DRAFT REPORT
TC 9214-03

LOWER COLUMBIA RIVER

BI-STATE PROGRAM

LOWER COLUMBIA RIVER PROBLEM AREA CONFIRMATION AND POLLUTANT SOURCE STUDIES

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1.0 INTRODUCTION

The Bi-State Lower Columbia River Water Quality Program was formed in 1990 at the direction of the legislatures from the states of Oregon and Washington. The states entered into an Interstate Agreement that directed the Bi-State Program to characterize water quality in the lower Columbia River, identify water quality problems, determine whether beneficial uses of the river are impaired, and develop solutions to problems identified in the river below Bonneville Dam (Bi-State Steering Committee 1990). Since the inception of the Bi-State Program, a number of studies have been conducted to help accomplish this legislative mandate. These studies have attempted to characterize historical and current contaminant levels in water, sediment, and a small number of fish species and crayfish throughout the river; quantify the amount and sources of pollutants entering the river; document beneficial uses of the river; provide recommendations on addressing human health concerns associated with beneficial uses of the river; and make recommendations concerning the storage, maintenance, and dissemination of data collected by the Bi-State Program.

The 1991 Reconnaissance Survey of the lower Columbia River identified several data gaps, sensitive areas, pollutant groups of concern, possible sources of contamination, and potential problem areas. Recommendations for future studies on each of these, as well as many other topics were made in the Task 7 report titled: Conclusions and Recommendations (Tetra Tech 1993a). The Bi-State Program identified a subset of these recommendations as priorities for further study. Among the top priorities were concerns associated with pollutant groups (either widespread or site specific), potential problem areas or hot spots, and possible sources of contamination. Additional reconnaissance/characterization of backwater depositional areas was also identified as a priority for future studies and a study on water, sediment, and tissue contaminant levels in backwater areas has been approved.

The goal of this work assignment is to provide additional data on specific problem areas, groups of pollutants, and probable sources of contaminant levels detected during the 1991 Reconnaissance Survey (Tetra Tech 1993b). There are multiple independent and overlapping objectives associated with each of the three areas listed above. At the direction of the Bi-State Program, these three study components have been combined into a single work assignment to take advantage of, and incorporate as many of the individual and overlapping objectives from each component into specific efforts, as possible.

As part of the 1991 reconnaissance survey, several potential problem areas were identified for each media (sediment, tissue, water) sampled. Although these areas of potential concern were located throughout the lower river, many of the sites were located in the more heavily industrialized stretch of river from Portland to downstream of Longview. Some of the areas that were sampled with elevated contaminant levels were confirmations of previously identified problem areas (e.g., St. Helens, Longview), while others were unknown prior to the reconnaissance survey (e.g., pesticides at Station E8). The new potential problem areas need to be further documented and confirmed by additional sampling and the confirmed areas need to be further delineated to determine the extent of the contamination.

In addition, several groups of pollutants were identified during the reconnaissance survey as being of concern. Like the potential problem areas, these pollutant groups were either widespread throughout the lower river (e.g., PCBs in tissue) or they were restricted to a few isolated locations but their concentrations were high enough to be of concern (e.g., semivolatiles in carp at Station D29). Pollutant groups of concern were identified for each media sampled. The pollutants identified for water samples (e.g., bacteria, metals, AOX) were very different from those identified for tissue and sediments (e.g., dioxins/furans, DDT and derivatives). Pollutant groups for water have already been further investigated through other studies funded by the Bi-State Program (e.g., the EILS bacteria study, the backwater reconnaissance survey), therefore, pollutant groups in water are not addressed further in this work assignment, rather, the focus of this work is on the sediment and tissue.

Evaluation of pollutant groups and problem area confirmation/hot spot evaluation may also address the question of the pollutant sources. Sources of pollution generally fall into two categories, point or nonpoint sources. Point sources of pollutants are effluent discharges from outfalls or pipes whereas, nonpoint sources tend to be more diffuse and do not tend to be concentrated at a single point. These two pollutant source categories require two different methods of evaluation. Point sources can be evaluated by systematically tracking the contaminant from downstream areas upstream until arriving at the source. A final effluent "fingerprinting" analysis may be performed to confirm the tracking conclusions. Nonpoint sources of pollution are more problematic to evaluate because the systematic approach to tracking is not appropriate. Instead, a much broader evaluation of contaminant usage in the drainage basin is a more typical approach to evaluating potential nonpoint source pollutants.

This work plan discusses each of these study components and suggests specific projects that address both individual and overlapping objectives. Several field sampling efforts are recommended, as is a literature review and usage survey to address the nonpoint source issues. Individual costs for each recommended study are provided.

2.0 STUDY PURPOSE

The goal of this work assignment is to provide additional data on specific problem areas, groups of pollutants, and probable sources of contaminants detected during the 1991 Reconnaissance Survey (Tetra Tech 1993b) to assist the Bi-State Program in characterizing water quality problems in the lower Columbia River. The objectives of the work assignment are to:

- Perform studies that address and integrate evaluation of problem area confirmation, pollutant groups, and pollutant sources

- Perform specific or focused studies on one or two of the study components (e.g., nonpoint pollutant sources) that will extend the information obtained in the reconnaissance survey or identify water quality problems

- Address as many of the priority issues (as identified by Tetra Tech 1993a) as possible in a cost efficient study design.

To accomplish these objectives, the Work Assignment is divided into several tasks:

- Work Plan Development (this document)
- St. Helen's Hot Spot Delineation/Source Tracking Study
- Kalama Problem Area Confirmation/Source Identification Study
- Station D29 Problem Area Confirmation
- Longview Problem Area Confirmation
- Pesticide Use Survey
- Project/Work Assignment Management.

The specific activities involved in each of these tasks will be discussed in the following sections.

3.0 STUDY APPROACH

The work assignment objectives listed in Section 2.0 will be met through the study approaches outlined below. The proposed work assignment approach includes the development of a work plan; the identification of individual studies to be performed with descriptions of the rationale for each study, the sampling and QA/QC plans (if appropriate), anticipated methods, and brief descriptions of anticipated deliverables; descriptions of project management responsibilities; anticipated schedules, deliverables, and costs.

3.1 TECHNICAL APPROACH AND RATIONALE

As part of the 1991 reconnaissance survey potential problem areas, pollutant groups of concern and probable pollutant sources were identified and prioritized by media (i.e., sediment and tissue) for future study. Each of these components is discussed in the following sections.

3.1.1 Problem Area Confirmation

The highest priority for further study recommended by Tetra Tech (1993a) was to conduct sampling to confirm and better define identified problem areas. The identification of putative problem areas in the river was based on collection and analysis of widely spaced, single samples. Designation of some of the sampled stations as problem areas needs to be confirmed by further sampling in the same locations. The areal extent and variation in contamination around the putative problem areas also needs to be investigated by replicated sampling. These studies are a logical follow on step to accomplishing the Bi-State Program's goal of identifying and characterizing problem areas in the river. The areas represented by the following stations were recommended for problem confirmation sampling.

<u>Sediment</u>

D24 (St. Helens): Highest rank for dioxins/furans and organotins, high ranks for pesticides and PAHs; moderate ranks for metals

E9 (Below St. Helens):	High ranks for pesticides and PAHs; moderate ranks for metals
D35 (Camas):	High ranks for metals and pesticides; moderate-low ranks for dioxins/furans
D22 (Kalama):	High ranks for metals and organotins; low-moderate ranks for PAHs and pesticides
E8 (Kalama Grain Terminal):	Highest ranks for pesticides; low-moderate for PAHs low ranks for metals
D19 (Longview):	High ranks for PAHs and organotins; low ranks for pesticides, metals, and dioxins/furans
D6 (Grays Bay):	Highest metals rank; low ranks for other groups.

