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6. Case Studies

The case studies presented in this guidance represent regional differences in geology, climate, and regulatory programs. Many case studies include sites that were overseen by the USEPA through CERCLA regulations rather than state regulations. The survey of states (Appendix A) presents a guide to approaches accepted in the sites overseen by states. One international case study, located in Australia, is also included. Case studies for European sites were not available.

The cases highlighted in this guidance have long and intricate histories, consistent with an adaptive management approach. Stakeholders are often more engaged at these complex sites than at less complex sites. Stakeholder involvement, however, often is not as well documented as other technical or regulatory aspects of site histories. Several case studies include detailed descriptions of stakeholder involvement based on the experience of stakeholder representatives on the authoring team who were familiar with (or helped write) the case studies. A list of site attributes and remedial approaches for each case study site is presented in Table 14.

Table 14. Index of case studies

Site Name	Location	Complexities/Site Attributes	Remedial Approach
1. Koppers Oroville Wood Treatment	California	Multiple contaminants DNAPL Impacts to drinking water aquifer Surface water impacts Recalcitrant contaminants	CSM revision On-site landfill TI waiver Deed restrictions Phased remedy (P&T system followed by bioremediation)
2. Moffett-MEW Regional Plume	California	Multiple source areas Multiple responsible parties Comingled plumes Large scale site (“regional plume”) Multiple aquifers (8 zones) Geologic heterogeneity VI	High resolution sampling Adaptive site management Redevelopment Excavation SVE Groundwater P&T system Slurry walls VI ventilation VI barriers Multiple remedial technologies LUCs ICs Long-term management
3. Rocky Flats Solar Ponds Plume	Colorado	Contaminated structures (800) Large scale site (421 SWMUs) Comingled plumes Elevated background concentrations	Long-term monitoring Landfills Groundwater treatment Interim actions/removal actions ICs Remediation potential assessment Remedy optimization

Site Name	Location	Complexities/Site Attributes	Remedial Approach
4. Rocky Mountain Arsenal	Colorado	Geologic heterogeneity Fractured bedrock Fluctuating groundwater levels Arid climate/scarce water resources Impacts to drinking water aquifer Comingled plumes LNAPL DNAPL Recalcitrant contaminants Emerging contaminants High contaminant concentrations Multiple contaminants of concern (15 separate plumes) High cumulative risk Elevated background concentrations Vapor issues (highly odorous) Unexploded ordnance Large-scale site (25 square miles, 10 square miles off-site) Changing site objectives Multiple PRPs Litigation (ambiguity in state enforcement authority)	ICs Redevelopment (wildlife refuge)
5. Naval Air Station Jacksonville OU 03	Florida	Site includes over 100 buildings Multiple source areas (8) DNAPL VI risk	Air sparging with soil vapor extraction (SVE) MNA High resolution site characterization
6. U.S. DOE Test Area North, Idaho National Engineering and Environmental Laboratory (INEEL)	Idaho	Deep contamination (200-300 feet) Long plume (2 miles) High contaminant concentrations (>20,000 µg/L TCE) Fractured basalt geology	Pilot test of multiple technologies: metal-enhanced reductive dechlorination, monolithic confinement, in situ chemical oxidation, enhanced in situ bioremediation (ISB), MNA Final remedy: ISB in high concentration areas and MNA in distal area
7. Joliet Army Ammunition Plant	Illinois	Extensive contamination (36 square miles) Multiple contaminants and sources Low-permeability heterogeneous glacial till overlying limestone dolomite bedrock	MNA Groundwater management zones ICs Monitoring Contingency phytoremediation
8. Tri-State Mining District	Kansas Oklahoma Missouri	Large site (2,500 square miles) Mining wastes Impacts to drinking water aquifer Geologic heterogeneity Fractured bedrock Karst-like conditions Ecological impacts	Reuse and reprocessing Backfilling and subaqueous disposal Capping Chemical stabilization Excavation and disposal Covers Grading Administrative controls Alternate water supply Residential buyout Engineering controls

