United States Environmental Protection Agency

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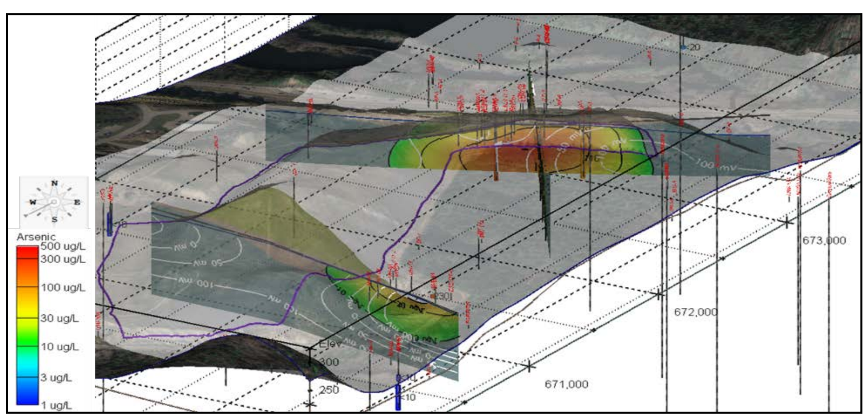
Office of Land and Emergency Management
October 2020

# Superfund Optimization Progress Report
# October 2020



# PHOTO CREDIT:

**Top**: East foundry pond at the Marathon Battery Site. Photo courtesy of U.S. Environmental Protection Agency (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI) from the 2019 Marathon Battery Optimization Review site visit.

**Center Left**: Approximately 10 miles south of Tar Creek operable unit 4, where the Spring River meets the Neosho River at the headwaters of Grand Lake o' the Cherokees. Photo courtesy of EPA OSRTI from the 2014 Tar Creek Remedial Action Optimization Review Report.

**Center:** Carson River Mercury Site. Photo courtesy of EPA OSRTI from the 2019 site visit.

**Center Right**: Wilcox Oil Company Site. Photo courtesy of EPA OSRTI from the 2016 XRF sampling event.

**Bottom**: 4DIM screen capture showing fence diagram with arsenic concentrations at the Charles George Reclamation Trust Landfill. Photo courtesy of EPA OSRTI from the 2018 Charles George Landfill Optimization Review Report.

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# TABLE OF CONTENTS

## Tables



## FIGURES

# NOTICE AND DISCLAIMER

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# EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA)'s optimization program has continued to make cleanups more efficient and effective and has spurred the Superfund program forward by:

- implementing recommendations provided in the *Superfund Task Force Recommendations* (EPA, 2017b), including Recommendation 7[1], which promotes the use of third-party optimization;
- implementing elements of the *National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion* ("the National Strategy");
- implementing recommendations for individual optimization reviews and conducting site-specific technical support projects; and
- implementing innovative best practices throughout the Superfund pipeline.

This report provides updates on the status of optimization reviews conducted during fiscal year (FY) 2015 through FY 2017 and includes optimization-related technical support projects that were substantially completed through 2018. Project highlights demonstrate results achieved from optimization reviews and optimization-related technical support projects and exemplify how the optimization program applies and promotes best practices to improve site cleanup.

***Implementing the Superfund Task Force Recommendations and the National Strategy*** - EPA expanded the optimization program to support 50 or more ongoing optimization reviews and optimization-related technical support projects in a typical year, completing about 20 of these evaluations per year and expanding the program to support all phases of the Superfund pipeline. Benefits realized from expanding the program to a larger number of sites include increasing remedy effectiveness, improving technical performance, reducing costs, moving sites to completion, and lowering the environmental footprint of remediation activities. The optimization reviews and technical support projects can improve approaches in: pre-remedial actions, such as characterization, remedy selection, and remedy design; remedial actions, including long-term response actions; and operations and maintenance, including long-term monitoring. Approximately 48 percent of the new optimization evaluations (or related support activities) conducted at Superfund sites were performed during pre-remedial action phases of the Superfund pipeline, 39 percent during remedial action phases, and 13 percent during operations and maintenance.

***Optimization Reviews*** - EPA's continued success with the optimization program is reflected in the status of optimization reviews presented in this report. This includes the status of the implementation of recommendations for 40 reviews performed since the last progress report and updates to the status of 35 reviews where implementation of recommendations has been on-going since the last progress report.

[1] Superfund Task Force Report Recommendation 7: Promote Use of Third-Party Optimization Throughout the Remediation Process and Focus Optimization on Complex Sites or Sites of Significant Public Interest

For the 40 new optimization reviews:

- 67 percent of optimization recommendations were implemented, are in progress, or are planned.
- 21 percent are still under consideration.
- 7 percent were declined.
- 3 percent were deferred to the state or Potentially Responsible Party for action.
- 2 percent do not have status information available.

***Optimization-Related Technical Support*** – As part of the optimization program, EPA also conducted 58 optimization-related technical support projects where work was substantially completed between FY 2015 and FY 2018. These projects provide direct support applying best practices and have helped expand optimization to earlier stages of the Superfund pipeline but can be conducted at any stage. Like optimization reviews, they use third-party experts to provide the support. Examples of the types of support provided include systematic project planning, demonstrations of method applicability, advanced data management techniques, strategic sampling techniques, high resolution site characterization, and three-dimensional visualization and analysis. For optimization-related technical support projects, EPA tracks the start and end dates, remedial phase, scope of project, best practices applied, and direct outcomes.

***Implementing Best Practices Across the Superfund Pipeline*** - EPA's optimization program continues to apply and promote best practices to improve site cleanup throughout the Superfund pipeline. In 2018, EPA published three technical guides based on lessons learned from the optimization program: *Scoping Environmental Investigations; Strategic Sampling Approaches,* and *Best Practices for Data Management* – to highlight best practices as well as provide technical resources and references to support the implementation of these best practices.

**Technical Guides**

**Smart Scoping for Environmental Investigations**

**Strategic Sampling Approaches**

**Best Practices for Data Management**

***Key Results from Applying Best Practices*** - EPA conducted a review of the recent optimization and technical support evaluations, which highlighted six key results of the direct support provided during a technical support project or that could result from implementing optimization recommendations. Those six are shown below along with the percentage of the new optimization reviews and technical support projects demonstrating that recommendation or outcome: (1) Improvements to Conceptual Site Model: 87 percent, (2) Improved System Engineering: 45 percent, (3) Streamlined or Improved Monitoring: 31 percent, (4) Change in Remedy Strategy: 32 percent, (5) Improved Site Characterization Through Strategic Sampling: 35 percent, and (6) Improved Data Management: 30 percent. Project highlights included in this report demonstrate how the optimization program applies and promotes best practices to improve site cleanup.

# 1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has been conducting optimization activities at Superfund sites since 1997 and periodically reporting on the progress of implementing optimization recommendations[2] (EPA, 2012a). EPA began its optimization efforts as a pilot program focused on groundwater pump and treat (P&T) remedies at Superfund (Fund-lead) sites by conducting remediation system evaluations and long-term monitoring optimizations. In August 2004, EPA developed the *Action Plan for Ground Water Remedy Optimization* ("Action Plan") (EPA, 2004) to further implement important lessons learned from the pilot phase and fully integrate optimization into the Superfund cleanup process, where appropriate. As the program matured, further recognition of the benefits of optimization prompted EPA to expand and formalize its optimization program. In 2012, EPA issued the *National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion* ("the National Strategy") (EPA, 2012b). Optimization activities under the National Strategy are conducted at every phase of the Superfund pipeline. In July 2017, EPA issued the *Superfund Task Force Recommendations* (EPA, 2017b), which included Strategy 4**: Use Best Management Practices, Systematic Planning, Remedy Optimization, and Access to Expert Technical Resources to Expedite Remediation** and Recommendation 7[3], promoting the use of third-party optimizations.

## Contents of Report



This *Superfund Optimization Progress Report October 2020* summarizes EPA's progress on

[2] All previous Optimization Progress Reports can be found at https://www.epa.gov/superfund/cleanup-optimization-superfund-sites#summary

[3] Superfund Task Force Report Recommendation 7: Promote Use of Third-Party Optimization Throughout the Remediation Process and Focus Optimization on Complex Sites or Sites of Significant Public Interest

implementing the elements of the overall National Strategy, the Superfund Task Force (Task Force) recommendations, optimization recommendations for individual optimization reviews, and in conducting optimization-related technical support projects.

The six main sections of this report are: Introduction (Section 1.0), including a discussion of the purpose of the report and the optimization program; Summary of Progress on Expanding the Optimization Program (Section 2.0), summarizing EPA's progress in implementing the National Strategy; Summary of Implementation Progress (Section 3.0), including a summary of EPA's progress in implementing optimization recommendations and a summary of technical support activities; Optimization Program and Best Practices (Section 4.0), describing how the optimization applies and promotes best practices; Summary of Progress on Implementing the National Optimization Strategy (Section 5.0); and References (Section 6.0). Appendix A provides a detailed discussion of EPA's progress on implementing the National Optimization Strategy. Appendix B lists the optimization reviews and technical support projects completed through fiscal year (FY) 2017.

## 1.1 Purpose and Scope

The purpose of this report is to: (1) update site-specific recommendations resulting from independent optimization reviews and optimization-related technical support projects; (2) describe how the optimization program applies and promotes EPA's best technical practices for site cleanup; and (3) provide a summary and analysis of the status of implementing the National Strategy and Task Force recommendations.

This report summarizes optimization support conducted through the EPA Headquarters (EPA HQ) optimization program. Similar work and technical support projects are conducted by other programs and regions. That work is not included in the data and analysis provided here. Optimization reviews and optimization-related technical support projects are collectively referred to in this report as evaluations.

**Optimization Reviews** result in site-specific reports with recommendations that fall within one of five categories: remedy effectiveness, cost reduction, technical improvement, site closure, and energy and material efficiency. Starting one year after completing the optimization review, the optimization team follows up with the site Remedial Project Manager (RPM) to determine the implementation status of optimization recommendations for the site. The implementation status is then tracked, and follow-up continues until all recommendations have been implemented, declined, or in some cases, deferred to the state.

**Optimization-Related Technical Support Projects** generally provide direct site support to apply optimization best practices. Technical support projects can be done at all stages of the Superfund pipeline and may precede or follow an optimization review. Technical Support projects can include developing a strategic sampling approach, conducting systematic project planning (SPP), conducting a focused technical review of a specific aspect of a site, and visualizing and analyzing data to help identify data gaps in the conceptual site model (CSM). Tracking these technical support projects captures efforts to optimize pre-remedial action stages of the cleanup process. It allows EPA to report on the application of lessons learned from later-stage optimizations to earlier stages of the cleanup process as described in the National Strategy. For optimization-related technical support projects, EPA tracks the start and end dates, remedial phase, scope of project, best practices applied, and direct outcomes.

**National Strategy and Superfund Task Force** implementation includes programmatic activities of planning, implementing, tracking, reporting on, and measuring progress of the optimization program. The optimization program has contributed to EPA's effort to develop and promote best practices related to scoping, sampling, and managing data. This report evaluates how implementing the National Strategy and Task Force recommendations also achieves key results from applying best practices and promotes the use of best practices.

This report presents project highlights showcasing sites where optimization and technical support evaluations have had positive impacts. Identifying the positive results and lessons learned may be beneficial to other sites.

This report focuses on the implementation of optimization recommendations from FY 2015 through FY 2017. Information is provided on the implementation of recommendations for 40 reviews where an optimization was performed since the last progress report and which are being reported on for the first time (see Table 3 in Section 3.0). Status updates are also provided for 35 reviews where implementation of recommendations has continued since the last progress report (see Table 4 in Section 3.0). In addition to the 75 optimization reviews, this report includes information and analysis on 58 optimization-related technical support projects completed since the last progress report. Technical support projects are included in the Superfund phase analysis of new optimization and technical support evaluations (see Figure 2) and in the analysis of key results achieved from conducting optimization evaluations (see Figure 7). Highlights documenting how best practices were applied during technical support projects are also included in the report. Most optimization and technical support evaluations were conducted at sites on the National Priorities List (NPL); some were conducted at non-NPL sites such as those from the Resource Conservation and Recovery Act (RCRA) Corrective Action and Brownfields programs.

## 1.2 Optimization Program

Sites are selected for optimization reviews and technical support projects collaboratively, based on input from EPA RPMs, regional management, Regional Optimization Liaisons (ROLs), EPA HQ staff and managers, and stakeholders. The optimization teams consist of an EPA HQ lead, the ROL, and a team of technically qualified individuals from within EPA, the U.S. Army Corps of Engineers (USACE), or one of EPA's pool of contractors with the advanced qualifications and extensive experience necessary to conduct the optimization review. The site teams generally consist of the RPM, regional technical support staff such as a hydrogeologist, state personnel, tribes, potentially responsible parties (PRPs), contractors, and other stakeholders such as community representatives.

The reasons for conducting an optimization review vary and can include:

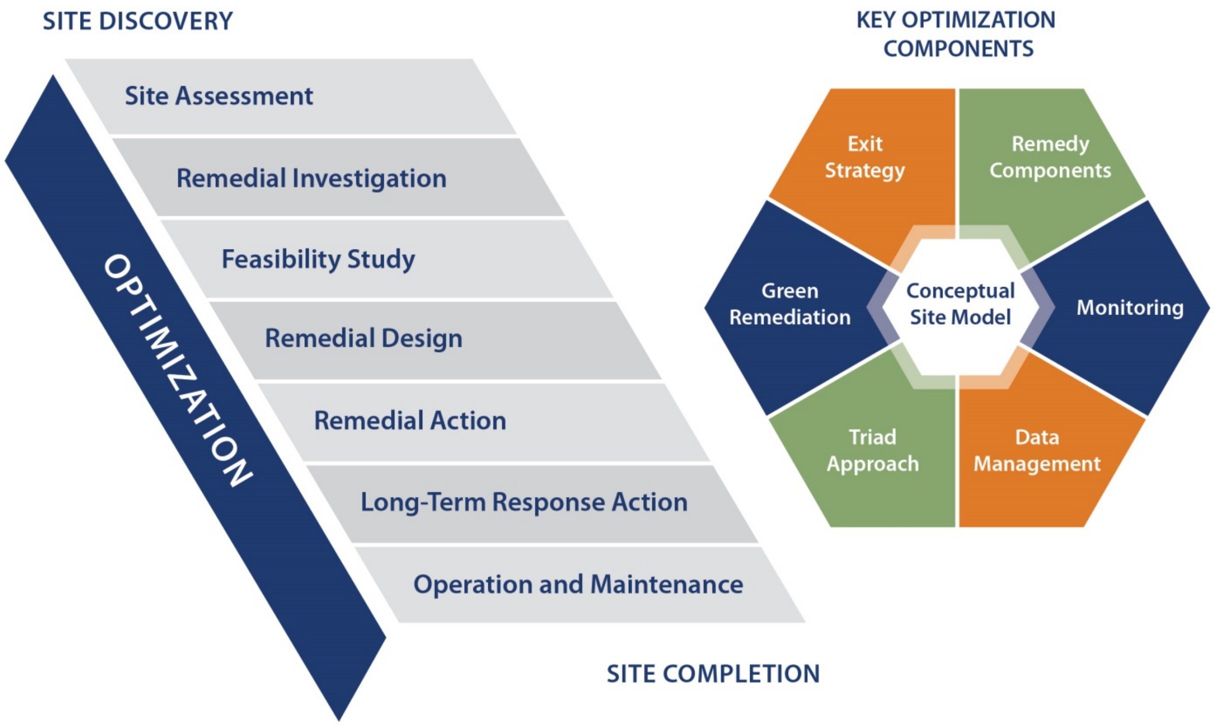
1) uncertainty regarding the current CSM;
2) highly complex site conditions with multiple sources, multiple contaminant plumes, or significant subsurface heterogeneity;
3) increasing investigative costs or expanding the scope of the investigation;

4) lack of progression to the next phase in the Superfund pipeline;
5) concerns regarding planned or existing remedy performance, effectiveness, or cost;
6) need to obtain an independent assessment of a remedial design or proposed site activities;
7) interest in applying innovative strategies or technologies;
8) not achieving the goals of the remedy as anticipated and wanting independent expertise to assess cleanup progress, suggest changes in remedial approach, or evaluate proposed changes from state or PRP;
9) exploring the opportunity to reduce monitoring points and costs;
10) a need to expedite the remediation time frame to allow for property redevelopment;
11) a need to reduce energy and effort and enhance efficiency; and
12) a need to develop or refine the site or remedy completion strategy.

# 2.0 SUMMARY OF PROGRESS ON EXPANDING THE OPTIMIZATION PROGRAM

Optimization reviews technical support projects are conducted at any phase of the Superfund pipeline. Optimization teams usually include an evaluation of the CSM for each site and make recommendations related to investigation activities when needed. This practice continues as EPA has learned that a continual focus on life-cycle CSMs and discussion of the overall site strategy are valuable in assisting site teams in improving site remedy performance and progress, no matter the phase of the Superfund pipeline. Figure 1 depicts the key components of optimization and the remedial pipeline phases at which optimization can be applied.[4,5]

**Figure 1: Key Optimization Components and Superfund Pipeline Activities**



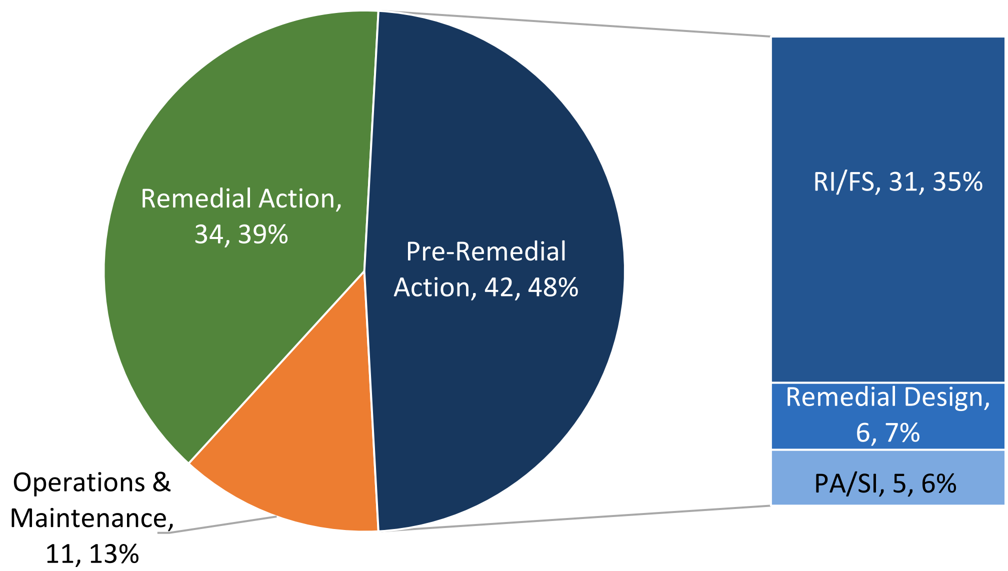

Source: Adapted from EPA 2012b.

