Implementing Optimization in the Superfund Program

For the Interagency Performance and Risk Assessment Community of Practice (P&RA CoP)
November 12, 2015

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We Have a Lot of Work to Do
(Estimated Number of Contaminated Sites)
(Cleanup Horizon: 2004 - 2033)

Total = $209 Billion

- NPL $32B
- RCRA-CA $45B
- States & Private $30B
- DOE $35B
- Civilian Agencies $19B
- UST $16B
- DOD $33B

Total Sites = 294,000

- NPL 736
- RCRA-CA 3,800
- States & Private 150,000
- DOE 5,000
- Civilian Agencies 3,000
- UST 125,000
- DOD 6,400

Source: www.clu-in.org/market/
**Working Definition of Optimization**

Systematic site review by a team of independent technical experts, at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness and cost efficiency; and to facilitate progress toward site completion.
**EPA Optimization History**

- EPA Optimization starts circa 1997
- EPA-USACE-USAF collaboration during 2000’s refines practice. Optimization techniques, practices, events and experience grow through late 1990’s and 2000s
- ~100 sites assessed by 2010 with EPA mission support contract and USACE. Good success.
- Late 2010 briefing for Assistant Administrator & Deputy AA for EPA’s waste programs (OSWER)
  - Directive: Develop National Optimization Strategy to meet goals
    - Goal: Expand optimization throughout pipeline
    - Goal: Increase number of sites optimized
    - Goal: Expand optimization resource access
    - Goal: Train staff in optimization techniques
    - Goal: Integrate optimization as “institutional” practice within Regions
    - Goal: Measure success
- Strategy developed by National Workgroup (Regions/HQ/ORD) w/full HQ review and approval.
  - “National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion’ is signed 9/28/2012
  - Further Implementation 10/2012 – present
EPA’s National Optimization Strategy

- Composed of four elements, 32 actions:
  - Planning and Outreach
  - Implementation
  - Communication and Training
  - Measurement

- Leverages regional and HQ resources for reviews.
- Develops regional optimization programs and expertise.
- Tracks optimization results for all reviews.
- Is in full swing during 2016.
Applies to Any Phase of Cleanup Pipeline
Focuses on Key Optimization Components

Optimization Stages
- Investigation Stage
  - Site Discovery
  - Site Assessment
  - Remedial Investigation
  - Feasibility Study
- Design Stage
  - Remedial Design
  - Remedial Action
- Remedy Stage
  - Long-term Response Action
- Long-term Monitoring Stage
  - Operation & Maintenance

Key Optimization Components
- Remedy Components
- Completion Strategy
- Green Remediation
- Monitoring
- Triad Approach
- Data Management

Conceptual Site Model

11/12/15 Interagency Performance and Risk Assessment Community of Practice (P&RA CoP) - EPA/Biggs703-823-3081biggs.kirby@epa.gov
# Applies to Any Site or Remedy Type

<table>
<thead>
<tr>
<th>Types of Sites</th>
<th>Types of Remedies Evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial facilities</td>
<td>• P&amp;T systems</td>
</tr>
<tr>
<td>Wood treating facilities</td>
<td>• Air sparging/soil vapor extraction</td>
</tr>
<tr>
<td>Dry cleaners</td>
<td>• Groundwater recirculation wells</td>
</tr>
<tr>
<td>Landfills</td>
<td>• NAPL recovery</td>
</tr>
<tr>
<td>Mines</td>
<td>• Biosparging</td>
</tr>
<tr>
<td>P&amp;T systems</td>
<td>• <em>In situ</em> thermal remediation</td>
</tr>
<tr>
<td>Air sparging/soil vapor extraction</td>
<td>• <em>In situ</em> chemical oxidation</td>
</tr>
<tr>
<td>Groundwater recirculation wells</td>
<td>• <em>In situ</em> bioremediation</td>
</tr>
<tr>
<td>NAPL recovery</td>
<td>• Monitored natural attenuation</td>
</tr>
<tr>
<td>Biosparging</td>
<td>• Sediment capping</td>
</tr>
<tr>
<td><em>In situ</em> thermal remediation</td>
<td>• Barrier walls</td>
</tr>
<tr>
<td><em>In situ</em> chemical oxidation</td>
<td>• Constructed wetlands</td>
</tr>
<tr>
<td><em>In situ</em> bioremediation</td>
<td>• Landfill gas collection</td>
</tr>
<tr>
<td>Monitored natural attenuation</td>
<td>• Surface water diversion/collection/treatment</td>
</tr>
<tr>
<td>Sediment capping</td>
<td></td>
</tr>
<tr>
<td>Barrier walls</td>
<td></td>
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<tr>
<td>Constructed wetlands</td>
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<td>Landfill gas collection</td>
<td></td>
</tr>
<tr>
<td>Surface water diversion/collection/treatment</td>
<td></td>
</tr>
</tbody>
</table>

