
REMEDICATION & ENVIRONMENTAL PROJECT & PROGRAM EXAMPLES

Treatment: Soil, Solid Waste and Water

- Invented the AMEOX™ treatment technology (patents pending) for the destruction of PFAS through bench and engineering scale testing on water, fluids, concentrates, brines, and spent granular activated carbon (GAC). Full-scale proof-of-concept field trials on 1000 lbs. of spent GAC from both drinking water and also groundwater treatment systems. Total PFAS (MI-28 telomere list) in drinking water GAC reduced from over 100,000 ppt to less than 3500 ppt, and groundwater remediation GAC of over 21,000,000 ppt PFAS destroyed to <3.7M ppt. Both AMEOX treatment trials produced treated GAC suitable for re-use, lower cost disposal, and/or alternative management options.
- MBT treatment of leachable heavy metals from abandoned/legacy mine wastes, tailings, and water treatment system residuals for onsite management or offsite disposal as non-hazardous waste. Metals include those on RCRA list, but also aluminum, copper, manganese, nickel, zinc. Field trials and studies from abandoned mine NPL sites in Colorado and Idaho. Developed MBT technology application for leachable PFAS telomeres from soils, solids, and sediments with patents pending
- Acid Mine and Rock Drainage treatment. Advanced Electro-Neutralization (AEN) process inception and development for pH neutralization, heavy metal removal without reagent additives, and hydropower packaging - Gold King Mine/Animas River Basin, Silverton/Durango, CO; and Bunker Hill Mine, Success Mine, Silver Valley/Kellogg, ID. Lime Softening-Pretreatment System design, fabrication and installation (Red Dog Mine, AK) with patents pending.
- Active and passive stormwater treatment throughout the Puget Sound, PNW, AK and CA areas at environmental construction, remediation, sediment dredging, and general civil construction projects. Contaminants targeted included a variety of general and specific constituents such as turbidity/suspended solids, pH, heavy metals, organics, PCB's, petroleum hydrocarbons, pesticides/herbicides, etc. Treatment technologies included: settling, chemical and electrical coagulation, clarification, filtration, media adsorption, and oxidation/reduction.
- Various: Treatment of lead in soil and sediments utilizing the patented MAECTITE® chemical treatment technology and other processes at projects such as: firing ranges (US Navy Subbase Bangor, WA -Camp Wesley Harris; Fred House – Utah; Suncadia – WA), auto shredder residue site (Zelman-Renton, WA), NPL Sites in Alaska (Standard Steel and Borough of Anchorage), and for sediments (Shearwater –South San Francisco, CA). All lead and other heavy metals rendered non-hazardous pursuant to RCRA and applicable state regulations. ~100 sites for chemical treatment / stabilization of lead and other heavy metals using MAECTITE chemical treatment process and conventional pozzolanic additives. Insitu and exsitu ranging from drum quantities to over 200,000 tons.
- Automobile Manufacturer, Hartland, WI. Multiphase project with preliminary removal of construction debris, concrete decking, scrap steel, buried drums. Second phase utilized in-situ Hot Air/Steam Stripping to strip various paint related solvents and cleaners from soil and groundwater (8000 CY) to allow for subsequent removal of soil as a non-hazardous Subtitle D solid waste. Off-gas control using chlorinated catalytic oxidation.
- FUSRAP/Lockheed-Martin - Robins Air Force Base Sludge Lagoon NPL Site, Robins AFB, GA. A one-year bench, engineering, and on-site pilot scale treatability project for lagoon closure (MAECORP) culminated in a two-year full-scale application of in situ Hot Air/Steam Stripping to remove volatile halogenated organic compounds from lagoon sludge with catalytic oxidation air treatment. Insitu thermal treatment was followed by exsitu stabilization of heavy metals using 150-ton crane mounted drill platform and 7' diameter cutter head on 1.5'x1.5'x35' Kelly bar drill stem with chemical oxidation for recovered off-gas. Processed material (30K CY) placed in constructed cell on top of former landfill and covered with protective cap. Wetland and stream mitigation. Sheet-piling for groundwater control, 200gpm wastewater treatment system, on-site laboratory for metals, VOC's and geotechnical parameters.

