GEM PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (*Trustee Council/GEM Data Policy**, adopted July 9, 2002) and reporting requirements *(Procedures for the Preparation and Distribution of Reports***, adopted July 9, 2002).

PROJECT TITLE: Sediment Quality Survey of Heavily-Oiled Beaches in Prince William Sound

Printed Name of PI: _____

Signature of PI: _____ Date _____

Printed Name of co-PI: _____

Signature of co-PI: _____ Date _____

Printed Name of co-PI: _____

Signature of co-PI: _____ Date _____

* Available at http://www.evostc.state.ak.us/pdf/admin/datapolicy.pdf
** Available at http://www.evostc.state.ak.us/pdf/admin/reportguidelines.pdf

Trustee Council Use Only **Project No:** ____ **Date Received:** ____	**GEM PROPOSAL SUMMARY PAGE** **(To be filled in by proposer)**

Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in Prince William Sound

Project Period: FY04 – FY05

Proposer(s): Betsy Day, Integral Consulting, Inc., bday@integral-corp.com

Study Location: Prince William Sound

Abstract: Recent work by Short et al. (2004) demonstrated that lingering oil is found in subsurface intertidal sediments in 43 of the 91 beaches sampled during the summer of 2001. This proposed research project is directed at understanding potential ecological effects to invertebrate populations resulting from lingering oil in subsurface intertidal sediments. Sediments from five locations containing heavily-oiled subsurface sediments, and five nearby reference areas, will be collected concurrently with the NMFS continuing lingering oil studies, and evaluated for PAHs, sediment toxicity using the mussel larvae bioassay, and benthic community structure. The results will provide information on the potential ecological impacts from lingering subsurface oil and will be evaluated using a weight-of-evidence approach. If this project shows that the heavily-oiled sediments are not causing impacts to benthic invertebrates then it can be assumed that benthic invertebrate populations in moderately or lightly-oiled sediments would not be affected by the lingering oil.

Funding:	EVOS Funding Requested:	FY 04 $ 73,100	
	(must include 9%GA)	FY 05 $ 51,900	
		FY 06 $ 0	
			TOTAL: $125,000
	Non-EVOS Funds to be Used:	FY 05 $ 0	
		FY 06 $ 0	
		FY 07 $ 0	TOTAL: $0

Date: April 13, 2004

(NOT TO EXCEED ONE PAGE)

RESEARCH PLAN

I. NEED FOR THE PROJECT

A. Statement of the Problem

The continued presence of residual oil from the 1989 *Exxon Valdez* oil spill (EVOS) was recently described by Short et al. (2004) based on field investigations conducted in 2001. Sampling by Short et al. was conducted on beaches that had been placed into the following categories in the first few years following the oil spill: Category I (heavily oiled), Category II (moderately oiled) or Category 3 (heavily oiled in 1989 but light to no oil during subsequent years). Oil was found at 78 of the 91 beach segments sampled by Short et al. in 2001. Of these 78 beach segments, oil was found in subsurface sediments at 43 beaches.

Potential ecological impacts to biota inhabiting sediments that continue to contain EVOS oil have not been studied. The ability of sediments to support diverse populations of invertebrates is a widely recognized indicator of the overall health of an ecosystem and is routinely used by federal and state regulatory programs to evaluate ecological impacts and determine the need for long-term monitoring or cleanup. As a resource, benthic infaunal organisms are a highly valuable food source for a variety of fish, bird and mammal species and can pass bioaccumulative contaminants to higher order species. The most common methods for determining sediment quality are assessing sediment chemical concentrations, sediment toxicity through laboratory bioassay testing, and, in some cases, the structure of resident benthic infaunal communities. The use of these measures for determining contaminated sediment impacts to benthic ecosystems is widespread in North America and Europe and is a core component of aquatic ecological risk assessments and sediment investigations conducted pursuant to current scientific and regulatory guidance. Taken together, this weight-of-evidence approach is similar to the sediment quality triad approach (Long and Chapman 1985; Chapman 1990).

The research described in this proposal is based on using sediment chemistry, toxicity testing, and benthic community structure to determine whether residual oil in sediments is resulting in adverse ecological impacts within the sedimentary environment. The research has four objectives: 1) to determine whether heavily-oiled sediments exhibit toxicity to invertebrates relative to nearby non-oiled sediments, 2) to determine whether the benthic infaunal community in heavily-oiled sediments differs from that community in nearby non-oiled sediments, 3) to determine whether a relationship exists among sediment PAH concentrations, bioassay response and benthic community structure in heavily-oiled sediments and 4) to evaluate the suitability of sediment toxicity tests and benthic infauna enumeration as elements of long-term monitoring. In the event that the heavily-oiled sediments are found to be toxic to invertebrates and/or contain an altered benthic infaunal community, then the research will have demonstrated that heavily-oiled sediments exhibit ecological impacts. This research project will not allow for quantification of potential ecological effects of moderately and lightly-oiled sediments as sediments with those characteristics are not being evaluated. However, if toxicity and altered benthic community structure are not observed in heavily-oiled sediments, then it can be assumed that sediments with lesser amounts of oil [i.e., lightly and moderately-oiled sediments described by Short et al. (2004)] would similarly lack ecological impacts due to the continued presence of EVOS oil.

B. Relevance to GEM Program Goals and Scientific Priorities

The central hypothesis of the GEM program concerns the need for identifying the natural forces and human activities that "bring about short term and long lasting changes *in the biological communities that support* birds, fish, shellfish and mammals" (italics added; GEM Research Program Document, pp. 21). This is refined for intertidal and subtidal habitats in the GEM Research Program Document to read "Natural forces (such as currents and predation) and human activities (such as increased urbanization and localized pollution) serve as distant and local factors, in causing short-term and long-lasting changes in community structure and dynamics of the intertidal and subtidal habitats." The research proposed herein focuses on understanding the effects of lingering oil on benthic communities that in turn support higher trophic level organisms. Over the past 15 years, a substantial portion of Prince William Sound has recovered from the oil spill. However, some areas still contain oil that is relatively unweathered (Short et al., 2004) and the ecological effects on organisms residing within the sediments are unknown.

The design of this project includes sampling non-oiled areas that are near the patches of heavily-oiled sediment. The information obtained from the non-oiled areas will also serve to increase the available information on ecological conditions where oil no longer occurs. The study design, detailed in Section II, includes evaluation of 5 pairs of sampling locations, with each pair including a sample (or replicate samples in the case of benthic infauna) from heavily-oiled sediments and a reference sample from nearby non-oiled sediments. This design will allow for an independent evaluation of 5 different sites so that an understanding of the range of benthic invertebrate responses to residual oil will be generated. Additionally, data from the non-oiled, reference locations can be used by themselves to characterize benthic community structure and potential toxicological response in non-impacted sediments.