*Optimization can be applied to all site types and all remedy types*
Sites Types That May Benefit From Optimization
(Based on past experience, current Regional practice)

- Sites with:
  - Protectiveness concerns, high uncertainty.
  - Technological challenges.
  - Data gaps in the CSM.
  - High costs or high projected costs for remedial activities.
  - Interim remedies.
  - GMNUC/HENUC
- Stalled sites not making RAOs.
- In advance of a Five Year Review (FYR).
- After a FYR – with recommendations for optimization.
- Before LTRA transfer.
- Mines (special focus initiative)
Key Superfund Optimization Tools

- **Investigation Process Optimization** – Conceptual site modeling, dynamic work-plans, real-time data collection, field methods, adaptive site management, 3D visualization -- in *all* stages of the pipeline.

- **Independent Design Review** – Will proposed design successfully address site conditions? Serves as Value Engineering Screen when properly constructed.

- **Remediation System Evaluation (RSE)** - Assessment of holistic site operation during construction underway or complete

- **Long-Term Monitoring Optimization (LTMO)** - Statistical modeling techniques to maximize remediation effectiveness and minimize cost during operation of the completed remedy

- **Green Remediation Evaluation** – Assessing and reducing the environmental footprint of the site through the pipeline
## EPA Headquarters Optimization Leads

<table>
<thead>
<tr>
<th>Division</th>
<th>Name</th>
<th>Email</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
### Regional Optimization Liaisons and Participating ORD Superfund Technical Liaisons

<table>
<thead>
<tr>
<th>Region</th>
<th>Name</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Derrick Golden Kimberly White</td>
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<tr>
<td>5</td>
<td>Vacant</td>
<td>Vacant</td>
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<td>6</td>
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Optimization Review Process

- Regional/HQ/Other Request for Optimization
- Project Scoping and Kick-off Call
- Document Exchange, Data Review and Evaluation
- Site Visit/Stakeholder Interviews
- Draft Report/Region Review/Comments Response
- Final Report/Post on CLU-IN or Tech Memo to Region
- Recommendation Implementation Tracking
OSRTI OPTIMIZATION PROCESS

Draft Final – 07/01/2015

Milestones/Timing listed in RED

Request from Region or HQ

Requestor Fills Out Engagement Form

Scoping Meeting (EPA Only)

Kick-Off Meeting (All Parties)

Site Visit

Stakeholder Comment Period

Draft Optimize Report

Draft Final Optimization Report

Optimization Recommendations entered into database (ORITT)

Review of Final Report

Upon Regional Approval

Given regional Doc ID # and report entered into SEMS

Post Report in Clu-In and/or SharePoint

Other Follow-up (Informal)

Reviews @ 6 Months, 1 Year & 2 Years

Upon Request

Upon Approval

21 Days

21 Days

45-60 Days

14 Days

14 Days

14-30 Days

14 Days

21 Days

21 Days

14 Days

14 Days
Supporting Documents/Workload

- Optimization Webpage – [www.cluin.org/optimization](http://www.cluin.org/optimization)
- Standard Operating Procedure (SOP) (EPA internal)
  - Engagement Form
  - Optimization Primer (on optimization webpage) [http://www.cluin.org/Optimization/pdfs/OptimizationPrimer_final_June2013.pdf](http://www.cluin.org/Optimization/pdfs/OptimizationPrimer_final_June2013.pdf)
  - Review Checklists for each stage
  - Report Templates [flexible], 3DVA, high res technical memoranda [specialty]
  - Recommendations Tracking
- Training Events
  - Internet seminars ([http://cluin.org/ studio](http://cluin.org/studio))
  - National Strategy Workgroup Training Modules
  - HRSC training course
    - Delivered – R2 and R6 / Scheduled – R3, R5 and R9
    - Two course versions – Overburden focus / bedrock focus (new)
- Training Program Development
  - Optimization Training Kit
  - Integration of optimization best practices into CEC courses
Progress of EPA Optimization Support FY11-15

