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Pilot Project to Optimize Ground Water Remediation Systems at RCRA Corrective Action Facilities: Summary Report and Lessons Learned

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NOTICE AND DISCLAIMER

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PREFACE

This report was prepared as part of a pilot project conducted by the United States Environmental Protection Agency (U.S. EPA) Office of Solid Waste (OSW) and the Office of Superfund Remediation and Technology Innovation (OSRTI). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump and treat systems under the Resource Conservation and Recovery Act. The following organizations are implementing this project.

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EXECUTIVE SUMMARY

Based on previous success with conducting independent optimization evaluations at Fund-lead pump and treat sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States), the EPA Office of Superfund Remediation and Technology Innovation (OSRTI) and the Office of Solid Waste (OSW) commissioned a study to pilot similar evaluations at facilities subject to corrective action under the Resource Conservation and Recovery Act (RCRA). During 2003 and 2004, independent evaluations were performed at five RCRA facilities by an independent EPA contractor. The Remediation System Evaluation (RSE) process developed by the U.S. Army Corps of Engineers was used. For each of the five sites, the RSE process included a review of site documents, a site tour to interview site stakeholders, and preparation of an RSE report. The RSE reports provided site background, summarized the findings from the site visit, and provided recommendations in the following categories:

- recommendations to improve system effectiveness in protecting human health and the environment
- recommendations to reduce life-cycle operation and maintenance (O&M) costs
- recommendations for technical improvement
- recommendations to improve the likelihood of site closure

The five sites that received RSEs were selected by the EPA OSRTI and OSW based on nominations provided by EPA project managers. The sites had a number of similarities, including the following:

- the primary contaminants of concern at all five sites were chlorinated solvents, such as TCE
- three of the five sites also had inorganic contaminants to address
- all five sites have either dense non-aqueous phase liquid (DNAPL) or indications that DNAPL may be present
- four of the five sites involve contamination that is present in fractured rock
- only one of the five sites had met both Environmental Indicators [1]

The annual costs for operating the systems ranged from approximately $60,000 to $1.1 million per year.

The RSE team was able to provide recommendations for each of the five sites. Recommendations for technical improvement and for improving effectiveness in protecting human health and the environment were provided at all five sites. Recommendations for reducing costs and gaining site close out were provided at four of the five sites.

Typical recommendations for improving effectiveness pertained to plume delineation, plume capture, or evaluating potential receptors. Typical recommendations for reducing costs generally included modifying the monitoring program and replacing a treatment component with a more efficient technology. If the cost reduction recommendations are implemented at all of the sites, the RSE team estimates that approximately $300,000 per year might be saved. Technical improvement recommendations varied by site, but at two of the sites, the RSE team recommended either instituting or enhancing routine performance reporting. With respect to gaining site close out, recommendations included developing a site exit strategy to serve as a guide for the duration of the remedy and enhancing remediation in the

[1] Current Human Exposures Under Control and Migration of Contaminated Ground Water Under Control (see http://www.epa.gov/superfund/accomp/ei/ei.htm for more information)

source area. In the case of enhancing source area remediation in a cost-effective manner, the RSE team recommended installing an additional extraction well and linking that well to the existing treatment system. Alternative remedial technologies, however, were also discussed.

Approximately one year after the RSE site visit, the stakeholders for each site were contacted by the RSE team to obtain feedback on the RSE process. All respondents found the RSE process beneficial and were impressed by the RSE team's ability to quickly grasp the nuances of each site and to provide meaningful feedback in the form of recommendations. At one site, the site team is moving forward with all of the recommendations. At another site, the RSE team confirmed that site team's current approach and the majority of recommendations are being implemented because they were consistent with already-planned activities. At the other sites, the RSE recommendations have not yet been implemented. In general, the facilities are proponents of remedy optimization. All of the facility representatives suggested that they would employ third-party evaluations at other sites in the future, but the following limitations were mentioned by one or more of the facility representatives:

- To receive an independent evaluation, a site should have sufficient complexity to merit the time and cost of the evaluation.

- Independent evaluations are best conducted internal to a facility's organization because it gives them control over how the report will be used.

- Independent evaluations may not be appropriate at sites where a remedy is operating with seemingly few problems; rather, the evaluations should be used at sites where there is disagreement between parties or there are known problems that are yet to be addressed.

