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David G. Livermore, R.G., L.H.G.
Principal

PROFESSIONAL PROFILE

Mr. David Livermore is a principal hydrogeologist with 25 years of experience in solving complex earth science problems centered on the interaction of hydrogeologic, geologic, and atmospheric systems. Mr. Livermore is a registered geologist in six states and a licensed hydrogeologist in Washington. Mr. Livermore has successfully managed the investigation and cleanup of hazardous waste sites throughout the United States and specializes in developing innovative strategies and solutions for negotiating streamlined site closures with regulatory agencies.

Mr. Livermore's technical expertise includes the hydrogeologic analysis of natural systems, and the geochemical assessment and cleanup of soil, sediment, and groundwater contamination at complex hazardous waste sites. Mr. Livermore's hydrogeologic expertise includes regional hydrogeologic studies, the evaluation of tidally influenced aquifers near surface water bodies, and groundwater/surface water interactions. His geochemical experience includes the evaluation of vadose zone transport of chemicals, geochemical processes affecting the natural attenuation of chemicals, and the effects of cosolvency on the mobility of chemicals in the environment. Mr. Livermore's remediation experience includes the analysis and optimization of remediation systems, non-aqueous-phase liquid (NAPL) remediation at sites with complex stratigraphy, and assessment of alternative remediation options.

Mr. Livermore's environmental litigation experience includes developing expert testimony and providing courtroom testimony on the source, extent, and cause of contaminant releases. His hydrogeochemical conceptual models have proven instrumental in the settlement of legal suits involving the source and timing of chemical releases to the environment.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Geology, University of Oregon, Eugene, Oregon, 1990

B.A., Geology, Macalester College, St. Paul, Minnesota, 1982

Registered Professional Geologist: Oregon License #G1174; Idaho #828; California #6072;
Missouri #961; Georgia #1569; North Carolina #1739

Licensed Hydrogeologist: Washington #2645

PROFESSIONAL AFFILIATIONS

National Ground Water Association Affiliate

RELEVANT EXPERIENCE

Remedial Investigation, Fate and Transport, Risk Assessment

Human Health and Ecological Risk Assessments, Former Chlor-Alkali Manufacturing Plant, Portland, Oregon—Principal-in-charge for human health and ecological risk assessments for the uplands and riparian areas of a former pesticide and chlor-alkali manufacturing facility located along the Willamette River. Chemicals of concern (COCs) included DDT, monochlorobenzene (MCB), sodium perchlorate, and hexavalent chromium.

Remedial Investigation for TCE, Former Metals Machining Facility, Milwaukie, Oregon—Managed the remedial investigation of trichloroethene (TCE) in groundwater and soil at a former metals machining facility. Designed and oversaw several phases of investigation that demonstrated the source of TCE was on two adjoining properties that were once a single parcel. Key technical issues included the sources, nature and extent, and fate and transport of TCE and other related chlorinated volatile organic compounds (VOCs) in groundwater at and downgradient from the site. Releases of TCE-containing degreaser waste, including DNAPL, created separate groundwater plumes in shallow and deeper groundwater zones at the site. Later phases of the remedial investigation included a cooperative, joint investigation between multiple responsible parties. After completion of the remedial investigation and feasibility study (RI/FS) and interim remedial measures (IRMs) for the site, a settlement was reached with the three primary responsible parties, insurance companies, and Oregon DEQ that allowed for a precedent setting settlement agreement that allowed a release of liability for the responsible parties and a settlement fund for the state of Oregon to complete the site cleanup.

Shipyards Construction and Repair Facility, San Diego, California—Principal hydrogeologist for an uplands investigation, fate and transport analysis, and corrective action recommendation. The site, located in a historically industrial area, had been affected by historical site uses, including a city garbage incinerator, tank farm, and marine fueling facility. Contaminants of concern included diesel and crude oil fuels that were present as LNAPL on the groundwater surface, in addition to lead, polycyclic aromatic hydrocarbon (PAH), and total petroleum hydrocarbon (TPH) in soil. The investigation identified contaminant source areas, migration pathways, and quantitatively assessed chemical transport and fate. The corrective action plan incorporated LNAPL removal, soil treatment, and *in situ* soil stabilization, which complemented the commercial redevelopment of the site. The preferred corrective action was accepted by the San Diego Regional Water Quality Control Board and the Port of San Diego.