Technology Development: Concept to Full-Scale Process Implementation/Commercialization

AMEOX™ Treatment Technology: Conceptualized, tested, and developed the technology to destroy PFAS telomeres and other persistent organic compounds in water and fluids, and spent granular activated carbon for its regeneration/disposal. AMEOX is patent-pending.

MBT Treatment Technology: Conceptualized, tested, and developed the technology for leachable PFAS, heavy metals, including mercury and its elemental form, in solids, soil, sediments, abandoned/legacy mine wastes and tailings, and other materials for HMR Solutions, Inc. MBT is patents-pending and owned by HMR.

Advanced Neutralization™ (AN™): Conceptualized and developed new water treatment technology. Oversaw fabrication and assembly of bench and engineering pilot systems for pH neutralization combining advanced dimensionally stable surface reactive electrodes, ultrasound, and oxidation/reduction technologies to neutralize acidic mine and other fluids carrying dissolved and total metals. Successful trials completed on various waters from Gold King Mine/Animas River Basin and portal drainage at the Bonita Peak Mining District NPL Site, Silverton/Durango, CO.

Reverse Osmosis: Laboratory scale directly to full-scale New York City potable water system control station mercury cleanup. Pretreatment filtration, pH adjustment and RO components for a 20 gpm system installed within a 2-ton van truck. Minimized mercury contaminated wash and rinsate water from cleaning of 88 vault stations beneath streets and intersections. First use of RO technology for an emergency response remediation cleanup using mobile system.

In-Situ Vitrification (ISV) – Parsons Chemical NPL Superfund Site, Grand Ledge, MI. Identified and evaluated ISV technology as viable remedy for site. Recommended and arranged for pilot and engineering-scale study with USEPA and Battelle NW Laboratories under USEPA Region V ERCS contract. Site prepared for ISV processing in 1990-91. USEPA implemented the ISV technology with GeoSafe in 1995 where ~3000 CY of material was converted to a vitrified glass mass using electricity applied to spatially oriented electrodes set to a depth of ~30-40 ft. across numerous grids through the contaminated zone.

Filter Press/Centrifuge Dewatering – Remediation and Construction Sites

- Duwamish Sediment Other Area, Boeing Plant 2 NPL Site. River sediment dredging project. Dredge/sediment drainage fluids containing up to 5.8% solids (100% passing 100#) treated by WaveIonics electrocoagulation (EC) technology at full-scale. Coagulated and settled solids from the process were dewatered at lab-scale using high pressure filter press generating filter cake containing >80% solids without polymer, filter pre-coat or body feed. Supported R&D to full-scale commercial application of treatment processing of MFT and related residuals associated with oil sands bitumen, including emulsion breaking, solids coagulation/densification, dewatering, and elutriate treatment for reuse/discharge to surface water.
- Centrifuge – Various: Dewatering of concrete interstate roadway grinding slurry solids separation, pH neutralization. Oil/water separation, oil reclamation and reuse at waste oil sites and on-going industrial processes. Pioneered use of centrifuge-based process for dewatering concrete grindings treatment, dewatering and water reuse (14 miles of all N/S bound I5 lanes, WA), and for sediment dewatering (S. San Francisco Bay Area, CA)
- Auto Ion Chemicals NPL Site, Kalamazoo, MI – Former coal burning powerhouse converted to electroplating waste processing facility. Abandoned. Cr (V), acid and caustic fluids treated to meet discharge. Filter press utilized to minimize sludge volume and eliminate free liquids for offsite disposal as a RCRA Subtitle C Hazardous Waste. Over 1,000 CY of filter cake disposed. Lab to full-scale. 1984
- Major International Electronics Company, Marion, IN – Facility operated a former leaded-glass disposal facility and yard for off-spec Cathode Ray Tube (CRT) televisions/vacuum picture tubes. Process fluids/drainage treated to remove lead and glass fines/dust. Filter press to dewater treatment system solids for minimized waste disposal and elimination of free liquids during RCRA corrective action. Lab to full-scale. Over 500 CY processed during remedial corrective action. System sold for ongoing process operations. 1990.

