

*Draft*  
*Work Plan*

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**2004 Assessment of  
Lingering Oil and Resource  
Injuries from the Exxon  
Valdez Oil Spill**

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*Prepared for the*

**State of Alaska  
Department of Law**

Anchorage, Alaska

*Prepared by*



Seattle, Washington

July 8, 2004

integral

# DRAFT WORK PLAN

## 2004 ASSESSMENT OF LINGERING OIL AND RESOURCE INJURIES FROM THE EXXON VALDEZ OIL SPILL

Prepared for

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## **ACRONYMS AND ABBREVIATIONS**

ABL	Auke Bay Laboratory
CEM	conceptual exposure model
EVO	Exxon Valdez oil
EVOS	Exxon Valdez oil spill
NOAA	National Oceanic and Atmospheric Administration
PAHs	Polycyclic aromatic hydrocarbons
PWS	Prince William Sound

## INTRODUCTION

### PURPOSE AND APPROACH

This work plan describes the approach that will be used to evaluate the nature and extent of lingering oil, and present-day resource injuries that can be linked to lingering oil from the Exxon Valdez oil spill (Task 2 and 3 from the Scope of Work; Integral 2004). The starting point for the overall evaluation is a comprehensive assessment of the existing literature related to the nature and extent of lingering oil in Prince William Sound (PWS) and nearby areas. Over the past several months, detailed review of this literature confirmed that lingering oil from the Exxon Valdez oil spill is present at a number of locations within Prince William Sound. Information on the nature and extent of lingering oil will now be synthesized and the linkages between resources and lingering oil will be evaluated in greater detail. The resources identified by the Trustee Council as “Recovering” or “Not Recovered” are the focus of this evaluation. Human use services that depend on natural resources are excluded from this evaluation in favor of focusing on the ecological resources that are directly affected by lingering oil exposure.

### BACKGROUND AND OBJECTIVES

The natural resources and habitats of Prince William Sound and other Alaskan waters have been studied extensively over the course of the 15 years since the occurrence of the Exxon Valdez oil spill. The collective data from studies conducted largely by natural resource Trustee scientists suggest that the coastal and marine ecosystems in the oil spill region have not fully recovered, that populations of several species remain impaired, and that continued exposure to persistent, biologically available, and toxic Exxon Valdez oil (EVO) might be at least partially responsible. These findings are not without scientific or public controversy. Most recently, for example, Exxon-funded scientists published data suggesting that EVO was neither bioavailable nor toxic<sup>1</sup>. Exxon scientists further contend that the methods used by National Oceanic Atmospheric Administration (NOAA) researchers in the lingering oil studies were flawed, and that the overall conclusions reached by NOAA researchers are the result of biases and/or incomplete information<sup>2,3</sup>.

Because fundamental questions remain, the Trustee Council has chosen to seek an independent perspective on the degree to which natural resources are injured and the degree to which that injury is caused by lingering oil.

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<sup>1</sup> Page et al. 2002. *Environ. Toxicol. Chem.* 21(7):1438-1450.

<sup>2</sup> Page et al. 2003. *Environ. Toxicol. Chem.* 22 (11):2540-2542.

<sup>3</sup> Neff & Gilfillan. 2004. *SETAC Globe.* 5(3):42-43.

To this end, Integral staff will conduct a series of evaluations using the available scientific data to provide an independent and comprehensive analysis of recovery status of key resources and define any linkage to residual oil. The overall goal of this work will be to provide information that can be used to characterize the probability and timeframe of resource recovery; to identify (if necessary) the options for restoration; to define the necessity, type, and geographic extent of continued monitoring and research; and to determine explicitly when restoration can be considered complete.

This work is intended to achieve the following objectives:

1. Provide the Trustee Council with an independent analysis of the ecological significance of lingering oil
2. Provide an independent evaluation of the recovery status of injured resources
3. Provide information to help focus and refine future work on oil-affected resources
4. Develop a process for achieving closure on the scientific and technical activities related directly to impacts from the Exxon Valdez oil spill
5. Identify areas in Prince William Sound (or other areas affected by the Exxon Valdez oil spill) where lingering oil persists or is likely to persist
6. Develop a long-term monitoring and management program for problem areas where lingering oil persists, with an emphasis on monitoring tools that are routinely used and broadly accepted by the regulatory community
7. Communicate the progress and results of these efforts to the Trustee Council
8. Communicate important technical conclusions to the public.

## **WORK PLAN ORGANIZATION**

The following sections describe:

- The approach for evaluating existing studies of the presence, nature, extent, and bioavailability of lingering oil
- The approach for characterizing lingering oil in more detail (bioavailability and toxicity, and its current impact on resources)
- The schedule for milestones and deliverables related to these activities. Milestones and deliverables associated with the Sediment Quality Survey (Task 8; Integral 2004) are included in the schedule.

## EVALUATE LINGERING OIL STUDIES

The first step in assessing ongoing resource injuries is to evaluate available documentation on the presence, nature, extent, and bioavailability of lingering oil from the Exxon Valdez oil spill. Over the past several months, publications and reports by Jeff Short, Stanley Rice, and others were reviewed to assess the strengths and weaknesses of the technical approach, statistical design and interpretation, and to characterize the inherent uncertainty of the technical findings regarding the presence, amount, and bioavailability of lingering oil. Related work and analyses performed by David Page, Paul Boehm, and others were also evaluated. Activities performed to date under this task include information compilation; library development; document review and analysis; internal discussions, meetings and technical discussions with Trustee scientists conducting studies of lingering oil; and development of the framework for any additional research tasks designed to refine scientific findings.