DDT Manufacturing Facility RI/FS, Portland, Oregon—Managed the upland RI/FS of a former DDT manufacturing facility. DDT manufacturing was conducted at the site in the 1940s and 1950s, and liquid residue discharges were directed into a discharge pond adjacent to

the Willamette River. Upland soil, groundwater, and stormwater investigations and preliminary sediment investigations were conducted. The groundwater investigation focused on the nature and extent and fate and transport of DDT and a DNAPL residue consisting of primarily MCB. DDT cosolvency in the MCB DNAPL waste was also investigated.

Active Steel Mill Remedial Investigation, Willamette River, Portland, Oregon—Managed the remedial investigation of a steel manufacturing facility, operating at the site since 1969. The facility manufactures high-quality steel plate, coil, and other products using primarily scrap steel. Key environmental issues investigated included the nature and extent of metals, PAHs, and PCBs in site soil, groundwater, stormwater and adjacent river sediments in addition to the identification and investigation of a former oil sump owned by the Port of Portland that was operated as a disposal facility for waste bunker fuel oil and other waste fluids. The site is adjacent to the Willamette River Portland Harbor Superfund site.

RCRA Facility Investigation of a Pulp and Paper Mill, Savannah, Georgia—As senior hydrogeologist completed the assessment of more than 100 solid waste management units (SWMUs) and participated in the preparation of a RCRA facility investigation work plan that provided an approach for the investigation and closure of SWMUs at an active pulp and paper mill and neighboring chemical plant. Successfully completed the preparation of the work plan under an extremely short time frame with a deadline that was subject to large stipulated penalties for any delay in submittal. The work plan was submitted on time and was accepted by the Georgia Environmental Protection Division.

Pier 23, Tacoma, Washington—Principal-in-charge of support for a remedial investigation and fate and transport analysis for a military reserve base on Commencement Bay. Support tasks included the installation of groundwater monitoring wells, hourly monitoring of groundwater levels using transducers and data loggers, data reduction and analysis to account for tidal fluctuation that propagate in the shallow groundwater zone and chemical fate and transport analysis using analytical solutions to demonstrate the low-mobility of chemicals, primarily PAHs, in site groundwater.

McCormick & Baxter Creosoting Company, Portland, Oregon—Served as lead geologist, hydrogeologist, and field team leader for a remedial investigation of the Superfund site. The remedial investigation included a multidisciplinary investigation of surface and subsurface soil, surface water, groundwater, and sediments containing inorganic (arsenic, chromium, copper, and zinc), and organic (PAH, PCP, and dioxin) compounds. Served as field team leader for field investigations, including surface and subsurface soil sampling; the installation, development, and sampling of more than 25 new monitoring wells; river sediment coring from the river bank and offshore barge platforms; hydraulic testing and evaluation; air investigation tasks; and residuals management. As lead geologist and hydrogeologist completed data analysis, nature and extent and fate and transport assessments and preparation of the soil and groundwater analysis portions of the remedial investigation report. Also served as health and safety officer and assisted with project management responsibilities, including field logistics, preparing progress reports,

statements of work for subcontractors, coordinating subcontractors, and scheduling of up to 20 field staff.

Sodium Chlorate Production Facility, Willamette River, Portland, Oregon—Managed the remedial investigation of hexavalent chromium releases from a sodium chlorate production facility located along the Willamette River in Portland Oregon. The investigation identified releases of hexavalent chromium in groundwater and soil beneath and downgradient of the facility. Key technical issues included characterization of the stratigraphically controlled vadose zone and shallow groundwater flow paths in the shallow hydrogeologic setting and the fate and transport of hexavalent chromium in shallow groundwater adjacent to the river.

Americium and Neptunium Radionuclide Mobility in Basalt Aquifers—Conducted research including batch partitioning experiments with americium-241 and neptunium-239 and the analysis of naturally occurring humic and fulvic acids in groundwater from basalt aquifers to estimate the potential mobility of these high-level radionuclides in deep Columbia River basalt aquifers.

Investigation of Potential Sources of TCE in Municipal Water Supply Wells, Milwaukie, Oregon—Served as principal investigator in Superfund investigations into the source of TCE and other volatile organic chemical contamination in eight municipal water supply wells in a 10 square mile area of Milwaukie, Oregon. Reviewed hydrogeologic data and prepared a conceptual model of groundwater flow within the study area, summarized and analyzed the existing groundwater data, and conducted review of chemical usage databases, property ownership records, and aerial photographs into and integrated assessment of potential VOC sources and pathways. Prepared recommendations based on the findings of the investigation.

