Final Report

Pilot Region-Based Optimization Program for Fund-Lead Sites in EPA Region 3

Site Optimization Tracker: Standard Chlorine of Delaware Superfund Site New Castle County, Pennsylvania

EPA Region III

Solid Waste and
Emergency Response
(5102P)

EPA 542-R-06-006g
December 2006
www.epa.gov

Pilot Region-Based Optimization Program for Fund-Lead Sites in EPA Region 3

Site Optimization Tracker: Standard Chlorine of Delaware Superfund Site New Castle County, Pennsylvania

EPA Region III

Site Optimization Tracker:

Standard Chlorine of Delaware Superfund Site
New Castle County, Delaware

EPA Region III

December 30, 2005

SECTION 1:

CURRENT SITE INFORMATION FORM

Date: 12/30/2005 Filled Out By: GeoTrans, Inc.

A. Site Location, Contact Information, and Site Status

1. Site name	2. Site Location (city and State)	3. EPA Region
Standard Chlorine of Delaware	**New Castle County, DE**	**3**

4a. EPA RPM	5a. State Contact
Mr. Hilary Thornton	**Ms. Lynn Krueger**
4b. EPA RPM Phone Number	5b. State Contact Phone Number
215-814-3323	**302-395-2632**
4c. EPA RPM Email Address	5c. State Contact Email Address
Thornton.hilary@epa.gov	**lynn.krueger@state.de.us**

5. Is the ground water remedy an interim remedy or a final remedy? Interim ☒ Final ☐

6. Is the site EPA lead or State-lead with Fund money? EPA ☒ State ☐

B. General Site Information

1a. Date of Original ROD for Ground Water Remedy	1b. Dates of Other Ground Water Decision Documents (e.g., ESD, ROD Amendment)
3/09/1995	**Final GW ROD Planned for 9/2007**
2a. Date of Projected O&F	2b. Date for Projected Transfer to State
1995 ROD O&F date planned for 9/07	**1995 ROD O&F date planned for 9/07**

3. What is the primary goal of the designed P&T system (select one)?

- ☒ Contaminant plume containment
- ☐ Aquifer restoration
- ☐ Containment and restoration
- ☐ Well-head treatment

4. Check those classes of contaminants that are contaminants of concern at the site.

- ☒ VOCs (e.g., TCE, benzene, etc.)
- ☒ SVOCs (e.g., PAHs, PCP, etc.)
- ☐ metals (e.g., arsenic, chromium, etc.)
- ☐ other

5. Has NAPL or evidence of NAPL been observed at the site? Yes ☒ No ☐

6. What is the designed total pumping rate? **60 gpm with capacity for 78 gpm**

7. How many extraction wells (or trenches) are there based on design? **6**

8. How many monitoring wells are proposed to be regularly sampled? **~10**

9. How many samples are proposed to be collected from monitoring wells or piezometers each year? (e.g., 40 if 10 wells are sampled quarterly) **~40**

10. How many process monitoring samples (e.g., extraction wells, influent, effluent, etc.) are proposed to be collected and analyzed each year? (e.g., 24 if influent and effluent are sampled monthly) **~100**

11. What above-ground treatment processes are proposed (check all that apply)?

- ☒ Air stripping
- ☒ Carbon adsorption (liquid phase only)
- ☐ Filtration
- ☒ Off-gas treatment
- ☐ Ion exchange
- ☒ Metals precipitation
- ☐ Biological treatment
- ☐ UV/Oxidation
- ☐ Reverse osmosis
- ☐ Other

12. What is the anticipated percentage of system downtime per year? 10% ☒ 10 - 20% ☐ >20% ☐

C. Site Costs

1. Projected Annual O&M costs

O&M Category	Projected Annual Costs for System Start-up (e.g., year 1)	Projected Annual Costs for Steady-State Operation (e.g., after year 1)
Labor: project management, reporting, technical support	**Unknown**	**Unknown**
Labor: system operation	**$93,600**	**$93,600**
Labor: ground water sampling	**Unknown**	**Unknown**
Utilities: electricity	**$29,000**	**$29,000**
Utilities: other	**Unknown**	**Unknown**
Consumables (GAC, chemicals, etc.)	**$320,000**	**$160,000**
Discharge or disposal costs	**Unknown**	**Unknown**
Analytical costs	**$24,000**	**$24,000**
Other (parts, routine maintenance, etc.)	**$87,800**	**$87,800**
O&M Total	**>$554,400**	**>$394,400**

The O&M total should be equal to the total O&M costs for the specified fiscal years, including oversight from USACE or another contractor. For costs that do not fit in one of the above cost categories, include them in the "Other" category. If it is not possible to break out the costs into the above categories, use the categories as best as possible and provide notes in the following box.

2. Non-routine or other costs	**Unknown**	**Unknown**

Additional costs beyond routine O&M for the specified fiscal years should be included in the above spaces. Such costs might be associated with additional investigations, non-routine maintenance, additional extraction wells, or other operable units. The total costs billed to the site for the specified fiscal years should be equal to the O&M total plus the costs entered in item 2.

3. Estimated costs for system design and/or construction	**$5.7 million**

Notes on costs:

The design and construction costs are for the barrier wall and the P&T system. The P&T system is scheduled to come online in FY06.

The O&M "start-up" costs provided above refer to the first three years of O&M when pumping will occur at 60 gpm to lower the water table within the area enclosed by the barrier wall.

The "steady-state" O&M costs provided above refer to the years after the first three years when pumping will occur at 30 gpm to maintain a lower water table within the area enclosed by the barrier wall.

D. Five-Year Review

1. Date of the Most Recent Five-Year Review	**N/A**

2. Protectiveness Statement from the Most Recent Five-Year Review

- ☐ Protective
- ☐ Not Protective
- ☐ Protective in the short-term
- ☐ Determination of Protectiveness Deferred

3. Please summarize the primary recommendations in the space below

The first five-year review is planned for 5/15/2009.

E. Other Information

If there is other information about the site that should be provided please indicate that information in the space below. Please consider enforcement activity, community perception, technical problems to be addressed, and/or areas where a third-party perspective may be valuable.

