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Les Williams, Ph.D.
Senior Science Advisor
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PROFESSIONAL PROFILE

Dr. Les Williams is a senior ecologist certified by the Ecological Society of America, specializing in the characterization and quantification of ecological risk and natural resource injury in support of focused management strategies for contaminated aquatic, sediment, and terrestrial systems. His consulting practice includes quantitative techniques and modeling applications that can be used in site-specific evaluations of injury to natural resources, management of contaminated sediment and dredged materials, determination of chemical bioaccumulation and toxicity in aquatic and terrestrial organisms, development of site-specific sediment quality and water quality values, and human health and ecological risk assessments.

Over the past 25 years, Dr. Williams has also provided technical, project, and program management leadership for numerous projects involving interdisciplinary teams of natural resource experts, scientists, and engineers. He has provided these services to the pulp and paper industry, mining and smelting corporations, petrochemical and pesticide manufacturing companies, power utilities, municipalities, state health and regulatory agencies, the U.S. Environmental Protection Agency (EPA), Department of Defense, and Department of Energy. He has also authored numerous publications and presentations in nationally and internationally recognized journals and professional societies. He is currently involved in a number of projects concerning metals bioaccumulation in fish, development of state water quality standards for temperature, and ecological and human health risk assessments associated with a former mining site and a former pesticide manufacturing facility.

CREDENTIALS AND PROFESSIONAL HONORS

Ph.D., Marine Studies, University of Delaware, Newark, Delaware, 1978
M.S., Marine Biology, University of the Pacific, Stockton, California, 1971
B.A., Biology, Whitman College, Walla Walla, Washington, 1968

PROFESSIONAL AFFILIATIONS

American Association for the Advancement of Science
Coastal and Estuarine Research Federation

Ecological Society of America, Certified Senior Ecologist
Society for Environmental Toxicology and Chemistry

RELEVANT EXPERIENCE

Natural Resource Assessment and Monitoring

Exxon Valdez Oil Spill Injury Re-evaluation, Prince William Sound, Alaska—Conducted a re-evaluation of natural resources that have not recovered from the oil spill. A conceptual exposure model was developed to place the unrecovered resources in the context of the original oil spill and determine possible continuing exposure to lingering oil in intertidal sediments. Critical resources listed as either recovering or not recovered (e.g., Pacific herring, sea otter, harlequin duck, intertidal communities) were evaluated for continuing long-term injury from the original spill or ongoing injury from existing exposure to lingering oil.

Long-Term Benthic Monitoring Program and Bioaccumulation Survey, Sitka, Alaska—Led design of a 40-year monitoring program to assess natural attenuation of wood waste and recovery of benthic communities in the vicinity of a former pulp mill discharge. Facilitated program development among various stakeholders with long-term interests in economic development and environmental stewardship of Sawmill Cove and other marine resources in the region.

Marine Effluent Discharge Assessment, Nationwide—Reviewed 35 Section 301(h) applications and evaluated the ecological effects of marine and estuarine sewage discharges on communities of phytoplankton, zooplankton, fishes, and benthic invertebrates throughout the U.S., including Hawaii, Alaska, Washington, California, Massachusetts, Rhode Island, New Jersey, Virginia, and Puerto Rico. Also managed quality assurance services and technical evaluations of acute and chronic bioassays.

Natural Resource Damage Assessment in Marine/Estuarine Environment—Provided technical support for determining ecological and toxic impacts of hazardous wastes on communities of marine and estuarine organisms, and for determining economic damages associated with those impacts.

Silver Bow Creek Remedial Investigation Review, Montana—Managed technical reviews of remedial investigation reports that characterized impacts of mining wastes on terrestrial, aquatic, and other natural resources in Silver Bow Creek and the upper Clark Fork River, Montana.

Ecological Risk Assessment

Preliminary Terrestrial Ecological Evaluation for the Quillayute Former Naval Air Auxiliary Station—Provided senior project management oversight for a preliminary terrestrial ecological evaluation (TEE), consistent with Washington State Model Toxics Control Act (MTCA) guidance, for a former naval air station on the Olympic Peninsula of Washington. This station was operational during World War II, and subsequently surplus upon which most of the site was purchased by a local municipality. Integral analyzed surface and

subsurface soil data, site habitat quality data, and historical processes and operations to evaluate whether a TEE was appropriate for the site, and conducted a preliminary screening of data against ecological benchmarks to refine the list of contaminants of interest. The appropriateness of a site-specific TEE was evaluated, and using maximum and upper-bound statistics for ecologically relevant soil data, Integral identified a small subset of metals and diesel range organics to retain for further evaluation as chemicals of interest. Conclusions were provided in a technical memorandum to the U.S. Army Corps of Engineers as part of a remedial investigation for the site.

Terrestrial Ecological Risk Assessment for Desert Habitat Reclamation, Golconda, Nevada—Managed a screening level ecological risk assessment for a mine expansion and heap leach pad closure in the arid lands of the Great Basin in northern Nevada. The mine expansion will create a pit lake with riparian habitat that will attract local wildlife. The heap leach closure and reclamation will involve placement of a cap on the pad and creation of a soil cover for an evapotranspiration basin. The cap will be vegetated with native plants from the shrub-steppe community. The cover for the evaporation basin will be vegetated with native phreatophytes to facilitate evapotranspiration of heap-leach fluids. Evapoconcentration of trace metals in the near surface soils and bioaccumulation of trace metals by native plants will be critical elements in the risk assessment.