Investigation of Potential Sources of TCE in Municipal Water Supply Wells, Lake Oswego, Oregon—Served as principal investigator in Superfund investigations into the source of TCE and other volatile organic chemical contamination in several municipal water supply wells in Lake Oswego, Oregon. Reviewed hydrogeologic data and prepared a conceptual model of groundwater flow within the study area, summarized and analyzed the existing groundwater data, and conducted review of chemical usage databases, property ownership records, and aerial photographs into and integrated assessment of potential VOC sources and pathways. Prepared recommendations based on the findings of the investigation.

Groundwater Monitoring Program at Boomsnub Chrome Plating Facility, Vancouver, Washington—Developed and implemented a detection monitoring program for chromic acid (hexavalent chromium) contamination of soil and groundwater. Established the first nested deep monitoring wells at the site to evaluate the horizontal and vertical extent of hexavalent chromium in groundwater.

Old Works East Anaconda Area Operable Unit, Anaconda Smelter NPL Site, Anaconda, Montana—Served as hydrogeologist and geochemist for completion of the engineering evaluation/cost analysis (EE/CA) report for the Old Works operable unit. Tasks included

reviewing and evaluating soil and pore water data and preparing geochemical evaluations of the mobility of arsenic, cadmium, copper, lead, and zinc in vadose zone soils and pore waters.

Screening Site Inspection of Former Pesticide and Herbicide Formulator, Oregon-California Chemical Company, Junction City, Oregon—Managed a screening site inspection of a pesticide and herbicide formulator/distributor located in Junction City, Oregon. Investigation included developing a sampling plan; performing field sampling of soils, groundwater, and a nearby slough; reporting levels of pesticides and herbicides found at the site; and tabulating data and ranking the site using the hazard ranking system.

Screening Site Inspection of Macleay Landfill, Salem, Oregon—Managed a screening site inspection of the Macleay Landfill, a closed municipal waste landfill located near Salem, Oregon. Investigation included developing a sampling plan, performing field sampling of site soils and nearby groundwater and surface water, reporting levels of organic and inorganic contaminants found at the site, and tabulating data and ranking the site using the EPA hazard ranking system.

Technical Oversight for RI/FS, Umatilla Army Depot Activity, Hermiston, Oregon—Provided technical review and oversight for the development of a work plan and field sampling plan and for the implementation of a remedial investigation of groundwater and soil at the Umatilla Army Depot Activity, Hermiston, Oregon. Chemicals of interest at the site included explosives (i.e., RDX, trinitrotoluene [TNT]), nerve gas agents (i.e., mustard gas), and other chemicals (i.e., nitrates).

Well Sampling, Sulphur Bank Mine, California—Conducted sampling of groundwater for mercury at the Sulphur Bank Mercury Mine in Clear Lake, California.

Soil and Groundwater Investigations, Washington, Oregon, and Idaho—Conducted soil and groundwater investigations into the release of petroleum hydrocarbons and volatile organic hydrocarbons from USTs or other systems in Oregon, Washington, and Idaho.

Feasibility Studies, Remedial Design, Remediation

Chemical Packaging and Distribution Facility, Santa Ana, California—Principal hydrogeologist in charge of the monitoring of TCE, PCE, and 1,4-dioxane in groundwater for ongoing site remediation. Leading the evaluation of the effectiveness of the existing groundwater extraction and treatment (pump and treat) system and system optimization.

Sediment Removal Action at Former DDT Manufacturing Facility, Willamette River, Portland, Oregon—Principal-in-charge of the in-water EE/CA for a sediment removal action at a former chlor-alkali manufacturing facility located within the Portland Harbor Superfund site on the Willamette River. The EE/CA addresses the potential for ongoing migration of chemicals from the uplands site to the river and involves evaluating remedial options to address chemicals in the site sediments and pore water. COCs include DDT, MCB, sodium perchlorate, and hexavalent chromium. Key technical and regulatory issues that are being addressed include the characterization of the stratigraphically controlled distribution of

COCs, defining the removal action area boundary, the timing of the removal action with respect to other groundwater and stormwater source control measures that are being implemented, and the evaluation, selection, and design of a non-time critical removal action for the site in accordance with a EPA Administrative Order of Consent.