Another aspect of the site that will require remediation is the wetlands. The cost for addressing the wetlands is not included in the above costs for the barrier wall and P&T system. Site team estimates for the wetlands remediation exceed $10 million.

SECTION 2:

FOLLOW-UP HISTORY AND SUMMARIES

Note: Follow-up summaries are provided in reverse chronological order and include updated and/or new recommendations.

FOLLOW-UP HISTORY

Date of Original Optimization Evaluation	February 10, 2005 (Evaluation meeting) August 5, 2005 (Final Report)

	Meeting Date	**Report Date**	**Item**
X	July 13, 2005	August 5, 2005	Follow-Up #1 (conducted as part of pilot project)
X	October 19, 2005	December 30, 2005	Follow-Up #2 (conducted as part of pilot project)
			Follow-Up #3
			Follow-Up #4
			Follow-Up #5
			Follow-Up #6
			Follow-Up #7
			Follow-Up #8

"x" in box indicates the item has been completed

Summary of Follow-up #2

Site or System Name	Standard Chlorine of Delaware Superfund Site
Date of This Follow-Up Summary	December 30, 2005
Date of Follow-Up Meeting or Call (Indicate if Meeting or Call)	October 19, 2005 – Meeting

ROET Members Conducting the Follow-up Evaluation:

Name	Affiliation	Phone	Email
Norm Kulujian	U.S. EPA Region 3	215-814-3130	kulujian.norm@epa.gov
Kathy Davies	U.S. EPA Region 3	215-814-3315	davies.kathy@epa.gov
Kathy Yager	U.S. EPA Region 3	617-918-8362	yager.kathleen@epa.gov
Paul Leonard	U.S. EPA Region 3	215-814-3350	leonard.paul@epa.gov
Peter Rich	GeoTrans, Inc.	410-990-4607	prich@geotransinc.com
Rob Greenwald	GeoTrans, Inc.	732-409-0344	rgreenwald@geotransinc.com
Doug Sutton	GeoTrans, Inc.	732-409-0344	dsutton@geotransinc.com
Steve Chang	U.S. EPA OSRTI	703-603-9017	chang.steven@epa.gov

Site Team Members (Including Contractors) Interviewed

Name	Affiliation	Phone	Email
Hilary Thornton	U.S. EPA Region 3 (RPM)	215-814-3323	thornton.hilary@epa.gov

IMPLEMENTATION STATUS OF ALL RECOMMENDATIONS UNDER CONSIDERATION BUT NOT PREVIOUSLY IMPLEMENTED

Recommendation	**E-2.1 Further Investigate the Presence of Contamination in the Potomac Aquifer**		
Recommendation Reason	Protectiveness	**Implementation Status**	Alternative in progress
Comments: The site team has commissioned the USGS to conduct a study of aquifer properties and aquifer usage in the area. The study is titled "Delaware City Potomac Aquifer Study" and will include surveying water usage in the area, installing of additional monitoring wells, tracking water levels to see if the site is influenced by pumping from production wells, and perhaps redoing a pump test that had been previously conducted. An interagency agreement with the USGS is in place. The workplan and QAPP were completed during summer 2005, and water level instrumentation was also installed in Summer 2005. Water level measurements will begin in Fall 2005, and this phase of the study should be complete in Spring 2006. The budget is $150,000. New monitoring wells in the Potomac are not scoped as part of the study, but are expected to be a follow-up item to the study. The State would like to better understand shallow ground water flow before installing new Potomac monitoring wells to reduce the potential for creating preferential pathways between the Columbia and Potomac aquifers. Additional monitoring wells in the Potomac will likely be installed as a follow-up to the USGS study in Summer 2006.			

Recommendation	**E-2.2 Compare Anticipated Full-Scale Costs of Chemical Oxidation for Downgradient Plume with the Costs of Additional Extraction in the Same Area**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Implemented
Comments: The site team reports that analyses have been done, and the final design includes discussion regarding additional extraction wells in the downgradient area that would be tied to the treatment plant. The final design also discusses the potential for a second wall if DNAPL is found downgradient of the currently planned wall.			

Recommendation	**E-2.3 Reevaluate Costs of Capping Northern Area of Site to Limit Infiltration and Reduce Extraction Rate**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Alternative implemented
Comments: The final design does not include a cap. Further discussion of the cap has been postponed until the remedy is up and running and the site team has a better understanding of the site hydrogeology under pumping conditions.			

Recommendation	**E-2.4 Consider the Potential for On-Site Regeneration of Vapor Phase GAC**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Implemented
Comments: The site team has reviewed the potential application of on-site regeneration of vapor phase GAC and has concluded that the payback period is approximately 5 to 6 years. Given this payback period, the site team is moving forward with the more traditional off-site regeneration of GAC, which has lower capital costs. Room has been left in the treatment plant design to incorporate on-site regeneration at a later date if operating conditions suggest it would be more cost-effective.			

Recommendation	**F1-1 Consider Constructing P&T System Before Constructing Barrier Wall**		
Recommendation Reason	Cost Reduction & Technical Improvement	**Implementation Status**	Implemented
Comments: The site team has considered this recommendation and is planning to move forward with parallel construction of the P&T system and barrier wall. The site team is planning to complete the barrier wall in one mobilization rather than the previously considered two mobilizations. This approach of parallel tracks for the P&T system and the barrier wall addresses the concerns identified by the ROET in its original recommendation.			

Recommendation	**F1-2 Avoid Substantial Investment for DNAPL Recovery**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Implemented
Comments: The site team has considered this recommendation and is moving forward in a manner consistent with the ROET recommendation. Additional efforts will not be focused on looking for and recovering DNAPL. However, the extraction wells will be completed to the clay layer to intercept DNAPL if it is present, and the treatment system will include an oil/water separator to address DNAPL if is present in the extracted water.			

Key for recommendation numbers:

- *E denotes a recommendation from the original optimization evaluation*
- *F1, F2, etc. denote recommendations from the first, second, etc. follow-up meeting*
- *The number corresponds to the number of the recommendation as stated in the optimization evaluation or follow-up summary where the recommendation was provided*

RECOMMENDATIONS PREVIOUSLY IMPLEMENTED OR THAT WILL NOT BE IMPLEMENTED

None.

