

ATTACHMENT
Upper Columbia River Remedial Investigation and Feasibility Study
Teck Cominco American Incorporated – Technical Team

The following is intended to provide a brief summary of the technical team that will be used to perform the work as set forth within the Statement of Work (SOW) for Remedial Investigations and Feasibility Studies (RI/FS) at the Upper Columbia River (UCR) site. A process flow diagram of Teck Cominco American Incorporated's (TCAI's) Technical Project Team is illustrated within Figure 1.

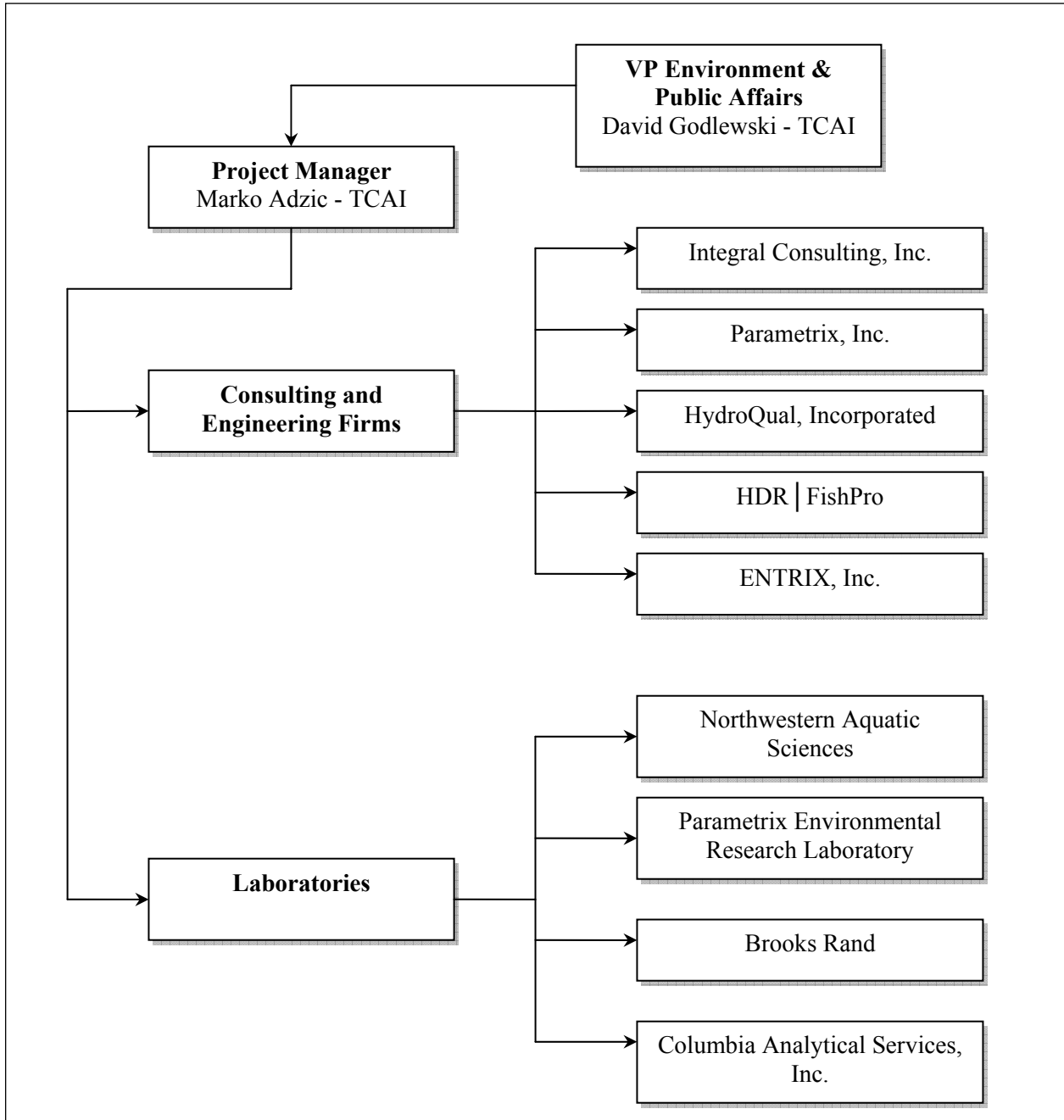


Figure 1. Upper Columbia River Remedial Investigation/Feasibility Study Technical Team

As indicated within Figure 1, consulting and engineering firms (i.e., contractors) to be employed in completing the work and/or portions thereof include Integral Consulting, Inc., Parametrix, Inc., HDR | FishPro, HydroQual, Incorporated and ENTRIX, Inc.. The following information was provided by the selected contractors and is intended to briefly describe their capabilities and key personnel.

Integral Consulting, Inc.

Integral Consulting, Inc. (Integral) is a full service science and engineering consulting firm providing support services in environmental assessment, remediation, ecological, health, and natural resources projects. Integral has work with commercial, legal, and institutional clients to identify technically sound and cost-effective solutions to complex problems. In addition, Integral provides support in the areas of environmental strategic planning, project management, agency negotiations, regulatory analysis and compliance, and peer review.

Integral scientists have substantial experience in conducting toxicological evaluations and risk assessments employing a wide variety of tools and advanced methodologies. Their expertise in human, aquatic, and terrestrial toxicology in combination with a broad-based experience in ecological assessments, exposure modeling, and environmental and analytical chemistry creates the essential foundation for accurate, comprehensive, and reliable evaluations that lead to scientifically sound management solutions to environmental challenges. Integral provides comprehensive sediment management services; hazardous waste site evaluation and remediation; management of sediments in lakes, rivers, and impoundments; and restoration/recovery of wetland and aquatic habitat for sensitive species.