Stormwater Source Control Measures at Former DDT Manufacturing Facility, Willamette River, Portland, Oregon—Principal-in-charge of the stormwater source control measure (SCM) for a former DDT manufacturing facility located along the Willamette River. Completed a focused feasibility and negotiated a preferred option with Oregon DEQ. Presently, providing strategic support for the negotiation of a Mutual Agreement and Order (MAO) with DEQ that will amend the existing NPDES permit and provide a scope and schedule for implementation of the stormwater SCM.

DDT Manufacturing Facility IRM Work Plan, Portland, Oregon—Managed the preparation of a work plan for the implementation of selected soil and storm water IRMs including soil removals and temporary soil capping. IRMs were approved by the Oregon DEQ.

Bulk Petroleum Fuel Facility, Willamette River, Portland, Oregon—Directed the completion of a focused feasibility study (FFS). Key technical issues focused on the evaluation of the existing air sparging/soil vapor extraction (AS/SVE) system to determine whether it was effective at reducing petroleum hydrocarbons (including BTEX and PAHs) and selected metals including arsenic in site groundwater. The analysis showed that an expansion of the existing AS/SVE system would effectively address the other non-petroleum-related chemicals (i.e., naturally occurring arsenic) and other remedial measures were not necessary. The FFS evaluation and recommendations were accepted by Oregon DEQ.

IRM for TCE, Former Metals Machining Facility, Milwaukie, Oregon—Managed the preparation of a report documenting technology screening and selection of a preferred IRM for TCE in groundwater and soil at a former metals machining facility. Screened technologies included groundwater extraction and treatment via wells or trenches, soil removal, and electrical resistive heating. The preferred alternative, groundwater extraction and treatment, was selected by Oregon DEQ and was implemented by one of the responsible parties under an Order with the State of Oregon.

Soil Remediation, Warrenton, Oregon—Managed the remediation of petroleum-hydrocarbon-contaminated soils at a former 48,000-gal-capacity tank farm and marine fueling facility. The site cleanup was conducted under the Oregon DEQ Voluntary Cleanup Program. The successful remediation included the treatment of 2,400 yd³ of gasoline, diesel, and heavy oil hydrocarbons by a combination of bioremediation and hot-air vapor extraction methods.

Preliminary Remedial Design, Alkali Lake Chemical Waste Disposal Area, South-Central Oregon—Managed the investigation and preliminary remedial design for the 500-acre Alkali Lake chemical waste disposal area Superfund site, where more than one million gallons of waste from the manufacture of Agent Orange and other herbicides had affected soil and groundwater for nearly 20 years. Key issues included contaminant transport from groundwater to surface water, contamination of surface soils and the food chain by dioxins,

and potential effects on rare or threatened species (e.g., Tui chub and snowy plover). Conducted a detailed characterization of the subsurface hydrogeology in the area to assess the potential effectiveness of a vertical containment wall, including characterization of groundwater flow in shallow and deep groundwater zones and numerical modeling of the groundwater flow system to evaluate cleanup options.

NAPL Removal Performance Evaluation, McCormick & Baxter Creosoting Company, Portland, Oregon—Served as hydrogeologist for the completion of a performance evaluation for the extraction of groundwater and NAPL, including the evaluation of enhanced extraction techniques such as dual phase and total fluids pumping. The results of the evaluation indicated that total fluids removal could increase NAPL recovery in one of two NAPL pool areas on site.

Revised Feasibility Study, McCormick & Baxter Creosoting Company, Portland, Oregon—Served as the lead hydrogeologist for the revised feasibility study of the Superfund site. The feasibility study included evaluation of soil, groundwater, and sediment remedial options. The feasibility study also included an assessment of technical impracticability for groundwater restoration and the calculation of alternate compliance limits for groundwater.

Sandy Oil Company Site, Sandy, Oregon—Managed an emergency response action to mitigate accumulations of explosive levels of gasoline vapors in storm drains at the former Sandy Oil Company site. Emergency response actions included the design and installation of two groundwater interceptor trenches and the installation of groundwater and vapor extraction equipment. A site soil vapor survey was conducted to investigate potential sources of gasoline vapors. Explosive levels of gasoline vapors were reduced to safe levels within 72 hours of the initial discovery. Site management included monthly monitoring of the vapor extraction and groundwater treatment systems.

Brownfield Redevelopment, Bremerton, Washington—As lead hydrogeologist prepared a remedial investigation report and prepared remedial options for the proposed redevelopment of a historically industrial area into a city park with active recreational facilities.