Based on the results of the RSEs and the feedback from the stakeholders, the RSE process is beneficial at RCRA facilities. Because sites vary in complexity, it would be helpful to develop a streamlined evaluation process (an "RSE-lite") that could accomplish a beneficial evaluation with a reduced scope of work and reduced cost. In addition, the facilities should play a key role in selecting sites to receive evaluations because the facilities are ultimately the parties that are responsible for implementing the recommendations. Application of independent evaluations, such as RSEs or RSE-lites, could be helpful for the following types of sites:

- sites where a remedy has stagnated or has not performed to expectations and additional measures are required

- sites where there is disagreement between the regulator and the facility with regard to a remedial approach

- sites where the facility is proposing a new or modified remedial approach and both the regulator and the facility see benefit in an independent analysis

- sites where a third party could help determine an appropriate level of financial assurance

- sites that will be transferred to a State or another party due to bankruptcy settlements

- sites where efficiencies and performance could be enhanced with respect to optimizing monitoring, extraction, treatment, etc.

- sites where the facility is interested in cost savings and other benefits by applying optimization while maintaining remedy effectiveness

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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

During fiscal years 2000, 2001, and 2002, Remediation System Evaluations (RSEs) were conducted at 24 Fund-lead pump and treat (P&T) sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, the EPA Office of Superfund Remediation and Technology Innovation (OSRTI) and the Office of Solid Waste (OSW) commissioned a study to pilot RSEs at RCRA facilities with operating P&T systems. Starting in January 2003, RSEs at up to five RCRA sites were conducted to evaluate the effectiveness of the RSE process as an optimization tool for this class of sites. An independent contractor conducted these evaluations, and representatives from EPA OSW and OSRTI attended the RSEs as observers.

For more information regarding this project, including the individual RSE reports, please visit

www.cluin.org/optimization

1.2 THE RSE PROCESS

The Remediation System Evaluation (RSE) process was developed by the U.S. Army Corps of Engineers (USACE) and is documented on the following website:

http://www.environmental.usace.army.mil/library/guide/rsechk/rsechk.html

The RSE process is a comprehensive, independent expert evaluation of an operating remediation system. For a P&T system, the RSE team includes one or more senior process engineers and one or more senior hydrogeologists working with the site team (i.e., the site regulator, facility representative, and site contractor). The RSE team evaluates the following items:

- system goals
- site conceptual model
- extraction network
- above-ground treatment system
- ground water and treatment process monitoring
- system effectiveness with respect to protection of human health and the environment
- data management
- costs

The RSE process includes scheduling a site visit, reviewing site data, visiting the site for one to two days, submitting a draft report for review by the site managers, and finalizing that report considering the comments from the review. The RSE site visit generally needs to be scheduled a month in advance to allow for transfer of key site documents to the RSE team for their review prior to the site visit. Once the site visit is conducted, the draft RSE report is generally submitted in approximately 45 days. The time frame for finalizing the RSE report depends heavily on the time taken for the site managers to review the draft report and send comments to the RSE team. The typical cost for an RSE is about $25,000.

During the site visit the RSE team tours the facility and surrounding area and interviews the site team. The RSE report documents the findings and presents recommendations to improve the remedy. The recommendations typically fall into the following categories:

- recommendations to improve system effectiveness and efficiency in protecting human health and the environment
- recommendations to reduce life-cycle operation and maintenance (O&M) costs
- recommendations for technical improvement
- recommendations to improve the likelihood of site closure

The recommendations obviously have the benefit of the operational data unavailable to the original designers; therefore, a RSE is viewed as a team effort between the site managers and the RSE team rather than a site audit.

1.3 THE RSE REPORT

The detailed RSE report for each site contains the following sections:

- an introduction that details the purpose of the visit, the RSE team, the documents reviewed, persons contacted, site location, history, hydrogeology, etc.

- a description of the remediation system including the extraction and treatment systems

- system objectives, plus performance and closure criteria

- findings and observations from the RSE site visit including system and component performance, recurring problems, capture zone evaluation, and contaminant delineation

- evaluation of the system effectiveness with respect to protection of human health and the environment for ground water, surface water, air, and soils

- recommendations intended to

    < enhance remedy effectiveness and efficiency with respect to preventing plume migration and monitoring other exposure pathways
    < reduce life-cycle O&M costs
    < improve technical operations
    < gain site closeout

- a table summarizing the recommendations, including estimated capital costs and estimated annual cost increases or decreases associated with each recommendation

The cost estimates provided in the RSE reports have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30/+50%). The observations and recommendations presented in the RSE reports are not intended to imply a deficiency in the work of either the designers, operators, or site managers. They are offered as constructive suggestions that have the benefit of an independent review of operational data that was unavailable to the original designers. In general, system improvements are merited because site conditions and/or available technologies may have changed since design and installation of the P&T systems.