Other sediment stations of concern include: D9 (Skamokawa), D2 (Ilwaco), D16 (Coal Creek Slough), D12 (Cathlamet), and D1 (Hammond, OR).

As part of Backwater Survey, resampling in Camas Slough (D35), and Elochoman Slough (near Stations D9 and D12) will occur for the entire suite of chemicals identified for that survey.

Tissue

D28 (Sauvie Island):	Metals, PCBs, dioxins/furans (crayfish, largescale sucker, and carp)
D38 (Reed Island):	Metals, PCBs, dioxins/furans
D19 (Longview):	Dioxins/furans
D10 (Clifton Channel):	PCBs, dioxins/furans (crayfish, largescale sucker)

D40 (Beacon Rock): Metals, dioxins/furans

D24 (St. Helens): Pesticides, dioxins/furans (peamouth)

D29 (Vancouver Lake flushing channel): Semivolatile organics, PCBs, (carp)

D3 (Astoria): Pesticides, PCBs, (peamouth)

None of these areas are being resampled as part of the backwater survey.

The tissue station rankings reflect equal weighting for all pollutant groups (e.g., metals = dioxins = pesticides = PAHs = PCBs etc.). Many of the stations with high metals concentrations are ranked as high, whereas if station ranks would have been selected based on weighted pollutant groups (e.g., toxicity), a different suite and ranking of tissue stations would have been identified.

Two types of problem areas were identified in the 1991 reconnaissance survey; those involving problem confirmation and those involving hot spot delineation. Problem confirmation is where additional sampling needs to occur to verify/confirm that the concentrations detected in 1991 are valid because they were based on a single unreplicated sample. An example of an area requiring confirmation is the high levels of semivolatile organics that were detected in the tissue of a single species at Station D29. These compounds were not detected in sediments or other species at this location, however, the levels in carp were high enough to be of concern.

The other type of study is where a location definitely has problems but the total extent or likely sources are not known. An example problem area of this type is the St. Helens area. It appears to be the worst location on the river and although a potential source appears obvious, source tracking through effluent/sediment/tissue fingerprinting has not been conducted. NPDES monitoring data indicate that the primary source effluent "fingerprint" does not provide a great match up with the sediment or tissue data. In addition, the areal extent of contamination has not been conducted.

3.1.2 Pollutant Groups of Concern

As part of the 1991 reconnaissance survey conclusions and recommendations report, groups of pollutants were identified for each media that were potential water quality problems in the lower Columbia River. The identification of these pollutants was based on the frequency of detection of chemicals and parameters, and the frequency of exceedance of effects-based reference values for these chemicals and parameters, without regard to measurements at specific locations. The following chemical groups/parameters were identified as problems for the lower Columbia River.

Water

1. Bacteria
2. Metals
3. Temperature
4. Dissolved Oxygen
5. AOX (potential)

Sediment

1. Dioxins and Furans
2. Organotins
3. DDT and derivatives, BHC, methyl parathion
4. Metals (selected chemicals and locations)

Tissue

1. Dioxins and Furans
2. PCBs
3. DDT and derivatives

Problem pollutants associated with water are being addressed adequately in other studies (i.e, separate bacteria study, the backwater survey) and are not considered further here.

The data collection activities associated with the backwater survey are addressing all these priority groups in each media, as well as the other groups analyzed during the 1991 reconnaissance survey, at all 15 locations. Thus, all of these groups will be addressed in additional areas throughout the river. However, some of these groups were widespread (e.g., dioxins/furans) while others were restricted to specific locations or media (e.g., PCBs) and should be investigated further.

Overall, pesticides did not appear to be of major concern in the river. However, certain pesticides, primarily DDT and its derivatives, appear to be particularly widespread and of concern regarding potential health effects. Although the manufacture and use of DDT and its derivatives has been banned, some trace amounts of it continue to be present in two common pesticides (dicofol and chlorobenzilate). This may account for its consistent detection and wide distribution in many environmental samples. Thus, additional sampling of DDT and its derivatives should be conducted to better characterize the distribution of these compounds and the potential health risk posed by them.

Although PCBs were not detected in water column samples and only detected at one station in sediments, they were widespread in most tissues sampled. Additional sampling and analysis of PCBs is recommended as part of this work assignment.

Polychlorinated biphenyls (PCBs) include a total of 209 industrially produced congeners. The toxicity of individual congeners depends on the degree of chlorination (1 to 10 chlorine atoms) and the position of the chlorine atoms on the biphenyl structure (i.e., two benzene rings joined by a single bond). PCB congeners were produced commercially in the U.S. between 1929 and 1977 as complex formulations of a mixture of congeners for a variety of applications that included:

- Fluorescent lighting fixtures
- Electrical transformers and capacitors
- Heat transfer and hydraulic systems
- Plasticizers
- Paints
- Sealants
- Protective surface coatings for wood
- Inks
- De-dusting agents
- Adhesives
- Pesticide extenders

- Carbonless copy paper
- Slide mounting medium for microscopes
- Lubricating and cutting oils

Each commercial formulation contained as many as 40 to 70 individual PCB congeners. PCBs also occur as incidental contaminants in the manufacture of chlorinated benzenes, solvents, alkanes, chlorophenylsiloxane adhesives, organosilicone drugs, and pigments. There are no known natural sources of PCBs.

Although the discharge and manufacture of PCBs has been banned and the use of PCB-containing material already in use has been restricted since 1977, PCBs are extremely persistent contaminants (one of the primary reasons for their wide commercial use) and have entered the environment directly from municipal and industrial effluents, accidental spills and leaks, and indirectly as a by-product of municipal wastewater chlorination and through incomplete combustion of chlorinated organic compounds and transformer fires.

Commercial production of PCBs resulted in products that were a mixture of congeners marketed as Aroclors by Monsanto Corporation. Aroclor mixtures were classified using a four digit number. The first two digits indicate that the parent molecule is biphenyl (i.e., 12), or terphenyl (44 or 54), and the last two digits indicate the chlorine content by weight percent (except Aroclor 1016 which is similar to Aroclor 1241 (i.e., mono- through hexa-chlorinated homologs with average chlorine content of 41 percent). For example, Aroclor 1254 is approximately 54 percent chlorine by weight. The percent chlorine substitution depended on the contact time in chlorination chamber during the production process and resulted in variable formulations as well as contamination, especially by poly-chlorinated dibenzofurans (PCDFs) and chlorinated naphthalenes. This was especially true for Aroclors 1254 and 1260.

The analytical methods generally used to quantitate PCBs identify Aroclor formulations and not individual PCB congeners. The determination of Aroclor concentrations in environmental samples is difficult and may result in significantly different responses from different laboratories, even though the analytical procedures are standardized. Also, survival of Aroclors intact in sediment and tissue matrices may not occur due to chemical weathering, photolysis, and biological transformation of individual congeners. The disadvantages of only measuring Aroclor formulations are:

- Aroclors in environmental samples are difficult to identify because of variation in the persistence, solubility, and adsorption characteristics of individual congeners which tend to obscure the original signature of the individual Aroclor formulations.

- Variations occurred among different commercial batches of Aroclors which make unequivocal characterization of environmental samples more difficult.