OTHER CHANGES, UPDATES, OR SIGNIFICANT FINDINGS SINCE LAST FOLLOW-UP

- The final design for the barrier wall and P&T system was completed in Summer 2005 and approved in September 2005. The site team is currently in the contracting phase and is planning to mobilize in Spring/Summer 2006 for construction.

NEW OR UPDATED RECOMMENDATIONS FROM THIS FOLLOW-UP

1. If DNAPL is found downgradient of the planned barrier wall, the ROET encourages the site team to fully consider the limitations of a second, smaller barrier wall if there is no competent aquitard in the area for the wall to be keyed into. The site team might consider initially extracting and treating ground water in this downgradient area and monitoring potential DNAPL migration before considering a barrier wall, trench, or other more active DNAPL remedy.

2. The site team should revisit discussions with the Regional toxicologists and ecologists about wetlands remediation. The proposed remedy using in-situ chemical oxidation would be costly and would likely sterilize/destroy the wetlands, eliminating the primary reason for remediating them. Technical Assistance Item #3 in Appendix A offers considerations regarding potentially more cost-effective options for wetlands remediation.

SUMMARY OF FOLLOW-UP #1

Site or System Name	Standard Chlorine of Delaware Superfund Site
Date of This Follow-Up Summary	August 5, 2005
Date of Follow-Up Meeting or Call (Indicate if Meeting or Call)	July 13, 2005 – Meeting

ROET MEMBERS CONDUCTING THE FOLLOW-UP EVALUATION:

Name	Affiliation	Phone	Email
Norm Kulujian	U.S. EPA Region 3	215-814-3130	kulujian.norm@epa.gov
Peter Schaul	U.S. EPA Region 3	215-814-3183	schaul.peter@epa.gov
Kathy Davies	U.S. EPA Region 3	215-814-3315	davies.kathy@epa.gov
Peter Rich	GeoTrans, Inc.	410-990-4607	prich@geotransinc.com
Rob Greenwald	GeoTrans, Inc.	732-409-0344	rgreenwald@geotransinc.com
Doug Sutton	GeoTrans, Inc.	732-409-0344	dsutton@geotransinc.com
Kathy Yager (by phone)	U.S. EPA OSRTI	617-918-8362	yager.kathy@epamail.epa.gov

SITE TEAM MEMBERS (INCLUDING CONTRACTORS) INTERVIEWED

Name	Affiliation	Phone	Email
Hilary Thornton	U.S. EPA Region 3 (RPM)	215-814-3323	thornton.hilary@epa.gov
Bernice Pasquini	U.S. EPA Region 3 (Hydro)	215-814-3326	pasquini.bernice@epa.gov

IMPLEMENTATION STATUS OF PREVIOUSLY IDENTIFIED RECOMMENDATIONS

Recommendation	**2.1 Further Investigate the Presence of Contamination in the Potomac Aquifer**		
Recommendation Reason	Protectiveness	**Implementation Status**	Alternative in progress
Comments: The site team has commissioned the USGS to conduct a study of aquifer properties and aquifer usage in the area. The study is titled "Delaware City Potomac Aquifer Study" and will include surveying water usage in the area, installing of additional monitoring wells, tracking water levels to see if the site is influenced by pumping from production wells, and perhaps redoing a pump test that had been previously conducted. The study should be conducted within one year. The budget is approximately $150,000. This scope is larger than that suggested by the evaluation team, but the evaluation team agrees that the collection of the additional information would be useful for the site design. The site team will provide the evaluation report to the USGS so that it can consider the recommendations for well placement provided in the optimization evaluation report.			

Recommendation	**2.2 Compare Anticipated Full-Scale Costs of Chemical Oxidation for Downgradient Plume with the Costs of Additional Extraction in the Same Area**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Delayed
Comments: The site team will consider how to address the downgradient contamination as part of the final remedy, and this consideration will depend, in part, on how the concentrations downgradient of the barrier wall enclosure respond to the containment effort. The site team recognizes that chemical oxidation may be costly relative to other remedial approaches for this downgradient location.			

Recommendation	**2.3 Reevaluate Costs of Capping Northern Area of Site to Limit Infiltration and Reduce Extraction Rate**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Delayed
Comments: The site team will consider whether or not to cap the northern area as part of the final remedy, and this consideration will depend, in part, on how well the barrier wall and P&T system are able to cost-effectively provide containment.			

Recommendation	**2.4 Consider the Potential for On-Site Regeneration of Vapor Phase GAC**		
Recommendation Reason	Cost Reduction	**Implementation Status**	Substantial progress
Comments: The site team is considering this recommendation as part of the 95% design, which is expected by the end of July 2005.			

OTHER CHANGES, UPDATES, OR SIGNIFICANT FINDINGS SINCE LAST FOLLOW-UP

- The USGS will be conducting a study of the Potomac aquifer in the vicinity of the site (as discussed in the update to Recommendation 2.1.

- Finalization of the barrier wall and P&T system design is expected by the end of FY05, and contracting for construction of both the P&T system and barrier wall should begin in Fall 2005 (i.e., the beginning of FY06). Construction is anticipated to begin in Spring

2006 and to take approximately 12 months.

- $4.2 million in funding for construction of the barrier wall and P&T system has been allocated to the project. Additional funding (up to $5.7 million total) may be required.

NEW OR UPDATED RECOMMENDATIONS FROM THIS FOLLOW-UP

1. The site team has been planning to install the barrier wall prior to installing the P&T system. The evaluation team suggests that the site team consider construction of the P&T system prior to construction of the barrier wall. Technical Assitance Item #1 in Appendix A provides some ideas related to sequencing for the site team to consider.

2. DNAPL has been recovered at the site previously. The evaluation team suggests avoiding substantial investment in a DNAPL recovery system given the high mass removal that this anticipated from the P&T system, the limited amount of DNAPL that would likely be recovered, the containment that will be offered by the barrier wall and P&T system, and the long time horizon for P&T system operation. The evaluation team provides additional information on this suggestion in Technical Assitance Item #2 in Appendix A.

NEW OR UPDATED RECOMMENDATIONS FROM THIS FOLLOWUP - OTHER

- None.