Ecological Risk Assessment Services for a Former Uranium Mine, Alaska—Provided expert review to legal counsel concerning site characterization, ecological inventory, risk-screening, and baseline ecological risk assessment methods for trace metals and radiochemicals at a former uranium mine located in southeast Alaska. Significant issues concerned fate and transport of trace elements and radiochemicals from upland source areas to forested, stream, and marine habitats; bioaccumulation potential and risk to local flora and fauna; and potential impacts to natural resources that are culturally important to the Native American community.

Ecological Risk Assessment Services for a Former Copper Mine, Nevada—Managed ecological risk services for trace metal contamination in soils, groundwater, and surface water. Ecological risk services included development of work plans for screening level ecological risk assessments at multiple operable units representing pit lake, upland, ephemeral pond, and agricultural fringe habitats. Managed a wildlife survey using continuous camera trap observations for mammals and point count transects for birds to determine relative site use and to provide basis for recommending appropriate techniques to mitigate exposure to metalliferous, low pH water. Based on the wildlife survey, developed, implemented and managed a mitigation and monitoring program to deter birds from perennial and ephemeral ponds containing low pH, metalliferous water.

Preliminary Ecological Risk Evaluation for a Proposed Granite Mine, California—Compared predicted concentrations of trace elements in pit lake water after 42 years of infilling with screening level values for wildlife drinking water and California EPA (2003, as amended) water quality criteria. For wildlife, none of the predicted concentrations exceed either the no-observed-adverse-effect level or the lowest-adverse-effect level for effects to birds and

mammals drinking water. Predicted concentrations of silver, lead, and selenium may exceed water quality criteria for protection of freshwater aquatic organisms. Found that differences expressed as hazard quotients were relatively small and should be judged in comparison with regional water quality conditions (background) for lakes or reservoirs with similar water sources and characteristics as those predicted for the pit lake.

Ecological Risk Assessment at a Former DDT Manufacturing Facility, Oregon—Managed ecological risk services for DDT and perchlorate contamination in upland soils, riverbank soils, and sediments. This multichemical and multipathway risk assessment required a wide range of techniques to focus on problem areas, including simple screening against soil or sediment benchmarks, toxicity identification and evaluation procedures for aquatic receptors, and food chain modeling to assess exposure to high trophic level birds and mammals. Reviewed a multi-volume (>25,000 pages) RI/FS and risk assessment and provided expert comments and consulting on uses, limitations, and scientific interpretation of the information to facilitate site understanding and effective site-management and remediation strategies.

Aquatic Ecological Risk Assessment at a Former Wood-Treating Facility, Minnesota—Developed site management plans for aquatic ecological risk assessment of dioxins, PCBs, DDT and related compounds, and mercury in the vicinity of a former wood treating facility and municipal dump pit in northern Minnesota. The ecological risk assessment was designed to evaluate a wide range of trophic levels and animal feeding guilds in a complex nearshore stream and lake ecosystem. Receptors of concern included representative species of aquatic plants, benthic invertebrates, fish, and semi-aquatic birds and mammals.

Ecological Risk Assessment of Benthic Communities in an Estuary, Texas—Conducted an evaluation of risks to the benthic community in an urbanized Texas bayou in the vicinity of a former pesticide manufacturing facility. The benthic community evaluation was based on three lines of evidence: sediment quality values vs. sediment chemistry concentrations; sediment toxicity tests; and benthic community analyses. The risk assessment showed that sediment concentrations of some pesticides and other chemicals of potential ecological concern were elevated above sediment quality values in some locations. However, none of the sediments in the vicinity of the facility with the highest concentrations of chemicals of concern were toxic to benthic invertebrates. The risk assessment also showed the presence of a stressed benthic community that was disturbed by natural estuarine gradients in salinity, temperature, and dissolved oxygen. Based on these comparisons, there was no indication that chemical residues related to the pesticide manufacturing facility had impaired the benthic community in the bayou.

Aquatic Ecological Risks of Iron and Manganese Discharges from Former Log Camp Landfills, Southeast Alaska—Anoxic groundwater discharged via seeps in the vicinity of three former log camp landfills contained high levels of iron and manganese. Conducted a critical review of iron and manganese toxicology, which indicated that concentrations of the substances in water and sediments did not pose a threat to aquatic organisms. The results

suggest that the fens receiving groundwater discharges are highly functional aerobic wetlands that are effective at reducing iron concentrations.

Ecological and Human Health Risks at Two Former Log-Camps, Southeast Alaska—Managed human health and ecological risk evaluations in support of non-time critical removal actions planned by the USDA Forest Service and Ketchikan Pulp Company for two former logging camp sites on Prince of Wales Island, Alaska. The risk evaluations were streamlined to accommodate approaches recommended by both EPA and the Alaska Department of Environmental Conservation, and to accommodate additional ecological receptors of concern identified in the Tongass National Forest Land and Natural Resource Plan. The streamlined risk evaluation (SRE) followed a tiered approach for each site. Tier 1 was a preliminary screening evaluation that compared detected concentrations of chemicals at the site to published screening values. Tier 2 refined the evaluation by using exposure and toxicity assumptions that better reflect site-specific conditions. Lead and diesel-range organic compounds were the only substances of concern for either human health or wildlife at the two locations. The SREs were used to support the evaluation of remedial alternatives and remedial action objectives for site cleanup.