- Presence of combinations of Aroclor mixtures may also make identification of Aroclors in environmental samples difficult.

- Aroclor formulation concentrations can not be used in the application of sediment-water equilibrium partitioning theory because octanol-water partitioning coefficients vary widely among individual congeners.

- No data are provided on the potential toxicity of the Aroclor formulation identified because the toxicity of the sample depends on the relative contribution of only a few of the most potently toxic congeners whose individual concentrations are not known.

A relatively more exact method (EPA Method 680) has been developed for the identification of selected individual congeners. The application of high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) can provide the resolution and specificity to identify a total of 12 individual coplaner (IUPAC Nos. 77, 81, 126, 169) and mono-ortho coplaner (IUPAC Nos. 105, 114, 118, 123, 156, 157, 167 189) PCB congeners. These compounds are considered to be the most dioxin-like in their toxic effects and potency and are the compounds for which toxicity equivalency factors (TEFs) have been recommended (U.S. EPA 1991). Recommended TEFs for these dioxin-like compounds show relatively good agreement between TEF-estimated toxicity and laboratory toxicity tests for Aroclors 1254 and 1260 which have been measured in lower Columbia River sediments. The TEFs for these PCB congeners will allow for an assessment of the relative contribution of toxicity from these PCB congeners and dioxin compounds measured in environmental samples.

Although the potential toxic effects of the remaining PCB congeners is less well known and also warrants additional research, the available toxicological data and analytical methods are not sufficient to warrant an attempt to measure all 209 PCB congeners in lower Columbia River sediments and animal tissues. Therefore, the present study proposes the analysis of the 12 coplaner and mono-ortho coplaner compounds.

Measuring the individual congeners rather than the aroclors will assist in identifying the specific toxicities of the detected PCBs. Thus, we recommend the use of cutting edge technology and high resolution analytical techniques for measuring these compounds at most, if not all, locations where PCBs are measured.

3.1.3 Pollutant Sources

Two of the studies that were recommended in the 1991 reconnaissance survey report (Tetra Tech 1993a) are listed below:

- **Conduct source-tracking studies near high priority problem areas. Sample along transects. Additional sampling of suspect effluent. Chemical "fingerprinting" for compounds with isomers, such as dioxins/furans and PCBs.**

  Once a potential problem area has been identified or confirmed, the question of the source of the contamination is raised. Studies to locate or track the source of the contamination are necessary. These studies consist of systematic sampling that provides increased resolution of potential locations or sources of contaminants. For example, if a problem area was identified below a tributary then the first step would be to take samples above the tributary. If no contamination was found above, then sampling would begin in the tributary above the first point source or subtributary. This type of source-tracking would continue until an area or a point source of contamination could be identified. Additional sampling of the suspect effluent for specific compounds or "fingerprints" would occur to confirm the identification of an area or point source.

- **Characterize the types and amounts of pollutants generated by various industries. Inventory use of pesticides and other toxic chemicals in the basin.**

  This recommendation is presented because of the importance of identifying linkages between types of contaminants measured in the river and their potential sources. Information about industrial chemicals, pesticides, and other toxic chemicals used in the basin will provide fundamental source information about trends observed during the reconnaissance survey. This information can also help identify the relative importance of point and nonpoint sources in contributing to contaminants detected in other studies of water, sediment, or tissue. Finally, it may provide information on potential future problems in the river, based upon increases in certain types of waste inputs.

Based on the preceding discussion, five studies are identified that will be conducted under this work assignment. The number of studies, and the possible range of studies, could be greatly expanded but the identified studies have tried to combine as many of these ideas and recommendations as possible into a few selected studies. Each study will be discussed below.

3.2 WORK PLAN DEVELOPMENT

The first task for the Work Assignment is the development of a work plan that addresses the Bi-State Program objectives for this task and the approach Tetra Tech will take to accomplish those objectives. The work plan (this document) describes the general approach and methodology that will be used to accomplish the work, and provides a schedule, list of deliverables, and cost estimate for this Work Assignment. Specific details of methodologies and QA/QC procedures to be used will be described in individual deliverables for each proposed study.

3.3 ST. HELENS HOT SPOT DELINEATION/SOURCE TRACKING STUDY

The 1991 Reconnaissance Survey of the Lower Columbia River (Tetra Tech 1993a,b) indicated that the St. Helens area had high concentrations of several compounds (e.g., dioxins/furans, PAHs, PCBs, DDE) in sediments and tissue. This area was the most impacted of the areas identified in the reconnaissance survey and is influenced by the discharge from a pulp and paper mill and the Multnomah Channel. Thus, this area is a known hot spot, but the extent of contamination is unknown and there is some question as to the sources of all the compounds detected at this site.

3.3.1 Objectives

There are two major objectives for this task. The first major objective is to document the extent of the contamination in the St. Helens area mainly by sampling sediments, crayfish, and largescale suckers. The second major objective is to perform additional source evaluation/tracking of the multiple contaminants found here. The study will establish a grid around the St. Helens area and select multiple samples throughout the grid to define the extent of contaminant problems. Data collected as part of NPDES monitoring will be used as additional data (providing replicated data) to further determine the extent of contamination. Analysis of the effluent fingerprint from the pulp mill and the Multnomah Channel will be used to evaluate effluent-sediment and effluent-tissue correlations.

3.3.2 Methods

A sampling and QA/QC plan will be developed and will provide details on how the sampling and analysis procedures will be conducted for the field and laboratory efforts. It will also discuss the details of the QA/QC procedures that will be used to ensure that the data collected during the reconnaissance survey meet the objectives of the Bi-State Program.

3.3.2.1 Sampling and Analysis. The Sampling and Analysis portion of the document will incorporate the results of the final selection of sampling sites, sampling media, and target analytes and provide detailed information on the following:

- The final sampling locations selected to be sampled throughout the grid area
- The media to be sampled at each station (i.e., sediments and tissues of aquatic organisms)
- The target aquatic organisms to be sampled for tissue analysis (and any alternate species)
- The analytes to be targeted for analysis in each medium
- The sampling methods to be used for each medium
- The field and/or laboratory analytical methods to be used for each medium
- The number and type of quality control (QC) samples to be collected for each medium
- The statistical methods, criteria, and/or guidance levels to be used to evaluate the data.

Brief details for each of the above bullets are provided in the following sections.

Selection of Sampling Sites. Ten stations will be located throughout the sampling grid, three replicate samples will be collected at five of the stations. Since few data are available on the sediment grain sizes to be expected throughout the grid area selected for sampling, the Sampling Plan will also outline the field sampling protocols to be followed in determining whether or not suitable fine-grained sediment and the target aquatic species are available at the selected location and the protocols to follow in the event that suitable sediment and/or target aquatic species are not available at the primary sampling location selected.

Selection of Media to be Sampled. Samples will be collected from the sediments and tissues of aquatic species collected at each of the sampling sites. Bulk sediment analyses are proposed for the sediment samples collected and whole-organism analyses are proposed for the target aquatic species collected. Analytes to be collected for each of the different media are given below.

Selection of Target Aquatic Species for Tissue Analysis. Two target aquatic species, crayfish and largescale suckers, will be collected and analyzed as part of this survey. These species will be collected at each of the sampling stations. Both of these species were also collected in the 1991 reconnaissance survey (Tetra Tech 1993b). Composites of whole organisms will be analyzed for these two species. Three replicate samples at five stations for both species will be analyzed. Alternate species for sampling in the event that one or both of the target species are not available at a selected sampling location will be, in order of preference, carp, peamouth, and northern squawfish. Rationale for these alternate species will be discussed in the Sampling Plan. The Sampling Plan will also include protocols for determining when to use an alternate species because a target species cannot be obtained.