UV/Peroxidation: UpJohn Company (Pfizer), Fine Chemical Division, North Haven, CT – Process combined hydrogen peroxide and ultraviolet light to generate hydroxyl radicals in presence of BCB's and PCB's. Constituents fully destroyed by advanced oxidation without intermediaries to carbon dioxide, water, and chloride. Lab to pilot study culminated in two (2) permanent 600 gpm unit installations at the facility.

MAETITE® Chemical Treatment Process: Chemical treatment process invented for the treatment of leachable lead, chromium, cadmium, other RCRA metals, and leachable radionuclides. Lab to full-scale. Commercialized for heavy metals in soils and solids waste, firing ranges, autofluff shredding facilities, battery cracking operations, popping furnaces, plating facilities, lead-based paint sand blasting sites. Lab to full-scale for radionuclides. Selected remedy at over 100 project sites.

MatCon® Impermeable Asphalt for Environmental Caps and Covers: Technology developed and commercialized through extensive laboratory, field pilot and full-scale trials. Numerous sites completed ranging in size from a few hundred square feet to over 30 acre sites across the United States at federal and private sector project sites.

WaveIonics® Electrocoagulation/Electrochemical (EC) Enhancement Applications

- End-of-pipe heavy industrial surface water drainage basin outfall discharge for heavy metals, PCB's, petroleum hydrocarbons, PAH's/cPAH's, dioxins/furans, turbidity, TSS, and pH. Lab and engineering-scale studies. Successful three (3) month multi-storm event 200 gpm field demonstration with local municipality performing independent confirmation sampling and analyses.
- Sanitary Sewage: non-biological/non-chemical treatment, solids dewatering, and discharge compliance with general NPDES permit requirements and for reuse as a hydrofracturing makeup fluid. TSS, phosphate, bacteria, BOD/sBOD, COD/sCOD, pH. Lab and engineering-scale.
- Radionuclide and removal from surface, storm run-off, cooling, and decontamination fluids. Demonstrated over 98-99% removal for all target parameters including: Cesium, Uranium, Thorium, Radium, Polonium, TSS and turbidity. Laboratory scale on synthesized waters for application in Japan.
- Hydrofracturing Polymer Flood backflow and produced fluids: Developed combination chemical and EC process to: break spent fluids; remove viscosity destabilizers, coagulated solids and reactive hydrogen sulfide; and re-established required high viscosity for reuse with reduced make-down polymer. Laboratory to full-scale.
- API separator effluent treatment using EC followed to remove TSS and other constituents, followed by electrochemical On-Site Generation (OSG) of mixed oxidants to destroy COD allowing for subsequent UF and/or RO polishing for discharge to surface water or reuse by refinery. Lab and engineering scale. On-site in-refinery field trial in-progress.
- Tannins, Humic and Fulvic Acids: Identified EC process and configuration modifications to remove turbidity contributors and UV light blockers without chemical. Lab to full-scale.
- Developed advanced electrochemical reduction/oxidation of selenium, sulfate, manganese, chromium, and nitrogen compounds – mining fluids/drainage.

Hot-Air/Steam Stripping

- Community School at Former Railroad Fueling and Maintenance Facility, WA. Bench-scale and engineering column study demonstrated removal of degraded Bunker C, diesel fuel, and total petroleum hydrocarbons using hot air, steam pulsing, and hot water flushing from glacial till, sand, and gravel to evaluate technology efficacy for full-scale implementation beneath the school.
- FUSRAP/Warner-Robins AFB Sludge Lagoon NPL Site. 2-year laboratory, engineering, and onsite pilot demonstration. Full-scale application on 30,000 CY yards of sludge and peaty swamp material. VOC's and HVOC's. Off-gas control using chlorinated catalytic oxidation. Material excavated post thermal processing, treated for leachable heavy metals, and interned within onsite RCRA repository. 700 ft by 50 ft sheet pile cut-off wall for groundwater control during insitu processing.