UPDATED COST SUMMARY TABLE

Recommendation	Reason	Implementation Status	Estimated Capital Costs ($)	Actual Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Actual Change in Annual Costs ($/yr)
Original Optimization Evaluation Recommendations						
2.1 Further Investigate the Presence of Contamination in the Potomac Aquifer	Protectiveness	Alternative in Progress	$75,000	$150,000	$0	$0
2.2 Compare Anticipated Full-Scale Costs of Chemical Oxidation for Downgradient Plume with the Costs of Additional Extraction I the Same Area	Protectiveness	Implemented	$0		$0	
2.3 Reevaluate Costs of Capping Northern Area of Site to Limit Infiltration and Reduce Extraction Rate	Protectiveness	Alternative Implemented	$0		$0	
2.4 Consider the Potential for On-Site Regeneration of Vapor Phase GAC	Protectiveness	Implemented	$0	$0	$0	
New or Updated Recommendations from Follow-up #1, July 13, 2005						
1. Consider constructing P&T system before constructing barrier wall	Cost Reduction & Technical Improvement	Implemented	$0		$0	
2. Avoid substantial investment for DNAPL recovery	Cost Reduction	Implemented	$0		$0	
New or Updated Recommendations from Follow-up #2, October 19, 2005						
1. Consider limitations of a downgradient, smaller barrier wall if there is no competent aquitard in the area	Cost Reduction		$0			
2. Considerations for wetlands remediation	Protectiveness Cost Reduction		$0			

Costs in parentheses imply cost reductions.

APPENDIX: A

ARCHIVE OF TECHNICAL ASSISTANCE PROVIDED BY THE ROET

Note: Technical assistance items are provided in reverse chronological order.

Technical Assistance Item #4
Presented December 30, 2005

Considerations for contracting construction of the barrier wall

Due to the relatively small number of contractors able to provide the construction services for the barrier wall and a desire to complete construction in one mobilization during the upcoming construction season, the ROET has the following ideas to consider for the associated contracting.

One potential option for structuring the request for proposal is to ask contractors to bid on completing 25%, 50%, 75%, or 100% of the wall and providing unit rates under each of those scenarios for completing additional portions of the wall. For the 100% option, the request for proposal could ask for costs associated with committing either one or two rigs to the job. The site team should attempt to obtain at least three competitive bids. The three bids can then be compared and one or more bids could be accepted. The costs for using one contractor with one rig, one contractor with two rigs, and multiple contractors can then be compared. The site team can then weigh the additional costs of some items against the benefits of potentially completing the job faster (because more than one rig is being used) and/or the benefits of redundancy in having multiple rigs in case there are problems with one rig. The bidders should not be constrained to bidding on the whole job. There should be flexibility, allowing them to bid on all scenarios or just some of the scenarios. By providing this flexibility and the number of options, smaller firms might bid on a fraction of the wall that might not have been able to bid on the whole job.

Although this makes for a more complex request for proposal, it provides the site team with more options. In addition, although managing multiple contractors is more complicated than managing a single contractor, the added security of using more than one contractor may outweigh the complications of managing multiple contractors.

Technical Assistance Item #3
Presented December 30, 2005

Considerations for alternative wetland remediation

The site team has indicated that consideration of in-situ chemical oxidation and other aggressive remedies for the impacted wetlands at an approximate cost of well over $10 million. The site team has also indicated, however, that Regional toxicologists are concerned that chemical oxidation or these other remedies will damage the wetlands.

After considering the possibility of excavation or chemical oxidation, which would definitively destroy the wetlands, the toxicologists and ecologists may prefer to leave the contamination in place. This approach would be based on a conclusion that having the current wetlands impacted by contamination is of more value destroying the wetlands as a result of the remediation.

If the above approach is unacceptable from a risk perspective, the site team could consider a containment approach. Rather than undertake aggressive remediation of the wetlands, it would likely be cost-effective to isolate the contaminated wetlands and cover them with an appropriate cap. Although this option would destroy the wetlands, so would any other option that would effectively address the contamination. To mitigate the effect of the lost wetlands from this or any other remedial approach, the site team might be able to replace them with newly constructed wetlands in another location.

It is recommended that the site team consider several remedial options and then discuss the potential for either taking no aggressive action with the wetlands or potentially containing the contamination and reconstructing the wetlands in a new location.

Technical Assistance Item #2
Presented August 5, 2005

Considerations for DNAPL Recovery at the Standard Chlorine of Delaware Superfund Site

The optimization evaluation team understands DNAPL has been recovered as free product from multiple site wells but that the recovery was fairly limited (approximately 10 gallons over several recovery events). The following are considerations for future DNAPL recovery at the site given the current understanding of site conditions and the anticipated performance of the planned P&T/barrier wall remedy.

- As documented in Section 2.4 of the optimization evaluation for this site, the planned P&T system may remove as much as 20,000 pounds of volatile organic compounds per year during the first three years and perhaps 10,000 pounds per year during subsequent years. These mass removal rates translate to approximately 2,200 gallons per year and 1,100 gallons per year of DNAPL recovery during those two time periods, respectively, assuming a specific density equal to that of chlorobenzene (approximately 1.11). The recovery of 10 gallons over several events is small (approximately 1%) by comparison.

- The planned remedy is anticipated to provide containment in both the horizontal and vertical directions, and aquifer restoration is not anticipated to occur in a reasonable time frame. As such, DNAPL recovery efforts, if they are to occur should be cost-effective relative to other mass removal occurring at the site. Given that past recovery efforts have been limited, regular DNAPL recovery events should probably not be scheduled. Rather, DNAPL should likely be collected only when it is observed during routine well gauging events.

- The cost per gallon of contamination removed by the P&T system will be approximately $250 to $500 per gallon assuming an annual O&M cost of $500,000 per year. This range of values ($250 to $500 per gallon of contaminants) can serve as a reasonable standard for determining whether or not additional DNAPL removal efforts are cost effective.

- During the next several monitoring events (e.g., four quarterly events) the site team can observe the presence of DNAPL and estimate the recoverable volume by multiplying the DNAPL thickness by the borehole area. If the site team observes a combined recoverable volume of more than 10 gallons from site wells, the site team could purchase a dedicated total fluids pump to use for future DNAPL recovery. To be cost-effective, the DNAPL recovery events should only occur during the routine monitoring events if sufficient volume (e.g., 10 gallons) of recoverable product is present.