Figure 2 shows the Superfund phase of the new optimization and technical support evaluations. EPA continues to expand optimization efforts across the Superfund pipeline. In the early years of the optimization program, all optimizations were done in the remedial action or operation and maintenance (O&M) phase of the Superfund pipeline. Currently 48 percent are completed in pre-remedial action phases (preliminary assessment/site inspection [PA/SI], remedial investigation/feasibility study [RI/FS], or remedial design), up from 35 percent in the previous progress report (EPA, 2017a). Pre-remedial action phase support often involved providing direct technical support focused on the application of optimization best practices.

[4] See CFR, title 40, sec 300, Subpart E, for details regarding the phases of the Superfund pipeline

[5] Information about the seven key components can be found at www.epa.gov/superfund/cleanup-optimization-superfund-sites

**Figure 2: Superfund Phase of New Optimization and Technical Support Evaluations**
Number of Superfund Optimization Reviews and Technical Support Projects = 87




- 11 sites are not Superfund sites and are not included in the percentages reported in Figure 2.
- 18 long-term response action projects are included with remedial action.

Table 1 shows the workflow of optimization and technical support evaluations from FY 2011 through FY 2017. The total number of optimizations supported per year has nearly doubled since the implementation of the National Strategy.

**Table 1: EPA Optimization and Technical Support Workflow**

| Fiscal Year | Started | Ongoing | Completed | Number of Optimization and Technical Support Evaluations Supported by OSRTI* |
|---|---|---|---|---|
| 2011 | 21 | 14 | 12 | 35 |
| 2012 | 21 | 23 | 18 | 44 |
| 2013 | 27 | 26 | 27 | 53 |
| 2014 | 18 | 26 | 29 | 44 |
| 2015 | 27 | 15 | 14 | 42 |
| 2016 | 38 | 28 | 31 | 66 |
| 2017 | 34 | 35 | 24 | 69 |

*** This column represents the number of evaluations started each fiscal year combined with the number of evaluations ongoing from the previous fiscal years.**

EPA has completed a total of 251 optimization and technical support evaluations from FY 1997 through FY 2017 (Table 2). A list of these optimization and technical support evaluations is provided in Appendix B. From FY 1997 through FY 2011, EPA completed 108 optimization and technical support evaluations, averaging seven evaluations per year. From FY 2012 through FY 2017, with the implementation of the National Strategy, EPA completed 143 optimization and technical support evaluations, averaging 24 evaluations per year. Through implementation of the National Strategy, EPA has more than tripled the number of optimization reviews and technical support projects it completes each year. As a result, EPA has expanded the benefits from optimization and technical support to a much larger universe of sites.

**Table 2: Completed Optimization and Technical Support Evaluations FY 1997 - FY 2017**

| Region | Number of Evaluations 1997-2014 | Number of Evaluations 2015-2017 | Total Evaluations 1997-2017 | % of Total Completions |
|---|---|---|---|---|
| 1 | 17 | 13 | 30 | 12% |
| 2 | 23 | 4 | 27 | 11% |
| 3 | 23 | 4 | 27 | 11% |
| 4 | 12 | 3 | 15 | 6% |
| 5 | 15 | 2 | 17 | 7% |
| 6 | 12 | 9 | 21 | 8% |
| 7 | 19 | 3 | 22 | 9% |
| 8 | 16 | 13 | 29 | 12% |
| 9 | 24 | 7 | 31 | 12% |
| 10 | 21 | 11 | 32 | 13% |
| **TOTAL** | **182** | **69** | **251** | **100%** |

In addition to expanding the program, EPA has implemented innovative approaches to optimization, such as reviewing a portfolio of sites located in a common geographic area. Coordinating site visits reduces costs associated with travel and deployments of personnel. EPA continues to target optimization reviews and technical support projects at certain types of sites, such as mining sites. Starting in FY 2016, EPA began preparing consultation packages at mining sites. These consultation packages evaluate planned remedial activities to be conducted at mining sites and provide recommendations on ways to mitigate the risk of the release of mining-influenced water during remedial activities. EPA has leveraged the expertise and independent perspective of the optimization experts to support the consultation process. Technical Support projects detailed in this report include 12 mining consultation packages.

# 3.0 SUMMARY OF RECOMMENDATION IMPLEMENTATION PROGRESS

A total of 75 optimization reviews are included in this report; 40 new optimization reviews (Table 3) and 35 optimization reviews carried over from the previous progress report to provide recommendation status updates (Table 4). The new evaluations focus on those completed in FY 2015 through FY 2017; however, some evaluations are included for the first time from earlier years if information on implementation status was not yet available as of the writing of the last report. EPA worked closely with regional staff including RPMs and ROLs to collect information on the status of the recommendations for each of the 75 optimization reviews. Sources of information for this report included information from RPMs, site-specific optimization reports, optimization recommendation follow-up recorded in past annual reports, and follow-up information provided in the most recent data collection effort.

**Table 3: New Optimization Reviews Included in this Progress Report**

| State | Optimization Reviews | FY Complete | Pipeline Phase | Total Optimization Reviews |
|---|---|---|---|---|
| **Region 1** | | | | **6** |
| VT | Elizabeth Mine | 2016 | Remedial Action | |
| VT | Jard Company | 2017 | RI/FS | |
| RI | Peterson/Puritan, Inc. | 2016 | O&M | |
| RI | Picillo Farm | 2017 | Remedial Action | |
| NH | Somersworth Sanitary Landfill | 2017 | Remedial Action | |
| MA | Sullivan's Ledge | 2016 | O&M | |
| **Region 2** | | | | **1** |
| NJ | Metaltec/Aerosystems | 2015 | Remedial Action | |
| **Region 3** | | | | **4** |
| DE | Dover Gas Light Co. | 2015 | RI/FS | |
| PA | Hellertown Manufacturing Co. | 2017 | O&M | |
| VA | Saunders Supply Co. | 2016 | O&M | |
| PA | Valmont TCE Site (Former - Valmont Industrial Park) | 2016 | Remedial Action | |
| **Region 4** | | | | **1** |
| NC | Charles Macon Lagoon and Drum Storage | 2016 | Remedial Action | |
| **Region 5** | | | | **2** |
| MI | Clare Water Supply | 2017 | O&M | |
| OH | Lincoln Fields Coop Water Assn Duke Well | 2015 | Remedial Action | |
| **Region 6** | | | | **8** |
| TX | Conroe Creosoting Co. | 2015 | Remedial Action | |
| TX | Garland Creosoting | 2017 | Remedial Action | |
| NM | McGaffey and Main Groundwater Plume | 2015 | Remedial Action | |
| NM | North Railroad Avenue Plume | 2015 | Remedial Action | |
| TX | Odessa Chromium #1 | 2016 | O&M | |

| State | Optimization Reviews | FY Complete | Pipeline Phase | Total Optimization Reviews |
|---|---|---|---|---|
| **Region 6** | **(Continued)** | | | |
| AR | Ouachita Nevada Wood Treater | 2015 | Remedial Action | |
| TX | Sprague Road Ground Water Plume | 2016 | Remedial Action | |
| TX | West County Road 112 Ground Water | 2016 | RI/FS | |
| **Region 7** | | | | **2** |
| NE | 10th Street Site | 2014 | Remedial Action | |
| NE | Parkview Well | 2017 | Remedial Action | |
| **Region 8** | | | | **5** |
| CO | Gold King Mine Release | 2017 | Not on NPL | |
| MT | Idaho Pole Co. | 2009 | Remedial Action | |
| MT | Idaho Pole Co. | 2010 | Remedial Action | |
| MT | Lockwood Solvent Ground Water Plume OU01 | 2014 | Remedial Design | |
| CO | Standard Mine | 2016 | Remedial Action | |
| **Region 9** | | | | **4** |
| NV | Carson River Mercury Site | 2014 | RI/FS | |
| CA | Klau/Buena Vista Mine | 2017 | RI/FS | |
| CA | Lava Cap Mine | 2017 | Remedial Design | |
| CA | Newmark Ground Water Contamination | 2015 | RI/FS | |
| **Region 10** | | | | **7** |
| ID | Bunker Hill Mining & Metallurgical Complex | 2014 | Remedial Design | |
| ID | Bunker Hill Mining & Metallurgical Complex | 2016 | Remedial Design | |
| ID | Bunker Hill Mining & Metallurgical Complex | 2017 | Remedial Action | |
| OR | J.H. Baxter & Co. | 2016 | RCRA | |
| AK | Kodiak USCG Integrated Support Command Base | 2015 | RCRA | |
| OR | Northwest Pipe & Casing/Hall Process Company | 2016 | O&M | |
| OR | Univar | 2017 | RCRA | |
| **TOTAL** | | | | **40** |

- Long-term response actions are included with remedial actions.

**Table 4: Updated Optimization Reviews Included in this Progress Report**

| State | Optimization Reviews | FY Complete | Optimization Focus | Total Optimization Reviews |
|---|---|---|---|---|
| **Region 1** | | | | **2** |
| MA | Baird & McGuire | 2013 | O&M | |
| NH | Ottati & Goss/Kingston Steel Drum | 2014 | O&M | |
| **Region 2** | | | | **5** |
| NY | GCL Tie and Treating Inc. | 2007 | Remedial Action | |
| NJ | Metaltec/Aerosystems | 2012 | Remedial Action | |
| NY | Richardson Hill Road Landfill/Pond | 2012 | Remedial Action | |
| NJ | Rockaway Borough Well Field | 2014 | Remedial Action | |
| NJ | Vineland Chemical Co., Inc. | 2011 | Remedial Action | |
| **Region 3** | | | | **4** |
| PA | Fischer & Porter Co. | 2014 | O&M | |
| PA | Mill Creek Dump | 2010 | O&M | |
| PA | North Penn - Area 6 | 2012 | Remedial Action | |
| VA | Peck Iron and Metal | 2013 | RI/FS | |
| **Region 4** | | | | **2** |
| FL | Alaric Area GW Plume | 2010 | Remedial Action | |
| NC | Benfield Industries, Inc. | 2007 | Remedial Action | |
| **Region 5** | | | | **3** |
| MN | Baytown Township Ground Water Plume | 2011 | Remedial Action | |
| WI | Moss-American Co., Inc. (Kerr-McGee Oil Co.) | 2011 | Remedial Action | |
| MI | Wash King Laundry | 2011 | Remedial Action | |
| **Region 6** | | | | **6** |
| TX | East 67th Street Ground Water Plume | 2014 | Remedial Design | |
| NM | Homestake Mining Co. | 2011 | Remedial Action | |
| TX | Jones Road Ground Water Plume | 2014 | Remedial Design | |
| TX | Sandy Beach Road Ground Water Plume | 2014 | Remedial Design | |
| TX | State Road 114 Groundwater Plume | 2014 | Remedial Action | |
| OK | Tar Creek (Ottawa County) | 2014 | Remedial Action | |
| **Region 7** | | | | **4** |
| IA | Fairfield Coal Gasification Plant | 2012 | Remedial Action | |
| NE | Hastings Ground Water Contamination | 2013 | Remedial Action | |
| MO | Lee Chemical | 2012 | O&M | |
| MO | Valley Park TCE | 2013 | Remedial Action | |
| **Region 8** | | | | **4** |
| CO | Central City, Clear Creek | 2007 | Remedial Action | |
| SD | Gilt Edge Mine | 2013 | Remedial Action | |
| MT | Lockwood Solvent Ground Water Plume OU02 | 2014 | Remedial Design | |
| CO | Standard Mine | 2014 | Remedial Design | |

| State | Optimization Reviews | FY Complete | Optimization Focus | Total Optimization Reviews |
|---|---|---|---|---|
| **Region 9** | | | | **2** |
| CA | Mew Study Area | 2012 | RI/FS | |
| CA | Sulphur Bank Mercury Mine | 2015 | RI/FS | |
| **Region 10** | | | | **3** |
| OR | Black Butte Mine | 2012 | RI/FS | |
| WA | Moses Lake Wellfield Contamination | 2015 | RI/FS | |
| WA | Palermo Well Field Ground Water Contamination | 2012 | Remedial Action | |
| **TOTAL** | | | | **35** |

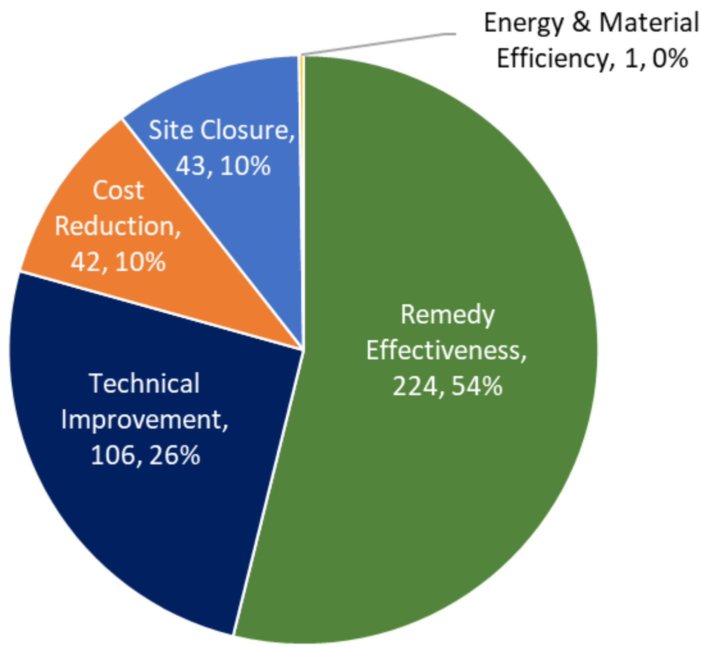
- Long-term response actions are included with remedial actions.

Section 3.1 summarizes the overall progress in implementing each of the recommendations and describes the five recommendation categories. Section 3.2 lists the evaluations and sites that no longer require follow up. Section 3.3 summarizes technical support projects conducted from FY 2015 through FY 2017 or substantially completed in 2018, which demonstrate the use of best practices.

## 3.1 Overview of Progress

Implementing recommendations from optimization reviews can result in improved: (1) understanding of the site conditions, (2) designs for remedies, or (3) operations of remediation systems, among other benefits. Site specific recommendations depend on the type of optimization review conducted and the phase of the Superfund pipeline. Optimization reviews typically identify several opportunities for improvements. These improvements are organized into five recommendation categories, remedy effectiveness, cost reduction, technical improvement, site closure, and energy and material efficiency. The number of recommendations in each category in relation to the total number of recommendations for the new optimization reviews are shown in Figure 3. It is important to note that recommendations were only counted in the primary category they represent but many recommendations could be counted in multiple categories. For example, a recommendation could both improve remedy effectiveness and move a site toward closure.

**Figure 3: Recommendations by Category**
Total Number of Recommendations = 416




**Remedy Effectiveness** - The majority of optimization recommendations (224 of the 416) fall into the remedy effectiveness category.

Examples of remedy effectiveness recommendations include the following:

- Improvements in the CSM through additional characterization of sources and environmental media.
- Changes in remedial approach to address subsurface contamination.
- Changes in management approach.
- Improvements to the performance of an existing system.
- identification and reduction of risk.

**Cost Reduction -** Optimization recommendations pertaining to cost reduction may cover many aspects of system operation, including the use of specific treatment technologies, operator and laboratory labor, reporting, and project management. Cost savings for this report were estimated as one-time cost savings or multiple year annual cost savings. It should be noted that a short-term investment may be required to realize longer-term cost savings. In addition, cost savings in the form of cost avoidance are often realized but are difficult to quantify. Optimization reviews continue to identify many opportunities to reduce on-site labor without affecting remedy performance. Such reductions may be possible following system shakedown, when a remedy is put through initial tests and improvements and is designated as operational and functional. Furthermore, some treatment components may become inefficient or unnecessary as a result of changing site conditions or overly conservative estimates used during the design phase. Simplifying a treatment system under such conditions has resulted in cost savings associated with reduced material costs, decreased energy usage, and reduced labor cost for maintaining or improving remedy performance. Further, improvements in remedy effectiveness, movement toward site closure, or energy and material efficiency can result in cost reduction or cost avoidance, but the benefits may not be as readily quantified.

Examples of cost reduction recommendations include the following:

- Automate systems to reduce labor costs.
- Reduce project management costs by streamlining contractor management and addressing technical issues to reduce oversight costs and needs for management of vendors.
- Streamline monitoring to reduce laboratory and reporting costs.
- Simplify treatment systems to reduce operating costs.
- Reduce costs for supporting systems operations such as facility or road maintenance and snow removal.

**Technical Improvement -** Technical improvement recommendations cover a wide range of items to improve overall site operations and usually relate to improving existing systems. These recommendations are generally straightforward to implement, require minimal funding, and are not typically contingent on other recommendations. Some recommendations for technical improvement were not implemented because they addressed an existing component that was likely going to be changed based on remedy effectiveness recommendations.

Examples of technical improvement recommendations include the following:

- Reconfigure components of the treatment train.
- Inspect and then clean, repair, or replace faulty equipment.
- Rehabilitate fouled extraction or injection wells.
- Consider more efficient pumps and blowers.

**Site Closure -** Optimization reviews continue to identify opportunities to accelerate progress toward achieving final cleanup goals and eventual site completion or closure. These recommendations most commonly involve developing a clear and comprehensive completion strategy and evaluating changes in the remedial approach in situations where the current remedy may no longer be the most effective approach.

When considering site closure for groundwater sites, EPA's *Groundwater Remedy Completion Strategy* (EPA, 2014) and related guidance documents provide an approach and statistical tool for assessing when monitoring results indicate that cleanup levels are achieved, and aquifer restoration is accomplished. A completion strategy "…is a recommended site-specific course of actions and decision-making processes to achieve groundwater RAOs [Remedial Action Objectives] and associated cleanup levels using an updated conceptual site model, performance metrics and data derived from site-specific remedy evaluations" (EPA, 2014). Using the completion strategy decision-making process will allow for the assessment of remedial performance and evaluation of whether a remedial action is working as anticipated or if the remedy selected in the decision document may need to be modified to achieve RAOs and associated cleanup levels. Such modifications have often included addressing additional source material or residual subsurface contamination. Implementing the Task Force recommendation to establish dynamic site strategies during RI/FS scoping and throughout the RI/FS process, may move sites to closure more readily.

Examples of site closure recommendations include the following:

- Further characterization of sources.
- Targeted treatment of remaining sources.
- Development of an exit strategy including performance metrics for determining achievement of RAOs.

**Energy and Material Efficiency -** Optimization reviews continue to identify opportunities to accelerate progress toward achieving energy and material efficiency and reductions in environmental footprints.

It should be noted that recommendations for other optimization categories—remedy effectiveness, cost reduction, and technical improvement—often include opportunities for reductions in environmental footprint. EPA also provides technical support conducting environmental footprint analyses during the design-phase to identify energy and material efficiency best management practices and to ensure remedy components are adaptively scaled when implemented.

Examples of energy and material efficiency recommendations include the following:

- Utilize local labor for site management and sampling to avoid air emissions associated with travel.
- Consider opportunities for renewable energy such as solar, wind, or renewable energy credits.
- Streamline the treatment train.
- Downsize pumps and blowers.