Dredging, Sediments and Shoreline

- Over 2.5 million cubic yards of sediment removed and/or handled, treated/processed, transported, and disposed. Over 20 miles of shoreline reconstructed, stabilized, and rehabilitated.
- Terminal 25 Dredged Sediment Barge-to-Rail Transload Facility, Port of Seattle, Seattle, WA. Conceptualized, designed, and directed construction and operation of a 14-acre terminal for the barge-offload, handling, dewatering, and load-out of 750,000 tons of contaminated sediments to railcars. Debris sorting, and sizing, water and sediment drainage capture, treatment and discharge, bull-rail sediment spillage prevention aprons, 2-slip offload locations, mile-long unit train production per day. Facility serviced six (6) marine dredging and waste transloading contracts over two (2) fish window seasons including multiple NPL Sites. Heavy metals, organics, PCB's, cPAH's/PAH's, petroleum hydrocarbons.
- MULTIPLE: Duwamish River CS1 – Remedial Action Sediment Drainage/Fluid Treatment NPL Site; Whitefish River Upper Reach Sediment and Shoreline Remedial Action, Phase 1, Skykomish Levee Removal Action; USACE-Port of Seattle East Duwamish Ship Channel; US Steel South Bay Shearwater NPL Site; Head of the Thea Foss Waterway NPL Site ; Head of the Hylebos Waterway – Weyerhaeuser OU NPL Site; Bear Creek Restoration;

Shiawassee River NPL Site - PCB Removal Action; USACE Great Lakes Harbor and Shipping Channel Maintenance Dredging S&A Investigation; and others.

- Eagle Harbor WOU NPL Superfund Site Remediation, Bainbridge Island, WA. Time critical project included tidal barrier wall and groundwater intercept trench installation, sediment dredging and upland soil excavation, exsitu material pugmill stabilization, on-site impoundment structure construction, sediment internment, underwater and intertidal capping, shoreline restoration/armoring, building and pier demolition, and underground tank removal, historic feature preservation. Site grading, new utility corridor and stormwater feature construction, and paving for future expansion by WA State Ferry's maintenance facility. Contaminants included mercury, lead and other heavy metals resulting from historic ship building activities.
- Marathon Battery NPL Site, Cold Spring, NY: Excavation/dredging, dewatering and treatment of over 150,000 CY of RCRA hazardous (characteristic toxicity rule for D-waste) soils and sediments for cadmium and lead from tidally influenced Constitution Marsh along the Hudson River. Responsible for treatability studies, onsite pilot demonstration, through full-scale processing of all sediments, cattail root mass, and soils using the MAECTITE™ chemical treatment process for TCLP heavy metals. Non-hazardous solids were transported by railcar and disposed at a licensed Subtitle D landfill.

General Site Remediation/Environmental Construction

- Residential and commercial property remediation projects for heavy metals and other mine processing ore residuals. U.S. Army Corps of Engineers, Bunker Hill/Silver Valley NPL Sites - Coeur d'Alene River Basin, Northern ID; USEPA/CDM, Basin Valley Operable Unit NPL Superfund Site, Basin, MT; Bunker Hill/Silver Valley CDA Basin NPL Site, IDEQ; Over 400 residential and commercial properties and other parcels, including mine adits and settling ponds within "OU" limits impacted with mine residuals were remediated and restored with top soil, seed or sod, with mine features closed, demolished, or protected as historic features. Combined contracts performed under Task/Delivery Ordering Master Service Agreement contracts over a period of 4 years.
- Butte/Silver-Bow NPL Site, Butte MT. Railway track and former rail yard remediation; embankment and steep grade stabilization and armoring; utility corridors mitigation, storm water channeling and armoring; repository construction, management, and cover; unknown shafts and adits encountered during work were demarcated and securely closed. Work during extreme fire hazard conditions through flash flooding and sub-zero work conditions.
- Various: PCB remediation; various other private and public sector Owners for wire chop, cyanide film chips, battery casings, smelter slag, lead-based paint sand blast grit, mercury, etc.
- Automobile Manufacturer, Chicago, IL. Removed leaking 500,000 gallon UST's used for storage of waste oil and spent solvents. Groundwater characterization, slug and pump tests. Designed, installed and operated comprehensive groundwater intercept and treatment system to complete site closure
- Automotive Company Brake Supplier – Two (2) 1 million gallon AST's containing waste water soluble cutting oil, wash waters, cleaning fluids. Utilized primary centrifuges to separate oil/water/solids, and secondary centrifuges to purify oil for resale. Water treated by conventional onsite equipment and discharged to sewer. Solids processed onsite using bioremediation methods. Soils used as clean fill after tank demolition. Centrifuges purchased after project for ongoing process discharge use.
- Management of >30 NPL site remediation projects across all USEPA Regions

