

EMSI Project Descriptions for Clients Needing Remedial Expertise

Lowry Landfill Superfund Site; Denver, CO

As Supervising Contractor, EMSI is responsible for management of all aspects of the remedial design, remedial action, operations, maintenance, and monitoring of this 500-acre site. Work is being performed for a multi-party PRP group comprised of 34 Fortune 500 companies, municipalities, and smaller private-sector firms. EMSI's involvement includes management/supervision of all components of the \$100M+ site-wide remedy, which consists of an 8,800 LF perimeter bentonite slurry wall; two groundwater extraction systems; two water treatment plants; product recovery from and closure of industrial waste pits; excavation and on-site treatment of 20,000 CY of waste pit material; five miles of buried waterlines; collection of landfill gas from 50 extraction wells via three miles of buried laterals/headers; treatment of landfill gas through a 2,000 scfm enclosed flare and a gas-to-energy facility; 20 perimeter gas monitoring probes; wetlands restoration; two landfill covers; approximately 1700 acres of buffer property; and ongoing implementation of a Groundwater Monitoring Plan that has triggered additional groundwater investigations offsite. Geotechnical, hydrogeologic, and bench scale treatability studies were performed in support of ROD. O&M manuals and Compliance Monitoring Plans were prepared for all remedial components and environmental media. Throughout the project, regulatory liaison with USEPA Region VIII and CDPHE have been provided, including speaking at public meetings, leading design review meetings, and preparing quarterly O&M status reports. EMSI also assisted with regulatory negotiations in support of ROD modifications, Explanation of Significant Differences, a new Consent Decree, and an industrial pretreatment discharge permit issued jointly by two POTWs. EMSI also provided documentation for two Five-Year Review reports. Budgeting, cost control, schedule control, and presentations to the PRP Steering Committee are also required.

Unique challenges included development of a new technology to biodegrade 1,4-dioxane and tetrahydrofuran from extracted groundwater, and application of emerging technologies to thermally treat waste pit material *insitu*, biotreat excavated waste material *exsitu*, optimize landfill gas extraction to fuel a gas-to-energy plant, and optimize subsurface conditions to enhance natural attenuation of organic compounds. Many of these activities were published in technical journals and/or presented to national technology-transfer organizations.

Additionally, EMSI was retained by several of the PRPs to evaluate the site's potential liability for a Natural Resource Damages claim by the state of Colorado. EMSI identified and evaluated the volumes of groundwater impacted by conditions at the site or that are subject to the site's institutional controls. EMSI delivered a presentation to the state Attorney General and other state agencies regarding the volumes of groundwater affected by the site.

Confidential Manufacturing Facility; Denver, CO

The basal alluvial deposits underneath the facility and offsite contain very high concentrations of 1,4-dioxane as well as chlorinated VOCs. EMSI evaluated the results of prior investigations, developed an approach to additional investigation, and conducted additional investigations of the nature and extent of chlorinated solvents and 1,4-dioxane in groundwater, indoor air, and sub-slab vapor.

Initial in-situ chemical oxidation (ISCO) work performed by EMSI under a state Hazardous Waste Corrective Action included bench-scale evaluations of oxidants including Fenton's reagent and sodium persulfate with and without pH activation to develop the most cost-effective dosages for 1,4-dioxane destruction. Subsequently, a large pilot-scale application was performed using sodium persulfate to assess degradation rates and endpoint effectiveness of injected solution. The pilot test involved long-term

monitoring for presence of residual persulfate, endpoint contaminant concentrations, and possible rebound effects.

EMSI also assisted with design, construction, operation, and permitting of an industrial wastewater pretreatment system for metals removal as well as environmental due diligence activities relative to a possible sale of the facility.

Confidential Wholesale Distributor

EMSI developed the Scope of Work and assisted counsel with negotiation of an Administrative Order on Consent for performance of a RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) for historic releases of tetrachloroethene (PCE). The site is the location of warehouses used for sale and distribution of cleaning supplies, equipment and other materials to hotel, restaurant, and dry cleaning facilities where PCE had been handled in bulk and stored in underground and aboveground tanks prior to sale offsite. EMSI is currently implementing the SOW including conducting site characterization consisting of drilling and sampling soil borings, monitoring well installation and sampling, sub-slab foundation sample point installation and sampling, indoor air sampling, and evaluation of sewer lines and backfill materials as potential preferential pathways for chemical migration of DNAPL liquid accumulation. EMSI prepared the RFI and is developing and evaluating potential corrective actions leading to development of the CMS report.