Risk-Based Preliminary Assessments and Site Investigations at Various Air Force Installations, Central Pacific—Provided management and technical oversight for the development of a risk-based approach for categorizing more than 140 sites at U.S. Air Force installations in Hawaii (Oahu and Kauai) and Wake Island. Information developed from literature searches and site-reconnaissance was used to identify possible sources or chemical release, develop preliminary conceptual site models, and identify important habitats and ecological receptors that may be exposed to released chemicals. Allometric relationships were used to standardize ecological risk models and predict risk-based screening concentrations (RBSC) for soil-borne contaminants. RBSC values were compared with existing site data to determine whether sites should be evaluated in an RI/FS or could be categorized as “No-Further-Action.”

Technical Support for Marine Ecological Risk Assessment in Dyes Inlet, Washington—Provided senior technical support to assist the Navy in negotiation of the final phase of the marine ecological risk assessment in the vicinity of the Jackson Park Housing Complex. This naval housing facility is located at the site of a former ordnance demilitarization operation on the shores of Ostrich Bay, Washington. The negotiation involved participants from the Navy, the Puget Sound Naval Shipyard, the Suquamish Tribe, the Washington State Department of Ecology, and EPA. The result of the negotiation was a focused approach to use sediment bioassays to further evaluate the extent of contamination and the toxicity of sediments associated with past ordnance demilitarization operations.

Ecological Risk Assessment at Landfills—Evaluated two landfills in the vicinity of the Naval Air Station for potential ecological risks associated with trace metals, pesticides, and volatile organic chemicals in forest, emerging meadow, wetland, and ephemeral stream habitats. For terrestrial habitats, a simple food-chain model was used to assess risks to burrowing mammals (voles) and their predators (coyote and northern harriers).

Compliance with ambient water quality criteria and sediment quality values was used to assess potential risks to aquatic biota in wetland and stream habitats.

Strandley/Manning Transformer Salvage Site, Burley Lagoon, Washington—Managed an ecological risk assessment for PCBs spilled during electrical transformer salvage operations. Environmental pathways, exposure matrices, chemical uptake routes, and biological receptors were evaluated for three kinds of habitats: a coniferous lowland forest, a freshwater stream, and a marine slough and mudflat.

Allied Plating RI/FS, Portland, Oregon—Managed an ecological risk assessment for trace metals and nonvolatile organic chemicals in soils and sediments in a waste lagoon, a riparian zone, and a receiving stream in the vicinity of a former chrome plating operation.

Ecological Risk Assessment, Adak Island, Alaska—Developed ecological risk-based screening concentrations to identify chemicals of potential concern in soils, to prioritize sites for further evaluation, and to set preliminary cleanup goals for soil remediation. Evaluated two stream drainages containing a total of seven hazardous waste sites for possible toxic effects in a subarctic tundra ecosystem. Using a general knowledge of Adak Island flora and fauna, a variety of food-chain models were used to estimate chemical exposure to representatives of freshwater and terrestrial communities. These receptors included fish, aquatic invertebrates, caribou, Norway rat, bald eagle, ptarmigan, and mallard. Chemicals of concern included several volatile organic compounds, PAHs, PCBs, and metals.

Aquatic Toxicology, Bioaccumulation, and Seafood Risk

Arsenic Bioaccumulation in Freshwater Fishes—Reviewed pertinent literature and identified 12 studies of arsenic bioaccumulation in freshwater fishes to explore differences in laboratory-generated bioconcentration factors (BCFs) and field-generated bioaccumulation factors (BAFs) and to assess their relationship to arsenic concentrations in water. Analysis indicates that arsenic concentrations in tissue and arsenic BAFs may be power functions of arsenic concentration in water. A power function indicates that the highest BCF values may occur at low background levels and may decrease as environmental concentrations increase above the ambient range.

Toxicity Identification and Evaluation (TIE) for Chemical Contaminants Associated with Past Effluent Discharges in the Vicinity of a Pulp Mill—Created a decision matrix to evaluate toxicity data and to interpret results of testing sediments in the vicinity of a pulp mill effluent. The matrix is based on a suite of toxicity tests (i.e., an acute 10-day interstitial dwelling amphipod and a sediment-water interface amphipod, acute and sublethal assessment of pelagic echinoderm larvae, and 28-day chronic amphipod tests). The results from each test were used in a step-wise evaluation of the cause of toxicity and were also used to assess the degree to which toxicity represents substantive (non-trivial) effects to the fitness of local populations of organisms.