II. PROJECT DESIGN

A. Objectives

The goal of the proposed work is to determine sediment quality and associated potential ecological impacts in sediments that are classified as heavily-oiled from the 1989 *Exxon Valdez* oil spill. Specific objectives are:

1. Determine whether heavily-oiled sediments are toxic to invertebrate larvae using laboratory bioassays.
2. Determine whether heavily-oiled sediments contain altered benthic infaunal communities relative to nearby non-oiled sediments.
3. Determine the relationship among sediment concentrations of polycyclic aromatic hydrocarbons, sediment toxicity, and benthic infaunal community structure
4. Evaluate the suitability of sediment toxicity tests and benthic infauna enumeration as elements of long-term monitoring.

These objectives will be met by collecting sediment and benthic infauna samples from 5 heavily-oiled beaches and their associated reference locations that do not contain oiled sediments. The results of this research will provide a basis for determining the degree to which benthic infauna are adversely affected by residual oil. Furthermore, the results will be useful for assessing whether potential future monitoring efforts are needed in these areas as well as the usefulness of this approach for monitoring.

B. Procedural and Scientific Methods

To meet the objectives listed above, sediment will be collected and analyzed for PAHs and conventional parameters (e.g., grain-size, TOC), and will also be used for laboratory bioassay testing. Additional sediment samples will be collected and processed for the identification and enumeration of benthic infaunal organisms. Methods for the collection and laboratory processing of sediment and benthic infaunal samples are discussed in this section.

Field Methods

The field portion of this project will be conducted cooperatively with the lingering oil study being performed by the National Marine Fisheries Service (NMFS), and sampling locations for this project will be a subset of the locations sampled by NMFS (see Section II.D of this proposal). Samples will be collected during the NMFS cruise that is scheduled to depart June 15.

To ensure that samples do not become contaminated, sampling and sample processing equipment will be made of stainless steel that will be decontaminated prior to sampling at each station. Equipment that will be used to collect sediment for chemical and bioassay testing will first be washed with Alconox detergent and rinsed with site water and then be decontaminated by rinsing with methanol. Decontaminated equipment will be wrapped in aluminum foil with the reflective side away from the equipment surfaces. Pre-cleaned, certified glass jars will be used to store sediment for chemical and bioassay analysis.

Sediment will be sampled for two purposes: chemical/bioassay testing and benthic infauna enumeration. Sediment for chemical and bioassay testing will be removed to a depth of 15 to 20 cm. The sampling horizon will be defined to characterize both the horizon where most benthic organisms occur and their likely exposure to residual oil. Sediment will be removed using a decontaminated stainless steel spoon and placed into a decontaminated stainless steel bowl. Approximately six liters of sediment will be collected at each sampling location. The sediment will be transported back to the sampling vessel where processing will occur. Sample processing will follow standardized Puget Sound Estuary Program (PSEP) protocols (PSEP 1997). Each sample will be homogenized using a stainless steel spoon until it is a uniform color and consistency. A portion of the homogenized sample will be place into containers for chemical analyses [i.e., PAHs, sediment grain size, total solids and total organic carbon (TOC)]. Samples for analysis of PAHs, total solids and TOC will be frozen while the samples for grain size will be refrigerated.

Approximately 2 liters of the remaining sediment will be used to prepare an elutriate sample for bioassay testing using the larval mussel bioassay. A mixture of 1 part sediment to 3 parts

seawater (by volume) will be prepared, the resulting mixture shaken for a standard period of time, the mixture allowed to settle for 5 minutes, and the water decanted into pre-cleaned, certified glass jars. A water sample for analysis of PAHs will be prepared from each elutriate sample and frozen for storage. Water for bioassay testing will be stored at 4^{o}C.

Eight replicate samples will be collected at each benthic sampling location. Samples for analysis of benthic community structure will be collected using a stainless steel 4-inch diameter hand corer that is pushed into the sediment a minimum of 15 cm. Once the corer has been pushed fully into the sediment, a stainless steel plate will be inserted across the bottom of the corer so that sediment can not be lost during retrieval of the corer. The corer will be removed from the sediment and the contents of the core placed into a heavy plastic bag. The bag will be labeled, sealed and transported back to the sampling vessel for processing. Onboard the sampling vessel each replicate will be sieved on a 1 mm screen using a gentle wash of site water to remove fine-grained sediment. Material held on the screen will be gently washed into heavy plastic bags, preserved with buffered formalin, labeled, placed in an additional plastic bag and sealed in plastic buckets prior to shipment to the laboratory.

Laboratory Methods

Sediment Chemistry

Sediment and elutriate samples and will be analyzed for PAHs by the NMFS Auke Bay Laboratory using their standard methods for EVOS sediment samples (Short et al., 1996). Analytical Resources, Inc. (Seattle, WA) will analyze sediment samples for total organic carbon (using EPA method 9060), total solids and grain size (using methods in PSEP 1986).

Sediment Bioassays

A chronic marine bioassay test using mussel larvae will be conducted by MEC Analytical Services, Tiburon, CA using methods from the Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. Testing Manual (USEPA/USACE 1998). This test was chosen because it is a relatively sensitive developmental test using a molluscan species (the mussel *Mytilus* sp.) that is representative of species present in Prince William Sound including the clams that serve as the primary food source for sea otters. The endpoints of this test are mortality and abnormality of the developing embryos, and the test runs for 48-72 hours. Full-strength elutriate and four dilutions will be tested, and five replicates will be run for each dilution. A positive control will also be run to ensure proper performance of the test. In extreme cases 100% toxicity is observed within the higher dilutions while 0% toxicity is observed in the remaining dilutions. Should this occur then the possibility of conducting additional testing on a dilution series between the dilutions with 100% and 0% toxicity will be evaluated. This evaluation will consider the amount of sample remaining, the age of the sample and the budget.

Benthic Infauna

Of the eight replicate samples collected at each location, five will be processed. The remaining three replicates would only be processed if there is large variability in species abundance among the five replicates[1]. Investigations by Ferraro et al. (1994) demonstrated that the power of

[1] Funding for these additional analyses is not included in this cost proposal.

detecting differences between sites using both grab and core samplers did not increase greatly for more than four replicates and that four replicate cores was the most cost-effective sampling design. Five replicates are proposed for this survey to account for unmeasured variability.