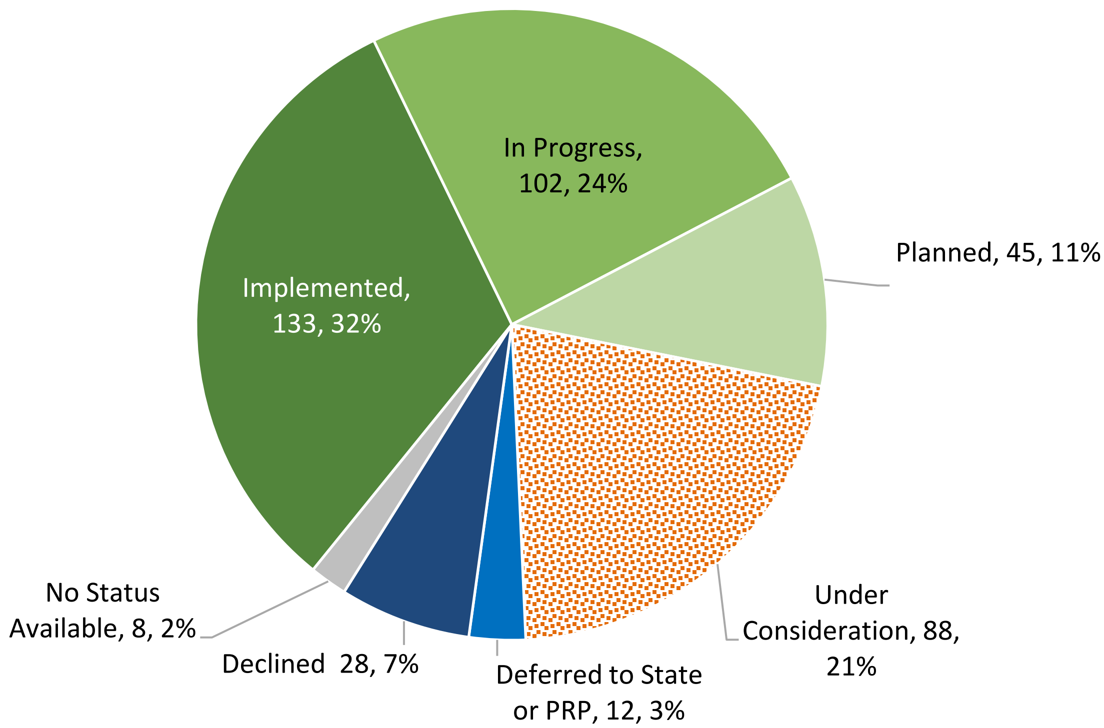
As shown in Figure 4, completed optimization reviews for the 40 new optimization reviews included in this report identified a total of 416 optimization recommendations[6].

Overall, 67 percent of optimization recommendations have been implemented, are in progress, or are planned, and another 21 percent are under consideration. Only 7 percent of optimization recommendations were declined. Recommendations can be declined for a number of reasons, including changed site conditions or selection of one option when several are offered. A small number of recommendations (3 percent) were deferred to the state or PRP for action. Recommendations are deferred to the state or PRP when site activities are their responsibility and the remedy is protective. In these cases, the recommendations are provided as suggestions for improvements to be addressed at the discretion of the state or PRP. No information was provided for 2 percent of the recommendations, labeled as no status available. These results demonstrate that

[6] Analysis conducted for all 1,565 recommendations tracked over the life of the optimization program showed that 68% of recommendations have been implemented, are in progress or planned, 11% are under consideration, 13% were declined, 4% were deferred to state or PRP and 4% have no status is available.

optimization review teams continue to evaluate site conditions and put forth reasonable recommendations for making improvements and that site teams are open to suggestions for improvement.

**Figure 4: Status of New Optimization Recommendations**
Total Number of Recommendations = 416




## 3.2 Evaluations and Sites Requiring No Further Follow-Up

RPMs continue to demonstrate a commitment to the implementation of optimization recommendations. The optimization process is now complete at several sites as a result of the successful implementation or thorough consideration of all optimization recommendations. EPA is no longer conducting annual follow-up discussions for the following evaluations and sites, although assistance is still available to site managers if any optimization-related issues arise:

- Benfield Industries, Inc.
- Black Butte Mine
- Elizabeth Mine
- Gilt Edge Mine
- Idaho Pole Co. (2009)
- Mill Creek Dump
- Moss-American Co., Inc. (Kerr-McGee Oil Co.)
- Newmark Ground Water Contamination

- North Penn - Area 6
- Peck Iron and Metal
- Picillo Farm
- State Road 114 Groundwater Plume
- Valley Park TCE
- Wash King Laundry

Previous progress reports identified 50 evaluations and sites that no longer require implementation tracking, for a total of 64 evaluations and sites that have successfully completed the follow-up process since it began as a result of the Action Plan in 2004.

## 3.3 Summary of Technical Support Projects

In addition to formal optimization reviews, EPA provides technical support that results in optimization principles being applied more broadly. Optimization-related technical support projects included in this report are specific to projects conducted as part of the EPA HQ optimization program. Projects can occur in early phases of the Superfund pipeline before there is a full remedial system operating, or later in the pipeline to support specific actions such as further source identification or plume delineation. Technical support projects may be conducted as a follow-on support to an optimization review. Technical support projects frequently involve collaboration among RPMs, Hydrogeologists, Risk Assessors, Chemists, and their State and Tribal counterparts.

Technical support projects incorporate best practices such as systematic project planning, preliminary scoping, demonstrations of method applicability (DMAs), strategic sampling design, high-resolution site characterization (HRSC), CSM development, mapping and three-dimensional visualization and analysis (3DVA), and advanced data management techniques. Activities can include comprehensive project planning, and management and implementation activities which are intended to help move projects forward and improve site decision-making. Technical support projects frequently develop products for the site team such as work plans, quality assurance project plans, decision logic diagrams, sampling designs and technical memos.

Often a technical support project can integrate multiple best practices at a single site. For example, a technical support project at the Carson River Mercury Site in Region 9 included a DMA to determine if a field portable x-ray fluorescence (XRF) instrument could be used in conjunction with incremental sampling to characterize mercury contamination in shallow soil. After the DMA was completed, EPA HQ facilitated a three-day SPP meeting that helped the EPA Region and State site teams plan and implement an incremental sampling pilot study.

Table 5 lists the technical support projects included in the report. The technical support efforts included were conducted from FY 2015 through FY 2017 or substantially completed in FY 2018 and demonstrated best management practices.

**Table 5: Completed Technical Support Projects**

| State | Technical Support Projects | FY Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 1** | | | **10** |
| MA | Baird & McGuire | 2018 | |
| MA | BJAT LLC | 2016 | |
| ME | Callahan Mining Corp | 2018 | |
| CT | Century Brass | 2019 | |
| MA | Charles George Reclamation Trust Landfill | 2017 | |
| VT | Elizabeth Mine | 2016 | |
| VT | Ely Copper Mine | 2017 | |
| VT | Ely Copper Mine | 2017 | |
| VT | Jard Company | | |
| MA | Sullivan's Ledge | 2016 | |
| **Region 2** | | | **5** |
| NY | Crown Cleaners of Watertown Inc. | 2018 | |
| NY | Eighteen Mile Creek | 2016 | |
| NJ | PUCHACK WELL FIELD | | |
| NJ | Sherwin-Williams/Hilliards Creek | 2017 | |
| NJ | Unimatic Manufacturing Corp Site | 2016 | |
| **Region 3** | | | **2** |
| PA | Clearview Landfill | 2019 | |
| VA | Saunders Supply Co. | 2018 | |
| **Region 4** | | | **3** |
| MS | Mississippi Phosphates Corporation | 2016 | |
| MS | Mississippi Phosphates Corporation | 2016 | |
| NC | Ore Knob Mine | 2018 | |
| **Region 5** | | | **1** |
| IL | Heart of Chicago | 2018 | |
| **Region 6** | | | **4** |
| AR | Arkwood, Inc. | 2016 | |
| NM | Jackpile-Paguate Uranium Mine | | |
| OK | Oklahoma Refining Co. | | |
| OK | Wilcox Oil Company | 2019 | |
| **Region 7** | | | **3** |
| MO | Big River Mine Tailings/St. Joe Minerals Corp. | 2016 | |
| NE | PCE Southeast Contamination | 2018 | |
| MO | Washington County Lead District - Furnace Creek | 2016 | |
| **Region 8** | | | **16** |
| CO | American Tunnel Mine | 2017 | |
| CO | Bonita Peak Mining District | 2017 | |
| CO | Captain Jack Mill | 2016 | |

| State | Technical Support Projects | FY Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 8** | **(Continued)** | | |
| CO | Colorado Smelter | 2018 | |
| CO | French Gulch | | |
| CO | Gold King Mine Release | 2016 | |
| CO | Gold King Mine Release | 2017 | |
| CO | Gold King Mine Release | 2018 | |
| MT | Idaho Pole Co. | 2018 | |
| CO | Lowry Landfill | 2018 | |
| CO | Lowry Landfill | 2016 | |
| CO | Marshall Landfill | 2018 | |
| CO | Nelson Tunnel/Commodore Waste Rock | 2018 | |
| CO | Rico - Argentine | 2016 | |
| CO | Standard Mine | 2016 | |
| CO | Vasquez Boulevard And I-70, OU3 | 2017 | |
| **Region 9** | | | **12** |
| NV | Carson River Mercury Site | 2017 | |
| NV | Carson River Mercury Site | | |
| CA | Central Basin | | |
| AZ | Cove Mesa Aggregated Uranium Mines | 2018 | |
| AZ | Cove Mesa Aggregated Uranium Mines | 2019 | |
| CA | DTSC Brownfields Support | 2018 | |
| CA | McCormick & Baxter Creosoting Co. | 2017 | |
| CA | Montrose Chemical Corp./Del Amo | | |
| CA | Newmark Ground Water Contamination | 2016 | |
| CA | Newmark Ground Water Contamination | | |
| CA | Orange County North Basin | | |
| CA | Selma Treating Co. | 2018 | |
| **Region 10** | | | **2** |
| ID | Bunker Hill Mining & Metallurgical Complex | 2017 | |
| ID | Eastern Michaud Flats Contamination | 2017 | |
| **TOTAL** | | | **58** |

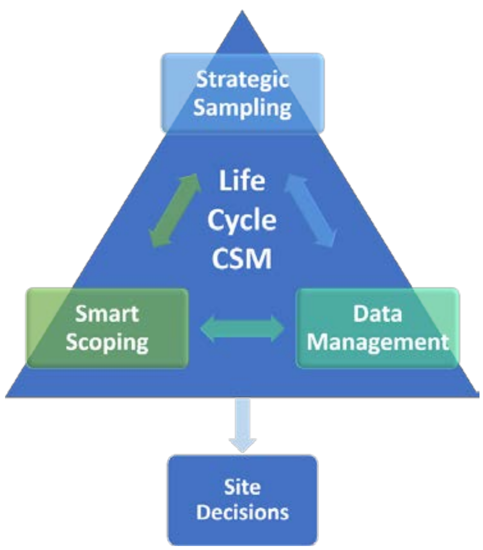
# 4.0 OPTIMIZATION PROGRAM AND BEST PRACTICES

EPA's understanding of best management practices for site characterization has grown through implementation of the Agency's 2012 Superfund National Optimization Strategy, the Superfund Task Force recommendations (EPA, 2017b)[7], interaction with state and industry leaders, engagement in EPA's Lean Management System (ELMS), and other relevant activities. EPA synthesized the lessons learned from conducting over 300 optimization reviews and technical support projects into three technical guides: *Smart Scoping for Environmental Investigations*, *Strategic Sampling Approaches,* and *Best Practices for Data Management*[8] (EPA, 2018b, 2018c, and 2018d). The guides were issued in November of 2018 and highlight these BMPs to help focus and streamline the site characterization process by presenting more efficient scoping, investigation, and data management approaches. The streamlining of these activities may reduce both time and costs during the RI/FS phase and throughout the Superfund process. EPA intends for the guides to strengthen Superfund site characterization activities, facilitate stronger site remedy decisions, and improve remedy performance.

> Lessons learned through the Superfund Optimization program informed the development of three technical guides: Smart Scoping for Environmental Investigations, Strategic Sampling Approaches, and Best Practices for Data Management

The best practices identified in the technical guides work together to evolve the CSM and improve the efficiency of site characterization and cleanup (Figure 5). Evolving the CSM over the site's life cycle results in better, more defensible site decisions and improved remedy performance.

**Figure 5: Best Practices and the Conceptual Site Model**




[7] https://www.epa.gov/sites/production/files/2017-07/documents/superfund_task_force_report.pdf

[8] Smart Scoping for Environmental Investigations Technical Guide: https://semspub.epa.gov/src/document/11/100001799; Strategic Sampling Approaches Technical Guide: https://semspub.epa.gov/src/document/11/100001800; Best Practices for Data Management Technical Guide: https://semspub.epa.gov/src/document/11/100001798

Optimization is itself a best practice that encourages site teams to improve all activities conducted to characterize and remediate sites. Under the optimization program, optimization reviews typically recommend best practices that the site team can subsequently apply, such as recommending additional contaminant source definition, while technical support projects typically assist site teams with using specific best practices, such as conducting SPP.

**Smart Scoping -** The smart scoping technical guide (EPA, 2018b) describes the use of smart scoping practices during any phase of a Superfund remedial investigation's project life cycle or in accordance with other similar federal, state, or tribal regulatory authorities. Use of these practices can support the development of a robust CSM, which, in turn, helps improve response action development, selection, and implementation. Smart scoping integrates adaptive management approaches and scoping and prioritization of site characterization activities. Adaptive management is an approach EPA is expanding to help ensure informed decision-making is coupled with the efficient expenditure of limited resources throughout the remedial process.

**Adaptive Management** is an approach particularly useful at large or complex sites that focuses limited resources on making informed decisions throughout the remedial process. Adaptive management requires the development of a clear site strategy with measurable decision points and focuses site decision-making on a sound understanding of site conditions and uncertainties. Based on site uncertainties, decisions are made from data collection to remedy selection and implementation that allow for the ability to adapt if these uncertainties result in fundamental changes to site conditions.

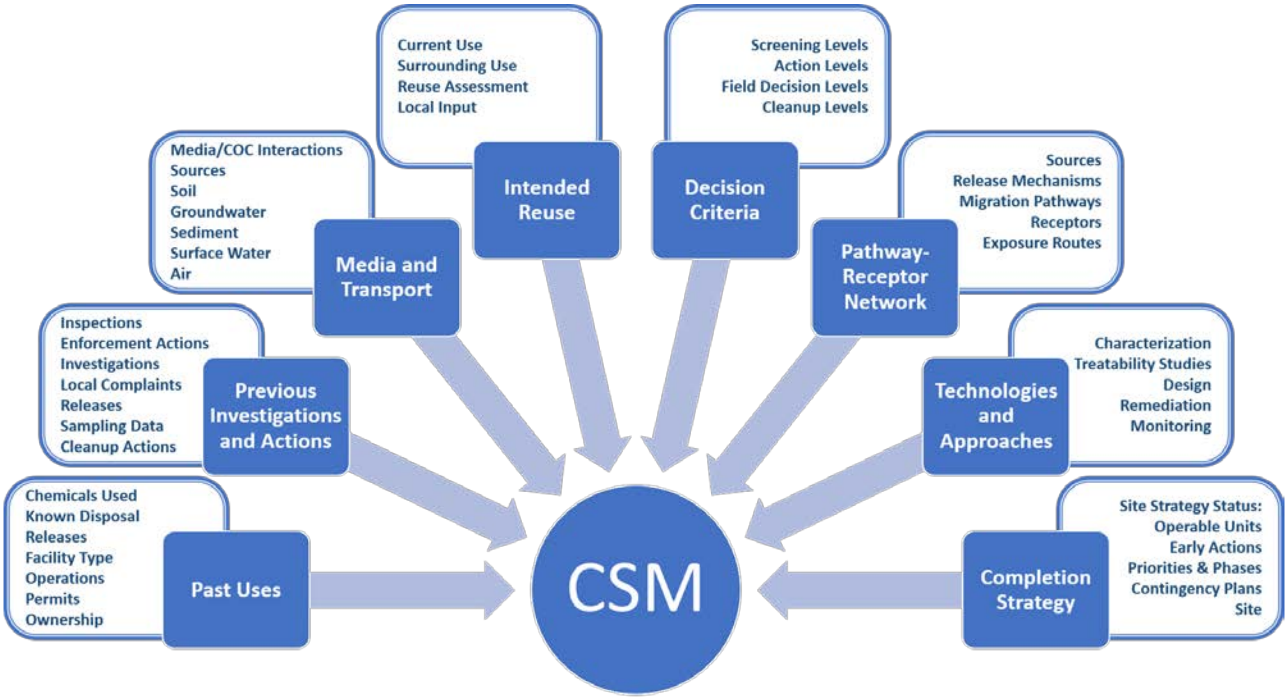
The smart scoping technical guide identifies the following best practices:

- Project life cycle conceptual site model
- Comprehensive team formation
- Systematic project planning
- Dynamic work strategies
- High-resolution and real-time measurement Technologies
- Use of collaborative data and multiple lines of evidence
- Stakeholder outreach
- Demonstration of method applicability
- Data management and communication
- Three-dimensional visualization and analysis
- Optimization

Smart scoping focuses on a complete CSM with all its components and the elements under each component (Figure 6). In 2020, EPA issued a new fact sheet on using a structured scoping approach for EPA-lead RI/FS projects. The new fact sheet includes a preliminary scoping step aimed at producing important site planning documents, such as the CSM. (EPA 2020)[9]

[9] Add link to RI/FS Scoping document

**Figure 6: Conceptual Site Model Components**




**Strategic Sampling Approaches -** The strategic sampling technical guide (EPA, 2018c) assists environmental professionals in identifying where strategic sampling approaches may benefit data collection activities at their project or site and what sampling approach may be most effective given site conditions. Strategic sampling is broadly defined as the application of focused data collection across targeted areas of the CSM to provide the appropriate amount and type of information needed for decision-making. Strategic sampling throughout a project's life cycle may help inform the evaluation of remedial alternatives or a selected remedy's design, improve remedy performance, conserve resources, and optimize project schedules. In addition, strategic sampling approaches assist with source definition and identify unique contaminant migration pathways, such as the vapor intrusion pathway.

The strategic sampling approaches technical guide identifies the following sampling approaches as best practices when site conditions allow their use:

- High-resolution site characterization in unconsolidated environments
- High-resolution site characterization in fractured sedimentary rock environments
- Incremental sampling
- Contaminant source definition
- Passive groundwater sampling
- Passive sampling for surface water and sediment
- Groundwater to surface water interaction
- Vapor intrusion

**Data Management** - The data management technical guide (EPA, 2018d) provides best practices for efficiently managing the large amount of data generated throughout the project life cycle. Thorough, up-front RI/FS planning and scoping combined with decision support tools and visualization can help reduce RI/FS cost and provide a more complete CSM earlier in the process. In addition, good data management practices, including robust management of data, meta data, and data quality, established during RI/FS can:

- Assist and streamline data management during subsequent phases of the remedial process (remedial design/remedial action and post construction).
- Improve data quality and usability of data generated throughout all phases of the Superfund pipeline.
- Enhance the accessibility of information needed to inform defensible decision making.

The data management technical guide identifies best practices for: planning for data collection and processing; collecting data; processing data; storing data; making decisions using data; and communicating data.

The following sections discuss the optimization program and best practices. Section 4.1 quantifies six key results site teams have achieved by applying recommended best practices. Section 4.1 also includes project highlights for three key results. Section 4.2 uses project highlights from site-specific optimization reviews and technical support projects to demonstrate how the optimization program promotes best practices.