Risk-Based Monitoring of Chemical Contaminants in an Intertidal Seep Zone, Washington—As part of a 5-year monitoring program at a military installation along the shore of a Puget Sound bay, metals and semivolatile organic chemicals, were measured in groundwater,

seeps, sediments downgradient of the seeps, and shellfish. A monitoring program was developed to: 1) document the effectiveness of natural processes on attenuation of chemical concentrations in groundwater; and 2) develop site-specific measures of chemical exposure that could not be accurately predicted in a risk assessment. Results indicate that sediment and tissue sampling are effective monitoring endpoints of ecological risk, natural attenuation, and recovery of contaminated groundwater discharge into the marine environment.

Bioaccumulation of Petroleum Hydrocarbons in Fish in the Vicinity of a Drum Storage Area—Managed an assessment of aliphatic and aromatic petroleum hydrocarbons in fish (rainbow trout) to verify estimates of risk based on a highly conservative model. The program involved development and implementation of a site-specific sampling and analysis plan that focused on size distributions of rainbow trout that would be vulnerable to predators potentially at risk. The program also required development of innovative technology for chemical analysis of petroleum hydrocarbons in fish tissues.

Fish Bioaccumulation Survey, NAS Adak Island, Alaska—Managed a preliminary survey of contaminant bioaccumulation in fishes in the vicinity of the Naval Air Station at Adak Island, Alaska. Sediment and surface water data from previous unreported investigations at Adak Island were used to predict chemical bioaccumulation in fishes. A survey was conducted to determine actual concentrations of chemicals in fishes from Trout Creek, the South Sweeper Creek drainage, and a reference stream that discharges into Thumb Bay. Tissue samples were analyzed for lipid content, and concentrations of PCBs, pesticides, and metals. The bioaccumulation data were used in preliminary estimates of human health and ecological risks.

National Bioaccumulation Study, Risk Analyst, Nationwide—Conducted a risk assessment for 16 chemicals or compound groups measured in aquatic fish and shellfish from more than 400 fresh-water and estuarine locations throughout the United States. Health risks for these substances were also presented graphically for a range of possible concentrations and consumption rates. The information developed in the risk assessment was used by EPA's Office of Water Regulations and Standards to develop a risk management perspective for contaminant bioaccumulation in aquatic organisms throughout the U.S.

Seafood Risk Assessment, Alaska—Managed a risk assessment for potential human exposure to lead, zinc, and mercury in sediments and seafood from Skagway Harbor, Alaska. A predictive relationship was developed between concentrations of lead in sediments and those in shellfish. This relationship was used to spatially characterize the bioaccumulation of lead in shellfish and potential health risks associated with shellfish consumption.

Puget Sound Protocols, Washington—Developed a saline-extract protocol for the Microtox® bioassay, and provided technical guidance for using the Microtox® bioassay in a comparative study of sediment toxicity in Puget Sound. Provided technical review and guidance for assessing transport, fate, and potential aquatic toxicological effects of pesticides used in the Puget Sound basin. Also managed quality assurance review, data

analysis, and summary of bacterial luminescence (Microtox®) and amphipod toxicity tests conducted on sediments collected at 50 locations throughout Puget Sound, Washington.

Commencement Bay Remedial Investigation, Washington—Reviewed bioassay methods and developed a saline-extract method for the Microtox® (bacterial luminescent) bioassay to assess toxicity of chemically contaminated marine sediments at 46 nearshore locations in the vicinity of the Commencement Bay Superfund site, Washington. Results of the Microtox® bioassay were then compared with those for oyster larva and amphipod toxicity tests and published in Marine Environmental Research.

Monitoring Guidance for Bioaccumulation—For EPA, reviewed methods for assessing contaminant bioaccumulation in aquatic organisms, and developed a monitoring guidance document for estimating the potential for bioaccumulation of priority pollutants and 301(h) pesticides discharged into marine and estuarine waters.

Puget Sound Estuary Program, Seafood Risk Assessment, Washington—Managed and conducted a risk assessment of chemically contaminated fish and shellfish in Puget Sound, Washington. Information was compiled from 10 regional studies to characterize potential health risks associated with chemical contaminants in 32 species of fish, shellfish, and macroalgae from 22 locations in Puget Sound. In addition to the risk assessment, generic graphs (nomographs) were developed to allow risk managers to quickly estimate potential health risks associated with a wide range of chemical concentrations and consumption rates for various kinds of seafood.

Risk-Based Sediment Assessment and Remediation

Ecological Risk Assessment, Dredge Material Characterization, and CDF Alternative Evaluation of DDT Contaminated Sediments—Consulted and provided expert opinion concerning ecological risks and potential bioaccumulation of DDT and other pesticides in the vicinity of a pesticide manufacturing facility. Provided expert opinion concerning the validity and conclusions of a study of chemical bioaccumulation in caged fathead minnows (*Pimephales promelas*).

Risk-Based Sediment Cleanup Goals for Brackish Salt Ponds in the San Francisco Bay Estuary, California—Determined ecological risk-based acceptable exposure levels for PCBs, DDT, zinc, and lead in sediments of two ponds that are being used for storm water management in South San Francisco Bay. Apparent effects level (AEL) values for each chemical were determined for waterfowl, shorebirds, fish-eating birds, and benthic invertebrates. The AEL values formed the technical basis for negotiation of remedial action objectives at the sites.