- Due to the containment and mass removal achieved by the P&T system, the optimization evaluation team discourages the installation of additional wells or the design and construction of an automated DNAPL recovery system at this point.

Technical Assistance Item #1
Presented August 5, 2005

Considerations for Sequencing Barrier Wall and P&T System Construction

The optimization evaluation team understands that the site team is currently planning on constructing the barrier wall (with the exception of one small downgradient portion) before constructing the P&T system. The small portion would be left open to prevent water from infiltration from pooling within the barrier wall enclosure and would be constructed in a separate mobilization after the P&T system begins operating. The optimization team believes there are several reasons to change the sequencing so that the P&T system is constructed prior to the barrier wall.

- Neither aspect of the remedy will provide full containment on its own. If the barrier wall is constructed first, contaminated water will still be able to discharge through the planned opening until it is closed after the P&T system comes on line. Similarly, if the P&T system is constructed first, it will provide partial containment, but the extraction rate will not be sufficient to provide full containment, especially in the vertical direction, until the barrier wall is constructed. Therefore, temporary incomplete capture should not be a determining factor in which item should be constructed first.

- A P&T system will typically undergo three to six months of start-up to ensure that the extraction and treatment systems are performing as designed and to correct potential problems that were not anticipated during design. If the P&T system is installed prior to the barrier wall, then the start-up period of three to six months can occur while the site team is constructing the barrier wall. However, if the barrier wall is constructed first (with the exception of the small downgradient portion), then a partially completed barrier wall will need to remain in place while the P&T system is constructed and for several more months while the P&T system is tested. Therefore, with a proper start-up period for the P&T system, the overall remedy should be completed sooner if construction begins with the P&T system. If the P&T system is not properly tested during a start-up period and the barrier wall enclosure is finalized, failures in the P&T system will result in water pooling up inside the barrier wall enclosure.

- The P&T system will yield valuable information about the site hydrogeology. For example, the actual yield of the extraction system might be lower than the design yield. By constructing the P&T system and monitoring it during the start-up period, the site team can determine at an earlier date if additional extraction wells will be needed.

- Constructing the majority of the barrier wall and then the P&T system and then finalizing the barrier wall would require two mobilizations of the barrier wall crew. This would likely be more costly, and there might be delays if the crew is not immediately available for either of these mobilizations.

- By constructing the P&T system first and beginning its operation, the site team will be able to better control water levels within the barrier wall enclosure as the barrier wall is constructed. If there is substantial precipitation and infiltration, barrier wall construction could be disrupted if water levels rise to an unacceptable level, particularly at the downgradient end of planned barrier wall enclosure.

APPENDIX: B

BASELINE SITE INFORMATION SHEET AND OPTIMIZATION EVALUATION REPORT

Streamlined
Optimization Evaluation Report

Standard Chlorine of Delaware Superfund Site
New Castle County, Delaware

EPA Region III

August 5, 2005

SECTION 1:

BASELINE SITE INFORMATION FORM

Date: 8/5/05 Filled Out By: Douglas Sutton (GeoTrans)

A. Site Location, Contact Information, and Site Status

1. Site name	2. Site Location (city and State)	3. EPA Region
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4a. EPA RPM	5a. State Contact
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4b. EPA RPM Phone Number	5b. State Contact Phone Number
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Thornton.hilary@epa.gov	**lynn.krueger@state.de.us**

5. Is the ground water remedy an interim remedy or a final remedy? Interim ☒ Final ☐

6. Is the site EPA lead or State-lead with Fund money? EPA ☒ State ☐

B. General Site Information

1a. Date of Original ROD for Ground Water Remedy	1b. Dates of Other Ground Water Decision Documents (e.g., ESD, ROD Amendment)
3/09/1995	**Final GW ROD Planned for 9/2007**
2a. Date of Projected O&F	2b. Date for Projected Transfer to State
1995 ROD O&F date planned for 9/07	**1995 ROD O&F date planned for 9/07**

3. What is the primary goal of the designed P&T system (select one)?

- ☒ Contaminant plume containment
- ☐ Aquifer restoration
- ☐ Containment and restoration
- ☐ Well-head treatment

4. Check those classes of contaminants that are contaminants of concern at the site.

- ☒ VOCs (e.g., TCE, benzene, etc.)
- ☒ SVOCs (e.g., PAHs, PCP, etc.)
- ☐ metals (e.g., arsenic, chromium, etc.)
- ☐ other

5. Has NAPL or evidence of NAPL been observed at the site? Yes ☒ No ☐

6. What is the designed total pumping rate? **60 gpm with capacity for 78 gpm**

7. How many extraction wells (or trenches) are there based on design? **6**

8. How many monitoring wells are proposed to be regularly sampled? **~10**

9. How many samples are proposed to be collected from monitoring wells or piezometers each year? (e.g., 40 if 10 wells are sampled quarterly) **~40**

10. How many process monitoring samples (e.g., extraction wells, influent, effluent, etc.) are proposed to be collected and analyzed each year? (e.g., 24 if influent and effluent are sampled monthly) **~100**

11. What above-ground treatment processes are proposed (check all that apply)?

- ☒ Air stripping
- ☒ Carbon adsorption (liquid phase only)
- ☐ Filtration
- ☒ Off-gas treatment
- ☐ Ion exchange
- ☒ Metals precipitation
- ☐ Biological treatment
- ☐ UV/Oxidation
- ☐ Reverse osmosis
- ☐ Other

12. What is the anticipated percentage of system downtime per year? 10% ☒ 10 - 20% ☐ >20% ☐

C. Site Costs

1. Projected Annual O&M costs

O&M Category	Projected Annual Costs for System Start-up (e.g., year 1)	Projected Annual Costs for Steady-State Operation (e.g., after year 1)
Labor: project management, reporting, technical support	**Unknown**	**Unknown**
Labor: system operation	**$93,600**	**$93,600**
Labor: ground water sampling	**Unknown**	**Unknown**
Utilities: electricity	**$29,000**	**$29,000**
Utilities: other	**Unknown**	**Unknown**
Consumables (GAC, chemicals, etc.)	**$320,000**	**$160,000**
Discharge or disposal costs	**Unknown**	**Unknown**
Analytical costs	**$24,000**	**$24,000**
Other (parts, routine maintenance, etc.)	**$87,800**	**$87,800**
O&M Total	**>$554,400**	**>$394,400**

The O&M total should be equal to the total O&M costs for the specified fiscal years, including oversight from USACE or another contractor. For costs that do not fit in one of the above cost categories, include them in the "Other" category. If it is not possible to break out the costs into the above categories, use the categories as best as possible and provide notes in the following box.