## 4.1 Key Results from Applying Best Practices

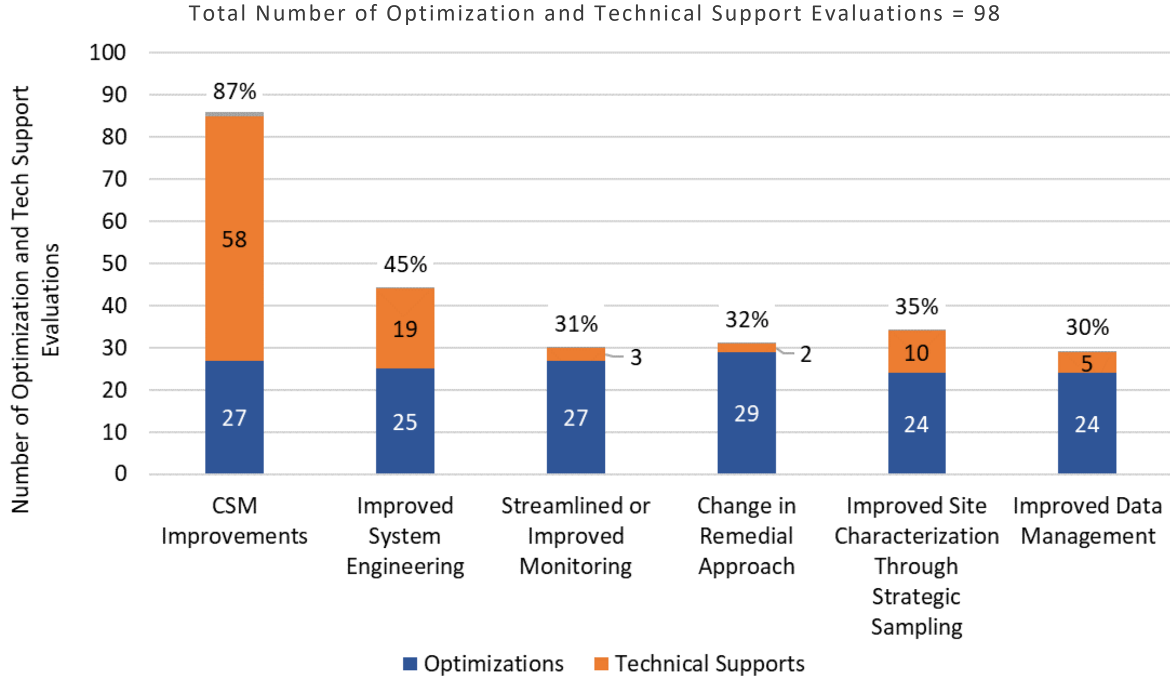
EPA has identified key results achieved by site teams when they applied best practices directly during technical support projects or results expected by implementing recommendations from optimization reviews. The key results analyzed are (1) CSM improvements, (2) improved system engineering, (3) streamlined or improved monitoring, (4) change in remedy approach, (5) improved site characterization through strategic sampling, and (6) improved data management.

The first four key results are related to the CSM and smart scoping best practices. The last two key results, while related to smart scoping, are discussed in their own technical guide. A comprehensive CSM has eight components and multiple elements under each component, many of which are difficult to quantify. The first key result (CSM improvements) quantifies general CSM improvements identified in the optimization recommendations. The next three key results (improved system engineering, streamlined or improved monitoring, and change in remedial approach) address elements of the Technologies and Approaches component of the CSM (see Figure 6) that are important to EPA. Improved system engineering includes modifying one or more engineered components of a remedial system to improve overall system performance. Improved system engineering can include adaptively-scaling remedies. Smart scoping, strategic sampling approaches, CSM improvement, and improved data management can facilitate adaptively-scaling remedies. Streamlined or improved monitoring involves adjustments to monitoring frequency, monitoring locations, and chemicals of concern analyzed as well as the analysis of monitoring results over time. Streamlined or improved monitoring also addresses data management practices. Changes in remedial approach include adding or changing remedies to better address remaining contamination or newly identified areas of contamination. The recommendations result in improved remedy effectiveness, cost reductions, and the achievement of site closure in a shorter period of time.

Specific strategic sampling approaches apply to several types of characterization activities conducted on various environmental media and help improve the technical understanding of site conditions. These approaches include HRSC[10] for groundwater and incremental sampling[11] for contaminated soil for improved characterization of source volumes and locations. Aspects of improved data management include improving data management planning, data acquisition, data processing, data analysis, data preservation and storage, and data publication and sharing.

Figure 7 shows the number of new optimization reviews and technical support projects that achieved or can achieve each of the key results. Each optimization review or technical support evaluation may have more than one key result.

**Figure 7. Key Results Achieved Through New Optimization and Technical Support Evaluations**




Project highlights are provided for these key results according to the best practice they are associated with in Section 4.2.1 Smart Scoping, 4.2.2 Strategic Sampling, and 4.2.3 Data Management.

## 4.2 Promoting Best Practices Through Optimization

EPA promotes the use and development of best practices through the optimization program. This section is organized by technical guide and provides optimization and technical support project

[10] More information on HRSC can be found here: https://clu-in.org/characterization/technologies/hrsc/index.cfm

[11] More information on Incremental Sampling can be found here: https://www.itrcweb.org/Team/Public?teamID=11

highlights for implementation of the smart scoping, strategic sampling, and data management best practices.

## 4.2.1 Smart Scoping

The Smart Scoping for Environmental Investigations Technical Guide (EPA, 2018b) describes the use of "smart scoping" practices during any phase of a Superfund site's project life cycle. These same practices can be applied to any site remediation. Use of these practices can support the development of a robust CSM, which, in turn, helps improve response action development, selection, and implementation.

**Focus on Smart Scoping Best Practices**

With the goal of developing and maintaining a robust CSM, smart scoping encourages both consideration of proven Superfund site strategies and the upfront commitment of time and resources. It also anticipates the use of best practices or tried-and-true strategies for cleanup of sites with similar contamination profiles. Smart scoping highlights the importance of: (1) participation by and input from RPMs, technical experts, risk managers, and other stakeholders; (2) establishing appropriate current and future land and groundwater resource use assumptions; (3) the appropriate design and use of human health and ecological risk assessments (including collection of appropriate information on natural or anthropogenic "background" and contaminant bioavailability); (4) leveraging in-house expertise (in lieu of contractor support); (5) considering the appropriate use of early or interim actions as a component of strategic site planning; and (6) highlighting sites which may benefit from the use of a structured adaptive management project or site management process.

**Smart Scoping highlights the importance of:**

- Participation by and input from technical experts and stakeholders.
- Understanding current and future land and groundwater resource use.
- The appropriate design and use of human health and ecological risk assessments.
- Leveraging in-house expertise.
- Appropriate use of early or interim actions.
- Identifying sites which may benefit from an adaptive management process.

Smart scoping best practices implemented at sites covered in this report include project life cycle CSM, SPP, dynamic work strategies and adaptive management, DMA, HRSC, and 3DVA.

**Project Life-Cycle Conceptual Site Model**

The EPA identified six stages of the project life cycle CSM including: Preliminary, Baseline, Characterization, Design, Remediation/Mitigation, and Post-Remedy. Each of these stages is a representation of the CSM as it evolves through defined states of both maturity and purpose over a project's life cycle.

The EPA has identified eight components that constitute a comprehensive CSM (Figure 6). A comprehensive CSM is not "one" thing but is comprised of several important elements that should be considered to move the project forward to completion. A comprehensive CSM addresses all eight components and multiple elements within each component.

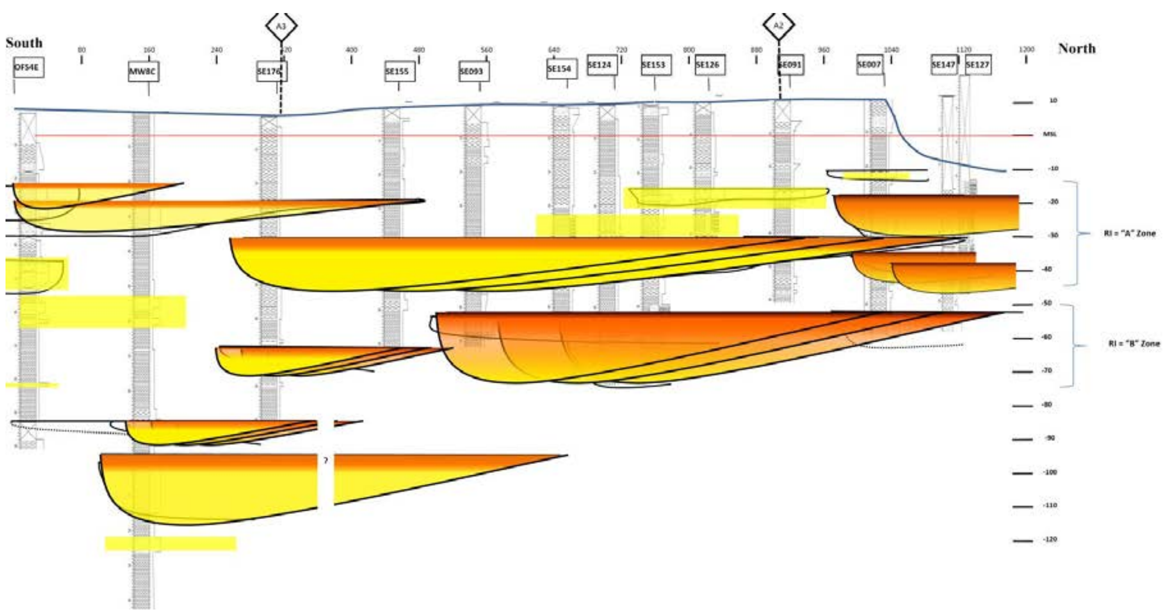
The EPA has found that the most effective investigations use a comprehensive CSM that addresses all elements of the project. Many CSM components are related to and affected by each other. For example, contaminant mass and distribution in the subsurface is greatly affected by the site-specific geology and the capacity of the aquifer to store and transport contaminants. The media component relates to the pathway-receptor network, technologies and approaches, and decision criteria components. Understanding the relationship between hydrogeology and the other CSM components can be especially important at sites with complex geology (e.g., fractured rock or intermixed gravels/ sands/silts/clays) where contaminant sources may occupy only a small area of the subsurface and flow occurs through thin zones. Under the CSM component Media and Transport, environmental sequence stratigraphy (ESS) applies geologic principles in these settings to help improve the understanding of groundwater flow and contaminant distribution and develop more effective remediation strategies. ESS refers to the application of both the concepts of sequence stratigraphy and facies models[12] to the types of datasets collected for environmental groundwater investigations, which are typically at the outcrop scale (tens to hundreds of feet vertically, hundreds to thousands of feet laterally) (EPA, 2017c). The application of ESS to contaminated groundwater sites can be broadly subdivided into three general phases:

- Phase 1 – Synthesize the geologic and depositional setting based on regional geologic work and identify facies models which are applicable to the site.
- Phase 2 – Review the existing CSM and site lithology data in light of Phase 1 findings and format existing lithology data to highlight vertical grain-size patterns (sequences) as a basis for correlations honoring stratigraphic “rules of thumb.”
- Phase 3 – Construct a hydrostratigraphic CSM consisting of maps and cross sections that depict the hydrostratigraphic units present as a basis to integrate and interrogate hydrogeology (e.g., water levels, pump test, slug test) and chemistry data (e.g., constituents, concentrations).

[12] Facies Model: Conceptual construct describing the processes acting in a particular depositional environment to transport, deposit, and preserve sediment, usually presented as a three-dimensional block diagram illustrating the organization of sedimentary bodies in the stratigraphic record (EPA, 2017c).

| McCormick & Baxter Creosoting Co. Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendations** | **Outcomes** |
| **Remedial Design** | • Improve understanding of media and transport | • Environmental Sequence Stratigraphy | • Vertical transport of NAPL occurs through thick channel sands, and permeability enhancement<br>• Permeable zones are relatively narrow and often truncated on the ends by abrupt change to silt/clay<br>• Large scale horizontal contaminant transport appears to be limited to within the channel sands | • CSM Improvements<br>• Change in Remedial Approach<br>• Cost Reduction<br>• Improved Data Management |

ESS technical support was provided for the **McCormick & Baxter Creosoting Co. Superfund Site** in Stockton, California in Region 9. Data for the investigation, including cone penetrometer (CPT), boring and geophysical logs, water level data, Laser Induced Fluorescence logs, and AutoCAD maps of the Site were provided by the EPA Region 9 Site Team. CPT logs from a total of 49 boreholes across the site were utilized in conjunction with borehole information from those locations. Four detailed cross sections were produced utilizing the 49 CPT logs and a sequence stratigraphic correlation approach was chosen to identify the hydrostratigraphic units based on relative permeability inferred from grain size. Permeable hydrostratigraphic units were interpreted as individual or stacked fluvial channel bars and splay/overbank deposits embedded within thick sequences of clay and silt.



The McCormick & Baxter Creosoting Co. ESS team concluded that while the channel bars indicated the highest porosity-permeability, and therefore the highest potential for contaminant transport, they were often truncated and discontinuous and limited the horizontal transport of contaminants and non-aqueous phase liquid (NAPL). The team also concluded that NAPL was non-mobile and the likelihood of offsite transport in the deeper zone was low. The site team used the updated CSM to consider more cost-effective remedies that did not require large scale treatment or removal of NAPL from discontinuous stream channels.

**Improved system engineering** includes modifying one or more engineered components of a remedial system to improve overall system performance. Improved system engineering can include adaptively scaling remedies or using a more targeted approach that applies technologies to a specific and well-defined area. Smart scoping, strategic sampling approaches, CSM improvement, and improved data management can facilitate adaptively-scaling remedies.

| Univar RCRA Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| Corrective Action | • Insufficient progress<br>• Inefficient P&T | • Statistical analysis of groundwater data using the Monitoring and Remediation Optimization System software | • Prioritize extraction of high flow rate wells to increase mass extraction<br>• Optimize air to water settings of the extraction system<br>• Determine impact of SVE on groundwater flow patterns | • CSM Improvements<br>• Improved System Engineering |

An optimization evaluation was conducted at the **Univar RCRA Site** in Portland Oregon in 2017. The Univar facility is an active chemical distribution facility within a heavily industrialized area northwest of downtown Portland. Univar operations have included packaging, storage, and distribution of bulk chemicals since 1947. Releases over the years have resulted in chlorinated volatile organic compounds (VOCs) contamination in soil and groundwater, including trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), and tetrachloroethene (PCE). Other non-chlorinated contaminants of concern (COCs) include benzene, toluene, ethylbenzene, and xylenes. Univar has constructed and implemented Interim Corrective Measure (ICMs) that include groundwater extraction, soil vapor extraction (SVE), a VOC water treatment system, a VOC vapor treatment system, and NAPL recovery.

The optimization review team recommended prioritizing the transition of groundwater extraction from two extraction wells that were removing very low contaminant mass due to low flow rates to wells with higher flow rates. The Univar site team implemented this recommendation and reported increased mass extraction from one of the extraction wells and is investigating what optimal air to water settings are needed in order to handle the increased contaminant load from the well so that they can maintain National Pollutant Discharge Elimination System (NPDES) permit compliance.

The optimization review team also recommended that current extraction wells, future extraction wells, and several monitoring wells with elevated concentrations of 1,1,1-TCA be analyzed at least one time for 1,4-dioxane, using EPA method 8270 (or 8270 SIM) to achieve a detection limit of 2 micrograms per liter. The objective was to determine if 1,4-dioxane is present in groundwater as a potential COC and evaluate the potential for the air stripper influent or effluent to be impacted by 1,4-dioxane (currently or in the future). This recommendation was implemented, and the site team confirmed that 1,4-dioxane is present and is passing through the treatment system in relatively low concentrations. The team is working with the risk assessor to determine what concentration should be allowed in treated effluent and working with Oregon Department of Environmental Quality on the NPDES permit renewal.

Other recommendations that are in progress include determining if SVE is impacting groundwater flow patterns, evaluating tidal influence on groundwater, delineating source areas, and updating the CSM before moving forward with the corrective measure study.

**Streamlined or improved monitoring** recommendations involve adjustments to monitoring frequency, monitoring locations, and chemicals of concern analyzed as well as the analysis of monitoring results over time. Streamlined or improved monitoring also addresses data management practices.

| Peterson/Puritan, Inc. Superfund Site –Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| **O&M** | • Large monitoring network with unknown efficiency<br>• Incomplete source characterization | • Statistical analysis of groundwater data using MAROS tool | • Develop source investigation plan addressing source containment and mass reduction, and plume stability<br>• Additional source characterization, synoptic well sampling | • CSM Improvements<br>• Streamlined and Improved Monitoring |

A 2016 optimization evaluation was conducted at **Peterson/Puritan Inc. Superfund Site**, located in an industrial area within the towns of Cumberland and Lincoln, Rhode Island in EPA Region 1. This optimization review focused on remedial activities in operable unit (OU) 01, including the source, downgradient and former Quinnville Wellfield areas. As a result of industrial activities, groundwater in the shallow and bedrock aquifers has become contaminated with VOCs. Priority contaminants in groundwater include PCE and TCE and degradation products cis-1,2-dichloroethene and vinyl chloride. Contamination has likely diffused into fractured bedrock and fine-grained sediments, creating the conditions for long-term, low-level release of contaminants through slow desorption. To support development of an optimized groundwater monitoring network, groundwater data were evaluated by the optimization team using the Monitoring and Remediation Optimization System (MAROS) software. Statistical results from the MAROS analysis, along with an evaluation of priority monitoring objectives, were used to recommend an optimized groundwater monitoring strategy for the source and downgradient areas of the plume.

Recommendations to streamline and improve monitoring included using the existing groundwater monitoring network to better characterize the remaining source. After the optimization evaluation, the existing groundwater network was sampled, and the results were used to inform the Source Investigation Plan.


Monitoring recommendations for Peterson/Puritan Inc. OU01, from June 2016 Optimization Review. Appendix C Monitoring Optimization Results. Figure C.2

The site monitoring plan was modified to accommodate specific groundwater monitoring objectives identified by the optimization team for long-term site management. The modifications include providing data to:

- demonstrate source mass containment and mass reduction;
- demonstrate potential downgradient plume stability, migration, or natural attenuation;
- delineate the plume extent above cleanup goals;
- support estimates of time to cleanup; and
- demonstrate remedy protectiveness and attainment of cleanup goals.

Additional recommendations that were incorporated after the optimization evaluation include a source characterization sampling plan, routine monitoring for source containment and source attenuation, downgradient plume monitoring, and adding wells for synoptic water level measurements.