Assessment and Preparation of Bark Remediation Plans for Two Log Transfer Facilities on the Tongass National Forest, Alaska—Managed an assessment of wood debris in the vicinity of two log transfer facilities in Southeast Alaska. The assessment for each site followed a phased approach pursuant to guidance developed by the Alaska Department of Environmental Conservation. Phase I was a review of site characterization information, an assessment of the extent of wood debris that exceeded Alaska standards, and a focused

evaluation of remedial action objectives and remedial alternatives. Phase II was a selection of the preferred remedial alternative and development of a bark remediation plan.

Remediation Work Plan for PAH Compounds in Harbor and River Sediments in the Mohawk River, New York—Led strategy development for dredging harbor sediments to meet navigational requirements and cleanup goals for PAH contamination. Developed decision framework for sediment management options, including leaving sediments in place, capping, and armoring. Provided cost-benefit strategy for optional toxicity testing of river or harbor sediments to minimize cleanup costs.

Remedial Investigation Work Plan for Chemicals and Wood Debris in Sediments near a Former Pulp and Paper Mill in Port Angeles Harbor, Washington—Set strategy and led study design for investigation of chemical contaminants and wood debris in sediments in the vicinity of a former log storage pond and effluent discharges from a former pulp and paper mill in Port Angeles Harbor. Provided expert analysis of historical sediment and receiving water investigations to established boundaries for study and reference areas.

Channel Deepening in the Lower Columbia River, Oregon—Managed technical support concerning possible impacts of the Columbia River Deepening Project to salmonids. Critically reviewed the scientific literature concerning key technical issues that were at the center of controversy among the various stakeholders and interveners for the deepening project. Issues included hydrodynamics (flow and salinity) associated with channel deepening, estuarine turbidity maximum, effects of turbidity on salmon, toxic contaminants in sediments, and vessel wakes and stranding of juvenile fish. Recommended a cost-effective technical strategy for resolving issues in a technically defensible and timely way.

Sediment Transport Impacts on Juvenile Salmon Migration in the Lower Snake River, Washington—Managed risk assessment support for predictions of the downstream transport of lake-bed sediments during the proposed removal of four lower Snake River dams for the U.S. Army Corps of Engineers Walla Walla District. The probable increase in suspended sediment concentrations during scour, as well as the desorption of sediment-bound chemicals to the water column, posed a potential environmental impact. Analysis showed that potential impacts were limited to possible odor and taste problems with drinking water supplies. None of the chemicals of concern represented a substantial health risk to salmon or other aquatic species, or to people via consumption of water or fish.

Evaluation of Fate and Effects of Wood Waste in the Marine Environment—Managed a review of the physical, chemical, and biological processes that govern decomposition of wood waste in the marine environment. The review included processes of wood degradation and remineralization of wood detritus, formation and release of inorganic gases from decomposing wood debris, transport and fate of inorganic gases in the water column and at the air-sea interface. Wood detritus and its degradation products (e.g., ammonia, hydrogen sulfide) were evaluated for potential effects to benthic communities, pelagic biota, and humans and at the sea surface. The review concluded with a discussion of the processes of natural recovery and benthic recolonization.

Marine Ecological Risk Assessment for Chemical Releases Associated with Sitka Mill Site, Alaska—Managed an ecological risk assessment of chlorinated dibenzodioxins and dibenzofurans, resin acids, and trace metals to marine invertebrates, fish, birds, and mammals in the vicinity of the Sitka Mill. Sediment chemistry, sediment toxicity testing, and sediment profile imaging were used to assess potential risks to benthic marine invertebrates. Sediment toxicity was limited to a core wood deposition area. Additional benthic community disturbance, but no toxicity, was evident in the surrounding wood deposition area. Toxicity and benthic community disturbance were primarily attributed to the effects of chemicals (e.g., ammonia) generated by the decay of partially degraded wood waste, a by-product from the pulping process. A state-of-the-science physiological-based biokinetic food chain model was used to evaluate exposure and risk to shorebirds, seabirds, sea otter, and harbor seal to demonstrate that potential risk to marine birds and mammals in the vicinity of the site were negligible.

Feasibility Study Report for the Bay Operable Unit at a Sitka Mill Site, Alaska—Provided strategic technical consulting in evaluation of the risks of the dredging remedy for wood waste deposited on the seafloor in the vicinity of a pulp mill discharge. The selection of the natural recovery alternative for a submerged wood deposition field was a landmark decision. Other mill locations in Alaska and the Northwest have been required to implement some combination of capping or dredging of submerged wood detritus and debris.

Duwamish Brownfields/TPH Coalition; Ecological Risk Assessment Approaches for Managing Petroleum Hydrocarbons in Terrestrial and Aquatic Habitats, Washington—Developed methods for predicting fate and transport, bioaccumulation, and toxicity of petroleum hydrocarbons to soil invertebrates, small mammals, and aquatic organisms. The approach was then used to establish risk-based screening levels for TPH in soils and groundwater. Evaluation of terrestrial receptors involved estimation of bioaccumulation of hydrocarbon fractions in earthworms, and subsequent exposure to small mammals via predation. The BAF model incorporated estimates of the freely dissolved fraction of petroleum hydrocarbons in soil water, and, therefore, avoided unrealistic estimates of bioaccumulation of high end carbon fractions. The approach to aquatic receptors involved innovative use of the general model for chemical narcosis in aquatic systems.