1.4 SITE SELECTION PROCESS

EPA OSW and OSRTI selected the five sites to receive RSEs by soliciting nominations from the 10 EPA Regions. In nominating sites, the Regions provided site-specific information with the understanding that OSW and OSRTI would select sites based on the following criteria.

- facilities that are on the corrective action GRPA baseline (http://www.epa.gov/epaoswer/hazwaste/ca/facility.htm#RCRA Cleanup Baseline)
- facilities with significant uncertainty with respect to whether the existing ground water remedy is sufficient to meet the Migration of Contaminated Groundwater Under Control environmental indicator (i.e., whether existing plumes of contaminated ground water are getting larger or adversely affecting surface water bodies)
- facilities with uncertainty with respect to whether the existing ground water remedy is sufficient to meet the Current Human Exposures Under Control environmental indicator (i.e., whether there is a significant potential for existing unacceptable exposures to contaminants in or from ground water)
- facilities located on highly valued ground water resources (e.g., sole source aquifers, nearby public or private uses of ground water as drinking water)
- facilities where a ground water remedy has been operating for at least one year
- facilities that are not making expected progress toward cleanup goals
- facilities where EPA project managers (PMs) would agree to provide copies of RSE reports (i.e., findings and recommendations) to all interested parties (e.g., facility owners/operators, State representatives, and EPA management)
- facilities where EPA project managers require technical assistance in reviewing a technical proposal put forth by the owners/operators of RCRA facilities to modify an existing ground water remedy
- facilities where the facility and the overseeing regulatory agency have a history of relatively good communication, the facility is willing to provide access to the RSE team, and the facility and/or the overseeing regulator is willing to provide copies of relevant reports and data.

In addition to the above selection criteria, facilities will not be considered if there is a conflict of interest for the RSE team.

Sites were selected from different Regions so that the RSE process could be introduced to multiple Regions.

1.5 EVALUATED SITES AND SCHEDULE

The five RCRA sites that were evaluated are listed in the following table along with the dates of various milestones in the RSE process.

Site Name and Location	EPA Region	Date of RSE Site Visit	Date Draft RSE Report was Submitted	Date Final RSE Report was Submitted
Risdon Manufacturing Corporation Danbury, CT	1	1/15/2003	2/28/2003	4/11/2003
Former Honeywell Facility Fort Washington, PA	3	1/30/2003	3/14/2003	9/4/2003
Delphi Corporation Vandalia, OH	5	3/6/2003	4/16/2003	6/10/2003
Eliskim Facility Anderson County, SC	4	4/29/2003	6/13/2003	6/7/2004
Former Occidental Facility Tacoma, Washington	10	7/8/2003	8/20/2003	7/27/2004

The following are brief descriptions of each of the evaluated sites. RSE findings and recommendations are discussed in the Section 2.0 of this report.

Risdon Manufacturing Corporation - Danbury, Connecticut

The Risdon Manufacturing Corporation facility is located in Danbury, Connecticut at the intersection of Old Newtown Road and Newtown Road and manufactures cosmetic containers. On-site practices historically included electroplating, chromating, acid/solvent stripping, degreasing, buffing, polishing, lacquering, hot stamping, silk screening, and assembly. The facility began operation in 1956. Some of these practices still continue, but a number of facility modifications have been implemented. Historical manufacturing activities have led to chlorinated hydrocarbon contamination of ground water, soil, and soil vapor as well as inorganics contamination of the soil and ground water. The contamination extends off site, and source area concentrations (30,000 ug/L of TCE) are indicative of NAPL.

At the time of the RSE, two separate P&T systems and one soil vapor extraction (SVE) system were operating at the facility. Off-site ground water and soil vapor contamination are present. The primary potential receptors include residences and commercial buildings potentially susceptible to contaminant vapors and surface water within 500 feet of known site-related contamination.

