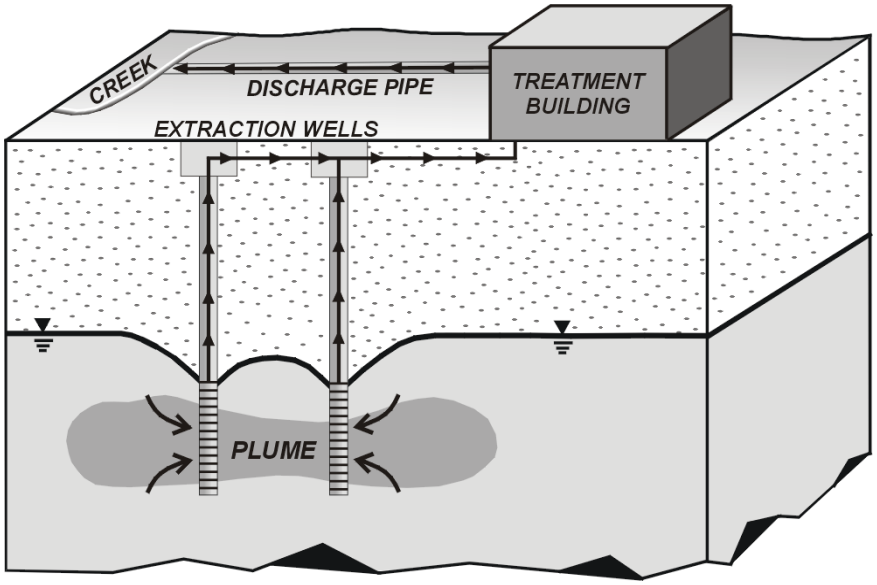
Pilot Project to Optimize Superfund-financed Pump and Treat Systems: Summary Report and Lessons Learned



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Pilot Project to Optimize Superfund-financed Pump and Treat Systems: Summary Report and Lessons Learned

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PREFACE

This report summarizes Phase II (site optimization) of the Nationwide Fund-lead Pump and Treat Optimization Project. This phase included conducting Remediation System Evaluations (RSEs) at each of the 20 sites selected in Phase I with the purpose of providing recommendations to improve remedy effectiveness, reduce remedy costs, improve technical operations, and gain site closeout. RSEs at four of the 20 P&T systems (two in Region 4 and two in Region 5) were previously conducted as part of a demonstration project completed in 2000.

ACKNOWLEDGMENTS

The project team is grateful for the help provided by the EPA Remedial Project Managers (RPMs) for each evaluated site and the EPA Project Liaisons from each Region. They were vital in transferring site documents to the RSE team, scheduling the site visits, providing information during site visits, and reviewing the RSE reports. The authors also extend sincere thanks to the principal investigators from the U.S. EPA Technology Innovation Office (TIO) and U.S. EPA Office of Emergency and Remedial Response (OERR).

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EXECUTIVE SUMMARY

As part of the Superfund program, the U.S. Environmental Protection Agency (EPA) provides funding for groundwater remedies at Superfund-financed (i.e., "Fund-lead") sites. A large percentage of these remedies are pump and treat (P&T) systems designed to restore groundwater and/or contain contaminants. On July 7, 2000, the EPA Office of Solid Waste and Emergency Response (OSWER) issued *Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy*, which outlined a commitment to optimize Fund-lead P&T systems. To assist EPA Regions in fulfilling this commitment, the EPA Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR) implemented a nationwide optimization project for Fund-lead P&T systems, consisting of the following three phases:

- Phase I (complete) involved identifying the Fund-lead P&T systems and selecting specific systems to receive optimization evaluations. The work performed during Phase I is summarized in *Groundwater Pump and Treat Systems: Summary of Selected Cost and Performance Information at Superfund-financed Sites* (EPA 542-R-01-021a).

- Phase II (complete), the subject of this report, involved conducting an optimization evaluation at each of the sites selected in Phase I. The optimization evaluations were accomplished using the Remediation System Evaluation (RSE) process, which was developed by the U.S. Army Corps of Engineers as a tool for remedy optimization.