The result of this initial evaluation was the determination that lingering oil from the Exxon Valdez oil spill is present at a number of locations within Prince William Sound. Consequently, a framework has been developed to characterize a number of issues related to lingering oil. The framework for evaluating the nature, extent, and toxicity of lingering EVO includes the following major components:

- **Nature and extent**
  - How much EVO remains?
  - Where is it found?
  - What form is it in?
  - How confident is the estimate of nature and extent?
  - What chemical and physical processes are currently acting on the EVO (current fate and behavior)?
  - Are there other major sources of oil in this area? (other oil spills; oil releases attributable to the 1965 earthquake)
- **Exposure of flora and fauna to EVO**
  - Can flora and fauna be exposed to EVO? (surface oil vs. subsurface oil; asphalt vs. oil)
  - What are likely pathways?
  - Is the remaining EVO toxic to exposed flora and fauna?
- **Temporal and spatial changes in EVO**
  - How much has the spatial extent of oiled beaches decreased over time?



- How have dominant transformation/loss mechanisms changed over time?
- What are the uncertainties in these estimates?
- Can the ultimate duration of EVO in the environment be predicted?

The evaluation framework developed under this task provides the critical foundation for the resource injury assessments described in the following section.

A project library to facilitate information synthesis and sharing was also developed under this task. This library allows reports and technical publications to be efficiently compiled, reviewed, classified, and shared among offices and staff.

There are no written deliverables associated with this task.

## EVALUATE AND SYNTHESIZE INFORMATION ON RESOURCE INJURY AND RECOVERY STATUS

Extensive investigation and research have been performed to characterize the overall health and degree of recovery of resources adversely affected by the Exxon Valdez oil spill. Some of the conclusions of this research have been the subject of debate, largely between Trustee scientists and Exxon-funded investigators. It is widely acknowledged that stressors other than oil (e.g., overfishing, large-scale shifts in weather or ocean circulation, other natural perturbations) contribute to delayed recovery or shifts in population, and it is critical that the impacts of these other types of stressors be fully considered during the evaluation of injury status and the link to EVO. In addition, the contributing or confounding role of contaminants other than EVO should be explored. Integral staff will independently assess work performed related to the various factors affecting resources and habitat in PWS (and other areas affected by the oil spill), distill the information to the core technical arguments, and reassess the technical basis for the recovery status classification (“Recovering” or “Not Recovered”).

Under this task, existing studies will be identified, screened for relevance, integrated into the overall resource-specific analysis, and synthesized. This evaluation will involve reanalysis of data extant at the time of the original injury determination and additional data that have become available through subsequent studies. In support of this task, mapping of information to provide a clear picture of inter-related conditions and information (habitat, presence of lingering oil, shoreline geomorphology) will be performed when areas of concern are identified. Meetings and discussions will be held with the scientists that performed the work to better understand the technical approaches and unique resource and site-specific issues, and to perform the work in a cost-effective manner.

The resources that are currently classified as not recovering or recovering are of highest priority.

<b>Not Recovering</b>	<b>Recovering</b>
Common loon	Clams
Cormorants (3 spp.)	Intertidal communities
Harbor seal	Killer whales (AB pod)
Harlequin duck	Marbled murrelets
Pacific herring	Mussels
Pigeon guillemot	Sea otter
	Sediments
	Wilderness areas

Human use services that depend on natural resources are excluded from the evaluation in favor of focusing on the natural resources that are directly affected by lingering oil exposure.

A general approach and plan of activities for this task are summarized below.

## **DEVELOP A GENERAL CONCEPTUAL EXPOSURE MODEL**

A general conceptual exposure model (CEM) will be developed to provide a pictorial representation of past and lingering sources of EVO, chemical release and transport mechanisms, and environmental exposure pathways leading to recovering and non-recovering habitats and natural resources of concern. The CEM will distinguish between EVO as a primary source of exposure at the time of the spill and lingering oil as a secondary and ongoing source of exposure since that time. The CEM will illustrate processes of physical forcing and dispersion of EVO, including sequestering mechanisms in intertidal sediments; chemical and microbial processes of degradation and alteration of EVO, and partitioning into biotic and abiotic environmental matrices; and biological processes of exposure, uptake, and food-chain transfer of toxic EVO constituents.

The CEM will serve two purposes. First, it will be used to illustrate critical questions and hypotheses that are being tested by currently funded research as well as by this reassessment of the nature and extent, bioavailability, exposure, and effects of lingering oil. Second, it will be used to communicate which resources are clearly associated with lingering oil and the relative importance of spatial and temporal components of exposure that can be used to discriminate low-risk from high-risk resources. For example, high-risk resources would include sediments and intertidal invertebrates in direct contact with lingering oil, which can act as vectors of exposure to higher trophic-level organisms like sea otters. The general CEM will be used as the foundation for the detailed evaluation of lingering oil (below), and for resource-specific CEMs, which will be presented for selected resources.

### **Deliverables**

A general CEM diagram with components for general fate and transport of EVO, lingering oil residues in intertidal sediments, and recovering and non-recovering resources will be developed. The general CEM will be presented along with a corresponding explanatory text discussion.

## **CONDUCT DETAILED EVALUATION OF LINGERING OIL**

Characterization of the nature, extent, bioavailability, and future persistence of lingering oil is the foundation for assessing current and future exposure of resources. In addition,

because lingering oil has been found primarily in the intertidal areas of the shoreline, it is very closely tied to two important resource categories: sediments and intertidal communities (both currently classified as “recovering”). The following discussion provides additional details on the approach for characterizing lingering oil.

## **Nature and Extent**

Efforts to characterize the nature and extent of EVO will focus on obtaining the best possible estimate of the location, spatial extent, and volume of lingering oil remaining in and around Price William Sound. As described above, the spatial extent and volume of lingering oil will be a very important consideration in assessing the magnitude of lingering effects on resources.