A **change in remedial approach** includes adding or changing remedies to better address remaining contamination or newly identified areas of contamination. The recommendations provide improvements in remedy effectiveness, cost reductions, and the achievement of site closure in a shorter period of time.

| Jones Road Ground Water Plume Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| **Design** | • Large and complex site | • Improve CSM, characterize downgradient Lower Chicot water-bearing zone, delineate shallow water-bearing zone | • Aggressive source treatment<br>• Phased remedial approach using SVE, in situ bioremediation | • CSM improvements<br>• Change in remedial approach from large P&T system to aggressive source control and smaller P&T system phased in as needed<br>• Remedy performance monitoring |

A 2014 optimization evaluation at the **Jones Road Ground Water Plume Superfund Site** in Region 6 led to changes in the site's remedial strategy. A dry-cleaning facility operated at the site between 1988 and 2002 in a small shopping center in an area of mixed commercial and residential land use. Releases of chlorinated VOCs from improper disposal of dry-cleaning solvents migrated vertically downward through the unsaturated zone to perched water and lower aquifers, where multiple private water supply wells were and are presently located. The 2010 Record of Decision (ROD) had selected installation of two P&T systems for the shallow source area soil, the Shallow Water-Bearing Zone (WBZ) and the Deep Chicot Aquifer; in situ chemical oxidation (ISCO) for shallow source area soil and the Shallow WBZ; and bioaugmentation for the Deep Chicot Aquifer.

The August 2014 optimization review recommended that the remedial action (1) prioritize the source mitigation of two zones of soil vapor-phase contaminants (the shallow source area soil and the Deep Unsaturated Chicot Sand) that are contributing to the Deep Chicot Aquifer contamination, and (2) initiate the in situ bioremediation (ISB) of the Shallow WBZ, the third source contributing to the deeper migration of contaminants. The Optimization Review concluded that addressing the continuing sources of contaminants to the dissolved phase groundwater will be more cost-effective at this time, with long-ranging benefits over time.

Recommendations included using a phased remedial approach to include aggressive source treatment to reduce VOC discharge to the Deep Chicot Aquifer, supporting aquifer restoration in the lower plume by installing an SVE system in the Deep Unsaturated Chicot Sand Unit, and pilot testing an SVE system for the shallow source area soil, installing a full system if successful. As the overlying active vapor-phase contaminant sources are eliminated, it will decrease the impacts to underlying groundwater contaminant concentrations over time. Recommendations included related groundwater monitoring to establish that source reduction was achieving predicted contaminant decreases in both the Shallow WBZ and the Deep Chicot Aquifer.

ISB was initiated in January 2016 with the injection of amendments to support enhanced reductive dechlorination to degrade the Site contaminants. This was followed up by hot spot treatments in March 2018. Groundwater monitoring results from the sampling done in May and November 2018 in the shallow wells show significant declines in the contaminant levels since ISB injections began in January 2016. Additional groundwater sampling conducted in June 2019 and January 2020 continue to show a significant decline except for one well from the January 2020 sampling results. This well is currently being evaluated and addressed. Construction on the SVE system began in April 2019, and operations began in July 2019.

As more groundwater monitoring data becomes available and the extent of contamination is refined further, the need for a P&T remedy to contain the migration of groundwater contaminants will be evaluated at that time.

### Systematic Project Planning

SPP is an efficient method for comprehensive planning, design, and implementation for all stages of hazardous waste site investigation and cleanup projects; it also supports the iterative decision-making process (i.e. learning by doing) established in adaptive management plans. SPP is a process that lays a scientifically defensible foundation for proposed project activities. It usually includes identification of key decisions to be made, the development of a CSM in support of decision-making, and an evaluation of decision uncertainty along with approaches for managing that uncertainty in the context of the CSM.

SPP meetings were held to develop planning and design goals for the **Saunders Supply Co. Superfund Site** and **Selma Pressure Treating Superfund Site** and prior to fieldwork at the **Wilcox Oil Company Superfund Site** and **Carson River Mercury Site Superfund Site**. The overall goal of an SPP Meeting is to gather all of the sites stakeholders for a multi-day meeting to discuss and review the CSM, address technical issues, and develop steps forward, including future site investigations, data quality objectives (DQOs), and an exit strategy towards site closure.

| Saunders Supply Co. Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| **O&M** | • Insufficient progress | • Improve CSM, additional characterization of source and downgradient plume areas<br>• Establish completion criteria | • Delineate current extent of potential source and groundwater contamination<br>• Update CSM with HRSC<br>• Improve treatment system capacity | • CSM Improvements<br>• Improved System Engineering<br>• Use of Strategic Sampling |

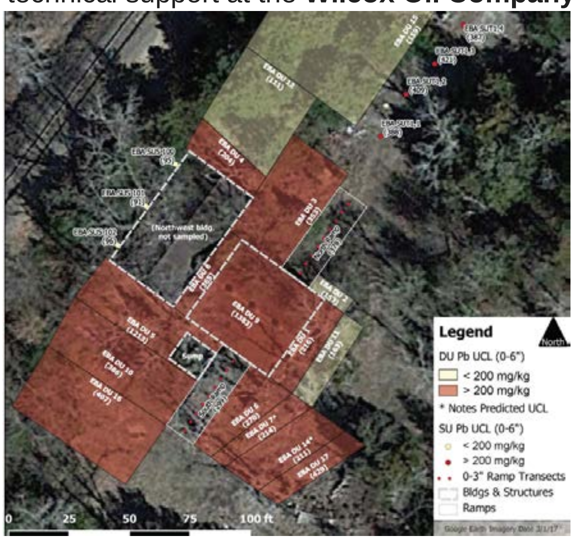
In 2016, an optimization evaluation was performed at the **Saunders Supply Superfund Site**. The Optimization Team recommended additional characterization in the source area, downgradient plume, and a nearby stream and pond using HRSC. The team also recommended improvements to the P&T system, performance monitoring, and establishing remedy operation completion criteria. To help plan the implementation of some of the recommendations from the 2016 Optimization, an SPP meeting was held for the Saunders Supply Site. Representatives from EPA HQ, EPA Region 3, and the state of Virginia participated in a two-day meeting that culminated in a work plan geared towards moving the site towards closure. The participants agreed on the CSM, data gaps, and data to be collected to fill the data gaps. EPA Region 3 and Virginia Department of Environmental Quality have planned the additional characterization activities and are identifying funding to carry out the actions.

### Dynamic Work Strategies

Design and implementation of dynamic work strategies applies to contaminated site characterization, remediation, or monitoring (or a combination thereof) and includes built-in flexibility guided by a pre-approved decision logic. As information is gathered, it is used to adapt the specific activities in real-time so that subsequent activities will best resolve remaining data and decision uncertainties. The goal is to evolve the CSM and complete remedial actions in as few mobilizations as feasible while providing flexibility for field teams and decision-makers to address site realities or unexpected features during these field activities. All planned work activities are described in written work plans appropriate to program oversight.

| Wilcox Oil Company Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| RI/FS | • Planning for site characterization and site management | • Dynamic work strategy<br>• Real-time measurement using XRF<br>• Incremental sampling<br>• HRSC | • Decide on location of next samples using results of samples collected earlier<br>• Update CSM as samples are processed | • CSM Improvements<br>• Use of Strategic Sampling<br>• Improved Data Management |

A dynamic work strategy was applied during the real-time analysis and incremental sampling technical support at the **Wilcox Oil Company Superfund Site** in Bristow, Oklahoma. The goal of the project was to quantify lead concentrations in surface (0 to 6 inches) and subsurface (6 to 24 inches) soil at two separate processing areas with different release mechanisms. Incremental composite soil sampling was used to produce a robust, statistically confident mean concentration of lead over a defined area and soil depth. The sample design optimized sample scale and coverage to provide high-resolution delineation of soil based on the 200 parts per million (ppm) action level. XRF data provided real time results to support decision making. This dynamic work strategy allowed the field team to decide on the location of the next sample based on the results of samples collected earlier in the day or week. Because statistically significant data were being generated in real-time, the field team was able to update the CSM as samples were processed and analyzed and adjust the sampling design to address newly identified source areas.




Although definitive 200 ppm boundaries could not be identified at the two study areas, the data collected during this adaptive sampling program led to real-time revision of the preliminary CSM. The revised CSM recognizes that high levels of lead contamination exist throughout the Wilcox area from many former operations across large areas. Lead particles transported by re-worked shallow material, wind, and vehicle travel further expanded the affected areas such that areas with concentrations less than 200 ppm are relatively small and represent the exception rather than the base condition. Finally, data from this study was used in a September 2018 Source Control ROD that included removal of highly contaminated soil from one of the study areas as part of the selected remedy.

### Demonstrations of Method Applicability

A DMA is also called a "methods applicability study" or a "pilot study" to evaluate the investigative approach. The method involves pretesting proposed sampling or analytical methods to evaluate site-specific performance. Such studies are recommended by EPA prior to finalizing the design of sampling and analysis plans for waste projects [SW-846 Section 2.1].

| Carson River Mercury Site Superfund Site– Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| **RI/FS** | • Planning for site characterization and site management | • Demonstrate Method Applicability<br>• Real-time measurement using XRF<br>• HRSC | • Established the comparability of the XRF data with traditional laboratory methods | • CSM Improvements<br>• Use of Strategic Sampling<br>• Improved Data Management |

Prior to conducting a full-scale field study project, managers for the **Carson River Mercury Superfund Site** in Nevada were interested in evaluating the performance of XRF instrumentation for the simultaneous analysis in the field of mercury, lead, arsenic, and selenium in soil affected by the mining operations associated with the Comstock Lode. Relevant aspects of performance included evaluation of several models of XRF for their respective detection limits, linear range, inter-element interferences, analytical precision, and comparability with other analytical methods. The most effective processing and analytical techniques were selected for use in a follow-up study that evaluated field sample collection. The team met the primary goal of the DMA and established the comparability of the XRF data with traditional laboratory methods, i.e., inductively coupled plasma mass spectrometry for lead, arsenic and selenium, and cold vapor atomic absorption spectroscopy for mercury. The information from the DMA was used as a proof of concept and foundation for the full-scale field study.

### High-Resolution and Real-Time Measurement Technologies

HRSC includes investigation tools and strategies appropriate to the scale of heterogeneities in the subsurface that control contaminant distribution, transport, and fate. The HRSC techniques provide the degree of detail necessary to understand exposure pathways, processes affecting the fate of contaminants, mass distribution and flux by phase and media, and how remediation or mitigation measures may affect the problem. Many HRSC techniques include real-time measurement technologies which refer to any data generation mechanism that supports real-time decision-making, including rapid turn-around from a fixed laboratory (using either quantitative or qualitative analytical methods) or field-based measurement technologies.

**Examples of Real-Time Measurement Technologies**

| Technology | Media | Example COCs and Properties |
|---|---|---|
| X-Ray Fluorescence (XRF) | Soil, Solid Surface | Metals |
| Membrane Interface Probe (MIP) | Soil, Groundwater | VOCs |
| Laser Induced Fluorescence (LIF) | Soil, Groundwater | NAPL PAHs, Dye LIF = chlorinated VOC |
| Electrical Conductivity Meter | Groundwater, Surface Water | Metals, Nitrate |
| Hydraulic Profiling Tools | Soil, Groundwater | Hydraulic Conductivity (estimate) |
| Forward-Looking Infrared Technology | Surface Water/Groundwater Interface | Groundwater Discharge Location via Temperature |
| Passive Samplers and Flux Meters | Groundwater | VOCs, SVOCs, Metals, PCBs, Groundwater Flow Rate |
| Bioassay and Colorimetric Test Kits | Groundwater, Surface Water | VOCs, SVOCs, Metals, PCBs |
| Mobile Laboratories | All | VOCs, SVOCs, Metals, PCBs |
| Surface and Borehole Geophysics | Sources, Overburden Soils and Bedrock | Drums/Tanks, Utilities, Lithology, Fractures, Groundwater Flow, Inferred COC |

Real-time XRF analysis was coupled with incremental sampling to characterize metal concentrations in surface (0 to 6 inch) and subsurface soil (6 to 24 inch) at the **Wilcox Oil Company Superfund Site** and **Carson River Mercury Superfund Site**. At both sites, bulk and sieved soil fractions were analyzed with a field portable XRF in benchtop mode for real-time analysis of lead at the Wilcox Site and mercury, lead, and arsenic at the Carson River Site. Bulk field samples were transferred into large “XRF Read” bags and at least four XRF “shots” were collected on the bag (two on each side). After each XRF run, the results were input into a real-time Excel XRF (RTeX) form that performs statistical calculations specific to the site. The RTeX form calculates and displays the sample mean, standard deviation, and error (reported as percent relative standard deviation). After the bulk samples were analyzed, they were sieved with a 100-mesh sieve (<0.149 mm) and placed in a new XRF read bag. The sieved samples were then analyzed with the XRF using the same protocol as the bulk sample.

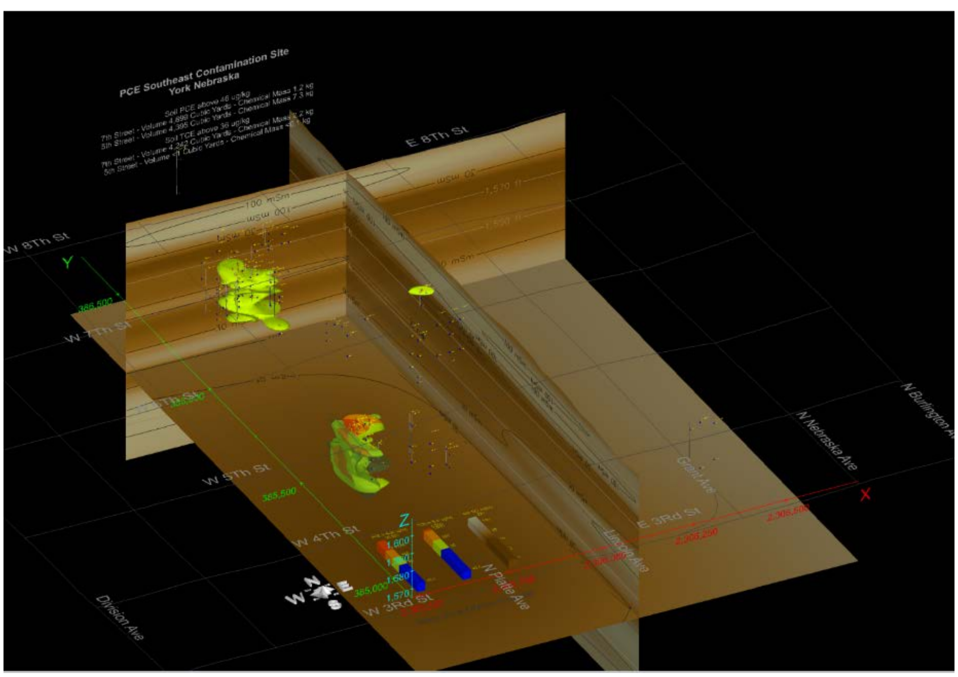
The real-time XRF analysis coupled with incremental sampling at these two sites allowed the site team to update the CSM in real time and adjust the sampling plan as a part of a dynamic work scope. The key to this coupled approach is that the site team can generate defensible, statistically significant results during the field mobilization. This allows the team to manage the field work with an adaptive approach and make necessary changes as data are generated. At the Wilcox Site, the team was able to adjust the boundaries of sample areas, add new sample areas, and omit planned samples as the lab team generated results. The sample design for the Wilcox Oil site relied heavily on this dynamic approach because the goal was to delineate the 200 ppm action level boundary around two source areas. The results of the first samples dictated whether the next sample would be collected closer to the source or farther from it. Also, preliminary results indicated that unpaved roads on the site may be contributing to contaminant transport, so the sampling was adjusted to collect samples along the roads.

### Three-Dimensional Visualization and Analysis

The EPA has found that understanding subsurface heterogeneity at a much higher resolution is critical for evaluating contaminant fate and transport, and in designing and implementing more effective and targeted remedial actions. Obtaining a correct geologic interpretation is foundational to depicting the subsurface. Visualization software has been successfully used to perform 3DVA that integrates three important subsurface parameters - geology, hydrogeology, and contaminant chemistry - into a single spatially correct format. The EPA has used 3DVA successfully to better understand subsurface structure and characteristics and to reconcile technical CSM discrepancies.

| PCE Southeast Contamination Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| RI | • Planning for site characterization | • 3DVA | • Consider that highest soil vapor concentrations are associated with the presence of COCs in soil in future decision making | • CSM Improvements |

A 3DVA was developed for the **PCE Southeast Contamination Superfund Site** in York, York County, Nebraska. The EPA has been conducting a time-critical removal action since 2011 to address the drinking water pathway and vapor intrusion pathway. Challenges at this site include widespread contamination across 2 square miles in a residential area, multiple sources, and a vapor intrusion pathway in residential properties. Since 2011, 27 vapor mitigation systems have been installed and 15 residential properties have been connected to the public water supply. Groundwater and vapor intrusion sampling activities are ongoing to ensure exposure pathways are not complete. The PCE Southeast 3DVA modeled COCs in soil, groundwater, and soil vapor across the site. The



3DVA revealed that the highest soil vapor concentrations are associated with the presence of COCs in soil. The 3DVA has been used in making site decisions and planning future site characterization efforts.

### 4.2.2 Strategic Sampling

The Strategic Sampling Approaches technical guide assists environmental professionals in identifying where strategic sampling approaches may benefit data collection activities at their project or site and what sampling approach may be most effective given site conditions and study objectives. Strategic sampling is broadly defined as the application of focused data collection across targeted areas of the CSM to provide the appropriate amount and type of information needed for decision-making. Strategic sampling throughout a project's life cycle may help inform the evaluation of remedial alternatives or a selected remedy's design, improve remedy performance, conserve resources, and optimize project schedules. In addition, strategic sampling approaches assist with source definition and identify unique contaminant migration pathways, such as the vapor intrusion pathway. Strategic sampling approaches also target early action opportunities to mitigate potential threats as well as the data needs for technology applications over the longer term, including targeted pilot studies.

| Ouachita-Nevada Wood Treaters Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| LTRA | • Insufficient progress | • Additional source delineation<br>• Additional characterization of dissolved plume | • Characterize media outside of slurry wall<br>• Characterize downgradient dissolved-phase plume<br>• Adjust monitoring frequency<br>• Consider three remedial options | • CSM Improvements<br>• Improved System Engineering<br>• Change in Remedial Approach<br>• Streamlined or Improved Monitoring |

A 2015 optimization evaluation was conducted at the **Ouachita-Nevada Wood Treaters Superfund Site** in Ouachita County, Arkansas. The five-acre site was in the long-term response action (LTRA) phase of remediation at the time of the optimization and was managed as a fund-lead remediation project by EPA Region 6[13]. COCs from primary releases include pentachlorophenol (PCP) and creosote components such as phenols, naphthalene, and polyaromatic hydrocarbons. A dissolved groundwater plume is present in the shallow sand aquifer and light non-aqueous phase liquid (LNAPL) is present in within the source area. A Remedial Action completed in 2006 included installation of a slurry wall (located along the western edge of the property boundary), recovery and injection wells, and an LNAPL recovery system.

[13] The site is currently in the O&M phase of remediation and O&M work is managed by the Arkansas Department of Environmental Quality.

The optimization review team determined that the LNAPL recovery system at the source was not working as effectively as anticipated. Because LNAPL is the source of mass to the dissolved phase plume, without LNAPL removal, any remedies for the dissolved phase plume will require long-term operation. The Optimization team recommended additional site characterization including soil borings for source soil delineation and groundwater grab samples for additional characterization of the dissolved phase plume. They also recommended the installation of four additional groundwater monitoring wells with the final locations contingent on the soil and groundwater investigation. If the additional site characterization and monitoring indicated that there was no potential for off-site migration, the Optimization team recommended continuing the groundwater monitoring program, manual LNAPL collection with a bailer during groundwater monitoring events, and considering ISCO to treat highly contaminated groundwater in the source area.