Two ISCO treatment programs were implemented at the facility to oxidize PCE concentrations in groundwater ranging from 1,100 to 310,000 ug/L. The first involved 12 injection wells and a solution containing 15,000 lbs of sodium permanganate injected over a 6,000 sq ft area. Another 15,000 lbs of sodium permanganate was injected into 10 additional injection wells over a separate 6,500 sq ft area and in an underground vault during the second program.

EMSI assisted with implementation of modifications to the heating, ventilation and air conditioning system to address vapor intrusion at the site. Indoor air sampling was conducted at adjacent buildings and a system to mitigate vapor intrusion into a building on an adjacent property was installed. EMSI also prepared a fact sheet and community interview form, conducted interviews of adjacent property owners, and prepared a Community Relations Plan.

West Lake Landfill NPL Site; St. Louis, MO OU-1 Remedial Investigation, Feasibility Study, Baseline Risk Assessment, and Remedial Design

The West Lake Landfill is a closed municipal landfill on a 200-acre parcel in St. Louis, MO that during the 1970's accepted radiologically-impacted soil for disposal or use as daily, intermediate, or in some instances final landfill cover. OU-1 includes the two areas where radiologically-impacted materials were subsequently found to be present. OU-2 includes the other closed, inactive or at the time of the RI, active portions of the landfill.

EMSI was initially retained in 1994 by a group of PRPs to provide technical oversight and project management of an existing large national consulting firm that had previously been retained to complete the RI/FS for the Site. In this role, EMSI performed independent technical review of all project evaluations and deliverables. EMSI also coordinated all project activities including preparation and review of project deliverables, scheduling and agenda for client meetings and meetings with EPA and State

agencies, cost analysis and management including independent cost estimation, cost summaries, project budget estimates and cash flow analysis for the project.

EMSI was subsequently retained by the parties to complete the RI field work and prepare the RI report. Site characterization work for OU-1 included an overland gamma survey to refine the extent of radiologically impacted soil, surface and subsurface soil sampling using both a regular and randomized grid approach, monitoring well installation and sampling, and measurement of radon emissions using large area carbon canisters. Sampling and characterization was performed not only to characterize radiological occurrences but also to characterize trace metal (primarily arsenic and lead), VOCs, SVOCs, PCBs, and hydrocarbons commonly found in older landfills. EMSI completed the geologic, hydrogeologic, chemical and radionuclide occurrences, fate and transport, engineering properties and ecological assessment for the OU-1 portion of the landfill. The final RI report was prepared and approved by EPA in 2000. As part of the RI, EMSI retained a nationally recognized firm that is a leader in radiological risk assessments to prepare the human health risk assessment for the project.

EMSI then prepared the FS report which was ultimately approved by EPA in June 2006. The FS included alternatives addressing institutional controls, minimal landfill maintenance, landfill regrading and recovering options, and excavation of "hot spots" and offsite disposal. The FS included evaluation of potential ARARs, development of remedial action objectives, evaluation of applicable technologies, development of remedial alternatives, and detailed analysis of the alternatives pursuant to the requirements of the NCP and applicable EPA guidance including EPA guidance on RI/FSs for CERCLA Municipal Landfills. EMSI negotiated with EPA and the State the scope of the remedial alternatives including the performance requirements and ARARs for each alternative in order to focus the FS report on the most cost-effective alternatives. The containment remedy selected by EPA in the May 2008 Record of Decision (ROD) for the OU-1 areas called for the installation of an engineered landfill cover and implementation of a long-term monitoring and cover maintenance program. EMSI began preparing the RD for the \$30M soil cover remedy and providing assistance to EPA in responding to comments from the public.

However, as a result of internal deliberations, in January 2011 EPA requested that the Respondents prepare a Supplemental Feasibility Study (SFS) comparing the ROD-selected remedy against two "complete rad removal" alternatives - excavation of radiologically-impacted materials with off-site commercial disposal of the excavated materials and excavation of radioactive materials with on-site disposal in an engineered disposal cell with a liner and cap. The SFS prepared by EMSI was finalized in December 2011.