Integral also specializes in providing risk-based solutions to air quality issues. Integral has the skills and experience needed to provide and implement the appropriate tools ranging from simple screening-level techniques to more complex and advanced methodologies to address air quality issues. Their expertise in atmospheric science, engineering, and toxicology, in combination with their broad-based experience in human health and ecological risk assessment, creates the essential foundation for accurate, comprehensive, and reliable evaluations that lead to scientifically sound management solutions.

Key Integral personal associated with the UCR project will include but not necessarily limited to the following:

Dr. Rosalind A. Schoof, PhD, Diplomate of the American Board of Toxicology - Principle

Dr. Schoof has more than 25 years of experience in assessing human health effects and exposures from chemical substances, and has coordinated and reviewed numerous risk assessments in air, surface water, soils and groundwater. She has directed evaluations of chemical toxicity, derivation of risk-based exposure levels, health risk assessments for carcinogenic and non-carcinogenic endpoints, and multimedia assessments of exposure to environmental chemicals at a wide range of sites.

Dr. Schoof is a nationally recognized expert on the bioavailability of metals from soil, with many publications in peer-reviewed journals on the bioavailability of arsenic, lead, and mercury. She has held and chaired numerous discussions on bioavailability at numerous National conferences and workshops, and directed the development of a U.S. Department of Defense field guide on the bioavailability of metals in soil. As a member of the National Research Council Committee on Toxicants and Pathogens in Biosolids Applied to Land, Dr. Schoof has a wide range of experience in examining toxicological risks.

Dr. Robert Pastorek, PhD. – Senior Science Advisor

Dr. Pastorek has more than 30 years of experience and is internationally known for his expertise in ecological risk assessment and restoration ecology of terrestrial and aquatic ecosystems. He has developed and applied mathematical models and bioassessment techniques to evaluate chemical exposure and toxicity to invertebrate, fish and wildlife species. He has led major multidisciplinary environmental investigations in Puget Sound, the Willamette, the Hudson and the Clark Fork Rivers. Dr. Pastorek was instrumental in the early development of the EPA ecological risk assessment framework and the EPA Puget Sound Estuary Program.

He was the lead author and editor of *Ecological Modeling in Risk Assessment: Chemical Effects on Populations, Ecosystems, and Landscapes*. He has participated in Pellston workshops convened by the Society for Environmental Toxicology and Chemistry, and has co-authored a number of texts on ecological risk assessments.

Dr. Benjing Sun, PhD. – Managing Scientist

Dr. Sun is an atmospheric scientist with over 16 years of experience managing and conducting air dispersion modeling, risk assessments, environmental sampling and monitoring, and atmospheric chemistry analysis. He specializes in air dispersion and deposition modeling, plume migration simulation, and accidental release reconstruction using site-specific information and local meteorological parameters. Dr. Sun has extensive experience in multi-pathway human health risk assessment, direct and indirect exposure assessments, fate and transport modeling, and sensitivity and uncertainty analysis. He has developed a comprehensive computer program based in the most recent EPA guidelines, to conduct multi-pathway human health and ecological risk assessments. Dr. Sun has evaluated emissions, multimedia fate and transport, toxicological effects, and health risks associated with various chemicals, such as polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDFs), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), trace metals including mercury, and volatile and semivolatile organics.

Betsy Day, MS. – Principal

Ms. Day is a recognized leader of sediment cleanup investigations in marine, riverine, and estuarine environments in the Pacific Northwest. Her professional strengths are in strategic management and technical oversight of contaminated sediment sites.

Ms. Day routinely provides senior-level consultation for sediment investigations, cleanup, and allocation projects. During her 18 years of experience, she has directed a variety of highly visible cleanup investigations and sediment assessment activities, including the Hylebos Waterway, Portland Harbor, and Slip 4, Duwamish River. Ms. Day has provided input to a variety of other contaminated sediment and dredged material characterization projects in Puget Sound, Washington. She holds a senior technical advisory role with the City of Seattle for its sediment cleanup efforts in the Duwamish River.

Parametrix, Inc.

Parametrix, Inc. (Parametrix) is an employee-owned firm dedicated to providing quality engineering, planning, and environmental sciences with superior client service. Founded in Sumner, Washington in 1969, Parametrix is an award-winning company specializing in the following areas and disciplines: toxicology and risk assessment, environmental engineering and science, natural resources and planning, surface water management, water/wastewater, land development, surveying, transportation, landscape architecture, and management consulting.

At Parametrix, internationally recognized ecotoxicologists, human health toxicologists, and environmental chemists focus on assessing the fate and effects of chemicals in the environment. With widely published expertise in aquatic and sediment toxicity testing, Parametrix is able to provide a unique combination of practical support for regulatory needs, as well as state-of-the-art-science research. Parametrix's toxicology related services include scientific literature compilation and critical review, construction and maintenance of toxicity databases supporting a wide range of regulatory needs, derivation and modification of regulatory water quality and sediment criteria, and the design of special studies. Their toxicologists are experienced in performing aquatic, terrestrial and human health risk assessments for a variety of contaminated sites. Remedial Investigation/Feasibility Study and related studies at sites contaminated with mining/smelter materials have included Lavaca Bay, TX, Magma, UT, Pinal Creek, AZ, Kellogg, ID, Laredo, TX, Leadville, CO, Harbor Island, Seattle, WA, and Reading, PA. Parametrix scientists routinely plan and conduct field investigations in support of risk assessments integrating technical consulting services with scientific research at our environmental research laboratory (Albany, OR).

The Parametrix Environmental Research Laboratory (PERL) has a 15-year history of conducting toxicity studies and associated testing as an integral part of its risk assessment, stormwater, environmental engineering, and wastewater treatment disciplines. The laboratory is capable of conducting routine bioassays for compliance purposes along with specialized studies including the derivation of site-specific water quality criteria, toxicity identification/reduction evaluations, and bench-scale treatability studies using both physical/chemical and passive treatment systems. PERL was established to focus more strongly on issue-based environmental research through leadership and experience of senior toxicologists who are nationally and internationally recognized leaders in their technical fields.