Benthic infauna samples will be sorted and identified by Marine Taxonomic Services, Corvallis, OR using PSEP protocols (PSEP 1987). Samples will be sorted under dissecting microscopes. After each sample has been sorted the remaining residue will be sorted by another individual. If the re-sort produces more than 5% of the original number of organisms removed from the sample then the entire sample will be resorted. Samples will be sorted into major taxonomic phyla (i.e., polychaetes, molluscs, crustacean, and other taxa).

Samples will be identified by individuals with expertise in each phylum. A reference collection will be developed containing individuals of each species. Samples of each species in the major phyla will be sent to outside experts for verification. Taxonomists who have been identified for this project include:

Polychaetes: Initial identification: Howard Jones
Reference Collection verification: Eugene Ruff

Molluscs: Initial identification: Susan Weeks
Reference collection verification: Allen Fukuyama

Crustaceans: Initial identification: Renee Zane
Reference collection verification: Craig Staude

Other taxa: Initial identification: Howard Jones, Scott McEuen
Reference collection verification: Bill Austin

Additional Test Recommendation

A second bioassay is recommended for inclusion but has not been included in the cost tables for this proposal as it represents an additional cost beyond the preliminary work authorization of $125,000. The second test is the chronic amphipod test using *Leptocheirus plumulosus*. This test species has been found to be quite tolerant of sediment grain sizes and bioassay methods have been developed for the growth endpoint as well as the mortality endpoint. This test is recommended because would provide a longer-term exposure period than the mussel larvae bioassay, it would provide a growth endpoint, and it would involve the testing of a non-molluscan species *(L. plumulosus* is a crustacean). Together, the mussel larvae and *Leptocheirus* tests would provide a solid evaluation of toxicity to lingering oil. The test would be administered by MEC Analytical Services using EPA (2001) methods. The cost to complete this test would be $60,000 including the collection, processing and shipping of additional sediment, laboratory testing, data evaluation and reporting.

C. Data Analysis and Statistical Methods

Sediment toxicity data will be evaluated using the publically available Seattle District, Army Corps of Engineers BioStat (v2.0c) software. This software tests for normality (Shapiro and Wilk W-Test) and homogeneity of variance (Levene's Test), and then uses the appropriate parametric t-test or non-parametric Mann-Whitney Test or Rankit Analysis to test for differences between samples from oiled versus reference areas. Analyses will be conducted using the $P<0.1$ probability level.

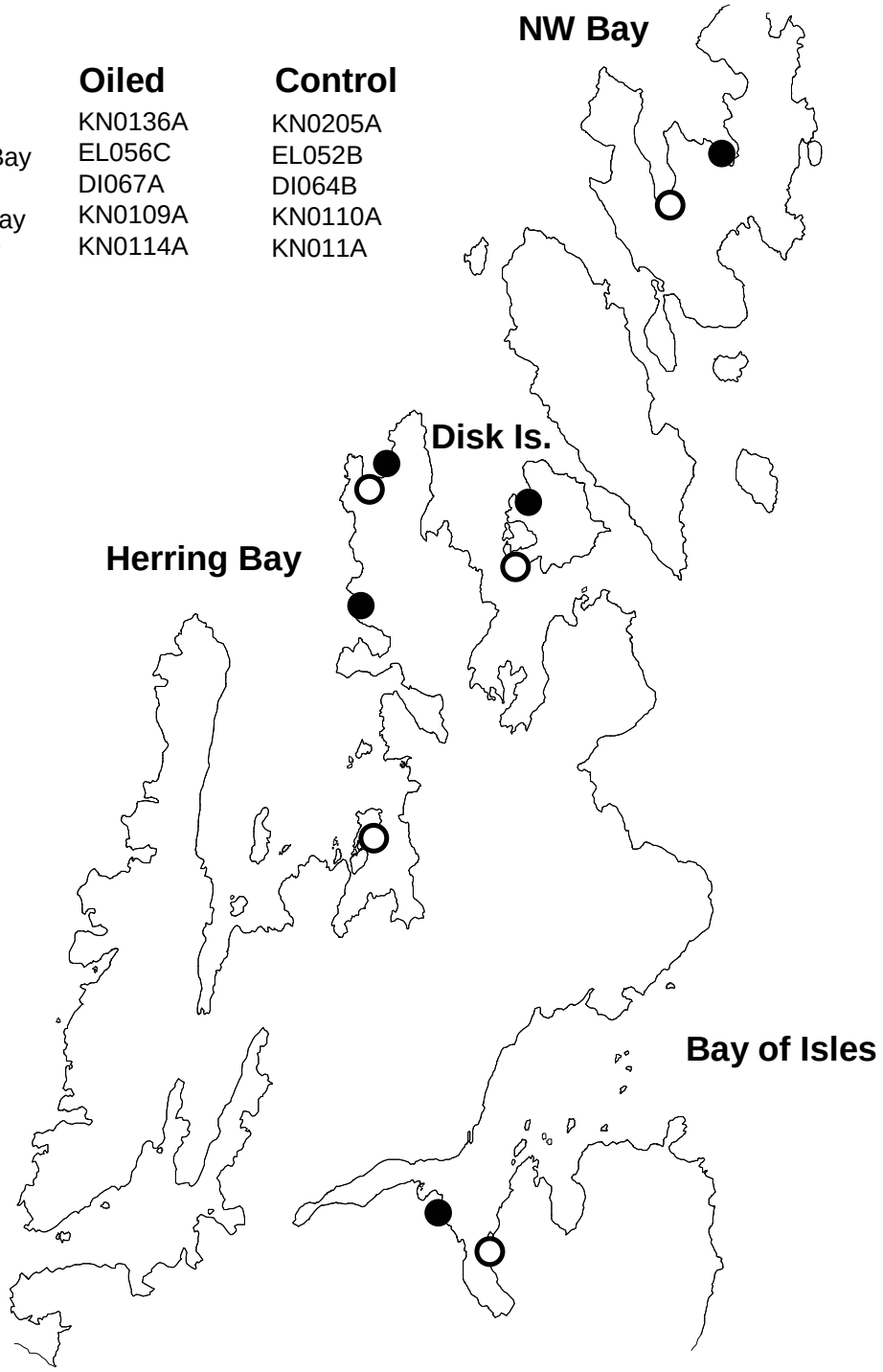
Benthic infauna data (and any additional analyses of the sediment toxicity data) will be evaluated using SYSTAT (v10) software. Evaluation of the benthic infauna data will include benthic metrics (e.g., abundance, number of species, abundance of major taxomonic groups, diversity evenness), classification, t-tests between oiled and nearby non-oiled reference samples, location comparisons, and principal component analysis.

