WATER AND SEDIMENT QUALITY IMPACT ENGINEERING ANALYSIS

Treatment Evaluation for WSDOT Bridge Washing Effluent

Prepared for

Washington State Department of Transportation

October 2003

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Treatment Evaluation for WSDOT Bridge Washing Effluent

Prepared for

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Certificate of Engineer

Washington State Department of Transportation

Water and Sediment Quality Impact Engineering Analysis
WSDOT Agreement No. Y-8314, Task AJ, Work Order MS 4254-01-0725

The technical materials and data contained in this report were prepared under the direction and supervision of the undersigned, whose seal as a professional engineer licensed to practice as such, is affixed below.

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Introduction

One of the responsibilities of the Washington State Department of Transportation (WSDOT) is to maintain and preserve steel bridges and marine transfer spans. Associated activities include periodically washing these structures for routine maintenance purposes and preparing the bridges and spans for painting. Effluent from bridge and transfer span maintenance activities contains pollutants such as suspended solids, metals from paint particles, and bacteria from bird feces. To ensure compliance with applicable environmental codes relative to bridge washing and painting activities, the Washington Department of Ecology (Ecology) and WSDOT have developed an Implementing Agreement (IA) specifying pollution prevention and reduction measures and procedures. At present, the IA requirements are being reviewed and updated by Ecology and WSDOT to promote more efficient project management, increase environmental clarity, and streamline permitting efforts. It is anticipated that future effluent discharges from WSDOT's bridge washing activities will be managed through a National Pollutant Source Discharge Elimination System (NPDES) permit or administrative order issued by Ecology.

To support decision making processes related to the above activities, Herrera Environmental Consultants, Inc. (Herrera) recently completed an engineering feasibility study (Herrera 2003) that evaluated potential measures to protect water quality during bridge and marine span washing activities. More specifically, this analysis identified a preferred treatment alternative out of a range of potential options that meets the definition of AKART (all known, available, and reasonable technology) as described in WAC 173-201A. In order to be defined as AKART, a treatment option must represent the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants associated with a discharge.

Results of the AKART engineering feasibility study (Herrera 2003) determined that AKART methodologies for contracted bridge painting and washing applications involves the use of filter tarps suspended beneath the bridge or marine transfer span during active washing operations. This filter tarp allows washwater to pass through and discharge to the waterway or land area below, but collects debris and particulate matter that is cleaned from the bridge. Paint particles and abrasive grit that are captured by the filter tarps would subsequently be sent to upland disposal areas. This is the preferred practice that is identified under the current IA and used on all of WSDOT's existing bridge washing projects. In addition, the AKART study determined that for routine maintenance bridge washing, that hand cleaning and vacuuming (vactor truck) followed by high-volume, low pressure water flushing, meets AKART if performed during periods of high river flows (i.e., winter and spring).

Once an AKART treatment methodology has been identified, Federal regulations (40 CFR 122.44) require analyses to determine if there is a "reasonable potential" for water quality standards to be violated due to discharge of the resulting effluent. Compliance with Washington State water quality standards requires a consideration of the requirements in WAC 173 201A, Water Quality for Surface Waters of the State of Washington, and WAC 173-204, Sediment Management Standards. In order to make this determination, site specific information for the following parameters must typically be compiled and evaluated: effluent pollutant concentrations, effluent discharge rate, receiving water pollutant concentrations, and receiving discharge rate. This assessment does not require 100 percent certainty; rather, it requires a judgment of reasonable potential based on a rational process and scientifically valid methods. If the reasonable potential assessment determines that there is a potential for violating water quality standards, limitations are imposed on the effluent discharges to receiving waters. Limitations on effluent discharges might include limiting quantities, time periods, compliance schedules, frequency, continued monitoring, or requiring additional treatment prior to discharge. In Washington, Ecology has the regulatory authority to implement the federal regulations and administer the NPDES permit process.

This report presents a "reasonable potential" analysis of potential water and sediment quality impacts related to effluent discharges from WSDOT's bridge washing operations. This analysis evaluates the potential for water and sediment standards to be violated due to effluent discharges from bridge washing operations, assuming that the effluent has been treated using preferred alternatives identified in the AKART feasibility study (Herrera 2003). This evaluation was conducted for bridge washing operations that occur over both river and marine systems. The associated analyses and results are presented sequentially in this report under the following headings:

- Description of Bridge Washing Procedures
- Methods
- Results
- Conclusions
- Recommendations.

Description of Bridge Washing Procedures

To provide the necessary background information for interpreting this reasonable potential determination, this section describes in more detail the procedures used during WSDOT's bridge washing operations. As noted in the *Introduction* to this report, Herrera recently completed a feasibility study (Herrera 2003) to identify a treatment alternative from a range of options that meets the definition of AKART, as described in WAC 173-201A. Based on the performance, technical feasibility, and cost criteria that were evaluated as part of the feasibility study, WSDOT's current treatment practices were identified as the preferred alternative.

WSDOT conducts two types of bridge and transfer span washing activities: 1) routine maintenance washing, and 2) surface preparation for painting. Typically, routine maintenance washing is conducted by WSDOT maintenance crews, while painting and associated washing are conducted by contractors. The procedures used for each of these washing activities is described in more detail in the subsections to follow.

Maintenance Washing

Bridges

Routine maintenance washing of bridges typically occurs on a one to five-year cycle and involves the following steps:

- Establish traffic control – traffic control is typically set up and taken down on a daily basis to reduce traffic congestion during peak travel times.
- Establish fall protection systems (scaffolding, rigging, ropes and other equipment).
- Remove dry debris, such as dust and bird feces, by hand and vacuum (vactor truck)
- Wash steel with clean water using a high-volume, low-pressure system.

To reduce pollutant discharge to receiving waters below, dry debris is disposed of at an upland location. In some cases, a vacuum is applied during washing to capture some of the loosened material. Maintenance washing activities are typically performed during high river flows (late fall, winter, and early spring), also reducing the potential impact on receiving water quality. Approximately 400 to 600 gallons of water is used to clean a typical bridge structure (625 tons of steel). Filter tarps are not used during bridge maintenance washing.

Marine Transfer Spans

Routine maintenance washing of marine transfer spans does not use filter tarps and typically occurs on a monthly to semi-annual cycle. Routine maintenance washing involves the following steps:

- Dry debris, such as bird feces, is removed by hand or vacuum and subsequently disposed of upland.
- When necessary, a biodegradable degreaser (e.g., Simple Green) is applied to the marine span surfaces. Surfaces are typically not washed after a degreaser is applied, but washing may occur in some instances depending upon the activity.
- Approximately 200-600 gallons of water are used to clean marine transfer spans.
- Steel structures are washed with clean water using a high-volume, low-pressure system.

Paint Preparation Washing

Bridges

Bridge washing in preparation for painting differs from maintenance washing. Paint preparation washing uses a low-volume, high-pressure washing system to more thoroughly remove debris and loose paint material from the steel surfaces. Maintaining paint coatings in good condition extends the service life of the bridge by reducing corrosion.

Bridge painting occurs on a schedule dictated by the rate at which paint systems deteriorate. Most bridges are inspected every one to two years and evaluated according to paint system condition. One of three paint system condition levels is identified at each bridge based on the following criteria:

- Condition level 1: Paint is in like new condition
- Condition level 2: Paint is peeling or deteriorating, but no steel is exposed
- Condition level 3: Paint is peeling or deteriorating exposing the underlying steel.

When a bridge is identified in the later stages of condition level 2 or at condition level 3 and has 2 percent or more steel exposed, it is added to the statewide painting list. Due to varied bridge settings and environmental conditions, the frequency of bridge painting varies and is typically greater than 15 years. The following steps are conducted during bridge painting:

- Establish traffic control.

- Establish fall protection systems.
- Construct tarp systems around and beneath the work area. Under current standards (WSDOT 2002a), filter tarps must have a minimum apparent opening size (AOS) of 212 micrometers, equivalent to a #70 sieve.
- Remove dry debris by hand and vacuum.
- Wash steel surfaces with a low-volume, high pressure (3,200 pounds per square inch) system – effluent passes through a filter tarp to remove particulate material before discharge to the environment below.
- After the steel surfaces have dried, spot blast with metal slag (Blastox or Kleenblast) to remove flaking/chipping paint and oxidized steel.
- Blow down surfaces to remove residual dust and debris from the steel – all material from spot blasting activity is contained and stored on site.
- Apply zinc-based primer coat to spot-blasted areas.
- Apply an intermediate coat and top coat of moisture cure urethane to all steel surfaces.

In some cases, full containment of washing activities has been conducted at WSDOT bridge painting sites. In these cases, effluent was often disposed of by discharging to land areas near the bridge site or to storm sewer systems. If effluent from the bridge washing activities exceeds disposal limits for local municipal sanitary sewer systems and treatment is not an option, the effluent is designated as a hazardous waste and subsequently disposed of at a licensed facility.

Marine Transfer Spans

Marine transfer spans are painted at a frequency of 15 or more years. In preparation for painting, the span surfaces are cleaned using the same methodology described above for bridges. Filtration tarps are also currently used during paint preparation washing of marine transfer spans.

Methods

The methods and protocols for performing reasonable potential determinations are specified in the following guidance documents from the U.S. EPA and Ecology:

- Technical Support Document for Water Quality-based Toxics Control (U.S. EPA 1991)
- Water Quality Permit Writer's Manual (Ecology 2002)

However, the procedures outlined in these guidance documents are mainly directed at the evaluation of potential water quality impacts from a fixed location point source that discharges either continuously or intermittently over long periods of time. The required input for these analyses typically take the form of site-specific data on effluent and receiving water characteristics.

In contrast to these typical analysis conditions, WSDOT's bridge washing operations occur at numerous locations throughout the state. The associated effluent discharge occurs over short, discontinuous durations. Furthermore, effluent characteristics for WSDOT's bridge washing operations are expected to vary significantly depending on the age and conditions of the bridge structure and the type of paint present. These factors make it difficult to directly apply many of the standard methods and procedures for performing an analysis of reasonable potential. Due to these characteristics of WSDOT's bridge washing operations, the standard procedures were modified to perform the analyses described in this report.

In addition, there are no guidance documents available from Ecology that specifies how a reasonable potential determination should be performed when evaluating sediment quality impacts in freshwater systems. Therefore, the methods presented for this component of the analysis were adapted from common engineering principles related to sediment settling and dispersion.

This reasonable potential analysis specifically focuses on bridge washing for paint preparation. Because these activities involve pressure washing to remove paint material and typically occur when rivers and streams are flowing at lower rates, it is assumed that they have a greater potential to impact receiving waters.

The following sections describe the methods that were used to conduct the reasonable potential determination for WSDOT's bridge washing operations. These sections include information regarding the calculations, input data, and assumptions that were used to evaluate water quality and sediment impacts in rivers and marine systems. Also noted are any deviations from the standard procedures for making reasonable potential determinations as defined in U.S. EPA (1991) and Ecology (2002). This methods discussion is organized in four subsections:

- Water Quality Impact Evaluation for Rivers

- Water Quality Impact Evaluation for Marine Systems
- Sediment Quality Impact for Rivers
- Sediment Quality Impact for Marine Systems

Water Quality Impact Evaluation for Rivers

This section describes the methods used to assess potential violations of water quality standards in rivers due to inputs of bridge washing effluent. The first subsection provides an overview of the basic evaluation approach and identifies the input data sources for the associated analyses. The next subsection describes in more detail the specific calculations, input data, and assumptions that were used to evaluate water quality impacts in rivers.

Overview of Approach and Data Sources

The analysis of water quality impacts on rivers was conducted based on Washington State water quality standards as defined in WAC 173-201A. These standards are differentiated based on whether they apply to acute or chronic impacts. The standards for acute impacts are promulgated to prevent injury or death to an organism as a result of short-term exposure to a substance or detrimental environmental condition. In contrast, standards for chronic impacts are intended to prevent injury or death to an organism as a result of repeated or constant exposure over an extended period of time to a substance or detrimental environmental condition. The actual acute standards are typically assessed based on a 1- hour average concentration that may not be exceeded more than once every three years on average. Chronic standards are assessed based on a 4-day average concentration that may not be exceeded more than once every three years on average. It follows that acute criteria generally apply to infrequent or intermittent discharges; chronic criteria apply to long-term exposures.

As noted above, effluent discharges from WSDOT's bridge washing occurs over very short, intermittent durations. For example, a typical bridge washing project typically takes two to four months to complete (Hamacher 2003b personal communication). Within this time span, three to five individual wash events would typically occur at two to three-week intervals between the actual bridge painting work. Not including time for mobilizing and demobilizing, each individual wash event generally lasts from 4 to 8 hours. Based on these considerations, the analysis presented in this report only evaluates water quality impacts to rivers based on acute water quality standards. In addition, acute criteria are much more conservative and potentially offer greater environmental protection. This decision was arrived at through a mutual agreement between Ecology and WSDOT (Ecology and WSDOT, 2003).

In this analysis, potential water quality violations from bridge washing effluent were assessed at the boundary of the allowable mixing zone for acute impacts as defined in WAC 173-201A. Mixing zones are the portions of a water body adjacent to an effluent outfall where mixing results in the dilution of the effluent with the receiving water. Water quality standards may be exceeded in a mixing zone as conditioned and provided for in WAC 173-201A-400. A mixing zone is only permitted in cases where it can be demonstrated that the effluent treatment technology meets the definition of AKART. The AKART feasibility study for WSDOT's bridge washing operations (Herrera 2003) satisfies this criteria. In rivers, the mixing zone where acute criteria may be violated is determined by the most restrictive combination of any of the following maximum size requirements:

1. Not extend beyond ten percent of the distance toward the upstream and downstream boundaries of an authorized mixing zone, as measured independently from the discharge port(s). The authorized mixing zone extends downstream from the discharge port(s) for a distance of three hundred feet plus the depth of water over the discharge port(s), and upstream for a distance of one hundred feet.

2. Not utilize greater than two and one-half percent of the flow, and

3. Not occupy greater than twenty-five percent of the width of the water body.

This evaluation focused only on water quality impacts as they relate to the second criteria listed above. The first and third criteria were not addressed in this evaluation because the associated impacts must be assessed through site-specific mixing zone studies that, for reasons discussed above, are not directly applicable to this particular analysis. In addition, Ecology has found that the second criterion is generally the most restrictive for water quality impacts in small and medium sized rivers (Ecology 2003a). This approach was agreed to by Ecology and WSDOT (Ecology and WSDOT, 2003).

In order to perform this analysis, a simple dilution equation was used to calculate concentrations of the target pollutants under different river discharge rates during bridge washing operations. Pursuant to the second criteria in the list above, it was assumed that only two and one half percent of the total river discharge was available for diluting the bridge washing effluent. In order to determine the range of river systems that would have a reasonable potential of violating water quality criteria, river discharge rates were varied from a maximum that resulted in no water quality violations for the target parameters to a minimum that resulted in water quality violations for some or all of the target parameters. Per Ecology (2002) guidelines, the evaluation of potential water quality impacts to rivers was conducted based on a reasonable worst-case scenario for WSDOT's bridge washing operations.

Because available data have shown that primary contaminants in bridge washing effluent are chromium, copper, lead and zinc, these analyses were directed specifically at these four target parameters. The following section describes the data sources that were used to characterize bridge washing effluent pollutant concentrations and discharge rates. A separate subsection identifies the data sources that were used to characterize concentrations of the target parameters in receiving waters throughout the state. The specific calculations and input data used for these analyses are described in the *Calculations and Data Input* section that follows.

Data Sources for Effluent Characterization

Only limited data are available that specifically characterize effluent characteristics from WSDOT's bridge washing activities. At present, the primary source of data is four separate studies that WSDOT conducted on steel bridges located within Western Washington (2001, 2002b, 2002c, 2003; included in Appendix B). The specific location and dates for these studies are as follows:

- Stillaguamish River bridge (No. 532/2) near Stanwood, Washington – August 2001 (involved two water quality monitoring events)
- Skykomish River bridge (No. 2/030) near Gold Bar, Washington – May 2002
- Cowlitz River bridge (No. 432N) near Kelso, Washington – June 2002.
- Nooksack River bridge (539/860) on SR539 – August 17, 2003.

The data from these studies included effluent flow rates and pollutant concentrations. All of these studies used similar data collection methodologies. Effluent from the bridge washing operations was collected after it passed through a filter tarp system. Sampling was conducted using U.S. EPA approved sampling and monitoring techniques/methodologies (i.e., "clean hands/dirty hands"). Both grab and representative composite effluent samples were collected during critical discharge times. Samples were subsequently submitted to Department of Ecology certified laboratories for analyses of dissolved and total metals and other selected pollutants. Field measurements of pH, dissolved oxygen, and conductivity were also recorded. A record of water quantities used to clean the bridge structures were obtained from the contractor and used to calculate average discharge rates. A detailed description of the sampling and analytical procedures used in these studies is provided in the field reports prepared by WSDOT (2001, 2002b, 2002c, 2003; included in Appendix B).

The length and steel surface area of all three bridges included in these studies are between the 25^{th} and 75^{th} percentiles of the cumulative frequency distribution for all WSDOT bridges. This would suggest that the associated effluent flow rates and pollutant concentrations can be readily extrapolated to the majority of WSDOT's bridges if structure size is the only factor that affects effluent concentrations and volumes. However, all the study bridges are located in the same general region of the state, so potential influences relating to climate or geography cannot be fully assessed. Furthermore, the overall variance in these data cannot be thoroughly assessed due to the low number of observations ($n \leq 5$) for each parameter.

Data from all four bridge washing studies are summarized in Appendix A. The actual field reports that were prepared from these studies (WSDOT 2001, 2002b, 2002c, 2003) are presented in Appendix B. Based on an examination of these data, it appears that the primary pollutants of concern in bridge washing effluent are chromium, copper, lead, and zinc. Dissolved concentrations of copper and zinc exceeded water quality standards for acute impacts in every sample (based on the average hardness of 26 mg/L as $CaCO_3$ in the sampled receiving waters). Worst-case dissolved metal concentrations for chromium, copper, lead, and zinc were 0.023 mg/L, 0.178 mg/L, 0.130 mg/L, respectively. Worst-case total recoverable metal concentrations for chromium, copper, lead, and zinc were 0.368 mg/L, 2.05 mg/L, 10.5 mg/L, 4.47 mg/L, respectively. Other toxic metals, conventional pollutants, and organic contaminants were generally not present at levels that are shown to cause significant water quality problems. Due to these considerations, chromium, copper, lead, and zinc were targeted for all subsequent analyses related to this impact evaluation. This decision was arrived at through a mutual agreement between Ecology and WSDOT (Ecology and WSDOT, 2003).

Data Sources for Receiving Water Characterizations

Data used to quantify background water quality characteristics in receiving waters were obtained from Ecology's Environmental Information Management (EIM) system and U.S. EPA's STORET Legacy Data Center (LDC). The EIM system is an environmental database, which stores physical, chemical, and biological environmental measurements. Extensive ancillary information about those measurements is also stored, including the geographic location of the sample station, detailed study information, and information about data quality. STORET is EPA's main repository of water quality monitoring data. It contains water quality information from a variety of organizations across the country, from small volunteer watershed groups to State and Federal environmental agencies. The LDC component of STORET contains data that were supplied to EPA before 1999.

For this analysis, both of the database systems were queried to obtain background water quality data for the target parameters (i.e., chromium, copper, lead, zinc) in freshwater systems. The database was also queried to obtain background data for water hardness in these systems to facilitate the calculation of hardness-dependent water quality standards. As noted above, the results from this analysis must be extrapolated to numerous WSDOT bridge washing locations. Because the EIM and STORET LDC systems contain compiled information from studies that occurred throughout the state, it was assumed that data obtained from these sources would provide the most representative characterization of receiving water quality for this purpose.

Calculations and Data Inputs

The following equation was used to evaluate receiving water pollutant concentrations following mixing with bridge washing effluent:

$$C_a = (1/F_d \times C_e) + ([1 - 1/F_d] \times C_b)$$

where:

C_a = acute pollutant concentration (mg/L)
F_d = dilution factor
C_e = effluent pollutant concentration (mg/L)

C_b = background (river) water quality concentration (mg/L).

The dilution factor (Fd) is calculated using the following equation:

$$F_d = 1/(Q_e/(Q_b \times 0.025))$$

where:

Q_e = effluent discharge rate (cfs).
Q_b = river discharge rate (cfs).

As noted above, the river discharge rate (Q_b above) was varied from a maximum at which no water quality violations are observed for the target parameters (i.e., chromium, copper, lead, zinc) to a minimum where some or all of the target parameters violated the standards. Based on the mixing zone criteria described in WAC 173-201A, this analysis assumed that only two and one half percent of the total river discharge is available for mixing and dilution of the bridge washing effluent. This evaluation of potential water quality impacts to rivers was conducted to evaluate a reasonable worst-case scenario for WSDOT's bridge washing operations. However, the analysis was segregated to reflect the different receiving water characteristics for river systems located in Eastern and Western Washington, respectively. Analyses were also performed to evaluate potential impacts from WSDOT's bridge washing operations using acute water quality standards that have been adjusted to reflect the influence of local water chemistry on metal toxicity. Finally, an additional sensitivity analysis was performed to evaluate how different assumptions regarding the partitioning of total recoverable and dissolved metals in bridge washing effluent effect the overall study conclusions.

The specific input data and associated assumptions for this analysis are described in the following subsections. Relevant guidance from Ecology for generating these input data is also presented.

Effluent Discharge Rate

According to Ecology guidance documents (Ecology 1997a, 2002), a worst-case effluent discharge rate must be used when performing a reasonable potential determination. More specifically, Ecology indicates that the maximum discharge rate that can occur should be used as the reasonable worst-case scenario for intermittent effluent streams like those affected by WSDOT's bridge washing operations.

Effluent discharge rates for this analysis were derived from the WSDOT bridge washing studies described above (WSDOT 2001, 2002b, 2002c, 2003; included in Appendix B). Effluent discharge rate data from these studies are summarized in Table 1. The total effluent discharge rate is a function of both the number of washers operating simultaneously and the effluent discharge rate per washer. In the worst-case scenario evaluated for this analysis, it was assumed that 6 washers were operating simultaneously with an effluent discharge rate of 3 gallons per minute (gpm) per washer. Based on these assumptions, the combined discharge rate

Table 1. Effluent flow rates and discharge volumes from WSDOT bridge washing projects.

Bridge Study	No. Washers Operating Simultaneously	Approximate Effluent Discharge Rate per Washer (gallons/minute)
Stillaguamish River (Bridge No. 532/2)	2	2.5 - 3.0
Skykomish River (Bridge No. 2/030)	2	1.8 - 2.0
Cowlitz River (Bridge No. 432N)	4	2.0 - 2.3
Nooksack River (Bridge No. 539/860)	3	1.5 - 1.7
Worst-Case Scenario:	6	3.0

Data Source: WSDOT (2001, 2002b, 2002c, 2003).

from all the washers under the reasonable worst-case scenario is 18 gpm (i.e., 6 washers × 3 gpm/washer = 18 gpm).

Effluent Pollutant Concentrations

According to guidelines promulgated by the U.S. EPA (1991) and Ecology (1997a, 2002), worst-case effluent pollutant concentrations are to be used when assessing water quality impacts for an analysis of reasonable potential; specifically, the 95th percentile pollutant concentration should be estimated for this purpose. To derive the 95th percentile pollutant concentration, the coefficient of variation (CV) of the data is used to obtain an appropriate reasonable potential multiplying factor from tabulated values found in U.S. EPA. (1991) and Ecology (2003c). This reasonable potential multiplying factor is then applied to the maximum concentration from the available data to calculate the 95th percentile pollutant concentration. Per Ecology (2002) guidance, an assumed CV of 0.6 was used for all the parameters in this analysis because the number of available samples for characterizing metals concentrations was less than 21.