- Phase III (ongoing) involves following up with site managers of the evaluated sites primarily to track the progress toward implementing the recommendations generated from the RSEs.

This report summarizes the results from RSEs performed at 20 Fund-lead sites with P&T systems. These 20 optimization evaluations have resulted in an improved understanding of the operating Fund-lead P&T systems and have identified a number of opportunities for improvements in efficiency and effectiveness relatively early in the operation of these systems. Throughout this project, effectiveness has been defined as the ability of a remedy to meet its stated objectives of protecting human health and the environment by containing ground water plumes and eliminating exposure pathways to site-related contamination. These opportunities have been conveyed to the site managers through RSE reports that highlight recommendations in the following four categories:

- recommendations to improve remedy effectiveness with respect to preventing plume migration and monitoring other exposure pathways
- recommendations to reduce life-cycle operation and maintenance (O&M) costs
- recommendations for technical improvement
- recommendations regarding site closeout

Each of the 20 RSEs resulted in recommendations related to one or more of the above-listed categories. In general, recommendations to improve effectiveness pertained to subsurface issues such as improving delineation of contaminant plumes and/or better evaluating the capture of those plumes. The recommendations to reduce costs generally pertained to the above-ground treatment system and included recommendations such as eliminating treatment components that are no longer necessary and reducing labor costs (often possible because actual influent concentrations are much lower than design influent concentrations). Technical improvement recommendations covered a wide range of items such as repairing or replacing faulty equipment and rehabilitating fouled extraction wells. Site closeout

recommendations generally involved developing a clearly stated site exit strategy or considering more aggressive source removal options. The RSE team estimated that the capital cost for implementing all recommendations is approximately $5.9 million but would result in a reduction in annual O&M costs of approximately $4.8 million per year. Ground water remedies at Fund-lead sites are typically expected to operate for more than 30 years.

In addition to summarizing the findings from this project, this report also presents specific lessons learned and other considerations, listed below:

- EPA Remedial Project Managers (RPMs) require additional technical assistance and guidance (e.g., capture zone analysis, exit strategy, recognizing and correcting treatment plant over-design, contracting, methods of life-cycle cost comparisons, etc.).

- The remedial process is dynamic, and system evaluations must be routinely performed in order to account for variations that occur in site conditions throughout the process.

- Many sites have continuing sources of NAPL contamination in the subsurface and are unlikely to reach target clean-up levels through the entire plume with existing remedial actions.

- Many ROD goals are not associated with specific metrics for evaluating progress, which makes it impossible to determine the success or failure of the remedy.

- RPMs are responsible for managing remedies that are protective of human health and the environment and, as a result, may not adequately consider the remedy cost-effectiveness. This may result in remedies with unnecessarily high costs.

- Independent technical evaluations provide more opportunities for improving systems than evaluations performed by site managers or O&M contractors.

- Oversight costs by EPA contractors are inconsistent and in some cases appear to be higher than necessary.

- Many recommendations require further engineering analysis to prove feasibility and may involve additional capital expenditure and time for design and construction.

In addition, the following recommendations are suggested to maximize the benefits of the RSE process and to develop the full-scale implementation of the project to all Fund-lead sites:

- Follow up on each of the sites evaluated to date, to ensure progress is being made toward implementing the recommendations, and to track associated costs and savings.

- Develop an ongoing program to track progress and costs/savings associated with implementation of RSE recommendations in the future, including an approach to resolve disputes if site managers do not implement RSE recommendations.

- Periodically update the database of Fund-lead P&T systems determined in Phase 1.

- Develop a strategy for selecting sites to receive future RSEs.

- Perform additional RSEs in the future utilizing RSE teams that are independent from the site managers and their contractors.

- Consider performing independent reviews of high-cost remedies during the design phase.

- Consider establishing a strategy to identify and address sites with continuing sources of ground water contamination (e.g., non-aqueous phase liquids) before transfer to the states.

- Develop guidance and training opportunities on technical deficiencies discovered during RSEs conducted to date (e.g., effective overall management of pump and treat systems, capture zone analysis, etc.).