D. Description of Study Area

Samples will be collected from areas within Prince William Sound that will be sampled in 2004 by the Auke Bay Laboratory personnel for their continued investigations into the effects of lingering oil. Stations will be located in Herring Bay, North Herring Bay, Bay of Isles, Disk Island, and Northwest Bay. Stations are shown in Figure 1.

Figure 1. PWS 2004 EVO Sites

Location	Oiled	Control
1. Bay of Isles	KN0136A	KN0205A
2. Northwest Bay	EL056C	EL052B
3. Disk Is.	DI067A	DI064B
4. N Herring Bay	KN0109A	KN0110A
5. Herring Bay	KN0114A	KN011A



E. Coordination and Collaboration with Other Efforts

This project is closely coordinated with the lingering oil research program that is being conducted by the NMFS Auke Bay staff. The field program will operate jointly on the June 15 NMFS cruise. Sampling for this program will occur at a subset of the locations being sampled by NMFS which will yield an even greater overall understanding of those locations.

The Auke Bay lab will perform the chemical analyses for this project. The lab's participation in the analyses was considered key to ensure that the resulting PAH data is comparable to the extensive PAH database that has been built since the oil spill occurred.

III. Schedule

A. Project Milestones

Project Milestones for each of the objectives listed above (II.A) are as follows:

Objective 1. Determine whether heavily-oiled sediments are toxic to invertebrates using laboratory bioassays.
To be met by March 15, 2005.

Objective 2. Determine whether heavily-oiled sediments contain altered benthic infaunal communities relative to nearby non-oiled sediments.
To be met by March 15, 2005.

Objective 3. Determine the relationship among sediment and porewater concentrations of polycyclic aromatic hydrocarbons, sediment toxicity, and benthic infaunal community structure.
To be met by March 15, 2005.

Objective 4. Evaluate the suitability of sediment toxicity tests and benthic infauna enumeration as elements of long-term monitoring.
To be met by March 15, 2005.

These milestones are dependent on completion of sampling in June 2004.

B. Measurable Project Tasks

FY04, 3rd quarter (April 1, 2004 – June 30, 2004)

April 2004:	Project funding approved by Trustee Council
June 30, 2004:	Complete field sampling

FY04, 4th quarter (July 1, 2004 – September 30, 2004)

September 30, 2004:	Complete laboratory analyses

FY05, 1st quarter (October 1, 2004 – December 31, 2004)
December 31, 2004: Complete data evaluation

FY05, 2nd quarter (January 1, 2005 – March 30, 2005)
(dates not yet known) Annual GEM Workshop
March 15, 2005: Submit final report. This will consist of a draft manuscript for publication

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

Charters to support the research will be solicited from the spill impact area. Shore-based laboratory support is being coordinated through Nancy Bird at the Prince William Sound Science Center. Briefings to stakeholders will be given as deemed needed or requested.

B. Resource Management Applications

Information gained from this project will provide resource managers with background information on potential ecological effects to invertebrate populations that may be consumed by a variety of fish, bird and mammalian populations including sea otters. Benthic infauna occupy one of the lowest positions in the food web and alterations to their natural community structure has the potential to affect the availability of food (either positively or negatively) for higher order consumers.

An understanding of sediment quality using the approaches outlined in this proposal is also directly applicable to future management and potential monitoring of these beach areas.

V. PUBLICATIONS AND REPORTS

A final report will be provided to the Trustees office by March 15, 2005. An expected publication title is "Ecological Effects to Benthic Infauna from Lingering Oil 15 years after the Exxon Valdez Oil Spill". This article will be submitted to Environmental Science and Technology.

VI. PROFESSIONAL CONFERENCES

The annual GEM Workshop will be attended by the principal investigator.

REFERENCES

Chapman, P.M. 1990. The Sediment Quality Triad Approach to Determining Pollution-Induced Degradation. Sci. Total Environ. 97/98:815-825.

EPA. 2001. Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-associated Contaminants with the Amphipod *Leptocheirus plumulosus.* USEPA/600/R-01/020.

EPA/USCOE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual. EPA-823-B-98-004. Washington, D.C.

Long, E.R. and P.M. Chapman. 1985. A Sediment Quality Triad: Measures of Sediment Contamination, Toxicity and Infaunal Community Composition in Puget Sound. Mar. Poll. Bull. 16: 405-415.

Short, J.W., M.R. Lindeberg, P.M. Harris, J.M. Maselko, J.J. Pella and S.D. Rice. 2004. Estimate of Oil Persisting on the Beaches of Prince William Sound 12 Years after the *Exxon Valdez* Oil Spill. Environ. Sci. Technol. 38:19-25.

PSEP. 1986. Puget Sound Estuary Program: Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA (minor corrections, Aril 2003).

PSEP. 1987. Puget Sound Estuary Program: Recommended Protocols for Sampling and Analyzing Subtidal Benthic Macroinvertebrate Assemblages in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA. Tetra Tech, Bellevue, WA.

PSEP. 1997. Puget Sound Estuary Program: Recommended Quality Assurance and Quality Control Guidelines for the Collection of Environmental Data in Puget Sound. *In*: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Puget Sound Action Team, Olympia, WA.

Short, J.W., T.J. Jackson, M.L. Larsen and T.L. Wade. 1996. Analytical Methods Used for the Analysis of Hydrocarbons in Crude Oil, Tissues, Sediments, and Seawater Collected for the Natural Resources Damage Assessment of the Exxon Valdez Oil Spill. Am. Fish. Soc. Symp. 18: 140-148.

Betsy Day
Principal Scientist

Professional Profile

Ms. Betsy Day (previously Striplin), a Principal Scientist at Integral, 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 investigation, cleanup, and allocation projects on behalf of private clients and regulatory agencies. During her 18 years of experience, she has directed a variety of highly visible cleanup investigations and sediment assessment activities, including the Hylebos Waterway (Tacoma, WA), Portland Harbor (OR), and Slip 4, Duwamish River (Seattle, WA). She has also conducted dredged material characterizations for private clients and directed the Washington State Department of Natural Resource's dredging program in the early 1990s. Ms. Day has provided input to a variety of other contaminated sediment and dredged material characterization projects in Puget Sound, Washington, and holds a senior technical advisory role with the City of Seattle for its sediment cleanup efforts in the Duwamish River.