Selected environmental research project experience:

- Derivation of Water Quality Criteria for Cobalt
- Derivation of Water Quality Criteria for Manganese
- Evaluation of Biotic Ligand Model for Copper
- Effects of Water Quality Parameters on Acute and Chronic Nickel Toxicity
- Review and Assessment of Ambient Water Quality Criteria for Cyanide

PERL is accredited with the Washington State Department of Ecology for numerous freshwater bioassays (Lab ID #C2000). All procedures and testing adhere to strict quality assurance/quality control (QA/QC), with the ability to conduct tests according to rigorous Good Laboratory Practice (GLP) standards.

Key Parametrix personnel associated with the UCR project will include but not necessarily limited to the following:

Dr. Rick Cardwell, PhD – Senior Aquatic Ecotoxicologist and Ecological Risk Assessor

Dr. Cardwell is a Senior Aquatic Ecotoxicologist and Ecological Risk Assessor whose 35 years of experience has focused on the effects of chemicals and changes in habitat and water quality on aquatic life. He holds a B.S. in fisheries from Oregon State University and M.S. and Ph.D. degrees in fisheries (emphases in fish physiology and aquatic toxicology) from the University of Washington. He has extensive experience studying the effects of mine effluents, metals, and organic chemicals on aquatic life in surface waters, assessing sediments, conducting risk assessments, and conducting laboratory toxicity tests. He has applied this experience at CERCLA sites at Lavaca Bay, TX, Eagle River, CO, Magma, UT, and Harbor Island, WA. He has extensive experience managing large and complex projects that require the highest level of quality control and quality assurance and database management.

Dr. Cardwell has studied the effects on aquatic life from mine and smelter wastes, heavy metals and metalloids using laboratory tests and field studies. These studies involved combinations of risk assessment, biological surveys, and toxicity testing, as well as analyses of metal fate and bioavailability in surface waters and sediments. Over the past 10 years, he has managed more than \$10 million of studies and assessments of the risks posed by metals and metalloids at mine sites throughout the world. Recently, he has assessed food chain risks to juvenile salmonids rearing in the lower Columbia River with respect to PCBs, dioxins, and DDT metabolites. These analyses, which ultimately proved to be key to NOAA Fisheries' endorsement of the risk assessment predictions, was performed for the Port of Portland's Columbia River channel deepening project.

Dr. William Stubblefield, PhD – Director of Aquatic Toxicology

Dr. Stubblefield is a senior environmental toxicologist with Parametrix in Corvallis, Oregon; he also serves as affiliate faculty in the Department Molecular and Environmental Toxicology at Oregon State University. Dr. Stubblefield has more than 15 years of experience in environmental toxicology, site impact assessment, derivation of water quality criteria, and aquatic and wildlife toxicology studies. He has authored more than 50 peer-reviewed publications, and technical presentations in the areas of aquatic/wildlife toxicology and environmental risk assessment. He has conducted a variety of research programs aimed at the evaluation of the toxicity of metals in the environment and issues associated with the discharge of mine-associated waters and tailings. Dr. Stubblefield's research has examined acclimation induced changes in the responses of aquatic organisms to copper, zinc, and cadmium; evaluated the acute and chronic toxicity of manganese; and quantified the effects of water quality characteristics, e.g., hardness, alkalinity, dissolved organic carbon, on the toxicity of boron, cobalt, nickel, and silver. His most recent research uses a combination of laboratory and field methods to investigate the effects of storm water-associated short-term pulse exposures of metals to aquatic organisms and examines the fate and disposition of storm water-associated metals in natural systems.

Dr. Stubblefield is an active member of the *Society of Environmental Toxicology and Chemistry (SETAC)*, where he serves as a member of the Society's Board of Directors, chairperson of the Publications Advisory Council, associate editor of the Society's newsletter, and chairperson of the Metals Advisory Group. In addition, he has also served as a member of the Editorial Board for *Environmental Toxicology and Chemistry*. He has been an invited participant at a number of scientific and regulatory conferences, served on EPA peer-review panels, and frequently acts as a technical reviewer for a number of scientific publications.

Dr. Stubblefield has a Ph.D. in Environmental Toxicology from the University of Wyoming, a M.S. degree in Toxicology/Toxicodynamics from the University of Kentucky, and a B.S. in Biology from Eastern Kentucky University.

Suzanne Robinson – Senior Human Health and Wildlife Toxicologist

Ms. Robinson is a Senior Toxicologist and Practice Leader (Environmental, Human Health and Wildlife Toxicology) within the Toxicology and Risk Sciences Group at Parametrix. She holds a B.S. in Biology (Marine emphasis) and a M.S. in Environmental/Wildlife Toxicology from Western Washington University. She has extensive experience preparing fate, toxicological and risk evaluations for a wide variety of chemicals (metals in particular) with the potential to affect human and/or ecological receptors. She has over 21 years in numerous technical areas related to the assessment of chemical impacts. Her work has included detailed evaluations and reviews of the toxicity, mobility and bioavailability of inorganic and organic chemicals in aquatic and terrestrial environments; terrestrial/aquatic environmental assessments; designing and managing comprehensive field investigations to support human and ecological risk assessment and cleanup

activities; and managing and conducting risk analyses. She has made numerous technical presentations related to chemical risk analysis.

Recently, Ms. Robinson was requested to be an external peer reviewer on the 2004 Metals' Risk Assessment Framework in recognition of her expertise in the toxicology of metals and in human and wildlife risk assessment. She is a full and active member of both the Society of Toxicology (SOT) and the Society of Environmental Toxicology and Chemistry (SETAC).

Dr. Eric Van Genderen, PhD – Laboratory Manager

Dr. Van Genderen is the manager for Parametrix's Environmental Research Laboratory. He holds a Ph.D. in Environmental Toxicology from Clemson University. His areas of expertise include aquatic toxicology, environmental chemistry, and metals bioavailability. In particular, Eric has coordinated several laboratory research projects that utilize customized exposure systems (flow-through, early life stage, etc.) with freshwater vertebrates, invertebrates, and phytoplankton. He has served as chief scientist on numerous studies related to site-specific water quality criteria evaluation, validation of the Biotic Ligand Model for freshwater systems, and evaluation of metal bioavailability in freshwaters. Eric has authored more than 20 peer-reviewed publications and technical presentations. He has served as an invited participant at a number of scientific and regulatory conferences and is an active member of the Society of Environmental Toxicology and Chemistry.