Technical Support for Marine Ecological Risk Assessment; Sinclair Inlet, Washington—Provided senior scientist support to review and oversee progress of an investigation of chemical contamination in sediments in the vicinity of the Puget Sound Naval Shipyard. Key components of the study were sediment chemistry, sediment geochemical profiles, sediment toxicity testing, growth and survivorship in caged mussels, bioaccumulation in bottom-dwelling flatfishes, and measurement of local circulation patterns that could affect sediment transport and deposition.

Remedial Investigation Strategy, Puget Sound Naval Shipyard, Washington—Designed a study and developed a work plan for a comprehensive ecotoxicology investigation of chemically contaminated sediments in the vicinity of the Puget Sound Naval Shipyard and other areas

of Sinclair Inlet near Bremerton, Washington. Key components of the study were sediment chemistry, sediment geochemical profiles, sediment toxicity testing, growth and survivorship in caged mussels, bioaccumulation in bottom-dwelling flatfishes, and measurement of local circulation patterns that could affect sediment transport and deposition.

EIS for City of Los Angeles Hyperion Sewage Outfall, California—Managed a health risk assessment for chemically contaminated marine fish and shellfish in the vicinity of the Hyperion sewage discharge into Santa Monica Bay, California. Major issues in this ongoing study are whether alteration in the composition of the effluent by full secondary treatment and realignment of the outfall can mitigate potential health risks associated with existing levels of chemical contamination.

Sediment Programs Summary—Managed preparation of *EPA Program Activities Related to Contaminated Sediments, and Relevant Statutes Office of Water Regulations and Standards*. The 23 program summaries were drafted by expert EPA personnel. Each of the draft summaries were reviewed for technical and editorial clarity, revised in consultation with the original authors, and compiled into a cohesive document for timely dissemination to the EPA Sediment Oversight Committee and Steering Committee.

Sediment Classifications Methods Compendium—Managed preparation of an Office of Water Regulations and Standards document titled *Sediment Classification Methods Compendium*. A wide range of expert personnel from EPA and other organizations drafted the 11 compendium chapters. Each of the draft chapters were reviewed for technical and editorial clarity, revised in consultation with the original authors, and compiled into cohesive documents for timely dissemination to the EPA Sediment Oversight Committee and Steering Committee.

San Francisco Bay Dredged Material Disposal EIS, California—Managed assessment of potential ecological effects associated with proposed disposal of dredged sediments into coastal waters offshore of San Francisco.

Human Health Risk Assessment

Risk-Based Site-Specific Water Quality Criteria for Treated Mine-Tailings Effluent—Managed a site-specific risk-based evaluation to identify more realistic and achievable goals for discharged arsenic in seawater that are consistent with the risk management objective of no more than 1 excess cancer case per 100,000 people (10^{-5}) for people who ingest arsenic in seafood. This evaluation showed numerous, substantial differences between the assumptions inherent in the risk assessment model used by EPA to estimate water quality criteria, and site-specific values that could be applied to the proposed discharge. Overall, the collective weight of evidence indicates that the concentration of arsenic in seawater that corresponds to the 10^{-5} risk management objective may be substantially (i.e., 10 to 1,000 times) higher than the 1.4 g/L criterion.

Health-Based Soil Action Levels for Utah Department of Health, Utah—Used risk assessment models for soil-dependent exposure pathways to define cleanup goals for arsenic,

cadmium, chromium, molybdenum, and lead in soils. The pathways that were evaluated were soil ingestion, consumption of locally grown produce, and consumption of beef. The integrated uptake and biokinetic model was used to determine cleanup levels for lead.

Sharon Steel Risk Assessment Support, Salt Lake City, Utah—Managed risk assessment review and in-depth toxicity assessment for lead, arsenic, and cadmium at the Sharon Steel/Midvale mine tailings area near Midvale, Utah. The toxicity assessment included critical evaluation of the kinetics, non-carcinogenic effects, carcinogenic effects, and appropriate target levels for lead in blood.

Preliminary Risk Assessment at Pesticide Formulation Facility, California—Managed and conducted a preliminary risk assessment for chemical contamination in the vicinity of the FMC pesticide formulation facility in Fresno, California. This project required development of a data management system to process 23,000 records of site-specific chemical concentration and data quality information, and development of a relational spreadsheet program to estimate risks and display the results.

Risk Assessment Support, Rocky Mountain Arsenal, Colorado—Managed toxicological support for the Colorado Department of Law's oversight of the Rocky Mountain Arsenal Superfund site. Support activities included a peer-review of a health effects assessment of diisopropyl-methylphosphonate, and technical review of nontraditional toxicity assessment and exposure assessment methods that were used by the U.S. Army to assess potential human health risks in the vicinity of the site.

Human Health Risk Assessment at Former Uranium Mill, Utah—Conducted a human health risk assessment for radioactive and nonradioactive contaminants in groundwater in the vicinity of tailings deposits from a former uranium mill site near Monticello, Utah. Radiologic substances of concern were radium, its parent isotope thorium-230, and its daughter decay products radon-222, lead-210, and polonium-210.