Former Honeywell Facility - Fort Washington, Pennsylvania

The former Honeywell facility is located at 1100 Virginia Drive in Upper Dublin Township, Montgomery County, Pennsylvania in the Fort Washington Industrial Park. The property is approximately 67 acres. The facility was built in 1964, and at the time, was the largest manufacturing facility east of the Mississippi River. The facility was primarily used for the manufacturing of electronic controls and mechanical valve assemblies. In 1986, Honeywell sold the property but continues to lease office space. A portion of the main building (approximately 103,000 square feet) is also used by the DeVry University. Soil sampling related to a tank excavation in 1986 provided the first documented presence of subsurface contamination. Further investigations revealed ground water concentrations of trichloroethene (TCE) exceeding 10,000 ug/L. The final remedy consists of a pump and treat (P&T) system, which has operated since 1997. The primary potential receptors include indoor air in the main building, residences that use ground water to the north of the property, and Pine Run Creek, which flows along the southern boundary of the site.

Delphi Corporation - Vandalia, Ohio

The Delphi facility evaluated by the RSE team includes the Energy and Chassis Systems plant located at 480 North Dixie Highway and the Safety and Interior Systems Plant located at 250 Northwoods Boulevard, both in Vandalia, Ohio. The facility occupies approximately 136 acres on two tracts of land, with industrial activities occurring on the 82-acre southern tract. The 54-acre northern tract is partially developed for railways but is otherwise undeveloped. The facility is located in a mixed industrial, residential, commercial, and agricultural area. Dense non-aqueous phase liquids (DNAPL) and volatile organic compound (VOC) contamination of soil and ground water have resulted in three primary interim measures:

- ground water migration control with a pump and treat system
- DNAPL recovery
- survey of ground water use in the area and connections to public water supplies

At the time of the RSE, the RCRA Facility Investigation was underway. Completion was expected by the end of 2003, and final remedial measures will be taken accordingly. Potential receptors include private supply wells at residences, an Unnamed Tributary to North Creek, the Great Miami River, and potential areas for vapor intrusion.

Eliskim Facility - Anderson County, South Carolina

The Eliskim site is a closed hazardous waste management facility located approximately one mile south of Anderson, South Carolina. The original facility consisted of approximately five acres of property used as an impoundment area (ponds and lagoons) for hazardous waste management associated with a plant originally owned by True Temper that was located on an adjoining parcel. An additional 20 acres east of the Impoundment Area was purchased as part of the ground water remediation. A P&T system became operational October 31, 1997. Contaminated ground water is extracted from a ground water collection trench near the toe of the plume and from a single well in the source area. The extracted water is treated with an air stripper and then discharged to surface water. The South Carolina Department of Health and Environmental Control (DHEC) is operating the remedy with funds from a performance surety bond that was set aside when the Eliskim facility filed for bankruptcy.

The dominant contaminant of concern is TCE. Ground water TCE concentrations in 1989 were over 10,000 ug/L in the source area, which is indicative of NAPL. These concentrations have since declined, but remain above 1,000 ug/L in the source area.

Former Occidental Facility - Tacoma, Washington

The former Occidental Chemical Corporation (OCC) property is approximately 37 acres in extent and is located at 605 Alexander Avenue in Tacoma, Washington. Between 1947 and 1973, OCC operated a chlorinated solvents plant and transferred the site to Pioneer Americas, Inc. in 1997. In addition, a portion of the site was also leased to the Navy in the 1940s and 1950s as part of their ship building and dismantling operations. The facility is currently used as a terminal for shipping and storing chemicals. Chemical production operations are currently idle. Remediation oversight was provided by the EPA RCRA program through 1998 when oversight was transferred to the Washington State Department of Ecology ("Ecology"). At the time of the RSE, Ecology and OCC were negotiating a scope of work to be incorporated into a Model Toxics Control Act (MTCA) agreed order, which will become part of a new

RCRA permit. In addition to the oversight provided by Ecology, the EPA RCRA program remains involved, particularly in regard to determining the attainment of the RCRA Environmental Indicators (EI), and the EPA Superfund Program is overseeing the remedy of the Embankment Area, which has included dredging and will soon include a sediment cap.