HDR | FishPro

HDR | FishPro specializes in fisheries projects and aquatic resource engineering since FishPro's inception in 1978. HDR | FishPro has worked with federal, state, and local governments, tribal nations, and public and private utility companies throughout the Pacific Northwest and across the nation. HDR | FishPro's in-house staff of fishery biologists, fishery engineers, technicians, and graphics personnel focus on all aspects of fisheries studies and projects including initial planning, site selection and feasibility studies, conceptual design, permitting, final design, construction administration assistance, monitoring and evaluation and operations consultation.

HDR | FishPro is a sister company of HDR Engineering Inc. (HDR). HDR is a full-service employee-owned engineering and environmental science services company, providing expertise in 50 different design and scientific disciplines. HDR employs more than 4,500 engineers, architects, consultants, scientists, planners and construction managers in over 100 locations worldwide.

Key HDR | FishPro personnel associated with the UCR project will include but not necessarily limited to the following:

Keith Underwood – Senior Fisheries Biologist

Mr. Underwood has over 15 years of fisheries management, modeling, research, monitoring, and evaluation experience for public, tribal and private organizations. He holds B.S. and M.S. degrees in Fisheries Biology from Eastern Washington University and has studied wild fish populations throughout the Pacific Northwest quantifying their habitats in both stream and lake environments. He has evaluated the affect of hatchery practices on fish performance, and identified environmental benefits and impacts of hatchery programs. He has served as Project Manager and Principal Investigator of large multifaceted research, monitoring and evaluation projects and has worked with numerous resource management and wide range of stakeholders. Mr. Underwood has participated in many Endangered Species Act related activities such as management of the Federal Columbia Hydro Power System, restoration planning for white sturgeon, modeled bull trout life history requirements, reviewed hatchery programs impacts on bull trout, steelhead and spring Chinook.

Mr. Underwood has written and published over 19 articles and papers for peer reviewed journals and symposia proceedings on population dynamics and bioenergetics analyses.

Mr. Underwood has and continues to serve as an active member in a wide range of professional organizations. These include the American Fisheries Society, President of the North Pacific International Chapter, the North American Lake Management Society, Columbia Basin Fish and Wildlife Authority Member, the Lake Roosevelt Water Quality Council, the Upper Columbia White Sturgeon Recovery Group, and the National Oceanic and Atmospheric Association Fisheries – Columbia River Federal Hydropower System.

HydroQual, Incorporated

HydroQual, Incorporated (HydroQual) is a privately owned environmental engineering and consulting firm established in 1980. HydroQual specializes in mathematical modeling to evaluate the fate and transport of pollutants and the effect of their presence in natural water systems, the assessment and optimization of water and wastewater treatment processes, environmental hydrodynamics and sediment transport modeling, natural resource investigations and hydrogeological and engineering services for site remediation. HydroQual was founded by a group of nationally and internationally recognized leaders (three of which have been elected to the National Academy of Engineering) in the development and application of models to assess environmental conditions.

Since its inception, HydroQual has successfully completed thousands of projects that have included the development and application of fate and transport models for trace metals and organic compounds. They continually invest in the development and refinement of new and unique technologies; applying innovative tools and technical resources to evaluate, define and address environmental issues.

Key HydroQual personal associated with the UCR project will include but not necessarily limited to the following:

Paul R. Paquin, PE – Principle

Mr. Paquin is an environmental engineer specializing in water quality modeling. He has directed numerous modeling analyses of freshwater and estuarine systems, for conventional pollutants, organic chemicals and trace metals. Mr. Paquin has also managed several efforts to develop modeling tools that may be used in exposure and risk assessments. He has overseen projects directed at the development of methods for evaluating sediment quality guidelines for metals and organic chemicals and projects related to the development of the Biotic Ligand Model (BLM). The BLM, a modeling tool that considers site-specific metal speciation in an assessment of metal bioavailability and effects, has recently been incorporated into a draft WQC document for copper, with similar activities having been initiated for additional metals. Mr. Paquin has also managed chemical fate and transport modeling efforts, for both organic chemicals (PCBs and a variety of pesticides) and metals. He was the lead author of an industry sponsored critique of models for assessing metal fate and transport, chemical speciation, bioaccumulation and effects. The review included recommendations for areas of future research and model development needs, recommendations that HydroQual has continued to address with industry support. These efforts are coming to fruition as evidenced by their incorporation into regulatory initiatives in North America (both Canada and the U.S.), Europe and elsewhere. Mr. Paquin is currently leading HydroQual's effort to develop metal bioaccumulation models that consider intracellular processes as a basis for relating organ-specific metal accumulation levels to effects.

Dr. Dominic Di Toro, PhD - Principle

Dr. Di Toro, a founding principal of HydroQual, has been a professor of Environmental Engineering for over 35 years, initially at Manhattan College and currently at the University of

Delaware. He has specialized in the development and application of mathematical and statistical models to stream, lake, estuarine and coastal water quality and sediment quality problems. His recent work has included the development of water and sediment quality criteria for the EPA, sediment chemistry models for nutrients and metals and the integration of hydrodynamic, sediment chemistry, sediment transport and water quality models. With regard to criteria development, he has been a leader in efforts to develop and apply methods that consider bioavailability in the assessment of effects, including the Equilibrium Partitioning (EqP) methodology for neutral organic chemicals in sediments, narcosis concepts for PAH's, and the BLM and AVS-SEM methodology for metals in water and/or sediments. Dr. Di Toro has also developed modeling frameworks that integrate these considerations such that metal fate and transport model results can be linked to simulated AVS levels in sediments, an essential aspect of evaluating the bioavailability of sediment metals. Dr. Di Toro has authored over one hundred scientific publications, including a recent textbook, *Sediment Flux Modeling*. He has participated as an Expert Consultant, Principal Investigator and Project Manager on numerous water quality studies for industry, research foundations and governmental agencies.