Follow up is underway in Phase III of this project. Preliminary results from follow up of the 20 sites suggest that the EPA Regions plan to implement 210 of the 230 RSE recommendations.

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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

As part of the Superfund program, the U.S. Environmental Protection Agency (EPA) provides funding for groundwater remedies at Superfund-financed (i.e., "Fund-lead") sites. A large percentage of these remedies are pump and treat (P&T) systems designed to restore groundwater and/or contain contaminants. On July 7, 2000, the EPA Office of Solid Waste and Emergency Response (OSWER) issued *Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy*, which outlined a commitment to optimize Fund-lead P&T systems. To assist EPA Regions in fulfilling this commitment, the EPA Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR) implemented a nationwide optimization project for Fund-lead P&T systems, consisting of the following three phases:

- Phase I (complete) involved identifying the Fund-lead P&T systems and selecting specific systems to receive optimization evaluations. A total of 88 Fund-lead P&T systems were identified and 20 of them were selected for Remedial System Evaluations (RSEs). The work performed during Phase I is summarized in *Groundwater Pump and Treat Systems: Summary of Selected Cost and Performance Information at Superfund-financed Sites* (EPA 542-R-01-021a).

- Phase II (complete), the subject of this report, involved conducting an optimization evaluation at each of the sites selected in Phase I. The optimization evaluations were accomplished using the Remediation System Evaluation (RSE) process, which was developed by the U.S. Army Corps of Engineers as a tool for remedy optimization.

- Phase III (ongoing) involves following up with site managers of the evaluated sites primarily to track the progress toward implementing the recommendations generated from the RSEs.

1.2 THE RSE PROCESS

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 EPA and state RPMs and site contractors. This team evaluates the following items:

- system goals
- site conceptual model
- extraction well network
- above-ground treatment system
- groundwater 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 managers, contractors, and key regulators (EPA and State). 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
- recommendations to reduce life-cycle operation and maintenance (O&M) costs
- recommendations for technical improvement
- recommendations to improve the likelihood of site close out

As a clarification, throughout this project, effectiveness has been defined as the ability of a remedy to meet its stated objectives of protecting human health and the environment by containing ground water plumes and eliminating exposure pathways to site-related contamination. 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 EVALUATED SITES AND SCHEDULE

This report summarizes the results from RSEs performed at 20 Fund-lead sites with P&T systems. Four of these RSEs were conducted in Regions 4 and 5 as part of a demonstration project, and 16 RSEs were subsequently conducted nationwide. Table 1-1 lists the 20 sites where the RSEs were conducted and provides the dates the RSE visits occurred, the dates the draft RSE reports were submitted, and the dates the finalized RSE reports were submitted. At the time of the evaluations, some of the evaluated sites were in a startup mode and others had been operating for approximately 10 years. On average, as of January 2002 the sites had been operating for approximately 4.5 years.

Table 1-1: Sites where RSEs were conducted as part of the nationwide Fund-lead pump and treat optimization project

Site Name	EPA Region	Date of RSE Site Visit	Date Draft RSE Report was Submitted	Date Final RSE Report was Submitted
Oconomowoc Electroplating	5	3/14/00 - 3/15/00	5/25/00	8/11/00
MacGillis and Gibbs	5	6/13/00 - 6/14/00	9/12/00	2/26/01
Elmore Waste Disposal	4	9/19/00 - 9/20/00	12/22/00	4/17/01
FCX Statesville	4	9/20/00 - 9/22/00	12/1/00	3/6/02
Bayou Bonfouca	6	2/21/01 - 2/22/01	3/28/01	7/9/01
Midland Products	6	2/27/01	4/11/01	6/4/01
Savage Municipal Water Supply	1	3/22/01 - 3/23/01	4/23/01	9/17/01
Mattiace Petrochemical	2	3/29/01 - 3/30/01	5/15/01	7/27/01
Baird and McGuire	1	4/18/01 - 4/19/01	6/13/01	1/18/02
Cleburn Street Well	7	4/24/01 - 4/25/01	6/13/01	7/30/01
Hellertown Manufacturing	3	6/5/01	7/18/01	11/14/01
Raymark	3	6/7/01 - 6/8/01	7/30/01	12/19/01
Claremont Polychemical	2	6/26/01 - 6/27/01	8/28/01	2/15/01
Modesto Groundwater Contam.	9	7/19/01 - 7/20/01	9/11/01	12/10/01
Silresim Chemical Corp.	1	8/15/01 - 8/16/01	10/8/01	12/20/01
Comm. Bay/S. Tac. Chan., Well 12A	10	8/21/01 - 8/22/01	10/9/01	12/11/01
McCormick and Baxter	10	8/23/01 - 8/24/01	10/19/01	2/8/02
Ott/Story/Cordova	5	9/27/01 - 9/28/01	11/19/01	3/12/02
Brewster Wellfield	2	10/30/01	12/17/01	4/8/02
Selma Pressure Treating	9	11/7/01 - 11/8/01	12/18/01	1/31/02