Site contamination predominantly consists of volatile organic compounds (VOCs) and elevated pH in the ground water. The pH in ground water and surface water seeps is as high as 11. The primary VOCs are tetrachloroethylene (PCE), trichloroethylene (TCE), and breakdown products including cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride. VOC concentrations in some locations exceed 100,000 ug/L, indicating the presence of wide spread DNAPL. A pump and treat (P&T) system has operated at the site since 1996, extracting contaminated ground water, treating it, reinjecting a portion of the treated water to the subsurface, and discharging the remaining treated water to the Hylebos Waterway. The RSE at this site addresses this P&T system and the other aspects of the site as they relate to this system.

2.0 SUMMARY OF RSE FINDINGS AND RECOMMENDATIONS

2.1 COMPARISON OF SITE/SYSTEM CHARACTERISTICS

The five evaluated systems had the following similarities:

- the primary contaminants of concern at all five sites were chlorinated solvents, such as TCE
- three of the five sites also had inorganic contaminants to address
- all five sites have either DNAPL or indications that DNAPL may be present
- four of the five sites involve contamination that is present in fractured rock (except Occidental)
- only one of the five sites had met both Environmental Indicators
- only one of the remaining four sites had met one Environmental Indicator
- two of the facilities were no longer active, and a third facility was at least temporarily shut down
- annual O&M costs for the systems in increasing order were
  - < $60,500 per year (Risdon)
  - < $86,600 per year (Eliskim)
  - < $220,000 per year (Honeywell)
  - < $265,000 per year (Delphi)
  - < $1.1 million per year (Occidental)
- only one of the systems, Risdon, utilized existing manufacturing infrastructure to assist in the treatment of extracted ground water

More information about each site can be found in the individual RSE reports, which can be accessed through www.cluin.org/optimization.

2.2 COMMON THEMES REGARDING RECOMMENDATIONS FOR IMPROVING EFFECTIVENESS

Each of the five evaluated sites had recommendations for improving effectiveness. However, at one of the five sites (Delphi), the majority of effectiveness recommendations simply suggested proceeding with some of the currently planned activities. For example, one recommendation was to proceed with the plan to connect an overburden extraction system to the existing treatment system. Another recommendation was to avoid sealing an old production well because it would alter the hydrogeology that was present when the remedy was designed. This latter recommendation was an affirmation of the site team's plan. One effectiveness recommendation (evaluations of seeps) was provided that the site team had not considered.

Common recommendations at the other four sites pertained to plume delineation, plume capture, and further evaluating potential receptors.

- Installation of additional monitoring wells for delineation were recommended at all four of the sites. At one of these sites (Risdon), the site team was aware that further delineation was needed, and the RSE recommendation was intended to help the site team with potential options for delineation and to help prioritize delineation with respect to other site activities.

- With regard to plume capture, the RSE team thought capture could be sufficient at two of the sites, but recommended additional data or further analysis to better confirm capture. At the other two sites, the RSE team believed capture was likely insufficient and provided recommendations to improve the evaluation of capture and enhance the extent of capture.

- Further evaluation of potential receptors was recommended at three of the four sites. At one site, the recommendation was to determine if domestic supply wells were present at the properties downgradient of the plume. At two sites, there was a recommendation to further evaluate the potential for vapor intrusion.

- At all four sites, the RSE team recommended either moving forward with or including institutional controls as part of the remedy.

2.3 COMMON THEMES REGARDING RECOMMENDATIONS FOR COST REDUCTION

Recommendations to reduce cost were provided at four of the five sites. Recommendations in this category generally pertained to modifying ground water monitoring programs or to replacing inefficient treatment technologies with more efficient ones.

The RSE team recommended modifying the monitoring program at four sites. The suggested modifications included the following:

- Reducing the number of water quality sampling locations was recommended at two sites.

- Reducing the sampling frequency was recommended at three sites.

- Reducing the number of sampling parameters was recommended at one site.

- Modifying the approach to collecting and interpreting water levels was recommended at one site.

The RSE team estimates that implementing these recommendations at all four sites could save approximately $300,000 per year.

The RSE team recommended replacing one treatment technology with another one at two of the sites. At one of these two sites, the RSE team recommended replacing a UV/Oxidation system with an air stripper, and at the other site, the RSE team recommended replacing GAC polishing with an air stripper so that the system would have two air strippers rather than an air stripper followed by GAC polishing. If implemented, the RSE team estimates that replacing the UV/Oxidation system could save $27,500 per year and replacing the GAC polishing could save over $160,000 per year without sacrificing protectiveness.

In total, the RSE team provided six cost-reduction recommendations that, if implemented, could potentially result in cost savings of $369,500 per year.