2. Non-routine or other costs	**Unknown**	**Unknown**

Additional costs beyond routine O&M for the specified fiscal years should be included in the above spaces. Such costs might be associated with additional investigations, non-routine maintenance, additional extraction wells, or other operable units. The total costs billed to the site for the specified fiscal years should be equal to the O&M total plus the costs entered in item 2.

3. Estimated costs for system design and/or construction	**$5.7 million**

Notes on costs:

The design and construction costs are for the barrier wall and the P&T system. The P&T system is scheduled to come online in FY06.

The O&M "start-up" costs provided above refer to the first three years of O&M when pumping will occur at 60 gpm to lower the water table within the area enclosed by the barrier wall.

The "steady-state" O&M costs provided above refer to the years after the first three years when pumping will occur at 30 gpm to maintain a lower water table within the area enclosed by the barrier wall.

D. Five-Year Review

1. Date of the Most Recent Five-Year Review	**N/A**

2. Protectiveness Statement from the Most Recent Five-Year Review

- [ ] Protective
- [ ] Not Protective
- [ ] Protective in the short-term
- [ ] Determination of Protectiveness Deferred

3. Please summarize the primary recommendations in the space below

The first five-year review is planned for 5/15/2009.

E. Other Information

If there is other information about the site that should be provided please indicate that information in the space below. Please consider enforcement activity, community perception, technical problems to be addressed, and/or areas where a third-party perspective may be valuable.

SECTION 2:

STREAMLINED OPTIMIZATION EVALUATION FINDINGS AND RECOMMENDATIONS

Standard Chlorine of Delaware Superfund Site

Date of Evaluation Meeting: February 10, 2005 Date of Final Report: August 5, 2005

ROET MEMBERS CONDUCTING THE STREAMLINED OPTIMIZATION EVALUATION:

Name	Affiliation	Phone	Email
Peter Ludzia	U.S. EPA Region 3 (Section Chief)	215-814-3190	ludzia.peter@epa.gov
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SITE TEAM MEMBERS (INCLUDING CONTRACTORS) INTERVIEWED

Name	Affiliation	Phone	Email
Hilary Thornton	U.S. EPA Region 3 (RPM)	215-814-3323	thornton.hilary@epa.gov
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Bob Asreen (by phone)	Delaware DNREC		
Chris Wolfe	Black and Veatch		
Gary Snyder	Black and Veatch		

1.0 SIGNIFICANT FINDINGS BEYOND THOSE REPORTED ON SITE INFORMATION FORM

- The Standard Chlorine of Delaware (SCD) facility began operation in 1965 and generated chlorinated benzene compounds by combining chlorine and benzene from neighboring facilities. The original owner went bankrupt in 1998. The facility continued to operate through 2002 when the second owner went bankrupt. A pump and treat (P&T) system was operated by the owners from September 1986 through December 2001. Although the system removed over 1,000 pounds of contaminants per month during operation between 1998 and 2001 (based on a quarterly monitoring report submitted by the facility in January 2002), system operation was discontinued because it was ineffective at containing the contaminant plume.

- The site team is currently at the 60% design stage for the interim ground water remedy, which includes the following elements:

    - Institutional controls in the form of deed restrictions to limit the use of contaminated ground water

    - Installation of a fully encircling slurry wall (barrier wall)

    - Extraction and treatment of ground water in the shallow aquifer within the slurry wall to maintain hydraulic control of the contamination

    - The use of chemical oxidation or additional pumping to address contamination that would remain outside of the barrier wall

    - Associated performance monitoring

  Although the 1995 ROD and the 2004 ROD Amendment discuss a remedy for remaining contamination in above-ground storage tanks and for contaminated soils and sediments, this optimization evaluation focuses on the interim ground water remedy and potential considerations for the final ground water remedy. The primary reason for this focus on ground water is because the site team has prepared the 60% design for the ground water remedy and is specifically requesting feedback on this aspect of the site remedy.

- The barrier wall as designed would be approximately 5,500 feet long, 2 to 4 feet thick, approximately 70 feet deep, and in most locations will be keyed into a clay layer. The anticipated permeability will be 10^{-7} cm/sec, and the anticipated effective life will be at least 30 years. Because of constructability issues, the barrier wall, as designed, does not extend to the shore of Red Lion Creek. Rather, the downgradient portion of the wall will be approximately 700 feet upgradient of the creek, leaving approximately 6 to 7 acres of contaminated soil and ground water between the downgradient portion of the barrier wall and the creek. The estimated cost for the installation of the barrier wall is approximately $3.5 million to $4 million, which is 60% to 70% of the interim ground water remedy capital costs.

- A pilot test of in-situ chemical oxidation is being considered for the ground water contamination outside of the barrier wall (based on results of planned in-situ chemical oxidation study for wetland soils). Based on this pilot test, the site team will determine if in-situ chemical oxidation is a cost-effective means of addressing this contamination. If it is not, the site team will likely install additional extraction wells to extract and treat this contamination. As noted in the previous bullet, the area to be treated would be approximately 6 to 7 acres.

- The site team provides two primary reasons for including a fully-encircling barrier wall in the ground water remedy:

  - By encircling the majority of the contamination, the amount of pumping that is required is reduced from approximately 210 gpm (with a downgradient-only barrier wall) to 60 gpm to maintain hydraulic capture. The reduced pumping should reduce the future operating costs for the P&T system.

  - By encircling the contamination and pumping within the area enclosed by the wall, the water level within the wall could be reduced such that an upward gradient between the shallow (Columbia) aquifer and deeper (Potomac) aquifer is established. This upward gradient should limit or eliminate further downward contaminant migration to the Potomac Aquifer, which is used for drinking water.