In 2016, a total of 30 soil samples were collected from 15 locations to help delineate 1/4 -acre of the source area west of the slurry wall. To identify the dissolved phase plume, two transects were installed per recommendations identified in the Optimization Report. Additionally, four permanent groundwater monitoring wells were installed to monitor contaminant attenuation and potential migration. EPA is currently working on the remedial design for in situ treatment in the source area west of the slurry wall.

### 4.2.3 Data Management

The Data Management Technical Guide (EPA, 2018d) provides best practices for efficiently managing the large amount of data generated throughout the data life cycle. Thorough, up-front RI/FS planning and scoping combined with decision support tools and visualization can help reduce RI/FS cost and provide a more complete CSM earlier in the process. In addition, data management plays an important role in identifying data gaps during the RI/FS, remedial design, and remedial action phases. Following advanced data management techniques ensures the utility and maximum usability of the data as a site moves through the cleanup lifecycle.

The benefits of managing the data life cycle in a comprehensive manner are:

1. Overall data quality improvement to support decision-making due to consistent content and a format that reduces data entry errors;
2. Clear data collection guidelines, processing, and storage, which eliminates the cost of recollecting samples and can preserve the integrity and availability of older information as inputs to the CSM;
3. A better understanding of data quality and any limitations when analyzing and making decisions; and
4. Improved accessibility to data in electronic format, which supports real-time interpretation and optimization of collaboratively collected data as well as the use of decision support tools (such as statistical analysis, visualization, and modeling) while field crews are mobilized. A comprehensive data management approach ensures the use of a common data platform and data consistency, accessibility, integration, and versatility.

| Jard Company Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| RI/FS | • Large and complex site | • Develop data management plan for historical data Update CSM | • Organize data into sampling chronology<br>• Determine data usability<br>• Identify which historic datasets are needed for decision-making | • CSM Improvements<br>• Improved Data Management |

During a 2017 optimization evaluation at the **Jard Company Superfund Site**, the optimization team recommended the organization of historical data into a sampling chronology to develop a record of all data collection events, the medium and locations sampled, and analyses performed. The goal was to determine which components of the historical dataset contain data usable for risk assessment or for screening purposes and which components are unusable due to problems with sampling and analysis or lack of quality assurance/quality control documentation. This recommendation was implemented along with updates to the CSM. It is important to identify which historic datasets are needed for decision-making before investing the time to incorporate them in a comprehensive database. Not all historic data is worth digitizing or converting into an updated format and efforts should focus on relevant data.

| Bunker Hill Mining and Metallurgical Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| RI | • Large and complex site | • Develop monitoring framework for remedy effectiveness and long-term monitoring<br>• Update data quality objectives | • Comprehensive review of existing data in taking into consideration of data quality objectives<br>• Improve data management and storage into comprehensive database | • Improved Data Management<br>• Streamlined and Improved Monitoring |

Several data management recommendations were made for the **Bunker Hill Mining and Metallurgical Superfund Site** during a 2014 optimization evaluation. The optimization team recommended a comprehensive review of existing data to address monitoring objectives included in the site's original DQOs. This comprehensive review and analysis of groundwater and surface water data was completed in 2016 to establish baselines and trends prior to remedy design and construction. Significant annual cost savings of up to approximately $150,000 annually resulted from reduction in the groundwater monitoring program.

The team also recommended storing data in an improved, comprehensive site database designed specifically for the Bunker Hill site that could accommodate historical soil, surface water, and groundwater data as well as ecological and habitat restoration metrics. They noted that the current database was not designed for large sites where diverse types of data, such as ecological metrics, are collected. Based on this recommendation, the site team transferred data to a site-specific Scribe database and the development of an associated Database Management Plan is in progress.

| Standard Mine Superfund Site – Highlight Summary | | | | |
|---|---|---|---|---|
| **Phase** | **Challenge** | **Tool/Analysis** | **Recommendation** | **Outcomes** |
| **RA** | • Quick turnaround technical review of the Emergency Action Plan needed | • Develop Emergency Action Plan | • EAP should include contact information for potentially impacted downstream users and easy to follow charts and tables<br>• Affix plan to communication devices | • Improved Data Management |

Following an FY 2016 optimization evaluation at the **Standard Mine Superfund Site**, the site team implemented several data management recommendations. These recommendations were incorporated in the updated 2017 Emergency Action Plan (EAP) to provide direction in the case of emergencies at the site. The EAP included contact information for potentially impacted downstream users and easy to follow charts and tables that can be quickly referenced. Procedures were included in the documents as well as affixed to the communication devices that would be relied upon in the event of an emergency.

# 5.0 SUMMARY OF PROGRESS ON IMPLEMENTING THE NATIONAL OPTIMIZATION STRATEGY AND THE RECOMMENDATIONS OF THE SUPERFUND TASK FORCE

EPA has continued to successfully implement the National Strategy and expand the optimization program and its many benefits to reach a larger number of sites, across all stages of the Superfund pipeline. Four main elements form the basis of development and implementation of the National Strategy. They include:

- Element 1 – Planning and Outreach.
- Element 2 – Integration and Training.
- Element 3 – Implementation.
- Element 4 – Measurement and Reporting.

## 5.1 Planning and Outreach

EPA has continued to increase its success in planning and outreach to continuously identify sites or site projects that would benefit from an optimization review. This collaborative process between EPA HQ and the Regions, facilitated by ROLs and Superfund and Technology Liaisons (STLs), includes Regions identifying sites that may benefit from an optimization evaluation and requesting technical support from the EPA HQ team. Other government stakeholders (such as states, tribes, and local governments) and communities are also requesting optimization and technical support evaluations through their respective EPA Regions. In addition, an increasing number of requests are being generated from the optimization material presented at CERCLA Education Center (CEC) and National Association of Remedial Project Managers (NARPM) Training Program courses and EPA HQ and regional presentations at outside conferences and training programs. Support may be provided by EPA HQ, Regions, or resources from other EPA offices such as the Office of Research and Development (ORD).

The use of optimization practices helps to address stakeholder concerns and provide information on the protectiveness and efficacy of remedies and may instill more confidence to communities that remedies are and will remain protective. EPA's optimization website contains detailed information on the optimization program and is accessible to the public.

## 5.2 Integration and Training

EPA continues to collect, synthesize, and share optimization lessons learned through: (1) CEC and Environmental Response Training Program (ERTP) courses; (2) NARPM and On-Scene Coordinator Academy training programs; (3) periodic meetings of the National Optimization Team composed of EPA HQ staff, ROLs, and STLs; and (4) presentations at conferences and training programs sponsored by other entities within EPA (Brownfields, Federal Facilities, and RCRA corrective action programs) and outside of EPA (such as Battelle conferences, Northeast Waste Management Officials' Association conferences, and Association of State and Territorial Solid Waste Management Officials events).

Since the National Strategy was issued, nearly 400 participants have received training on optimization and optimization best practices. An optimization course was offered at NARPM in 2012, 2014, and 2016 and one is planned for the next NARPM. A total of 135 students have attended the optimization courses to date. Starting in April 2014, there have been 13 deliveries of the Best Practices course, with a total of 258 students attending.

EPA's understanding of best management practices for site characterization has grown through implementation of the National Strategy. EPA synthesized the lessons learned from conducting over 300 optimization reviews and technical support projects into three technical guides*: Smart Scoping for Environmental Investigations*, *Strategic Sampling Approaches,* and *Best Practices for Data Management*. EPA issued these three technical guides in November 2018 on topics related to optimization that were identified in the *Superfund Task Force Recommendations* (EPA, 2017b), Recommendation 8[14], to facilitate additional technology transfer of these best management practices. EPA has also developed standard operating procedures such as project engagement forms, checklists, and documentation to facilitate the scoping and conduct of optimization reviews.

## 5.3 Implementation

The primary goals of implementation are to extend optimization to all phases of the Superfund pipeline and to build capacity for integrating optimization concepts throughout the pipeline. EPA accomplishes this goal not only by executing training and integration efforts, but also by increasing the amount of optimization reviews conducted with site teams in all regions, introducing site team members to optimization concepts that then become incorporated as standard operating practice. Initially, all optimizations were done for sites in the remedial action or O&M phase of the Superfund pipeline. In FY 2015 through 2017, 48 percent of all optimizations were done in pre-remedial action phases including PA/SI, RI/FS, and remedial design phases (Figure 2, Section 2.0).

For the new optimization reviews, 67 percent of optimization recommendations were implemented, are in progress, or are planned. Another 21 percent are still under consideration and only 7 percent were declined. A small number of recommendations (3 percent) were deferred to the state or PRP for action, and 2 percent do not have status information available (Figure 3, Section 3.1).

Prior to implementing the National Strategy, EPA completed approximately seven optimizations per year. In late 2010, EPA initiated the development of the National Strategy to increase the capacity for conducting optimizations. Since implementing the National Strategy, EPA now completes approximately 20 optimizations per year on average (Table 1, Section 2.0). In addition to the number of completions per year, the capacity to support ongoing optimization events has increased to an average of 50 or more optimizations per year, with 69 events supported in FY 2017 (Table 1, Section 2.0). EPA also finalized the implementation of the Task Force Recommendation 7[15], promoting the

[14]Superfund Task Force Report Recommendation 8: Reinforce Focused Scoping Which Closely Targets the Specific Areas for Remediation and Identify and Use Best Management Practices in the Remedial Investigation/Feasibility Study Stage

[15] Superfund Task Force Report Recommendation 7: Promote Use of Third-Party Optimization Throughout the Remediation Process and Focus Optimization on Complex Sites or Sites of Significant Public Interest

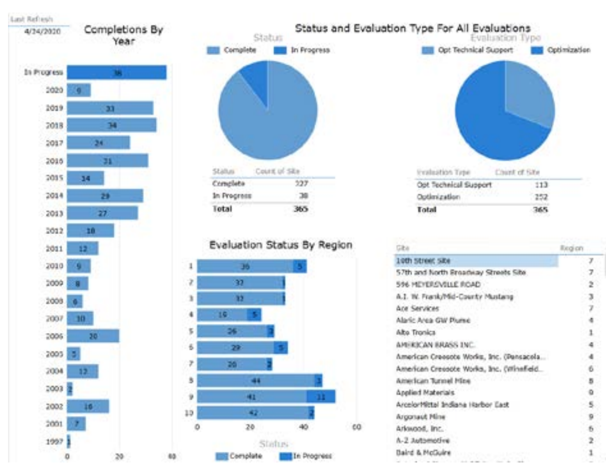
use of third-party optimizations. In the *Superfund Task Force Recommendations 2018 Update*[16], EPA noted "Since July 2017, EPA has implemented 18 optimization evaluations and is considering 17 additional optimization candidates. To prioritize allocation of optimization resources, EPA has established criteria to prioritize site attributes tied to Task Force recommendations, such as human exposure not under control; large and complex, such as sites with remedies greater than $50 million; stakeholder interests or concerns; projected completion dates within 5-15 years, where optimization may accelerate closure; and placement on the [Administrator's Emphasis List]. EPA is also implementing several projects to advance optimization practices and related tools in all phases of cleanup." (EPA, 2018a)

## 5.4 Measurement and Reporting

In order to more accurately track optimizations and be able to provide data and information regarding the program, EPA uses two tracking tables: the Optimization Project Log (OPL) and the Optimization Report Inventory and Tracking Tool (ORITT). In OPL, EPA lists all optimization evaluations (technical support projects and optimization review events) by site name and records key information about each event including:

- Event type (technical support or optimization review).
- Project lead, regional contact, and contractor support.
- Site type, media, and contaminant groups addressed.
- Current project status (anticipated, in progress or complete).
- Major project milestone dates (scoping call, kickoff call, site visit, drafts, and final reports).
- FY start and completion dates.

OPL is updated each week. Summary reports on the current status of all events supported during the current fiscal year are provided to EPA management.




In 2018, two SharePoint sites were developed for the optimization program. The first is an optimization and optimization-related technical support project file storage area for use by the headquarters optimization team. The site allows RPMs and other stakeholders to share background documents and data with EPA project leads and their contractor support for use in conducting the optimization evaluations. These background files are stored for easy access and knowledge of materials used to support the optimization effort. In addition, draft and final documents are stored on this SharePoint site. The second SharePoint site is available

[16] Superfund Task Force Recommendations 2018 Update (https://www.epa.gov/sites/production/files/2018-07/documents/sftf_recs_v9_final.pdf)

to all EPA staff and includes a dashboard showing data visualizations of all historical projects and details of projects being supported in the current fiscal year. The dashboards can be manipulated by the user in real time, such as focusing on projects conducted in one region or in one year. The site also includes a digital engagement form that can be filed out by any RPM seeking optimization support on a site.

In 2019, the optimization program began participating in ELMS. As part of that effort, tracking sheets referred to as proxy cards were developed for each ongoing optimization review. The proxy cards identify project leads, significant project milestones, and provide projected dates for future milestones. Each week, the headquarters optimization team meets in a “huddle” for 20 minutes to quickly provide any updates and identify any projects that are lagging. The proxy cards are placed on a flow board to display the status of the projects as a visual management tool. The visual management tools also help manage workload distribution. A goal of the optimization program ELMS project was to increase the number of headquarters project leads to more evenly distribute workload. The number of headquarters project leads has increased from two to seven since implementing ELMS.

ORITT houses recommendation data from all optimization reviews that have been completed to date. EPA records the names and category of recommendations and the implementation status of the recommendations. ORITT also includes the potential costs and savings projected by the optimization team for implementing each recommendation and can also include actual cost data when available. EPA is currently pursuing development of an enhanced ORITT system to be developed in Oracle.

Further details on meeting the goals of the National Strategy are included in Appendix A.

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# APPENDIX A

# PROGRESS ON IMPLEMENTING THE NATIONAL OPTIMIZATION STRATEGY

# TABLE OF CONTENTS

U.S. Environmental Protection Agency (EPA) has been successful in implementing the National Optimization Strategy ("the National Strategy") and expanding the optimization program, extending the benefits of optimization to a larger number of sites and across all stages of optimization and the Superfund pipeline from site assessment to site completion. This section presents a discussion of the successes and challenges EPA experienced while implementing the Strategy.

The National Strategy instituted changes to the Superfund remedial program business processes to take advantage of newer tools and strategies that promote more effective and efficient cleanups. The National Strategy identified several objectives to achieve verifiably protective site cleanups faster, cleaner, greener, and cheaper. The National Strategy envisions iterative efforts by Regions to pursue cost-effective expenditure of Superfund dollars, lower energy use, reduced carbon footprint, improved remedy effectiveness, improved project and site decision making, and accelerated project and site completion by deploying newer tools and strategies for site evaluation and remediation throughout the life cycle of the site cleanup.

Optimization in the context of the National Strategy is defined as:

> "Efforts at any phase of the removal or remedial response to identify and implement specific actions that improve the effectiveness and cost-efficiency of that phase. Such actions may also improve the remedy's protectiveness and long-term implementation which may facilitate progress towards site completion. To identify these opportunities, regions may use a systematic site review by a team of independent technical experts, apply techniques or principles from Green Remediation or Triad, or apply other approaches to identify opportunities for greater efficiency and effectiveness." (EPA, 2012b)

The National Strategy is built on the success of existing strategies, coordination with similar optimization technical support efforts, and the expansion of optimization reviews to more sites and to all phases of the remedial pipeline. Four elements form the basis of development and implementation of the National Strategy, as discussed in the following subsections:

- Section A.1 - Element 1 – Planning and Outreach.
- Section A.2 - Element 2 – Integration and Training.
- Section A.3 - Element 3 – Implementation.
- Section A.4 - Element 4 – Measurement and Reporting.

## A.1 Progress on Implementing Element 1: Planning and Outreach

Element 1 involves a series of planning and outreach efforts to document National Strategy goals, apply optimization to improve community engagement, nominate sites for optimization, and coordinate with related efforts. Element 1 is divided into four sub-elements. EPA's progress on each sub-element under Element 1 is discussed below.

**Element 1.1: Establish Strategy Goals:** The National Strategy established the following overarching goals:

- Incorporate optimization experience and principles in remedial program business practices including:
  - assessment of site cleanup progress, site technical performance, and costs;
  - Regional/EPA Headquarter (HQ) work planning and reviews; and
  - implementation of acquisition strategies and contracts management practices;
- Collect, synthesize, and share optimization lessons learned;
- Apply optimization practices earlier and throughout the remedial pipeline;
- Increase the number of optimization reviews supported by EPA to 20 to 30 sites annually; and
- Measure optimization outcomes and report results.

EPA has successfully achieved or is in the process of achieving the overarching goals of Element 1.1. EPA has incorporated optimization experience and principles in remedial program business practices by continuing to assess site cleanup progress, technical performance, and costs and documenting those in optimization reports and technical memos. Regions and EPA HQ work planning and reviews include an optimization component and all but one Region has identified a Regional Optimization Liaison (ROL) to facilitate optimization efforts at the regional level. In addition, Superfund and Technology Liaisons (STL) in all Regions are also participating in and facilitating Regional optimization activities. The EPA Superfund remedial program is in the process of replacing regional remedial contracts with a suite of national contracts to execute Superfund remedial work. Under these contracts, EPA will have the ability to incorporate optimization into task order requirements.

EPA continues to collect, synthesize, and share optimization lessons learned through (1) CERCLA Education Center (CEC) and Environmental Response Training Program (ERTP) courses, (2) National Association of Remedial Project Managers (NARPM) and On-Scene Coordinator Academy training programs, (3) periodic meetings of the National Optimization Team composed of EPA HQ staff, ROLs, and STLs, and (4) presentations at conferences and training programs sponsored by other entities within EPA (Brownfields, Federal Facilities, and Resource Conservation and Recovery Act corrective action programs) and outside of EPA (such as Battelle conference, Northeast Waste Management Officials' Association conference, and Association of State and Territorial Solid Waste Management Officials events).

EPA has applied optimization practices earlier and throughout the remedial pipeline, as evidenced in Figure 2 (Section 2.0 of main report). Figure 2 shows the Superfund stage of completed optimization reviews and technical support projects from fiscal year (FY) 2011 through FY 2017. EPA currently has a number of additional ongoing optimization reviews and technical support projects underway, as shown in Table A-1. This table lists the number of initiated, ongoing, and completed evaluations supported by EPA each year from FY 2011 through FY 2017. EPA has increased the number of optimization reviews and technical support projects it supports and has exceeded the goal of supporting 20 to 30 optimization reviews annually. EPA continues to measure optimization outcomes and is reporting on the results with this optimization progress report.