Selection of Analytes for Each Medium. The specific list of analytes proposed for each of the media will be presented in the Sampling Plan. The list of analytes may be reduced from the 1991 analyte list to account for entire groups of undetected compounds, however, because of the widespread contamination in this area, the analyte list may look very similar to the 1991 list for each media. Key analytes will be dioxins and furans, PAHs, pesticides, organotins, and metals in sediments and dioxins and furans, pesticides, and individual congeners of PCBs (see discussion in Section 3.1). Inclusion of toxicity testing, using established protocols, for sediment samples is proposed. The use of sediment bioassays to determine sediment toxicity is a commonly used technique in marine, estuarine, and freshwater sediments. This technique is included in this study because it will provide a direct measure of sediment quality (i.e., biological response); the results may assist in interpreting the sediment contaminant concentrations detected at each location, particularly in the absence of sediment quality reference values; and it was an indicator that was recommended based on the 1991 reconnaissance survey results.

Selection of Sampling Methods for Each Medium. The Sampling Plan will specify the field and laboratory sampling methods for the collection and preparation of sediment and tissues samples. A research vessel will be used for sediment and crayfish sampling. A 0.1-m^2 van Veen grab sampler will be used to collect fine-grained sediments. Each sample will consist of a composite of the top 2 cm of sediment from four or more individual grab samples at a particular station. Crayfish will be collected using submerged and baited traps. Largescale suckers will be collected using a shallow-draft vessel equipped for electrofishing. A detailed description of the sampling methods to be employed in this study will be provided in the Sampling Plan.

Selection of Analytical Methods for Each Medium. The analytical method to be used for each analytical group is presented in Table 1. Modifications of any referenced method will be described in the Sampling and QA/QC Plan. In addition to identification of the method to be used, target quantitation limits are also specified in Table 1.

Quality Control Samples for Each Medium. The number and type of QC samples to be analyzed for each analytical group and medium is given in Table 1. In addition to QC samples generated by the laboratory (i.e., method blanks, laboratory duplicates, matrix spike/matrix spike duplicates), field replicates and standard reference materials (where available) will be submitted to the laboratories.

Statistical Methods, Criteria, and Guidance Levels for Data Evaluation. The Sampling and QA/QC Plan will provide a description of the statistical methods to be used in data reduction and analysis (e.g., how detection limits will be handled in data reduction and statistical calculations). The plan will also include the criteria and/or guidance levels to be used to evaluate the environmental significance of the data. The potential negative effects of the measured contaminant levels on aquatic organisms, terrestrial wildlife, and humans will be made based on comparison to these criteria and guidelines. Sediment contaminant data will be evaluated based on the Washington Marine Sediment Quality Standards (WAC 173-204-315), the effects-range low concentrations of Long and Morgan (1990), and the Ontario's freshwater Provincial Sediment Quality Guidelines (Persaud et al. 1991). The aquatic organism tissue concentrations will be evaluated using the New York State fish flesh guidelines (Newell et al. 1987).

3.3.3 Quality Assurance/Quality Control (QA/QC)

The remainder of the document will describe the field and laboratory sampling and analysis procedures to be followed to ensure timely detection of data quality problems and quick implementation of corrective actions to ensure that the data produced for this work assignment are of high quality. Included will be

TABLE 1. ANALYTICAL METHODS, QUANTITATION LIMIT OBJECTIVES, AND QC SAMPLES TO BE COLLECTED FOR THE ST. HELENS HOT SPOT DELINEATION STUDY (Page 1 of 2)

Analytical Group	Method	Matrix	Quantitation Limit	QC Samples
Semivolatiles	EPA 8270 (GC/MS; SIM for PAHs)	Sediment	3-200 μg/kg (dry)	Method blanks, 5 sets of 3 Field replicates, MS/MSD, SRM
		Tissue	15-1000 μg/kg (wet)	Method blank, 5 sets of 3 Field replicates, 2 MS/MSD, SRM
Pesticides/PCBs	EPA 8081 (GC/ECD)	Sediment	0.05-2 μg/kg (dry)	Method blank, 5 sets of 3 Field replicates, MS/MSD, SRM
		Tissue	0.25-10 μg/kg (wet)	Method blank, 5 sets of 3 Field replicates, 2 MS/MSD, SRM
Dioxins/Furans	EPA 1613; EPA 8290 (Prep., Extraction)	Sediment	1-10 pg/g	Method blank, 5 sets of 3 Field replicates, MS/MSD, SRM
		Tissue	1-10 pg/g	Method blank, 5 sets of 3 Field replicates, 2 MS/MSD, SRM
Metals	ICP, GFAA, CVAA (Total Recov. Digest. for sed., tiss.)	Sediment	0.1-10 mg/kg (dry)	Lab duplicate, 5 sets of Field replicates, Method blank, MS, SRM
		Tissue	0.0004-0.4 mg/kg (wet)	2 Lab duplicates, 5 sets of 3 Field replicates, Method blank, 2 MS, SRM

TABLE 1. ANALYTICAL METHODS, QUANTITATION LIMIT OBJECTIVES, AND QC SAMPLES TO BE COLLECTED FOR THE ST. HELENS HOT SPOT DELINEATION STUDY (Page 2 of 2)

Analytical Group	Method	Matrix	Quantitation Limit	QC Samples
TBT	Uhler et al. (1989) (GC/FPD)	Sediment	4 µg/kg (dry)	Method blank, 5 sets of 3 Field replicates, MS/MSD
		Tissue	4 µg/kg (dry)	Method blank, 5 sets of 3 Field replicates, 2 MS/MSD
Grain Size	PSEP	Sediment	0.0001 g	5 sets of 3 Field replicates, Lab triplicate
Total Sulfides	PSEP	Sediment	20 mg/kg	Method blank, 5 sets of 3 Field replicates, Lab duplicate
Cyanide	SM 4500CN E	Sediment	0.5 mg/kg	Method blank, 5 sets of 3 Field replicates, Lab duplicate
Organic Carbon (TOC, DOC, POC)	SM 5310.C	Sediment (TOC)	200 mg/kg	Method blank, 5 sets of 3 Field replicates, MS/MSD
TVS	PSEP	Sediment	0.01%	5 sets of 3 Field replicates, Lab duplicate
Total Solids (moisture)	PSEP	Sediment	0.01%	5 sets of 3 Field replicates, Lab duplicate

a discussion of the protocols to be used for laboratory oversight and procedures for what will occur if problems with the data are encountered.

In general, the QA/QC portion of the Sampling and QA/PC Plan will specify and provide the appropriate reference and any modifications to the methods to be followed in the analysis of both field and laboratory samples. For laboratory analyses this will include the requirements established for the U.S. Environmental Protection Agency's Contract Laboratory Program (CLP) guidelines for data validation (U.S. EPA 1991; 1988a,b). This document will specify sample containers and sample volumes, holding time limits for sample analysis, the frequency and number of method blank analyses, frequency of calibration and analysis of check standards, the frequency and number of analyses of matrix spike and matrix spike duplicates, the frequency of laboratory duplicate analysis, the analysis of available standard reference materials, and the number and frequency of field replicate analyses. The QA/QC sections will be prepared in accordance with guidelines provided by the Washington State Department of Ecology (1991).