Dr. Di Toro has been widely recognized by his peers for his technical excellence, as evidenced by his selection as the 1998 recipient of the Society of Environmental Toxicology and Chemistry's highest award for contributions to the field, the Founders Award. He was also the first recipient of the Donald J. O'Connor Chair of Environmental Engineering at Manhattan College, and he is currently the Edward C. Davis Professor of Civil and Environmental Engineering at the University of Delaware. Dr. Di Toro's most recent honor was his 2005 election to the National Academy of Engineering.

Nicholas Kim – Hydrodynamic Modeling

Mr. Kim has more than 16 years of experience in the field of environmental science. He has participated in numerous hydrodynamic and water-quality modeling studies for water bodies located throughout the world. His contributions to these studies include data analysis, model design and setup, and development of hind-cast and real-time forecast systems utilizing external independent data sources. Mr. Kim has worked on a variety of studies including coastal and estuarine hydrodynamics, tracer studies, outfall citing, pathogen fate models, particle tracking models, and thermal impact assessments.

Mr. Kim has developed a coupled hydrodynamic and water-quality model of New York Harbor for the New York City Department of Environmental Protection (NYC DEP). The hydrodynamic model evaluates the tidal and non-tidal circulation patterns in the New York Harbor, Hudson and East Rivers and the Raritan Bay estuary. Model simulations include the inputs of combined sewer overflows (CSOs), effluents from sewage treatment plants, rainfall runoff, and river discharges. The models developed for NYC DEP later evolved into System-Wide Eutrophication Model (SWEM) that covers New York Harbor system as well as coastal regions in New York Bight. The model has been used to assess various hydrodynamic and water quality issues in the region.

Mr. Kim has also been responsible for conducting three-dimensional hydrodynamic modeling studies such as a recent assessment of the impacts of thermal discharges from several nuclear power plants in Korea. His responsibilities in these projects typically include the oversight of data analysis tasks, development of wetting and drying algorithms, model setup and calibration, and leading training sessions on use of the models for subsequent assessment purposes.

Robert Santore – Associate

Mr. Santore is an environmental scientist with over twelve years of experience in the area of environmental and aquatic chemistry. He has been an integral component in the development of

models to predict the speciation, bioavailability, fate and effects of metals in aquatic and terrestrial settings. This work has led to the development of the BLM, a model that is the basis of the recently released draft revision to the EPA ambient water quality criteria for copper. The BLM considers site-specific chemistry to evaluate the concentrations of the various metal species that are present in solution (not all forms are uniformly bioavailable to an organism), information that is needed to assess the potential for effects. Mr. Santore has worked directly with regulatory agencies in the development of the draft copper water quality criteria document and continues to make strides on analogous models for other trace metals. The BLM has recently been extended in its applicability to sediments, as a refinement to the AVS-SEM methodology and, more recently, to soils. With regard to the latter, Mr. Santore is currently the lead investigator on an ongoing project that is funded by ICA to develop a terrestrial version of the BLM (i.e., a tBLM) for Cu in soils. The NiPERA is about to initiate a similar effort for Nickel. Mr. Santore has also recently completed the development of an interactive water column and sediment model for mercury in New York Harbor.

ENTRIX, Inc.

ENTRIX, Inc. (ENTRIX) is an environmental consulting services company specializing in water resources management, environmental risk management, natural resources management, natural resource economics, and facility permitting and compliance. ENTRIX was founded in 1984 and currently has offices throughout the United States and in Canada and Ecuador.

ENTRIX employs a multidisciplinary team of individuals, including experienced and recognized experts which includes biologists, chemists, geologists, oceanographers, toxicologists, meteorologists, economists, and environmental, chemical, and civil engineers.

Key ENTRIX personnel associated with the UCR project will include but not necessarily be limited to the following:

Dr. John Giesy, PhD. – Senior Consultant

Professor Giesy attended Alma College in Alma, Michigan where, in 1970, he obtained a B.S. Degree, *Summa cum laude* with honors in Biology. Professor Giesy obtained his Masters and Doctor of Philosophy Degrees in Limnology from Michigan State University in 1971 and 1974, respectively. From 1974 until 1981 he was affiliated with the Savannah River Ecology Laboratory and a faculty member in the Institute of Ecology and Department of Zoology at the University of Georgia. Until 2006, he was Distinguished Professor of Zoology at Michigan State University in East Lansing, Michigan, where he was also a Professor of Veterinary Medicine and on the faculties of the Center for Integrative Toxicology and National Food Safety and Toxicology Center. Currently he is a Professor of Zoology Emeritus at MSU and Canada Research Chair at the University of Saskatchewan where he is a faculty member in the Department of Veterinary Biomedical Sciences and on the Faculty of the Toxicology Centre. He is also Chair Professor at Large of Biology & Chemistry, at City University of Hong Kong and Concurrent Professor of Environmental Science at Nanjing University, China. He is a NIEHS Preceptor and member of the National Institutes of Health Faculty.