- The proposed P&T system consists of the following components:

  - 6 extraction wells (6 inches in diameter) installed to depth of approximately 70 feet below ground surface (bgs) and constructed of 316 stainless steel. The extraction system will be designed to extract up to 78 gpm (the estimated 60 gpm that is needed for maintaining an upward gradient between the Columbia and Potomac Aquifers plus a 30% design contingency).

  - 5,000-gallon influent holding tank to blend extracted water and allow recovered DNAPL (if any) to settle out of the process water

  - Filtration system consisting of two 25-micron bag filters in parallel followed by two 10-micron bags in parallel

  - A low-profile air stripper with four trays

  - Two 5,000-pound vapor phase granular activated carbon (GAC) units to treat the air stripper offgas

  - A secondary filtration system consisting of two 10-micron bag filters in parallel

  - Two 2,500-pound liquid phase GAC units to serve as a polishing step for the air stripper

- pH adjustment through the addition of sodium hydroxide and oxidation through potassium permanganate addition
- Metals removal with a green sand filter
- Potential use of ion exchange to remove copper and zinc if required to meet discharge standard
- Discharge of treated water to Red Lion Creek or a conveyance that discharges to Red Lion Creek

- The following table provides the reported influent design criteria for select compounds based on the most recent Remedial Investigation ground water sampling along with potentially applicable discharge standards.

Compound	Average Influent Concentration (ug/L)	Maximum Influent Concentration (ug/L)	Potential Average Discharge Limit* (ug/L)
Benzene	9,890	70,000	57
Chlorobenzene	29,598	110,000	142
Dichlorobenzene isomers	31,349	85,200	142**
Trichlorobenzene isomers	4,726	21,519	196**
Tetrachlorobenzene isomers	290	1,170	N/A
Nitrobenzene	374	1,300	2,237
Aluminum	11,078.8	71,400	N/A
Calcium	27,574.8	70,900	N/A
Iron	21,951.7	60,100	2,000
Manganese	10,040.4	25,100	N/A
Copper			1.2***
Zinc			95

** These standards are based on the NPDES permit previously maintained by the facility in 1998 assuming a discharge rate of approximately 460 gpm. The actual standards for the proposed P&T system may differ.*
*** Listed standards are for 1,4-Dichlorobenzene and 1,2,4-Trichlorobenzene*
**** An interim average copper standard of 300 ug/L applied for the first 37 months of operation. The provided standard was the "final" standard.*

Data from the previously operated P&T system at the site provides an indication of the contaminant concentrations under pumping conditions. In general, the influent concentrations decreased by a factor of two to three at each of the previous recovery wells over a two-year period; however, those extraction wells were located downgradient from where treated water was reinfiltrated to the subsurface. A comparison of the design average influent concentration with the contaminant concentrations from monitoring wells and previous recovery wells that are located near the proposed recovery well locations indicates that the design average influent concentration is a reasonable approximation of the expected influent.

- The site is underlain by the Columbia Aquifer, which consist of medium to coarse grained sand with varying amounts of gravel. The aquifer is 70 to 100 feet thick and has interspersed lenses of clay or clayey silt. Ground water in the Columbia Aquifer flows north toward Red Lion Creek. The average hydraulic gradient is 0.005 feet per foot, and the hydraulic conductivity is estimated to range from 5 to 134 feet per day or higher.

- The Columbia Aquifer is underlain in some areas by the Merchantville Formation, which consists of generally silty clay and likely serves as a confining layer. In other portions, the Columbia Aquifer is underlain by the clays and silts of the Upper Potomac Aquifer. Recent monitoring in the Potomac Aquifer indicates the presence of site-related contamination, which suggests that the silts and clays do not isolate the water-bearing portions of the Potomac Aquifer from the contamination in the Columbia Aquifer. The Potomac Aquifer flows to the southeast and is used for drinking water. The site team is aware of residential wells approximately 0.75 miles to one mile north and west of the site (upgradient in the Potomac Aquifer) and public wells approximately three miles southeast of the site (downgradient in the Potomac Aquifer). Other supply wells for nearby industries are also completed in the deeper portion of the Potomac Aquifer and are located one to two miles south of the SCD facility.

- Site contaminants generally include benzene, chlorobenzene, dichlorobenzenes, and trichlorobenzenes. The total concentration of all contaminants of concern is as high as 345,000 ug/L at MW-20 and exceeds 50,000 ug/L in at least 15 other monitoring wells. The concentrations are indicative of DNAPL, and DNAPL has been observed as free product in several site wells, including RW-2, RW-5, TW-5, TW-28, TW-30, and MW-28. A few gallons have been pumped from some of these wells intermittently, but EPA has not located a large continuous “pool” of recoverable DNAPL. The proposed barrier wall encircles most of the area with elevated concentrations; however, some of the highest concentrations on site have been detected in monitoring wells between the proposed barrier wall and Red Lion Creek. At least nine of the site monitoring wells with high levels of contamination (including MW-20, which has in excess of 300,000 ug/L of site-related contaminants) would be located downgradient of the proposed wall enclosure. In addition, site-related contamination has been detected in the Potomac Aquifer (e.g., 35 ug/L of benzene and 29 ug/L of chlorobenzene at PW-01).

2.0 CONSIDERATIONS FOR THE GROUND WATER REMEDY AND DESIGN

Because this site is in the design phase and does not have an operating remedy, this evaluation is focused on providing suggestions for the site team to consider during design and remedy implementation. The suggestions are geared toward designing and implementing a protective and cost effective remedy, but because many of the suggestions are provided for both protectiveness and cost-effectiveness reasons, the suggestions have not been divided into the traditional four optimization evaluation categories of improving effectiveness, reducing cost, improving technical operations, and gaining site closure.

2.1 FURTHER INVESTIGATE THE PRESENCE OF CONTAMINATION IN THE POTOMAC AQUIFER

A downward gradient is present between the Columbia and Potomac Aquifers at monitoring well clusters MW-15/PW-1 and C-31/PW-2. In addition, site-related contamination has been identified at PW-1. The site team is planning to investigate the impacts in the Potomac Aquifer. This investigation should occur before plans for the ground water remedy design are finalized. The optimization evaluation team provides the following for the site team to consider when planning the investigation.