Integral’s evaluation of the nature and extent of EVO will entail a reassessment and critique of the lingering oil work performed by National Marine Fisheries Service’s Auke Bay Laboratory (ABL), including SCAT 1 and subsequent investigations. Recent Trustee research results provide explicit estimates on the spatial extent of oiled beach (28 acres), mass of subsurface residual oil (122,500 pounds, or 55,600 kg), percent volume remaining from original spill (0.14 to 0.28%), and annual volumetric loss rate (20 to 26% lost per year) (Short et al. 2004).

The evaluation will also include a review and synthesis of research related to nature and extent that was largely funded by Exxon, including the Exxon-sponsored Shoreline Ecology Program, work by Page et al. (2002) on toxicity of EVO, and any related work by Jerry Neff, Paul Boehm, and others.

Integral’s evaluation of the nature and extent studies will additionally include a detailed examination and critique of the statistical strength and potential limitations associated with the designs and sampling techniques of the studies and their effect on the precision, accuracy, and uncertainty associated with the resultant estimations of the nature and extent of EVO. This examination will rely on Integral’s independent review as well as on technical discussions with key Trustee and Exxon-sponsored scientists.

## **Other Sources**

There are a number of other anthropogenic as well as natural sources of oil and oil constituents that could potentially confound the interpretation of the nature and extent of Exxon Valdez oil. For example, there were widespread releases of oil (California asphalt) from oil storage facilities during the 1965 earthquake. It has also been argued that natural oil seeps are also sources of oil to Prince William Sound and vicinity. Other oil spills attributed to oil transport and fishing industries also need to be considered.

Research on other sources of oil in PWS has been conducted by both Trustee and Exxon-sponsored scientists. A variety of techniques, ranging from qualitative overviews to quantitative forensic analyses (e.g., chemical fingerprinting), have been employed in an

attempt to differentiate or correlate sources of oil. To date, little research has been conducted with respect to linking other sources of oil and their potential impact on resource recovery.

Integral's independent evaluation of both the Trustee and Exxon-sponsored research on other sources will include a review and critique of published studies, discussions with technical leads, as well as Integral's assessment of the nature and magnitude of other sources potentially impacting resource recovery.

## **Bioaccessibility, Bioavailability, and Toxicity**

Lingering oil is present in a variety of forms, ranging from the highly weathered asphalt and pavement to largely nondegraded subsurface oil in permeable shorelines. Oil in the form of tarballs and tar patties is also observed.

Both the form and location of oil will determine the degree to which resources can be exposed. For example, when oil has been weathered to asphalt or pavement, remaining oil constituents have very limited bioavailability because they are bound in a solid form. Effects from asphalt and pavement are largely physical. In contrast, when unweathered or partially weathered oil has been sequestered in permeable shorelines, mobile constituents have the potential to adversely affect resources that come in contact with it. In this latter case, the location and depth of lingering oil is very important. For example, oil that is largely subsurface (e.g., >15 or 20 cm below the beach or sediment surface) is not accessible to the vast majority of species that inhabit the benthos.

The physical and chemical composition of oil is of profound importance in determining the toxicity of oil. For example, during weathering, oil changes in composition from generally smaller to larger polycyclic aromatic hydrocarbons (PAHs), although the degree to which this occurs varies. Other weathering byproducts may include a variety of oxidation and biological degradation products. The composition of PAHs in oil, the presence of other constituents and byproducts, and the attendant chemical bioavailability of each component are key considerations in determining relative toxicity of weathered versus unweathered oil. Also of critical importance is the potential concentration and associated dose to which receptors in PWS may be exposed. All of these considerations are further complicated by the fact that laboratory results are not always directly applicable to conditions which may exist in the field (and vice versa).

Integral's evaluation of lingering oil toxicity will include an assessment of the chemical composition of EVO present, its chemical bioavailability and general accessibility of its toxic constituents, other potential byproduct contributors to toxicity (e.g., oxidation and degradation products), and a determination of potential concentrations and concomitant doses to which resources may be exposed in PWS. This evaluation will consist of the review and critique of the principal studies on chemical composition and toxicity of lingering EVO, including those performed for mussels, pink salmon, and herring. In

addition, technical discussions may be held separately with Trustee and Exxon-sponsored scientific leads on these research efforts.

## Future Persistence

The future persistence of lingering EVO in PWS is an additionally important consideration under this subtask. Long-term persistence could translate to ongoing or future potential impacts on resource recovery beyond current conditions. Based on research conducted in PWS, as well as general research on persistence of crude oil in the environment following other oil spills, Integral will synthesize the available data to project the future persistence of lingering EVO and to elucidate upon its potential future impact, if any, on resource recovery.

## Deliverables

The product of this subtask will be a report summarizing existing information on the nature, extent, bioaccessibility, bioavailability, and toxicity of lingering oil.

## IDENTIFY PRIORITY RESOURCES

The objective of this subtask is to establish priorities for re-evaluation of injury status for the various recovering and non-recovering resources. This subtask has already been initiated, and, as indicated in Figure 1, a preliminary categorization of resources has been established. This prioritization scheme was based on consideration of six risk factors for resource exposure to lingering oil:

- **Factor 1 – Spatial/temporal correlation:** Is the resource co-distributed with sources or transport pathways of lingering oil? Is lingering oil exposure likely to occur frequently or over a long duration?
- **Factor 2 – Contact routes:** Can the resource contact lingering oil directly or indirectly via ingestion of food?
- **Factor 3 – Exposure indicators:** Has exposure been inferred by the presence of the CYP1A biomarker or by other measures of exposure (e.g., tissue analyses)?
- **Factor 4 – Critical life stage/duration:** Does the exposure occur at a critical life-history stage or over a significant portion of the life-history cycle?
- **Factor 5 – Surrogate for other species:** Is the resource representative of a broader range of species within the nearshore community or a feeding guild?
- **Factor 6 – Linkages to other injured resources:** Does the injured resource provide critical services to or is it dependent upon other injured resources?