Professor Giesy is an aquatic toxicologist with interests in many aspects of this field, including both the fates and effects of potentially toxic compounds and elements, particularly in the area of ecological risk assessment. He has conducted research into the movement, bioaccumulation and effects of toxic substances at different levels of biological organization, ranging from biochemical to ecosystem. Professor Giesy has done extensive research in the areas of metal speciation, multi-species toxicity testing, biochemical indicators of stress in aquatic organisms, fate and effects of PAHs, halogenated hydrocarbons, including chlorinated dibenzo-dioxins and -furans, PCBs and pesticides. In addition to his work in aquatic toxicology, Professor Giesy has become world-

famous for his wildlife toxicology studies, particularly in the area of endocrine modulating compounds. In addition to his work as an ecologist and biochemical toxicologist he is a world-class environmental chemist, having developed and applied both analytical and bio-analytical techniques to environmental issues. Currently, Professor Giesy and his research group are actively studying the toxicity and reproductive effects of organic compounds, with special emphasis on herbicides, chlorinated dioxins and perfluorinated compounds. Studies are being conducted in the field and laboratory on fish, fish-eating birds and mammals in the Great Lakes region, including mink and raptors such as hawks and eagles and in marine mammals. Professor Giesy is an expert in ecological risk assessments of both industrial and agricultural chemicals and has been active in the development and application of methods for the assessment of the toxicity of contaminated sediments, especially in the North American Great Lakes.

Professor Giesy has published over of 500 peer-reviewed articles, presented over 900 lectures world-wide, is the member of many editorial boards, and is the editor of the Environmental Toxicology and Risk Assessment section of *Chemosphere*. He has served as a member of the EPA Science Advisory Boards and a member of six National Academy of Sciences panels, including: 1) Endocrine Disruptors, 2) Remediation of PCB-Contaminated Sediments and 3) Bioavailability of Residues from Sediments and Soils. Currently he serves on the Boards of Scientific Councilors (BOSC) of the National Toxicology Program (NTP) of the National Institutes of Health (NIH) and the US EPA Office of Research and Development (ORD) (Executive Committee).

Dr. Shaun A. Roark, PhD. – Senior Staff Scientist

Dr. Roark has a uniquely diverse background in ecotoxicology, aquatic ecology, and genetics. His academic research focused on adaptation and genetic change in populations of fishes and invertebrates in metal- and PCB-contaminated environments, and included the application and development of molecular tools in ecotoxicology. Dr. Roark's experience encompasses a diversity of aquatic systems, including lakes, streams, and rivers in the Midwestern and western states, as well as estuaries on the Atlantic coast. He has used numerous methods for sampling populations of fish and aquatic invertebrates, as well as surface water, ground water, and sediments. His laboratory experience includes biochemical and molecular genetic methods, and various techniques in analytical chemistry. Dr. Roark has experience culturing laboratory strains of fishes and aquatic invertebrates for experimental use, and has designed and constructed recirculating systems for rearing large numbers of laboratory fishes. His bioassay experience includes early life stage exposures with fishes as well as *in situ* exposures with fishes and invertebrates.

Dr. David J. Rowan, PhD. – Project Scientist

Dr. Rowan has developed, conducted and led extensive multi-disciplinary research programs on the fate and transport of metals, organics and radionuclides in aquatic and terrestrial ecosystems. Through this research, he has developed innovative techniques using contaminants as tracers of ecological processes and ecosystem health. He also has considerable expertise in conducting ecological and human health risk assessments. With graduate degrees in both geology (MS) and biology (PhD), he has knowledge and expertise on both biotic and abiotic components of ecosystems. His publications reflect this, and are largely split between sediment and food-web related topics. He has developed and led research projects that have yielded widely cited parameters and models, including some adopted by the National Council on Radiation Protection and Measurements and the International Atomic Energy Agency as national and international standards for risk assessment. Dr. Rowan has served as a consultant for the International Atomic Energy Agency (Dose Assessment Methods for Limiting Radioactive Releases), the National Council on Radiation Protection and Measurements (Cesium-137 in the Environment) and on the EPRI Working Group on Paradigms of Metal Bioaccumulation in Aquatic Ecosystems. Dr. Rowan

has also served as Associate Editor for the Journal of Environmental Quality, and has reviewed manuscripts for many other journals including: Environmental Science and Technology; Canadian Journal of Fisheries and Aquatic Sciences; Environmental Toxicology and Chemistry; Water, Air and Soil Pollution; Journal of Environmental Radioactivity; Health Physics; Journal of Applied Ecology; Ecological Applications; Marine Biology.

LABORTORIES



EXPERIENCE

Northwestern Aquatic Sciences (NAS) is located on Yaquina Bay, Oregon and specializes in providing aquatic toxicology testing and consulting services to industries, municipalities, environmental consultants, ports, and other private and governmental entities. NAS provides aquatic toxicity tests required for effluent biomonitoring, TIE/TRE evaluations, dredge spoil disposal, sediment remediation, hazardous waste testing, and industrial chemical evaluation. The staff has years of research experience and have published numerous technical articles in toxicology, chemistry, and other areas of environmental science.

ACCREDITATIONS

NAS is a Washington State certified aquatic toxicology laboratory and is certified for over thirty marine and freshwater sediment and effluent testing protocols. In particular, NAS has very extensive experience in recent years in quality performance of a variety of both freshwater (*Hyalella*, *Chironomus*) and marine (*Rhepoxynius*, *Leptocheirus*, *Ampelisca*, *Eohaustorius*, *Mytilus*, *Crassostrea*, *Dendraster*, *Strongylocentrotus*, *Neanthes*) sediment test protocols. Individual client projects have employed two or more test protocols and from 2 to more than 200 test sediments.

CAPABILITIES

NAS routinely maintains cultures of standard sediment bioassay test organisms such as *Hyalella azteca* and *Chironomus tentans*. The laboratory is also supplied with oil-free compressed air, dechlorinated fresh water, and Milli-Q[®] deionized water. The laboratory includes 4°C space for sample storage. Temperature control of bioassay and culture aquaria is achieved both by immersion of containers in water baths and by using several constant temperature rooms. Temperature monitoring of water baths and aquaria is available, as is instrumentation for measurement of dissolved oxygen, salinity, pH, ammonia, and other water quality parameters. A chemistry laboratory with GC/MS, and office facilities provide support for toxicology work.

CONTACT INFORMATION

For additional information, please contact Richard Caldwell at 3814 Yaquina Bay Rd., Newport, OR 97365, 541-265-7225 or by email at rcaldwell@nwaquatic.com.