Credentials and Professional Honors

M.S., Marine Biology, University of Victoria, 1984
B.A., Biology, University of Vermont, 1979

Pacific Estuarine Research Society
Society of Environmental Toxicology and Chemistry
Hazardous Waste Operations and Emergency Response 40-hour Certification

Relevant Experience

Development of Benthic Infaunal Reference Area Sediment Performance Standards, Washington — Provided quality assurance oversight to the development of reference area performance standards for the Washington Department of Ecology.

Portland Shipyard Site Investigation, Portland, Oregon — Provided senior technical review of an intensive and rapid sediment characterization (chemical and bioassay testing) of sediments in the vicinity of the Portland Shipyard for the Port of Portland. The goals of the characterization were to establish the area impacted by shipyard operations, the volume of sediments that may require remedial actions, and the possible identification of responsible parties over the 60 years of shipyard operations.
Jackson Park Housing Complex RI/FS, Tacoma, Washington — Conducted the sediment quality and benthic community analyses for the Jackson Park Housing Complex (Dyes Inlet) RI/FS ecological risk assessment. Related biological effects to sediment variables (i.e., sediment grain

size, total organic carbon, chemical concentrations). Evaluated chemical and biological data under the Washington State Sediment Management Standards. Compared chemical data to estimated sediment criteria derived using Equilibrium Partitioning.

Commencement Bay Nearshore/Tideflats RI/FS, Tacoma, Washington — Managed final preparation of the Commencement Bay Nearshore/Tideflats Feasibility Study for Washington Department of Ecology and U.S. EPA. Prepared initial evaluation of benthic community structure data for the Commencement Bay RI for Tetra Tech.

Puget Sound Marine Sediment Monitoring — Managed analysis of benthic community structure and relationships among sediment chemistry, sediment toxicity, and benthic community structure for the Marine Sediment Monitoring Task of the 1989 Puget Sound Ambient Monitoring Program.

Puget Sound Dredged Disposal Analysis (PSDDA) — Managed the PSDDA program for the Washington Department of Natural Resources. Reviewed sampling and analysis plans and interpreted resulting chemical and biological data for dredging projects. Administered and provided technical guidance for the first two years of the physical and environmental monitoring programs at PSDDA disposal sites, including sediment chemistry, sediment bioassays and benthic infauna sampling.

Hylebos Waterway Pre-Remedial Design, Tacoma, Washington — Served as project manager (1993-1998) for the sediment assessment activities to delineate areas of Hylebos Waterway (part of Commencement Bay CERCLA site) that require active remediation, natural recovery, or no action. Managed preparation of the existing data compilation report, sampling and analysis plans for sediment surface, subsurface, intertidal, and habitat sampling, quality assurance project plans, and the technical memoranda and data reports. Developed data evaluation approach to identify remediation, natural recovery, and no action areas. Represented the Hylebos Cleanup Committee in scope-of-work negotiations with U.S. EPA as well as subsequent negotiations regarding data evaluation, delineation of no action, natural recovery and remediation areas, and future sampling and data evaluation needs.

Selected Publications

Striplin, B., D. Kendall, and J. Lunz. 1991. Environmental conditions at two PSDDA open-water disposal sites: do they match the predictions? *In:* Puget Sound Research '91 Proceedings. Puget Sound Water Quality Authority, Seattle, WA.

Les Williams, Ph.D.

Managing Scientist

Professional Profile

Dr. Les Williams is aquatic ecologist specializing in the characterization and quantification of ecological risk and natural resource injury in support of focused management strategies for contaminated aquatic and sediment 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 organisms, development of site-specific sediment quality and water quality values, and human health and ecological risk assessments.

Credentials and Professional Honors

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

Association of Environmental Health and Sciences
Estuarine Research Federation
Society for Environmental Toxicology and Chemistry
Society for Risk Analysis

Relevant Experience

Remedial Investigation Strategy, Puget Sound Naval Shipyard WA—Designed study and developed work plan for comprehensive ecotoxicology investigation of chemically contaminated sediments in the vicinity of the PSNS 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.

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.

Puget Sound Protocols, WA—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. Also 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, WA—As the Marine Scientist/Aquatic Toxicologist, 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.

Remediation Work Plan for PAH Compounds in Harbor and River Sediments in the Mohawk River—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.

Technical Support for Marine Ecological Risk Assessment; Sinclair Inlet, WA—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 (PSNS). 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.

Selected Publications

Williams, L. and G. Braun. 2001. Costs and benefits of a toxicity testing program to facilitate contaminated sediment cleanup. Abstract. Society for Risk Analysis, 2001 Annual Meeting, Seattle, WA.

Williams, L. and G. Braun. 1999. Benthic community succession: Sediment profile photography and supporting information. Technical Memorandum, Alaska Pulp Corporation, Sitka Mill Site. Foster Wheeler Environmental, Bellevue, WA.

Williams, L.G., P.M. Chapman, and T.C. Ginn. 1986. A comparative evaluation of marine sediment toxicity using bacterial luminescence, oyster embryo, and amphipod sediment bioassays. Mar. Environ. Res. 19:225-249.

Pamela J. Sparks
Associate Scientist

Professional Profile

Ms. Pamela Sparks has over 10 years of experience in program design and the collection, analysis, and interpretation of terrestrial, estuarine, and marine biological data, especially related to contaminated sediments. An Associate Scientist at Integral, Ms. Sparks was a co-author of the Sediment Management Standards (WAC Chapter 173-204) for the State of Washington. She is an expert in the regional procedures that specify a cleanup decision process for managing contaminated sediments, and managed the State of Washington's development of benthic infaunal reference standards. Ms. Sparks has been a crustacean taxonomist since the mid-1980s.

Credentials and Professional Honors

M.S., Oceanography, University of Maine, 1999
B.S., Zoology and Fisheries, University of Washington, 1984

Northern Association of Marine Invertebrate Taxonomists
American Fisheries Society, Oregon Chapter
Hazardous Waste Operations and Emergency Response 40-hour Certification

Relevant Experience

Development of Benthic Infaunal Assessment Endpoints and Reference Area Sediment Performance Standards, Washington Department of Ecology — Served as project manager for the development of proposed benthic metrics (e.g., abundance, diversity, dominance, etc.) and Puget Sound reference ranges for inclusion in WAC Chapter 173-204. Given the regulatory framework, synoptic chemically uncontaminated data were assessed via a weight-of-evidence approach in evaluating the pro/cons of proposing performance thresholds (i.e., administrative ranges) for benthic indicators. Puget Sound data were assessed within habitat categories and then evaluated by analytical sequential steps (multivariate analysis) to derive the statistical confidence of the reference value range.