Federal guidelines (40 CFR 122.45) also require that all permit effluent limitations, standards, or prohibitions for a metal be expressed in terms of "total recoverable metal". However, acute water quality standards for metals in WAC 173-201A are generally expressed in terms of dissolved metals. Therefore, a metals translator value is required to convert the effluent total recoverable metal concentration to an estimate of the dissolved metal concentration that would be present in the receiving water. Specifically, the translator values is the fraction of total recoverable metal in the receiving water that is dissolved (U.S. EPA 1996). These translator values can be determined empirically based on site-specific monitoring data, or published values may be utilized. For this analysis, the translator values presented in Pelletier (1996) for copper, lead, zinc and were employed in all calculations because there were insufficient data to develop site-specific values. These are the default translator values that are generally used for all reasonable potential determination that are performed in Washington State (Ecology 2003c). A translator value is not required for chromium where laboratory methods to measure the tri-valent form of this metal are unavailable.

The worst-case effluent concentrations for this study were derived from the measured total recoverable metals concentrations that were obtained from the WSDOT bridge washing studies described above. Table 2 presents the worst-case dissolved metal concentration (i.e., the 95 percentile) in the receiving water based on the maximum total recoverable metals concentrations from these studies. The applicable reasonable potential multiplying factors and translator values for each metal are also presented in Table 2. These estimated worst-case dissolved metal concentrations were used in subsequent calculations to determine the minimum flow rate at which acute water quality standards would be violated for each of the target metals.

However, one of the primary uncertainties surrounding this analysis relates to the accuracy of the translator values discussed above for determining the dissolved to total recoverable metal concentrations in the receiving water. In general, the primary mechanism for metals toxicity is by adsorption to or uptake across the gills of an aquatic organism; this physiological process requires the metal to be in a dissolved form (U.S. EPA 1996). Thus, particulate metal exhibits

Table 2. Maximum expected dissolved metal concentrations in rivers and marine water based on measured tota recoverable metal concentrations in bridge washing effluent.

	Cr	Cu	Pb	Zn
Worst Case Bridge Washing Scenario				
Data Obtained from WSDOT Studies[a]				
No. Samples:	2	3	3	3
Maximum Measured Total Recoverable Metal Concentration (mg/L):	0.993	2.05	10.5	4.47
Metals Translator for Freshwater[b]:	1.000	0.996	0.466	0.996
Multiplier[c]:	3.79	3.00	3.00	3.00
Worst-Case Dissolved Metal Concentration for Rivers (mg/L)[d]:	3.76	6.13	14.7	13.4
Metals Translator for Marine Water[e]:	n.a.	0.830	0.951	0.946
Multiplier[c]:	n.a.	3.00	3.00	3.00
Worst-Case Dissolved Metal Concentration for Marine Water (mg/L)[d]:	n.a.	5.10	30.0	12.7

Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Appendix A.

[a] Total recoverable metals concentrations in bridge washing effluent after passing through a filter tarp with an apparent opening size (AOS) equivalent to a #40 sieve.

[b] Translator values for converting total recoverable metal concentrations to dissolved concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.

[c] Multipliers were calculated based on number of samples using guidance from Ecology (2002, 2003c).

[d] Maximum expected effluent dissolved metal concentrations (i.e., 95 percentile) for freshwater and marine water based on measured total recoverable metal concentrations (i.e., maximum expected dissolved metal concentration in effluent = maximum measured total metal concentration x metals translator x multiplier).

[e] Translator values for converting total recoverable metal concentrations to dissolved concentrations in marine water were obtained from Ecology (2002, 2003c).

n.a.: Not applicable.

mg/L: milligram/liter.

substantially less toxicity relative to the more biologically available dissolved metal fraction. At issue is the accuracy of the default metals translator values obtained from Pelletier (1996) for estimating how much of the total recoverable fraction of metals in bridge washing effluent will partition over to a dissolved form after discharge to a receiving water.

As noted above, there are insufficient data available from bridge washing operations for calculating site-specific translator values for bridge washing operations. However, the published translator values assume that a large majority (e.g., 46 percent for lead and 99 percent for copper and zinc; see Table 2) of the total recoverable metals in the effluent will be present in a dissolved form after discharge to a receiving water body. This is a reasonable assumption for more typical wastewater discharges where the associated effluent has been highly processed. However, metals associated with bridge washing effluent are much more likely to be bound up with other materials in the paint matrix and, therefore, less prone to be present as dissolved constituents within the receiving water. Based on these considerations, water quality impacts in this reasonable potential analysis are likely overestimated since the metals translators are overly conservative when applied to this reasonable potential particular effluent stream.

To address this concern, the WSDOT and Ecology concluded that an additional sensitivity analysis should be performed to evaluate how uncertainties surrounding the partitioning of total recoverable metals to dissolved metals might effect the overall study conclusions (Ecology and WSDOT 2003). For this analysis, worst-case effluent concentrations (i.e., 95 percentile estimates) were derived from the effluent dissolved metal concentrations as measured in the WSDOT bridge washing studies described above. The 95 percentile estimates were arrived at using the same methodology that was described above for total coverable metals. Table 3 shows the resultant worst-case values for each metal and the associated reasonable potential multiplying factors. These values were then used to determine the minimum flow rate at which acute water quality standards would be violated for each of the target metals. These flow rates were then compared to those obtained using the worst-case estimates from the total recoverable metals data. This comparison was then factored into the subsequent reasonable potential determination for WSDOT's bridge washing operations.

Receiving Water Background Pollutant Concentrations

Ecology (2002) guidelines for performing an analysis of reasonable potential specify different methods for determining background pollutant concentrations in the receiving water based on the amount of data available. If 20 or fewer samples are available for characterizing background pollutant concentrations, the geometric mean of the receiving water should be multiplied by a factor of 1.74 to estimate the 90th percentile. If more than 20 samples are available, the receiving water background concentration is defined as the 90th percentile value derived from a cumulative frequency distribution analysis of data collected during a period of critical condition.

As noted above, background pollutant concentrations for this analysis were obtained through queries of Ecology's EIM system and the U.S. EPA's STORET LDC system. The data from this initial query were further processed as follows:

Table 3. Maximum expected dissolved metal concentrations in freshwater and marine water based on measured dissolved metal concentrations in bridge washing effluent.

	Cr	Cu	Pb	Zn
Worst Case Bridge Washing Scenario				
Data Obtained from WSDOT Studies[a]				
No. Samples:	5	5	5	5
Maximum Measured Dissolved Metal Concentration (mg/L):	0.023	0.178	0.130	2.10
Multiplier[b]:	2.32	2.32	2.32	2.32
Worst-Case Dissolved Metal Concentration for Rivers and Marine Water (mg/L)[c]:	0.053	0.413	0.302	4.87

Data Source: WSDOT (2001, 2002b, 2002c, 2003)

[a] Dissolved metals concentrations in bridge washing effluent after passing through a filter tarp with an apparent opening size (AOS) equivalent to a #40 sieve.

[b] Multipliers were calculated based on number of samples using guidance from Ecology (2002, 2003c).

[c] Maximum expected effluent dissolved metal concentrations (i.e., 95 percentile) for freshwater and marine water based on measured dissolved metal concentrations (i.e., maximum expected dissolved metal concentration in effluent = maximum measured dissolved metal concentration x multiplier).

n.a.: Not applicable.

mg/L: milligram/liter.

1. Because bridge washing operations typically occur in during dry weather periods, all data from samples collected during wet weather periods (i.e., October through April) were removed from the original query results. Dry weather periods are also considered the period of critical condition in this analysis.

2. Data from rivers systems that are on Washington State's 303(d) list were removed if the associated impairment was related to contamination from the target metals in this analysis. This was done because these waters are not representative of typical receiving water conditions and would likely not be covered under any forthcoming permit from Ecology that addresses WSDOT's bridge washing operations.

3. Individual data that exceed acute water quality standards for the target metals (based on a typical hardness value of 20 mg/L as CaCO3) were removed. Again, this was done because these data are likely not representative of typical receiving water conditions.

The 90th percentile values for the target metals in this analysis were then computed from the data that remained after the steps above were completed. The resultant values are shown in Table 4. These values were used in all subsequent calculations for assessing impacts to rivers from WSDOT's bridge washing operations.

Acute Water Quality Standards for Target Metals

Water quality standards for metals in freshwater typically vary with water hardness. More specifically, these water quality standards tend to become more restrictive as receiving water hardness decreases because hardness reduces the metal toxicity. To assess worst-case conditions, the guidelines for conducting an analysis of reasonable potential (Ecology 2002) require that the lowest hardness value observed during critical conditions be used if there are 20 or fewer samples available for the receiving water. If the data consists of more than 20 samples, the hardness value used in the assessment should be based on the 10th percentile value from the available data.

As noted above, background hardness concentrations for this analysis were obtained through queries of Ecology's EIM system and the U.S. EPA's STORET LDC system. The data from this initial query were further processed as follows:

1. The data from the original database queries was segregated based on whether the samples were collected in Eastern or Western Washington. This was done because there are consistent differences in hardness between samples collected from each of these respective areas due to naturally occurring watershed characteristics.

Table 4. Background concentrations of target heavy metals (dissolved form) and hardness for rivers and marine waters.

	Cr	Cu	Pb	Zn	Hardness Eastern WA	Hardness Western WA
Rivers						
No. Samples:						
- EIM Data[a]	365	238	219	209	3,068	3,772
- STORET Data[b]	118	68	59	64	135	114
- Total	483	306	278	273	3,203	3,886
90^{th} Percentile (mg/L):	0.0050	0.0014	0.0007	0.0053	--	--
10^{th} Percentile (mg/L as $CaCO_3$):	--	--	--	--	20.0	14.0
Worst Case (metals: mg/L; hardness mg/L as CaCO3)[c]:	0.0050	0.0014	0.0007	0.0053	20.0	14.0
Marine Water						
No. Samples						
- EIM Data[a]	n.a.	49	60	57	--	--
- STORET Data[b]	n.a.	0	0	0	--	--
- Total	n.a.	49	60	57	--	--
90^{th} Percentile (mg/L):	n.a.	0.0022	0.0100	0.0160	--	--
Worst Case (mg/L)[c]:	n.a.	0.0022	0.0100	0.0160	--	--

[a] Data source: Queries of Environmental Information Management system; Ecology (2003b).

[b] Data source: Queries of STORET system; U.S. EPA (2003).

[c] Worst case values based on 90th percentile values from compiled metals data and 10th percentile values from compiled hardness data.

mg/L: milligram/liter.

n.a.: Not applicable. Cr not evaluated for marine waters because there is no acute water quality standard for this parameter .

2. Because bridge washing operations typically occur in during dry weather periods, all data from samples collected during wet weather periods (i.e., October through April) were removed from the original query results.

The 10^{th} percentile values for hardness were then computed from the data that remained after the steps above were completed. The respective values for Eastern and Western Washington are presented in Table 5. The acute water quality standards that were calculated based on these hardness values are also shown in Table 5.

In general, the water quality standards for heavy metals, as defined by the Washington State (WAC 173-201A) and the U.S. EPA (1986, 2002), are derived from a diverse set of national toxicity data and calculated on the basis of numerous general assumptions (U.S. EPA 1992, Gauthier and Early 1998). In most cases, the toxicity data are directly transcribed, without modification, into water quality standards. Consequently, these standards are based on data for organisms that may or may not be resident in the ambient water that is of regulatory concern. Thus, the standards may be underprotective or overprotective because the species actually present in these waters may be more or less sensitive than those evaluated in the national toxicity data. Furthermore, physical and/or chemical characteristics of the ambient water may alter the biological availability and/or toxicity of the material (U.S. EPA 1992, Gauthier and Early 1998). Finally, there is some indication toxicity values in the national database may be exceedingly protective because the toxicity tests that form the basis of these data were performed using filtered water from an uncontaminated source (U.S. EPA 1994). Filtered water has relatively low concentrations of metal-binding particulate and, possibly, colloidal organic matter relative to typical ambient waters. Therefore, toxicity tests performed in filtered water may overestimate the toxicity of metals that interact with particulate matter or colloidal organic matter under ambient conditions. As noted above, bound (i.e., particulate) metals are generally considered to be significantly less bioavailable and toxic relative to dissolved metals. Thus, a lower proportion of the metal added to the ambient waters would be present in a toxic form due to the binding capacity of the dissolved organic and particulate matter contained in the receiving waters.

To address these issues, the U.S. EPA allows site-specific water quality standards to be developed for metals using an adjustment called the water-effect ratio (WER). The WER is a factor that expresses the difference between the toxicity of a heavy metal in laboratory water and the toxicity in the water from a specific site. Thus, the WER provides a mechanism to account for that portion of a metal which is toxic under certain physical, chemical, or biological conditions. At this time, WERs are only applicable to certain metals, which are listed in *Interim Guidance on the Determination and Use of Water-Effect Ratios* (U.S. EPA 1994). The U.S. EPA's procedures for developing site-specific water quality standards are designed to consider two general factors that may make the state and national standards in appropriate for a specific water body. According to these guidelines:

Table 5. Background hardness concentrations and associated acute water quality standards for target metals, with and without adjustment using water effects ratios (WERs).

	Eastern Washington	Western Washington
Receiving Water Hardness (mg/L as $CaCO_3$)[a]:	20	14
Freshwater Acute Water Quality Standard (mg/L)[b]		
Cr[c]:	0.1469	0.1097
Cu:	0.0037	0.0027
Pb:	0.0108	0.0072
Zn:	0.0293	0.0216
Marine Water Acute Water Quality Standard (mg/L)[d]		
Cr:	n.a.	n.a.
Cu:	n.a.	0.0048
Pb:	n.a.	0.2100
Zn:	n.a.	0.0900
Freshwater Acute Water Quality Standard with WER adjustment (mg/L)[e]		
Cr[e]:	0.2864	0.2138
Cu:	0.0109	0.0078
Pb:	0.0408	0.0272
Zn:	0.0413	0.0305
Marine Water Acute Water Quality Standard with WER (mg/L)[f]		
Cr:	n.a.	n.a.
Cu:	n.a.	0.0144
Pb:	n.a.	n.a.
Zn:	n.a.	n.a.

[a] Hardness values are derived from queries of the Environmental Information Management system (Ecology 2003b) and STORET system (U.S. EPA 2003).

[b] Freshwater acute water quality standards for dissolved metals as defined in WAC 170 201A. Standards vary with receiving water hardness.

[c] The acute water quality standard for Cr is for the total-recoverable fraction where methods to measure the tri-valent fraction are unavailable.

[d] Marine acute water quality standards as defined in WAC 170 201A. These standards do not vary with hardness.

[e] Freshwater acute water quality standards after adjustment with the following water effects ratios (WERs): Cr, WER = 1.95; Cu, WER = 2.92; Pb, WER = 3.78, Zn, WER= 1.41.

[f] Marine acute water quality standards after adjustment with the following water effects ratios (WERs): Cu, WER = 3.005

n.a.: not applicable.

> *Site-specific criterion derivation may be justified because species at the site may be more or less sensitive than those in the national criterion document, or because…differences in physical and chemical characteristics of water have been demonstrated to ameliorate or enhance the biological availability and/or toxicity of chemicals in freshwater or saltwater environments (U.S. EPA 1994).*

In order to determine a WER, side-by-side toxicity tests are performed to measure the toxicity of a metal in dilution waters. One of these waters has to be a water that is acceptable for use in laboratory toxicity tests conducted for the derivation of national water quality standards. In most situations, the second dilution is a simulated downstream water prepared by mixing ambient water from a site of interest with effluent in an appropriate ratio; in other situations, the second dilution is a sample of actual site water to which the site-specific standard is to apply. The WER is calculated by dividing the toxicity test end point (e.g., LC50) obtained in the site water by the endpoint obtained in the laboratory dilution water. Most WERs are expected to be equal or greater than one, but in some cases may be less than one (U.S. EPA 1994). A separate WER must be developed for acute and chronic impacts that are associated with a specific metal.

In order to account for possible site-specific interactions that might alter the bioavailability and/or toxicity of heavy metals in bridge washing effluent, a literature search was performed to identify hypothetical WERs that could be applied to the acute water quality standards presented in Table 4. Based on this research, the following hypothetical WERs were identified for the target metals in this study: chromium: WER = 1.95; copper: WER = 2.92; lead: WER = 3.78; and zinc: WER = 1.41. The WER for copper was obtained from a study (Dunbar 1997) that was used to support the development and adoption of site-specific standards for selected freshwater streams in Connecticut. The WERs for chromium, lead, and zinc were derived from a U.S. EPA (1992) report titled: *Synopsis of Water-Effect Ratios for Heavy Metals as Derived for Site-Specific Water Quality Criteria*. This report critically examined the procedures used and data presented in numerous studies performed to develop acute WERs. Based on this examination, unacceptable and acceptable WERs were identified and summarized. For this analysis, the acceptable WERs identified for chromium, lead, zinc in this study were averaged to provide hypothetical WERs for evaluating bridge washing effluent. The individual WERs that were averaged for this purpose are presented in Appendix D.

In order reflect potential site-specific influences on metal toxicity, the resultant hypothetical WERs for each target metal were used to adjust the associated acute water quality standard (see Table 5). The WER adjusted water quality standards were subsequently analyzed in the same way as the unadjusted standards and the respective results compared. The results from this comparison were then assessed in the reasonable potential determination for WSDOT's bridge washing operations. However, it should be stressed that these are merely hypothetical WERs for evaluating how some of the uncertainties discussed above in relation to the development and application of acute water quality standards might impact the overall results of this study. At this time, WERs have not been specifically developed to evaluate site-specific influences on the toxicity of metals in WSDOT's bridge washing effluent.

Water Quality Impact Evaluation for Marine Systems

This section describes the analysis methods used to assess potential water quality impacts in marine systems due to inputs of bridge and marine transfer span washing effluent. The first subsection provides an overview of the basic approach that was used in this evaluation and identifies the data sources that provided input for the associated analyses. The next subsection describes in more detail the specific calculations, input data, and assumptions that were used to evaluate water quality impacts in these systems.

Overview of Approach and Data Sources

This analysis of water quality impacts due to bridge washing over marine waters was conducted based on criteria in WAC 173-201A that define the allowable size and location of effluent mixing zones. These mixing zones are only permitted in cases where it can be demonstrated that the effluent treatment technology meets the definition of AKART. For the reasons described in the *Water Quality Impact Evaluation for Rivers* section above, impacts from bridge washing will be evaluated based on acute water quality criteria. The specific criteria for defining a mixing zone where acute criteria may be exceeded in marine waters (estuarine waters, as defined by WAC 173-201A) shall generally comply with the most restrictive combination of the following:

> Not extend beyond ten percent of the distance of an authorized mixing zone, as measured independently from the discharge port(s). The authorized mixing zone shall:
>
> 1. Not extend in any horizontal direction from the discharge port(s) for a distance greater than two hundred feet plus the depth of water over the discharge port(s) as measured during mean lower low water; and
>
> 2. Not occupy greater than twenty five percent of the width of the water body as measured during mean lower low water.

This evaluation focused only on water quality impacts as they relate to the first criteria listed above. The second criteria in the list above was not addressed in this evaluation because the associated impacts must be assessed through site-specific mixing zone studies that are not directly applicable to this particular analysis.

Mixing of bridge washing effluent was estimated using CORMIX, a steady-state hydrodynamic mixing zone modeling program. CORMIX cannot explicitly model the scenario of interest due to limitations in the physical configuration of effluent plumes, but reasonable estimates of mixing can be developed using simplifying assumptions.

This evaluation is based on distance from discharge, rather than proportion of flow, as in the impact evaluation for rivers. For this reason, a simplified method was selected to evaluate pollutant concentrations at the downstream end of the acute mixing zone for discharge of effluent from individual washers. The use of multiple washers is assumed to have a redundant effect, in that similar pollutant concentrations can be expected at the acute mixing zone boundary associated with each washer. Depending upon the spacing between individual washers, effluent plumes may overlap downstream of washing activities. Elevated pollutant concentrations within overlapping plumes were not modeled in this study, and would require site-specific analysis based on washer spacing and configuration.

Available data (WSDOT 2001, 2002b, 2002c) have shown that primary contaminants in bridge washing effluent are chromium, copper, lead, and zinc. Because there is no state water quality standard for chromium in marine waters, this analysis was directed specifically at copper, lead, and zinc. Like the analysis performed for rivers, potential water quality impacts were evaluated for the reasonable worst-case scenario. Individual parameter values were selected to represent this scenario (as described below), and a sensitivity analysis was conducted by varying parameters related to the effluent and receiving water characteristics.

The following subsections describe the data sources that were used to characterize bridge washing effluent pollutant concentrations and discharge rates, and receiving water pollutant concentrations. The specific calculations and input data used for these analyses are described in the *Calculations and Data Input* section that follows.

Data Sources for Effluent Characterizations

Data sources for effluent characterizations are the same as discussed in the *Water Quality Impact Evaluation for Rivers* section above.

Data Sources for Receiving Water Characterizations

Data used to quantify background water quality characteristics in receiving waters were obtained from Ecology's Environmental Information Management (EIM) system. U.S. EPA's STORET Legacy Data Center (LDC) was also queried, but insufficient data from marine waters were available.

For this analysis, the EIM database system was queried to obtain background water quality data for the target parameters (i.e., copper, lead, zinc) in marine systems. As noted above, the results from this analysis must be extrapolated to numerous WSDOT bridge washing locations. Because the EIM system contains compiled information from studies that occurred throughout the state, it was assumed that data obtained from these sources would provide the most representative characterization of receiving water quality for this purpose.

Calculations and Data Inputs

CORMIX is a steady state hydrodynamic model that is commonly used to analyze regulatory mixing zones. The model is designed to model pipe or diffuser outfall discharges, therefore application to bridge washing effluent requires the use of simplifying assumptions. It was determined that the most appropriate way to apply CORMIX to bridge washing effluent was to model the effluent as a diffuser discharge at the surface of the receiving water. CORMIX2 is the module of CORMIX that models diffuser discharges, but only allows submerged diffuser configurations. To estimate mixing of a discharge at the water surface, CORMIX2 can be applied in reverse (a mirror image) using a discharge at the receiving water bottom with a negatively buoyant effluent (Doneker 2003 personal communication). This method requires recalculation of the density of the effluent so that it displays negative buoyancy equal in magnitude to the positive buoyancy in the real system.

The specific data that were used as input for this analysis are briefly described in the following subsections with any associated assumptions.

Effluent Data

Discharge Configuration

Bridge washing effluent discharges to receiving waters in a dispersed fashion similar to precipitation. This discharge occurs over a limited area centered under the washing activity. To analyze the impact of this discharge on receiving waters, it was assumed that the width over which bridge washing effluent from a single washer is dispersed at any one time measures 6.6 feet (2 meters) (along bridge face and perpendicular to ambient flow).

To model this configuration, a diffuser structure was created in CORMIX2 that is aligned at the bottom of the receiving water and discharges the effluent upward uniformly along it's length. As mentioned above, the discharge is being modeled as a mirror image, so that with revised density values (see below) this configuration will model a downward-facing discharge at the receiving water body surface.

The number of diffuser ports and port diameter values were designed to produce an effluent velocity approximately equal to that which would be expected from the free-falling effluent. Because the effluent discharge is diffuse like precipitation, the terminal velocity of an average rain drop, or approximately 6.5 meters per second (Weather Almanac 2003), was used. As a part of the sensitivity analysis to address uncertainty in model parameters, the effect of increasing the velocity value to the terminal velocity of a large rain drop, or approximately 9 meters per second (Weather Almanac 2003), was also investigated.