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2.0 SUMMARY OF RSE FINDINGS AND RECOMMENDATIONS

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 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 available technologies have changed since design and installation of the P&T systems.

Information on how to obtain the report from each of the 20 RSEs are included in the Appendix.

2.1 COMMON THEMES REGARDING EFFECTIVENESS

The RSE team generally found the Fund-lead P&T systems to be operating, regularly meeting treatment plant discharge levels, and removing contaminant mass from the subsurface. The RSE team did, however, identify at 17 of the 20 sites recommendations to improve remedy effectiveness (i.e., improve the ability of a remedy to meet its stated objectives of protecting human health and the environment by containing ground water plumes and eliminating exposure pathways to site-related contamination). The recommendations to improve effectiveness predominantly suggested more rigorous evaluation of the

subsurface portion of the remedy rather than the above-ground treatment portion. In total, the RSE team estimates that the capital costs for implementing all of these recommendations would be approximately $1.25 million and the increase in annual O&M costs would be approximately $270,000 per year. The majority of effectiveness recommendations made by the RSE team fall into three categories, summarized below.

Improve capture zone analysis and/or plume delineation

The RSE team found that plume containment (or "capture") is not being evaluated sufficiently at 16 of the 20 RSE sites. In addition, a "target capture zone" was typically not specified, further complicating the evaluation of plume containment. In many cases updated plume maps were not being generated, even though groundwater monitoring data were routinely collected. At 10 of 20 sites it appeared that the extent of the plume was not fully delineated and that plume migration toward potential receptors was not being actively evaluated. A total of 17 sites had issues with either containment or plume delineation.

Conduct additional sampling

At 7 of the 20 sites, the RSE team recommended additional sampling, including air sampling in buildings for volatile organic compounds (4 of 20 sites), water sampling of drinking wells (2 of 20 sites), and surface water or sediment sampling (5 of 20 sites). These recommendations were warranted by potential impacts from site contaminants, in the opinion of the RSE team. In some cases, this sampling may already be collected by other parties but is not regularly reviewed by site managers.

Improve data collection, interpretation, and/or reporting

At some of the 20 sites the RSE team found that routine O&M reports did not contain sufficient information or analysis to adequately assess the effectiveness of the system. In some cases key data were not included in the report (such as water levels), and in other cases the reports were not being produced and/or reviewed in a timely manner.

2.2 COMMON THEMES REGARDING COST REDUCTION

The RSE team found that the evaluated sites had annual O&M costs ranging from under $100,000 per year to approximately $3.4 million per year. The total annual O&M cost for these systems is approximately $13.3 million per year. The RSE team identified cost savings opportunities at 17 of the 20 sites, with the greatest potential cost savings associated with higher cost systems. The estimated capital cost for implementing all of these recommendations would be approximately $3.5 million; however, the estimated potential annual cost savings from implementation would be approximately $5.1 million, which would represent an approximate 38% decrease in annual O&M costs (excluding the costs for implementing the effectiveness, technical improvement, or site closeout recommendations). The following six categories represent the most common types of recommendations for cost reduction.