Groundwater: Recovery, Intercept, Barriers, Treatment

- Various – Major Oil Producers & Airline Carriers - conveyance pipeline breaks, distribution centers, bulk fueling, and truck and auto service stations. UST testing and removal, site and plume characterization, remediation. Well/piezometer installation, development, and sampling, site and groundwater characterization, aquifer performance/pump testing and modeling, groundwater recovery and treatment. Granular activated carbon, stripping tower, cut-off walls/intercept trenches, insitu/exsitu/catalytic oxidation, bio-augmentation, flushing, vacuum extraction, natural attenuation, and other technologies. Over 150 locations addressed under program contracts in Northeastern IL and Northwestern IN, MI, OH, and WI for leaded-gas residuals, gasoline, diesel, MBTE, JP-5, ethanol/derivatives.
- Various – installation of various types of groundwater cut-off, sheet-pile walls, and barrier systems with and without groundwater recovery, treatment and discharge, or flushing.

- Solvent Packaging Company, Wisconsin. Installation of a 50-foot deep by 500-foot long intercept trench to recover trichloroethane in a peat bog with flowing sands. Groundwater recovery, 100 gpm treatment by stripping tower and granular and vapor-phase activated carbon for discharged to POTW and the atmosphere.

Landfill, Impoundment, Retention & Water Conveyance Facilities and Features

- Various: Landfill construction, capping, and closure. Examples include: Kitsap County Bainbridge Island; Olympic View; Roseburg; Short Mountain Lane County Landfills. Excavation cut to fill/embankment; material processing; leak detection/leachate collection; waste sorting and screening; membrane, geotextiles/composites; grade control; material placement & compaction; low perm material manufacture; landfill gas/methane collection, recovery, and combustion systems; composting; top soil; seeding; access haul roads, weigh scales.
- Cam-OR Superfund Site, Westville, IN. Directed emergency response action where liquids contaminated with metals, organics, and PCB's were treated to discharge permit specification with mobile treatment system. Temporary double membrane lined TSCA cell with leak detection was constructed to contain 120,000 CY of sediments and sludge. Material excavation and placement. Liner cap installation. Facility Demolition.
- Commercial Oil Superfund Site, Oregon, OH. Free-board maintenance of 12-million gallon lagoon system. Mobile water treatment system to remove heavy metals, floating oils, dissolved priority pollutant organics (including PCB's, Dioxins/furans), suspended solids and nutrients to comply with former NPDES permit and state of Ohio water quality objectives for warm water habitats. On-site metals and organic lab using UESAP approved methods for process control and discharge monitoring. Entire lagoon contents treated on three (3) separate occasions for USEPA and PRP clients using emergency response 24-hour site operations to prevent immediate lagoon system overflow to Lake Erie watershed. Lagoon berm repair and enhancement. Sediment consolidation.
- Greiners Lagoon NPL Superfund Site, Fremont, OH. Treatment and discharge of 200,000 gallons of impounded liquids for organics and PCB's. Berm repair, sludge stabilized and site prepared for in situ vitrification (ISV) with Battelle PNL. Developed stabilization approach that lead USEPA to examine use of lime for PCB destruction. Onsite TSCA cell construction, solid waste interment, cell closure for 5million cubic yards of PCB contaminated soil.
- Gilboa Dam, Gilboa, NY. Developed innovated construction approach for the WaveIonics electrocoagulation treatment technology for the processing of turbid construction and concrete truck & batch plant wash, and surface rinse and quench waters using lined concrete ponds for solids precipitation and settling to lower costs. Multi-year contract for the refurbishment of a reservoir dam supplying majoring of the potable water for the city of New York. Hurricane Irene (fall 2011) impacts destroyed and washed out job site except for treatment equipment.
- Various planned and emergency response irrigation and potable water conveyance channel, ditch, berm, and pump station construction/repair projects. Cascade Mountains, WA