Former Wood Products Treating and Manufacturing Site, Longview, Washington—Provided senior hydrogeologic support for the investigation and cleanup of a former wood treating, cabinet manufacturing, and related wood products industrial site. Led the fate and transport chemical modeling analysis for Site C that demonstrated that chemicals were not migrating to a nearby surface water body. Provided key strategic technical planning, and participated in consent decree negotiations with EPA and the Washington State Department of Ecology that substantially reduced the scope of work initially requested from the regulatory agencies.

Wood Products Treating Facility, Joplin, Missouri—Provided senior hydrogeologic and strategic support for the renegotiation of a RCRA permit for the wood treating site. Strategic technical plans for groundwater cleanup included conducting limited

nonaqueous-phase liquids extraction and demonstrating the technical impracticability for cleanup of groundwater in a deep fractured limestone bedrock aquifer affected by creosote and PCP. Technical evaluation also supported a permit modification to reduce the scope of the groundwater extraction, and monitoring program.

Morgan Door Manufacturing Facility, Weed, California—Provided senior hydrogeologic and strategic support for the investigation and cleanup of a former door manufacturer that used PCP in a treatment process. Strategic support included defining a focused RI/FS framework for completing the investigation and evaluating the need for remediation and negotiating with the Regional Water Quality Control Board. Preliminary soil excavation was conducted to remove most of the remaining PCP source, and initial assessments of the groundwater plume indicated that it was stable and that active groundwater remediation would not be required.

Oregon Cherry Growers, The Dalles, Oregon—Managed the compliance monitoring of groundwater quality for a UST removal. Site closure was recommended to and granted by the Oregon DEQ after 1 year of compliance monitoring was completed.

UST and Other Petroleum Hydrocarbons Management, Oregon—Managed the investigation of several sites in Oregon. Site investigations included two UST decommissioning evaluations and an investigation and cleanup of a spill of an unknown oily substance in a remote forested area.

Woodwaste Landfill Closure, Oakridge, Oregon—Managed the monitoring and closure of a wood waste landfill along the middle fork of the Willamette River near Oakridge, Oregon. Directed the preparation of a site closure plan, completed monitoring and reporting of groundwater and surface water quality in the vicinity of the landfill to address Oregon DEQ compliance issues, and successfully demonstrated that the landfill closure was effective and that water quality monitoring could be discontinued for the site.

Abandoned Hazardous Waste Characterization and Management, Oregon—Managed the identification and disposal of more than three dozen abandoned drums and containers of petroleum-hydrocarbon oils, solvents, oil-based paints, and acid wastes and associated soil contamination at a lumber mill in Warrenton, Oregon. Tasks included properly identifying and coding of wastes to facilitate legal waste disposal or treatment and reduce client liability while achieving the lowest possible disposal cost.

Indoor Air and Soil Vapor Intrusion

Indoor Air Vapor Intrusion Monitoring, Milwaukie, Oregon—Managed the design and implementation of indoor air monitoring program at a TCE solvent release site. Negotiated the scope of indoor air monitoring to account for the potential interference from background urban air TCE concentrations. Successfully negotiated a monitoring program that included sub-slab vapor sampling and monitoring combined with site-specific Johnson & Ettinger vapor intrusion modeling that demonstrated that groundwater plumes were not causing an adverse impact on indoor air above acceptable regulatory levels.

Vapor Intrusion, Lumber Mill, Vaughn, Oregon—Managed the assessment of indoor air sample results for a petroleum hydrocarbon plume at a lumber mill in Vaughn, Oregon. Demonstrated to the Oregon DEQ that benzene concentrations measured in indoor air were not related to the petroleum hydrocarbon plume undergoing remediation but instead were within the range of urban background benzene concentrations and were likely related to normal vehicle use in ongoing facility operations.

Groundwater and Soil Vapor Intrusion Assessment, Valdosta, Georgia—Managed the assessment of toluene concentrations in groundwater at an active RCRA site. Successfully negotiated with the Georgia Environmental Protection Division to use groundwater concentration data and Johnson & Ettinger modeling to demonstrate that toluene in indoor and outdoor air exposure environments would not exceed concentrations that would already be expected through the active handling and management of toluene under the typical facility work environment.