<table>
<thead>
<tr>
<th>Optimization Events</th>
<th>FY2011</th>
<th>FY2012</th>
<th>FY2013</th>
<th>FY2014</th>
<th>FY2015</th>
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<tbody>
<tr>
<td>Started</td>
<td>18</td>
<td>19</td>
<td>25</td>
<td>19</td>
<td>19</td>
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<tr>
<td>Ongoing from Prior FY(s)</td>
<td>11</td>
<td>22</td>
<td>25</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Completed</td>
<td>7</td>
<td>16</td>
<td>28</td>
<td>25</td>
<td>11</td>
</tr>
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</table>

Total: FY2011-2015
- Events: 123
- Sites: 110
- Reports: 74
- Optimization Reviews: 92
- Technical Support: 30

Total 1997 to 2015
- Total Events: 247
- Total Sites: 218
Progress of EPA Optimization Support 2015

- In FY15, the National Optimization Program fully implemented the 2012 National Optimization Strategy.
- In FY15, OSRTI conducted optimization projects (studies or technical support) at 32 sites, including 14 ongoing efforts from FY14 and 19 new projects starts in FY 15.
- Twenty projects were completed.

Mining Optimization and Technical Support
- OSRTI continued its implementation of the mine sites optimization initiative to determine if there are ways to address mining sites more efficiently and effectively.
- OSRTI supported (in FYs 14 and 15) optimization studies at 12 mining sites and reviewed 1 mining site conducted prior to 2014.
**Site Support Issues / Lessons Learned**

- Virtually all sites can benefit from optimization reviews
  - Some from holistic review / others from targeted review
  - Not a one time activity
- Reviews provide insight on
  - Future site needs, expenditures and schedules
  - Application of most effective technologies
  - Additional opportunities for optimization
  - Long term management
- Optimization methods and level of effort vary per pipeline stage
- New RPMs most interested in performing reviews; repeat customers as well
- Documentation of lessons learned to date can be improved
- May have to spend money to save money – not an easy proposition
Progress Towards Institutional Practice in Waste Programs

• Standardized processes applied to
  • COI, site engagement and kickoff
  • Onsite visits and interviews
  • Report format and development/review/QC process
  • Optimization Report Inventory and Tracking Tool (ORITT) – tool for tracking metrics
  • Optimization Project Log (OPL) – tool for program/project management

• Identifying and applying process improvements to reduce cost and time
  • Streamlined standardized optimization report template
  • “Portfolios”: multiple reviews conducted during singular travel events

• Regional management involved in optimization
  • Increased number of sites and level of interest
  • Staffing realities, leveraging program expertise

• Other programs adapting
  • Office of Underground Storage Tanks: 7 Tribal Sites
  • RCRA-LEAN RFI
  • Region-lead Optimization

• Provide access to broad network of optimization support
  • Superfund HQ Mission Support Contractors
  • Regional Remedial Action Contractors
  • Support from other Agencies: USACE, Argonne National Laboratories
**Improving Cleanup Practice - Best Management Practices**

- Life Cycle CSM – road map to progress
- Characterization, characterization, characterization
  - Need better characterization, earlier
  - Importance of a comprehensive and evolving conceptual model
  - May or *may not* require additional characterization
  - Scoping and planning are essential
- High Resolution Site Characterization for groundwater sites;
  - Tools, platforms for field analysis, sampling
  - Data management
  - Data visualization
- Smart RI scoping
- Managing uncertainty
- Adaptive management techniques
- Managing sites to completion
- Green remediation-reducing the environmental footprint of cleanup
- Flexibility to adapt
- Project management costs – opportunity for saving money
- Understanding incentives, disincentives to change
- Focus on completion strategy for site, exit strategy for stage
**Federal Agency Optimization Policies: Many Federal Partners have embraced both Optimization and Green Remediation**