3.3.4 Field Sampling Effort

The field sampling effort will be carried out according to the instructions provided in the Sampling and QA/QC Plan. A brief description of the proposed field sampling effort for each medium is provided below.

3.3.4.1 Field Sampling of Sediment. Field sampling of sediment is to be conducted with a 0.1-m^2 van Veen grab sampler deployed from a research vessel. The vessel will be equipped with a winch and davit system which will facilitate the retrieval of the grab sampler. Sediment will be collected from the top 2 cm of each acceptable grab sample. A composite sediment sample consisting of at least four acceptable grab samples will be collected from each of the selected sediment sampling locations. The sediment to be used for sediment bioassays will be collected from the same composite sample as the sediment chemistry samples.

3.3.4.2 Field Sampling of Tissue. Two sampling events will be undertaken to collect tissue samples. Crayfish will be collected using baited traps deployed from a vessel. The sampling location will be as close as possible to the sediment sampling location, so that an attempt can be made to correlate sediment contaminant concentration with crayfish contaminant concentrations. As many as 10 traps will be deployed at a particular station on one day and retrieved the following day. If an insufficient number of crayfish are caught, the traps will be redeployed, possibly at a slightly different location.

Largescale suckers will be collected using a shallow-draft vessel equipped for electrofishing. Because these fish are not expected to remain in one location throughout their life, the sampling locations will be fewer in number and will typically be in slightly deeper and faster water than the sediment sampling locations. A single "station" may extend as much as one kilometer along the river bank.

3.3.5 Data Validation Report

The quality assurance/quality control data collected during field and laboratory analysis for the samples will be reviewed to determine the validity of the data reported. Data will be evaluated for precision and accuracy. QA/QC data will be compared to established control limits to identify the need for the qualification of any data. As part of this report, data tables will be prepared which will include all of the analytical data with any applicable data qualifiers added.

3.3.6 Deliverables

The following deliverables will be produced as part of this study. A short description of each product is presented below. All deliverables, except the monthly reports, will be submitted in draft and final form.

1. **Sampling and QA/QC Plan.** This report will identify the locations to be sampled; analytes to be measured in each media; contain a detailed description of the protocols to be followed in the field to identify and sample the sampling locations; the field sampling and analysis techniques to be used, and the laboratory analytical methods and target detection limits to be achieved for this work assignment. In addition, this report will provide a detailed outline of the QA/QC procedures that will be performed to ensure that the data produced for this work assignment are of high quality.

2. **Data Validation Report.** This report will evaluate the quality of the data produced based on the QA/QC data provided by the field and laboratory analysis results. Data will be qualified based on comparison to criteria and guidance provided or referenced in the Sampling and QA/QC Plan.

3. **Hot Spot Delineation/Source-Tracking Report.** This report will provide a brief summary of the results of the data validation report and identify relevant data qualifiers if necessary. The reader will be referred to the Data Validation Report for more detailed information regarding the validation of the data. The report will also summarize the study results in tabular and graphical form and compare the data to the criteria and guidance values adopted for the study. Based on these comparisons, an assessment of the potential adverse effects to aquatic organisms and terrestrial wildlife will be made. The results of the study will be compared to the 1991 reconnaissance survey results and the NPDES monitoring results to provide an indication of the degree to which these indicate more serious environmental problems relative to the 1991 survey. Finally, suggestions about future sampling that should be performed will be made.

3.4 KALAMA PROBLEM AREA CONFIRMATION/SOURCE IDENTIFICATION STUDY

This study involves the confirmation of the pesticides and PAHs found at coarse-grained Station E8, located just below a large grain terminal at the Port of Kalama. This station is unique in that the station is not in a depositional area, but yet has the highest concentration of pesticides in the river. Clearly, additional sampling to confirm the concentrations, as well as to determine the extent of the impacted area is warranted. This study will also serve double purposes, as a problem confirmation study and source identification.

3.4.1 Objectives

There are two primary objectives to be addressed in this study. First, to confirm/verify the high pesticide and PAH concentrations detected during the 1991 reconnaissance survey at this location. The second objective is to perform sediment sampling on transects above and below the grain terminal to try and identify the terminal as the source of the pesticide concentrations.

3.4.2 Methods

A sampling and QA/QC plan will be developed and will provide details on how the sampling and analysis procedures will be conducted for the field and laboratory efforts. It will also discuss the details of the

QA/QC procedures that will be used to ensure that the data collected during the reconnaissance survey meet the objectives of the Bi-State Program.

In general, the same protocols as identified for the St. Helens study will be utilized for this study and they will not be repeated here (see Sections 3.3.2-3.3.5). This study is a much smaller scale study than St. Helens. Only sediment concentrations of a limited suite of compounds (i.e., pesticides and PAHs) will be measured at six stations. Three replicate composite samples will be analyzed at each of the six stations. One station will reoccupy the 1991 station, two additional stations will be located further downriver, one station will be located directly in front of the terminal, and two stations will be located upriver of the terminal along a transect just inshore of the outer terminal pier. No tissue sampling is proposed for this location at this time. However, tissue sampling may be recommended depending on the results of the problem confirmation process.

All other procedures, processes and deliverables will be the same as that proposed in Section 3.3, with the exceptions noted above.

3.5 STATION D29 PROBLEM AREA CONFIRMATION STUDY

Problem area confirmation study of carp tissue concentrations of semivolatiles organics and PCBs at Station D29, located near the Vancouver Lake flushing channel. The results at this station were unique in that this was the only station and the only species where the semivolatile organics were detected. Some of the concentrations exceeded the effects-based levels of concern. This study will include resampling of carp, as well as another species (i.e., largescale sucker) to determine if the detected concentrations can be verified and if they are limited to one species. The study will also collect samples from two additional sites located above and below Station D29 to provide some preliminary information on possible sources.

3.5.1 Objectives

The primary objective of this study is to confirm the results of the tissue analysis found at Station D29 during the 1991 reconnaissance survey. A secondary objective of the study is to determine if a second fish species also shows high levels of semivolatile organics at this location. A final objective is to collect some preliminary data that may put boundaries on the source(s) on the contaminants by adding additional sampling sites up and down river from Station D29.

3.5.2 Methods

A sampling and QA/QC plan will be developed and will provide details on how the sampling and analysis procedures will be conducted for the field and laboratory efforts. It will also discuss the details of the QA/QC procedures that will be used to ensure that the data collected during the reconnaissance survey meet the objectives of the Bi-State Program.

In general, the same protocols as identified for the tissue portions of the St. Helens study will be utilized for this study and they will not be repeated here (see Sections 3.3.2-3.3.5). This study is a much smaller scale study than St. Helens. Only tissue concentrations of a limited suite of compounds (i.e., semivolatile organics and individual PCB congeners) will be measured at three stations. All stations and species will have three replicate samples. One station will reoccupy 1991 Station D29, one station will be located further downriver, and one station will be located upriver of the flushing channel. No sediment sampling is proposed for this location at this time. However, sediment sampling may be recommended depending on the results of the problem confirmation process.

All other procedures, processes and deliverables will be the same as that proposed in Section 3.3, with the exceptions noted above.

3.6 LONGVIEW PROBLEM AREA CONFIRMATION STUDY

The Longview area (Station D19) was identified by both the tissue and sediment rankings as being among the highest priority problem sites. The area was also identified as impaired based on historical data, as summarized in Tetra Tech (1992). Thus, this area of the river has been fairly well sampled and can be characterized as impaired. The 1991 reconnaissance survey listed PAHs, organotins, pesticides, metals, and dioxins/furans in sediment and dioxins/furans for tissues as the compounds of most concern. Longview is the location of a lot of industrial activities (aluminum smelter, wood products) so it is not surprising that it consistently is listed as an impaired area.