The various receptors were evaluated initially based on the likelihood of their potential spatial and temporal correlation with lingering oil (Figure 1). Wilderness areas and the AB pod of killer whales were placed in Group 1 (little or no potential for exposure) because they have virtually no potential exposure to lingering oil. The remaining resources were further segregated based on the likelihood of contact with lingering oil over a significant portion of their foraging range or life history. Seabirds (common loon, three species of cormorants, pigeon guillemot, and marbled murrelet) and harbor seals were placed in Group 2 (low likelihood of exposure) because of the relative large size of their foraging and home ranges in relation to the size of lingering oil patches, and because they forage in deeper water in offshore subtidal areas removed from the intertidal location of lingering oil patches. The remaining resources (harlequin duck and other seaducks, sea otter, Pacific herring, sediments, clams, mussels, and intertidal resources) were placed in Group 3 (high likelihood of exposure) because they live or forage within the intertidal zone during a significant portion of their life cycle or during a sensitive life history stage.

The risk factors listed above were also used as lines of evidence to qualitatively characterize potential exposure for each resource and to identify priorities for injury re-evaluation and recovery status. Table 1 lists each resource and the preliminary assignment of corresponding exposure factors associated with its potential exposure to lingering oil. Group 1 contains the lowest priority resources, killer whales and wilderness areas. Group 2 contains two intermediate priority resources, seabirds and harbor seals. Group 3 contains the seven resources assigned highest priority for a detailed evaluation of injury and recovery status. With the exception of sediments, a detailed re-evaluation of the injury and recovery status will be provided for all of these resources, as described below. Sediments are being evaluated as part of the evaluation of lingering oil.

## **EVALUATE RESOURCE INJURY AND RECOVERY**

The resources in Groups 1 and 2 will be critically reviewed to determine the technical basis for their present injury designation and recovery status. Resources in Group 3 will receive a detailed injury re-evaluation according to the general outline and format shown in Table 2. Each injury re-evaluation will describe the natural history of the injured resource, summarize the technical basis for its current injury classification, present a resource-specific CEM, and identify new sources of information that can be used in the re-evaluation. Methods and results of the injury re-evaluation will then be described with an emphasis on spatial and temporal correlations of lingering oil and exposure, mechanisms of injury, and potential impacts to reproductive fitness and populations. Key scientific uncertainties associated with the conclusions also will be fully characterized.

Specific methods used in the injury re-evaluation will vary depending on the type of resource and the amount and quality of available information. Nevertheless, Integral

expects each detailed injury re-evaluation to provide an independent analysis of the impacts and ecological significance of lingering oil. For those resources that are affected by lingering oil, the re-evaluation will also provide a detailed and updated CEM that can be used to focus and refine future work on oil-affected resources, as well as identify appropriate monitoring tools for measuring their recovery. The injury re-evaluation is also expected to provide information needed to evaluate closure for those resources that are not affected by lingering oil or those that can be reclassified as recovered.

## **Deliverables**

The product of this task will be a series of 10 technical memoranda or white papers. Four of the white papers will be focused appraisals of injury recovery status for Group 1 and Group 2 resources. Six of the white papers will be detailed re-evaluations of injury and recovery status for high-priority resources in Group 3.



## SCHEDULE AND DELIVERABLES

The schedule (Table 3) describes key milestones and activities conducted to date (including meetings) and future deliverables described in this work plan:

- General CEM
- 2004 Assessment of Lingering Oil in Prince William Sound
- Detailed Resource Status Reports (6)<sup>4</sup>
  - Harlequin duck (and other seaducks)
  - Sea otter
  - Pacific herring
  - Clams
  - Mussels
  - Intertidal resources
- Focused Resource Status Report (4)<sup>5</sup>
  - Seabird
  - Harbor Seal
  - Wilderness areas
  - Killer whale (AB Pod).

These individual deliverables will be prepared in a format that can be assembled into a summary notebook as the final product.

The schedule does not currently include final drafts of the deliverables. It is anticipated that discussion and finalization of these documents will occur in 2005.

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<sup>4</sup> Sediments are addressed as part of the lingering oil assessment.

<sup>5</sup> The four seabirds currently classified as recovering or not recovering will be evaluated in a single report.

## REFERENCES

Integral. 2004. Applied Research Related to Lingering Oil, Resource Recovery, and Management and Monitoring of Impaired Water Bodies. Submitted to EVOS Trustee Council, May 2004. Integral Consulting, Inc., Mercer Island, WA.