<table>
<thead>
<tr>
<th>Agency</th>
<th>Optimization Policy (Y/N), Remedial Phases</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOD</td>
<td>Y Post and including Remedy Selection</td>
<td>General requirement to optimize – no specific requirements</td>
</tr>
<tr>
<td>Army</td>
<td>Y Same as DOD</td>
<td></td>
</tr>
<tr>
<td>USACE</td>
<td>Y Same as DOD, also RA-O</td>
<td>Required optimizations on existing FUDS remedial systems with annual O&amp;M costs&gt;$100,000</td>
</tr>
<tr>
<td>Navy</td>
<td>Y All</td>
<td>Optimization across all remedial phases</td>
</tr>
<tr>
<td>Air Force</td>
<td>Y All</td>
<td>Performance-based contracting (PBC) requires optimization approaches with major focus of achieving accelerated site completion</td>
</tr>
<tr>
<td>DOE</td>
<td>N unknown</td>
<td>Anecdotal suggests some localized efforts</td>
</tr>
<tr>
<td>EPA</td>
<td>Y All</td>
<td>Formal program, selected third party optimizations, also recognizes processes typically used by project team e.g. CSM, TRIAD, GR, as included in optimization</td>
</tr>
</tbody>
</table>

Source: Dr. Carol Dona USACE EMCX
EPA Optimization Resources Available on EPA Web Page: www.cluin.org/optimization

- Remediation Optimization: Definition, Scope and Approach
- Optimization Review Guides
  - Investigation-Stage
  - Design-Stage
  - Remedy-Stage
  - LTM-Stage
- Site-specific reports
- Summary Reports on Implementation Progress
Questions on Part 1

Part 2
Part 2:

Optimization Stages: 
What to Expect throughout EPA’s “Pipeline”

Does not include additional field work
Investigation-Stage Optimization
Timing of Investigation-Stage Optimization

- Conducted during any part of the remedial process before the remedy is selected but also appropriate for any remedy that is revisiting investigation and the CSM
Why Request an Investigation-Stage Optimization?

- Uncertainty regarding current CSM
- Highly complex site conditions
  - Multiple sources
  - Multiple plumes
  - Significant subsurface heterogeneity
- Increasing RI costs or scope
- Lack of progression to next stage
- Interest in applying innovative strategies and technologies

Newmark Superfund Site, CA
What is Reviewed During the Investigation-Stage Optimization?

• Historical information and data
  • Geology, hydrogeology, chemistry, operations
  • Data quality, usability, net information value

• CSM status and alignment with project life cycle needs
  • Source identification and volume/mass
  • Plume delineation (plume core and dissolved)
  • Completed migration and exposure pathways

Continued . . .
What is Reviewed During the Investigation-Stage Optimization?

- Technologies previously applied or may apply in the future
  - Analytical, sampling and measurement tools
  - 3-D visualization and analysis
- Stakeholder views
- Completion strategy
Common Findings for Data: Investigation-Stage Reviews

- Low data density
  - High spatial uncertainty
  - Repeated investigations
- CSM out of date or under-developed
- Existing data not fully leveraged

Other Common Findings: Investigation-Stage Reviews

- Strategies and Technologies
  - Use of non-dynamic work strategies
  - Over-reliance on high cost, conventional methods
  - Scale of measurement insufficient to reveal scale of heterogeneity
- End data user needs not adequately considered
Common Recommendations: Investigation-Stage Reviews

- Use systematic project planning and other best practices
- Develop or improve CSM using existing data
- Use 3-D visualization and analysis (3DVA) for CSM
- Investigate based on identified data gaps
Common Recommendations: Investigation-Stage Reviews

• Perform HRSC using DWS and real-time measurement technologies
• Sequence field investigations to maximize information and resources
• Plan for and collect collaborative data to support risk assessment, remedy selection and design
• Reduce environmental footprint of investigation efforts
Design and Remedy Stage Optimization
Timing of Design and Remedy Stage Optimization

- Design Stage – the period when the remedy is selected but prior to implementation and operation
- Remedy Stage – the period when the remedy is implemented and operated
Why Request a Design- or Remedy-Stage Optimization?

- Concerns regarding planned or actual remedy performance, protectiveness or cost
- To obtain independent assessment of design
  - Value engineering screen and review
  - Independent design review
- Uncertainty about current CSM
Why Request a Design or Remedy Stage Optimization?

