wells for injection, extraction, and monitoring or if separate wells will be used for each function. The MDE generally does not allow for one well to serve all three purposes as this generally leads to only cleaning of the well and immediately adjacent formation.

CRHC Response: The plan includes the utilization of existing 4-Inch diameter monitoring wells as injection points followed by extraction points once the residence time of Ivey-sol has elapsed (24 hours). In our professional opinion, utilizing the existing wells would provide the maximum site coverage required. During this period we understand that these monitoring wells will not be used for prescribed monitoring of the sites performance, with the exception of the EPA approved Ivey-sol field test which is essential as a performance monitoring tool during the application operation.

***MDE Response:** With such a large area proposed for injection and recovery, the Department is concerned that there is not a large enough population of wells to monitor the progress of the treatments to ensure that down-gradient sensitive receptors are protected. Therefore, the Department is approving a limited use of the surfactant process as described further below.*

- The plan must present and discuss measurable endpoints for the activities. This is critical to both parties agreeing to what will constitute completion of the remediation project.

CRHC Response: Our proposal is to eliminate the free product and TPH-DRO as an indication that remediation is complete and that the process for case closure can be more fully documented. We assume that year end quarterly reports will be the basis for this determination. At that time, in addition to the standard reporting requirements prescribed by MDE, our team will provide an end of process report which provides our professional opinion on the success of the Ivey-sol applications.

MDE Response: Eliminating free product and TPH-DRO in monitoring wells is the understood goal of the proposed remediation plan. As with all forms of remedial actions, the Department will require a minimum of one year post-remedial monitoring prior to determining case closure. This would begin when it has been analytically demonstrated that all surfactant has been purged from the formation.

- The MDE agrees that the existing recovery well network and the existing pump and treat system can be used to assist in the proposed remediation. However, the extent that the existing pump and treat system will be used is not clear from the proposal.

CRHC Response: So as to separate the existing pump and treat process from this added Ivey-sol application which will only last for thirty (30) days, the CRHC Team is recommending that the pump and treat process be shut down during the Ivey-sol application. The Team has fully evaluated the pros and cons of leaving the pump and treat system on and have not been able to conclude that it would in any way benefit the Ivey-sol process. To the extent that the pump and treat system may need to be turned on at a later date will depend solely on the success of the "Push-Pull" application. At this time, based on Ivey International's experience on other sites, this process typically removes any residuals and results in an end point in and of itself to the remediation process.

MDE Response: It is proposed that the pump and treat system be shut down during the Ivey-sol process. Previous post shut-down gauging confirmed that water table rebounded to non-pumping equilibrium within three days of cessation of pumping. This would provide for a high water table and possible delivery of treatment above the smear zone and not where it will be most effective. If the system is shut down prior to delivery of surfactant, it is highly encouraged that the injection event be completed in an expeditious manner so that the groundwater table rise can assist in the distribution of the surfactant.

Vacuum trucks will not be reliably effective at this site due to the water table depths; therefore, a series of submersible pumps will likely be required for the "Pull" operations. The Department strongly suggests that the CRHC consider using the existing pump and treat system to function as the "Pull" force. At a minimum, the pump and treat system must be fully operational and able to be immediately turned on at short notice.

- A discussion of any potential complications of the Ivey-sol chemical with the treatment train of the existing pump and treat system must be presented.

CRHC Response: Ivey International has been able to verify that Mycelx treatment process being very similar to GAC treatment systems, and clients globally who he has worked with have reported no negative effect from his Ivey-sol application on wastewater treatment systems. These treatment systems have included but are not limited to; oil/water separators, GAC treatment systems, organo-clay, membrane separation, bioreactors, air strippers, and use of coagulants and flocculants. However, by turning the pump and treat system off during the Ivey-sol application the extracted water will be collected in tanks/drums and disposed of offsite at approved facilities.

MDE Response: The Department understands that the Ivey-sol product and mixture of the Ivey-sol product and any liberated hydrocarbons will not cause adverse effects to the treatment train of the existing pump and treat system.

- If the extracted water will be hauled off-site for treatment and disposal, a discussion of any potential complications to haulers must also be presented.

CRHC Response: There will be no complications to haulers as the Ivey-sol chemicals are all compounds which can be ordinarily found in common use and disposal practices. This can be discussed further at our August 26, 2013 meeting in such a way that those present agree not to disclose responses which would in any way negatively affect the patented process.

MDE Response: The Department understands that the Ivey-sol product and mixture of the Ivey-sol product and any liberated hydrocarbons will not cause adverse effects to the treatment train of any off-site treatment systems that the water may be hauled to.

- An MSDS sheet for the Ivey-sol chemical must be submitted. Documentation must also be presented on how the extracted material meets with typical NPDES permit requirements.

CRHC Response: The requested MSDS sheet is attached for your information and use.

MDE Response: Received as part of the August 22, 2013 email and attached to this letter.

- Because there have been detections of several volatile organic compounds (VOCs), including naphthalene and PCE, the MDE will require sampling of VOCs during this implementation of the plan as they will also likely increase in concentration during treatment.
- The MDE requires the sampling of groundwater for the EPA methods identified in the Ivey International Plan (EPA Method SM5540D and EPA Method SM5540C). Analysis of these parameters should be completed for quarterly sampling events.

CRHC Response: Sampling for VOCs including Oxygenates via EPA Method 8260B will be included in the monitoring plan. Groundwater sampling for the presence of Ivey-sol surfactant will be performed on a quarterly basis by either EPA Method SM5540D or EPA Method SM5540C.