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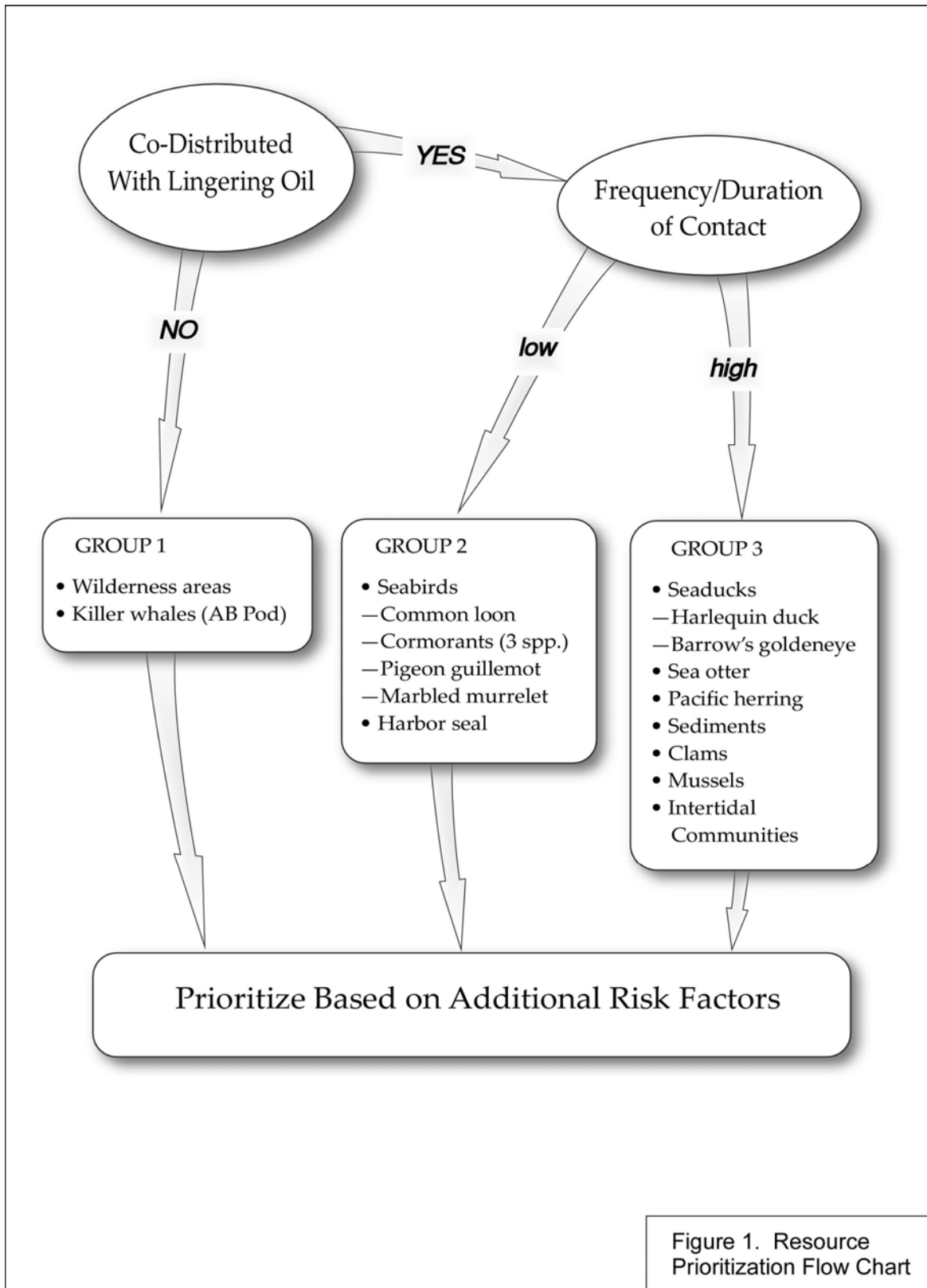


Table 1. Draft Matrix for Prioritization of Resources for Injury Re-evaluation

Status	Community or Guild	Resource	Lingering Oil Exposure			Receptor Characteristics	
			Spatial/Temporal Correlation	Contact Routes	Exposure Indicator	Critical Lifestage/Duration	Surrogate for Other Species in Community/Guild
Recovering	Habitats & communities	Sediments	■		■	■	
		Intertidal communities	■			■	
		Wilderness areas					
	Invertebrates - Infauna	Clams	■			■	■
	Invertebrates - Epifauna	Mussels	■			■	■
	Seabirds	Marbled murrelet	□	□			
	Marine Mammals	Sea otter	■	■	■	■	
		Killer whales (AB pod)					
		Pacific herring	■	■		■	
Not Recovered	Fish	Common loon	□	□			
		Cormorants (3 spp.)	□	□			
		Pigeon guillemot	□	□			
		Harlequin duck	■	■	■		■
		Harbor seal	□				
	Seaducks						
	Marine Mammals						

- Primary exposure based on high likelihood of contact with lingering oil over a significant portion of their foraging range or life history.
- Secondary exposure based on low likelihood of contact with lingering oil over a significant portion of their foraging range or life history.

Table 2. General Outline for Technical Memoranda for Re-evaluation of Injury and Recovery Status for EVOS-affected Resources

- 1) Abstract
- 2) Introduction
- 3) Natural history
- 4) Current injury and recovery status
  - a) Summary of existing information
  - b) Technical basis for injury and recovery classification
  - c) Conceptual model
- 5) Identification and summary of new information
- 6) Reanalysis methods
- 7) Re-analysis results (recovery matrix)
  - a) Lingering oil exposure
    - i) Frequency and duration
    - ii) Direct via contact/respiration/ingestion
    - iii) Indirect via foraging
    - iv) Biomarker confirmation
  - b) Effects of exposure
    - i) Acute and chronic toxicity
    - ii) Recent population surveys and trends
    - iii) Reproductive rates relative to reference
  - c) Habitat uses impacted by lingering oil
    - i) Food
    - ii) Shelter
    - iii) Migratory behavior
  - d) Spatial extent of exposure and effects
  - e) Causality – Likelihood of lingering oil impacts to resource populations
  - f) Recovery trends
  - g) Uncertainties
- 8) Summary and recommendations