Since the SFS was finalized, EMSI was tasked with preparing additional evaluations and conducting additional site activities requested by EPA including: investigation and sampling of upgradient groundwater monitoring wells, quarterly sampling of 77 on-site and adjacent monitoring wells, extensive additional subsurface characterization of Areas 1 and 2 of OU-1, installation of security fencing and signage around the two OU-1 areas, evaluation of excavating smaller volumes of radiologically-impacted materials, studying the potential effects of a tornado, evaluating several alternate cover designs, and fate and transport groundwater modeling.

In late 2015, EPA directed the OU-1 Respondents to prepare an RI Addendum (to update the RI Report with site characterization data collected since 2000), Final Feasibility Study (to evaluate alternatives in addition to those in the FS and SFS) and updates to the 2000 Baseline Risk Assessment. EMSI with assistance from landfill design/civil engineering, risk assessment, and fate and transport/modeling consultants, completed the updated documents in 2016.

**Rocky Flats Industrial Park; Denver, CO
Site Characterization, EE/CA and
Removal Action Design, Implementation, and Close-out**

The Rocky Flats Industrial Park consists of several former solvent recycling facilities plus an active inorganic chemical manufacturing facility and a waste oil recycling facility. The site had previously been the subject of several EPA and private party removal actions including removal of thousands of drums and tanks of spent solvent. More recent monitoring data indicate the presence of offsite groundwater and possibly surface water contamination along with the potential for DNAPL occurrences. Soil sampling suggested the presence of arsenic and other trace metal contamination in soil and sediment along with a potential for PCB occurrences in soil.

EMSI was initially retained by a group of industrial companies that had used two of the former solvent recycling facilities to assist in the development of a scope of work and administrative order for site characterization and preparation of an engineering evaluation/cost analysis (EE/CA). EMSI subsequently was awarded the contract to perform the site characterization and prepare the EE/CA. Plan preparation was coordinated with an EPA contractor responsible for characterization of the active inorganic chemical manufacturing facility. Site characterization included surface soil sampling using a grid-based scheme, onsite and offsite surface water and sediment sampling, installation of new monitoring wells onsite and offsite, sampling of existing and new monitoring wells, and pilot-testing of soil vapor extraction (SVE) and air sparging (AS) as methods of removing DNAPL mass. EMSI performed the site characterization of the two former solvent recycling facilities and all offsite characterization. EMSI prepared a site data characterization/interpretive report that included incorporation of the results obtained from EPA's contractor. EMSI subsequently prepared a feasibility study report that presented and evaluated potential removal action alternatives for the Site. EMSI then assisted the parties with development of a scope of work and Consent Order for implementation of the selected removal action. As the selected remedy was mass removal, a key component of the SOW/Consent Decree negotiations was development of the shutdown criteria for termination of the mass removal effort. EMSI prepared draft shutdown criteria and negotiated the scope of the final shutdown criteria with EPA.

Upon finalization of the SOW and Consent Decree, EMSI prepared the removal action design including performance of long-term pilot-scale testing of AS/SVE for removal of DNAPL mass in the saturated and unsaturated zones beneath the Site. EMSI also performed the \$2M construction of AS/SVE systems at the two former solvent recycling facilities, which included 108 SVE wells and 20 AS wells. SVE offgas treatment at one of the sites included thermal oxidation followed by a dry scrubbing system utilizing lime. EMSI operated, maintained and monitored the systems from 2005-2012 including performance of groundwater monitoring at on and off-site wells.

EMSI prepared the evaluation of system performance relative to the shutdown criteria for each of the former solvent recycling sites and received approval from EPA for system shutdown. EMSI self-performed demolition of the AS/SVE above-ground blower and offgas treatment equipment, piping, electrical, and other appurtenant facilities and oversaw a drilling contractor in abandonment of the 120 AS/SVE and 45 groundwater monitoring wells. Much of the equipment and materials was sold or recycled. EPA filed POLREPs to close-out the Removal Action for the site.