Reduce groundwater or process treatment monitoring

Reducing or eliminating groundwater or process monitoring that is no longer necessary was the most common recommendation for reducing costs. The RSE team recommended reductions in groundwater or treatment process monitoring at 9 of the 20 sites. Achieving these reductions would require estimated capital costs of approximately $30,000 (for piping modifications at one site); however, the combined annual cost savings from the reductions at the 9 sites would be approximately $800,000 per year.

Approximately three quarters of this potential annual cost savings stems from a recommendation to reduce process monitoring at one site.

Replace existing treatment components with more efficient units or technologies

Due to highly conservative estimates of influent concentrations during design or due to changing site conditions, some treatment components were inefficient given current site conditions. For example, at one site a thermal oxidizer was installed to destroy contaminants removed from the subsurface. Because contaminant loading was lower than expected, the thermal oxidizer required excess natural gas to operate and was inefficient compared to using granular activated carbon with onsite regeneration. Recommendations to replace existing treatment components with more efficient units or technologies were made at 7 of the 20 sites. The estimated capital cost for implementing these recommendations is approximately $1.8 million with estimated potential cost savings of approximately $800,000 per year.

Simplify existing system and/or remove unnecessary treatment components

At 5 of the 20 sites, the RSE team found a treatment plant that was over-designed or had treatment components that are no longer necessary due to changing site conditions. By simplifying the systems and removing the components, reductions in material usage, utilities, and labor can potentially result. The estimated capital cost for implementing these recommendations is approximately $1 million; however, the estimated potential annual costs savings from implementing them is approximately $1.3 million per year.

Consider alternate discharge options for treated groundwater

The RSE team recommended reviewing the discharge criteria or considering alternate discharge options for the treated water at 5 of the 20 sites. The estimated capital cost for implementing these recommendations is approximately $54,000, and the estimated potential annual savings is approximately $175,000 per year.

Reduce labor costs

The RSE team identified 3 of the 20 sites where operator or onsite labor could be reduced without sacrificing the effectiveness of the remedy. At one of the sites automation is required to achieve this reduction in labor. The estimated capital cost for implementing these recommendations are approximately $103,000; however, the estimated potential annual cost savings from implementing these recommendations would be approximately $1.6 million per year. In addition, many recommendations that fall into other categories (e.g. removing treatment components that are no longer needed) also result in reductions in labor and commensurate reductions in cost.

Reduce oversight or project management costs

At 4 of the 20 sites, the RSE team recommended that oversight and/or project management costs be reduced. However, the potential cost savings for only 2 of those sites were estimated. Reductions in project management and oversight at these two sites could potentially save approximately $175,000 per year.

2.3 COMMON THEMES REGARDING TECHNICAL IMPROVEMENT

In general, the RSE team found most Fund-lead P&T sites well maintained. Recommendations in this category include repairing or replacing faulty equipment, changing data evaluation protocols, rehabilitating fouled extraction or injection wells, reformatting reports, modifying sampling protocols, and other site-specific recommendations to improve overall operations. A total of 63 recommendations for technical improvement were made at 16 of the 20 evaluated sites received. The RSE team estimates that implementing these recommendations would require approximately $360,000 in capital costs and an additional $25,000 in annual O&M costs.

2.4 COMMON THEMES REGARDING SITE CLOSEOUT

The RSE team found it unlikely that any of the evaluated sites would reach closeout or system shutdown prior to the transfer of the site to the State (which for Fund-lead sites with restoration as a goal occurs 10 years after the system is Operational and Functional). A primary reason is that continuing sources of dissolved phase groundwater contamination will continue to persist at many sites, most often due to the presence of non-aqueous phase liquids (NAPLs). Of the 20 evaluated sites, 16 have either direct evidence, anecdotal evidence, or groundwater concentrations indicating the presence of NAPL. The science of NAPLs has evolved over time, and the potential presence of NAPL at many of these sites may not have been adequately recognized during remedy selection and design.