Table 3. Schedule

<b>Milestone/Deliverable</b>	<b>Description</b>	<b>Date</b>
Applied Research – Scope and Budget (draft)	Draft scope and budget provided to Alaska Dept. of Law	April 5, 2004
Sediment Quality Survey of Heavily-oiled Beaches in Prince William Sound (draft)	Draft scope and budget provided to Trustee Council	April 13, 2004
Sediment Quality Survey of Heavily-oiled Beaches in Prince William Sound (final)	Final scope and budget provided to Trustee Council	May 6, 2004
Applied Research – Scope and Budget (final)	Final scope and budget provided to Trustee Council	May 11, 2004
Field Sampling	Joe Thompson and Pam Sparks collect sediment for benthic enumeration, toxicity testing and chemical analysis (with NOAA scientists)	June 12 through 20, 2004
Work Plan—2004 Assessment of Lingering Oil and Resource Injuries from the Exxon Valdez oil spill (draft)	Submitted to Alaska Department of Law and Trustee Council	July 8, 2004
Conceptual Exposure Model (draft)	Submitted to Alaska Department of Law and Trustee Council	July 30, 2004
Laboratory Analyses Completed (from June 2004 Sediment Quality Survey)	Chemical analysis, toxicity testing, and benthic infauna enumeration	September 30, 2004
Detailed Resource Status Reports (6) (Draft)	Submitted to Alaska Department of Law and Trustee Council	September – November 2004 <sup>6</sup>
Focused Resource Status Report (4) (Draft)	Submitted to Alaska Department of Law and Trustee Council	September – November 2004 <sup>7</sup>
2004 Assessment of Lingering Oil in Prince William Sound (draft)	Submitted to Alaska Department of Law and Trustee Council	November 19, 2004
Meeting	Discuss Initial Conclusions and Recommendations	December 2004
Field Data Evaluation Complete	Verbal communication of results	December 31, 2004

<sup>6</sup> Reports will be submitted sequentially. The first report will be distributed as an example of the approach and level of detail.

<sup>7</sup> Reports will be submitted sequentially. The first report will be distributed as an example of the approach and level of detail.

## 2004 ASSESSMENT OF LINGERING OIL AND RESOURCE INJURIES FROM THE EXXON VALDEZ OIL SPILL

### BUDGET DETAILS

This document summarizes the budgets for *Applied Research Related to Lingering Oil, Resource Recovery, and Management and Monitoring of Impaired Water Bodies* (Tasks 1 through 7; Integral 2004a) and *Sediment Quality Survey of Heavily-Oiled Beaches in Prince William Sound* (Task 8; Integral 2004b). A detailed budget breakdown is provided for Tasks 2, 3, and 8. A detailed discussion of activities associated with Tasks 2 and 3 is provided in the work plan for the *2004 Assessment of Lingering Oil and Resource Injuries from the Exxon Valdez Oil Spill* (Integral 2004c). Activities associated with Task 8 are described in Integral (2004b).

The total budget for Tasks 1 through 8 is \$857,700.

#### **Task 1—Project Scoping and Meetings—\$75,000**

See Integral (2004a) for a more detailed task description.

#### **Task 2—Evaluate Lingering Oil Studies—\$55,000**

- Initial Evaluation of Lingering Oil Studies—\$25,000
- Library Development and Information-gathering—\$17,000
- Framework for Detailed Evaluation of EVO—\$13,000

#### **Task 3—Evaluate and Synthesize Information on Resource Injury and Recovery Status—\$304,000**

- Task 3.1—Develop a General Conceptual Exposure Model—\$27,000
- Task 3.2—Conduct Detailed Evaluation of Lingering Oil—\$112,000
  - Nature and extent—\$37,000
  - Other sources—\$19,000
  - Bioaccessibility, bioavailability, and toxicity—\$30,000
  - Future persistence—\$26,000
- Task 3.3—Identify and Characterize Priority Resources—\$19,000

- Task 3.4—Evaluate Resource Injury and Recovery—\$146,000
  - Six detailed resource status assessments (average cost of \$18,000/report)
  - Four focused resource status assessments (average cost of \$9,500/report)

**Task 4—Evaluate Existing Data to Identify Areas of Concern—\$40,000**

Not yet scoped in detail, see Integral (2004a) for a more detailed task description.

**Task 5—Develop a Long-term Monitoring and Management Plan—\$50,000**

Not yet scoped in detail, see Integral (2004a) for a more detailed task description.

**Task 6—Development of Restoration Options—\$80,000**

Not yet scoped in detail, see Integral (2004a) for a more detailed task description.

**Task 7—Public Communication—\$46,000**

Not yet scoped in detail, see Integral (2004a) for a more detailed task description.

**Task 8—Sediment Quality Survey of Heavily-oiled Beaches—\$207,700**

- Fiscal Year 2004—\$145,690
  - Proposal Development—\$7,836
  - Project Planning—6,240
  - Mobilization, Field Sampling, and Demobilization—\$30,656
  - Laboratory Analysis—\$95,567
  - Data Validation—\$5,392
- Fiscal Year 2005—\$62,009
  - Data Management and Analysis—\$27,696
  - Manuscript Preparation—\$23,364
  - GEM Work Shop—\$5,957
  - Project Management—\$2,992.

**REFERENCES**



Integral. 2004a. Applied Research Related to Lingering Oil, Resource Recovery, and Management and Monitoring of Impaired Water Bodies. Submitted to EVOS Trustee Council, May 2004. Integral Consulting, Inc., Mercer Island, WA.

Integral. 2004b. GEM Proposal. Sediment Quality Survey of Heavily-Oiled Beaches in Prince William Sound. Submitted to EVOS Trustee Council, May 2004. Integral Consulting, Inc., Mercer Island, WA.

Integral. 2004c. Draft Work Plan. 2004 Assessment of Lingering Oil and Resource Injuries from the Exxon Valdez Oil Spill. Submitted to Alaska Department of Law, July 2004. Integral Consulting, Inc., Mercer Island, WA.

# ***Applied Research Related to Lingering Oil, Resource Recovery, and Management and Monitoring of Impaired Water Bodies***

**Project Period**—FY04 through FY05

**Principal Investigators**—Lucinda Jacobs, Les Williams, Damian Preziosi, Betsy Day, Dana Houkal

**Study Location**—This work is an evaluation and synthesis of work conducted by others in Prince Williams Sound and vicinity

**Abstract**—The natural resources and habitats of Prince William Sound and other Alaskan waters have been studied extensively for the 15 years since the occurrence of the Exxon Valdez Oil spill. The collective data from studies conducted largely by natural resource Trustee scientists suggest that the coastal and marine ecosystems in the oil spill region have not fully recovered, that populations of several species remain impaired, and that continued exposure to persistent, biologically available and toxic Exxon Valdez oil (EVO) might be at least partially responsible. These findings are not without scientific or public controversy. Most recently, for example, Exxon-funded scientist published data suggesting that EVO was neither bioavailable nor toxic<sup>1</sup>, and that the methods used and conclusions reached by NOAA researchers in the lingering oil studies were flawed<sup>2</sup>. A full and complete understanding of the degree to which natural resources are injured and the degree to which that injury is caused by lingering oil is critical to defining the probability and timeframe of resource recovery, the options (if any) for restoration, and the necessity, type and geographic extent of continued monitoring and research.