Disposal Site Environmental Monitoring and Assessment, Washington Department of Natural Resources — Serves as the project manager for the PSDDA disposal site monitoring program, which assesses the chemical and biological effects (including bioassays and benthic infauna) of dredged material deposited at the PSDDA sites. Coordinates field, data evaluation, and reporting efforts. Recent PSDDA monitoring events include a 2001 full monitoring effort in Commencement Bay and a 2002 tiered-partial monitoring effort in Elliott Bay.

Puget Sound Ambient Monitoring Program, Washington Department of Ecology — Responsible for implementing the marine sediment monitoring task of the Puget Sound Ambient Monitoring Program. Directed the sediment task for the 1993 and 1994 monitoring cycles, which included

preparing the implementation plan (SAP/QAPP) and scope of work, and administering a $450,000 contract for the annual work effort. In subsequent years, administered contracts for sediment chemistry and toxicity testing and EPA functional guideline data validation while performing the fieldwork benthic taxonomy, data management, and report preparation with an in-house staff of eight personnel.

Puget Sound Estuary Program Protocols: Sediment Bioassay Testing, Washington Department of Ecology — Provided technical refinements to the Puget Sound Estuary Program protocols for the collection and analysis of sediment bioassay samples in Puget Sound for U.S. EPA Region 10.

Sediment Chemical/Biological Source Control Evaluations, Tacoma, Washington — Coordinated the evaluation of the potential for recontamination prior to sediment remediation in the Sitcum, Hylebos, Milwaukee, and Blair waterways. Compiled and evaluated seeps, marine intertidal and subtidal sediments, and physical modeling data from multiple industrial sites, as well as NPDES and municipal stormwater monitoring data, at the Superfund site. Compared marine data to applicable criteria and standards using statistical analysis such as uni-variate tests.

Selected Publications

Sparks-McConkey, P.J., and L. Watling. 2001. Effects on the ecological integrity of a soft-bottom habitat from a trawling disturbance. *Hydrobiologia* 465:45-57.

Sparks-McConkey, P.J., P.L. Striplin, and B. Day. 1986. Effects of Organic Enrichment on the Benthic Infaunal Communities Under a Salmon Farm. No. ll87-E200. U.S. Department of Commerce, National Marine Fisheries Service, Manchester Laboratory, Manchester, WA.

Sparks-McConkey, P.J., Margaret Dutch, H. Dietrich, and F.A. Svendsen. 1994. Puget Sound Ambient Monitoring Program Marine Ecology Monitoring Task. Annual Report 1993. No. 94-95. Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, Olympia, WA.

Word, J.Q., P.L. Striplin, P.J. Sparks, and K. Keeley. 1984. Subtidal benthic ecology. Final Report Vol. Sect. 6. *In*: J. Stober and K.K. Chew, principal investigators. FRI-UW-8413. Renton Sewage Treatment Plant Project. Seahurst Baseline Study. Fisheries Research Institute, University of Washington,

Word, J.Q., P.L. Striplin, P.J. Sparks, and K. Keeley. 1983. Subtidal benthic ecology. Chapter 7. pp. 280-422. *In*: Renton Sewage Treatment Plant Project. Seahurst Baseline Annual Report 1982-1983. J. Stober and K.K. Chew, principal investigators. Prepared for the Municipality of Metropolitan Seattle, Washington.

BUDGET JUSTIFICATION

Future litigation and decisions about potential sediment cleanup will be based on the persistence of oil and continuing ecological effects. This study addresses potential continuing ecological effects within the sediments which have not been studied relative to lingering oil. This habitat provides significant food resources for fish, birds and mammals and an understanding of potential effects to this habitat by lingering oil is an essential component of future decisions regarding the management of these areas.

In addition, this study will use sediment assessment methods that may be appropriate for use in future monitoring efforts. By generating data using all of these methods, resource managers will be able to evaluate the potential usefulness of each of the methods.

DATA MANAGEMENT AND QA/QC STATEMENT

1. The proposed study is designed to test whether subsurface sediments that remain heavily-oiled are associated with ecological effects to resident invertebrates. It will also enable the assessment of the proposed methods as methods for future monitoring of PWS beaches. The study design includes five pairs of heavily-oiled and non-oiled intertidal sediment locations in Prince William Sound (Herring Bay, North Herring Bay, Bay of Isles, Disk Island, and Northwest Bay). The use of five pairs of stations will increase the potential range of conditions encountered and the associated range of responses. Sediments will be subsampled at five locations within each sampling location and composited for chemical and bioassay analyses. This compositing strategy will yield a sample that is likely more representative of actual conditions at the sampling area than would sediment from an individual sampling location. Five replicate benthic samples will also be processed at each sampling site. Ferraro et al. (1994) found that four replicate core samples provided the most cost-effective sampling approach for a site in Southern California. Five replicates are proposed herein to further decrease data variability.

2. During field sampling the sediment samples for analysis of PAH concentrations and for bioassay testing will be taken from sediments known to contain EVOS oil. Members of the Auke Bay Laboratory field crew who have extensive experience sampling these sediments will participate in identifying the appropriate locations and strata within the sediments to sample. Benthic samples will be collected using standard collection and processing techniques (EPA 1987). Standard criteria for sample acceptability will be applied to the benthic samples (EPA 1987).

Standard laboratory methods will be followed for all analyses. During PAH analyses the QA/QC methods found in Short et al. (1996) and Short and Heintz (1997) will be followed. During bioassay testing the QA/QC methods found in EPA/USACE (1998) will be followed, and the QA/QC methods in PSEP (1987) will be followed for the processing of benthic infauna samples. Acceptable QA/QC will enable the resulting data to be statistically evaluated to meet project objectives.

3.a) Federal Geographic Data Committee (FGDC) metadata files will be produced using either the freely available USGS MetaLite (v1.7.5) software. The Metalite metadata file is attached as Table 1.

3.b) Physical measurements will include sediment chemistry and sediment toxicity (using a larval bioassay). Taxon sampling will include benthic infauna sampling to characterize biodiversity and organism abundances. Table 2 displays the data-field structure of the data tables that will be used to store collected data.

4. N/A

5. Field sampling

Field and field QA methods were described previously in Section 2.B. of the Research Plan and are not restated here. Sample packing, transport and chain-of-custody are discussed in the following paragraphs.