**Aerojet Rocketdyne; Sacramento, CA
CERCLA Remedial Investigation and Multiple Feasibility Studies**

Aerojet Rocketdyne Sacramento consists of approximately 8,500 acres where since 1953 the facility has been devoted primarily to manufacturing of liquid and solid propellant rocket propulsion systems to support national defense, space exploration, and commercial applications. The development of these

devices requires the use/generation of multiple chemicals, including perchlorate (a component of an oxidizer in solid rocket fuel), N-Nitrosodimethylamine (NDMA) [a byproduct of combustion of liquid rocket fuel], and industrial solvents such as trichloroethylene (TCE). During the standard use of these chemicals, releases occurred, which caused impacts to soil and groundwater. Underlying the site are 40 to 100 foot-deep dredge tailings, a remnant of past gold mining operations.

Aerojet Rocketdyne entered into a Partial Consent Decree with USEPA and the State of California which, in addition to specifying procedures and obligations toward achieving the goals delineated in CERCLA, divided the site into Operable Units (OUs) because of the overall size of the investigation and remediation effort and to expedite the remediation. Five OUs to address groundwater issues beyond the Aerojet property boundaries and an area east of the facility and four OUs to address potential source areas within the property boundaries were established.

Ongoing, since 1997, EMSI has assisted Aerojet Rocketdyne in preparing cost estimates for the potential environmental liability associated with potential projects within each OU for the Sacramento facility that must annually be reported to the Securities and Exchange Commission (SEC). These cost estimates are currently updated quarterly. In 2006, EMSI assisted in preparing the report that documents the initial survey/assessment of the nature and extent of Conditional Asset Retirement Obligations (CAROs) at each of the Aerojet facilities in the U.S, as required by the Financial Accounting Standards Board (FASB) Interpretation No. 47 (FIN 47).

With respect to the CERCLA RI/FS process for the multiple OUs at the Sacramento site, EMSI developed the FS for the Western Groundwater OU (OU-3), the initial RI for Area 40, the FS for the Perimeter Groundwater OU (OU-5), assisted in preparing the FS for potential source areas located within the Boundary OU (OU-6), and is currently assisting in preparing the FS for Area 40. In preparing the FSs for these various OUs, numerous containment and source removal exsitu and insitu treatment technologies for removal of TCE, 1,4-dioxane, NDMA, perchlorate, PCBs, and metals in soil, soil vapor, and groundwater media are evaluated in developing remedial alternatives.

EMSI also prepared the Groundwater Cleanup and Abatement Plan (CAP) and remedial design for the former White Rock North Dump (WRND) south-central plume.

Vasquez Boulevard/Interstate-70 Superfund Site Operable Unit 2, Denver, CO Remedial Investigation/Feasibility Study

EMSI was retained by the City and County of Denver to conduct an RI/FS for this 50-acre CERCLA site. Work involved assessing the nature and extent of buried smelter wastes and municipal and solid wastes beneath the Operable Unit. Contaminants of concern were primarily heavy metals with some volatile and semi-volatile organic compounds. Work began with an evaluation of environmental data collected by others to assess the need for and scope of additional data collection. EMSI assisted Denver with negotiating a focused scope of investigation and data needs with EPA Region 8, then prepared work plans, performed a limited drilling and soil sampling program, then prepared the RI and FS documents.

ISCO Treatability Studies

EMSI routinely conducts treatability studies on in-situ chemical oxidation (ISCO) of soil and groundwater contaminated with chlorinated solvents and 1,4-dioxane. Because 1,4-dioxane is generally more difficult to oxidize to its elemental constituents than the chlorinated ethanes or ethanes it is often associated with,

ISCO strategies using aggressive oxidants are often performed at an early stage of remedial planning. To this end, EMSI designs and conducts bench scale, and if warranted, pilot scale studies using oxidants such as persulfate, permanganate, ozone, and peroxide, with or without activators such as iron and caustics. Results from bench-scale testing have proven valuable at the FS and pre-RD level by either identifying the most cost-effective an ISCO strategy for further study, or determining that even the best ISCO strategy may be ineffective.