Facility Decontamination/Demolition

- Sternoff /Zelman Industries Site, Renton, WA. Multiple buildings totaling over 90,000 SF were decontaminated and demolished. Devised and implemented treatment process for over 100,000 CY of wire fluff and paint chips were treated for TCLP lead and to achieve suitable geotechnical properties for a structural fill. Treated materials used as fill and capped beneath new 300,000 SF pop-up buildings, and semi-truck distribution center. Sampling, characterization, packaging, and disposal of >3000 unknown drums for paint waste, PCB's, plating fluids, solvents, and petroleum hydrocarbons. Lead-based paint and asbestos survey, mitigation and disposal. Facility demolition and dismantlement, backfill, compaction, and grading. New utility corridors constructed, site grading, stormwater conveyance structures, curb/gutter, and final site paving.
- Dutch Boy Paints Site, Chicago, IL. Decontamination of 300,000 SF abandoned and deteriorating 4-story facility for friable asbestos and uncontained white lead oxide. Facility shoring for safe work, followed by demolition, scrap steel salvage, and concrete crushing for reuse as a controlled-use aggregate. IEPA State Superfund Site. Former utility corridors located, piping and conduit systems purged, washed/rinsed, drained and capped, and removed.
- Auto Ion Chemicals NPL Site, Kalamazoo, MI. Treatment of plating wastes and decontamination fluids and sludge containing cyanide and Hexavalent chromium in a former coal fired power plant converted to a hard-chrome plating waste processing facility serving the Midwest auto industry. Complex water treatment system with filter press dewatering. Former 10ft diameter cooling water intakes/outfalls used for illegal discharge of waste were decontaminated and filled with impermeable grout. Included building shoring, sewer cleaning, facility decontamination and demolition.

- Refinery Products, IL State Superfund Site, Schiller Park, IL. Cleanup of abandoned 3-story oil reclamation and hazardous waste disposal facility. Emptied, cleaned, scrapped and disposed tank and vault contents totaling 500,000 gallons. Sampled, characterized and disposed of 1,200 unknown drums; On-site treatment of impounded liquids for metals organics, and PCB's. Identified/located pipe and conduit runs for former facility waste handling and processing, cleaned/capped and removed. Asbestos pipe and insulation materials identified, removed and disposed. Decontaminated and demolished site structures and buildings. Graded and seeded site.

Emergency Response

- Mercury Decontamination and Treatment, NY. Decontamination of 88 subsurface 100 year old water main control vaults within all Boroughs of the City of New York. Removed 3,000 pounds of elemental mercury for reclamation. All rinsates and decontamination fluids treated using reverse osmosis to minimize off-site disposal volumes.
- Commonwealth Edison (Chicago land area) - PCB Cleanup and Decontamination,. Managed crews, equipment, material resources to remediate soils contaminated from damaged/exploded transformers on residential, public, and other privately owned property. Work included yard cleanup, concrete/asphalt decontamination/replacement, utility corridor decontamination, traffic control, interface with city, county, state and federal utility and environmental enforcement agencies. Multiple multi-year master service ordering contracts.
- Railroad & related party emergency response slide repair program for endangered, obliterated rail lines throughout the Puget Sound and Cascade Mountains. Established emergency response preparedness procedures and response management teams consisting of personnel, equipment, specialty subcontractors, materialmen, and other suppliers with integrated liaison with RR's, geotechnical engineering firms, state and federal DOT authorities. Remote and inaccessible terrain, shoreline, wetlands, high traffic corridors and severe weather conditions. Drill & shoot, rock scaling/bolting, highline towers, helicopter & work-train support, under-rail utility corridor boring, structure, steel and timber structures/trestles, earthwork and armoring. Project scale ranged from small culverts, to 2000 ft drop and overhead rock wall collapse onto rail-bed through Stevens Pass with permanent rockfall/slide detection electronic sensor alert notification system, to a 175,000 CY mudslide along Puget Sound washing out dual track mainline.
- Multiple emergency spill response and train derailments: CSX; IL Central, Amtrak; Beltway; BNSF railroads. Tank car and semi-truck trailer material transfer, chemical/fuel spill and impacted soil cleanup. Coordination with railroad power and railcar re-railing response companies. Chemical neutralization, fume mitigation, community evacuation coordination, emergency agency liaison and coordination.
- Pipeline, tank, vessel oil spill response and cleanup to land, water tables, shorelines, open fresh/marine waters.
- USEPA Region V, Emergency Response and Cleanup Services (ERCS) contract. Technical responsibility for characterization of waste, remedy and treatment technology selection and implementation, spill and residual cleanup, waste management/containment, and site stabilization for over 50 time critical emergency response and time critical removal actions during this 3-year contract throughout Region V. Sites included: earthen impoundments, underground chemical fires, buried and abandoned drum sites, truck and train spills/derailments, abandoned plating and battery cracking facilities, illegal waste disposal facilities, and others. Contract >\$56 MM, plus contract modifications.