To assist EPA and the States in eventually closing sites, the RSE team identified recommendations regarding site closeout at 16 of the 20 evaluated sites. At one site, excavation of a remaining source area is recommended for an estimated capital cost of $500,000. Including this recommendation, the total capital cost for implementing the recommendations for site closeout at all of the sites is approximately $775,000 and the estimated increase in annual O&M costs is approximately $35,000 per year. The RSE team also offered recommendations for consideration of alternative technologies that could replace or augment the existing P&T system, especially with respect to more aggressive source removal. The costs and potential life-cycle savings of implementing these technologies were sometimes estimated when practicable but are not included in the estimated costs provided above. The majority of recommendations made by the RSE team with regard to site closeout fall into the following two categories.

Develop an exit strategy

An exit strategy consists of outlining the specific requirements for achieving closeout of the remedy or various components of the remedy. Developing an exit strategy involves establishing realistic cleanup goals, and it also involves determining the specific data and criteria to be used to evaluate if goals are met such that some or all of the system can be shut down. An exit strategy involves setting milestones for the remedy and determining intermediate goals and metrics to measure progress. If the intermediate goals and milestones are not met, site managers should then consider alternatives to the current system. At 10 of the 20 sites visited, the RSE team made a recommendation that pertains to development of an exit strategy. The RSE team specifically recommended development of an exit strategy at 4 sites, establishment or reconsideration of specific cleanup goals at 5 sites, and determining data needs specifically related to exit strategy at 1 site.

Consider more aggressive source removal or alternate technologies

At 13 of the 20 sites evaluated, the RSE team recommended consideration alternate technologies to replace pump and treat or to supplement it with more aggressive source removal. Such recommendations are site specific and range from increased pumping in "hot spot" areas to the potential use of chemical

oxidation, air sparging, or in-situ thermal remediation. The selection of a particular technology may depend on commercial or industrial activities at the surface, the geology, the nature and extent of contamination, the proximity to receptors, and other factors. Because aggressive source removal does not necessarily improve site conditions to the point of shutting down the operating P&T system (there is some debate regarding the ability of these technologies to achieve concentrations that allow P&T to be discontinued), the RSE team encourages the site managers to consider the life-cycle costs of an optimized P&T system versus the life-cycle costs of the P&T plus the more aggressive source removal alternatives. Prior to proceeding with a pilot test for an innovative technology, the RSE team encourages the site managers to consider the scaled-up costs for using the technology site wide (or over the entire source area). If the cost for implementing the technology at the full scale is impracticable, then the RSE team generally suggests considering other technologies rather than moving forward with the pilot test.

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3.0 CONCLUSIONS, LESSONS LEARNED, & RECOMMENDATIONS

These optimization evaluations have resulted in an improved understanding of the operating Fund-lead P&T systems and have identified a number of opportunities for improvements in efficiency and effectiveness relatively early in the operation of these systems. These opportunities have been conveyed to the EPA Remedial Project Managers (RPMs) through recommendations highlighted in RSE reports. The following table provides the predominant RSE recommendation categories and the number of sites where such recommendations were made.

Table 3-1: Number of RSE Recommendations in each Recommendation Category

Recommendation Category	Number of Sites where Recommendations in each Category were Made
Improvement in effectiveness	17 of 20 sites
Cost reduction	17 of 20 sites
Technical improvement	16 of 20 sites
Site closeout	16 of 20 sites

In general, recommendations to improve effectiveness pertained to subsurface issues such as improving delineation of contaminant plumes and/or better evaluating the capture of those plumes. The recommendations to reduce costs generally pertained to the above-ground treatment system and included recommendations such as eliminating treatment components that are no longer necessary and reducing labor costs. Technical improvement recommendations covered a wide range of items such as repairing or replacing faulty equipment and rehabilitating fouled extraction wells. Site closeout recommendations generally involved developing a clearly stated site exit strategy or considering more aggressive source removal options.

To assist site managers in considering and implementing the recommendations, the RSE team provided cost estimates where feasible. The following table reports the four recommendation categories and the total cost estimates for the recommendations in each category.