- The investigation should limit the number of borings through the most contaminated area of the aquifer. New, deep aquifer monitoring wells should therefore be installed outside of the known Columbia Aquifer plume.

- Based on areal photographs, the area to the east of the site (the downgradient side in the Potomac Aquifer) is wooded and accessibility might be limited in places.

- MW-11 and MW-12, which are both Potomac Aquifer wells and located downgradient of the site (MW-11 to the south and MW-12 to the east), have undetectable concentrations of site-related contamination. These wells should serve as the outer bounds of additional Potomac Aquifer investigation. Furthermore, the gradient between the Columbia and Potomac Aquifers is upward closer to the creek (e.g., near the OR-6 cluster). The upward gradient in this area and the ground water flow to the southeast in the Potomac Aquifer makes it unlikely that contamination will be able to migrate to the Potomac Aquifer and then impact it north of MW-12.

Based on these considerations, the optimization evaluation team would recommend the installation of the following three new monitoring wells installed in the upper 50 feet of the Potomac Aquifer:

- Midway (horizontally) between MW-11 and PW-2

- Co-located with MW-17

- Downgradient of PW-1 (i.e., the proposed location of PW-3)

Installation and sampling of these wells could likely be accomplished for approximately $75,000, including documenting the results and determining the need for further investigation.

2.2 Compare Anticipated Full-Scale Costs of Chemical Oxidation for Downgradient Plume with the Costs of Additional Extraction in the Same Area

The proposed barrier wall would likely enclose much of the site-related contamination; however, a 6 to 7 acre area of contamination (some of the highest concentrations on site) would remain outside of the wall, outside of the influence of ground water extraction, and adjacent to Red Lion Creek. The site team stated that they would consider the use of in-situ chemical oxidation for this area.

Based on an estimated 25-foot radius of influence, approximately 140 injection points would be required, and based on the elevated concentrations and the potential for residual NAPL, multiple injections would be required. Given these parameters, the optimization evaluation team estimates that the use of in-situ oxidation may require approximately $2 million to design, test, apply, and evaluate. Furthermore, the application of in-situ chemical oxidation could not guarantee that concentrations would be low enough to avoid future ground water extraction and treatment in this area. Given the uncertainty associated with this remedial approach and the cost, it is recommended that the site team compare anticipated full-scale chemical oxidation costs with the cost of pumping in this location. If the site contractor’s expected full-scale costs (which may be different than the $2 million mentioned in this report) are substantially higher than the costs of additional pumping in this location, then the site team may decide against piloting or further considering chemical oxidation for this downgradient area.

2.3 Reevaluate Costs of Capping Northern Area of Site to Limit Infiltration and Reduce Extraction Rate

The site team is considering potentially capping the northern area of the site to limit infiltration and reduce the amount of water that would be extracted from within the barrier wall enclosure. The cost of capping this area should be compared with the estimated savings from treating the reduced amount of extracted water. Therefore, the decision to cap the northern portion of the site should likely be delayed until the P&T system has been operated for a few years and a more accurate estimate of the cost savings from reduced pumping can be determined. Capping could actually be counterproductive to eventual cleanup of the site due to the lack of flushing and the inability of aerobic water to infiltrate through the capped area. The cap provides no extra protectiveness if hydraulic containment is maintained and the site is secure.

2.4 Consider the Potential for On-Site Regeneration of Vapor Phase GAC

The O&M costs include an estimated cost of $140,000 per year for the vapor phase GAC that would be used to treat the air stripper off-gas. This estimate is consistent with GAC usage and unit costs estimated by the evaluation team. With an extraction rate of 60 gpm and a total VOC influent of approximately 75,000 ug/L (based on reported estimated average influent concentrations), the mass loading to the air stripper will be approximately 20,000 pounds of VOCs per year. Based on air stripper modeling for Northeast Environmental Products (NEEP) tray aerators, the offgas concentration would likely be on the order of 100 ppmv. The estimated GAC usage for benzene and related compounds at this concentration is approximately 4 pounds of GAC per pound of contaminant. Therefore, the estimated GAC usage may be as high as 80,000 pounds per year. At a cost of approximately $1.75 per pound, this would translate to costs of approximately $140,000 per year for vapor phase GAC.

Although influent concentrations may decrease over time, the decrease is likely to be quite small due to the presence of NAPL and the limited amount of clean water entering the area enclosed by the barrier wall. Also, although the site team anticipates reducing the extraction rate to 30 gpm after a few years of operation, the required extraction rate may be higher than expected due to minor inconsistencies in the barrier wall construction or higher than expected water from the underlying Potomac Aquifer. Any pumping from contaminated areas outside of the barrier wall would also increase the overall mass loading and therefore the vapor phase GAC usage.

Based on the above information, it appears that the vapor phase GAC costs may be higher than expected, and it may be more cost-effective to regenerate the vapor phase GAC on site. The Savage Municipal Well Fund-lead site uses on-site vapor phase GAC regeneration, and this approach may also work for the Standard Chlorine of Delaware site. The system would require operation and maintenance of a boiler to generate steam for the GAC regeneration. The recovered product would be stored and later disposed of offsite at an appropriate facility.

It is recommended that the site team investigate the cost-benefit of on-site vapor phase GAC regeneration. Savings would be realized from eliminating an estimated $140,000 in GAC replacements, but costs would be incurred for purchasing the regeneration system, operating and maintaining the boiler (which may be high if additional labor is required), and disposing of the recovered contamination. If preliminary cost estimates done during design do not suggest substantial savings, it may be most appropriate to proceed with off-site regeneration and re-evaluate GAC usage during actual P&T operation before investing in an on-site regeneration system.

Cost Summary Table

Recommendation	Estimated Capital Cost
2.1 Further Investigate the Presence of Contamination in the Potomac Aquifer	$75,000
2.2 Compare Anticipated Full-Scale Costs of Chemical Oxidation for Downgradient Plume with the Costs of Additional Extraction in the Same Area	$0
2.3 Reevaluate Costs of Capping Northern Area of Site to Limit Infiltration and Reduce Extraction Rate	$0
2.4 Consider the Potential for On-Site Regeneration of Vapor Phase GAC	$0