RI/FS for Coal Gasification Facility, Sacramento, California—Developed computer implementation of the California Decision Tree Model to estimate public health risks associated with PAH and other substances in soils and groundwater at a former coal gasification facility.

Expedited Response Action at a Wood Treatment Facility, Washington—Conducted a risk assessment for human health and marine ecological effects associated with creosote and pentachlorophenol contamination in the vicinity of a wood-treatment facility near Eagle Harbor, Washington.

Review of Endangerment Assessment for a Wood Treatment Facility, Washington—Reviewed an endangerment assessment for compliance with EPA recommended methods for assessing health risks associated with PAHs and pentachlorophenol in soils, groundwater, and shellfish in the vicinity of a wood-treating facility at Budd Inlet, Washington.

Bunker Hill RI/FS Work Plan, Idaho—Reviewed blood-lead data and proposed a risk assessment approach for evaluating human health impacts that may be associated with

past emissions of lead and other trace metals from the Bunker Hill smelter. Developed an approach to assess impacts of trace metals on aquatic communities of fishes and benthic macroinvertebrates in reaches of the South Fork of the Coeur D'Alene River, Idaho, that may be affected by mining wastes associated with the Bunker Hill Superfund site.

Mill Creek RI/FS, Montana—Critically reviewed the endangerment assessment approach and unrealistic assumptions that were used by EPA to characterize human health risks associated with exposure to arsenic, cadmium, and lead in Mill Creek, Montana. Conducted a baseline risk assessment to characterize human health risks associated with exposure to arsenic, cadmium, and lead in Mill Creek. Also performed risk assessment modeling to evaluate health risks associated with the various remedial alternatives that were proposed in the feasibility study.

Anaconda RI/FS, Montana—Performed a quantitative human health risk assessment using EPA methods for multimedia exposure to arsenic, cadmium, and lead in the vicinity of the Anaconda copper smelter near Anaconda, Montana.

Aquatic Plant Management Environmental Impact Statement, Washington—Conducted a human health risk assessment to evaluate potential public and occupational health impacts associated with aquatic application of 2,4-D. Public health risks were evaluated for exposure via fishing, swimming, drinking water, and using lake or river water for irrigation. Occupational risks were evaluated for herbicide applicators who followed recommended health and safety practices and those who had accidental contact through mishandling or spilling the herbicide.

Strandley/Manning RI/FS, Burley Lagoon, Washington—Performed a quantitative risk assessment to evaluate potential human health impacts associated with exposure to PCB, dioxin, and trichlorobenzene-contaminated soils, sediments, water, and seafood at an electrical transformer recycling facility near Burley Lagoon.

Expert Review, Regulatory Negotiation, and Litigation Support

Expert Testimony Regarding Water Withdrawal Effects on Salmon— Provided oral and written testimony concerning possible effects that extension of permits for municipal water withdrawal may have on salmonid rearing and spawning during periods of low stream flows in the lower Clackamas River, OR. Significant issues addressed in testimony concerned the spatial and temporal scales of the quality and quantity of spawning and rearing habitat in the affected reach; the scale of impacts from the proposed water withdrawals and their potential influence on the persistence of the affected populations of listed fish species; and the ecological basis and interpretation the target flow objectives that are used to forecast stream conditions predict impacts.

Review Final Rulemaking for Water Temperature Standards, Colorado—As Senior Science Advisor, provided technical oversight and review for a Reasonable Potential analysis for temperature excursions associated with effluent discharges to a segment of the South Platte River. Also provided senior project review for analyses of instream water temperatures,

composition of fish communities, and recalculation procedures for determining compliance with the proposed water temperature standards.

Expert Testimony Regarding a Proposed Water Quality Temperature Standard, Colorado—Described significant uncertainties in implementation of the proposed temperature regulation as justification for the Littleton/Englewood Wastewater Treatment Plant's petition for a temporary modification to its permit.

Expert Review of Caged-Fish Study Conducted in the HCFCD Ditch, Texas—In litigation support, provided an expert review and report concerning a study of chemical bioaccumulation by caged fathead minnows (*Pimephales promelas*) that were placed in a small stream that had received waste water discharges of DDT.

Expert Peer Review for Ecological Impacts of Wood Debris in the Marine Environment, Southeast Alaska—Consulted and provided expert commentary on Alaska Department of Fish and Game's proposed plan for assessing marine ecological impacts associated with wood debris in the vicinity of log transfer and storage facilities in Southeast Alaska. Recommended alternative approach to document key processes of ecosystem structure and function that would provide basis for management decisions concerning natural recovery vs. active site remediation. Authored review article on marine ecological impacts of wood waste.

Wood Debris Scientific and Technical and Policy Development for Log Transfer Facilities, Southeast Alaska—Participated on Alaska Department of Environmental Conservation's Science and Technology Committee for Log Transfer Facilities as an expert on biological and chemical processes that affect degradation of wood waste in the marine environment. Assisted the committee in developing remediation practices and alternatives at log transfer facilities.

Water Quality Assessment and Risk Management, Sutter Bypass Power Plant, Yuba City, California—Provided risk communication services at a public meeting with the California Energy Board. Provided testimony concerning analyses and interpretation of water quality data for trace metals in a proposed discharge of cooling water. Provided strategic risk management services for trace metals in cooling water and their potential impact to stream biota and wildlife. Risk management activities included regulatory negotiation concerning the advisability of a highly conservative and unrealistic application of an ecological risk assessment model for an endangered snake.