Environmental Due Diligence and Preliminary Assessments

Phase I Environmental Site Assessment, Tool Manufacturing Facility, Milwaukie, Oregon—Managed the Phase I environmental site assessment of a 7.7-acre tool manufacturing facility for a prospective purchaser of the property. The assessment was conducted in accordance with ASTM E-1527-00 and found that the site had a low potential from environmental impact from historical operations and found no recognized environmental conditions according to ASTM standards. Three areas of environmental concern were identified.

Illicit Drug Laboratory, Central Point, Oregon—Managed a detailed site assessment of an illicit drug laboratory site. Investigation included the collection of existing site use and environmental data, including an evaluation of the process used to synthesize amphetamines at the site, conducting a site visit, and preparation of a report to evaluate whether a release or a threat of a release of hazardous substances had occurred and whether further investigation was required at the site.

Titanium and Metal Casting Facility Preliminary Assessment, Albany, Oregon—Managed Parts I and II of a preliminary assessment of a titanium and rare metal casting facility located near Albany, Oregon. Investigation tasks included the collection of existing site use and environmental data, conducting a site visit, and preparation of a report to evaluate whether a release or a threat of a release of hazardous substances had occurred and whether further investigation was required at the site. Through the review of existing data, extensive soil and groundwater contamination by organic solvents was identified at the site.

Biochemical Research Facility Preliminary Assessment, Eugene, Oregon—Managed Part I of a preliminary assessment a producer and developer of fluorescent dyes and research chemicals used in the biochemical and medical research industry. Investigation tasks included collecting existing site use and environmental data, conducting a site visit, and preparing a report to evaluate whether a release or a threat of a release of hazardous substances had occurred and whether further investigation was required at the site.

Phase I Environmental Property Transfer Assessment of a Metal Parts Manufacturing Facility, Northwest Portland, Oregon—Managed a Phase I environmental property transfer assessment of a facility that manufactured and milled large metal parts. The Phase I investigation included a review of historical data and federal, state, and local environmental records; a title search; and a site visit. Results were incorporated into a final report that evaluated, within the limitations of the data, the probability of a release of hazardous substances to the site soils or groundwater.

Subtitle D Landfill Siting Studies, Portland, Oregon—Hydrogeologist for the evaluation of groundwater hydrology and geotechnical siting criteria for six candidate landfill sites in the Portland metropolitan area. Conducted hydrogeologic review and site ranking according to landfill siting criteria. Assisted in report preparation and attended public meetings. None of the six sites reviewed were selected as the State-proposed location for a municipal landfill.

State Preliminary Assessments, Oregon—Performed senior technical review for more than five state preliminary assessments to evaluate the release or threat of a release of hazardous substances to industrial sites located across Oregon.

Environmental Site Assessments, Washington, Oregon, and Idaho—Conducted or assisted in more than 20 environmental site assessments at industrial, private, and government properties in the Pacific Northwest.

Hydrogeologic Evaluations and Groundwater Development

Aquifer Recharge Model, Umatilla, Oregon—Managed the development of a three-dimensional model and animation in support of a proposed aquifer recharge project in Umatilla, Oregon. Existing geologic and hydrogeologic data were used to establish a geologic block model and to animate the predicted change in hydraulic head that would result from river water diversion and aquifer recharge.

Gravel Quarry, California—Principal geologist for a hydrogeologic investigation to support the permit application for a proposed gravel quarry in California. The bedrock aquifer system underlying the site includes a narrow, highly-conductive fracture zone that supports large pumping flows. A groundwater model was developed to assess mine water management requirements; to evaluate the potential for the development of a lake in the quarry after mining cessation; and to evaluate impacts of quarry dewatering on area groundwater levels, local creek flows, and on another quarry planned for future development adjacent to the proposed quarry site.

Hydrogeologic and Geochemical Evaluation, Olympia, Washington—Principal-in-charge of the development of a scope of work and cost estimate for a grant application for a comprehensive hydrogeologic study to identify, monitor, and mitigate sources of nitrate to groundwater in the vicinity of a municipal water supply well in east Olympia. The scope of work included vadose zone monitoring in potential source areas, and groundwater monitoring to evaluate groundwater and chemical migration pathways to assess the impacts of anthropogenic and natural sources of nitrate in groundwater near selected city

of Olympia municipal drinking water well. The city initially was awarded a \$500,000 Washington State Centennial Clean Water Fund grant to conduct the study; however, the grant was later rescinded due to state financial constraints.