The effluent discharge was assumed to occur away from the receiving water bank (10 meters away in the CORMIX model). However, the effect of discharge at the receiving water bank was also investigated in the sensitivity analysis.

Density

Wash water effluent density was estimated as 999 kilograms per cubic meter (kg/m^3) based on a temperature of 14.4 degrees Celsius using a diagram in Jirka, et al. (1996). This temperature represents the maximum measured in the WSDOT bridge washing studies (WSDOT 2001, 2002b, 2002c). This value is 25 kg/m^3 less than that estimated for the receiving water (see below). Because a mirror-image configuration was used, the effluent density value was recalculated as 1049 kg/m^3 (25 kg/m^3 greater than the receiving water density) for use in the CORMIX2 model.

Discharge Rate

According to Ecology guidance documents (Ecology 1997a, 2002), a worst-case effluent discharge rate must be used when performing a reasonable potential determination. More specifically, Ecology indicates that the maximum discharge rate that can occur should be used as the reasonable worst-case scenario for intermittent effluent streams like those observed during WSDOT's bridge washing operations.

Effluent discharge rates for this analysis were derived from the WSDOT bridge washing studies (WSDOT 2001, 2002b, 2002c, 2003; included in Appendix B). Effluent discharge rate data from these studies are summarized in Table 1. For the reasonable worst-case estimate evaluated for this analysis, it was assumed that a single washer would be operating at a rate of 3 gallons per minute. Discharge rates are assumed to be equal for bridges and marine transfer spans, though the duration of washing activities would be less for the transfer spans due to lower steel surface area (Hamacher 2003 personal communication).

Pollutant Concentrations

Effluent pollutant concentrations are the same as discussed in the *Water Quality Impact Evaluation for Rivers* section above.

Receiving Water Data

Depth

Average depth and depth at discharge were estimated at 6.6 feet (2 meters) to represent relatively shallow conditions. As a part of the sensitivity analysis to address uncertainty in model parameters, the effect of a more shallow depth (3.3 feet [1 meter]) on model results was also investigated.

Current Velocity

In the absence of site-specific current velocity data, the *Guidance for Conducting Mixing Zone Analyses* (Ecology 1997a) states that "a sensitivity analysis should be run using a wide range of possible velocities which could reasonably occur for any 1-hour duration", and that the velocity which produces the lowest dilution should be considered the critical velocity. Preliminary model runs indicated that lower dilution occurred at lower velocities, representing the critical condition. A reasonable low velocity was estimated at 0.08 feet per second (0.025 meters per second) based on professional judgment. As a part of the sensitivity analysis to address uncertainty in model parameters, a range of values from 0.033 feet per second (0.01 meters per second) to 0.33 feet per second (0.1 meters per second) were also evaluated.

Wind Speed

Wind speed is not expected to have a great effect on mixing within the acute mixing zone. A value of 2 meters per second was used based on recommendations of Jirka, et al. (1996). As a part of the sensitivity analysis to address uncertainty in model parameters, the effect of wind speed on model results was investigated by using an alternate value of 0 meters per second.

Friction Factor

In the absence of site specific data, a value of 0.025 was selected based on recommendations of Jirka, et al. (1996). As a part of the sensitivity analysis to address uncertainty in model parameters, the effect of friction factor on model results was investigated by using an alternate value of 0.020.

Density

Density of the receiving water was estimated at 1,024 kilograms per cubic meter, based on salinity and temperature statistics taken from Ecology's EIM database. The 90th percentile salinity value (30.4 parts per thousand) and 10th percentile temperature value (8.3 degrees Celsius) from the EIM data were used to estimate this density value using a diagram in Jirka, et al. (1996).

Background Pollutant Concentrations

Ecology (2002) guidelines for performing an analysis of reasonable potential specify different methods for determining background pollutant concentrations in the receiving water based on the amount of data available. If 20 or fewer samples are available for characterizing background pollutant concentrations, the geometric mean of the receiving water should be multiplied by a factor of 1.74 to estimate the 90th percentile. If more than 20 samples are available, the receiving water background concentration is defined as the 90th percentile value derived from a cumulative frequency distribution analysis of data collected during a period of critical condition.

As noted above, background pollutant concentrations for this analysis were obtained through queries of Ecology's EIM system. The data from this initial query were further processed as follows:

1. Data from receiving waters that are on Washington State's 303(d) list were removed if the associated impairment was related to contamination from the target metals in this analysis. This was done because these waters are not representative of typical receiving water conditions and would likely not be covered under any forthcoming permit from Ecology that addresses WSDOT's bridge washing operations.

2. Individual data that exceed acute water quality standards for the target metals were removed. Again, this was done because these data are likely not representative of typical receiving water conditions.

The 90^{th} percentile values for the target metals in this analysis were then computed from the data that remained after the steps above were completed. The resultant values are shown in Table 4. These values were used in all subsequent calculations for assessing impacts to marine waters from WSDOT's bridge washing operations.

Acute Water Quality Standards for Target Metals

Water quality standards for target metals (copper, lead, and zinc) in marine waters were taken from WAC 173-201A (see Table 5). As described in the *Water Quality Impact Evaluation for Rivers* section above, the U.S. EPA allows site-specific water quality standards for metals using adjustment called the Water-Effect Ratio (WER). In order to account for possible site-specific interactions that might alter the bioavailability and/or toxicity of heavy metals in bridge washing effluent, a literature search was performed to identify hypothetical WERs that could be applied to the acute water quality standards presented in Table 5. Based on this research, a hypothetical WER of 3.005 was identified for copper in marine waters. No suitable WERs were identified for the other parameters of concern in marine waters. The WER for copper was obtained from a study conducted by the City of San Jose (1998) for South San Francisco Bay.

In order to reflect potential site-specific influences on metal toxicity, the resultant hypothetical WER was then used to adjust the associated acute water quality standard (see Table 5). The WER adjusted water quality standard was subsequently analyzed in the same way as the unadjusted standards and the respective results compared. The results from this comparison were assessed in the reasonable potential determination for WSDOT's bridge washing operations. However, it should be stressed that this is merely a hypothetical WER for evaluating how the issues discussed above in relation to the development of water quality standards from national toxicity data might impact the overall results of this study. At this time, WERs have not been specifically developed to evaluate site-specific influences on the toxicity of metals in WSDOT's bridge washing effluent.

Sediment Impact Evaluation for Rivers

This section describes the analysis methods used to assess potential sediment impacts in streams due to inputs of bridge washing effluent. The first subsection provides an overview of the basic approach that was used in this evaluation and identifies the data sources that provided input for the associated analyses. The next subsection describes in more detail the specific calculations, input data, and assumptions that were used to evaluate water quality impacts in these systems.

Overview of Approach and Data Sources

This section describes the methods used to assess potential impacts on sediment quality in rivers due to sediment inputs from bridge washing effluent. At present, Sediment Management Standards (SMS) have not been defined for sediments in freshwater or low salinity systems. Therefore, the impacts in this section were assessed relative to marine sediment quality standards as defined in WAC 173-204-320, and proposed freshwater standards as identified in Ecology (1997b).

Similar to the water quality impact evaluation described in previous sections, this evaluation of sediment impacts is not meant to be site-specific. Rather, the analysis is meant to address potential impacts for the wide variety of bridge crossings where WSDOT's washing operations might be performed. Furthermore, insufficient data are available on sediment characteristics (e.g., particle size distributions) to perform detailed analyses of the potential impacts from bridge washing activities. Therefore, this analysis should be considered a screening level evaluation of potential impacts and potential for violations of the SMS.

The first step in this sediment quality evaluation was to estimate the areal extent of sediment deposition from bridge washing for a wide variety of bridge and waterway configurations. Sediment deposition is highly specific to the hydraulic and geomorphic characteristics of the river upstream and downstream of each bridge. In typical mixing zone analysis of sediment deposition, complex mixing zone and sediment transport models such as CORMIX (Cornell Mixing Zone Expert System), BRI-STARS (Bridge Streamtube Model for Alluvial River Simulation), or EFDC-1D (Environmental Fluids Dynamics Code one-dimensional contaminant transport model) are used to evaluate sediment deposition characteristics from an effluent source. These models require assumptions for many parameters, including particle size distribution, and particle re-suspension rates. They also require a significant amount of input data for sediment transport modeling.

Because this evaluation of reasonable potential is not intended to address site-specific impacts, these types of models were considered inappropriate.

For this analysis, a simplified modeling approach was used to evaluate whether the sediments from bridge washing operations will aggrade in the immediate vicinity of the bridge, or disperse over longer distances. This modeling approach was based on a worst-case scenario with the following assumptions:

- Grain size distribution with a high density of coarser particles passing the tarp mesh opening of 0.425 mm (assumes more large particles with higher settling velocities)
- Rapid settlement of a perfect spherical object
- Low river flow rates and current velocities with low Reynolds numbers (use 7Q10 flows)

- Non-cohesive sediments with no clays, very fine organics, or colloidal material.

This approach to estimating sediment deposition includes sequential steps to estimate sediment characteristics; river flow rates; and sediment transport rates, deposition rates, and contaminant concentrations. These steps include:

1. Estimate physical characteristics of sediment
2. Obtain 7Q10 flows and river depths
3. Estimate average river horizontal current velocities
4. Estimate sediment vertical settling velocities
5. Estimate extent of sediment deposition using simple one-dimensional transport of horizontal and vertical velocity vectors
6. Estimate worst case sediment concentration downstream of bridge

To ensure that a wide variety of bridge sizes were included in the analysis, nine bridges were selected based on bridge length and the availability of flow data. Of the nine bridges, three with lengths less than the 10^{th} percentile length, three with lengths between the 10^{th} percentile and the 50^{th} percentile length, and three with lengths between the 50^{th} percentile and 90^{th} percentile lengths were selected.

As described in the water quality impact evaluation section, the primary pollutants of concern as a result of bridge washing include chromium, copper, lead and zinc. Other toxic metals, conventional pollutants, and organic contaminants are generally not present at concentrations that are shown to cause significant violations of water quality criteria. Therefore, chromium, copper, lead and zinc were the pollutants analyzed for the sediment quality impact evaluation.

Sediment quality was not directly evaluated in the available data sources described previously for characterizing bridge washing effluent (WSDOT 2001, 2002b, 2002c, 2003). Therefore, sediment quality passing though the filter tarp was estimated using the worst case effluent water quality concentrations developed in the water quality analyses section of this report.

The following subsections describe the data sources that were used to characterize background sediment quality concentrations; characterize the discharged sediment; and estimate flow rates and water depths. The specific calculations and input data used for these analyses are described in the *Calculations and Data Input* section that follows.

Data Sources for Background Sediment Quality

Data used to quantify background sediment quality characteristics in receiving waters were obtained from Ecology's Environmental Information Management (EIM) system. The EIM system is an environmental database, which stores physical, chemical, and biological environmental measurements. Extensive ancillary information about those measurements is also stored, including the geographic location of the station where a sample was collected, detailed study information, and information about the quality of the data.

For this analysis, the above database system was queried to obtain background sediment quality data for the target parameters (i.e., chromium, copper, lead, zinc) in freshwater systems. As noted above, the results from this analysis must be extrapolated to numerous WSDOT bridge washing locations. Because the EIM system contains compiled information from studies that occurred throughout the state, it was assumed that data obtained from these sources would provide the most representative characterization of background sediment quality for this purpose.

Data Sources for Sediment Characterization

Very limited data are available that specifically characterize the sediment that passes through the filter tarp containment system used by WSDOT. The Illinois Department of Transportation (IDOT) conducted a study in 2002 that included an analyses of solids and metals reduction using a filter tarp similar to the one used by WSDOT (KTA-Tator 2002). The filter tarp had an apparent opening size (AOS) equivalent to the US #40 sieve (0.425mm). The IDOT study found a reduction in the total solids of 12.92 percent (87 percent passing) but the study did not include a detailed characterization of the solids for parameters such as contaminant concentrations or particle size distribution.

Data Sources for River Stage and Flow Rates

Data used to estimate river depths and flow rates were obtained from the USGS NWISWeb Data website for Washington (USGS 2003). The website includes real time flow data, stage (depth) data for the past 18 months, and historical records and statistics for flow rates in Washington's rivers. The website does not include the low flow statistics for the 7Q10 flows. The 7Q10 flows were obtained from Volume I and II of the USGS Streamflow Statistics open file report (USGS 1985a, 1985b).

Calculations and Data Inputs

The following calculations and equations were used to calculate the total mass of sediment released from a bridge washing operation, estimated river velocity, settling velocity of sediment particles, and sediment quality concentrations after the sediment is deposited on the bottom of the river bed.

Background Sediment Quality

Background sediment quality was estimated using Ecology's Environmental Information Management (EIM) system for the primary pollutants of concern (chromium, copper, lead and zinc). The data from this initial query were further processed as follows:

1. Data from receiving waters that are on Washington State's 303(d) list were removed if the associated impairment was related to contamination from the target metals in this analysis. This was done because these waters are not representative of typical receiving water conditions and would likely not be covered under any forthcoming permit from Ecology that addresses WSDOT's bridge washing operations.

2. Individual data that exceed sediment standards for the target metals were removed. Again, this was done because these data are likely not representative of typical receiving water conditions.

The 90^{th} percentile values for the target metals in this analysis were then computed from the data that remained after the steps above were completed. The resultant values are shown in Table 6. These values were used in all subsequent calculations for assessing sediment impacts to freshwater from WSDOT's bridge washing operations.

Sediment Quality Criteria

Currently, there are no approved freshwater sediment quality criteria for the State of Washington. Ecology has developed draft guidelines (Ecology 1997b) based on the marine sediment quality standards (SQS) in WAC 173-204-320. The guidelines include a comparison of the marine standards and recently developing Apparent Effects Threshold (AET) values. For the analyses described in this report, the worst case values for the marine SQS and lowest AET were used to compare the estimated sediment quality concentrations downstream of the bridges (see Table 7).

Sediment Mass

The sediment mass generated by a bridge washing operation was estimated by calculating a wash water volume and applying the solids concentrations calculated in the water quality section of this report. The wash water volume was calculated using the worst case volume from Table 1, assuming that washing occurred continuously over an 8 hour period. This 8 hour period represents one wash event. It was assumed that the 10^{th} percentile length, 50^{th} percentile length, and 90^{th} percentile length bridges required one, two, and three wash events respectively. The mass of sediments (solids) and pollutants were calculated by multiplying the flow rate by the solids concentrations developed in the worst case water quality analysis, as shown in Tables 2 and 3. The sediment pollutant concentration was estimated as the total pollutant concentration minus the dissolved pollutant concentrations, as follows:

Table 6. Freshwater sediment background concentrations.

	Sediment Concentrations[a]			
	Cr (mg/Kg)	**Cu (mg/Kg)**	**Pb (mg/Kg)**	**Zn (mg/Kg)**
No. Samples:	123	160	213	111
Mean (mg/L):	35	50	42	95
Worst Case [b] (mg/L):	73	98	95	180

Notes:

[a] Data source: Queries of Environmental Information Management (EIM) system; Ecology (2003b).

[b] Worst case values based on 90th percentile values from compiled metals data

Table 7. Freshwater sediment criteria.

	Proposed Sediment Criteria			
	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
FSQV[b]	260	390	450	410
LAET[c]	280	840	260	520
Worst Case	260	390	260	410

Notes:

[a] Freshwater sediment criteria is not yet Established for Washington State. Proposed criteria presented is from draft Ecology "*Creation and Analysis of Freshwater Sediment Quality Values in Washington State"*

[b] FSQV = Freshwater Sediment Quality Values derived from Probable Apparent Effects Threshold (PAET) values from the marine Sediment Management Standards (SMS)

[c] LAET = Lowest Probable Apparent Effects Threshold

$$Sediment\ Mass = Flow(gallon/\min) \times 8hr \times 60\min/hr \times 3.7845L/gallon \times conc(mg/L)$$

River Velocity

An average river velocity was calculated using the flow and depth data collected from the USGS website and historical flow volume reports (USGS 1985a, 1985b) Depths were estimated using the USGS website (2003) by matching the stage flow depths with the 7Q10 flows. The width of the river was assumed to be the length of the bridge plus a side slope allowance based on a 3 to 1 slope. The width of the water in the river at lower 7Q10 values will likely be significantly less than the bridge width. However, this is a conservative approach that will underestimate the river velocity and conservatively predict that sediments will deposit close to the bridge. River velocities for the nine sample bridges are provided in Table G-2 of Appendix G.

Settling Velocity

The following equation relates the terminal settling velocity of a smooth, rigid sphere in a viscous fluid of known density and viscosity when subjected to a known force to the diameter of the sphere. The calculations are shown in detail in Appendix G. The equation is:

$$V_s = \sqrt{\frac{4\ g\ (\rho_{part} - \rho_w)\ d}{3\ C_D\ \rho_w}}$$

where:

V_s = velocity of fall (ft sec^{-1}),
g = acceleration of gravity (ft sec^{-2}),
d = size ("equivalent" diameter) of particle (ft),
ρ_{part} = density of particle (lb ft^{-3}),
ρ_w = density of water (lb ft^{-3})
C_D = Coefficient of drag

$$C_D = \frac{24}{R_e} + \frac{3}{\sqrt{R_e}} + 0.34$$

$$R_e = \frac{\rho\ V_s\ d}{\mu}$$

where:

Re = Reynolds Number
μ = viscosity of water (lb sec^{-1} ft^{-1}).

This calculation is iterative. An initial velocity is required to determine the level of turbulence (Reynolds number) and drag coefficient. The equation is used to calculate the new velocity, and the procedure is repeated until the initial and final velocities are equal. Stokes law, assuming laminar flow, is used to estimate the initial starting velocity.

$$V_s = \frac{2\ g\ r2\,(Ppart - Pw)}{9\ \mu}$$

The settling velocity was calculated for various sphere sizes based on a grain size distribution. A theoretical grain size distribution was developed assuming that the sediment in the wash water is similar to a non-cohesive fine sand and silt, much like the solids content in stormwater runoff. This is a conservative assumption because a non-cohesive sediment will settle faster than a cohesive solid with colloidal-type organic matter. The US Army prepared a technical manual for their central vehicle wash facilities that includes a typical non-cohesive washwater sediment gradation (U.S. Army 1992). The gradation included mostly fine sands and silts and a percent passing of the #40 sieve of 87 percent, which matches the percent passing for the filter tarps in the IDOT study. For this study, the particle size distribution curve was normalized to represent the materials gradation passing though the tarp as shown on Table 8.

Sediment Quality

The estimated concentrations of chromium, copper, lead, and zinc in sediment discharged from bridge washing activities are presented in Table 9. These concentrations are displayed separately for different particle size ranges based on the distribution shown in Table 8. The sediment is deposited in a zone downstream of the bridge based on the horizontal and vertical settling velocities for each particle size. First the time to settle is determined as:

$$Time\ to\ Settle\ (s) = \frac{Depth\ (ft)}{Settling\ Velocity\ \ (ft/s)}$$

Next the distance traveled for each particle size is calculated by:

$$Distance\ (ft) = Time\ to\ Settle\ (s) \times River\ Velocity\ (ft/s)$$

The migration zone is determined for each particle size as the average length between settling distance for each particle size multiplied by the width of the river.

$$Migration\ \ Zone\ (ft2) = Settling\ \ Distance\ Length\ (ft) \times River\ Width\ (ft)$$

The metals concentration in the sediment is then estimated for each sediment migration zone to determine the maximum sediment quality concentrations downstream of the bridge. Using this approach, it is assumed that the sediment is evenly deposited over the river bed in each zone. To obtain pollutant concentration, an effective sample volume is required that would represent the volume of the sample. The sampling protocol from Section 7 of *Technical Guidance for Assessing the Quality of Aquatic Environments* (Ecology 1992) suggests a sample depth of two centimeters. Therefore, the concentration increase due to the wash water sediment is calculated as:

Table 8. Sediment gradation.

Sieve Size (mm)	Percent passing (total)	Percent passing (sediments to river)	Mean Particle Size (mm)	Percent Composition for mean particle size
0.425	87%	100.0%		
			0.363	21.8%
0.3	68%	78.2%		
			0.265	20.7%
0.23	50%	57.5%		
			0.215	11.5%
0.2	40%	46.0%		
			0.150	23.0%
0.1	20%	23.0%		
			0.075	10.3%
0.05	11%	12.6%		
			0.035	6.9%
0.02	5%	5.7%		
			0.0125	5.7%
0.005	0%	0.0%		

Data Source: Chapter 3 of US Army's Technical Memorandum for Central Vehicle Wash Facilities
Sediment gradation based on typical non-cohesive soil comprising fine sand and silt

Table 9. Mass of solids and heavy metals in sediments released to river.

Mean Particle Size (mm)	Percent Composition for mean particle size	Mass[a]				
		Total Solids (Kg)	Cr (mg)	Cu (mg)	Pb (mg)	Zn (mg)
0.363	21.8%	1.107	4,418	6,800	17,115	10,100
0.265	20.7%	1.049	4,185	6,442	16,215	9,569
0.215	11.5%	0.583	2,325	3,579	9,008	5,316
0.150	23.0%	1.165	4,650	7,158	18,016	10,632
0.075	10.3%	0.524	2,093	3,221	8,107	4,784
0.035	6.9%	0.350	1,395	2,147	5,405	3,190
0.0125	5.7%	0.291	1,163	1,790	4,504	2,658
	Total	5.069	20,228	31,138	78,371	46,248

Data Source: Chapter 3 of US Army's Technical Memorandum for Central Vehicle Wash Facilities

[a] Mass calculated using worst case wash water generation estimates from Table 1 over a wash period of 8 hours

Mass assumes one washing event

[b] Mass concentrations calculated from worst case total metal concentrations from Table 2 minus the worst case dissolved concentrations from Table 3

$$Conc(mg/Kg) = \frac{Total\ Mass\ of\ \ Metals\ (mg)}{Migration\ Zone(\ ft2) \times 2cm \times 0.03281\ ft/cm \times \rho_{part}}$$

This calculation does not assume a total pollutant concentration. Background concentrations (see Table 6) are added to the above concentration to represent a total pollutant concentration.

Sediment Impact Evaluation for Marine Systems

This section describes the analysis methods used to assess potential sediment impacts in marine systems due to inputs of bridge washing effluent. The first subsection provides an overview of the basic approach that was used in this evaluation and identifies the data sources that provided input for the associated analyses. The next subsection describes in more detail the specific calculations, input data, and assumptions that were used to evaluate water quality impacts in these systems.

Overview of Approach and Data Sources

This section describes the methods used to assess potential impacts on sediment quality in a marine environment as per the marine sediment management standards (SMS) defined in WAC 173-204-320 due to sediment inputs from bridge washing effluent.

The approach for estimating sediment deposition and quality is similar to the river sediment approach (see previous section). As with all evaluations in this report, the marine sediment quality evaluation is not meant to be site-specific. Rather, the analysis is meant to address potential impacts for a variety of bridge crossings with conservative assumption. Furthermore, insufficient data are available on sediment characteristics (e.g., particle size distributions) to perform detailed analyses of the potential impacts from bridge washing activities. Therefore, this analysis should be considered a screening level evaluation of potential impacts and potential for violations of the SMS similar to that conducted for the river sediment evaluation.

Similar to the river sediment quality analysis, sediment quality was not directly evaluated in the available data sources described previously for characterizing bridge washing effluent (WSDOT 2001, 2002b, 2002c, 2003). Sediment quality was estimated using the worst case effluent water quality concentrations developed in the water quality analyses section of this report.

The following sections describe the data sources that were used to characterize background sediment quality concentrations; estimate the sediment quantities generated from bridge washing; and estimate flow rates and water depths. The specific calculations and input data used for these analyses are described in the *Calculations and Data Input* section that follows.