Table 3-2: Summary of Cost and Cost Savings Estimates by Recommendation Category

Recommendation Category	Estimated Capital Cost* ($)	Estimated Change in Annual O&M Costs* ($/yr)
Improvement in effectiveness	$1.25 million	$270,000
Cost reduction	$3.5 million	($5.1 million)
Technical improvement	$360,000	$25,000
Site closeout	$775,000	$35,000
Total	$5.9 million	($4.8 million)

**Cost estimates have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30/+50%)*

Given that the annual O&M costs for these 20 sites is approximately $13.3 million per year, implementing all of the recommendations would require an estimated 44% increase in spending for one year but could potentially result in a savings of approximately 36% in annual O&M costs. Therefore, life-cycle savings would likely be realized within approximately two years of implementing the recommendations, if all recommendations are implemented. Savings would then accrue by millions of dollars per year in subsequent years as ground water remedies at Fund-lead sites are typically expected to operate for more than 30 years.

3.1 LESSONS LEARNED

Some of the lessons learned from this project are listed below:

- EPA Remedial Project Managers (RPMs) generally require additional technical assistance and guidance (e.g., capture zone analysis, exit strategy, recognizing and correcting treatment plant over-design, contracting, methods of life-cycle cost comparisons, etc.)."

- The remedial process is dynamic, and system evaluations should be routinely performed in order to account for variations that occur in site conditions through the process. The RSE team frequently found that plume delineation and capture zone analyses were last conducted during system design and had not been updated or evaluated once the system was operating. In addition, changing influent concentrations to the treatment plant over time and the development of new technologies for treatment provide opportunities for future cost savings.

- Many sites have continuing sources of NAPL contamination in the subsurface and are unlikely to reach target clean-up levels over the entire plume with existing remedial actions. The potential presence of NAPL at many of these sites may not have been adequately recognized during remedy selection and design; as a result, the cleanup time estimates stated in the ROD are unrealistically low at some sites.

- Many ROD goals are not associated with specific metrics for evaluating progress, which makes it impossible to determine the success or failure of the remedy.

- RPMs are responsible for managing remedies that are protective of human health and the environment and, as a result, may not adequately consider the remedy cost-effectiveness. This may result in remedies with unnecessarily high costs.

- Independent technical evaluations provide more opportunities for improving systems than evaluations performed by site managers or O&M contractors. Despite efforts by site managers to evaluate their own performance and optimize their own systems, the RSE team was able to identify a number of additional opportunities for system improvement. The outside perspective and combined technical expertise of the RSE team yielded increased opportunity for developing recommendations to improve operating P&T systems.

- Oversight costs by EPA contractors are inconsistent and in some cases appear to be higher than necessary.
- Many recommendations require further engineering analysis to prove feasibility and may involve additional capital expenditure and time for design and construction.

3.2 RECOMMENDATIONS TO MAXIMIZE THE BENEFITS OF THE RSE PROCESS FOR FUND-LEAD P&T SYSTEMS

The following recommendations are suggested to maximize the benefits of the RSE process and potentially scale up the project to all Fund-lead P&T systems:

- Follow up on each of the sites evaluated to date, to ensure progress is being made toward implementing the recommendations, and to track associated costs and savings.

- Develop an ongoing program to track progress and cost/savings associated with implementation of RSE recommendations in the future, including an approach to resolve disputes if site managers do not implement RSE recommendations. This should also include reviewing the actual costs of implementing RSE recommendations versus the implementation costs estimated in the RSE reports.

- Periodically update the database of Fund-lead P&T systems determined in Phase 1.

- Develop a strategy for selecting sites to receive future RSEs.

- Perform additional RSEs in the future utilizing RSE teams that are independent from the site managers and their contractors.

- Consider performing independent reviews of high-cost remedies during the design phase.

- Consider establishing a strategy to identify and address sites with continuing sources of ground-water contamination (e.g., non-aqueous phase liquids) before transfer to the states.

- Develop guidance and training opportunities on technical deficiencies discovered during RSEs conducted to date (e.g., effective overall management of pump and treat systems, capture zone analysis, etc.).