2.4 COMMON THEMES REGARDING RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

The recommendations for technical improvement were provided at all fives sites. The recommendations varied by site and included, repairing a damaged cap, considering alternative material for system piping, considering an alternative material for an extraction well drop tube, and considering abandoning a sludge-drying unit. Technical improvement recommendations at two of the sites pertained to reporting. At one site, the RSE team recommended instituting quarterly monitoring reports. At the other site, the RSE team recommended improving the content of the reports and provided specific suggestions.

2.5 COMMON THEMES REGARDING RECOMMENDATIONS FOR SITE CLOSURE

The RSE team provided recommendations in this category at four of the five sites.

- At two of the sites, the RSE team recommended considering an exit strategy that could serve as a plan for the duration of the remedy. At one of these two sites, the RSE team placed emphasis on achieving and maintaining adequate containment rather than focusing on source removal. At the other site, the RSE team suggested establishing short term, intermediate term, and long-term goals so that high priority items would be addressed before lower priority ones. Examples of such goals were provided.

- At two of the sites, the RSE team suggested additional remediation in the source area. At both sites, the RSE team suggested cost-effectively achieving this additional remediation by installing an extraction well in the source area and linking that extraction well to the existing P&T system. Other technologies were also discussed in case the site team would prefer another remedial approach.

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3.0 FEEDBACK ON THE RSE PROCESS FROM SITE STAKEHOLDERS

As part of a preliminary follow-up process, the site stakeholders were contacted in June 2004 and were requested to provide general feedback regarding the RSE process, the merits of the recommendations, the status of implementing recommendations, and their experience with this pilot project. Site stakeholders from both the regulatory side and facility side for each site were contacted for feedback, with the exception of Eliskim. At Eliskim, only the State was contacted because the State funds, operates, and oversees the remedy.

3.1 FEEDBACK REGARDING THE RSE PROCESS

All of the respondents referred to the RSE as a helpful and/or beneficial process. The site stakeholders were impressed by the RSE team's ability to quickly grasp the nuances of each site and to provide meaningful feedback in the form of recommendations.

Regulatory Stakeholders

In general, the regulatory stakeholders found that the RSE process provided assurance. In some cases, it was assurance that the remedy was on the right track. In other cases, it independently confirmed that additional action was required to improve the effectiveness of the remedy. In at least one case, the RSE was helpful in defining the strategy that the site has since adopted for attaining the RCRA Environmental Indicators. For one of the sites, EPA used the RSE process to provide an independent evaluation of a document recently submitted by the facility.

Facility Stakeholders

All four of the facility representatives found merit in employing a third-party evaluation. Three of the four facility representatives mentioned that third-party evaluations had previously been conducted at other sites within their organizations. In fact, one of the facility organizations had conducted third-party evaluations at most of their nationwide sites in the past few years. All four of the facility representatives suggested that they would employ third-party evaluations at other sites in the future, but the following limitations were mentioned by one or more of the facility representatives:

- To receive an independent evaluation, a site should have sufficient complexity to merit the time and cost of the evaluation. (The facility representative that provided this comment noted that the site that received the RSE was sufficiently complex to merit an RSE but that other sites in their organization were not.)

- Independent evaluations are best conducted internal to a facility's organization to provide the facility with more control over the evaluation. Evaluation findings and recommendations could be shared with the regulatory community after internal consideration.

- Independent evaluations may not be appropriate at sites where a remedy is operating with seemingly few problems; rather, the evaluations should be used at sites where there is disagreement between parties or there are known problems that are yet to be addressed.

3.2 FEEDBACK REGARDING RSE RECOMMENDATIONS, INCLUDING PROGRESS TOWARD IMPLEMENTING RECOMMENDATIONS

The response to the recommendations has varied from site to site. At one site, the site team has collectively agreed to implement all or most of the recommendations and is making substantial progress. In contrast, at the State-funded site, the recommendations have not been implemented, primarily due to a shortage of funding and staff. At yet a third site, the recommendations primarily confirmed the activities and approach at the site, and the site team is continuing to follow their plan.

The recommendations at the two remaining sites have been interpreted differently by the regulatory community and the facility representatives. One facility representative views the recommendations as considerations for their benefit but are concerned that the regulatory stakeholders may choose to enforce the implementation of the recommendations. At these sites, recommendations have generally not yet been implemented and further discussion will likely occur between the regulatory and facility stakeholders. To date, it appears that focus has primarily been placed on issues related to site monitoring. More involved recommendations, such as utilizing alternative treatment approaches, have not received as much attention, either because implementation is contingent on other upcoming activities or because of the substantial capital expense.