Hydrogeochemical Evaluation, St. Johns Landfill and Smith and Bybee Lakes, Portland, Oregon—Completed an analysis of the hydrogeologic flow system in the Smith and Bybee Lakes area of northern Portland. Also, evaluated the development of a leachate plume from the St. Johns Landfill and its effect on the adjacent wetland area. Compiled historical soil and groundwater data for the region, developed a hydrogeologic model of the groundwater and surface water flow systems, and evaluated the existing landfill groundwater monitoring program.

Hydrogeologic Characterization for Proposed Low-level Radioactive Waste Repository, Central Illinois—Conducted site investigations including innovative hydraulic conductivity slug tests using compressed air and pressure transducer/data loggers to develop a model of the geology and hydrogeology and to estimate aquifer parameters for several proposed low-level radioactive waste repository sites in central Illinois.

Deep Groundwater Well Design Installation and Testing, Boardman, Oregon—Supported well design and development of drilling specifications, provided drilling supervision, and conducted geophysical logging and aquifer testing of a greater than 1,000 ft deep, basalt water supply well near Boardman, Oregon.

Water-Supply Well Design, Corvallis, Oregon—Completed an evaluation of hydrogeologic conditions in the vicinity of a proposed new package handling and distribution facility. Prepared a report summarizing the summarized the well installation permit requirements, site hydrogeologic conditions, and a proposed target well depth and well design.

Geohydrological Investigation of the Lake Oswego, Oregon area—Conducted a geohydrological investigation of the Lake Oswego, Oregon area. Evaluated the effect of groundwater discharge from the underlying basalt aquifers on Lake Oswego surface water quality and the potential mitigation of nutrient driven algal blooms in the lake through the enhanced use of deep groundwater flushing.

Geotechnical Studies

Kelly Avenue Landslide, The Dalles, Oregon—As a field hydrogeologist, oversaw air-rotary drilling, lithologic logging, and installation of six dewatering wells to control the landslide around Kelly Avenue in The Dalles. Conducted slope inclinometer and water level monitoring utilizing transducers and data loggers. Conducted data analysis and evaluated the effectiveness of groundwater dewatering on reducing landslide movement.

Parking Lot Expansion Joint/Mount St. Helens Ash Assessment, Portland, Oregon—Conducted field sampling of ash accumulated in an expansion joint of a shopping mall parking lot. Documented and described the sedimentary structures, consulted with experts in the composition of Mount St. Helens ash composition, and obtained geochemical analyses of

the ash samples. The investigation established that a large accumulation of Mount St. Helens ash in parking lot expansion joints caused their failure.

Bull Run Dam Slope Stability Monitoring, Bull Run, Oregon—Conducted slope inclinometer monitoring and used pre-existing and new monitoring data to prepare a report documenting the movement of a landslide within the Bull Run watershed.

Field Hydraulic Analysis, Centralia Coal Mine, Chehalis, Washington—As a field hydrogeologist, conducted drilling and hydraulic testing of several flowing, artesian probes to evaluate hydraulic pore pressures within an access road dike system for use in engineering stability studies.

Kuebler Boulevard Geotechnical Investigation, Salem, Oregon—Led the field investigation for the proposed construction of Kuebler Boulevard in Salem, Oregon, including borehole drilling, test pits, soil sampling, standard penetration tests, and preparation of geotechnical soil lithologic logs and descriptions.

Geotechnical Field Investigations—As a field geologist conducted dozens of soil investigation studies utilizing various drilling methods (i.e., hollow-stem auger, mud-rotary, push-probe, cable tool) to collect and describe soil samples in accordance with ASTM or similar soil classification standards. Conducted field standard penetration testing and various laboratory tests to measure soil properties that were used in geotechnical engineering evaluations and design.

Expert Testimony—Deposition and Trial

Puget Sound Energy, Inc. v. Alba General Insurance Co. et al. Case No. 97-2-29050-3 SEA in Superior Court of the State of Washington, King County. Subject: The sources and timing of contamination from the former manufactured gas plant (MGP) and other contaminated sites located in the vicinity of 5th Avenue and Jackson Street in Seattle, Washington. Conducted data analysis and prepared written expert opinion on the sources, timing, and continuity of contamination at the site. Deposition: 2005. Case settled.