- Interest in using innovative remedial approach
- Uncertainty regarding conclusions or findings from site consultant
- Uncertainties in monitoring plan
- Questions regarding interpretation of monitoring data
What is Frequently Reviewed during Design or Remedy Stage Optimization Events...?

• RI/FS Reports
• Decision documents
• Design basis and related data
• Design submittals (including technical memos)
• Work plans for future work
• Pilot test results
• Implementation reports (such as construction, start-up, performance monitoring)
Common Findings: Design and Remedy Reviews

- Gaps in CSM
- Shortcomings in modeling
- Issues in design basis
- High cost estimates

Vineland Chemical Company, NJ
Common Recommendations: Design and Remedy Reviews

- Refinements to CSM and/or design basis through additional monitoring or investigation
- Suggestions for improving numerical model
- Suggestions for reducing/streamlining costs and cost estimates
- Phase remedial components so later components benefit from results of earlier phases
- Consider specific alternative strategies or technologies
- Suggestions for technical improvements
- Suggestions for increasing effectiveness
- Alternative strategies or technologies are available for implementing selected remedy
  - Carefully designed injection wells instead of direct-push technology injections
  - Pre-fabricated system instead of on-site construction
  - Treatment and reinjection instead of discharge to POTW
  - Use of extracted groundwater instead of potable water for reagent blending, injection and circulation
Long-term Monitoring-Stage Optimization (LTMO)
Timing of LTMO

- The 10 year period between the operational and functional (O&F) determination and the start of operations and maintenance (O&M)
Why Request a LTMO?

- Remedy not achieving goals as anticipated
- Cost issues
- Opportunity to reduce monitoring points and costs
- Uncertainty about protectiveness of remedy
- Property re-development needs expedited time frame
- Need to reduce energy and effort and enhance efficiency
- Development or refinement of completion strategy
What is Frequently Reviewed During LTMO?

• CSM
  • Original CSM at time of design
  • Changes to CSM since design

• Remedies
  • Remedial objectives
  • Design basis
  • Original remedial design and as-built design
  • Existing performance criteria
  • Performance data – correlate treatment performance with criteria and cost
What is Frequently Reviewed During LTMO?

- Changes in COC concentrations
- Rate of mass removal
- Effluent discharge
- Evaluate costs and effort
- Environmental footprint
- Containment
- Monitoring network

Groveland Wells, MA

Continued...
What is Frequently Reviewed During LTMO?

- Extraction and monitoring well locations
- Balance of groundwater extraction rates, capture zone and treatment capacity
- Treatment system and components performance
- Amendment injection amount and location
- Chemical feed rate and storage requirements
- Metals treatment and sludge management

East 67th Street Site, TX
Common Findings: LTMO Reviews

• CSM needs update
  • Conditions since end of active remedy
  • Sources
  • Low and high permeability zones
  • NAPL

• Endpoint and metrics for site completion need better definition

• Need for improved data management, analysis and reporting
  • Tracking and reporting performance
  • Spatial data
  • Historic data (paper → electronic)
**Common Recommendations: LTMO Reviews**

- Remedy system and components
  - Operational improvements and maintenance
  - Update current system
  - Monitoring optimization
  - Operator costs
  - Reduce excess staff
  - Automation
- Completion strategy
  - How close is site to achieving cleanup?
  - What data are needed to show attainment?
**Path Forward For the National Strategy**

- Continued Implementation of ongoing strategy elements
  - Annual candidate site identification
  - Further training program development
  - State and Tribal outreach
  - Region-lead projects
  - Recommendations implementation tracking (underway)
    - Cost impacts
    - Benefits (Protectiveness / cost / success stories)
    - Obstacles
- Mining sites
- Federal Remediation Technologies Roundtable Collaboration
- Coordination with other Federal partners
Federal and State Links to Optimization Resources

- EPA Home Page: Remedy Optimization, [www.epa.gov/superfund/cleanup/postconstruction/optimize.htm](http://www.epa.gov/superfund/cleanup/postconstruction/optimize.htm)
- EPA Hazardous Waste Cleanup Information (CLUIN)
  - Optimization Page, [www.cluin.org/optimization/](http://www.cluin.org/optimization/)
- Interstate Technology Regulatory Council, [www.itrcweb.org/Team/Public?teamID=4](http://www.itrcweb.org/Team/Public?teamID=4)
Questions and Discussion