3.6.1 Objectives

The objectives of the Longview problem area/hot spot delineation are to further determine the extent of sediment and tissue contamination. Sampling stations will be located through the use of a grid technique similar to that described for the St. Helens area. Both sediment and tissue will be analyzed for a broad suite of compounds, although it will be fewer compounds than were analyzed during the 1991 reconnaissance survey. Because there are several industrial facilities located in this region of the river, a second objective may also be addressed by performing some effluent analyses ("fingerprint") and attempting to match individual point sources with sediment and or tissue concentrations. However, the cost for doing these analyses are not included as part of this work plan.

3.6.2 Methods

A sampling and QA/QC plan will be developed and will provide details on how the sampling and analysis procedures will be conducted for the field and laboratory efforts. It will also discuss the details of the QA/QC procedures that will be used to ensure that the data collected during the reconnaissance survey meet the objectives of the Bi-State Program.

In general, the same protocols as identified for the St. Helens study will be utilized for this study and they will not be repeated here (see Sections 3.3.2-3.3.5). This study is on a similar scale as that described for St. Helens. Both sediment and tissue concentrations of a broad suite of compounds (e.g., PAHs, dioxins/furans, pesticides, metals) will be measured at eight stations. At half of the stations, three replicate composite samples will be analyzed. No toxicity testing on sediments or individual PCB congener analyses are proposed for this study. These stations will be located in the Longview area using a grid system. Attempts will be made to sample sediment from locations of similar grain size distributions. One station will reoccupy 1991 Station D19, two additional station will be located further downriver, one station will be located directly below the Reynolds Aluminum facility outfall, two stations will be located upriver of the outfall along a transect parallel to shore, and two additional stations will be located along the shore of Lord Island. Tissue sampling will consist of two species (crayfish and largescale sucker) at each sediment station.

All other procedures, processes and deliverables will be the same as that proposed in Section 3.3, with the exceptions noted above. Individual tables of analytes and QA/QC samples will be provided in the Sampling and QA/QC plan.

3.7 PESTICIDE USE SURVEY

The 1991 Reconnaissance Survey of the Lower Columbia River (Tetra Tech 1993) indicated that certain pesticides (e.g., DDT and its metabolites, endrin, dieldrin) can be found in sediments and fish tissue throughout the study area. Many of these pesticides are toxic to freshwater organisms, and their active ingredients or degradation products may be highly persistent in the environment. The source of these pesticides, however, is largely undocumented. In order to determine the source of these pollutants, a pesticide use survey is proposed. Only by determining the source of these pesticides can actions be taken to minimize their potential adverse impacts to the Columbia River basin.

3.7.1 Objectives

There are two major objectives for this task. First, the amount and distribution of contemporary pesticides used in the Columbia River basin will be determined. The entire Columbia River Basin must be considered as one unit because of the long-lived nature of many of the pesticides in the aquatic environment. Persistent pesticides detected in the lower Columbia River may have been applied anywhere within the basin. Second, the potential for these pesticides to migrate to the aquatic environment and induce toxic effects on aquatic organisms will be assessed. This task will be accomplished by defining categories of pesticide uses, locating sources of available information, and surveying these sources to determine quantities of pesticides used on a county-wide basis. Information collated from a variety of sources will be used to characterize the environmental fate and toxicity of pesticides. Finally, a tiered scoring method, based on annual usage rates, and potential fate and toxicity in the aquatic environment, will be used to rank pesticides and to determine the level of concern for individual pesticides in the Columbia River basin.

The information from this task can be used to design future monitoring studies and will allow pesticide users and regulatory agencies to assess the environmental impact of various pesticide application strategies.

3.7.2 Methods

The methods to be used for the pesticide use survey are based on those used for a pesticide use survey for the Puget Sound basin (Tetra Tech 1988) with the addition of an interactive database.

A comprehensive assessment of pesticide use in the Columbia River basin has not been conducted previously. Only a few surveys have been performed, each one focusing on a specific group of pesticide users, such as the agricultural sector. In this task, usage of contemporary pesticides by all major groups of users will be estimated for 18 different user categories in each of the counties of the basin. These categories comprise major pesticide users in the basin and biocides of particular interest to the study of the Columbia River. The categories are identified as:

- Agriculture
- Federal agencies:
  - Department of the Army (Army)
  - Department of the Air Force (Air Force)
  - Department of Agriculture (USDA)
  - Department of Interior (USDI)
  - Department of Transportation (USDOT)
  - Department of Energy (DOE)
  - Army Corps of Engineers
- State agencies:
  - Washington Department of Natural Resources (WDNR)
  - Washington Department of Transportation (WDOT)
  - Washington Department of Wildlife (WDOW)
  - Oregon Department of Fish and Wildlife (ODFW)
- County Road Departments
- Urban:
  - Cities/school districts
  - Commercial applicators
  - Private households
- Private timber companies
- Railways

Usage estimates for pesticides in the Columbia River basin will be compiled for each of these user categories by the following methods:

- Abstraction from published surveys of pesticide usage in Columbia River basin counties

- Telephone and letter surveys of current users in the basin

- Extrapolation from published sources of pesticide usage for the San Francisco Bay area. (These latter data are for urban pesticide usage only, and supplement data from limited surveys of local urban users.

Determination of the level of concern for contemporary pesticides identified in the pesticide use survey additionally involves characterization of their likely fate in the environment and toxicity to aquatic organisms. In general, the fate of most pesticides in the environment is dependent on their persistence in the soil and water their potential to migrate away from the site of application. Persistence and mobility are dependent on the physical and chemical properties of the pesticide and the physico-chemical and microbiological environment of the soil. Hence, soil residence time and half-life, hydrolysis half-life, photolysis half-life, and vapor pressure will be compiled as measures of persistence in the environment. Water solubility and soil adsorption (K_{oc}) will be summarized as indices of mobility potential. Measures of bioaccumulation potential are bioconcentration factors (BCFs) and, when BCFs are not available, octanol-water partition coefficients (log K_{ow}). Data will be similarly compiled on pesticide toxicities to freshwater and estuarine fish, and mammals.

The algorithm to determine the level of concern involves assigning threshold levels for each of these variables, based on U.S. EPA recommendations, that delimit the potential for pesticides to persist in the environment, migrate to aquatic systems, bioaccumulate, and pose a toxic threat to aquatic organisms. This algorithm will be implemented using an interactive database (Paradox). Each pesticide will be evaluated by these thresholds and for their level of usage in the basin. Pesticides will then be ranked using these evaluations, and assigned to one of four levels of concern for the Columbia River basin: primary, secondary, low, and uncertain. Those pesticides with high usage, high mobility, high persistence, and high acute toxicity will be assigned to the primary level of concern. Pesticides with lower mobility and/or persistence will be placed in the secondary or low level of concern. These pesticides include those with high toxicity that are of concern primarily during acute exposures. Those pesticides for which data are insufficient to evaluate are placed in the uncertain level. Pesticides will be further identified for their potential distribution among water, sediments, or biota of the basin, and with respect to concern for toxicity and fate of their identified metabolites.