Program Management

Environmental Services at Various Pacific Northwest Naval Activities, Pacific Northwest—Provided program management for a multi-year \$5 million contract for environmental services throughout the Pacific Northwest. The scope of services included ecological investigations; ecological and human health risk assessment; geotechnical and geohydrological investigations; sediment quality evaluation; RI/FS, engineering design, plans, and specifications; and technical support for community relations activities. Projects included a remedial design and recreational opportunity assessment for Submarine Base Bangor; development of work plans for incineration of stockpiled soils at Submarine Base

Bangor; and work plans for sediment toxicity testing and monitoring chemical contaminants in groundwater, sediments, and shellfish tissues at NUWC Keyport.

U.S. Navy CLEAN Program, Alaska and Washington—Managed and coordinated human health and ecological risk assessment services for U.S. Navy facilities in Alaska (Adak Island), and Washington (Whidbey Island, Hood Canal, Dyes Inlet, and Sinclair Inlet). Provided senior management review and oversight for affiliate contractors conducting risk assessments for facilities at Point Barrow, Alaska, and Liberty Bay, Washington. Facilitated and presented workshops and training seminars on risk communication, risk assessment, and risk management. Assisted the Navy in risk management discussions with Technical Review Committees and regulatory agencies.

Fish and Shellfish Assessment

Oregon State Fish Commission, Applied Shellfish Ecology—Assisted in a research and management program that was designed to determine the relative effects of environmental factors, recreational harvesting, and commercial harvesting on populations of the razor clam *Siliqua patula* along the Oregon coast.

Oregon State Fish Commission, Sockeye Salmon Transplantation Survey—Evaluated migratory behavior of sockeye salmon, and assisted in survey of fish species and water quality in lakes and reservoirs of Willamette River, Oregon, drainage system.

National Marine Fisheries Service, Temporal Patterns in Pacific Salmon Migration, Oregon—Supervised five-person sampling team in a study to assess the effects of dams and nitrogen supersaturation on the timing of downstream migration of juvenile Pacific salmon in the Columbia River, Oregon.

Research Projects

University of Washington, Algal Abiosis Study, Washington—Studied the proliferation of bacterial pathogens of oyster larvae caused by organic substances excreted by phytoplankton.

University of Delaware, Chemical Ecology of Predation, Delaware—Researched the behavioral and chemical ecology of prey detection and prey location by the marine snail.

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- Rummel, B., and L.G. Williams. 1992. Draft ecological risk assessment, Jackson Park Housing Complex, Bremerton, Washington. Prepared for U.S. Navy, Engineering Field Activity Northwest, Naval Facilities Engineering Command, Silverdale, WA. URS Consultants, Inc., Seattle, WA.
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- Williams, L.G. 1989. Potential health effects associated with radiologic and nonradiologic chemicals in groundwater in the vicinity of a former uranium mill. Prepared for UNC GeoTech, Grand Junction, CO. Tetra Tech, Inc., Bellevue, WA. 25 pp.
- Williams, L.G., G.A. Pascoe, T. Whitehead, and M. Matyjas. 1989. Preliminary risk assessment for the FMC Fresno Pesticide Formulation Facility. Prepared for U.S. Environmental Protection Agency, Region IX, San Francisco, CA. Tetra Tech, Inc. Bellevue, WA. 102 pp.

- Pastorok, R.A., P.N. Booth, and L.G. Williams. 1988. Estimating potential health risks of chemically contaminated seafood. *Puget Sound Notes*, May, 1986. pp. 3–6.
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PRESENTATIONS/POSTERS

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Williams, L., and M. Herrenkohl. 2007. Costs and benefits of a toxicity testing in sediment management decisions. Abstract. 4th International Conference on Remediation of Contaminated Sediments, Savannah, GA.

Williams, L., D. Preziosi, R. Pastorok, and L. Jacobs. 2006. Application of the ecological risk assessment paradigm to assess the current effects of the *Exxon Valdez* oil spill on natural resources in Prince William Sound, Alaska. Pacific Northwest Society of Environmental Toxicology and Chemistry, Annual Meeting, Port Townsend, WA.

Williams, L., L. Jacobs, M. Staton. 2005. Ground water vs. surface water influences on sediment toxicity and geochemistry in a Puget Sound estuary. Abstract. Society of Environmental Toxicology and Chemistry, 26th Annual Meeting, Baltimore, MD.

Williams, L., R. Schoof, A. Schuler, P. Zieber, J. Yager, and J. Goodrich-Mahoney. 2004. Arsenic bioaccumulation – Implications of using a power function to estimate bioaccumulation factors. Abstract. Society of Environmental Toxicology and Chemistry, 25th Annual Meeting, Portland, OR.

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Hummell, R., and L.G. Williams. 1994. Use of allometric relationships to standardize ecological risk models and predict risk-based screening concentrations for soil-borne contaminants. Poster Abstract, Society of Environmental Toxicology and Chemistry, 15th Annual Meeting, Denver, CO.