Washington Water Power Company v. Underwriters at Lloyds and Certain London Market Companies. Case No. 96-2-07431-9 in Superior Court of the State of Washington, Spokane County. Subject: The timing, fate, and transport of releases of Bunker C fuels at a former power plant in Spokane, Washington. Conducted analysis of historical groundwater and NAPL monitoring data, power plant use and release records, and groundwater flow paths including an analysis of the bedrock surface as a potential preferential pathway. Deposition: 1998. Case settled.

The City of Vancouver v. Judith Griffee and Ronald Griffee, et al. Case No. 94-2-01544-7 in Superior Court of the State of Washington, Clark County. Subject: The sources, transport, and fate of tetrachloroethene (PCE or PERC) and other related organic chemicals in groundwater near the Water Station 4 groundwater supply for the city of Vancouver, Washington. Researched the location and historical operations of former dry cleaning facilities and other potential sources upgradient of Water Station 4. Drew conclusions

based on historical data and newly collected groundwater data. Prepared questions based on the historical and current data to be used for the deposition of an opposing expert witness. Case settled in 1997 prior to deposition.

Litigation Support for Private Landowner in Support of a Property Valuation Lawsuit for Former Gasoline Station, Portland, Oregon—Reviewed existing site investigation and remediation documentation and prepared a written opinion regarding the source and distribution of petroleum hydrocarbons at the site. Provided fact witness courtroom testimony based on written opinion.

Litigation Support, Cost Allocation, and Environmental Forensics

Litigation Support for TCE at Former Metals Machining Facility, Milwaukie, Oregon—Designed data collection activities to support litigation related cost allocation and cost recovery requirements. Provided declarations opining on the source and areas of TCE-containing waste disposal, the characteristics of TCE migration, and the timing and location of historical releases based on an evaluation of the groundwater flow system.

Litigation Support on Source, Transport, and Fate of TCE in a Karst Aquifer in Lead-Zinc Mining District, Joplin, Missouri—Prepared detailed hydrostratigraphic cross-sections showing the interconnection of highly permeable bedrock fractured zones and abandoned mine adits and shafts, evaluated groundwater capture zones, and provided oversight of the opposing expert's installation of monitoring wells on the defendant's site. The opposing party's claim that TCE was migrating from sources on the defendant's site onto the plaintiff's site was dismissed by the court.

Lumber Mill, Vaughn, Oregon—Prepared a conceptual model of petroleum hydrocarbon releases to soil and groundwater in support of cost allocation negotiations with the existing property owner.

Litigation Support for Investigation of Elevated Nitrate Levels in Groundwater near Chicken Farm, Deer Park, Washington—Developed and sampled existing monitoring wells and nearby domestic wells, mapped groundwater flow directions, and integrated the data into a conceptual model of groundwater flow and contaminant source relationships. The data demonstrated that high concentrations of nitrate detected in some homeowners' water wells were primarily associated with other sources (e.g., farm cesspools and septic systems) not the nearby chicken egg production facility.

PUBLICATIONS/PRESENTATIONS

Dodak, E., D. Livermore, E. Strandhagen, and T. Slater. 2009. Modeling and analyzing mass and volume of DDx contamination in sediment for environmental remediation. Fifth International Conference on Remediation of Contaminated Sediments, Jacksonville, FL. February 2009.

Strandhagen, E., E. Dodak, and D. Livermore. 2008. Modeling and analyzing mass and volume of DDx contamination in sediment for environmental remediation. American Society of Photogrammetry and Remote Sensing Annual Conference, Portland, OR.

McWilliams L., D. Livermore, D. Lamadrid, T. Sparacio, and E. Dodak. 2002. Using a chemical tracer to map groundwater flow in vadose zone soils. Presentation at the National Ground Water Association 2002 Ground Water Expo, Las Vegas, NV, December 2002.

Boggs, S., Jr., D. Livermore, and M.G. Seitz. 1985. Humic macromolecules in natural waters. *J. Macromol. Sci.* 25(4):599–657.

Boggs, S., Jr., D. Livermore, and M.G. Seitz. 1984. Humic substances in natural waters and their complexation with trace metals and radionuclides: a review. ANL-84-78. Argonne National Laboratory, Argonne, IL.

Siegel, D.I., and D.G. Livermore. 1984. A chloride budget for the Mississippi River, headwaters to mouth. *Water Resour. Bull.* 20:503–509.

Livermore, D.G., and D.I. Siegel. 1983. A mass budget for chloride in the Mississippi River from headwaters to mouth (abs.). *EOS* 64:700.