Data Sources for Background Sediment Quality

Similar to the river sediment quality analysis described above, chromium, copper, lead and zinc data were obtained from Ecology's Environmental Information Management (EIM) system to characterize background marine sediment quality.

Data Sources for Sediment Characterization

The same wash water effluent sediment characteristics used for the river sediment evaluation were used for the marine sediment evaluation (see previous section).

Data Sources for Flow Velocity

Data used to estimate marine tidal flow velocities are described in the marine water quality section of this report. Velocities developed for the water quality analysis were used for the marine sediment impact evaluation.

Calculations and Data Inputs

The following calculations and equations were used to calculate the total mass of sediment released from a bridge washing operation, estimated trade velocity, settling velocity of sediment particles, and sediment quality concentrations after the sediment is deposited.

Background Sediment Quality

Background sediment quality data was characterized using data from Ecology's EIM database (see Table 10).

Sediment Quality Criteria

The marine sediment quality criteria for the State of Washington are defined in WAC 173-204-320. The criteria for the pollutants of concern, chromium, copper, lead, and zinc, are shown in Table 11.

Sediment Mass

The sediment mass generated by a bridge washing operation was estimated by calculating a wash water volume and applying the solids concentrations calculated in the water quality section of this report. The wash water volume used for the marine sediment evaluation assumed the worst case effluent volume from Table 1, one washing event occurring continuously over an 8 hour period, and 3 washing events used in total. Three washing events is a very conservative estimate for the marine environment given that the washing would be spread out over a one to two month period and the tidal influences would likely spread the initial sediment loadings from the first wash over a larger area and hence diluting the maximum sediment concentration.

$$Mass = Flow(gallon/\text{min}) \times 8hr/event \times 60\,\text{min}/hr \times 3.7845\,L/gallon \times conc(mg/L) \times 3\ events$$

Table 10. Marine sediment background concentrations.

	Sediment Concentrations			
	Cr (mg/Kg)	**Cu (mg/Kg)**	**Pb (mg/Kg)**	**Zn (mg/Kg)**
No. Samples:	116	127	137	128
Mean (mg/L)	34	58	43	102
Worst Case (mg/L)	45	132	116	237

Notes:
[a] Data source: Queries of Environmental Information Management (EIM) system; Ecology (2003b).
[b] Worst case values based on 90th percentile values from compiled metals data

Table 11. Marine sediment criteria.

Sediment Criteria[a]			
Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
260	390	450	410

Notes:

[a] Marine sediment criteria taken from WAC 173-204 - Sediment Management Standards (SMS)

Tidal Water Velocity

A tidal water velocity of 0.1 meters per second (0.33 feet per second) was used as developed and described in the marine water quality evaluation (see previous section). The velocity is assumed to be constant throughout the length of the bridge.

Settling Velocity

Settling velocities for each particle size was calculated using the same methodology described fro the river sediment evaluation (see previous section). The calculations assumed a density of marine water of 64 pounds per cubic feet. The calculations are shown in detail in Table G-3 in Appendix G.

Sediment Quality

Sediment quality estimates for several distances away from the bridge were calculated using the same migration zone and horizontal and vertical velocity vector methodology described for the river sediment evaluation (see previous section).

Results

The section presents results from the analyses that were performed for this water quality impact evaluation. The presentation of these results is organized into four separate subsections analyses performed to evaluate water quality and sediment impacts in rivers and marine waters. The conclusions that are derived from these results are then discussed collectively in a subsequent section.

Water Quality Impact Evaluation for Rivers

The minimum flow rates and dilution ratios that would be needed to meet acute water quality standards in rivers given a worst-case scenario for bridge washing effluent discharge are shown in Tables 12 and 13, respectively. More detailed summaries for the associated analyses are also presented in Appendix D. These results show that there is a reasonable potential to violate acute water quality standards for all the target parameters (i.e., chromium, copper, lead, and zinc) that were evaluated, regardless of what type of data were used as input in the analysis.

However, the minimum flow rate needed to meet acute water quality standards varies markedly depending on whether the analyses are based on total recoverable or dissolved metal concentrations, and whether the acute water quality standards are adjusted or not adjusted using a WER. For example, the minimum required discharge rates required to prevent acute water quality standard exceedences for all the target metals are 4,262 and 7,929 cfs for Eastern and Western Washington rivers, respectively, when the analysis is performed based on total recoverable metal concentrations. If WER adjusted water quality standards are used with the same total recoverable metal data, the minimum required discharge rates for preventing exceedences drop to 1,037 and 1.544 cfs for Eastern and Western Washington rivers, respectively. The most dramatic differences, however, are observed between the results based on total recoverable metals versus dissolved metals. For example, the minimum required discharge rates for preventing water quality exceedences are only 327 and 332 cfs for Eastern and Western Washington rivers, respectively, based on an analysis of the dissolved metal concentrations. If the same data are used with WER adjusted acute water quality standards, the minimum required discharges rates drop to only 218 and 311 cfs for Eastern and Western Washington rivers, respectively.

When performing an analysis of reasonable potential, Ecology (1997a, 2002) guidelines require water quality impacts in streams to be assessed relative to critical, low flow conditions. More specifically, these impacts are to be assessed for the river discharge rate that is equivalent to the 7-day low flow period having a recurrence interval of 10 years (otherwise known as the 7Q10 low flow). To provide some frame of reference for interpreting the minimum river discharge rates reported above, the 7Q10 low flow value for the Cedar River at the location of WSDOT bridge 900/020 (Cedar River at Renton) is 51 cfs. Similarly, the 7Q10 low flow values for the Columbia at the location of WSDOT bridges 017/401 (Columbia at Bridgeport) and 097/420

Table 12. Mininum river discharge rates (in cubic feet per second) that would be required to meet acute water standards.

	To meet Acute Water Quality Standard (CFS)					To meet WER Adjusted Acute Water Quality Standard (CFS)				
	Cr	Cu	Pb	Zn	Maximum	Cr	Cu	Pb	Zn	Maximum
Based on measured total recoverable metals										
Eastern Washington:	43	4,262	2,341	896	4,262	22	1,037	588	597	1,037
Western Washington:	58	7,929	3,640	1,315	7,929	29	1,544	889	852	1,544
Maximum:	58	7,929	3,640	1,315	7,929	29	1,544	889	852	1,544
Based on measured dissolved metals										
Eastern Washington:	0.6	287	48	327	327	0.3	70	13	218	218
Western Washington:	0.8	332	75	299	332	0.4	104	19	311	311
Maximum:	0.8	332	75	327	332	0.4	104	19	311	311

Table 13. Minimum river dilution factors that would be required to meet acute water standards (river CFS/wastewater CFS).

	To Meet Acute Water Quality Standard					To meet WER Adjusted Acute Water Quality Standard				
	Cr	Cu	Pb	Zn	Maximum	Cr	Cu	Pb	Zn	Maximum
Based on measured total recoverable metals										
Eastern Washington:	27	2,657	1,459	559	2,657	14	646	367	372	646
Western Washington:	36	4,943	2,269	820	4,943	18	962	554	531	962
Maximum:	36	4,943	2,269	820	4,943	18	962	554	531	962
Based on measured dissolved metals										
Eastern Washington:	0.4	179	30	204	204	0.2	44	8	136	136
Western Washington:	0.5	532	47	480	532	0.2	65	12	194	194
Maximum:	0.5	532	47	480	532	0.2	65	12	194	194

(Columbia at Beebe) are 41,135 and 47,569 cfs, respectively. Additional 7Q10 low flow values for selected Western Washington rivers and streams have been compiled in Appendix E. Based on these data, it can be inferred that there is a reasonable potential for acute water quality standards to be exceeded in small to medium sized streams during critical, low flow periods due to inputs of bridge washing effluent. However, as noted above, the type of data used in the analyses has significant influence on the minimum discharge thresholds for observing these exceedances.

The following subsections discuss the results for each of the respective target metals in more detail:

Chromium

These analyses show that the minimum river discharge rate required to meet acute water quality standards is lowest for chromium relative to the other target parameters evaluated (Table 12). For example, river discharge rates must be at least 43 cfs in Eastern Washington to meet the acute water quality standard based on an evaluation of total recoverable metal concentrations and assuming no WER adjustment. Similarly, river discharge rates in Western Washington must be at least 58 cfs using the same analysis assumptions. Using dissolved metal concentrations and assuming no WER adjustment, river discharge rates in Eastern and Western Washington must be at least 22 and 29 cfs, respectively. Based on these results, chromium does not appear to be a significant constraining parameter for WSDOT's bridge washing operations.

Copper

Relative to the other metals evaluated, copper appears to be the primary constraining parameter for meeting acute water quality standards (Table 12). For example, using total recoverable concentrations and no WER adjustment, river discharge rates in Eastern and Western Washington rivers must be at least 4,262 and 7,929 cfs, respectively, in order to meet the acute water quality standard for copper. By way of comparison, the minimum required discharge rate for all the other metals evaluated is less than 3,700 cfs using same analysis assumption. Similarly, the minimum required river discharge rates are relatively high for copper in comparison to other metals when the analyses are performed based on dissolved metal concentrations. For example, using dissolved metal concentrations and assuming no WER adjustment, river discharge rates in Eastern and Western Washington must be at least 287 and 322 cfs, respectively, in order to meet the acute water quality standard for copper.

Lead

Relatively high river discharge rates are also required to meet the acute water quality standard for lead (Table 12). For example, using total recoverable concentrations and assuming no WER adjustment, river discharge rates in Eastern and Western Washington rivers must be at least 2,341 and 3,640 cfs, respectively, in order to meet the acute water quality standard for lead. Based on this information, lead also appears to be a constraining parameter for WSDOT's bridge washing operations. However, lead appears to be less of a concern when the analysis is performed using dissolved metal concentrations. For example, river discharge rates in Eastern and Western Washington must be at least 48 and 75 cfs, respectively, in order to meet the acute water quality standard for lead based dissolved metal concentrations and assuming no WER adjustment. These discharge rates are generally lower than those observed for copper and zinc using the same analysis assumptions (see proceeding and following subsections).

Zinc

Zinc appears to be a constraining parameter for meeting acute water quality standards when the analyses are performed based on dissolved metal concentrations (Table 12). For example, using dissolved concentrations and assuming no WER adjustment, river discharge rates in Eastern and Western Washington rivers must be at least 327 and 299 cfs, respectively, in order to meet the acute water quality standard for zinc. These minimum discharge rates are approximately equal to those obtained for copper using the same analysis assumptions.

Water Quality Impact Evaluation for Marine Waters

Results from the water quality impact evaluation for marine waters are summarized in Table 14. More detailed tables summarizing model input parameters and results for all model runs are presented in Appendix F. These results suggest that acute water quality standards for all the target parameters (i.e., copper, lead, and zinc) would potentially be violated based on the bridge washing scenarios that were evaluated.

Model results indicate that acute water quality standards would be exceeded for all target metals using effluent metals concentrations developed from measured total recoverable metals values (based on Ecology guidance [Ecology 2002]). However, when effluent metals concentrations developed from measured dissolved metals values were used, acute water quality standards are only exceeded for copper.

As discussed in the *Methods* section, water quality standards can be adjusted if an appropriate Water Effect Ratio is developed for the project location. No WER has been developed for the target metals in marine waters in Washington. The acute water quality standard for copper was adjusted using a hypothetical WER value developed for South San Francisco Bay to determine what effect it might have on the impact evaluation results. When model results were compared against this lower standard, the estimated copper concentration still exceeded the adjusted water quality standard when effluent concentrations were developed from total recoverable metals data. However, when dissolved metals data were used to develop effluent concentrations, the estimated copper concentration meets the WER, adjusted standard.

The following subsections discuss modeling results for each of the target metals, along with results of sensitivity analyses conducted to address uncertainty in input parameters.

Table 14. Target metals concentrations (in mg/L) at the acute mixing zone boundary in marine waters.

	Cu	Pb	Zn
CORMIX model results			
Based on measured total recoverable metals	**0.050**	**0.290**	**0.135**
Based on measured dissolved metals	**0.0060**	0.0127	0.0615
Acute water quality standard	0.0048	0.2100	0.0900
WER-adjusted acute water quality standard	0.0144	n.a.	n.a.

All metals concentrations and water quality standards shown are in the dissolved form.

Values in boldface exceed the acute water quality standard.

Copper

Copper concentrations estimated at the acute mixing zone boundary exceed the water quality standard when both total recoverable and dissolved metals values were used to develop effluent concentrations. These results are displayed in Table 14 and in Table 15, which also presents results from the sensitivity analysis, described below. A complete table of model input parameters and results is provided in Appendix F.

As described in the *Methods* section, a sensitivity analysis was conducted by varying selected model input parameters to investigate their effect on the results (see Table 15). While results vary with varying input parameter values, all copper concentrations exceed the water quality standard at the acute mixing zone boundary when effluent concentrations were based on total recoverable values. Copper concentrations estimated when effluent concentrations were based on dissolved metals values meet the water quality standard only in two cases: higher current velocity and lower water depth.

Estimated copper concentrations using lower and higher receiving water current velocity values were lower than using the base input value. These results indicate that the selected current value of 0.08 feet per second (0.025 meters per second) is a better estimate of the critical (reasonable worst-case) condition. Estimated concentrations were slightly higher when discharge was modeled at the bank, and less when higher effluent discharge velocity and lower water depth values were used. Varying wind speed and friction factor values did not have a substantial influence on model results.

Lead

The lead concentration estimated at the acute mixing zone boundary exceeds the water quality standard when total recoverable metals values were used to develop effluent metals concentrations. When dissolved metals values were used to develop effluent concentrations, the estimated lead value falls well below the standard. These results are displayed in Table 14 and in Table 16, which also presents results from the sensitivity analysis, described below. A complete table of model input parameters and results is provided in Appendix F.

As described in the *Methods* section, a sensitivity analysis was conducted by varying selected model input parameters to investigate their effect on the results (see Table 16). When effluent concentrations were based on total recoverable metals values, lead concentrations estimated in the sensitivity analysis meet the water quality standard at the acute mixing zone boundary in only two cases: higher current velocity and lower water depth. Lead concentrations estimated when effluent concentrations were based on dissolved metals values meet the water quality standard under all sensitivity analysis model runs.

Estimated lead concentrations using lower and higher receiving water current velocity values were lower than using the base input value. These results indicate that the selected current value of 0.08 feet per second (0.025 meters per second) is a better estimate of the critical (reasonable

Table 15. Sensitivity analysis of copper concentrations (in mg/L) at the acute mixing zone boundary in marine waters.

Model Run	Cu - Based on Total Recoverable Metals Data	Cu - Based on Dissolved Metals Data
Base input parameters	**0.050**	**0.0060**
Lower current velocity	**0.043**	**0.0055**
Higher current velocity	**0.015**	0.0032
Higher effluent discharge velocity	**0.038**	**0.0051**
Bank discharge	**0.054**	**0.0064**
Lower water depth	**0.017**	0.0034
Lower wind speed	**0.051**	**0.0061**
Lower friction factor	**0.050**	**0.0060**

All metals concentrations and water quality standards shown are in the dissolved form.
Values in boldface exceed the acute water quality standard for copper in marine waters (not WER-adjusted), 0.0048 mg/L.

Table 16. Sensitivity analysis of lead concentrations (in mg/L) at the acute mixing zone boundary in marine waters.

Model Run	Pb - Based on Total Recoverable Metals Data	Pb - Based on Dissolved Metals Data
Base input parameters	**0.290**	0.0127
Lower current velocity	**0.249**	0.0123
Higher current velocity	0.082	0.0107
Higher effluent discharge velocity	**0.219**	0.0120
Bank discharge	**0.315**	0.0130
Lower water depth	0.095	0.0108
Lower wind speed	**0.294**	0.0128
Lower friction factor	**0.290**	0.0127

All metals concentrations and water quality standards shown are in the dissolved form.

Values in boldface exceed the acute water quality standard for lead in marine waters, 0.21 mg/L.

worst-case) condition. Estimated concentrations were slightly higher when discharge was modeled at the bank, and less when higher effluent discharge velocity and lower water depth values were used. Varying wind speed and friction factor did not have a substantial influence on model results.

Zinc

The zinc concentration estimated at the acute mixing zone boundary exceeds the water quality standard when total recoverable metals values were used to develop effluent metals concentrations. When dissolved metals values were used to develop effluent concentrations the estimated zinc value falls well below the standard. These results are displayed in Table 14 and in Table 17, which also presents results from the sensitivity analysis, described below. A complete table of model input parameters and results is provided in Appendix F.

As described in the *Methods* section, a sensitivity analysis was conducted by varying selected model input parameters to investigate their effect on the results (see Table 17). When effluent concentrations were based on total recoverable metals values, zinc concentrations estimated in the sensitivity analysis meet the water quality standard at the acute mixing zone boundary in only two cases: higher current velocity and lower water depth. Zinc concentrations estimated when effluent concentrations were based on dissolved metals values meet the water quality standard under all sensitivity analysis model runs.

Estimated zinc concentrations using lower and higher receiving water current velocity values were lower than using the base input value. These results indicate that the selected current value of 0.08 feet per second (0.025 meters per second) is a better estimate of the critical (reasonable worst-case) condition. Estimated concentrations were slightly higher when discharge was modeled at the bank, and less when higher effluent discharge velocity and lower water depth values were used. Varying wind speed and friction factor did not have a substantial influence on model results.

Sediment Impact Evaluation for Rivers

The results of the river sediment evaluation are summarized in Table 18. More detailed results are provided in Tables H-1, H-2, and H-3 of Appendix H for several zones downstream of the bridge. Table 18 includes the total estimated contaminant concentrations in sediment that results from a bridge washing effluent discharge. The applicable worst-case sediment standards for chromium, copper, lead, and zinc are also presented, for comparison. These results indicate that there is low potential for sediment quality standards to be exceeded as a result of sediments settling from bridge wash water. For chromium, copper, and zinc, the projected concentration increase compared to background concentrations is less than 10 percent. Lead concentrations increased approximately 24 percent, but are still less than 61% of the proposed freshwater worst-case sediment standards. As discussed in the methods section, these sediment concentration estimate calculations are based on extremely conservative assumptions. For example, this

Table 17. Sensitivity analysis of zinc concentrations (in mg/L) at the acute mixing zone boundary in marine waters.

Model Run	Zn - Based on Total Recoverable Metals Data	Zn - Based on Dissolved Metals Data
Base input parameters	**0.135**	0.0555
Lower current velocity	**0.117**	0.0487
Higher current velocity	0.047	0.0217
Higher effluent discharge velocity	**0.105**	0.0439
Bank discharge	**0.145**	0.0594
Lower water depth	0.052	0.0237
Lower wind speed	**0.136**	0.0560
Lower friction factor	**0.134**	0.0553

All metals concentrations and water quality standards shown are in the dissolved form.

Values in boldface exceed the acute water quality standard for zinc in marine waters, 0.09 mg/L.

Table 18. Sediment concentrations for worst case areas downstream of bridge.

Bridge ID	Percentile Lengths	River	Worst Case Sediment Concentrations			
			Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
507/008	10th	Skookumchuck	83	113	134	203
006/008		Willapa	89	123	158	217
900/020		Cedar	78	106	115	192
005/140	50th	Toutle	76	103	107	187
203/106		Skykomish	75	101	103	182
014/201		White Salmon	75	101	103	185
101/204	90th	Queets	77	104	109	188
542/010		Nooksack	75	101	104	185
395/545		Columbia	73	98	95	180
		Proposed Criteria	**260**	**390**	**260**	**410**

Notes:

[a] Sediment concentrations = background concentrations (Table 7) plus concentration increase at worst case zone downstream of bridge (Tables 11 through 13)

analysis assumed rapid settlement of the sediment, no scour to disperse sediment, no sediment re-suspension that might allow further migration and dilution downstream, and low current velocities.

The results of this analysis indicate that effluent discharges from washing the larger 90th percentile length bridges have very little impact on sediment quality, even under the low flow scenario. For these bridges, the sediment concentrations increased by approximately 0.5 percent to 5 percent over background. Effluent discharges from washing the smaller 10th percentile length bridges caused the highest increase in metals concentrations, approximately 6 percent to 24 percent over the background sediment concentrations, nonetheless the sediment quality concentrations still did not exceed the worst case proposed sediment quality standards. These higher metal concentrations in the sediments were a result of very low river flow rates of 20 to 50 cfs and rapid deposition of the sediments near the bridge. Given that these low flow rates are five to ten times less than the minimum flow rates required to meet the criteria for water quality standards (see previous section), the results suggest that bridge washing effluent impacts on sediment quality are not the driving regulatory constraint associated with bridge washing.

Sediment Impact Evaluation for Marine Waters

The results of the marine sediment quality evaluation and estimates for the total pollutant concentrations in sediments from a bridge washing effluent discharge are summarized in Table 19. More detailed results are provided in Table H-4 of Appendix H. For comparison, Table 19 includes the applicable marine sediment management standards (SMS) for chromium, copper, lead, and zinc as derived from WAC 173-204-320. These results indicate that there is low potential for sediment quality standards to be exceeded as a result of sediments settling from bridge wash water in a marine environment.

Sediment quality impacts were evaluated for three relatively shallow depths: two, five, and ten feet. For the worst case of two feet, the increase over background concentrations was less than 8 percent and the total pollutant concentration in sediments was approximately 21 percent, 38 percent, 34 percent and 63 percent of the marine SMS for chromium, copper, lead, and zinc, respectively. Given the results of the marine water quality analysis (see previous section), these results suggest that bridge washing effluent impacts on sediment quality are not the driving regulatory constraint associated with bridge washing in an marine environment.

Table 19. Sediment concentrations for marine environment for worst deposition area.

Water Depth (ft)	Worst Case Sediment Concentrations			
	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
2	55	147	153	259
5	49	137	130	245
10	48	136	127	243
SMS Criteria	**260**	**390**	**450**	**410**

Notes:

[a] Sediment concentrations = background concentrations (Table 15) plus concentration increase at worst case zone downstram of bridge (Table 17)

Discussion and Conclusions

As noted previously, the water quality standards for both river and marine systems are defined in WAC 173-201A. These standards were established based on existing and potential uses of the surface water of the state including: 1) aquatic life uses, 2) water contact recreation uses, and 3) shellfish harvesting. Pursuant to these standards, toxic substances such as heavy metals may not be introduced into waters of the state at levels that have the potential either singularly or cumulatively to adversely affect these characteristic uses. Similarly, sediment quality standards, as defined in WAC 173-204A, were promulgated to reduce or eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination. Both the surface water and sediment standards must be considered when assessing compliance with the state surface water quality standards. Where a reasonable potential determination indicates that these water quality standards may be violated due to an effluent discharge, Ecology may impose limitations or restrictions on this effluent.

Based on the results presented in the preceding sections of this report, there appears to be a reasonable potential for state water quality standards to be violated in some river systems due to inputs of bridge washing effluent. The results also show a reasonable potential exists for violating water quality standards in marine systems. Violations of sediment standards appear unlikely in both rivers and marine systems. Therefore, the remainder of this discussion focuses on the water quality analysis.