**Table A-1: EPA Support of Optimization**

| Fiscal Year | Started | Ongoing | Completed | Number of Optimization and Technical Support Evaluations Supported by OSRTI* |
|---|---|---|---|---|
| 2011 | 21 | 14 | 12 | 35 |
| 2012 | 21 | 23 | 18 | 44 |
| 2013 | 27 | 26 | 27 | 53 |
| 2014 | 18 | 26 | 29 | 44 |
| 2015 | 27 | 15 | 14 | 42 |
| 2016 | 38 | 28 | 31 | 66 |
| 2017 | 34 | 35 | 24 | 69 |

*** This column represents the number of evaluations started each fiscal year combined with the number of evaluations ongoing from the previous fiscal years.**

**Element 1.2: Apply Optimization as a Means to Improve Community Engagement:** The National Strategy identifies how optimization can be instrumental in providing structure and tools to improve communication with communities, local stakeholders, regulatory agencies, tribes, and Potentially Responsible Parties (PRPs). Below are examples of how optimization was used during FY 2011 through FY 2017 to facilitate or improve community involvement and communication:

1.2.1 *Triad Approach*. The Triad is an innovative approach to decision-making for hazardous waste site characterization and remediation. The Triad approach proactively exploits new characterization and treatment tools using innovative work strategies. The Triad refers to three primary components: systematic planning, dynamic work strategies, and real-time measurement systems. Efforts to advance site management strategies that help to more fully characterize sites and to increase confidence in the understanding of the extent, location, and behavior of contamination can help communicate site conditions and progress to stakeholders. EPA recently updated its Triad training with revision of the CEC course "Best Practices for Site Characterization Throughout the Remediation Process," which included identifying the best practices, updating the case studies with recent examples, and developing exercises that give participants the opportunity to apply the Triad concepts covered in the course.

1.2.2 *Remediation System Evaluations* (RSE) and *Long-Term Monitoring Optimization* (LTMO). EPA continued to conduct RSEs and LTMOs as part of remedy and LTM optimization reviews. The use of these and other optimization practices help to address stakeholder concerns and provide information on the protectiveness and efficacy of remedies and may instill more confidence to communities that remedies are and remain protective. The website www.epa.gov/superfund/cleanup-optimization-superfund-sites contains detailed information on the optimization program and is accessible to the public.

1.2.3 *Energy and material efficiency*. EPA has continued its effort to reduce the environmental footprint of remedies through environmental footprint reviews and has developed technical resources and training to assist project teams with site-specific efforts. These efforts help stakeholders understand the potential effects of remedies on their environment and project teams to understand and minimize those effects. The website www.epa.gov/superfund/superfund-green-remediation contains more information, technical resources, and available training sessions and is accessible to the public.

1.2.4 *Knowledge Transfer.* Current information resources and infrastructure, provided through www.epa.gov/superfund and www.epa.gov/superfund/superfund-training-and-learning-center and the Technology Innovation and Field Services Division's (TIFSD) internet seminars, provide a great deal of readily available and accessible information to stakeholders. In addition, EPA HQ, Regions, and Office of Research and Development (ORD) subject matter experts have assisted regions with community meetings related to site characterization and cleanup.

1.2.5 *Training.* EPA's CEC and ERTP provided training for the EPA and state regulators, tribes, other government stakeholders, and private industry that has been updated and revised to integrate both optimization and stakeholder engagement concepts. CEC and ERTP training courses are described on the website www.trainex.org/, which is also used for course registration.

**Element 1.3: Identify Projects and Sites for Optimization:** A collaborative process between EPA HQ and the Regions, facilitated by ROLs and STLs, is being used to identify sites or site projects that would benefit from an optimization review. Regions determine which sites may warrant an independent optimization review and, as applicable, request optimization support from the EPA HQ team. Support can be provided by EPA HQ, Regional, or ORD resources. In addition, an increasing number of requests are being generated from the optimization material presented at CEC and NARPM Training Program courses and EPA HQ and regional presentations at outside conferences and training programs.

Other government stakeholders (such as states, tribes, and local governments) and communities may also seek optimization technical support through their respective EPA regions and these requests are also frequently triggered after CEC course deliveries. Based on regional determination and available resources, EPA HQ, ORD, and Regions have provided stakeholders the requested technical support.

**Element 1.4: Coordinate with Complementary Technical Support Efforts:** Optimization efforts continue to support established remedial program goals. Optimization reviews and technical support projects collaterally support the National Remedy Review Board, Contaminated Sediments Technical Advisory Group, and Value Engineering efforts, five-year reviews, and transfer of sites from long-term response action to operation and maintenance (O&M). Optimization efforts also facilitate progress towards achievement of program measures such as construction completion, site-wide ready for anticipated use, human exposure under control, and groundwater migration under control.

Under this element, the National Optimization Program coordinates with key related EPA workgroups to connect with optimization and avoid conflicts with their efforts. Key workgroups include the subgroups of the Technical Review Workgroup and the forums under EPA's Technical Support Program, including NARPM and the Ground Water Forum, Engineering Forum, and Federal Facilities Forum.

## A.2 Progress on Implementing Element 2: Integration and Training

EPA has integrated optimization into program operations by creating technical resources to supplement existing guidance documents (as appropriate) and integrating optimization into its training programs. EPA is in the process of evaluating current incentives for optimization, addressing optimization in new guidance, and incorporating optimization language into contracts. Element 2 of the National Strategy has three sub-elements which are discussed below.

**Element 2.1: Create Technical Resources to Supplement Existing Guidance and Policy, and Address Optimization in New Guidance:** EPA organized existing optimization-related resources on the website www.epa.gov/superfund/cleanup-optimization-superfund-sites to provide easy access for a broad spectrum of stakeholders. Written resources include report templates, technical Triad resources, and completed optimization review reports. In addition, EPA technical staff with expertise in optimization (EPA HQ and regional ROLs and STLs) are identified on the optimization website. These resources describe how optimization principles, practices, and techniques can be utilized with current programmatic guidance. Existing guidance has been and continues to be supplemented by directives, technical bulletins, fact sheets, and other technical materials to explain how optimization applies at various stages of cleanup. EPA synthesized the lessons learned from conducting over 300 optimization reviews and technical support projects into three technical guides: Smart Scoping for Environmental Investigations, Strategic Sampling Approaches, and Best Practices for Data Management. EPA issued these three technical guides in November 2018 on topics related to optimization that were identified in the *Superfund Task Force Recommendations* (EPA, 2017b), Recommendation 8[17], to facilitate additional technology transfer of these best management practices. EPA has also developed standard operating procedures such as project engagement forms, checklists, and documentation to facilitate the scoping and conduct of optimization reviews.

**Element 2.2: Adopt Lessons Learned into Business Practices:** On a routine basis, optimization lessons learned are collected, summarized, and discussed by EPA and regional program and project staff to determine how business practices, including contracting, can benefit from these lessons learned. The National Optimization Team meets regularly to identify these lessons learned and create strategies to ensure they are distributed broadly across the Superfund program. The EPA Superfund remedial program has replaced regional remedial contracts with a suite of national contracts to execute Superfund remedial work. Under these contracts, EPA will have the ability to incorporate optimization into task order requirements.

**Element 2.3: Formalize an Optimization Training Program:** EPA made significant progress on this element of the National Strategy through in-person classroom training events and internet-based training events and by presenting optimization findings at numerous national conferences. EPA focused its training efforts on Remedial Project Managers (RPMs) and technical staff by participating

[17]Superfund Task Force Report Recommendation 8: Reinforce Focused Scoping Which Closely Targets the Specific Areas for Remediation and Identify and Use Best Management Practices in the Remedial Investigation/Feasibility Study Stage

in and developing training courses for the CEC, NARPM training program, and Technical Support Project Forum meetings.

Since the National Strategy was issued, nearly 400 participants have received training on optimization and optimization best practices. An optimization course was offered at NARPM in 2012, 2014, and 2016 and one is planned for 2020. A total of 135 students have attended the optimization courses to date. Starting in April 2014, there have been 13 deliveries of the Best Practices course, with a total of 258 students attending. All existing CEC courses have been revised and updated to include optimization concepts and promote optimization efforts. EPA developed two technical groundwater courses on High-Resolution Site Characterization (HRSC) for unconsolidated environments and fractured sedimentary bedrock environments and has been delivering these courses since 2012. Groundwater HRSC optimizes the characterization of contamination in groundwater, which leads to targeted actions and combined remedies that facilitate restoration and site completion. In addition, significant revisions were made to the CEC's "Best Practices for Site Characterization Throughout the Remediation Process" to clearly identify the set of best practices for investigation-focused optimization activities and to include recent case studies. EPA continues to review optimization training needs, consolidate existing training material, and develop new training as needed. New training will be delivered to RPMs and other project managers and technical staff using the CEC, ERTP, and internet-based training events.

Optimization training supplements guidance and other technical resources and provides a number of benefits, including, but not limited to:

- increased knowledge of optimization practices and tools for all participants;
- national consistency in the quality of, approach to, and outcomes of optimization efforts;
- an increase in the number of sites that are recommended for optimization; and
- expansion of region-led optimization efforts.

## A.3 Progress on Implementing Element 3: Implementation

Element 3 involves implementing the National Strategy based on the goals established through the planning process. Implementation involves conducting optimization reviews at all stages of the project pipeline beginning with site assessment; incorporating Triad, Green Remediation, and other best practices; providing access to a pool of qualified optimization contractors; developing the capabilities of regions and other stakeholders; and advancing the application of innovative optimization strategies. EPA's progress on implementing the seven sub-elements of Element 3 are described below.

**Element 3.1: Conduct Optimization Reviews at all Stages of the Project Pipeline Beginning with Site Assessment:** EPA has achieved its goal of supporting 20 to 30 optimization reviews and technical support projects as shown in Exhibit A-1 above. Investigation-focused optimization reviews and technical support projects are being conducted at a steady pace. EPA now completes 23 optimizations per year on average (Table 1, Section 2.0). In addition to the number of completions per year, the capacity to support ongoing optimization events has increased to an average of nearly 60 optimizations per year, with 69 events supported in FY 2017 (Table 2, Section 2.0). EPA has completed five technical support projects in the site assessment phase (before listing of the sites on the National Priority List) with 3-dimentional visualization and analysis (3DVA) of existing data to supplement the Hazard Ranking System packages for those projects and with development of Conceptual Site Models (CSMs).

**Element 3.2: Expand Optimization to Earlier Project Pipeline Stages and Incorporate Triad, Green Remediation and Other Best Practices:** In accordance with the National Strategy, EPA has expanded optimization to sites earlier in the Superfund project pipeline. In FY 2015 through 2017, 48 percent of all optimizations were done in pre-remedial action phases including Preliminary Assessment/Site Investigation, Remedial Investigation/Feasibility Study, and remedial design phases, as demonstrated in Figure 2, in Section 2.0 of this report. Site characterization best practices are stressed in investigation-focused optimization reviews and technical support projects, regardless of which phase of the remedial pipeline site characterization activities are being conducted. EPA has expanded the use of 3DVA (characterization best practice) by supporting projects in all phases, from site assessment to the remedial action phase. EPA is currently providing technical site support for conducting HRSC for groundwater and incremental sampling using x-ray fluorescence for soil, both of which are considered to be strategic sampling approaches and best practices for site characterization. In addition, energy and material efficiency is addressed during every optimization review conducted by EPA. EPA also provides technical support for conducting environmental footprint analyses and implementing green remediation best management practices.

EPA also accomplished Recommendation 7[18] of the *Superfund Task Force Recommendation* report (EPA, 2017b), promoting the use of third-party optimizations. In the *Superfund Task Force Recommendations 2018 Update*[19], EPA noted "Since July 2017, EPA has implemented 18 optimization evaluations and is considering 17 additional optimization candidates. To prioritize allocation of optimization resources, EPA has established criteria to prioritize site attributes tied to Task Force recommendations, such as human exposure not under control; large and complex, such as sites with remedies greater than $50 million; stakeholder interests or concerns; projected completion dates within 5-15 years, where optimization may accelerate closure; and placement on the [Administrator's Emphasis List]. EPA is also implementing several projects to advance optimization practices and related tools in all phases of cleanup." (EPA, 2018a)

**Element 3.3: Independent Party Optimization Review Steps:** EPA developed several documents to establish a consistent and standardized approached to implementing optimization reviews. These documents facilitate the tracking of optimization and technical support evaluations from team development to issuance of a final report or technical support product and ease the identification and tracking of optimization recommendations from optimization review reports. As the number of different parties conducting optimization reviews and technical support has increased, it is even more important that everyone adhere to standard operating procedures. Without consistency, both the tracking of the optimization reviews and technical support projects and the identification and tracking of optimization recommendations is more difficult. Moving forward, EPA will be able to

[18] Superfund Task Force Report Recommendation 7: Promote Use of Third-Party Optimization Throughout the Remediation Process and Focus Optimization on Complex Sites or Sites of Significant Public Interest

[19] Superfund Task Force Recommendations 2018 Update (https://www.epa.gov/sites/production/files/2018-07/documents/sftf_recs_v9_final.pdf)

update these documents as any procedures or tracking requirements change. These documents are made available in electronic format to optimization team members and include:

- an optimization standard operating procedure;
- an optimization primer and overview;
- an optimization engagement form;
- management notification emails; and
- a template optimization report.

**Element 3.4: Provide Access to a Pool of Qualified, Independent Contractors:** Optimization involves the synthesis and analysis of a significant quantity of data in a limited time frame and budget. To accomplish optimization objectives, EPA must have access to a pool of highly qualified technical experts with the demonstrated qualifications to provide the capacity to accomplish these goals on highly challenging, unique, and complex sites across the country. EPA expanded the number of these technical experts in various organizations including in EPA HQ (TIFSD), Environmental Response Team and Assessment and Remediation Division, ORD, Argonne National Laboratory, the U.S. Army Corps of Engineers, and EPA contractors. EPA will continue to look for ways to increase this pool of qualified experts, including through training of staff and accessing additional expertise through EPA contracts such as the new Remedial Action Framework national contracts.

**Element 3.5: Develop Regional Optimization Capabilities:** To fully integrate optimization into the remedial program, regional offices are involved in planning and implementing optimization at all stages of the remedial process. All Regions but one has assigned an ROL to facilitate the expansion of regional optimization capabilities. STLs in every region are also helping to identify optimization opportunities and facilitate optimization reviews and technical support activities. ROLs and STLs are assisting with implementation of the National Strategy.

**Element 3.6: Develop Other Stakeholders' Capabilities:** A wide range of stakeholders, including state project managers and tribal nations are included at the outset of optimization reviews, during implementation, and during follow-up tracking. EPA continues to build the capabilities of stakeholders through its various training programs, which integrate optimization concepts with other technical content related to Superfund. Many state and tribal stakeholders have already taken or are planning to participate in these trainings.

**Element 3.7: Advance Application of Innovative Optimization Strategies:** EPA has continued to advance innovation in the optimization arena by participating in ongoing research projects (for example, ORD, Department of Defense's Strategic Environmental Research and Development Program and Environmental Security Technology Certification Program, National Institute of Environmental Health Sciences Superfund Research Program, Interstate Technology and Regulatory Council, national laboratories and universities), performing general tracking of developments by other agencies or the private sector, and encouraging and deploying innovative approaches at Superfund sites.

## A.4 Progress on Implementing Element 4: Measurement and Reporting

Element 4 involves tracking progress of optimization, measuring outcomes, and accounting for related costs. Element 4 has three sub-elements which are discussed below.

**Element 4.1: Track Implementation of Recommendations:** EPA tracks the implementation of all optimization review recommendations provided in optimization reports. The Superfund Optimization Progress Report is EPA's primary vehicle for reporting on the progress of optimization recommendation implementation, with this current version providing an update on progress primarily during FY 2015 through FY 2017. EPA has focused its optimization resources on scaling up the program to cover activities across all focus areas of the optimization process and all phases of the Superfund pipeline and to increasing the number of optimization reviews and technical support projects. Currently, EPA collects the following information for optimization reviews:

- Status of each optimization recommendation (implemented, alternative implemented, in progress, planned, under consideration, deferred to state/PRP, and declined)—the collection of this information is facilitated by use of a menu of choices that can then be easily tracked;
- Cost impacts of each optimization recommendation (capital costs, O&M costs, and cost savings)—the collection of cost savings has been difficult and could be improved;
- Benefits that resulted from implementation—recommendations are put into five categories, which describe five broad benefits. Collecting more detailed information on the benefits, such as the use of best practices and strategic sampling approaches and improved data management, can only be discovered by reading each recommendation follow-up narrative. The reporting process would benefit from the development of a drop down list from which specific benefits could be chosen; and
- Obstacles encountered during implementation are recorded by narrative provided by the project manager for each recommendation. RPMs are encouraged in their description of progress to discuss any obstacles. The process would benefit from follow-up phone interviews with RPMs to acquire additional information.

EPA uses the Optimization Report Inventory and Tracking Tool (ORITT) database to house recommendation data from all optimization reviews that have been completed to date. EPA records the names and category of recommendations and the implementation status of the recommendations. ORITT also includes the potential costs and savings projected by the optimization team for implementing each recommendation and can also include actual cost data when available. EPA is currently pursuing development of an enhanced ORITT system to be developed in Oracle.

**Element 4.2: Measure Optimization Outcomes and Report Results:** The analyses performed for the Superfund Optimization Progress Report included measuring the optimization outcomes using the available data and information collected for the report. EPA is improving its processes for collecting optimization data and information, including identifying ways to streamline data collection. For example, EPA is making the process of collecting follow-up information on the implementation of optimization recommendations easier and more frequent.

EPA uses the database Optimization Project Log (OPL) to track all optimization events (technical support events and optimization review events) by site name and record key information about each event including:

- event type (technical support or optimization review);
- project lead, regional contact, and contractor support;
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OPL is updated each week. Summary reports on the current status of all events supported during the current fiscal year are provided to EPA management.

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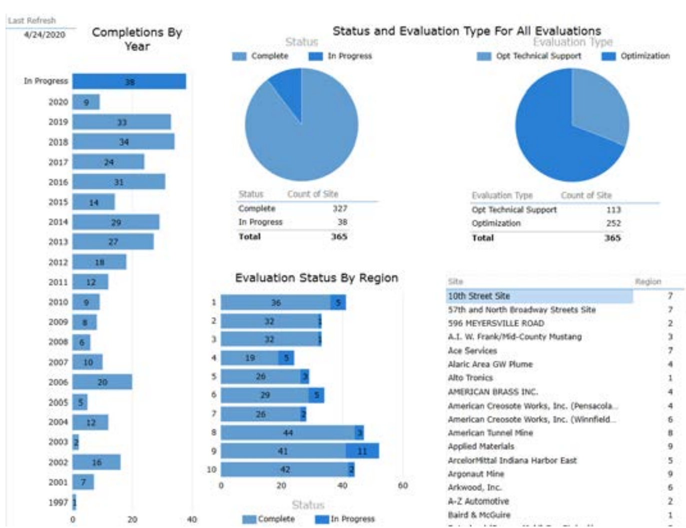


In 2019, the optimization program began participating in the EPA Lean Management System (ELMS). As part of that effort, tracking sheets referred to as proxy cards were developed for each ongoing optimization review. The proxy cards identify project leads and significant project milestones and provide projected dates for future milestones. Each week, the optimization team meets in a “huddle” for 20 minutes to quickly provide any updates and identify any projects that are lagging. The proxy cards are placed on a flow board to display the status of the projects as a visual management tool. The visual management tools also help manage workload distribution. A goal of the optimization program was to increase the number of headquarters project leads to more evenly distribute workload. The number of headquarters project leads has increased from two to seven since implementing ELMS.

**Element 4.3: Monitor Cost Accounting:** EPA tracks and reports on the costs of conducting individual optimization reviews and implementing the National Strategy. In addition, the optimization team's estimates of potential costs and savings of implementing individual recommendations are included as part of an optimization review. However, the availability of actual cost information on the implementation of optimization recommendations has been limited, with these data often difficult to obtain. Reasons cited include time constraints on remedial staff and difficulty in quantifying actual cost savings. For example, as optimizations are implemented earlier in the Superfund pipeline, improving site characterization and having more complete CSMs are intended to lead to better remedy selection and design, leading to rapid achievement of Remedial Action Objectives and site closure. However, quantifying the difficulties and "avoided costs" that could have resulted from not conducting optimization early on can be difficult to estimate. EPA is continuing to work on improving cost data.