3.3 FEEDBACK ON THE PILOT PROGRAM

The stakeholders from both the regulatory and facility sides agreed to the professionalism and technical ability of the RSE team and the quality of the RSE report. Representatives from both sides, however, questioned whether or not there would be additional followup. In some cases, the regulatory representatives suggested that the RSE team continue to provide technical assistance/advice or further clarification on recommendations. In general, the facility representatives found no particular reason for the RSE team to provide further support.

4.0 LESSONS LEARNED AND RECOMMENDATIONS

4.1 LESSONS LEARNED

The primary lessons learned are as follows:

- RSEs, or other optimization evaluations, can effectively be conducted at RCRA sites with the involvement of both the regulatory and facility stakeholders. Prior to this project, RSEs had primarily been conducted by EPA at publicly funded sites. In this project, four of the five RSEs were conducted at privately owned and operated sites. Information can be easily transferred between parties, and the RSE reports can be beneficial to all stakeholders.

- In addition to identifying opportunities to improve remedy effectiveness, RSEs at RCRA sites can yield substantial cost-reduction recommendations. These five RCRA RSEs yielded six cost-reduction recommendations that, if implemented, could potentially result in cost savings of approximately $369,500 per year.

- Although stakeholders unanimously commented that the RSE team behaved independently in conducting the evaluation and provided clear recommendations, the RSE reports and recommendations were interpreted differently by different stakeholders. It may be appropriate to include limited followup with the RSE team for further clarification if there are differences in how a recommendation is interpreted.

- These five RSEs were conducted at sites where there was general agreement between the stakeholders. Due to the independent nature of the RSEs, they may be even more beneficial at sites where there has been a breakdown in communication, there is a general disagreement between the stakeholders, or progress has stagnated in achieving fundamental objectives (such as the Environmental Indicators).

- Some sites do not need the level of evaluation that other sites need. If remedy progress is commendable and the relationship between stakeholders is strong, then the RSE will only serve to confirm the current approach. Likewise, if a particular site has funding problems or a shortage in manpower, recommendations may not be implemented, even if they would be beneficial to the site.

4.2 RECOMMENDATIONS

Based on the above lessons learned, the following items are recommended:

- Because the facilities are responsible for implementing the recommendations from an optimization evaluation, facility representatives should play a significant role in nominating sites to receive optimization evaluations. If the regulating authority is solely responsible for nominating or selecting a site for optimization, the optimization process could be viewed as an enforcement-type activity. By including the facility in the selection process, it increases the likelihood that implementation of recommendations will occur.

- Although the RSE process is effective and efficient at evaluating sites, each site requires a different level of evaluation. A streamlined evaluation process (an "RSE-lite") could be developed to offer a reduced evaluation effort for a lower cost. The RSE-lite could be used as a first level of evaluation that would suffice for many sites, and if further evaluation was needed, the RSE-lite could be converted into a full-scale RSE. It would be beneficial for EPA to pilot the RSE-lite process.

- It should be clear to all parties that the recommendations in the RSE reports are not enforceable. Rather, they are provided for the consideration of all stakeholders. If necessary, the RSE team should be available to provide clarification to a recommendation so that it is not misinterpreted.

- Consideration should be given to how RSEs and RSE-lites can be funded by responsible parties and still have the RSE team independent of the work at the site, the facility, and the regulating agency.

- Application of independent evaluations, such as RSEs or RSE-lites, could be helpful for the following types of sites. To learn more about the RSE process, the reader is directed to www.cluin.org/optimization.

  < sites where a remedy has stagnated or has not performed to expectations and additional measures are required

  < sites where there is disagreement between the regulator and the facility with regard to a remedial approach

  < sites where the facility is proposing a new or modified remedial approach and both the regulator and the facility see benefit in an independent analysis

  < sites where a third party could help determine an appropriate level of financial assurance

  < sites that will be transferred to a State or another party due to bankruptcy settlements

  < sites where efficiencies and performance could be enhanced with respect to optimizing monitoring, extraction, treatment, etc.

  < sites where the facility is interested in cost savings and other benefits by applying optimization while maintaining remedy effectiveness