A closer evaluation of the results for river systems suggests that there are three broad categories of rivers systems with differing levels of potential impact from bridge washing effluent. Thus, any future effluent limits associated with bridge washing activities would be expected to address the specific conditions and concerns associated with each of these categories. In general, these categories are differentiated on the basis of river discharge rates and the level of uncertainty in the associated analysis results. These categories are defined as follows:

> **Large River Systems**: Based on the data presented in Tables 12 and 13, there is sufficient dilution capacity in a subset of river systems with very high flow rates (e.g., discharge greater than 4,000 cfs) such that water quality violations would not occur for any of the target metals evaluated in this analysis. Presumably, no future effluent limits would be required for these systems.
>
> **Medium River Systems**: For a subset of medium sized rivers (e.g., discharge between 200 and 4,000 cfs), the uncertainties in the data and analyses make it difficult to make definitive conclusions regarding potential water quality violations from bridge washing effluent. These uncertainties stem from the issues discussed above in relation to metal translator values and potential site-specific influences on metal toxicity. For these systems, the minimum river flow rates needed to meet acute water quality standards vary markedly depending on what type of data (e.g., dissolved versus total metals concentrations) are used as input in the analysis. Given these uncertainties, it is likely that some type of effluent

limit would be imposed for river systems of this size. However, it is also expected that a significant emphasis would also be placed on data collection efforts designed to resolve some of these uncertainties.

Small River Systems: For some smaller sized river systems (e.g., discharge less than 200 cfs), the results indicate that a reasonable potential for water quality violations exists even if analysis and data uncertainties are reduced. Presumably, more stringent permit requirements, compliance schedules and effluent limits would be issued for these smaller systems.

Unlike the river systems, the impact analysis for marine systems generally showed there was a reasonable potential for water quality standards to be violated despite the analysis uncertainties surrounding the metal translator values and potential site-specific influences on metal toxicity. Many of these potential violations are related to high estimated copper concentrations at the edge of the mixing zone, based on both total recoverable and dissolved concentrations for this parameter. The water quality standard for copper was also exceeded when the associated WER was included in the analysis. Presumably, more stringent permit requirements, compliance schedules, and effluent limits would be issued for marine systems.

However, the modeling results from this analysis indicate that bridge wash water effluent discharged to marine water bodies will form a relatively thin, buoyant plume at the receiving water surface due to the density difference between the waters. Therefore, it is unlikely that pollutant concentrations that exceed water quality standards will harm fish, as this plume configuration will allow them to avoid contact with effluent contaminants by remaining in deeper water. In most situations, much of the water column will be free of elevated pollutant concentrations, providing space for fish to move freely without harm in the vicinity of washing activities.

In addition to the previously identified analysis uncertainties, additional factors specific to WSDOT's bridge washing activities influence the interpretation of these results. Most notable of these are potential biases that are introduced into the analysis through the application of protocols that are mainly directed at an evaluation of potential water quality impacts from a fixed, point source that discharges either continuously or intermittently over long periods of time. As noted above, Ecology (2002) guidelines require the reasonable potential determination to be performed based on a reasonable worst-case scenario.

Specifically, these protocols require that all input parameters for the analysis reflect potential worst-case conditions which likely results in a gross over estimation of the likely hood of exceeding standards for WSDOT bridge and marine transfer span washing and painting operations. For the impact analysis for rivers, the input parameters include: effluent discharge rate, effluent metal concentrations, receiving water metal concentrations, receiving water hardness concentration, and receiving water flow rate. Worst-case assumptions were used for a similar suite of parameters in the impact evaluation for marine systems.

Worst-case scenarios of this type are generally considered appropriate for an effluent source that discharges continuously at a fixed location because there is a relatively high probability that most or all of the individual worst-case conditions will occur simultaneously in the operational lifetime of the facility. However, WSDOT's bridge washing operations occur at numerous locations throughout the state and the associated effluent discharge only occurs over short, discontinuous intervals with typically 10 to 15 year time spans between separate wash event at each location. Therefore, the probability that all these individual worst-case conditions will occur simultaneously is much lower than it would be for a continuous point discharge. Based on thee considerations it is likely that the compounding effect of worst-case assumptions for each parameter results in an overly conservative estimate of impacts from WSDOT's bridge washing operations.

Recommendations

This section presents recommendations for those situations where the preceding analysis showed water quality standards would potentially be exceeded due to inputs of bridge washing effluent. It is anticipated that these recommendations will support subsequent negotiations between WSDOT and Ecology to develop NPDES permit conditions for bridge washing activities.

Reducing Analysis Uncertainty

As noted in the *Conclusion* section to this report, a number of uncertainties have been identified in the data and analyses that were conducted for this reasonable potential determination for WSDOT's bridge washing activities. Furthermore, the analysis was performed using numerous worst-case assumptions that likely cause potential water quality impacts to be overestimated. The following recommendations are made to address these concerns:

- Additional studies are recommended to better characterize effluent pollutant concentrations and generate more representative metals translator values. The data obtained from these studies would allow a more accurate and scientifically defensible assessment of water quality impacts from bridge washing operations. Furthermore, it is anticipated that any subsequent analyses performed using these additional data will likely show a reduced level of impact from bridge washing effluent. These studies should be done in consultation with Ecology so that the resultant data can be applied without qualification to any ensuing analysis of reasonable potential for WSDOT's bridge washing operations.

- Once additional data are available to characterize effluent pollutant concentrations, potential impacts from WSDOT's bridge washing operations should be revaluated using alternative analysis procedures that describe the statistical probability for exceeding water quality standards. For example, a Monte Carlo simulation could be used to model receiving water pollutant concentrations using the simulated probability distributions for one or more of the following input parameters: effluent pollutant concentration, effluent discharge rate, receiving water flow rate, receiving water background pollutant concentrations, and receiving water hardness. In contrast to the worst-case approach used in this reasonable potential evaluation, the results from such an analysis would provide an actual probability distribution for predicting the frequency of water quality standard exceedances. This output would, in turn, provide Ecology with significantly more information for determining what permit requirements may be warranted for bridge washing activities.

- Whole effluent toxicity (WET) limits should be derived for WSDOT's bridge washing effluent in accordance with RCW 90.48.520, 40 CFR 122.44(d), and 40 122.44(e) for inclusion into any subsequent NPDES permit. Per these regulations, WET limits are required when it has been shown that there is reasonable potential to discharge toxics in toxic amounts. The specific procedures for deriving WET limits are presented in WAC 173-205 and Ecology (2002).

Bridge Washing Operational Changes

Based on the results presented in the preceding section, there appears to be a reasonable potential for state water quality standards to be violated in some river systems due to inputs of bridge washing effluent. The results also show a reasonable potential exists for violating water quality standards in marine systems. Therefore, it is likely that some type of effluent limit or permit compliance schedule would be imposed for these systems to provide a margin of safety for protecting the associated aquatic resources. The following recommendations are proposed for these situations:

- For smaller rivers and marine systems may that lack adequate dilution capacity, the number of washers operating simultaneously should be limited so as to reduce overall pollutant loading rates and prevent the occurrence of water quality violations.

- For bridge washing projects that are occurring over particularly sensitive receiving waters during critical conditions (e.g., low flow), full containment of the bridge wash water should be considered. WSDOT and Ecology would need to negotiate and acceptable disposal option for the recovered wash water.

- The scheduling of wash events should be prioritized around receiving water hydrologic conditions that will minimize water quality impacts. This might include, implementing a scheduling system such that high flow years are predicted based on hydrologic and climatic indicators. Bridges over the most sensitive receiving waters would then be targeted for washing during these periods. Bridge washing activities might also be scheduled during high flow periods in receiving waters that are associated with spring snow melt.

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APPENDIX A

Summary Table for Data Collected During WSDOT Bridge Washing Studies

Table A1. Effluent pollutant concentrations from WSDOT bridge washing studies.

Parameter	Stillaguamish River Bridge near Stanwood, WA		Skykomish River Bridge near Gold Bar, WA	Cowlitz River Bridge near Kelso, WA	Nooksack River Bridge	Average	Maximum	CV
Sampling Date	August 17, 2000[c]	August 31, 2001	May 17, 2002	June 3, 2002	August 17, 2003			
Conventional/Biological Parameters								
Temperature (C°)[a]	NM	NM	8.2/8.8	13.8/14.4	ND	10.42	14.4	0.273
PH	7.88/7.94	7.79/7.88	7.99/8.30	7.49/7.75	ND	7.81	8.30	0.035
Dissolved Oxygen (mg/L)[a]	NM	NM	11.65/12.22	10.17/10.78	ND	11.11	12.22	0.070
Conductivity (mS/cm)[a]	NM	NM	0.23/0.37	0.18/0.39	ND	0.23	0.39	0.328
Total Coliform (MPN/100 ml)[a]	NM	NM	95/400	NM	ND	149.25	400	1.180
Biochemical Oxygen Demand (mg/L)	100	170	33	67	ND	92.5	170	0.632
Total Suspended Solids (mg/L)	300	520	403	930	ND	538	930	0.513
Hardness (mg/L)	NM	NM	120	130	ND	125	130	0.057
Heavy Metals								
Antimony – dissolved (mg/L)	0.07 U	0.07 U	0.003 U	0.0025 U	ND	0.036	0.070	1.067
Antimony – total recoverable (mg/L)	NM	NM	NM	0.0067	ND	0.007	0.007	NA
Arsenic – dissolved (mg/L)	0.007	0.005 U	0.0011	0.0025 U	ND	0.004	0.007	0.672
Arsenic – total recoverable (mg/L)	NM	NM	0.12	0.0061	ND	0.063	0.120	1.277
Beryllium – dissolved (mg/L)	0.003 U	0.003 U	0.002 U	0.002 U	ND	0.003	0.003	0.231
Beryllium – total recoverable (mg/L)	NM	NM	NM	0.002 U	ND	0.002	0.002	NA
Cadmium – dissolved (mg/L)	0.005 U	0.005 U	0.0005 U	0.0025 U	ND	0.003	0.005	0.671
Cadmium – total recoverable (mg/L)	NM	NM	NM	0.0011	ND	0.001	0.001	NA
Chromium – dissolved (mg/L)	0.01 U	0.01 U	0.01 U	0.01 U	0.0227	0.013	0.023	0.453
Chromium – total recoverable (mg/L)	NM	NM	NM	0.368	0.993	0.681	0.993	0.649
Chromium – total (mg/L)	NM	NM	NM	NM	1.03	1.030	1.030	NA
Copper – dissolved (mg/L)	**0.022**	**0.041**	**0.178**	**0.0263**	**0.0590**	**0.065**	**0.178**	0.991
Copper – total recoverable (mg/L)	NM	NM	2.05	0.128	0.0815	0.753	2.050	1.491
Copper – total (mg/L)	NM	NM	NM	NM	0.0829	0.083	0.083	NA
Lead – dissolved (mg/L)	**0.07**	**0.076**	**0.13**	**0.0645**	**0.0775**	**0.084**	**0.130**	0.316
Lead – total recoverable (mg/L)	NM	NM	6.48	10.5	1.22	6.067	10.500	0.767
Lead – total (mg/L)	NM	NM	NM	NM	1.28	1.280	1.280	NA
Mercury – dissolved (mg/L)	0.0002 U	0.002 U	0.002 U	0.0002 U	ND	0.001	0.002	0.945
Mercury – total recoverable (mg/L)	NM	NM	NM	0.0002 U	ND	0.000	0.000	NA
Nickel – dissolved (mg/L)	0.02 U	0.02 U	0.01 U	0.01 U	ND	0.015	0.020	0.385
Nickel – total recoverable (mg/L)	NM	NM	NM	0.0227	ND	0.023	0.023	NA
Selenium – dissolved (mg/L)	0.05 U	0.05 U	0.003 U	0.0025 U	ND	0.026	0.050	1.034
Selenium – total recoverable (mg/L)	NM	NM	NM	0.003 U	ND	0.003	0.003	NA
Silver – dissolved (mg/L)	0.007 U	0.007 U	0.01 U	0.0025 U	ND	0.007	0.010	0.467
Silver – total recoverable (mg/L)	NM	NM	NM	0.01 U	ND	0.010	0.010	NA
Thallium – dissolved (mg/L)	0.005 U	0.2 U	0.0005 U	0.0025 U	ND	0.052	0.200	1.898
Thallium – total recoverable (mg/L)	NM	NM	NM	0.005 U	ND	0.005	0.005	NA
Zinc – dissolved (mg/L)	**2.1**	**1.7**	**1.06**	**1.34**	**1.02**	**1.444**	**2.100**	0.316
Zinc – total recoverable (mg/L)	NM	NM	3.63	4.47	1.65	3.250	4.470	0.446
Zinc – total (mg/L)	NM	NM	NM	NM	1.57	1.570	1.570	NA
Volatile Organics[b]								
Ethylbenzene (mg/L)	NM	NM	0.0024	NM	ND	0.0024	0.0024	NA
m, p-Xylene (mg/L)	NM	NM	0.0079	NM	ND	0.0079	0.0079	NA
o-Xylene (mg/L)	NM	NM	0.0036	NM	ND	0.0036	0.0036	NA
1, 3, 5-Trimethylbenzene	NM	NM	0.0014	NM	ND	0.0014	0.0014	NA
4-Chlorotoulene	NM	NM	0.00053	NM	ND	0.0005	0.0005	NA
1, 2, 4-Trimethylbenzene	NM	NM	0.0043	NM	ND	0.0043	0.0043	NA

Data source: WSDOT 2001, 2002a, 2002b

[a] Values presented are the median and maximum, respectively, from replicate field measurements.

[b] Parameters listed are present in the paints used by WSDOT on bridge structures.

[c] A two tarp system was used on this date to filter bridge washing effluent.

CV: Coefficient of variation.

NM: Not measured.

ND: Data not currently available.

NA: Not applicable.

U: Analyte not detected at the specified detection limit.

Values in **bold** exceed state water quality standards for acute freshwater toxicity (based on an assumed hardness of 26 mg/L as $CaCO_3$).

APPENDIX B

Field Reports from WSDOT Bridge Washing Studies

Stillaguamish River Bridge Painting Project
Near Stanwood, Washington
August 2001

Contents:

- Project Narrative
- Summary Spreadsheet of Water Quality Monitoring Results
- Filter Fabric Specifications
- Field Report
- Data Calculations and Interpretations
- Analytical Laboratory Report
- Pictures of Washing Operations

NOTE: First of Three Bridge Washing Monitoring Projects

Submitted
12/24/02
[illegible]

MONITORING REPORT
of the
STLLAGUAMISH RIVER BRIDGE PAINTING PROJECT
October 4, 2001

The Washington State Department of Transportation (WSDOT), Northwest Region, is involved with a painting and rocker bearing repair project on the Stillaguamish River Bridge (532/2). The bridge is located on state-road 532 from mileposts 3.39 to 3.48. The bridge project is operating under contract C-6160 and the Contractor hired to paint the bridge is A&A Coatings, Inc.

The Maintenance and Operations Programs, Safety and Health Services Office, cooperating with the Northwest Region Safety Office and the Everett Engineering Office, continues to be involved with an ongoing study of environmental and occupational hazard exposures. The study involves an extensive amount of site reconnaissance, project participation, communication, and data collection and interpretation. Work happening on the Stillaguamish River Bridge allowed for an opportune time to monitor on-site exposures. Exposure monitoring on the Stillaguamish River Bridge project was performed during pressure washing of the structural steel and of the subsequent discharge of water through a specified "belly tarp system".

On August 17, 2001, using a two-tarp system, the Contractor performed pressure washing work activities between piers three (3) and four (4). On August 31, 2001, using a one-tarp system, the Contractor performed pressure washing work activities between piers five (5) and six (6) on the Stillaguamish River Bridge. Pressure-wash equipment used to clean the steel surfaces generated approximately 3200 psi of pressure. Approximately 2000 to 2400 gallons of potable water (obtained from the city of Stanwood) was used to clean steel between piers. The Contractor estimated he would use approximately 8000 to 9600 gallons of water to clean the entire bridge. Containment and filtration of the wash-water consisted of non-porous side tarps, and a porous belly tarp system. Specification of the filtration belly tarp system used on the painting project is shown in attachment No. 1. Also, included with this attachment is a small example "swatch" of the filter fabric being used on WSDOT's various painting projects. The filter fabric is the absorbent type capable of containing paints, debris, and oil and grease contaminants.

During all critical and representative periods of the pressure washing conducted on August 17 and 31, 2001, composite discharge water samples were collected. The water samples, designated as "screened discharge", were collected after belly tarp filtration and prior to discharge to the environment. In addition to the screened discharge samples and for quality assurance/control grab samples of the receiving water, wash water, and a field blank were collected. Field analyses for pH was measured at the time of discharge using calibrated equipment. All samples collected at the project site were submitted to CCI Analytical Laboratories, Inc. (an accredited laboratory) via chain of custody protocols. Parameter analyses of the water samples consisted of heavy metals, biochemical oxygen demand (BOD), total suspended solids (TSS), visual oil and grease, and pH.

Shown in attachment No. 2 is a complete data summary of the analytical testing results. The spreadsheet shows the sample identification, parameter test results, standard comparisons, and other pertinent information.

Shown in attachment No. 3 are site pictures of the work operations, field reports, and other project pertinent information.

As evidenced by the analytical data collected from the Stillaguamish River Bridge project, and from the site reconnaissance, field observations, and post project follow up, the following findings and recommendations are provided:

- Using "dissolved" analytical methodologies for the heavy metal parameters, and with a few exceptions, water samples collected after belly tarp filtration and prior to discharging into the environment are below or equal to maximum contaminant levels (MCL). The MCL are drinking water standards established by the Clean Water Act.
- Optimum water quality measurements for pH collected during the pressure wash discharge ranged from 7.40 to 7.90 units.
- Small concentrations of arsenic, copper, lead and zinc were detected in the discharge water. Only lead was detected slightly above the MCL.
- Analytical detection limits for a few metal parameters are above the MCL.
- On average for the entire bridge pressure wash work activities, approximately 30lb to 35lb of total suspended solids (TSS) was discharged to the environment. As a comparison, there are approximately 2,490lbs in 1.0 yd^3 of washed sand. Washed sand is a good example of a suspended solid.
- On average for the entire bridge pressure wash work activities, approximately 10lb to 12lb of biochemical oxygen demand (BOD) was discharged to the environment. As a comparison, a small brewery may discharge approximately 10,500lbs per day into a publicly owned treatment works (POTW). Daily, a POTW may discharge from 300 lb to 600 lb of BOD into Washington State receiving waters.
- Visual sheens of oil and grease were not observed post tarp filtration.
- Publicly Owned Treatment Works (domestic and commercial wastewater treatment plants) that discharge millions of gallons of water per day into the environment are not required to have hydraulic permits.
- I recommend that for future bridge painting projects and/or for maintenance work operations (i.e., bridge cleaning) that a single ply of filter fabric be used for filtering the pressure wash water.

- From my experiences with bridge painting projects, some recent research, data and information contained herein, and from my understanding of environmental law (RCW 77-55-100), NONE of the work associated with bridge painting requires hydraulic permits. I strongly recommend that WSDOT stop obtaining hydraulic permits. Also, I suggest that we work with the Attorney Generals Office (i.e., get it in writing that hydraulic permits are not required for our painting projects).
- WSDOT should consult with the Department of Ecology to determine if a National Pollution Discharge Elimination System (NPDES) general permits are needed for bridge painting projects.

NOTE 1: It is very important to know that the data and information collected as part of this project is NOT considered to be "baseline" or "representative". WSDOT will need to collect similar data and information on upcoming painting projects in order to establish a more representative baseline.

NOTE 2: I am confident that WSDOT maintenance personnel may be able to use the data and information contained in this report, especially as it relates to bridge cleaning and maintenance activities. I've had the opportunity to observe bridge-cleaning operations using pressure washing and vacuum-truck equipment. Pressure washing using a filtering tarp system appears to be much safer, much more efficient, and the structural steel is significantly cleaner.

NOTE 3: A complete copy of the laboratory report will be kept on file in the Safety and Health Services Office.

NOTE 4: Please forward this report to personnel in your region that may have an interest in the data and information contained herein.

DRH:drh

ATTACHMENT

No. 1

Filter Fabric Specifications

SYNTHETIC INDUSTRIES
CONSTRUCTION PRODUCTS DIVISION
"Smart Solutions in Synthetics"

401 Nonwoven Geotextile

401 is a polypropylene, staple fiber, needlepunched nonwoven geotextile manufactured at one of Synthetic Industries' facilities that has achieved ISO-9002 certification for its systematic approach to quality. The fibers are needled to form a stable network that retain dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils. Synthetic Industries 401 conforms to the property values listed below:

PROPERTY	TEST METHOD	MINIMUM AVERAGE ROLL VALUES[1]	
Mechanical		**English**	**Metric**
Grab Tensile Strength	ASTM D4632	100 lbs	445 N
Grab Elongation	ASTM D4632	50 %	50 %
Puncture Strength	ASTM D4833	65 lbs	285 N
Mullen Burst	ASTM D3786	225 psi	1550 kPa
Trapezoidal Tear	ASTM D4533	45 lbs	200 N
Hydraulic			
Apparent Opening Size (AOS)	ASTM D4751	70 US Std. Sieve	0.212 mm
Permittivity, Ψ	ASTM D4491	2.00 sec^{-1}	2.00 sec^{-1}
Permeability, $k = \Psi \bullet t$	ASTM D4491	0.22 cm/sec	0.22 cm/sec
Water Flow Rate	ASTM D4491	140 gpm/ft^2	5700 $l/min/m^2$
Endurance			
UV Resistance (% retained @ 500 hours)	ASTM D4355	70 %	70 %

Notes:

1 Values shown are in weaker principal direction. Minimum average roll values represent a 95 percent confidence level, calculated as the mean minus two standard deviations.

Standard Roll Size: 12.5' x 360' = 500 sq. yds. 15.0' x 360' = 600 sq. yds.

NW401-4-4.24.95

4019 Industry Drive • Chattanooga, TN 37416 • 615/899-0444 FAX 615/899-7619 Toll Free 800/621-0444

ATTACHMENT

No. 2

Analytical Data Summary

Field Report 8/17/01 DRH

* Pictures taken

@ 9:10 Am arrived on site, met w/ Tricia & contractors (Abercrombie). Power spraying operations commenced - I proceeded to collect representative discharge sample from / thru the belly tarps.

@ 9:25 Am collected 1st rep. sample (i.e., partially filling sample bottles at critical discharge points).

pH = 7.75

@ 9:40 Am collected 2nd rep. from 1st power-spray section. pH = 7.70

Notes → according to plans, power spray operation were/are occuring between Piers 3 & 4.

→ Tanker truck holds ~2400 gallons

→ AA obtained water from hydrant Stanwood.

→ Contractor is moving belly tarps to Section 2 that will be washed.

@ 10:25 Am started power washing section 2

@ 10:30 Am collected 3rd rep sample - pH = 7.84

@ 10:40 Am collected 4th rep sample - pH = 7.90

@ 10:50 Am - collected "field blank" - water used to decon pH meter.

@ 11:05 Am - collected "receiving water" sample - Note water was flowing down stream - low tide.

@ 11:15 Am - collected "tanker" water sample - tanker water is used to power-wash bridge.

@ 11:25 Am - AA started washing 3rd section of bridge between piers 3 + 4.

@ 11:35 Am collected 5th representative sample
pH = 7.89

@ 11:45 Am collected 6th + final representative sample.
pH = 7.94 - bottles full.

Note - collected 3 full bottles of screened discharge, 1 full bottle of QA/QC samples
→ samples are immediately being deliver to Lab.
→ samples kept on ice while in field

~ 15 pictures (digital) of power-spraying work operation were taken.

Note - contractor will use approximately 2000 to 2400 gallons of water to wash steel between piers 3 + 4. Also, will use approximately the same water amount between other piers during spray operations.

Note - samples collected @ various times thruout bridge cleaning had No visual O+G sheen.

Field Report 8/31/01 DRH * pictures taken

@ 7:35 Am - arrived on site, met w/ Tricia and AA Painting, Abercrombies. Work is between piers 5 & 6.

AA Painting is using a single ply of tarp during the power washing activities this morning. (see attached tarp spec). This single tarp system is per the request of Terra Hegy of WDFW.