# APPENDIX B

# COMPLETED OPTIMIZATION REVIEWS AND TECHNICAL SUPPORT PROJECTS FY 1997 – FY 2017

*Some later technical support projects were completed in time to be included in the progress report.

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 1** | | | **30** |
| MA | Baird & McGuire - Evaluation 1 | 2002 | |
| MA | Baird & McGuire - Evaluation 2 | 2013 | |
| NY | BCF Oil Refining, Inc. | 2009 | |
| MA | BJAT LLC | 2016 | |
| MA | Charles George Reclamation Trust Landfill - Evaluation 1 | 2017 | |
| ME | Eastern Surplus | 2012 | |
| VT | Elizabeth Mine - Evaluation 1 | 2016 | |
| VT | Elizabeth Mine - Evaluation 2 | 2016 | |
| VT | Ely Copper Mine - Evaluation 1 | 2017 | |
| VT | Ely Copper Mine - Evaluation 2 | 2017 | |
| MA | Engelhard Corporation Facility | 2005 | |
| MA | Fairmont Line- Modern Electroplating | 2013 | |
| MA | Groveland Wells No. 1 & 2 - Evaluation 1 | 2002 | |
| MA | Groveland Wells No. 1 & 2 - Evaluation 2 | 2013 | |
| MA | Groveland Wells No. 1 & 2 - Evaluation 3 | 2014 | |
| VT | Jard Company | 2017 | |
| NH | Kearsarge Metallurgical Corp. | 2010 | |
| NH | Ottati & Goss/Kingston Steel Drum | 2014 | |
| RI | Peterson/Puritan Inc. | 2016 | |
| RI | Picillo Farm - Evaluation 1 | 2017 | |
| CT | Ridson Corporation | 2004 | |
| NH | Savage Municipal Water Supply - Evaluation 1 | 2001 | |
| MA | Silresim Chemical Corp. - Evaluation 1 | 2002 | |
| MA | Silresim Chemical Corp. - Evaluation 2 | 2014 | |
| NH | Somersworth Sanitary Landfill - Evaluation 1 | 2009 | |
| NH | Somersworth Sanitary Landfill - Evaluation 2 | 2017 | |
| MA | Sullivan's Ledge - Evaluation 1 | 2016 | |
| MA | Sullivan's Ledge - Evaluation 2 | 2016 | |
| NH | Sylvester | 2009 | |
| MA | W.R. Grace & Co., Inc. (Acton Plant) | 2017 | |
| **Region 2** | | | **27** |
| NJ | A-Z Automotive | 2004 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 2** | **(Continued)** | | |
| NJ | Bog Creek Farm | 2002 | |
| NY | Brewster Well Field | 2002 | |
| NJ | Ciba-Geigy Corp. | 2012 | |
| NY | Circuitron Corp. | 2005 | |
| NY | Claremont Polychemical | 2002 | |
| NY | Eighteen Mile Creek | 2016 | |
| NJ | Ellis Property | 2006 | |
| NY | Fulton Avenue | 2013 | |
| NY | GCL Tie and Treating Inc. | 2007 | |
| NJ | Higgins Farm | 2004 | |
| NJ | King of Prussia | 2012 | |
| NY | Mattiace Petrochemical Co., Inc. | 2001 | |
| NJ | MetalTec/Aerosystems - Evaluation 1 | 2012 | |
| NJ | MetalTec/Aerosystems - Evaluation 2 | 2015 | |
| NY | Morgan Terminal | 2004 | |
| NJ | Passaic River- Diamond Alkali | 2011 | |
| NY | Richardson Hill Road Landfill/Pond | 2012 | |
| NJ | Rockaway Borough Well Field, OU 2 | 2014 | |
| NJ | Sherwin-Williams/Hilliards Creek | 2017 | |
| NJ | Shorco South | 2004 | |
| NY | Sidney Landfill | 2012 | |
| NY | SMS Instruments, Inc. | 2004 | |
| NY | South Buffalo Brownfields Opportunity Area | 2012 | |
| VI | Tutu Wellfield | 2011 | |
| NJ | Unimatic Manufacturing Corp Site | 2016 | |
| NJ | Vineland Chemical Co., Inc. | 2011 | |
| **Region 3** | | | **27** |
| PA | A.I. W. Frank/Mid-County Mustang | 2006 | |
| PA | Butz Landfill | 2006 | |
| PA | Clearview Landfill - Evaluation 1, OU 03 | 2014 | |
| PA | Crossley Farm | 2006 | |
| PA | Croydon TCE | 2006 | |
| PA | Cryochem, Inc. | 2006 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 3** | **(Continued)** | | |
| DE | Dover Gas Light Co., OU2 | 2015 | |
| PA | Fischer & Porter Co. | 2014 | |
| PA | Former Honeywell Facility | 2003 | |
| VA | Fort Eustis (US Army) | 2013 | |
| VA | Greenwood Chemical Co. - Evaluation 1 | 2004 | |
| VA | Greenwood Chemical Co. - Evaluation 2 | 2006 | |
| PA | Havertown PCP - Evaluation 1 | 2004 | |
| PA | Havertown PCP - Evaluation 2 | 2006 | |
| PA | Hellertown Manufacturing Co. - Evaluation 1 | 2002 | |
| PA | Hellertown Manufacturing Co. - Evaluation 2 | 2006 | |
| PA | Hellertown Manufacturing Co. - Evaluation 3 | 2017 | |
| PA | Mill Creek Dump | 2010 | |
| PA | North Penn - Area 1 | 2006 | |
| PA | North Penn - Area 6 | 2012 | |
| VA | Peck Iron and Metal | 2013 | |
| PA | Raymark - Evaluation 1 | 2002 | |
| PA | Raymark - Evaluation 2 | 2006 | |
| VA | Saunders Supply Co. - Evaluation 1 | 2006 | |
| VA | Saunders Supply Co. - Evaluation 2 | 2016 | |
| DE | Standard Chlorine of Delaware, Inc. | 2007 | |
| PA | Valmont TCE Site (Former - Valmont Industrial Park) | 2016 | |
| **Region 4** | | | **15** |
| FL | Alaric Area GW Plume | 2010 | |
| FL | American Creosote Works, Inc. (Pensacola Plant) | 2006 | |
| NC | Benfield Industries, Inc. | 2007 | |
| NC | Cape Fear Wood Preserving | 2005 | |
| NC | Celanese Corp. (Shelby Fiber Operations) | 2009 | |
| NC | Charles Macon Lagoon and Drum Storage | 2016 | |
| FL | Chemko Technical Services, Inc. Facility | 2005 | |
| SC | Eliskim Facility | 2004 | |
| SC | Elmore Waste Disposal | 2001 | |
| NC | FCX, Inc. (Statesville Plant) | 2002 | |
| MS | Mississippi Phosphates Corporation - Evaluation 1 | 2016 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 4** | **(Continued)** | | |
| MS | Mississippi Phosphates Corporation - Evaluation 2 | 2016 | |
| FL | Taylor Road Landfill | 2007 | |
| TN | Velsicol Chemical Corp. (Hardeman County) | 2013 | |
| GA | Woolfolk Chemical Works, Inc. | 2008 | |
| **Region 5** | | | **17** |
| MN | Baytown Township Ground Water Plume | 2011 | |
| MI | Clare Water Supply - Evaluation 1 | 2007 | |
| MI | Clare Water Supply - Evaluation 2 | 2007 | |
| MI | Clare Water Supply - Evaluation 3 | 2017 | |
| OH | Delphi VOC Site | 2003 | |
| IN | Douglass Road/Uniroyal, Inc. Landfill | 2004 | |
| OH | Lincoln Fields Co-Op Water Assn Duke Well | 2015 | |
| MN | MacGillis & Gibbs Co./Bell Lumber & Pole Co. | 2001 | |
| WI | Moss-American Co., Inc. (Kerr-McGee oil Co.) | 2011 | |
| WI | Oconomowoc Electroplating Co., Inc. | 1997 | |
| MI | Ott/Story/Cordova Chemical Co. - Evaluation 1 | 2002 | |
| MI | Peerless Plating Co. | 2006 | |
| WI | Penta Wood Products | 2006 | |
| IN | Reilly Tar & Chemical Corp. (Indianapolis Plant) | 2004 | |
| WI | Stoughton City Landfill | 2008 | |
| MI | Wash King Laundry - Evaluation 1 | 2006 | |
| MI | Wash King Laundry - Evaluation 2 | 2011 | |
| **Region 6** | | | **21** |
| LA | American Creosote Works, Inc. (Winnfield Plant) | 2008 | |
| AR | Arkwood, Inc. | 2016 | |
| LA | Bayou Bonfouca - Evaluation 1 | 2001 | |
| TX | Conroe Creosoting Co. | 2015 | |
| LA | Delatte Metals | 2009 | |
| TX | East 67th Street Ground Water Plume | 2014 | |
| TX | Garland Creosoting | 2016 | |
| NM | Grants Chlorinated Solvents | 2008 | |
| NM | Homestake Mining Co. | 2011 | |
| TX | Jones Road Ground Water Plume | 2014 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 6** | **(Continued)** | | |
| NM | McGaffey & Main Groundwater Plume - Evaluation 1, OU 02 | 2012 | |
| NM | McGaffey & Main Groundwater Plume - Evaluation 2, OU 03 | 2015 | |
| AR | Midland Products | 2001 | |
| NM | North Railroad Avenue Plume | 2015 | |
| TX | Odessa Chromium #1 | 2016 | |
| AR | Ouachita Nevada Wood Treater | 2015 | |
| TX | Sandy Beach Road Ground Water Plume | 2014 | |
| TX | Sprague Road Ground Water Plume | 2016 | |
| TX | State Road 114 Groundwater Plume | 2014 | |
| OK | Tar Creek (Ottawa County) | 2014 | |
| TX | West County Road 112 Ground Water | 2016 | |
| **Region 7** | | | **22** |
| NE | 10th Street Site - Evaluation 1 | 2010 | |
| NE | 10th Street Site - Evaluation 2 | 2014 | |
| KS | 57th and North Broadway Streets Site | 2006 | |
| KS | Ace Services - Evaluation 1 | 2007 | |
| KS | Ace Services - Evaluation 2 | 2013 | |
| MO | Big River Mine Tailings/St. Joe Minerals Corp. | 2016 | |
| NE | Cleburn Street Well | 2001 | |
| NE | Eaton Corp-Kearney | 2006 | |
| IA | Fairfield Coal Gasification Plant | 2012 | |
| IA | General Motors S.C. | 2012 | |
| NE | Hastings Ground Water Contamination | 2013 | |
| MO | Lee Chemical | 2012 | |
| MO | Missouri dioxin reassessments | 2014 | |
| MO | Missouri Tannery Sludge | 2010 | |
| IA | Nichols Groundwater Contamination, (Cropmate) | 2014 | |
| NE | Ogallala Ground Water Contamination - Evaluation 1 | 2013 | |
| NE | Parkview Well | 2017 | |
| IA | Railroad Avenue Groundwater Contamination | 2014 | |
| MO | Rt. 66 Park (Under MO Dioxin Reassessment site) | 2014 | |
| MO | Strecker Dioxin Site (Under MO Dioxin Reassessment) | 2014 | |
| MO | Valley Park TCE | 2013 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 7** | **(Continued)** | | |
| MO | Washington County Lead District - Furnace Creek | 2016 | |
| **Region 8** | | | **29** |
| CO | American Tunnel Mine | 2017 | |
| SD | Batesland (Former Mobil Gas Station)) | 2013 | |
| CO | Bonita Peak Mining District | 2017 | |
| MT | Burlington Northern (Somers Plant) (BNSF Railway) - Evaluation 1 | 2015 | |
| CO | Captain Jack Mill - Evaluation 1 | 2016 | |
| CO | Captain Jack Mill - Evaluation 2 | 2016 | |
| CO | Central City, Clear Creek | 2007 | |
| UT | Former Old Hilltop (Hilltop Station) | 2013 | |
| CO | French Gulch | 2013 | |
| SD | Gilt Edge Mine | 2013 | |
| CO | Gold King Mine Release - Evaluation 1 | 2016 | |
| CO | Gold King Mine Release - Evaluation 2 | 2017 | |
| CO | Gold King Mine Release - Evaluation 3 | 2017 | |
| MT | Idaho Pole Co. - Evaluation 1 | 2009 | |
| MT | Idaho Pole Co. - Evaluation 2 | 2009 | |
| MT | Idaho Pole Co. - Evaluation 3 | 2010 | |
| UT | Intermountain Waste Oil Refinery (IWOR) | 2011 | |
| UT | Jacobs Smelter - Evaluation 1 | 2010 | |
| MT | Lockwood Solvent Ground Water Plume - Evaluation 1, (OU 01) | 2014 | |
| MT | Lockwood Solvent Ground Water Plume - Evaluation 2, (OU 02) | 2014 | |
| CO | Lowry Landfill - Evaluation 1 | 2016 | |
| UT | Ogden Railroad Yard | 2013 | |
| SD | Pine Ridge Oil | 2013 | |
| CO | Rico - Argentine | 2016 | |
| CO | Standard Mine - Evaluation 1 | 2014 | |
| CO | Standard Mine - Evaluation 2 | 2016 | |
| CO | Standard Mine - Evaluation 3 | 2016 | |
| CO | Summitville Mine - Evaluation 1 | 2002 | |
| CO | Vasquez Boulevard And I-70 - Evaluation 1 | 2017 | |
| **Region 9** | | | **31** |
| CA | Applied Materials | 2012 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 9** | **(Continued)** | | |
| NM | Bond & Bond/Nav 046 Site | 2013 | |
| CA | BP Carson Refinery | 2006 | |
| NV | Carson River Mercury Site - Evaluation 1, OU 02 | 2014 | |
| NV | Carson River Mercury Site - Evaluation 2, OU 00 | 2017 | |
| AZ | Davis Chevrolet/Nav 185 Site | 2013 | |
| CA | Intel Magnetics - Evaluation 1 | 2013 | |
| AZ | Iron King Mine - Humboldt Smelter - Evaluation 1 | 2014 | |
| AZ | Iron King Mine - Humboldt Smelter - Evaluation 2 | 2014 | |
| AZ | Iron King Mine - Humboldt Smelter - Evaluation 3 | 2013 | |
| CA | Klau/Buena Vista Mine - Evaluation 1 | 2010 | |
| CA | Klau/Buena Vista Mine - Evaluation 2 | 2017 | |
| CA | Lava Cap Mine - Evaluation 1 | 2014 | |
| CA | Lava Cap Mine - Evaluation 2 | 2017 | |
| CA | McCormick & Baxter Creosoting Co. - Evaluation 1 | 2014 | |
| CA | McCormick & Baxter Creosoting Co. - Evaluation 2 | 2017 | |
| CA | Middlefield – Ellis – Whisman (MEW) Superfund Study Area - Evaluation 1 | 2012 | |
| CA | Middlefield – Ellis – Whisman (MEW) Superfund Study Area - Evaluation 2 | 2012 | |
| CA | Modesto Ground Water Contamination | 2002 | |
| CA | Newmark Ground Water Contamination - Evaluation 1 (First MAROS) | 2007 | |
| CA | Newmark Ground Water Contamination - Evaluation 2 (Second MAROS) | 2009 | |
| CA | Newmark Ground Water Contamination - Evaluation 3 (First 3DVA) | 2014 | |
| CA | Newmark Ground Water Contamination - Evaluation 4 (Third MAROS) | 2015 | |
| CA | Newmark Ground Water Contamination - Evaluation 5 (Second 3DVA) | 2016 | |
| AZ | Painted Desert Inn/Nav 049 Site | 2013 | |
| CA | Pemaco Maywood | 2011 | |
| CA | San Fernando Valley (Area 1) | 2012 | |
| CA | Selma Treating Co. - Evaluation 1 | 2002 | |
| CA | Sulphur Bank Mercury Mine | 2015 | |
| AZ | Telles Ranch/CRIT 002 | 2013 | |
| CA | Treasure Island Naval Station-Hunters Point Annex | 2013 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 10** | | | **32** |
| OR | Black Butte Mine | 2012 | |
| WA | Boomsnub/Airco | 2002 | |
| ID | Bunker Hill Mining & Metallurgical Complex - Evaluation 1 | 2006 | |
| ID | Bunker Hill Mining & Metallurgical Complex - Evaluation 2, OU 02 (CTP) | 2013 | |
| ID | Bunker Hill Mining & Metallurgical Complex - Evaluation 3, OU 03 | 2014 | |
| ID | Bunker Hill Mining & Metallurgical Complex - Evaluation 4, OU 03 (Upper Basin area) | 2016 | |
| ID | Bunker Hill Mining & Metallurgical Complex - Evaluation 5, OU 03 (East Mission Flats and Big Creek Repository areas) | 2017 | |
| ID | Bunker Hill Mining & Metallurgical Complex - Evaluation 6 | 2017 | |
| WA | Colbert Landfill - Evaluation 1 | 2011 | |
| WA | Commencement Bay, South Tacoma Channel - Evaluation 1 | 2002 | |
| WA | Commencement Bay, South Tacoma Channel - Evaluation 2 | 2008 | |
| ID | Eastern Michaud Flats Contamination | 2017 | |
| WA | Fort Lewis Logistics Center | 2011 | |
| WA | Frontier Hard Chrome, Inc. | 2008 | |
| WA | Hamilton/Labree Roads GW Contamination (HRIA) - Evaluation 1 | 2010 | |
| WA | Hamilton/Labree Roads GW Contamination (HRIA) - Evaluation 2 | 2015 | |
| WA | J.H. Baxter & Co. | 2016 | |
| WA | Keyport (Official name: Naval Undersea Warfare Engineering Station (4 Waste Areas), Operable Unit 1/Area 1– Keyport Landfill, WA | 2013 | |
| AK | Kodiak USCG Integrated Support Command Base | 2015 | |
| OR | McCormick & Baxter Creosoting Co. (Portland Plant) | 2002 | |
| WA | Moses Lake Wellfield Contamination | 2015 | |
| OR | Northridge Estates | 2015 | |
| OR | Northwest Pipe and Casing/Hall Process Company - Evaluation 1 | 2007 | |
| OR | Northwest Pipe and Casing/Hall Process Company - Evaluation 2 | 2016 | |
| WA | Occidental Chemical Corporation | 2004 | |
| WA | Palermo Well Field Ground Water Contamination | 2012 | |
| OR | Portland Harbor | 2011 | |
| OR | Univar | 2017 | |
| WA | Upper Columbia River | 2013 | |
| WA | USNavy Whidbey Island Naval Air Station, (Ault Field/OU 1) | 2014 | |

| State | Site | Fiscal Year Complete | Total Optimization Evaluations |
|---|---|---|---|
| **Region 10** | **(Continued)** | | |
| WA | Wyckoff Co./Eagle Harbor - Evaluation 1 | 2005 | |
| WA | Wyckoff Co./Eagle Harbor - Evaluation 2 | 2014 | |
| **TOTAL** | | | **251** |