Olympic View Sanitary Landfill Site - Port Orchard, WA

EMSI prepared cost estimates for seven alternatives considered for covering the existing leachate lagoon to prevent over 70 inches per year of precipitation from accumulating in the lagoon. For the selected alternative, a flexible membrane floating cover and lagoon mixing system, EMSI prepared design/build documents and assisted Waste Management, Inc. during construction of the cover. As required by an Agreed Order for the closed site, EMSI also prepared an RI/FS pursuant to Washington solid waste regulations and Model Toxics Control Act.

Expert Witness/Litigation Support

EMSI has provided expert assistance and expert testimony for numerous litigation cases. Some of these are listed below:

- LaPlata County Detention Center site (former Plummer Precision Optics/Redfield Rifle Scope facility), Durango, CO. Expert testimony regarding NCP consistency; nature, extent, and causation of solvent contamination; human health risks; and remedial actions.
- Former Burlington Northern Santa Fe Railyard, Livingston, MT. Expert testimony regarding claims made in both federal and state courts relative to the nature, extent, and causation of chlorinated solvent and hydrocarbon contamination; the necessity, scope, effectiveness, and cost of various remedial actions; nature and extent of contamination on various (over 100) plaintiff properties; necessity and appropriateness of potential remedial actions to address contamination at the plaintiff properties; and the consistency of BNSF actions relative to Montana's CECRA regulations and the NCP.
- San Gabriel Valley, Suburban Operable Unit, Azusa, CA. Expert assistance for mediation between U.S. EPA and a potentially responsible party relative to recovery of past cost claims asserted by EPA for chlorinated solvents, 1,4-dioxane, and perchlorate contamination.
- Midnite Mine, Spokane, WA. Expert witness regarding scoping and data needs for the RI/FS and cost recovery (radionuclides and trace metals contamination).
- Galley Road Dump Site, Colorado Springs, CO. Expert testimony regarding NCP consistency and cost allocation.
- Mystery Bridge Site, WY. Expert assistance regarding NCP consistency, cost recovery and cost allocation issues (petroleum hydrocarbons and chlorinated solvents contamination).
- Talache Mining District, ID. Expert testimony regarding cost allocation for CERCLA remediation of tailings dam failure.

- Bartlesville, OK. Expert testimony related to NCP consistency, cost recovery and cost allocation and technical representative for one PRP for the Corrective Measures Study including ground-water modeling evaluations and risk assessment (trace metals contamination).
- Commerce, TX. Expert testimony related to proposed class action certification and subsequent toxic tort claims at a former pesticide manufacturing facility subject of a CERCLA Removal Action. Expert assistance with groundwater conditions, water supply well operations and reported arsenic occurrences in Ridgeway, TX.
- Fisher-Calo Site, IN. Expert testimony related to cost allocation and divisibility of harm relative to chlorinated solvents and PCBs at a multi-facility NPL site.
- Michigan Ave Site, Kalamazoo, MI. Expert testimony related to NCP consistency in conjunction with cost recovery action for chlorinated solvent contamination.
- Bunker Hill Mine, Wallace ID. Consultant for cost allocation and evaluation of hydrologic conditions including interconnection of mine drainage for the Crescent and Bunker Hill Mines (trace metals contamination).
- Former Conoco (current Suncor Energy) Refinery, Denver, CO. Expert witness for nature and extent of dissolved and free phase contamination; and necessity, scope, and costs of corrective actions. Also, expert assistance regarding RFI, CMS, and RCRA Corrective Action activities.
- Former TOSCO Refinery, Avon, CA. Expert testimony regarding the nature, extent, and causation of LNAPL contamination; and necessity and scope of corrective actions for regulated units and SWMUs.
- Sundstrand Aviation Operations Facility, Denver, CO. Expert testimony regarding the nature and extent of soil and groundwater contamination (chlorinated solvents, cutting/lubricating oils, and fuels) and effectiveness of remedial actions.
- Oil and Gas Production Unit, Aztec, NM. Expert testimony regarding nature and extent of soil and groundwater contamination and the relative contributions from the produced water disposal pit and equipment associated with the oil and gas production facilities.
- Noma Outdoor Products Facility, Jackson, TN. Expert witness work related to sources, nature, and extent of chlorinated solvent contamination of soil and groundwater.
- Amoco Refinery and Downtown/North Casper groundwater contamination, Casper, WY. Expert testimony regarding nature and extent of groundwater contamination associated with the petroleum refinery and several other sources including a railyard, dry cleaning facility, petroleum tank farm, and retail gas station. Also evaluated appropriateness and efficacy of existing and possible additional remedial measures at the refinery as well as the possibility of DNAPL occurrences beneath the refinery.
- Former Fender Guitar/Rhodes Piano Manufacturing Facility, Fullerton, CA. Expert assistance regarding the nature, extent and causation of solvents contamination both at the facility and as part of a regional groundwater contamination area.
- Redfield Rifle Scope Facility, Denver, CO. Expert testimony relative to the nature and extent of chlorinated solvent contamination originating from and extending into the residential neighborhood downgradient of former manufacturing facility.