MDE Response: The proposal includes analysis for TPH-DRO one week after injections and quarterly sampling of the injection/extraction wells and off-site down-gradient monitoring wells (MW17, MW18, MW23, MW25, MW28, and MW29) for TPH-DRO by EPA Method 8015, full suite VOCs by EPA Method 8260, and for MBAS by EPA Method 5540C.

Because of the vicinity of this site in relationship to sensitive receptors, the Department requires submittal of analytical data reports as received from the laboratory. This can be accomplished by emailing laboratory analytical data packages to the MDE project team. Standard reporting timelines can be followed for the full reports.

Ivey-sol is described as a nonionic surfactant. EPA Method 5540C discusses anionic surfactants as methylene blue active substances (MBAS) and EPA Method 5540D discusses nonionic surfactants as cobalt thiocyanate active substances (CTAS). The Department's understanding is that EPA Method 5540D would be applicable to the Ivey-sol formulation.

- The proposal does not specifically define what the residence time will be for the Ivey-sol chemical. In other similar implementations approved in Maryland, 24 hours has been typical. Please define either the time or the decision matrix that will be used to determine in the field.

CRHC Response: Based on experience at numerous sites the residence time for the applications will be 24 hours.

MDE Response: *The Department understands that the residence time for the Ivey-sol product will be 24 hour, but notes that the Remediation Action Plan does not define the residence time.*

- The Wastewater Permits Program has determined the injection wells will be permitted by rule under the Underground Injection Control program. A letter will be issued to the CRHC as part of the final plan approval.

CRHC Response: No response.

MDE Response: *No "Request for a Rule" has been submitted under separate cover and was not included as part of the proposal. CRHC must submit a letter to the MDE Water Management Administration as agreed during the August 22, 2013 meeting.*

Conditional Plan Approval

The Department generally does not approve a corrective action of this magnitude without an initial pilot test. Given the proximity of the sensitive receptors, the Department is approving the implementation of the Ivey-sol product and "Push-Pull" application with the following restrictions:

- At this time, the Department does not approve the injection of Ivey-sol in any area south of Brown Street.

- On July 24, 2013, 0.41 feet of free product was measured in well RW3B. The Department does not have a record of being contacted within 2 hours of the detection and there is no documentation of whether LPH were recovered as required in the agreed to plans.

The fact that there was measurable LPH in the subsurface after the treatment system had been running for little more than a month indicates there is still residual LPH that could be mobilized by the introduction of the surfactant solution. Because of this recognized risk, the Department will only approve a limited pilot scale testing of the Ivey-sol product.

The implementation will be limited to the area defined by wells RW6, RW2D, MW13, and MW10R. Injection in this area will ensure that any potential LPH or high dissolved phase concentrations that are mobilized would be within the known capture zone of the remediation system. This allows for the Department to gain confidence in CRHC's implementation of the proposed corrective action while maintaining a level of protection from the hydraulic control of the pump and treat system.

The Department will allow CRHC to perform the Ivey-sol "Push-Pull" application within this area up to three times over the proposed two week timeframe. Although the plan does not detail the "Pull" mechanism with any specifics, the Department will allow CRHC to utilize available technologies it sees fit for the job. However, the pump and treat system must be immediately ready to turn back on if directed. Following this time frame, the Department will require the treatment system to be turned back on while wells are monitored for a period of at least three months. At that time, the Department and CRHC can determine the next steps.

- The Department makes the following recommendation for CRHC to consider. Using the recovery system to expose the smear zone is a very effective strategy to ensure penetration of surfactant into the formation. Typically, the surfactant can be injected into numerous wells simultaneously and then the system is turned off to allow the water table to rise. Once the water table has returned to roughly static conditions, the treatment system can be restarted to remove the mobilized hydrocarbons and surfactant. When doing this, typically a poly tank is connected to the system to catch the initial surge of surfactant-impacted water and emulsified product to keep from clogging the groundwater treatment system.
- There were no discussions on the construction details of the proposed wells other than they would be a 4-inch diameter. It is assumed the well construction will be similar to existing wells. The Department approves the installation of MW8R. The Department recommends CRHC consider the installation of one or more of the remaining proposed wells in the parking lot north of Brown Street. Alternatively, CRHC could wait to install the remaining wells south of Brown Street until the Department approves the use of Ivey-sol in that area.
- Over 85,000 gallons of product have moved through the pumping wells and LPH have been measured in many other wells through the history of the case. The Department recommends all monitoring and pumping wells that have historically contained measurable LPH be redeveloped using a small amount of surfactant prior to surfactant injection. This will provide more accurate post treatment gauging

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data. It is important to determine if detected LPH or high dissolved concentrations are coming from the formation or from an oily screen and gravel pack.

If you have any questions, please contact me at 410-537-3499 (email: susan.bull@maryland.gov).

Sincerely,

Handwritten signature of Susan R. Bull in black ink, followed by the word "FOR" in a similar script.

Susan R. Bull, Eastern Region Section Head
Remediation and State-Lead Division
Oil Control Program

SRB/chr

cc: Mayor Margo G. Bailey (Town of Chestertown)
Mr. Bill Ingersoll (Manager-Town of Chestertown)
Mr. John Beskid (Kent County Health Dept.)
Mr. Andrew Bullen (Earth Data, Inc.)
Mr. Dane Bauer (Daft McCune Walker, Inc.)
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