We propose to conduct a series of evaluations using the available scientific data to provide an independent and comprehensive analysis of recovery status of key resources and define any linkage to residual oil. The overall goal of this work will be to provide information that can be used to better characterize recovery status, better define restoration options, better target future monitoring and research, and more explicitly define when restoration can be considered complete.

Specifically, the work proposed here is intended to achieve the following objectives:

1. Provide the Trustee Council with an independent analysis of the ecological significance of lingering oil
2. Provide an independent evaluation of the recovery status of injured resources
3. Provide information to help focus and refine future work on oil-affected resources
4. Develop a process for achieving closure on the scientific and technical activities related directly to impacts from the Exxon Valdez Oil Spill
5. Identify areas in Prince Williams Sound (or other areas affected by the Exxon Valdez Oil Spill) where lingering oil persists or is likely to persist

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<sup>1</sup> Page et al. 2002. Environ. Toxicol. Chem. 21(7):1438-1450.

<sup>2</sup> Page et al. 2003. Environ. Toxicol. Chem. 22 (11):2540-2542.

6. Develop a long-term monitoring and management program for problems areas where lingering oil persists, with an emphasis on monitoring tools that are routinely used and broadly accepted by the regulatory community
7. Communicate progress and results of these efforts to the Trustee Council
8. Communicate important technical conclusions to the public.

**Funding**—A total budget of 650K is needed to complete all of the tasks specified below. Timing of expenditure (in FY 04 or FY05) will depend on milestones that will be established in planning discussions. The budget for individual tasks is noted below in parentheses.

### ***Approach to Evaluation and Synthesis of Existing Studies***

**Task 1: Project Scoping and Meetings (\$75,000)**—Scoping activities include initial document compilation and review; meetings and discussions with ADEC staff, Trustee council members, and agency scientists; and identification of the different library resources, technical experts, and data/mapping sources to determine what available work on resource characterization, monitoring design, and restoration should be incorporated into this applied research. This scoping effort will ensure that work that has already been done is not repeated, and will serve to focus the work on those investigations and studies of greatest relevance to achieving the task objectives described above.

Meetings and other forms of communication are critical to the successful completion of this work, given the magnitude of work performed to date, the large number of parties involved both currently and historically, the decisions that need to be made regarding prioritizing activities, and the need to communicate the results of the various work efforts described here to trustee council members. It is assumed that a total of seven meetings will be held in Anchorage (two), Juneau (two), and Seattle (three).

**Task 2: Evaluate Lingering Oil Studies (\$55,000)**—Publications and reports by Jeff Short, Stanley Rice, and others will be reviewed to assess the strengths and weaknesses of the technical approach, statistical design and interpretation, and to characterize the inherent uncertainty of the technical findings regarding the presence, amount, and bioavailability of lingering oil. Related work and analyses performed by David Page, Paul Boehm, and others will also be evaluated. Additional research to refine the scientific understanding and/or reduce scientific uncertainties in the distribution and bioavailability of lingering oil may be warranted. Activities under this task include document review and data analysis, internal discussions, telephone conversations with the scientists conducting the studies, and development of the framework for any additional research tasks designed to refine scientific findings.

**Task 3: Evaluate and Synthesize Information on the Nature of Resource Injury and Recovery Status (\$304,000)**—Extensive investigation and research has been performed to characterize the overall health and degree of recovery of resources adversely affected

by the Exxon Valdez Oil Spill. Much of this work has been done by researchers focused on specific topics and areas of specific expertise and interest. Some of the conclusions of this research have been the subject of debate, largely between Trustee agency scientists and Exxon-funded investigators. It is widely acknowledged that stressors other than oil (e.g., overfishing, large scale shifts in weather or ocean circulation) contribute to delayed recovery or shifts in population, and it is critical that the impacts of these other types of stressors be fully considered during the evaluation of injury status and the link to EVO. In addition, the contributing or confounding role of contaminants other than EVO should be fully explored.

We propose to independently assess work performed related to the various factors affecting resources and habitat in Prince Williams Sound (and other areas affected by the oil spill), distill the information to the core technical arguments, and reassess the technical basis for the recovery status classification (recovering, not recovered, unknown). Existing studies will be identified, screened for relevance, integrated into the overall resource-specific analysis, and synthesized. This evaluation will involve reanalysis of existing data using statistical methods or other technical tools not previously applied, and mapping of information to provide a clear picture of inter-related conditions and information (habitat, presence of lingering oil, shoreline geomorphology). Meetings and conference calls will be held with the scientists that performed the work to better understand the technical approaches and unique resource and site-specific issues, and to perform the work in a cost-effective manner.

The seven resources that are currently classified as not recovering<sup>3</sup> and the twelve resource categories currently classified as recovering<sup>4</sup> are of highest priority. For the purpose of this cost estimate, it is assumed that six resource categories will require detailed evaluation and interpretation, four resource categories will need more limited analysis, and remaining resource categories will not be addressed.

Activities under this task include document review, data analysis, internal discussions, and communication with the scientists that performed the resource studies. The product of this task will be a balanced, technically rigorous classification of resources using a screening and classification process with well-defined criteria that relies on weight-of-evidence for final decisions. Key scientific uncertainties associated with the conclusions also will be fully characterized.