Experience

Since the late 1980's, Brooks Rand has been a pioneer in the development and commercialization of many of the now widely accepted methodologies and technologies used for analysis of trace level metals and metals species.

Brooks Rand has a great deal of experience providing services to a diverse customer base, including environmental consultants, government agencies, other analytical laboratories, large industrial companies and research institutions. Past projects include remedial investigation, environmental site characterization, effluent monitoring, bioavailability and bioaccumulation studies, pollution source investigation, air monitoring, industrial process characterization, fate and transport, toxicology and USEPA method validation studies. Brooks Rand has performed analysis for a number of superfund sites including Eagle Harbor (WA), Cheyenne River Basin (SD), and Nyanza (MA) to name just a few.

Accreditations

Brooks Rand is currently accredited by the following agencies for a variety of analytical methods: NELAC and NY - NY Lab ID 11688 / EPA Lab Code WA00252, California – Certificate Number 2617, Maine – Lab ID WA00252, Washington – Lab ID C1349, and Wisconsin – Lab ID Number 998364070

Capabilities

Brooks Rand routinely analyzes the following matrices:

- Aqueous – surface water, ground water, waste water, influent, effluent, saline water
- Geological & industrial – soil, sediment, coal, oil, ore, chemicals, sludge
- Tissue – whole body and organs for fish, invertebrates, birds, amphibians, plankton, plants
- Biomonitoring – blood, urine, hair

Brooks Rand routinely analyzes for the following analytes:

- Total and total recoverable metals – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Sr, Th, Ti, Tl, U, V, Zn
- Metals species – methyl mercury, elemental mercury, acid labile mercury, mercury sulfide, arsenite, arsenate, mono and dimethyl arsenic, selenite, selenate

Contact Information

For additional information, please contact Colin Davies at 3958 6th Ave. NW, Seattle, WA 98107, 206-632-6206 or by email at colind@brooksrand.com, or feel free to visit our website at www.brooksrand.com.



EXPERIENCE

Since 1986, CAS has performed chemical analyses in support of remedial investigation and feasibility studies (RI/FS), risk assessment, natural resource damage assessments, remedial activities for Superfund sites and related programs. Many of these programs have required CLP methodologies and deliverables for both organic and inorganic parameters on large numbers of air, water, soil and sediment samples. Analytical parameters have included a wide spectrum of methodologies. In some cases, standard operating procedures were written as part of the quality assurance project plan, which outlines project organization and responsibilities, data quality and sample management objectives, stringent quality control, and performance and system audit procedures. CAS has developed special methodology for analytical, quality control, and sampling procedures of non-routine matrices needed to support project goals. CAS can complement the site project team by participating early in the planning stages and by providing technical advice to all involved including the consultants, potentially liable parties, and governing agencies.

Selected CERCLA and RI/FS examples:

- Portland Harbor RI/FS, Portland, OR (fish tissue analysis for metals, pesticides, PCB Aroclors, and lipids).
- USACE Portland District Willamette River Sediment Investigation, Portland, OR (low-level analyses of sediment, water and tissues for pesticides, PCBs PAHs, SVOCs, Dioxins, metals, and general chemistry parameters as well as sediment particle sizing).
- Moffett Federal Airfield, San Francisco, CA (low-level analyses of several hundred sediment, water, tissues and soil for pesticides, PCBs and metals).

CERTIFICATIONS AND ACCREDITATIONS

- American Council of Independent Laboratories (ACIL) Seal of Excellence Laboratory Program Canoga Park (277), Houston (274), Jacksonville (278), Kelso (275), Phoenix (272), Redding (276), Rochester (271), and Simi Valley (273)
- American Industrial Hygiene Association (AIHA) Accredited Laboratory (Simi Valley-101661)
- National Environmental Laboratory Accreditation Program (NELAP) (Primary AA), Canoga Park (California), Houston (Florida, Kansas, Louisiana, New York, Oregon and Utah), Jacksonville (Florida and Louisiana), Kelso (Florida, Kansas, Louisiana, New Jersey, New York, Oregon, Pennsylvania, and Utah), Phoenix (California), Redding (California, Florida, Kansas, Oregon, and Utah), Rochester (Florida, New Hampshire, New Jersey, and New York), and Simi Valley (New Jersey and New York)
- U.S. Air Force, Air Force Center for Environmental Excellence (AFCEE) Approved Laboratory (Jacksonville-project awarded, Kelso and Redding)
- U.S. Army Corps of Engineers (ACOE), Laboratory Testing of Hazardous and Toxic Wastes Approved Laboratory (Kelso, Redding, and Rochester)
- U.S. Naval Facilities Engineering Service Center (NFESC), Navy Installation Restoration Quality Assurance Program Accepted Laboratory (Canoga Park, Houston, Jacksonville, Kelso, Redding, Rochester, and Simi Valley)