Site Name	Location	Complexities/Site Attributes	Remedial Approach
9. Paducah Gaseous Diffusion Plant (PGDP) Groundwater	Kentucky	Geologic heterogeneity Low permeability zones LNAPL or DNAPL High contaminant concentrations Multiple COCs Long-lived contaminants Large site Depth of contamination Comingled plumes	Source removal Hydraulic control Natural attenuation Interim actions (source control) Innovative technologies testing and implementation
10. Velsicol Chemical	Michigan	Multiple aquifers Geologic heterogeneity Impacts to drinking water aquifer High contaminant concentrations Highly toxic contaminants Contaminated sediment Ecological impacts DNAPL Fluctuating water levels Deep groundwater contamination Residential soil impacts	ICs Slurry wall, clay cap Leachate collection Sediment removal Excavation Impoundment, capping Sheet piling TI waiver In situ thermal treatment In situ chemical oxidation City wellfield replacement DNAPL extraction and incineration Groundwater extraction and treatment (planned)
11. Onondaga Lake	New York	Multiple sources including industrial discharges, stormwater runoff and wastewater treatment plant effluent Sediment contamination Artesian conditions (mudboils)	DNAPL removal from wells Sewer retrofits Metro treatment system upgrades Lakeshore barrier wall and groundwater collection/ treatment system Removal of contaminated sediments, dredging, disposal in an on-site containment facility Isolation and thin-layer capping Pilot and treatability testing Calcium nitrate addition to inhibit MeHg formation Revegetation Slurry wall, groundwater collection system, cap Rehabilitate storm drain system ICs Landfill waste consolidation and capping Excavation Retention pond Leachate collection system Settling basins Depressurization wells Five-year reviews
12. UGI Columbia Manufactured Gas Plant (MGP)	Pennsylvania	DNAPL Fractured bedrock Contaminated sediment	On-site capping ICs Interim actions TI waiver

Site Name	Location	Complexities/Site Attributes	Remedial Approach
13. Savannah River Site (SRS) F-Area Seepage Basins Groundwater	South Carolina	Impact to surface water system Low pH plume Multiple contaminants of concern (tritium, uranium (U), radioactive iodine (I) and technetium) Diversity of contaminants (radiologic, cationic, anionic) Cumulative risk associated with long lived radionuclides, primarily U, I, and strontium Sr Large-scale site (extent of groundwater plume)	Funnel-and-gate for groundwater In situ treatment of groundwater multiple remedial strategies
14. Former Naval Weapons Industrial Reserve Plant, McGregor	Texas	Comingled plumes (TCE/TCA plume with perchlorate plume) Fractured limestone Emerging contaminant (perchlorate)Porpoising effect created three separate plumes miles downstream	Bench-scale studies to evaluate remediation methods Multiple pilot studies including active and passive anaerobic bioremediation systems (fluidized bed reactor [FBR], biowall) Maintain groundwater elevation to prevent discharge to streams Remedy expand passive anaerobic biowall with emulsified vegetable oil (EVO) and maintain FBR Optimize system, transition fully to biowalls
15. Hanford 200 Area	Washington	Large scale site (12 square kilometer plume) Multiple contaminants Radionuclides Comingled plumes DNAPL Deep groundwater	Source removal Interim actions MNA Technology demonstrations Multiple treatment trains
16. Industrial Site	Australia	Saline groundwater Geologic heterogeneity Fractured bedrock (basalt) Multilayer aquifers Low-permeability zones DNAPL Large source area High dissolved phase concentration Competing electron acceptors	Source area remediation Air sparge and SVE Enhanced in situ bioremediation (EISB) Bioaugmentation Adaptive management Groundwater recirculation Blast fracturing Natural attenuation Optimization and monitoring PRBs P&T system Plume containment Radiofrequency heating of groundwater Multiple remedial technologies Flux mass discharge (passive flux meters) Cleaned up to the extent practicable