PAH samples will be packed by Auke Bay Laboratory personnel using their standard procedures. Individual sample containers for the remaining chemical and bioassay analyses will be placed into a sealed plastic bag. Samples will then be packed in a cooler lined with a large plastic bag. Glass jars will be packed to prevent breakage and separated in the shipping container by bubble wrap or other shock-absorbent material. Ice in sealed plastic bags or "blue ice" will then be placed in the cooler to maintain a temperature of approximately 4ºC. When the ice chest is full, the completed chain-of-custody form will be placed into a zip-locked bag and taped on the inside lid of the cooler. A temperature blank will be added to each cooler. Each ice chest will be sealed with three chain-of-custody seals. On each side of the cooler a *This End Up* arrow label will be attached; a *Fragile* label will be attached to the top of the cooler.

Benthic samples will be sealed in leak-proof buckets with three chain-of-custody seals. Two *This End Up* arrow labels will be attached to each bucket and a *Fragile* label will be attached to the top of the bucket.

These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24. The coolers will be clearly labeled with sufficient information (i.e., name of project, time and date container was sealed, person sealing the cooler, and company name and address) to enable positive identification.

Samples for TOC and grain size analysis, as well as bioassay and benthic samples, will be shipped by air to the respective laboratories. Samples for PAH analyses will be transported by Auke Bay Laboratory personnel. Coolers and buckets will be maintained under strict chain-of-custody procedures at all times.

6. QA/QC procedures for analytical instrumentation for analysis of PAHs are those previously described by the Auke Bay Laboratory. Methods for analysis of total organic carbon (TOC), total solids and grain size are:

- **TOC:** EPA method 9060 will be used to analyze TOC. Samples will be pretreated with HCl to remove inorganic carbon, dried at 70^{o}C and analyzed by combustion in an induction furnace. The method detection limit is 0.018% TOC (dry weight basis) and the method reporting limit is 0.02% TOC (dry weight basis).
- **Total solids:** Total solids will be determined according to PSEP (1986).
- **Grain size:** Grain size analysis will be completed using PSEP (1986) protocols. Organic material in the samples will not be oxidized prior to the grain-size analysis. Sieve sizes 4, 10, 18, 35, 60, 120, and 230 will be used to determine gravel and sand fractions, and phi sizes 5, 6, 7, 8, and >8 will be determined for the silt and clay fractions using the pipette method.

7. Sediment toxicity data will be evaluated using the publicly available Seattle District, Army Corps of Engineers BioStat (v2.0c) software. This software tests for normality (Shapiro and Wilk W-Test) and homogeneity of variance (Levene's Test), and then uses the appropriate parametric t-test or non-parametric Mann-Whitney Test or Rankit Analysis. Benthic infauna data (and any additional analyses of the sediment toxicity data) will be evaluated using SYSTAT (v10) software. Evaluation of the benthic infauna data will include benthic metrics, classification, t-test location comparisons, and principal component analysis.

REFERENCES

EPA/USCOE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual. EPA-823-B-98-004. Washington, D.C.

Ferraro, S.P., R.C. Swartz, F.A. Cole, and W.A. DeBen. 1994. Optimum macrobenthic sampling protocol for detecting pollution impacts in the southern California Bight. *Environmental Monitoring and Assessment* 29:127-153.

PSEP. 1986. Puget Sound Estuary Program: Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Final Report, TC-3991-04. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA (minor corrections, Aril 2003).

PSEP. 1987. Puget Sound Estuary Program: Recommended Protocols for Sampling and Analyzing Subtidal Benthic Macroinvertebrate Assemblages in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA. Tetra Tech, Bellevue, WA.

PSEP. 1997. Puget Sound Estuary Program: Recommended Quality Assurance and Quality Control Guidelines for the Collection of Environmental Data in Puget Sound. *In*: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Puget Sound Action Team, Olympia, WA.

Short, J.W., T.J. Jackson, M.L. Larsen and T.L. Wade. 1996. Analytical methods used for the analysis of hydrocarbons in crude oil, tissues, sediments, and seawater collected for the Natural

Resources Damage Assessment of the Exxon Valdez oil spill. Am. Fish. Soc. Symp. 18: 140-148.

Shore, J.W. and R.A. Heintz. 1997. Identification of Exxon Valdez oil in sediments and tissues from Prince William Sound and the northwestern Gulf of Alaska based on a PAH weathering model. Environmental Science & Technology 31: 2375-2384.

Short, J.W., M.R. Lindeberg, P.M. Harris, J.M. Maselko, J.J. Pella and S.D. Rice. 2004. Estimate of Oil Persisting on the Beaches of Prince William Sound 12 Years after the *Exxon Valdez* Oil Spill. Environ. Sci. Technol. 38:19-25.

Table 1. 2005 EVOS Proposal Example Metadata File

Metadata:

Identification_Information:
Citation:
Citation_Information:
Originator: Integral Consulting, Inc.
Publication_Date:
Title: 2005 EVOS Proposal Example Metadata file
Geospatial_Data_Presentation_Form: map
Description:
Abstract:
Example metadata file for sediment toxicity and benthic infauna geographic data.
Purpose: Display sampling locations and result summaries.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 2004
Ending_Date: 2004
Currentness_Reference:
Status:
Progress: Planned
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate:
East_Bounding_Coordinate:
North_Bounding_Coordinate:
South_Bounding_Coordinate:
Keywords:
Theme:
Theme_Keyword_Thesaurus:
Theme_Keyword: biodiversity
Theme_Keyword: biodiversidad
Access_Constraints:
Use_Constraints:

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Point

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Day
Contact_Organization: Integral Consulting, Inc.
Contact_Address:
Address_Type: Mailing and Physical Address
Address: 7900 SE 28th Street, Suite 300
City: Mercer Island
State_or_Province: WA
Postal_Code: 98040
Country: USA
Contact_Voice_Telephone: 206-230-9600
Contact_Facsimile_Telephone: 206-230-9601
Contact_Electronic_Mail_Address: bday@integral-corp.com
Distribution_Liability:

Metadata_Reference_Information:
Metadata_Date:
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Day
Contact_Organization: Integral Consulting, Inc.
Contact_Address:
Address_Type: Mailing and Physical Address
Address: 7900 SE 28th Street, Suite 300
City: Mercer Island
State_or_Province: WA
Postal_Code: 98040
Country: USA
Contact_Voice_Telephone: 206-230-9600
Contact_Facsimile_Telephone: 206-230-9601
Contact_Electronic_Mail_Address: bday@integral-corp.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Generated by mp version 2.6.0 on Fri Apr 09 13:14:28 2004

Table 2. Structure of Tables to Store Collected Data.