- SDWA Water Supply (WS) Performance Evaluation Studies Houston, Jacksonville, Kelso, Phoenix, Redding, and Rochester
- CWA Water Pollution (WP) Performance Evaluation Studies Canoga Park, Jacksonville, Kelso, Phoenix, Redding, and Rochester
- USEPA, Discharge Monitoring Report Quality Assurance Program (DMR-QAP) Facility-Specific PE NPDES Analytes for Permitted Clients (Canoga Park, Jacksonville, Kelso, Phoenix, Redding, and Rochester)
- RCRA Soil/Hazardous Waste (S/HW) Performance Evaluation Studies Canoga Park, Houston, Jacksonville, Kelso, Phoenix, Redding, and Rochester
- RCRA Underground Storage Tank (UST) Performance Evaluation Studies Canoga Park, Jacksonville, Kelso, Phoenix, Redding, and Rochester State Programs
- State of Alaska, Department of Environmental Conservation Approved UST Laboratory (Kelso-UST-040 and Redding-UST-001)
- State of Arizona, Department of Health Services Licensed Laboratory (Canoga Park-AZ0136 and AZ0544, Kelso-AZ0339, Phoenix-AZ0497 and Mobile Lab AZM491, Redding-AZ0604, and Simi Valley-AZ0550)
- State of Arkansas, Department of Environmental Quality, Laboratory Certification Program Certified Laboratory (Houston-88-0635, Jacksonville-88-0600, Kelso-88-0637, and Redding-88-0636)
- State of California, Department of Health Services, Environmental Laboratory Accreditation Program Accredited Environmental Laboratory (Canoga Park-1296A and 02115CA, Houston-2452, Kelso-2286, Phoenix-02108CA, Redding-01105CA, and Simi Valley-2380)
- State of Colorado, Department of Public Health and Environment, Laboratory Certification Program Certified Laboratory (Kelso)
- State of Connecticut, Department of Health Services Approved Public Health Laboratory (Houston-PH-0300 and Rochester-PH-0556)
- State of Delaware, Department of Natural Resources and Environmental Control Approved Laboratory (Rochester)
- State of Florida, Department of Health, Bureau of Laboratories Accredited Environmental Laboratory (Houston-E87611, Jacksonville-E82502, Kelso-E87412, Redding-E87203, and Rochester-E87674)
- State of Georgia, Department of Natural Resources, Environmental Protection Division Accredited Laboratory (Canoga Park, Houston, Jacksonville-904, Kelso, Phoenix, Redding, Rochester, and Simi Valley)
- State of Hawaii, Department of Health, Safe Drinking Water Program Approved Laboratory (Houston and Kelso)
- State of Idaho, Department of Health and Welfare Certified Drinking Water Laboratory (Kelso)
- State of Indiana, Department of Health, Environmental Laboratory Division Certified Laboratory (Kelso-C-WA-01)
- State of Kansas, Department of Health and Environment Accredited Environmental Laboratory (Houston-E10333, Kelso-E10357, and Redding-E10323)

- State of Louisiana, Department of Environmental Quality Accredited Environmental Laboratory (Houston-03048, Jacksonville-02086, and Kelso-03016 and LA040001)
- State of Maine, Department of Human Services Certified Laboratory (Houston-TX901 and Kelso-WA901)
- State of Michigan, Department of Environmental Quality Certified Laboratory (Kelso-9949)
- State of Massachusetts, Department of Environmental Protection Certified Laboratory (Redding-M-CA025 and Rochester-M-NY032)
- State of Minnesota, Department of Health Certified Laboratory (Kelso-053-999-368)
- State of Montana, Department of Health and Environmental Sciences Certified Laboratory (Kelso-CERT0047)
- State of Nebraska, Department of Health and Human Services Regulation and Licensure Certified Laboratory (Kelso and Rochester)
- State of Nevada, Division of Environmental Protection, Laboratory Certification Program Certified Laboratory (Kelso-WA35-2004-76)
- State of New Hampshire, Department of Environmental Service Accredited Environmental Laboratory (Rochester-294103)
- State of New Jersey, Department of Environmental Protection, Environmental Laboratory Certification Program Accredited Environmental Laboratory (Kelso-WA005, Rochester-NY004, and Simi Valley-CA009)
- State of New Mexico, Environment Department, Drinking Water Bureau Certified Laboratory (Kelso)
- State of New York, Department of Health, Environmental Laboratory Approval Program Accredited Environmental Laboratory (Houston-11707, Kelso-11775, Rochester-10145, and Simi Valley-11221)
- State of North Carolina, Department of Environmental, Health, & Natural Resources Certified Laboratory (Jacksonville-527 and Kelso-605)
- State of North Dakota, Department of Health, Environmental Laboratory Certification Program Certified Laboratory (Kelso-R-174)
- State of Oklahoma, Department of Environmental Quality Certified Laboratory (Kelso-9801 and Redding-9952)
- State of Oregon, Environmental Laboratory Accreditation Program Accredited Environmental Laboratory (Houston-TX200002, Kelso-WA200001 and Redding-CA200004)
- State of Pennsylvania, Department of Environmental Protection Registered Environmental Laboratory (Kelso-68-659, Rochester-68-786, and Simi Valley-68-3307) Accredited Laboratory (Kelso-68-659)
- State of Rhode Island, Department of Health Licensed Laboratory (Rochester-00158)
- State of South Carolina, Department of Health & Environmental Control, Environmental Laboratory Certification Program Certified Laboratory (Houston-82014, Jacksonville-96021, Kelso-61002, and Rochester-91012)

- State of Tennessee, Department of Health, Division of Laboratory Services Certified Laboratory (Kelso-02868)
- State of Utah, Department of Health, Division of Epidemiology and Laboratory Services, Environmental Laboratory Certification Program Accredited Environmental Laboratory (Houston-COLU2, Kelso-COLU, and Redding-QUAL1)
- State of Washington, Department of Ecology, Environmental Laboratory Accreditation Program Accredited Laboratory (Houston-C291, Kelso-C001, and Redding-C037)
- State of West Virginia, Division of Environmental Protection, Office of Water Resources Certified Laboratory (Rochester-292)
- State of Wisconsin, Department of Natural Resources Certified Laboratory (Kelso-998386840 and Redding-999767340)
- State of Wyoming, U.S. EPA, Region 8 Certified Laboratory (Kelso)

CAPABILITIES

CAS routinely analyzes sample of various matrices:

- Aqueous – surface water, pore water, ground water
- Geological and industrial – soil, sediment, coal, oil, ore, chemicals, sludge
- Tissue – whole body and organs for fish, invertebrates, birds, amphibians, plankton, plants
- Biomonitoring – blood, urine, hair

CAS routinely analyzes for the following analytes:

- Total and total recoverable metals – Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Sr, Th, Ti, Tl, U, V, Zn
- Organics – chlorinated dibenzo-*p*-dioxins (PCDDs) and dibenzofurans (PCDFs) (EPA Method 8290); congener specific polychlorinated biphenyls (PCBs) (EPA Method 1668A)

CONTACT INFORMATION

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