@ 7:55 Am Contractor started power-spraying work operations the 1st representative sample was collected @ 8:05 am - pH = 7.49

Note: I plan to collect six representative samples and have a composite sample for analyses. (i.e., bottles are being filled 1/6 of volume for each grab)

@ 8:15 Am collected 2nd rep sample pH = 7.88

Note - as compared to sampling performed on 8/17/01, this water appears a little more "cloudy". Also, the bridge does appear to be "dirtier" between piers 5 & 6.

@ 8:45 Am Contractor started washing 2nd section of bridge
@ 8:50 collected 3rd rep sample - pH = 7.83
@ 9:00 collected 4th rep sample - pH = 7.76

@ 9:25 Contractor started power washing 3rd section

@ 9:30 collected 5th rep pH = 7.69
@ 9:40 collected 6th & final rep pH = 7.81

Departed site for delivery of samples to analytical lab. CCI.

Note - low tide w/ river flowing out - most water falling on bank. Env. conditions were sprinkles ~ 60°F

Pound conversions for screened discharges on 8/17/01 and 8/31/01.

Note 1 - Two belly tarps (see attached tarp specification) were used during the washing event between piers 3 & 4 on 8/17/01.

Note 2 - One belly tarp (same spec. as above) was used during the washing event between piers 5 & 6 on 8/31/01.

Analytical Results & conversions for data collected on 8/17/01.

Total Suspended Solids (TSS) $300\,\mathrm{mg}/\mathrm{L} \times \frac{1.0\,\mathrm{L}}{0.2642\,\mathrm{gal}} \times \frac{1\,\mathrm{kg}}{1\times10^6\,\mathrm{mg}} \times \frac{2.20\,\mathrm{lb}}{\mathrm{kg}} = \boxed{\frac{0.0025\,\mathrm{lb\ TSS}}{\mathrm{gal}}}$

Contractor estimated he would use approximately 2000-2400 gallons of water between piers 3 & 4.

$$\frac{0.0025\,\mathrm{lb\ TSS}}{\mathrm{gal}} \times \frac{2400\,\mathrm{gal}}{\mathrm{wash\ event}} = \boxed{\frac{6.0\,\mathrm{lb\ TSS}}{\mathrm{wash\ event}}}$$

Biochemical oxygen Demand (BOD) $\left[\overset{\mathrm{BOD}}{100\,\mathrm{mg}/\mathrm{L}} \times \frac{1.0\,\mathrm{L}}{0.2642\,\mathrm{gal}} \times \frac{1\,\mathrm{kg}}{1\times10^6\,\mathrm{mg}} \times \frac{2.20\,\mathrm{lb}}{\mathrm{kg}}\right] \times \frac{2400\,\mathrm{gal}}{\mathrm{wash\ event}} = \boxed{\frac{2.0\,\mathrm{lb\ BOD}}{\mathrm{wash\ event}}}$

Analytical Results & conversions for data collected on 8/31/01.

TSS $520\,\mathrm{mg}/\mathrm{L} \times \frac{1.0\,\mathrm{L}}{0.2642\,\mathrm{gal}} \times \frac{1\,\mathrm{kg}}{1\times10^6\,\mathrm{mg}} \times \frac{2.20\,\mathrm{lb}}{\mathrm{kg}} \times \frac{2400\,\mathrm{gal}}{\mathrm{wash\ event}} = \boxed{\frac{10.4\,\mathrm{lb\ TSS}}{\mathrm{wash\ event}}}$

BOD $170\,\mathrm{mg}/\mathrm{L} \times \frac{1.0\,\mathrm{L}}{0.2642\,\mathrm{gal}} \times \frac{1\,\mathrm{kg}}{1\times10^6\,\mathrm{mg}} \times \frac{2.20\,\mathrm{lb}}{\mathrm{kg}} \times \frac{2400\,\mathrm{gal}}{\mathrm{wash\ event}} = \boxed{\frac{3.4\,\mathrm{lb\ BOD}}{\mathrm{wash\ event}}}$

Note 3 - contractor estimated he would use approximately 2000-2400 gallons of water between piers 5 & 6.
Note 4 - Contractor had four (4) wash events for Still?? bridge.

Comparisons of Discharge

1) There are approximately 2,490 lbs in $1.0\,\mathrm{yd}^3$ of washed sand (i.e. TSS)

2) A standard sized brewery may discharge approximately 10,500 lb/day of BOD to a treatment system.

3) A treatment plant may discharge 200 to 500 lb BOD per day into state waters. (reference LOTT)

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ANALYTICAL
LABORATORIES, INC.

CERTIFICATE OF ANALYSIS

CLIENT: WASHINGTON STATE DEPT. OF TRANSPORTATION
P.O. BOX 47311
OLYMPIA, WA 98504-7311

DATE: 9/7/01
CCIL JOB #: 108056
CCIL SAMPLE #: 1
DATE RECEIVED: 8/17/01
WDOE ACCREDITATION #: C142

CLIENT CONTACT: DAVID HAMACHER

CLIENT PROJECT ID: STILLIGUAMISH RIVER BRIDGE (SRB)
CLIENT SAMPLE ID: SCREENED DISCHARGE 8/17/01

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
BOD	EPA-405.1	100	MG/L	8/17/01	LMH
TOTAL SUSPENDED SOLIDS	EPA-160.2	300	MG/L	8/27/01	HJK
DISSOLVED ANTIMONY	EPA-6010	ND(<0.07)	MG/L	8/24/01	LMH
DISSOLVED ARSENIC	EPA-7060	0.007	MG/L	9/6/01	LMH
DISSOLVED BERYLLIUM	EPA-6010	ND(<0.003)	MG/L	8/24/01	LMH
DISSOLVED CADMIUM	EPA-6010	ND(<0.005)	MG/L	8/24/01	LMH
DISSOLVED CHROMIUM	EPA-6010	ND(<0.01)	MG/L	8/24/01	LMH
DISSOLVED COPPER	EPA-6010	0.022	MG/L	8/24/01	LMH
DISSOLVED LEAD	EPA-7421	0.070	MG/L	8/31/01	LMH
DISSOLVED MERCURY	EPA-7470	ND(<0.0002)	MG/L	8/27/01	LMH
DISSOLVED NICKEL	EPA-6010	ND(<0.02)	MG/L	8/24/01	LMH
DISSOLVED SELENIUM	EPA-6010	ND(<0.05)	MG/L	8/24/01	LMH
DISSOLVED SILVER	EPA-6010	ND(<0.007)	MG/L	8/24/01	LMH
DISSOLVED THALLIUM	EPA-7841	ND(<0.005)	MG/L	9/4/01	LMH
DISSOLVED ZINC	EPA-6010	2.1	MG/L	8/24/01	LMH

* "ND" INDICATES ANALYTE NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES

** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY: ____________________

Dept. of Transportation
SEP 17 2001
Safety and Health

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CERTIFICATE OF ANALYSIS

CLIENT: WASHINGTON STATE DEPT. OF TRANSPORTATION
P.O. BOX 47311
OLYMPIA, WA 98504-7311

DATE: 8/28/01
CCIL JOB #: 108056
CCIL SAMPLE #: 2
DATE RECEIVED: 8/17/01
WDOE ACCREDITATION #: C142

CLIENT CONTACT: DAVID HAMACHER

CLIENT PROJECT ID: STILLIGUAMISH RIVER BRIDGE (SRB)
CLIENT SAMPLE ID: FIELD BLANK 8/17/01 10:50AM

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
DISSOLVED ANTIMONY	EPA-6010	ND(<0.07)	MG/L	8/24/01	LMH
DISSOLVED ARSENIC	EPA-6010	ND(<0.03)	MG/L	8/24/01	LMH
DISSOLVED BERYLLIUM	EPA-6010	ND(<0.003)	MG/L	8/24/01	LMH
DISSOLVED CADMIUM	EPA-6010	ND(<0.005)	MG/L	8/24/01	LMH
DISSOLVED CHROMIUM	EPA-6010	ND(<0.01)	MG/L	8/24/01	LMH
DISSOLVED COPPER	EPA-6010	ND(<0.006)	MG/L	8/24/01	LMH
DISSOLVED LEAD	EPA-6010	ND(<0.06)	MG/L	8/24/01	LMH
DISSOLVED MERCURY	EPA-7470	ND(<0.0002)	MG/L	8/27/01	LMH
DISSOLVED NICKEL	EPA-6010	ND(<0.02)	MG/L	8/24/01	LMH
DISSOLVED SELENIUM	EPA-6010	ND(<0.05)	MG/L	8/24/01	LMH
DISSOLVED SILVER	EPA-6010	ND(<0.007)	MG/L	8/24/01	LMH
DISSOLVED THALLIUM	EPA-6010	ND(<0.2)	MG/L	8/24/01	LMH
DISSOLVED ZINC	EPA-6010	ND(<0.007)	MG/L	8/24/01	LMH

* "ND" INDICATES ANALYTE NOT DETECTED AT LEVEL ABOVE REPORTING LIMIT. REPORTING LIMIT IS GIVEN IN PARENTHESES

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CLIENT: WASHINGTON STATE DEPT. OF TRANSPORTATION
P.O. BOX 47311
OLYMPIA, WA 98504-7311

DATE: 8/28/01
CCIL JOB #: 108056
CCIL SAMPLE #: 3
DATE RECEIVED: 8/17/01
WDOE ACCREDITATION #: C142

CLIENT CONTACT: DAVID HAMACHER

CLIENT PROJECT ID: STILLIGUAMISH RIVER BRIDGE (SRB)
CLIENT SAMPLE ID: RECEIVING WATER 8/17/01 11:05AM

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
TOTAL SUSPENDED SOLIDS	EPA-160.2	86	MG/L	8/27/01	HJK
DISSOLVED ANTIMONY	EPA-6010	ND(<0.07)	MG/L	8/24/01	LMH
DISSOLVED ARSENIC	EPA-6010	ND(<0.03)	MG/L	8/24/01	LMH
DISSOLVED BERYLLIUM	EPA-6010	ND(<0.003)	MG/L	8/24/01	LMH
DISSOLVED CADMIUM	EPA-6010	ND(<0.005)	MG/L	8/24/01	LMH
DISSOLVED CHROMIUM	EPA-6010	ND(<0.01)	MG/L	8/24/01	LMH
DISSOLVED COPPER	EPA-6010	ND(<0.006)	MG/L	8/24/01	LMH
DISSOLVED LEAD	EPA-6010	ND(<0.06)	MG/L	8/24/01	LMH
DISSOLVED MERCURY	EPA-7470	ND(<0.0002)	MG/L	8/27/01	LMH
DISSOLVED NICKEL	EPA-6010	ND(<0.02)	MG/L	8/24/01	LMH
DISSOLVED SELENIUM	EPA-6010	ND(<0.05)	MG/L	8/24/01	LMH
DISSOLVED SILVER	EPA-6010	ND(<0.007)	MG/L	8/24/01	LMH
DISSOLVED THALLIUM	EPA-6010	ND(<0.2)	MG/L	8/24/01	LMH
DISSOLVED ZINC	EPA-6010	ND(<0.007)	MG/L	8/24/01	LMH

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CLIENT: WASHINGTON STATE DEPT. OF TRANSPORTATION
P.O. BOX 47311
OLYMPIA, WA 98504-7311

DATE: 8/28/01
CCIL JOB #: 108056
CCIL SAMPLE #: 4
DATE RECEIVED: 8/17/01
WDOE ACCREDITATION #: C142

CLIENT CONTACT: DAVID HAMACHER

CLIENT PROJECT ID: STILLIGUAMISH RIVER BRIDGE (SRB)
CLIENT SAMPLE ID: TANKER 8/17/01 11:15AM

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
DISSOLVED ANTIMONY	EPA-6010	ND(<0.07)	MG/L	8/24/01	LMH
DISSOLVED ARSENIC	EPA-6010	ND(<0.03)	MG/L	8/24/01	LMH
DISSOLVED BERYLLIUM	EPA-6010	ND(<0.003)	MG/L	8/24/01	LMH
DISSOLVED CADMIUM	EPA-6010	ND(<0.005)	MG/L	8/24/01	LMH
DISSOLVED CHROMIUM	EPA-6010	ND(<0.01)	MG/L	8/24/01	LMH
DISSOLVED COPPER	EPA-6010	ND(<0.006)	MG/L	8/24/01	LMH
DISSOLVED LEAD	EPA-6010	ND(<0.06)	MG/L	8/24/01	LMH
DISSOLVED MERCURY	EPA-7470	ND(<0.0002)	MG/L	8/27/01	LMH
DISSOLVED NICKEL	EPA-6010	ND(<0.02)	MG/L	8/24/01	LMH
DISSOLVED SELENIUM	EPA-6010	ND(<0.05)	MG/L	8/24/01	LMH
DISSOLVED SILVER	EPA-6010	ND(<0.007)	MG/L	8/24/01	LMH
DISSOLVED THALLIUM	EPA-6010	ND(<0.2)	MG/L	8/24/01	LMH
DISSOLVED ZINC	EPA-6010	0.026	MG/L	8/24/01	LMH

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CERTIFICATE OF ANALYSIS

CLIENT: WASHINGTON STATE DEPT. OF TRANSPORTATION
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OLYMPIA,WA 98504-7311

DATE: 9/11/01
CCIL JOB #: 108109
CCIL SAMPLE #: 1
DATE RECEIVED: 8/31/01
WDOE ACCREDITATION #: C142

CLIENT CONTACT: DAVID HAMACHER

CLIENT PROJECT ID: STILLIQUAMISH RIVER BRIDGE (SRB)
CLIENT SAMPLE ID: SCREENED DISCHARGE #2 8/31/01 8:00-10:00 AM

DATA RESULTS

ANALYTE	METHOD	RESULTS*	UNITS**	ANALYSIS DATE	ANALYSIS BY
BOD	EPA-405.1	170	MG/L	8/31/01	LMH
TOTAL SUSPENDED SOLIDS	EPA-160.2	520	MG/L	9/7/01	HJK
ANTIMONY	EPA-6010	ND(<0.07)	MG/L	9/10/01	LMH
ARSENIC	EPA-7060	ND(<0.005)	MG/L	9/6/01	LMH
BERYLLIUM	EPA-6010	ND(<0.003)	MG/L	9/10/01	LMH
CADMIUM	EPA-6010	ND(<0.005)	MG/L	9/10/01	LMH
CHROMIUM	EPA-6010	ND(<0.01)	MG/L	9/10/01	LMH
COPPER	EPA-6010	0.041	MG/L	9/10/01	LMH
LEAD	EPA-7421	0.076	MG/L	8/31/01	LMH
MERCURY	EPA-7470	ND(<0.0002)	MG/L	9/6/01	LMH
NICKEL	EPA-6010	ND(<0.02)	MG/L	9/10/01	LMH
SELENIUM	EPA-6010	ND(<0.05)	MG/L	9/10/01	LMH
SILVER	EPA-6010	ND(<0.007)	MG/L	9/10/01	LMH
THALLIUM	EPA-6010	ND(<0.2)	MG/L	9/10/01	LMH
ZINC	EPA-6010	1.7	MG/L	9/10/01	LMH

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** UNITS FOR ALL NON LIQUID SAMPLES ARE REPORTED ON A DRY WEIGHT BASIS

APPROVED BY: ______________

Dept. of Transportation
SEP 17 2001
Safety and Health

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CCI Analytical Laboratories, Inc.
8620 Holly Drive
Everett, WA 98208
Phone (425) 356-2600
(206) 292-9059 Seattle
(425) 356-2626 Fax

Chain Of Custody/ Laboratory Analysis Request

CCI Job# (Laboratory Use Only)

Date 8/31/01 Page 1 Of 1

PROJECT ID: SR Snohomish River Bridge (SRB)
REPORT TO COMPANY: WSDOT
PROJECT MANAGER: David [illegible]
ADDRESS: P.O. box 47311
Olympia WA 98504-7311
PHONE: 360-705-77[illegible] FAX: --- 6357

INVOICE TO COMPANY:
ATTENTION: Dave
ADDRESS:

P.O. NUMBER NR Region CCI QUOTE:

ANALYSIS REQUESTED: NWTPH-GX; BTEX; NWTPH-DX; NWTPH-HCID; EPA 8021 [ ] 602 [ ]; EPA 8010 [ ] 601 [ ]; EPA 8260 [ ] 624 [ ]; EPA 8270 [ ] 625 [ ]; EPA 8081/8082 [ ] 608 [ ] PCB only [ ] Pest only [ ]; Metals Priority Pollutant [X] RCRA [ ] TAL [ ]; Metals Other (Specify); TCLP-Metals [ ] VOA [ ] Semi-Vol [ ] Pest [ ] Herbs [ ]

OTHER (Specify): BOD; TSS

SAMPLE I.D.	DATE	TIME	TYPE	LAB#	Metals Priority Pollutant	BOD	TSS	NUMBER OF CONTAINERS	RECEIVED IN GOOD CONDITION?
1. Second Discharge #2	8/31/01	[illegible]	comp		✓	✓	✓	2	
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									

SPECIAL INSTRUCTIONS – Dissolved metals analyses – "Do not preserve"

SIGNATURES (Name, Company, Date, Time):

1. Relinquished By: [signature]
Received By: Walt J Kunst CCIAL 8/31/01 10:45 am

2. Relinquished By:
Received By:

TURNAROUND REQUESTED in Business Days*

Organic, Metals & Inorganic Analysis: ~~10~~ Standard | 5 | 3 | 2 | 1 | SAME DAY

Fuels & Hydrocarbon Analysis: 5 Standard | 3 | 1 | SAME DAY

OTHER:
Specify:

* Turnaround request less than standard may incur Rush Charges

CCI Analytical Laboratories, Inc.
8620 Holly Drive
Everett, WA 98208
Phone (425) 356-2600
(206) 292-9059 Seattle
(425) 356-2626 Fax

Chain Of Custody/ Laboratory Analysis Request

CCI Job# (Laboratory Use Only)

Date 8/17/01 Page 1 Of 1

PROJECT ID: Snohomish River Bridge (SRB)
REPORT TO COMPANY: WSDOT
PROJECT MANAGER: David Hamacher
ADDRESS: P.O. Box 47311
Olympia WA 98504-7311
PHONE: 360-705-7746 FAX: ...6837

INVOICE TO COMPANY:
ATTENTION: Same
ADDRESS:

P.O. NUMBER NW Region CCI QUOTE:

ANALYSIS REQUESTED / OTHER (Specify)

	SAMPLE I.D.	DATE	TIME	TYPE	LAB#	NWTPH-GX	BTEX	NWTPH-DX	NWTPH-HCID	EPA 8021 [ ] 602 [ ]	EPA 8010 [ ] 601 [ ]	EPA 8260 [ ] 624 [ ]	EPA 8270 [ ] 625 [ ]	EPA 8081/8082 [ ] 608 [ ] PCB only [ ] Pest only [ ]	Metals Priority Pollutant [X] RCRA [ ] TAL [ ]	Metals Other (Specify)	TCLP-Metals [ ] VOA [ ] Semi-Vol [ ] Pest [ ] Herbs [ ]	BOD	TSS					NUMBER OF CONTAINERS	RECEIVED IN GOOD CONDITION?
1.	Screened Discharge	8/17	comp.	wash water											✓			✓	✓						
2.	Field Blank	8/17	10:50A	grab											✓										
3.	Receiving Water	8/17	11:05A	grab											✓				✓						
4.	Tanker	8/17	11:15A	grab											✓										
5.																									
6.																									
7.																									
8.																									
9.																									
10.																									

SPECIAL INSTRUCTIONS All metal analyses shall be dissolved.

SIGNATURES (Name, Company, Date, Time):

1. Relinquished By: [signature] 1:00pm 8/17/01
Received By: [signature] CCIAL 1:00pm 8/17/01
2. Relinquished By:
Received By:

TURNAROUND REQUESTED in Business Days*

Organic, Metals & Inorganic Analysis
~~10~~ Standard | 5 | 3 | 2 | 1 | SAME DAY

Fuels & Hydrocarbon Analysis
5 Standard | 3 | 1 | SAME DAY

OTHER:
Specify:

* Turnaround request less than standard may incur Rush Charges

Field Report 8/17/01 DRH

* Pictures taken

@ 9:10 Am arrived on site, met w/ Tricia + contractors (Abercrombie). Power spraying operations commenced – I proceeded to collect representative discharge sample from / thru the belly tarps.

@ 9:25 Am collected 1st rep. sample (i.e., partially filling sample bottles at evident discharge points).

pH = 7.75

@ 9:40 Am collected 2nd rep. from 1st power spray section. pH = 7.70

Notes → according to plans, power spray operations were/are occurring between piers 3 + 4.

→ Tanker truck holds ~2400 gallons

→ AA obtained water from hydrant Stanwood.

→ Contractor is moving belly tarps to section 2 [illegible]

@ 10:25 Am started power washing section 2

@ 10:30 Am collected 3rd rep sample – pH = 7.84

@ 10:40 Am collected 4th rep sample – pH = 7.70

@ 10:50 Am – collected "field blank" – water used to clean pH meter.

@ 11:05 Am – collected "receiving water" sample. Note water [illegible] low tide.

@ 11:15 Am – collected "tanker" water sample – tanker water is used to powerwash bridge.

@ 11:35 Am - AA started washing 5th [illegible]
bridge [illegible] piers 3 + 4.

@ 11:35 Am collected 5th representative sample
pH = 7.89

@ 11:45 Am collected 6th + final representative sample.
pH = 7.94 - bottles full

Note - collected 5 full bottles of [illegible] discharge,
1 full bottle of QA/QC samples
→ samples are [illegible] being delivered to Lab.
→ samples kept on ice while in field

~ 15 pictures (digital) of power-spraying
work operation were taken.

Note - contractor will use approximately 8000 to 8100
gallons of water to wash steel between
piers 3 + 4. Also, will use approximately [illegible]
[illegible] water [illegible] between [illegible]
during spray operation.

Note - samples collected @ [illegible] thruout
bridge cleaning [illegible] 1/10 [illegible]

Field Report 8/31/01 DRH * pictures taken

@ 7:35 Am – arrived on site, met w/ Tricia and AA Painting, Abercrombies. Work is between piers 5 & 6.

AA Painting is using a single ply of tarp during the power washing activities this morning (see attached tarp spec). This single tarp system is per the request of Terra Hegy of WDFW.

@ 7:55 Am Contractor started power-spraying work operations the 1st representative sample was collected @ 8:05am – pH = 7.49

Note. I plan to collect six representative samples and have a composite sample for analyses. (i.e., bottles are being filled ~~1/6~~ of volume for each grab)

@ 8:15 Am collected 2nd rep sample pH = 7.88

Note – as compared to sampling performed on 8/17/01, this water appears a little more "cloudy". Also, the bridge does appear to be "dirtier" between piers 5 & 6.

@ 8:45 Am Contractor started washing 2nd section of bridge
@ 8:50 collected 3rd rep sample – pH = 7.83
@ 9:00 collected 4th rep sample – pH = 7.76

@ 9:25 Contractor started power washing 3rd section

@ 9:30 collected 5th rep pH = 7.69
@ 9:40 collected 6th & final rep pH = 7.81

Departed site for delivery of samples to analytical lab. CCI.

Note – low tide w/ river flowing out – most water falling on bank. Env. conditions were sprinkles ~ 60°F

Pound conversions for screened discharges on 8/17/01 and 8/31/01.

Note 1 - Two belly tarps (see attached tarp specification) were used during the washing event between piers 3 & 4 on 8/17/01.

Note 2 - One belly tarp (same spec. as above) was used during the washing event between piers 5 & 6 on 8/31/01.

Analytical Results & conversions for data collected on <u>8/17/01</u>.