All of the collected information (pesticide use survey results, environmental fate and toxicity parameters, and level of concern) will be entered into a interactive database (Paradox). This database will allow the user to identify specific information for a particular pesticide or region or a combination of the two. If additional information becomes available at a future date, it can easily be added to the database.

3.7.3 Report

The pesticide use survey report will include not only a summary of pesticide usage in the Columbia River basin, but will discuss the environmental fate and toxicity of these pesticides and determine a level of concern for each pesticide. Following these sections, ongoing research, sampling, and monitoring programs will be summarized. Information gaps in the database will be discussed. Finally, recommendations for a sampling strategy for Columbia River basin pesticides will be made.

4.0 DELIVERABLES

The following deliverables will be produced under this Work Assignment. A short description of each product is presented below. Three bound copies and one unbound copy of each deliverable will be submitted to Oregon DEQ and Washington DOE. All reports will be double-sided and produced on recycled paper. Final reports will include the following statement displayed prominently on the first inside page of the document:

> THIS DOCUMENT IS AVAILABLE IN ALTERNATIVE FORMAT (E.G., LARGE PRINT, BRAILLE) UPON REQUEST. PLEASE CONTACT EITHER ED SALE IN OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY'S PUBLIC AFFAIRS OFFICE AT (503) 229-5766 OR KURT HART IN WASHINGTON DEPARTMENT OF ECOLOGY'S PUBLIC AFFAIRS OFFICE AT (206) 459-6712 TO REQUEST AN ALTERNATE FORMAT.

All deliverables, except the monthly reports, will be submitted in draft and final form.

1. **Work Plan.** The work plan document includes a description of the scope, proposed methodology, schedule of work, cost estimate, and deliverables to be completed as part of this work assignment.

2. - **St. Helens Hot Spot Sampling and QA/QC Plan**
   - **Kalama Problem Area Confirmation Sampling and QA/QC Plan**
   - **Station D29 Problem Confirmation Sampling and QA/QC Plan**
   - **Longview Problem Area Delineation Sampling and QA/QC Plan.**

   These reports will identify the locations to be sampled; analytes to be measured in each media; contain a detailed description of the protocols to be followed in the field to identify and sample the sampling locations; the field sampling and analysis techniques to be used, and the laboratory analytical methods and target detection limits to be achieved for this work assignment. In addition, this report will provide a detailed outline of the QA/QC procedures that will be performed to ensure that the data produced for this work assignment are of high quality.

3. **Data Validation Reports for each study.** These reports will evaluate the quality of the data produced based on the QA/QC data provided by the field and laboratory analysis results. Data will be qualified based on comparison to criteria and guidance provided or referenced in the Sampling and QA/QC Plans.

4. - **St. Helens Hot Spot Study Report**
   - **Kalama Problem Area Confirmation Study Report**
   - **Station D29 Problem Area Confirmation Study Report**
   - **Longview Problem Area Delineation Study Report.**

   These reports will provide a brief summary of the results of the data validation report and identify relevant data qualifiers if necessary. The reader will be referred to the Data Validation Report for more detailed information regarding the validation of the data. The report will also summarize the study results in tabular and graphical form and compare the data to the criteria and guidance values adopted for the study. Based on these comparisons, an assessment of the potential adverse effects to aquatic organisms and terrestrial wildlife will be made. The results of the each study will be compared to the 1991 reconnaissance survey to provide an indication of the degree to which these study areas indicate more or less serious environmental problems relative to the 1991 survey. Finally, suggestions about future sampling that should be performed will be made.

5. **Pesticide Use Survey Report.** The pesticide use survey report will include summary of pesticide usage in the Columbia River basin, will discuss the environmental fate and toxicity of these pesticides, and determine a level of concern for each pesticide. Following these sections, ongoing research, sampling, and monitoring programs will be summarized. Information gaps in the database will be discussed. Finally, recommendations for a sampling strategy for Columbia River basin pesticides will be made.

6. **Monthly Reports.** Monthly reports will be prepared that summarize both the technical progress and the financial status of the project. Specifically, the reports will include, progress to date, problems encountered, and work to be completed in the next month. All deliverables will be listed with target and actual delivery dates. The financial information will include the individuals that worked on the project, their billing category and current and cumulative hours.

5.0 SCHEDULE

Item Number	Deliverables	Due Date to Bi-State Program	Comments Due to Tetra Tech
1	Draft Work Plan	June 23, 1993	July 15, 1993
2	Final Work Plan	July 30, 1993	
3-6	Draft Sampling/QA/QC Plan	August 1993	August 30, 1993
7-10	Final Sampling/QA/QC Plan	September 1993	
11-14	Draft Data Validation Report	December 1993	January 1994
15-18	Final Data Validation Report	February 1994	
19-22	Draft Survey Report	January 1994	February 1994
23-26	Final Survey Report	March 1994	
27	Draft Pesticide Use Survey Report	November 1993	December 1993
28	Final Pesticide Use Survey Report	January 1994	

6.0 STAFFING

The following personnel will carry out this Work Assignment.

Name	Description	Activities
Dr. Steve Ellis	Work Assignment Manager St. Helens Study Leader	Supervision, financial issues, study design, report preparation and review, technical support and work group presentations
Mr. Gary Braun	Kalama Study Leader Longview Study Leader	Field supervision, report preparation, study design
Mr. Tad Deshler	Pesticide Use Study Leader Station 29 Study Leader QA Officer	Data validation, study design, field supervisor, report preparation
Mr. Curtis DeGasperi	Field Technician	Field support, data analysis, report preparation
Ms. Jennifer Stanhope	Environmental Chemist	Field support, data analysis, report preparation
Ms. Kimberlee Stark	Field Technician	Field support, Data validation, report preparation
Ms. Lisa Fosse	Clerical	Word processing
Ms. Kim Tapia	Graphics	Illustrations, presentation support

7.0 COST

The projected level of effort and cost estimate to complete the Work Assignment are shown in the Tables 2-8. All rates and costs shown in the table are fully burdened. Labor rates include the employee's direct rate, employee benefits, overhead, general and administrative expense, and fee. All other direct costs are burdened with general and administrative expenses and fee. Subcontractors are burdened only with fee. The total estimated Work Assignment cost is $819,963. The laboratory analytical costs for the four technical studies are $388,260, or 53 percent of the four field studies, and 47 percent of the total estimated cost.

The contractual agreement for this Work Assignment specifies that reimbursement for work completed is to be made on a time and materials basis. Monthly invoices will be submitted along with monthly reports that indicate costs incurred during the preceding month.