**Task 4: Evaluate Existing Data to Identify Areas of Concern (\$40,000)**—Information relevant to the identification of areas of concern will be identified, reviewed, and distilled to develop a map or series of maps of current shorelines, shoreline areas, adjacent water bodies, and sediment areas of concern due to lingering oil. This work will be closely coordinated with the agencies and scientists who have developed detailed maps of these properties and conditions. Areas of concern will be based on the best available and most current information, although historical shoreline characterizations dating back to the spill will be considered. Varying degrees of impairment will be characterized where

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<sup>3</sup> common loon, cormorants (3 spp.), harbor seal, harlequin duck, Pacific herring, pigeon guillemot

<sup>4</sup> clams, designated wilderness areas, intertidal communities, killer whales (AB pod), marbled murrelets, mussels, sea otter, sediments, recreation/tourism, commercial fishing, passive uses, subsistence

possible. Technical information that supports the classification will be summarized in tables and text for each water body/area of concern.

**Task 5: Develop a Long-term Monitoring and Management Plan (\$50,000)**—A monitoring plan will be developed that will assess the persistence and attenuation of lingering oil and provide regulatory decision-makers with the information needed to determine when water and sediment in areas of concern have achieved acceptable quality. The objectives and study elements of the long-term monitoring plan prepared under this task may overlap in some areas with the work being done by Jim Bodkin (Monitoring in the Nearshore—a Process for Making Reasoned Decisions) and Jeff Short (Development of a Strategy for Monitoring Exxon Valdez Oil and Other Contamination in Prince Williams Sound). This work will be closely coordinated with these and other researchers to distinguish similarities and differences and to identify if and when the complimentary efforts should be combined. It is assumed that the focus of this monitoring will be on residual oil in intertidal and subtidal sediments and pore waters, not surface water. The monitoring and management plan will emphasize monitoring tools that are routinely used and broadly accepted by the regulatory community. A decision process and specific decision criteria will be developed to determine when an affected water body can be determined to have achieved acceptable sediment quality.

**Task 6: Development of Restoration Options (\$80,000)**—If adverse effects associated with lingering oil are determined to be of sufficient concern, restoration alternatives will be developed and then evaluated to assess technological and ecological feasibility, efficacy, and implementation timeframe. The types of restoration activities likely to be explored during this task include 1) long-term monitoring of resources adversely affected by residual oil 2) supplemental studies of lingering oil and associated resources, 3) in-place treatment of residual oil, and 4) removal and disposal of contaminated media and associated habitat restoration. If it is determined that restoration options should be considered, cost-benefit criteria and an evaluation process will be developed and applied to candidate restoration alternatives. This task will draw on available cost-benefit evaluations developed by other regulatory entities. Restoration options will be evaluated using cost and benefit criteria to select the option that reflects a reasonable and appropriate balance.

**Task 7: Public Communication (\$46,000)**—Effective communication of the technical decisions made regarding lingering oil, resource recovery, and long-term monitoring in Prince Williams Sound and other areas affected by the spill will require preparation of a clear and well-defined message and understandable presentation material. This task encompasses the development and finalization of presentation material, which will include PowerPoint presentations, maps, and fact sheets. It is assumed that three presentations will be prepared under this subtask. Travel to Alaska is included in this cost estimate.

**Information Produced:** The following information will be produced:

- An analysis of the ecological significance of lingering oil, with recommendations for areas of additional study, if applicable

- An independent evaluation of the recovery status of injured resources, focusing on the resources of greatest ecological relevance and scientific debate
- A recommended process for achieving closure on the scientific and technical activities related directly to impacts from the Exxon Valdez Oil Spill, including criteria for focusing and refining future work on oil-affected resources
- A clear and understandable characterization of ongoing problems areas
- A long-term monitoring and management program for problems areas, using monitoring tools and a decision process widely accepted by the regulatory community
- Presentations to the Public.







**EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 2005 - September 30, 2006

<b>Contractual Costs:</b>		Proposed
Description		FY 2006
	Robert Spies (Applied Marine Sciences)	33,800.0
	Robert Spies Travel (Applied Marine Sciences)	7,500.0
	Dan Esler (Simon Fraser University)	3,800.0
	Dan Esler travel	3,000.0
	Craig Matkin (North Gulf Oceanic Society)	2,185.0
	Craig Matkin Travel	3,000.0
	Al Springer (University of Alaska)	10,560.0
	Al Springer travel	600.0
	Jim Harvey (Moss Landing Marine Laboratory)	9,120.0
	Jim Harvey travel	3,000.0
	<b>Contractual Total</b>	<b>\$76,565.0</b>
<b>Commodities Costs:</b>		
Description		
	Large Document Production and Copying and Misc. Project Purchases	5,885.0
	Integral Overhead (Direct Project Expenses)	16,704.0
	Subcontractor Burden	7,657.0
	<b>Commodities Total</b>	<b>\$30,246.0</b>

<b>FY06</b>	Project Number:
	Project Title: Information Synthesis and Recovery Recommendations for Resources and Services Injured by the Exxon Valdez Oil Spill Name: L. Jacobs, L. Williams, R. Pastorok, and D. Preziosi

FORM 4B  
Contractual &  
Commodities  
DETAIL

**EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**  
 October 1, 2005 - September 30, 2006

<b>New Equipment Purchases:</b>				<b>Proposed</b>
Description	Number of Units	Unit Price	Number of Units	FY 2006
No equipment will be purchased				0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.			<b>New Equipment Total</b>	<b>\$0.0</b>
<b>Existing Equipment Usage:</b>			Number of Units	
Description				
No equipment will be used				

**FY06**

Project Number:  
 Project Title:  
 Name:

**FORM 4B  
 Equipment  
 DETAIL**