Total Suspended Solids (TSS) $300\,mg/L \times \frac{1.0\,L}{0.2642\,gal} \times \frac{1\,kg}{1\times10^6\,mg} \times \frac{2.205\,lb}{kg} = \boxed{\frac{0.0025\,lb\ TSS}{gal}}$

Contractor estimated he would use approximately 2000-2400 gallons of water between piers 3 & 4.

$$\frac{0.0025\,lb\ TSS}{gal} \times \frac{2400\,gal}{wash\ event} = \boxed{\frac{6.0\,lb\ TSS}{wash\ event}}$$

Biochemical Oxygen Demand (BOD) $\left[\overset{BOD}{100\,mg/L} \times \frac{1.0\,L}{0.2642\,gal} \times \frac{1\,kg}{1\times10^6\,mg} \times \frac{2.205\,lb}{kg} \right] \times \frac{2400\,gal}{wash\ event} = \boxed{\frac{2.0\,lb\ BOD}{wash\ event}}$

Analytical Results & conversions for data collected on <u>8/31/01</u>.

$$TSS\ 520\,mg/L \times \frac{1.0\,L}{0.2642\,gal} \times \frac{1\,kg}{1\times10^6\,mg} \times \frac{2.205\,lb}{kg} \times \frac{2400\,gal}{wash\ event} = \boxed{\frac{10.4\,lb\ TSS}{wash\ event}}$$

$$BOD\ 170\,mg/L \times \frac{1.0\,L}{0.2642\,gal} \times \frac{1\,kg}{1\times10^6\,mg} \times \frac{2.205\,lb}{kg} \times \frac{2400\,gal}{wash\ event} = \boxed{\frac{3.4\,lb\ BOD}{wash\ event}}$$

Note 3 - contractor estimated he would use approximately 2000-2400 gallons of water between piers 5 & 6.

Note 4 - Contractor had four (4) wash events for SR [illegible] bridge.

<u>Comparisons of Discharge</u>

1) There are approximately 2,490 lbs in $1.0\,yd^3$ of washed sand (i.e. TSS)

2) A standard sized brewery may discharge approximately 10,500 lb/day of BOD to a treatment system

3) A treatment plant may discharge 200 to 500 lb BOD per day into state waters. (reference LOTT)

Washington State Department of Transportation (DRAFT)

Stillaguamish River Bridge 532/2 (SR 532 MP 3.39 to MP 3.48) Bridge Painting and Rocker Bearing

Pressure Washing Discharge – Analytical Results Data Summary

August 17 and 31, 2001

Sample Identification	Sample Type	Biochemical Oxygen Demand (BOD)	Total Suspended Solids (TSS)	pH (units)	Visual oil & Grease	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc	Comments
Screened Discharge (08-17-01)	Composite	100	300	7.06 to 7.80	No	ND <0.07	0.007	ND <0.003	ND <0.005	ND <0.01	0.122	0.070	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.005	2.2	Used a two-tarp system to filter the pressure wash water
Screened Discharge (08-31-01)	Composite	170	520	7.40 to 7.90	No	ND <0.07	ND <0.075	ND <0.003	ND <0.005	ND <0.01	0.141	0.076	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	1.7	Used a two-tarp system to filter the pressure wash water
Receiving Water	Grab	NA	86	NA	No	ND <0.07	ND <0.075	ND <0.003	ND <0.005	ND <0.01	ND <0.006	ND <0.05	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	ND <0.007	Tidal and Stillaguamish River water.
Tanker Water	Grab	NA	NA	NA	No	ND <0.07	ND <0.075	ND <0.003	ND <0.005	ND <0.01	ND <0.006	ND <0.05	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	0.026	Tanker truck contained water from the city of Stanwood
Field Blank	Grab	NA	NA	NA	No	ND <0.07	ND <0.075	ND <0.003	ND <0.005	ND <0.01	ND <0.006	ND <0.05	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	ND <0.007	Water used in the field to reduce cross contamination.
Primary Standard (MCL) Maximum Contaminant level	NA	NA	NA	NA	No	0.006	0.05	0.004	0.005	0.1	1.3	0.015	0.002	0.1	0.05	0.05	0.002	NA	The MCL is the primary and enforceable drinking water standard
Secondary Standard	NA	NA	NA	6.5 to 8.5	No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.10	NA	5	Recommended standards.

NOTE: All analytical results except for pH are reported in mg/L. All metal analyses used dissolved testing methodologies

NA: Not Applicable/Available

ND: Not detected (beyond analytical detection limits)

< = Less than

Laboratory Analyses were completed by CCI Analytical Laboratories, Inc.

Additional Notes:

Pound conversions for screened discharges on August 17 and 31, 2001. Contractor estimated 2000 to 2400 gallons of water to be used between piers 3 & 4 and between piers 5 & 6.

TSS 300mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 6.0lb TSS/wash event discharged through belly tarp.

TSS 520mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 10.6lb TSS/wash event discharged through belly tarp.

As a comparison, there are approximately 2,490lbs in 1.0yd^3 of washed sand (i.e., TSS)

BOD 100mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 2.0lb BOD/wash event discharged through belly tarp

BOD 170mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 3.40lb BOD/wash event discharged through belly tarp.

As a comparison, a waste water treatment plant can discharge approximately 300lb to 600lb of BOD into Washington State waters per day.

Contractor said "there will be four (4) wash events to clean the bridge"

On week ending 8/24/01 visited the project site with Terra Hegy of WDFW and Paul Wolf of WSDOT.

Need to collect more water quality data from up coming bridge painting projects to establish a more representative "baseline"

Washington State Department of Transportation (DRAFT)

Stillaguamish River Bridge 532/2 (SR 532 MP 3.39 to MP 3.48) Bridge Painting and Rocker Bearing

Pressure Washing Discharge -- Analytical Results Data Summary

August 17 and 31, 2001

Sample Identification	Sample Type	Biochemical Oxygen Demand (BOD)	Total Suspended Solids (TSS)	pH (units)	Visual oil & Grease	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc	Comments
Screened Discharge (08/17/01)	Composite	100	300	7.73 to 7.92	No	ND <0.07	0.007	ND <0.005	ND <0.005	ND <0.01	0.022	0.079	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.005	2.1	Used a two-tarp system to filter the pressure wash water.
Screened Discharge (08/31/01)	Composite	170	520	7.49 to 7.92	No	ND <0.07	ND <0.005	ND <0.005	ND <0.005	ND <0.01	0.043	0.076	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	1.7	Used a one-tarp system to filter the pressure wash water.
Receiving Water	Grab	NA	36	NA	No	ND <0.07	ND <0.03	ND <0.005	ND <0.005	ND <0.01	ND <0.006	ND <0.05	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	ND <0.007	Tidal and Stillaguamish River water.
Tanker Water	Grab	NA	NA	NA	No	ND <0.07	ND <0.03	ND <0.005	ND <0.005	ND <0.01	ND <0.005	ND <0.05	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	0.026	Tanker truck contained water from the city of Stanwood.
Field Blank	Grab	NA	NA	NA	No	ND <0.07	ND <0.03	ND <0.005	ND <0.005	ND <0.01	ND <0.005	ND <0.05	ND <0.0002	ND <0.02	ND <0.05	ND <0.007	ND <0.2	ND <0.007	Water used in the field to reduce cross contamination.
Primary Standard -- (MCL) Maximum Contaminant level	NA	NA	NA	NA	No	0.006	0.05	0.004	0.005	0.1	1.3	0.015	0.002	0.1	0.05	0.05	0.002	NA	The MCL is the primary and enforceable drinking water standard.
Secondary Standard	NA	NA	NA	6.5 to 8.5	No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.10	NA	5	Recommended standard.

NOTE: All analytical results except for pH are reported in mg/L. All metal analyses used dissolved testing methodologies.

NA: Not Applicable/Available

ND: Not detected (beyond analytical detection limits)

< -- Less than

Laboratory Analyses were completed by CCI Analytical Laboratories, Inc.

Additional Notes:

Pound conversions for screened discharges on August 17 and 31, 2001. Contractor estimated 2000 to 2400 gallons of water to be used between piers 3 & 4 and between piers 5 & 6.

TSS 300mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 6.0lb TSS/wash event discharged through belly tarp.

TSS 520mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 10.6lb TSS/wash event discharged through belly tarp.

As a comparison, there are approximately 2,490lbs in 1.0yd^3 of washed sand (i.e., TSS).

BOD 100mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 2.0lb BOD/wash event discharged through belly tarp.

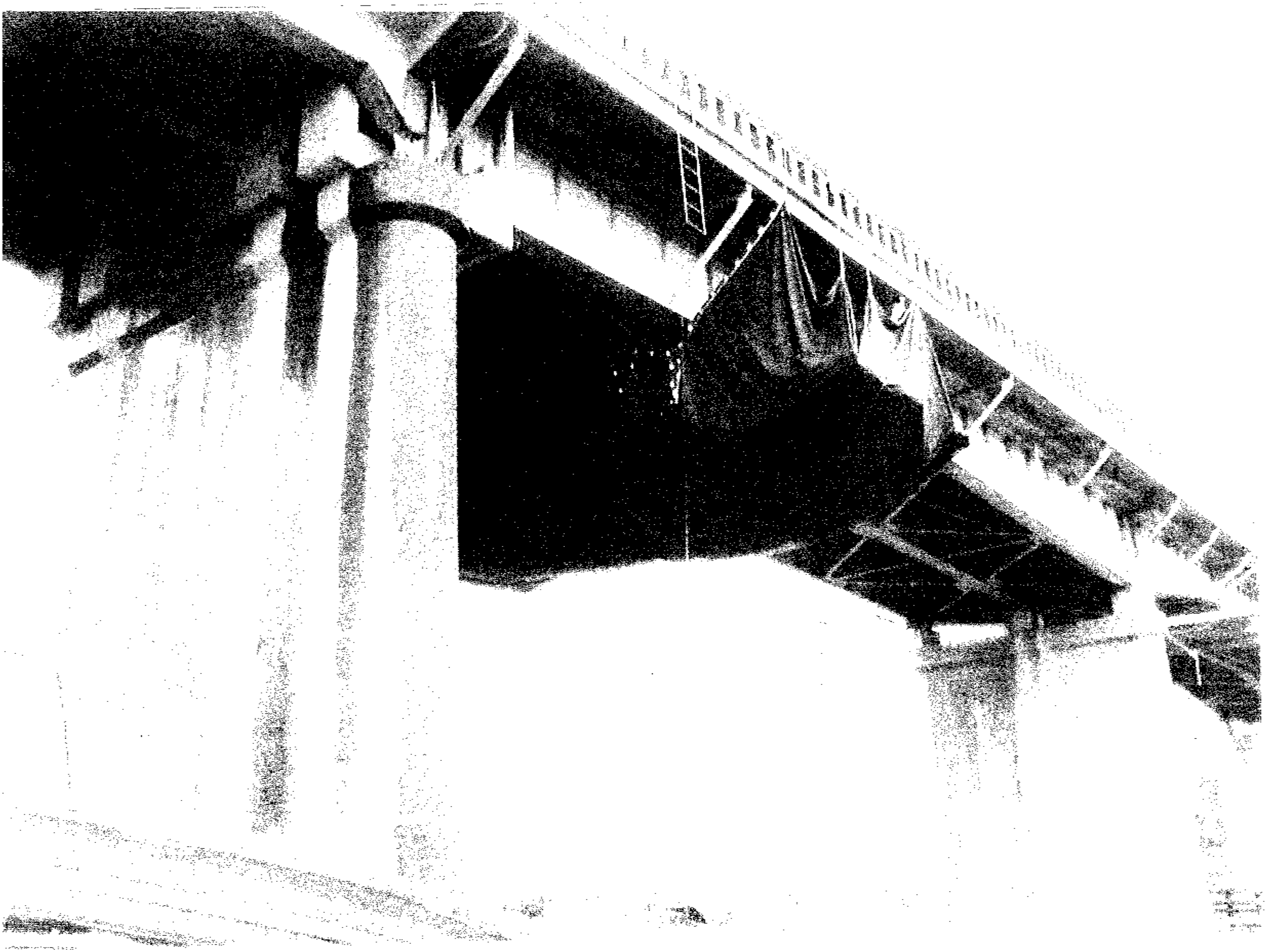
BOD 170mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 2400gal/wash event = 3.40lb BOD/wash event discharged through belly tarp.

As a comparison, a waste water treatment plant can discharge approximately 300lb to 600lb of BOD into Washington State waters per day.

Contractor said "there will be four (4) wash events to clean the bridge".

On week ending 8/24/01 I visited the project site with Terra Hegy of WDFW and Paul Wolf of WSDOT.

Need to collect more water quality data from up coming bridge painting projects to establish a more representative "baseline".



Skykomish River Bridge Painting Project
Near Gold Bar, Washington
May 2002

Contents:

- Field Report
- Summary Spreadsheets of Water Quality Monitoring Results
- Data Calculations and Interpretations
- Analytical and Bioassay Laboratory Reports

NOTE: Second of Three Bridge Washing Monitoring Projects

Submitted
12/24/02
dh

Washington State Department of Transportation (DRAFT)
Skykomish River Bridge (2/0.40) Bridge Painting Project
Pressure Washing Discharge -- Analytical Results Data Summary
May 17 2002

Sample Identification	Sample Type	Biochemical Oxygen Demand (BOD) (mg/L)	Total Suspended Solids (TSS) (mg/L)	Hardness (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Beryllium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)	ethyl-benzene (mg/L)	m,p - Xylene (mg/L)	o - Xylene (mg/L)	1,3,5 - trimethyl Benzene (mg/L)	4-isopropyl-toluene (mg/L)	1,2,4 - trimethyl Benzene (mg/L)	Comments
Screened Discharge #3 & #8	composite	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.0024	0.0079	0.0036	0.0014	0.0053	0.0043	Expected results. These VOC's are contained in WSDOT specified paints
Screened Discharge #1 thru #13 (dissolved analysis)	composite	33	403	125	ND<0.003	0.011	ND<0.002	ND<0.004	ND<0.01	1.78	0.15	ND<0.0002	ND<0.6	ND<0.003	ND<0.01	ND<0.0005	1.56	----	----	----	----	----	----	
Screened Discharge #1 thru #13 (total analysis)	composite	----	----	----	-	0.012	----	----	----	2.65	6.48	----	----	----	----	----	5.53	----	----	----	----	----	----	
Skykomish River Water	grab	----	ND	14	----	ND<0.001	----	----	----	ND<0.01	ND<0.0005	----	----	----	----	----	ND<0.5	----	----	----	----	----	----	
Tanker Water	grab	----	----	21	----	ND<0.001	----	----	----	ND<0.07	0.007	----	----	----	----	----	0.037	----	----	----	----	----	----	
Metals -- Field Blank	grab	----	----	----	----	0.0031	----	----	----	ND<0.01	ND<0.0005	----	----	----	----	----	ND<0.01	----	----	----	----	----	----	
VOC -- Field Blank	grab	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	ND	ND	ND	ND	ND	ND	
DOE Water Quality Standard	----	----	----	----	----	0.36	----	----	----	0.0027	0.0072	----	----	----	----	----	0.0216	----	----	----	----	----	----	
Primary* or Secondary** Standards -- (MCL)	----	----	----	Soft Water -- <125**	0.006*	0.05*	0.004*	0.005*	0.1*	1.3*	0.015*	0.002*	0.1*	0.05*	0.1**	0.002*	5**	0.7*	10*	10*	NA	NA	NA	

MCL - maximum contaminant level limit. The MCL is the safe drinking water standards as established by the Clean Water Act. Reference - Department of Ecology CLARC version 3.1 spreadsheet

Department of Ecology (DOE) -- dissolved criteria water quality standards "calculated acute freshwater standards" (reference WAC 173-201A-040)

NA - Not Applicable/Available

Volatile Organics (VOC) - were analyzed using USEPA method 5030/8260B

Dissolved and total metals (except mercury) were analyzed using USEPA methods 6010 and [illegible]

ND- Not detected (beyond analytical detection limits)

All units are expressed in mg/L unless otherwise noted

< -- Less than

USEPA - United States Environmental Protection Agency

All metals analyses for the screened discharge composite sample were analyzed via dissolved analytical methodologies

Accredited laboratory analyses were completed by STL Seattle and Amec Earth & Environmental Analytical Laboratories

Additional Notes:

A total of 13 grab samples were collected during all critical periods of pressure washing and discharge through the belly-tarp. The 13 grab samples were composited into a single sample (screened discharge)

Personnel from Root Painting, Inc. estimated that 800 gallons of water would be used to wash 5 bays of steel east of the east pier. Also, five 5x? loads (approximately 3,600 to 4,000 gallons of water obtained from local PUD hydrants) would be used to wash the entire bridge structure

TSS 403mg/L x 1.0L/0.2642gal x Kg/10^6mg x 2.205lb/Kg x 800gal/wash event = 2.7lb TSS/wash event discharged through belly-tarp -- Approximately 13.5lb TSS discharged through tarp for entire bridge pressure wash

As a comparison, there is approximately 2,4?0lbs in 1.0yd^3 of washed sand (i.e., TSS). Also, as a comparison, and via discharge permits, large manufacturers can discharge upwards of 8,000 lbs to 33,000 lbs of TSS into Washington State Water Daily

Relative to TSS, belly-tarp filtration and pressure washing, approximately 1600 lbs of waste was captured during the bridge pressure washing work. These data show a 99.2% containment (belly-tarp) efficiency

BOD 33mg/L x 1.0L/0.2642gal X Kg/10^6mg x 2.205lb/Kg x 800gal/wash event = 0.22lb BOD/wash event discharged through belly-tarp -- Approximately 1.1lb BOD discharged through tarp for entire bridge pressure washing

As a comparison, a waste water treatment plant (several hundred across the state) can discharge approximately 300lb to 900lb of BOD into Washington State waters per day

Dissolved Lead 0.15mg/L x 1.0L/0.2642gal X Kg/10^6mg x 2.205lb/Kg x 800gal/wash event = 0.0008lb lead/wash event discharged through belly-tarp -- Approximately 0.004lb dissolved lead discharged through tarp for entire bridge pressure washing

Total Lead 6.48mg/L x 1.0L/0.2642gal X Kg/10^6mg x 2.205lb/Kg x 800gal/wash event = 0.044lb lead/wash event discharged through belly-tarp -- Approximately 0.22lb lead discharged through tarp for entire bridge pressure washing

As a comparison, several manufacturing companies (point source discharge) located on prime salmonid and recreational areas of Washington State waterways are allowed to discharge 2.7lb Lead/day

Need to collect more water quality data from upcoming bridge painting projects to establish a more representative "baseline"

Specifications for nonwoven geotextile belly-tarp used for this project are shown below (Layfield LP7).

Grab tensile (lbs) = 160	Elongation (%) = 50	Water Flow (gpm/ft^2) = 190
Tear (lbs) = 75	Puncture (lbs) = 100	Weight (oz/yd^2) = 7.0
Mullen burst (psi) = 330	AOS (sieve size) = 70	Thickness (mil) = 85
Permittivity (sec^-1) = 1.5	Permeability (cm/sec) = 0.34	UV resistance = 70

Bioassay Testing Results

	Concentration						
Species	Control	6.25	12.5	25	50	100	
Fathead Minnow	100	100	93.3	93.3	60	56.7	Percent
Ceriodaphnia	100	40	0	0	0	0	Survival

Concentration is the percentage of the screened discharge composite sample mixed with control water; represented as 6.25% through 100%

Field Report 5/10/02

Skykomish River Bridge Painting Project (Gold Bar) C-6287

@ 6:15am arrived on site, met w/ Dan Wolf + crew of Root Paint, Inc. began preparing/calibrating equipment,

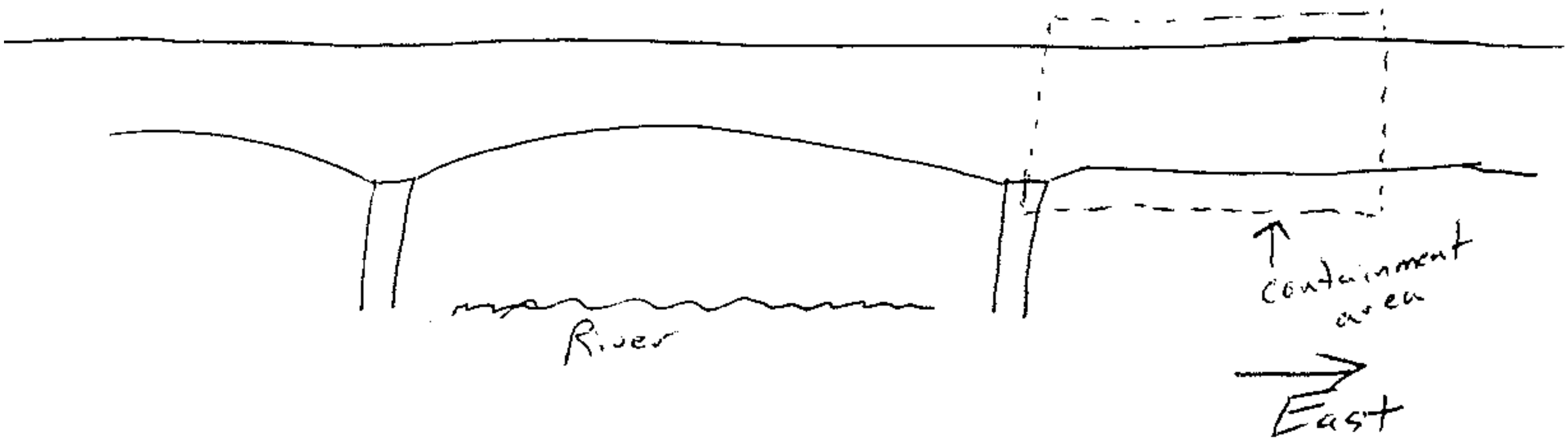
→ Dan gave me the spec on filter-fabric material used in belly tarp. (Lp 7) - Layfield
→ Dan said that "he obtained water (contained in tanker truck) from a local PUD hydrant". Dan estimated he would use approximately 700 gal to 800 gal of water to wash the bridge - today - Dan said that "five (5) loads of water is needed to wash the entire bridge (~4,200 gallons).

@ ~6:30Am I collected a water sample from the tanker truck (holding wash-water) - Don't know if water is chlorinated - didn't have any chlorine odors. F conc. is unknown.

@ ~6:50 Am I collected water quality measurement from Skykomish River and collected grab samples for analytical
DO = 12.11 EC = 0.07 mS/cm 0.00 Salinity
pH = 7.91 Temp 6.9°C

Note: samples are being kept on ice. - a field blank was prepared prior to starting the work, see sketch

Approximate location of pressure-wash work activities - 4 "bays" of structural steel - also see pictures.



@ ~ 7:15 Root Painting began pressure-washing work activities. Just prior to starting the pressure washing I took 8-10 pictures of the structural steel.

Note: the structural steel is very dirty (as compared to many other bridges observed throughout the state). Bottom trusses contained 1/4" to 1/3" of dirt and debris. Other structural members had a significant amount of flaking paint and rust - and a build-up of 1/16" of mud/debris (see pictures) reddish/gray mud on steel.

Sampling Technique - Composite via grabs

During all critical periods of the pressure washing I will be using a 5gal bucket to collect grab samples of the discharge water (i.e., water being filtered thru the belly tarp). Each time a grab sample is collected a portion of the grab will ~~be~~ be poured into the composite sample. Also, field measurements for DO, pH, temp, salinity + conductivity will be collected from each grab sample.

Grab samples will be collected ~~fr a~~ from all areas beneath the filter tarp + prior to discharge to the bank.

@ ~ 7:20 Am I began collecting the 1st grab.