TABLE 2. SUMMARY OF COSTS BY MAJOR TASK	
St. Helens Hot Spot Delineation/Source Identification Study	$353,815
Kalama Problem Area Confirmation/Source Identification	$81,852
Station D29 Problem Area Confirmation Study	$59,702
Longview Problem Area Confirmation Study	$241,110
Pesticide Usage Study	$53,484
Project Management/Presentations	$30,000
TOTAL	$819,963

TABLE 3. ST. HELENS HOT SPOT DELINEATION STUDY COST BREAKDOWN			
	Rate	Hours	Cost
Ellis	$85.44	170	$14,525
Braun	$73.61	300	$22,083
Deshler	$55.26	420	$23,209
DeGasperi	$52.23	60	$3,134
Baier	$35.35	190	$6,717
Stark	$54.49	200	$10,898
Fosse	$45.68	50	$2,284
Tapia	$46.26	36	$1,665
Total Labor			$84,515
ODCs			
Per Diem			$3,760
Consultant (Editor)			$1,275
Van Rental			$829
Shipping			$223
Computer			$2,231
Phone			$128
Reproduction			$1,211
Equipment/Supplies			$1,402
Total ODC's			$11,057
Subcontractors			
Vessel			$7,700
ARI (Semivol. Pest. Radionuclides)			$49,610
Pac. Anal. (Dioxins, Organotin)			$164,802
Aquatic Resources (Metals, Nutrient, Conv.)			$22,942
Amtest (Sed. Conv.)			$2,904
NAS (Amphipod)			$10,285
Total Subcontractor			$258,243
TOTAL COST ESTIMATE			$353,815

TABLE 4. KALAMA PROBLEM AREA CONFIRMATION STUDY COST BREAKDOWN			
	Rate	Hours	Cost
Ellis	$85.44	82	$7,007
Braun	$73.61	210	$15,458
Deshler	$55.26	272	$15,031
Baier	$35.35	168	$5,939
Stark	$54.49	120	$6,539
Fosse	$45.68	50	$2,284
Tapia	$46.26	36	$1,665
Total Labor			$53,923
ODCs			
Per Diem			$1,020
Consultant (Editor)			$956
Van Rental			$574
Shipping			$223
Computer			$1,529
Phone			$127
Reproduction			$574
Equipment/Supplies			$828
Total ODC's			$5,831
Subcontractors			
Vessel			$3,850
ARI (Semivol. Pest. Radionuclides)			$15,477
Amtest (Sed. Conv.)			$2,772
Total Subcontractor			$22,099
TOTAL COST ESTIMATE			$81,852

TABLE 5. STATION D29 PROBLEM AREA CONFIRMATION STUDY COST BREAKDOWN			
	Rate	Hours	Cost
Ellis	$85.44	74	$6,323
Braun	$73.61	162	$11,925
Deshler	$55.26	202	$11,163
Baier	$35.35	56	$1,980
Stark	$54.49	102	$5,558
Fosse	$45.68	42	$1,919
Tapia	$46.26	32	$1,480
Total Labor			$40,346
ODCs			
Per Diem			$255
Consultant (Editor)			$956
Van Rental			$446
Shipping			$287
Computer			$1,083
Phone			$159
Reproduction			$319
Equipment/Supplies			$319
Total ODC's			$3,824
Subcontractors			
Vessel			$2,750
ARI (Semivol. Pest. Radionuclides)			$3,542
Pac. Anal. (Dioxins, Organotin)			$9,240
Total Subcontractor			$15,532
TOTAL COST ESTIMATE			$59,702

TABLE 6. LONGVIEW PROBLEM AREA CONFIRMATION STUDY COST BREAKDOWN			
	Rate	Hours	Cost
Ellis	$85.44	150	$12,816
Braun	$73.61	270	$19,875
Deshler	$55.26	356	$19,673
DeGasperi	$52.23	48	$2,507
Baier	$35.35	180	$6,363
Stark	$54.49	170	$9,263
Fosse	$45.68	50	$2,284
Tapia	$46.26	36	$1,665
Total Labor			$74,446
ODCs			
Per Diem			$3,378
Consultant (Editor)			$1,275
Van Rental			$828
Shipping			$414
Computer			$2,039
Phone			$159
Reproduction			$669
Equipment/Supplies			$1,147
Total ODC's			$9,910
Subcontractors			
Vessel			$7,700
ARI (Semivol. Pest. Radionuclides)			$40,590
Pac. Anal. (Dioxins, Organotin)			$87,318
Aquatic Resources (Metals, Nutrient,. Conv.)			$18,770
Amtest (Sed. Conv.)			$2,376
Total Subcontractor			$156,754
TOTAL COST ESTIMATE			$241,110

TABLE 7. PESTICIDE USE STUDY COST BREAKDOWN			
	Rate	Hours	Cost
Ellis	$85.44	74	$6,323
Deshler	$55.26	340	$18,788
Baier	$35.35	172	$6,080
Stark	$54.49	200	$10,898
Fosse	$45.68	82	$3,746
Tapia	$46.26	36	$1,665
Total Labor			$47,500
ODCs			
Consultant (Editor)			$1,275
Shipping			$318
Computer			$2,320
Phone			$319
Reproduction			$1,306
Misc			$446
Total ODC's			$5,984
TOTAL COST ESTIMATE			$53,484

TABLE 8. PROJECT MANAGEMENT/PRESENTATIONS COST BREAKDOWN			
	Rate	Hours	Cost
Ellis	$85.44	170	$14,525
Braun	$73.61	80	$5,889
Deshler	$55.26	60	$3,316
Fosse	$45.68	16	$731
Tapia	$46.26	44	$2,035
Total Labor			$26,496
ODCs			
Per Diem			$1,274
Shipping			$127
Computer			$1,338
Phone			$96
Reproduction			$670
Total ODC's			$3,505
TOTAL COST ESTIMATE			$30,000

8.0 REFERENCES

Long, E.R. and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. National Oceanic and Atmospheric Administration, Seattle, WA. NOAA Technical Memorandum NOS OMA 52.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. Niagara river biota contamination project: Fish flesh criteria for piscivorous wildlife. New York State Department of Environmental Conservation, Division of Fish and Wildlife, Bureau of Environmental Protection.

Persaud, D., R. Jaagumagi, and A. Hayton. 1991. Draft. The Provincial Sediment Quality Guidelines. Water Resources Branch, Ontario Ministry of the Environment, Toronto, Ontario, Canada. Draft.

Puget Sound Estuary Program. 1989. Recommended protocols for measuring selected environmental variables in Puget Sound. Puget Sound Estuary Program, U.S EPA Region X, Seattle, WA.

Tetra Tech. 1988. Pesticides of concern in the Puget Sound basin: A review of contemporary pesticide usage. Prepared as part of the Puget Sound Estuary Program for U.S. Environmental Protection Agency, Office of Puget Sound, Seattle, Washington. Tetra Tech, Inc., Bellevue, Washington. 97 pp. + appendices.

Tetra Tech. 1992. Reconnaissance Survey of the Lower Columbia River. Task 1: Final Report. Tetra Tech, Inc., Redmond, WA.

Tetra Tech. 1993a. Reconnaissance Survey of the lower Columbia River. Task 7: Conclusions and Recommendations. Final Report. Prepared for Lower Columbia River Bi-State Committee. Tetra Tech, Inc., Redmond, WA.

Tetra Tech. 1993b. Reconnaissance Survey of the lower Columbia River. Task 6: Reconnaissance report. Prepared for Lower Columbia River Bi-State Committee. Tetra Tech, Inc., Redmond, WA.

U.S. Environmental Protection Agency. 1988a. Laboratory data validation functional guidelines for evaluating inorganics analyses. U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

U.S. Environmental Protection Agency. 1988b. Laboratory data validation functional guidelines for evaluating organics analyses. U.S. Environmental Protection Agency/Hazardous Site Evaluation Division, Washington, D.C.

U.S. Environmental Protection Agency. 1991. National functional guidelines for organic data review. Draft report. U.S. EPA Contract Laboratory Program, Washington, D.C.

U.S. Environmental Protection Agency. 1991. Workshop report on toxicity equivalency factors for polychlorinated biphenyl congeners. EPA/625/3-91/020. U.S. Environmental Protection Agency, Washington, D.C.

Washington State Department of Ecology. 1991. Guidelines and specifications for preparing quality assurance project plans. Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, Quality Assurance Section, Manchester, Washington. 17 pp. + appendices.