Unknown Waste/Buried Drums

- Berlin and Ferro NPL Site, Swartz Creek, MI. Excavation, sampling, characterization and bulking of 45,000 unknown buried drums that included cyanides and acids, Agent Orange/C-56 manufacturing residuals; treatment of lagoon contents; landfill excavation; and site stabilization. Implemented community-wide emergency monitoring and evacuation alarm system for cyanide gas during remedial activities. No alarms or releases. Project highlighted in National Geographic Magazine
- Conservation Chemical Superfund Site, Gary, IN. Directed the sampling, characterization, and removal of 10,000 unknown drums; lagoon solidification and excavation; removal, decontamination, disposal, of 25 tanks containing cyanide brine and crystals, acids and caustics; structure piping; and tank demolition. Intense health and safety protective measures and community emergency evacuation alert system; unknown material characterization for disposal analyses, licensed TSD disposal acceptance, waste consolidation, packaging, and transport coordination for disposal by incineration, treatment, stabilization, and landfill internment.
- Krejci NPL Site, Cuyahoga National Park, OH. Directed the sampling, characterization, and removal over 100,000 unknown buried and surface drums; removal, decontamination, disposal. Buried underground and above grade surface waste tanks, contaminated soil excavation, and disposal. Liquids, solids, reactive waste. Intense health and safety protective measures and community emergency evacuation alert system; unknown material characterization for

disposal analyses and waste consolidation, licensed TSD disposal acceptance profiling and testing, waste packaging for disposal criteria, and transport coordination for disposal by incineration, treatment, stabilization, and landfill internment. Onsite field laboratory, drum/container handling equipment, container/drum handling and staging area, transport vehicle loadout and decontamination facility. Detailed record keeping and waste tracking logging.

Sampling and Analytical Programs

- Authored and published detailed unknown waste and material sampling and analytical characterization manual for internal company use by field chemists and waste handling technicians for soil, solids, slurries, sludge, and liquids. Included health and safety protocols, sampling equipment and methods, documentation procedures, waste characterization field methods for reactive, flammable, shock-sensitive, corrosive, and toxic materials common to unknown drums, containers, and lab-pack remedial operations. Included detailed lists of incompatible materials. Provided for multiple safe and effective methods to classify, containerize, consolidation, and package similar compatible materials for disposal profiling and disposal acceptance, transportation and disposal. Manual was accepted for use by USEPA Region V OSC's for emergency response at unknown waste sites.
- Various. Developed/advanced mobile laboratories, and trained chemists for the onsite monitoring and operational control of onsite treatment systems. USEPA SW-846, Standard Methods for Analysis of Water and Wastewater, ASTM, and others for heavy metals, organics, geotechnical, radionuclides, and other parameters. Data corroboration and QA/QC validation in conjunction and cooperatively with third party licensed testing and analytical laboratories.
- Ecological study, Western Michigan Regional Shoreline Development Commission, Muskegon County, MI. Designed, planned, supervised, and performed comprehensive sampling of fish, benthos, sediments, and water quality of all navigable waters (lakes, ponds, rivers and streams, substantial wetlands) and major industrial/storm water outfalls within Muskegon County watershed systems. Inorganic and organic priority pollutants scanned.
- USACE Great Lakes navigable waterway and channel maintenance program. Sediment and water quality sampling and analyses for pre-dredging planning and spoils management coordination for Lakes, Erie, Huron, and Michigan. Heavy metals, organics, benthic organisms, elutriate characteristics.
- Fish/Bird/Amphibian Removal and Translocation: Fish/animal trapping/capture and relocation to waters outside limits or remedial action. Skykomish, Whitefish River, Constitution Marsh NPL Site; Various oil spill, containment and cleanup projects; USX Shearwater; Bear Creek Streambed and Shoreline Reconstruction; Shiawassee River NPL Site.