- Conoco and Total (CRC) Refineries, Commerce City, CO. Expert testimony related to seepage of petroleum and dissolved petroleum constituents in groundwater originating from the CRC refinery that migrated beneath a public highway and underneath the adjacent Conoco Denver refinery; including the amount, rate and impacts of hydrocarbon migration from the CRC refinery; and the need for, potential scope and approaches, and possible costs of remedial actions for preventing ongoing hydrocarbon migration.
- Conoco and Total (CRC) Refineries, Commerce City, CO. Expert testimony related to cost recovery action for RCRA remediation associated with hydrocarbon seepage from operations at two petroleum refineries.
- Former Lockheed Manufacturing and Test Facility, Redlands, CA. Expert witness and expert assistance, including reviewing and providing options relative to site operating history, environmental data, water supply well operating data, groundwater flow data, and chlorinated solvent contaminant plume distributions over a 25 year period relative to plaintiffs' toxic tort claims.
- Natural Gas Well Litigation, Northwestern NM. Expert assistance and testimony in two matters relative to claims of contamination of private water wells by methane and other natural gases and hydrogen sulfide allegedly resulting from oil and gas exploration and development in the San Juan Basin.

Denver Radium NPL Sites Operable Unit 2, DuWald Steel Site, Denver, CO

On behalf of prospective purchaser, EMSI prepared and negotiated scope of Materials Management Plan (MMP) to address residual radium-contaminated soils that would be excavated during re-development of the property. EMSI assisted the purchaser with implementation of the MMP, which included health and safety monitoring, soil screening, sampling, analysis and disposal. EMSI also performed routine groundwater, indoor air and radon monitoring.

Denver Radium NPL Sites Operable Unit 8, Shattuck Chemical Site, Denver, CO

EMSI provided independent technical review of the remedial design for excavation of soils containing radium and uranium, onsite solidification and stabilization using flyash and cement, placement and compaction of the stabilized material into a monolith and subsequent construction of a multiplayer layer cap over the constructed monolith. Subsequently, EMSI served as the owner's engineer and site representative during the construction activities and acted as technical liaison with the various contractors and regulatory agencies. During construction, EMSI developed methods to address unexpected conditions including dust emissions from the processing equipment and kerosene impacted soil from historic rhenium recovery operations to prevent or reduce the size of possible claims for changed conditions and to address regulatory agency concerns. EMSI was also responsible for the implementation and evaluation of the onsite and offsite groundwater monitoring, operations and maintenance inspections and reporting, and the long-term maintenance activities at the Site.

EMSI also provided technical representation at technical meetings with EPA Region VIII, the Colorado Department of Public Health and Environment, City and County of Denver, and local citizens; provided client representation and technical input to the scoping and review of evaluations being performed by a Peer Review Panel and the Five Year Review; and provided technical assistance and representation during the facilitated dialogue process initiated by EPA Headquarters to resolve citizen and Denver's concerns regarding the protectiveness of the remedy. EMSI prepared comments and supervised the

overall preparation of comments on EPA's Five Year Review Report. In addition, EMSI assisted counsel in development and negotiation of a cash-out settlement for the client.

Confidential In-Situ Leach (ISL) Uranium Mining Company

For two ISL uranium mining projects in the western US, EMSI prepared preliminary design and construction/operating/restoration cost estimating in support of permitting and Life of Mine (LOM) costing efforts. Preliminary design included aboveground uranium recovery, yellowcake production, land application, and mining unit header house equipment, facilities, and buildings, as well as supporting utilities and infrastructure.