DATABASE TABLE	DATABASE FIELD	DATATYPE	REQ/KEY	PARENT/FOREIGN KEY	DESCRIPTION/EXAMPLES
Sediment Chemistry Data Table					
dt_result	sys_sample_code	Text [40]	Y/K	samples.sys_sample_code	Unique sample identifier
dt_result	lab_anl_method_name	Text [35]	Y/K	methods.analytic_method	Analytical method
dt_result	analysis_date	Date	N		Start date of test
dt_result	analysis_time	Text [5]	N		Start time of test
dt_result	total_or_dissolved	Text [1]	N		Metals, total or dissolved
dt_result	cas_rn	Text [15]	Y/K	parameters.cas_rn	
dt_result	chemical_name	Text [60]	N		
dt_result	result_value	Text [20]	N		
dt_result	lab_qualifiers	Text [7]	N		
dt_result	reporting_detection_limit	Text [20]	N		
dt_result	result_unit	Text [15]	N	units.unit_code	mg/kg, ug/kg, percent
Sediment Toxicity Data Table					
dt_bioassay	sys_sample_code	Text (40)	Y/K	samples.sys_sample_code	Unique ID for each replicate
dt_bioassay	test_batch_id	Text (40)	N	dt_bioassay_batch.test_batch_id	Unique ID for test groups
dt_bioassay	test_date	Date	N		Start date of test
dt_bioassay	test_type	Text (20)	N		site, reference, control
dt_bioassay	toxicity_endpoint	Text (20)	N		survival, abnormality
dt_bioassay	percent_dilution	real	N		
dt_bioassay	initial_value	real	N		
dt_bioassay	final_value	real	N		
dt_bioassay	value_unit	Text (15)	N	units.unit_code	individuals
dt_bioassay	beaker	Text (20)	N		
Sediment Toxcity Batch Table					
dt_bioassay_batch	test_batch_id	Text (40)	Y/K		Unique ID for test groups
dt_bioassay_batch	lab_anl_method_name	Text (15)	N	methods.analytic_method	Analytical method
dt_bioassay_batch	taxonomic_serial_number	Text (20)	N	taxonomy.taxonomic_serial_number	Taxonomic serial number
Benthic Infauna Data Table					
dt_benthic_result	sys_sample_code	Text (40)	Y/K	samples.sys_sample_code	Unique sample identifier
dt_benthic_result	taxonomic_serial_number	Text (20)	N	taxonomy.taxonomic_serial_number	Taxonomic serial number
dt_benthic_result	abundance	integer	N		Abundance
dt_benthic_result	abundance_unit	Text (15)	N		Abundance unit of measure

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Budget Category:	Proposed FY 04	Proposed FY 05	Proposed FY 06		TOTAL PROPOSED
Personnel	$37.5	$47.2	$0.0		$84.7
Travel	$2.2	$1.1	$0.0		$3.3
Contractual	$27.3	$0.0	$0.0		$27.3
Commodities	$6.1	$3.6	$0.0		$9.7
Equipment	$0.0	$0.0	$0.0		$0.0
Subtotal	$73.1	$51.9	$0.0		$125.0
Indirect (rate will vary by proposer)					
Project Total	$73.1	$51.9	$0.0		$125.0
Trustee Agency GA (9% of Project Total)	$6.6	$4.7	$0.0		$11.3
Total Cost	$79.7	$56.6	$0.0		$136.3

Note: Per March 12, 2004 EVOS technical meeting on lingering oil, Integral was requested to not include the 9% GA fee.

FY 04-07

Date Prepared:

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Personnel Costs:			Months	Monthly		Personnel
Name	Description		Budgeted	Costs	Overtime	Sum
B Day	Principal, PI		0.500	24.0		12.0
L Williams	Managing Scientist		0.100	26.4		2.6
M Tritt	Sr. Scientist		0.100	17.6		1.8
V Fagerness	Sr. Scientist		0.100	15.2		1.5
P Sparks	Associate Scientist		0.700	13.6		9.5
I Stupakoff	Associate Scientist		0.700	14.4		10.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	2.2	111.2	0.0	
					Personnel Total	$37.5

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
P. Sparks; Cordove; Field work (per diem not charged for vesse	0.7	1	2	0.2	1.1
I. Stupakoff; Cordova; Field work (per diem not charged for ves	0.7	1	2	0.2	1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.2

FY 04

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Contractual Costs:	Contract
Description	Sum
Analysis of total organic carbon, total solids and grain size (Analytical Resources, Inc., Seattle, WA)	1.5
Mussel Larvae bioassays (MEC Analytical Services, Tiburon, CA)	11.2
Benthic infauna sample sorting and identifications (Marine Taxonomic Services, Corvallis, OR)	14.6
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$27.3

Commodities Costs:	Commodity
Description	Sum
Miscellaneous field supplies (formalin, methanol, corer, shipping)	0.5
Shipping	2.6
Van rental	0.4
Lab rental	0.2
Integral overhead	2.4
Commodities Total	$6.1

FY 04

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Name: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
None			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
None		

FY 04

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Personnel Costs:			Months	Monthly		Personnel
Name	Description		Budgeted	Costs	Overtime	Sum
B Day	Principal, PI		1.2	24.0		28.8
L Williams	Managing Scientist		0.1	26.4		2.6
S Trevathan	Sr. Scientist		0.1	14.4		1.4
P Sparks	Associate Scientist		0.4	13.6		5.4
T Shulz	Associate Scientist		0.5	12.8		6.4
R Nelson	GIS Specialist		0.2	12.8		2.6
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	2.5	104.0	0.0	
					Personnel Total	$47.2

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
					0.0
B. Day; Anchorage; GEM Workshop	0.7	1	2	0.2	1.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.1

FY 05

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Contractual Costs:	Contract Sum
Description	
None	
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$0.0

Commodities Costs:	Commodity Sum
Description	
Integral overhead	2.6
Manuscript page charges	1.0
Commodities Total	$3.6

FY 05

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
None			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
None		

FY 05

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Personnel Costs:			Months	Monthly		Personnel
Name	Description		Budgeted	Costs	Overtime	Sum
None						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:		Ticket	Round	Total	Daily	Travel
Description		Price	Trips	Days	Per Diem	Sum
None						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

FY 06

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

Contractual Costs:	Contract Sum
Description	
None	
Contractual Total	$0.0

Commodities Costs:	Commodity Sum
Description	
None	
Commodities Total	$0.0

FY 06

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.

EXXON VALDEZ OILSPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
None			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
None		

FY 06

Project Number:
Project Title: Sediment Quality Survey of Heavily-Oiled Beaches in PWS
Proposer: Integral Consulting, Inc.