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4.0 PRELIMINARY FINDINGS FROM PHASE III

In Phase III of the Nationwide Fund-lead P&T Optimization Project, EPA OERR and the RSE team followup with the site managers on the RSE reports that were generated during Phase II and have been summarized in this report. OERR has the following primary objectives for Phase III:

- note the progress made toward implementing RSE recommendations
- communicate with RPMs to determine and assess ongoing challenges at the sites
- provide further technical assistance or clarification to the RPMs with respect to RSE recommendations
- provide further regulatory assistance or clarification to the RPMs with respect to Superfund policy and Headquarter's current areas of focus
- determine the effectiveness of the RSE process from the perspective of the RPMs
- for each site, determine an appropriate time for the next follow up call

Phase III of the Nationwide Fund-lead P&T Optimization project has begun with promising results. Initial follow up conference calls have been conducted for all 20 of the sites, and progress on approximately 230 recommendations has been discussed. Of those recommendations, approximately 20 will not be further pursued by the Regions for various technical reasons. Table 4-1 summarizes the progress made toward implementing the remaining approximate 210 recommendations in four categories.

Table 4-1 Summary of Progress Made Toward Implementing RSE Recommendations that will be Pursued by the Regions

Recommendation Category	Approximate number of recommendations that will be pursued by the Regions	Percentage of recommendations where implementation is in progress	Percentage of recommendations where implementation is complete
Effectiveness/Protectiveness	65	40%	20%
Cost Reduction	63	29%	13%
Technical Improvement	56	13%	52%
Site Closeout	24	33%	0%

Based on these followup calls, EPA Regions are currently implementing recommendations that will lead to enhanced effectiveness and annual O&M cost savings of over $2 million per year. Additional information regarding the anticipated time frames for implementation and resulting changes in O&M costs will be discussed in a summary report for Phase III of this project.

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APPENDIX:
REMEDIATION SYSTEM EVALUATION (RSE) REPORTS FOR 20 FUND-LEAD SITES WITH PUMP AND TREAT SYSTEMS

Reports from each of the 20 RSEs are available on-line at www.epa.gov/tio and www.cluin.org/rse. Report titles and document numbers are listed below.

RSE Report Name	**EPA Document Number**
Remediation System Evaluation, Oconomowoc Electroplating Superfund Site	EPA 542-R-02-008b
Remediation System Evaluation, MacGillis and Gibbs Superfund Site	EPA 542-R-02-008c
Remediation System Evaluation, Elmore Waste Disposal Superfund Site	EPA 542-R-02-008d
Remediation System Evaluation, FCX Statesville Superfund Site	EPA 542-R-02-008e
Remediation System Evaluation , Bayou Bonfouca Superfund Site	EPA 542-R-02-008f
Remediation System Evaluation, Midland Products Superfund Site	EPA 542-R-02-008g
Remediation System Evaluation, Savage Municipal Water Supply Superfund Site	EPA 542-R-02-008h
Remediation System Evaluation, Mattiace Petrochemical Superfund Site	EPA 542-R-02-008i
Remediation System Evaluation, Baird and McGuire Superfund Site	EPA 542-R-02-008j
Remediation System Evaluation, Cleburn Street Well Superfund Site	EPA 542-R-02-008k
Remediation System Evaluation, Hellertown Manufacturing Superfund Site	EPA 542-R-02-008l
Remediation System Evaluation, Raymark Superfund Site	EPA 542-R-02-008m
Remediation System Evaluation, Claremont Polychemical Superfund Site	EPA 542-R-02-008n
Remediation System Evaluation, Modesto Groundwater Contamination Superfund Site	EPA 542-R-02-008o
Remediation System Evaluation, Silresim Chemical Corp. Superfund Site	EPA 542-R-02-008p
Remediation System Evaluation, Comm. Bay/South Tacoma Channel, Well 12A Superfund Site	EPA 542-R-02-008q
Remediation System Evaluation, McCormick and Baxter Superfund Site	EPA 542-R-02-008r
Remediation System Evaluation, Ott/Story/Cordova Superfund Site	EPA 542-R-02-008s
Remediation System Evaluation, Brewster Wellfield Superfund Site	EPA 542-R-02-008t
Remediation System Evaluation, Selma Pressure Treating Superfund Site	EPA 542-R-02-008u

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