1st grab – DO = 11.62 mg/L
pH = 7.95 ~~pf~~ units
EC = 0.34 mS/cm
Temp = 7.7 °C
Salanity = ND

~15 minutes to 20 minutes between grab samples – taking ~10 minutes to fill 5 gallon bucket

	2nd	3rd	4th
DO =	11.65	11.58	11.64
pH =	7.96	8.00	7.98
EC =	0.20	0.23	0.16
Temp =	7.7	7.9	7.9
Sal =	ND	ND	ND

Same

5th	6th	7th	8th
11.64	11.52	11.47	missed
7.95	7.95	7.98	
0.19	0.25	0.22	
7.7	8.0	8.4	
ND	ND	ND	

	9th	10th	11th	12th	13th
DO =	11.66	11.65	11.75	11.91	12.22
pH =	8.16	8.18	8.24	8.30	8.10
EC =	0.22	0.27	0.24	0.23	0.37
Temp =	8.4	8.4	8.4	8.8	8.8
Sal =	ND	ND	ND	ND	ND

After collecting the composite samples, each bottle was labeled and a chain-of-custody was completed.

Samples are being delivered to Severn Trent laboratories, Inc. and Amec in the Tacoma area.

Approximately 10 pictures of the structural steel were taken after all pressure-washing work activities were completed.

Personnell on Site: Fred Rock - WSDOT
Haim Strasburger - WSDOT
Root Paint

@ ≈ 12:15 pm I departed site.

Washington State Department of Transportation
Skykomish River Bridge Painting Project
Pressure Washing Discharge -- Field Measurements and Analytical Results
May 10, 2002

Sample Identification	Sample Type	Dissolved Oxygen (mg/L)	pH (units)	Visual oil & Grease	Conductivity (mS/cm)	Temperature (celcius)	Salinity (%)	Total Coliform (MPN/100ml)
#1 - discharge	grab	11.62	7.95	No	0.34	7.7	ND	NA
#2 - discharge	grab	11.65	7.96	No	0.20	7.7	ND	50
#3 - discharge	grab	11.58	8.00	No	0.23	7.9	ND	NA
#4 - discharge	grab	11.64	7.98	No	0.16	7.9	ND	NA
#5 - discharge	grab	11.64	7.95	No	0.19	7.7	ND	NA
#6 - discharge	grab	11.52	7.95	No	0.25	8.0	ND	NA
#7 - discharge	grab	11.47	7.98	No	0.22	8.4	ND	140
#8 - discharge	NA	NA	NA	No	NA	NA	NA	NA
#9 - discharge	grab	11.66	8.16	No	0.22	8.4	ND	NA
#10 - discharge	grab	11.65	8.18	No	0.27	8.4	ND	NA
#11 - discharge	grab	11.75	8.24	No	0.24	8.4	ND	NA
#12 - discharge	grab	11.91	8.30	No	0.23	8.8	ND	400
#13 - discharge	grab	12.22	8.10	No	0.37	8.8	ND	NA
River Water	grab	12.11	7.91	No	0.07	6.9	ND	7

NOTES:

Pressure washing work activities at the Skykomish River Bridge (Gold Bar) started at approximately 7:15 am and were completed at approximately 10:45 am. Highly representative samples of the discharge water (water filtered through belly-tarp) were collected during all critical periods of the pressure-wash work activities.

All field measurements were collected using calibrated equipment (Horiba - 10). Water is discharged from the belly-tarp at approximately 3.5 to 4.0 gpm; comparatively, flow rates from 3/4" pipe are approximately 10 gpm.

Lead

reference 173-201A-040

Acute Chronic
g, c i, d

$CF = 1.46203 - [(\ln hardness)(0.145712)]$

$CF = 1.46203 - [(\ln 14)(0.145712)]$

$= 1.46203 - [(2.639)(0.145712)]$

$= 1.46203 - 0.38826$

$CF \boxed{= 1.074}$

Results from Skykomish River Bridge Painting Project

River Water hardness = 14.0 mg/L

Lead dissolved = 0.13 mg/L ppm

Lead total = 6.48 mg/L or ppm

763.6 L = 1 yd^3

Formula for lead acute

$$(CF)\left(e^{1.273[\ln(hardness)] - 1.460}\right)$$

$$=(1.074)\left(e^{1.273[\ln(14)] - 1.460}\right)$$

$$=(1.074)\left(e^{1.273(2.639) - 1.460}\right)$$

$$=(1.074)\left(e^{1.899}\right)$$

$$\boxed{= 7.17\ \mu g/L \text{ or } 0.00717\ mg/L \quad \text{Acute lead}}$$

Skykomish River bridge

$C_1 V_1 = C_2 V_2$

$(0.13 ppm)(1L) = (C_2)(763.6 L)$

$C_2 = 1.70 \times 10^{-4} ppm/yd^3$

@ 0.13 mg/L (diss lead) mixed w/ 1 cubic yard of water

lead = 0.00017 mg/L

$(6.48 ppm)(1L) = C_2 (763.6 L)$

$C_2 = 0.0085$

@ 6.48 mg/L (total lead) mixed w/ 1 cubic yard of water

lead = 0.0085 mg/L

Copper o,p freshwater
Acute

$= (0.96)(e^{(0.9422[\ln(14)]-1.464)})$

$= (0.96)(e^{(1.023)})$

$\boxed{= 2.67\,ug/L \text{ or } 0.0027\,mg/L \quad \text{Acute Cu}}$

Skykomish

Zinc aa, c freshwater
Acute

$= (0.978)(e^{(0.8473[\ln(14)+0.8604)})$

$= (0.978)(e^{3.096})$

$\boxed{= 21.6\,ug/L \text{ or } 0.0216\,mg/L \quad \text{Acute Zn}}$

Skykomish

Arsenic - Freshwater

Acute = 360 ug/L or 0.36 mg/L

SEVERN TRENT SERVICES

STL Seattle
5755 8th Street East
Tacoma, WA 98424

Tel: 253 922 2310
Fax: 253 922 5047
www.stl-inc.com

TRANSMITTAL MEMORANDUM

DATE: May 24, 2002

TO: David Hamacher
WSDOT - Safety
P. O. Box 47311
Olympia, WA 98504

Dept. of Transportation
JUN 10 2002
Safety and Health

PROJECT: SR-2 MP 030

REPORT NUMBER: 105888

TOTAL NUMBER OF PAGES: 40

Enclosed are the test results for nine samples received at STL Seattle on May 10, 2002.

The report consists of this transmittal memo, analytical results, quality control reports, a copy of the chain-of-custody, a list of data qualifiers and analytical narrative when applicable, and a copy of any requested raw data.

Should there be any questions regarding this report, please contact me at (253) 922-2310.

Sincerely,

Dawn Werner
Project Manager

STL Seattle

Sample Identification:

Lab. No.	Client ID	Date/Time Sampled	Matrix
105888-1	#2 SR-2 MP 030		Liquid
105888-2	#7 SR-2 MP 030	05-10-02 *	Liquid
105888-3	#12 SR-2 MP 030	05-10-02 *	Liquid
105888-4	River	05-10-02 06:55	Liquid
105888-5	Tanker	05-10-02 06:30	Liquid
105888-6	#3 and #8 (Composite)	05-10-02 *	Liquid
105888-7	VOC - Blank	05-10-02 *	Liquid
105888-8	Metals - Blank	05-10-02 *	Liquid
105888-9	Discharge - Composite	05-10-02 *	Liquid

* - Sampling time not specified for this sample

STL Seattle

Client Name	WSDOT - Safety
Project Name	SR-2 MP 030
Date Received	05-10-02

✓ - QA/QC reviewed
- added to spreadsheet summaries

General Chemistry Parameters

Client Sample ID #2 SR-2 MP 030
Lab ID 105888-01

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Coliform	SM 9221B	05-10-02	MPN/100 ml	50 ✓	0

Client Sample ID #7 SR-2 MP 030
Lab ID 105888-02

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Coliform	SM 9221B	05-10-02	MPN/100 ml	140 ✓	0

Client Sample ID #12 SR-2 MP 030
Lab ID 105888-03

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Coliform	SM 9221B	05-10-02	MPN/100 ml	400 ✓	0

Client Sample ID River
Lab ID 105888-04

Parameter	Method	Date Analyzed	Units	Result	PQL
Hardness	EPA 130.2	05-16-02	mg/L	14 ✓	4
Total Coliform	SM 9221B	05-10-02	MPN/100 ml	7 ✓	0
Total Suspended Solids	EPA 160.2	05-14-02	mg/L	ND ✓	2

Client Sample ID Tanker
Lab ID 105888-05

Parameter	Method	Date Analyzed	Units	Result	PQL
Hardness	EPA 130.2	05-16-02	mg/L	21 ✓	4

STL Seattle

	Client Sample ID	Discharge - Composite
	Lab ID	105888-09

Parameter	Method	Date Analyzed	Units	Result	PQL
BOD (5-day)	EPA 405.1	05-15-02	mg/L	33	11
Hardness	EPA 130.2	05-16-02	mg/L	120	5
Total Suspended Solids	EPA 160.2	05-14-02	mg/L	403	10

STL Seattle

Client Name	WSDOT - Safety
Client ID:	RIVER
Lab ID:	105888-04
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	RIVER
Lab ID:	105888-04
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND ✓	0.001	
Lead	ND ✓	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	TANKER
Lab ID:	105888-05
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Copper	ND	0.01	
Zinc	0.0305	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	TANKER
Lab ID:	105888-05
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.001	
Lead	0.00693	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	METALS - BLANK
Lab ID:	105888-08
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	METALS - BLANK
Lab ID:	105888-08
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.00308	0.001	
Lead	ND	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Received:	5/10/02
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	2.05	0.01	
Lead	6.48	0.015	
Zinc	3.63	0.01	

10.1

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Received:	5/10/02
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.0118 ✓	0.0005	

10.2

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Beryllium	ND	0.002	
Chromium	ND	0.01	
Copper	0.178	0.01	
Nickel	ND	0.01	
Silver	ND	0.01	
Zinc	1.06	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.00109	0.001	
Antimony	ND	0.003	
Cadmium	ND	0.0005	
Lead	0.13	0.0005	
Selenium	ND	0.003	
Thallium	ND	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Received:	5/10/02
Date Prepared:	5/17/02
Date Analyzed:	5/17/02
Dilution Factor	1

Dissolved Mercury by CVAA - USEPA Method 7470

Analyte	Result (mg/L)	PQL	Flags
Mercury	ND	0.0002	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	#3 AND #8 (COMPOSITE)
Lab ID:	105888-06
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

Surrogate	% Recovery	Flags	Recovery Limits Low	Recovery Limits High
Dibromofluoromethane	92.8		85	114
Fluorobenzene	95.5		91	110
Toluene-D8	97.7		92	107
Ethylbenzene-d10	93.7		86	108
Bromofluorobenzene	101		87	110

Analyte	Result (ug/L)	PQL	MRL	Flags
Dichlorodifluoromethane	ND	1	0.5	
Chloromethane	ND	1	0.5	
Vinyl chloride	ND	1	0.5	
Bromomethane	ND	2	1	
Chloroethane	ND	1	0.5	
Trichlorofluoromethane	ND	1	0.5	
1,1-Dichloroethene	ND	1	0.5	
Methylene chloride	ND	1	0.5	
trans-1,2-Dichloroethene	ND	1	0.5	
1,1-Dichloroethane	ND	1	0.5	
2,2-Dichloropropane	ND	1	0.5	
cis-1,2-Dichloroethene	ND	1	0.5	
Bromochloromethane	ND	1	0.5	
Chloroform	ND	1	0.5	
1,1,1-Trichloroethane	ND	1	0.5	
Carbon Tetrachloride	ND	1	0.5	
1,1-Dichloropropene	ND	1	0.5	
Benzene	ND	1	0.5	
1,2-Dichloroethane	ND	1	0.5	
Trichloroethene	ND	1	0.5	
1,2-Dichloropropane	ND	1	0.5	
Dibromomethane	ND	1	0.5	
Bromodichloromethane	ND	1	0.5	
cis-1,3-Dichloropropene	ND	1	0.5	
Toluene	ND	1	0.5	
trans-1,3-Dichloropropene	ND	1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for 105888-06 continued...

Analyte	Result (ug/L)	PQL	MRL
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1,2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	2.36	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	7.86	2	1
o-Xylene	3.65	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	1.39	1	0.5
4-Chlorotoluene	0.529	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	4.29	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

Client Name	WSDOT - Safety
Client ID:	VOC - BLANK
Lab ID:	105888-07
Date Received:	5/10/02
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

Surrogate	% Recovery	Flags	Recovery Limits Low	Recovery Limits High
Dibromofluoromethane	88		85	114
Fluorobenzene	95.7		91	110
Toluene-D8	97		92	107
Ethylbenzene-d10	101		86	108
Bromofluorobenzene	102		87	110

Analyte	Result (ug/L)	PQL	MRL	Flags
Dichlorodifluoromethane	ND	1	0.5	
Chloromethane	ND	1	0.5	
Vinyl chloride	ND	1	0.5	
Bromomethane	ND	2	1	
Chloroethane	ND	1	0.5	
Trichlorofluoromethane	ND	1	0.5	
1,1-Dichloroethene	ND	1	0.5	
Methylene chloride	ND	1	0.5	
trans-1,2-Dichloroethene	ND	1	0.5	
1,1-Dichloroethane	ND	1	0.5	
2,2-Dichloropropane	ND	1	0.5	
cis-1,2-Dichloroethene	ND	1	0.5	
Bromochloromethane	ND	1	0.5	
Chloroform	ND	1	0.5	
1,1,1-Trichloroethane	ND	1	0.5	
Carbon Tetrachloride	ND	1	0.5	
1,1-Dichloropropene	ND	1	0.5	
Benzene	ND	1	0.5	
1,2-Dichloroethane	ND	1	0.5	
Trichloroethene	ND	1	0.5	
1,2-Dichloropropane	ND	1	0.5	
Dibromomethane	ND	1	0.5	
Bromodichloromethane	ND	1	0.5	
cis-1,3-Dichloropropene	ND	1	0.5	
Toluene	ND	1	0.5	
trans-1,3-Dichloropropene	ND	1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for 105888-07 continued...

Analyte	Result (ug/L)	PQL	MRL
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1.2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	ND	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	ND	2	1
o-Xylene	ND	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	ND	1	0.5
4-Chlorotoluene	ND	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	ND	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID: Batch QC
Lab ID: 105818-1
QC Batch Number: 1071-79

Method Blank

Parameter	Result (mg/L)	PQL
Total Suspended Solids	ND	2

Duplicate

Parameter	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD (%)	Flag
Total Suspended Solids	78	79	-1.27	

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID: Batch QC
Lab ID: N/A
QC Batch Number: 1089-15

Method Blank

Parameter	Result (mg/L)
BOD (5-day)	0.02

QC Check Standard

Parameter	Result (mg/L)	Mean Value (mg/L)	%D
Glucose	185	198	6.6

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID: Batch QC
Lab ID: 105831-1
QC Batch Number: 856-78

Method Blank

Parameter	Result (mg/L)	PQL
Hardness	ND	2

Duplicate

Parameter	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD (%)	Flag
Hardness	185	186	0.5	

STL Seattle

Lab ID:	Method Blank - TP538
Date Received:	-
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Lab ID:	Method Blank - TP578
Date Received:	-
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Lead	ND	0.015	
Zinc	ND	0.01	

STL Seattle

Matrix Spike Report

Client Sample ID:	WS-513
Lab ID:	105912-01
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	TP538

Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Copper	0	0.5	0.439	88	
Zinc	0	1	0.888	89	

STL Seattle

Matrix Spike Report

Client Sample ID:	POND S-3
Lab ID:	106188-01
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
QC Batch ID:	TP578

Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Copper	0.035	0.5	0.481	89	
Lead	0.027	1	0.966	94	
Zinc	0.014	1	0.941	93	

STL Seattle

Duplicate Report

Client Sample ID:	WS-513
Lab ID:	105912-01
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	TP538

Metals by ICP - USEPA Method 6010

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Copper	0	0	NC	
Zinc	0	0	NC	

STL Seattle

Duplicate Report

Client Sample ID:	POND S-3
Lab ID:	106188-01
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
QC Batch ID:	TP578

Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Copper	0.035	0.024	37.0	X4a
Lead	0.027	0.025	7.7	
Zinc	0.014	0.013	7.4	

STL Seattle

Lab ID:	Method Blank - TP538
Date Received:	-
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	Result (mg/L)	PQL	Flags
Arsenic	ND	0.001	
Lead	ND	0.0005	

STL Seattle

Lab ID:	Method Blank - TP578
Date Received:	-
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0005	

STL Seattle

Matrix Spike Report

Client Sample ID:	WS-513
Lab ID:	105912-01
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	TP538

Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Spike Amount (mg/L)**	**MS Result (mg/L)**	**MS % Rec.**	**Flag**
Arsenic	0.00153	4	4.17	104	
Lead	0	1	1.13	113	

STL Seattle

Matrix Spike Report

Client Sample ID:	POND S-3
Lab ID:	106188-01
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
QC Batch ID:	TP578

Metals by ICP-MS - USEPA Method 6020

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Arsenic	0.00649	4	3.78	94	

STL Seattle

Duplicate Report

Client Sample ID:	WS-513
Lab ID:	105912-01
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	TP538

Metals by ICP-MS - USEPA Method 6020

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Arsenic	0.0015	0.0011	31.0	X4a
Lead	0	0	NC	

STL Seattle

Duplicate Report

Client Sample ID:	POND S-3
Lab ID:	106188-01
Date Prepared:	5/30/02
Date Analyzed:	5/30/02
QC Batch ID:	TP578

Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Arsenic	0.0065	0.0069	-6.0	

STL Seattle

Lab ID:	Method Blank - DP537
Date Received:	-
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Beryllium	ND	0.002	
Chromium	ND	0.01	
Copper	ND	0.01	
Nickel	ND	0.01	
Silver	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Matrix Spike Report

Client Sample ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	DP537

Dissolved Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Beryllium	0	0.1	0.0902	90	
Chromium	0	0.4	0.367	92	
Copper	0.18	0.5	0.626	90	
Nickel	0	1	0.883	88	
Silver	0	0.6	0.48	80	
Zinc	1.1	1	1.89	83	

STL Seattle

Duplicate Report

Client Sample ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	DP537

Dissolved Metals by ICP - USEPA Method 6010

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Beryllium	0	0	NC	
Chromium	0	0	NC	
Copper	0.18	0.18	0.0	
Nickel	0	0	NC	
Silver	0	0	NC	
Zinc	1.1	1.1	0.0	

STL Seattle

Lab ID:	Method Blank - DP537
Date Received:	-
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
Dilution Factor	1

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.001	
Antimony	ND	0.003	
Cadmium	ND	0.0005	
Lead	ND	0.0005	
Selenium	ND	0.003	
Thallium	ND	0.0005	

STL Seattle

Matrix Spike Report

Client Sample ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	DP537

Dissolved Metals by ICP-MS - USEPA Method 6020

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Arsenic	0.00109	4	3.8	95	
Antimony	0	3	2.55	85	
Cadmium	0	0.1	0.101	101	
Lead	0.13	1	1.14	101	
Selenium	0	4	3.95	99	
Thallium	0	4	4.24	106	

STL Seattle

Duplicate Report

Client Sample ID: DISCHARGE - COMPOSITE
Lab ID: 105888-09
Date Prepared: 5/14/02
Date Analyzed: 5/14/02
QC Batch ID: DP537

Dissolved Metals by ICP-MS - USEPA Method 6020

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Arsenic	0.0011	0.0012	-8.7	
Antimony	0	0	NC	
Cadmium	0	0	NC	
Lead	0.13	0.13	0.0	
Selenium	0	0	NC	
Thallium	0	0	NC	

STL Seattle

Lab ID:	Method Blank - ZD934
Date Received:	-
Date Prepared:	5/17/02
Date Analyzed:	5/17/02
Dilution Factor	1

Dissolved Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Matrix Spike Report

Client Sample ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Prepared:	5/17/02
Date Analyzed:	5/17/02
QC Batch ID:	ZD934

Dissolved Mercury by CVAA - USEPA Method 7470

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Mercury	0	0.002	0.00136	68	x7

STL Seattle

Blank Spike/Blank Spike Duplicate Report

Lab ID:	ZD934
Date Prepared:	5/17/02
Date Analyzed:	5/17/02
QC Batch ID:	ZD934

Mercury by CVAA - USEPA Method 7470

Compound Name	Blank Result (mg/L)	Spike Amount (mg/L)	BS Result (mg/L)	BS % Rec.	BSD Result (mg/L)	BSD % Rec.	RPD	Flag
Mercury	0	0.002	0.00165	82.7	0.00166	83.2	0.6	

STL Seattle

Duplicate Report

Client Sample ID:	DISCHARGE - COMPOSITE
Lab ID:	105888-09
Date Prepared:	5/17/02
Date Analyzed:	5/17/02
QC Batch ID:	ZD934

Dissolved Mercury by CVAA - USEPA Method 7470

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Mercury	0	0	NC	

STL Seattle

Lab ID:	Method Blank - ITS1586
Date Received:	-
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

			Recovery Limits	
Surrogate	**% Recovery**	**Flags**	**Low**	**High**
Dibromofluoromethane	88.9		85	114
Fluorobenzene	94.3		91	110
Toluene-D8	98.9		92	107
Ethylbenzene-d10	102		86	108
Bromofluorobenzene	98.1		87	110

Analyte		**Result (ug/L)**	**PQL**	**MRL**	**Flags**
Dichlorodifluoromethane	ND		1	0.5	
Chloromethane	ND		1	0.5	
Vinyl chloride	ND		1	0.5	
Bromomethane	ND		2	1	
Chloroethane	ND		1	0.5	
Trichlorofluoromethane	ND		1	0.5	
1,1-Dichloroethene	ND		1	0.5	
Methylene chloride	ND		1	0.5	
trans-1,2-Dichloroethene	ND		1	0.5	
1,1-Dichloroethane	ND		1	0.5	
2,2-Dichloropropane	ND		1	0.5	
cis-1,2-Dichloroethene	ND		1	0.5	
Bromochloromethane	ND		1	0.5	
Chloroform	ND		1	0.5	
1,1,1-Trichloroethane	ND		1	0.5	
Carbon Tetrachloride	ND		1	0.5	
1,1-Dichloropropene	ND		1	0.5	
Benzene	ND		1	0.5	
1,2-Dichloroethane	ND		1	0.5	
Trichloroethene	ND		1	0.5	
1,2-Dichloropropane	ND		1	0.5	
Dibromomethane	ND		1	0.5	
Bromodichloromethane	ND		1	0.5	
cis-1,3-Dichloropropene	ND		1	0.5	
Toluene	ND		1	0.5	
trans-1,3-Dichloropropene	ND		1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for ITS1586 continued...

Analyte	Result (ug/L)	PQL	MRL
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1,2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	ND	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	ND	2	1
o-Xylene	ND	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	ND	1	0.5
4-Chlorotoluene	ND	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	ND	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

Blank Spike/Blank Spike Duplicate Report

Lab ID:	ITS1586
Date Prepared:	5/14/02
Date Analyzed:	5/14/02
QC Batch ID:	ITS1586

Volatile Organics by USEPA Method 5030/8260B

Compound Name	Blank Result (ug/L)	Spike Amount (ug/L)	BS Result (ug/L)	BS % Rec.	BSD Result (ug/L)	BSD % Rec.	RPD	Flag
1,1-Dichloroethene	0	2	2.02	101	2	100	-1	
Benzene	0	2	2.15	108	2.04	102	-5.7	
Trichloroethene	0	2	2.11	105	2.07	103	-1.9	
Toluene	0	2	2.19	109	2.11	106	-2.8	
Chlorobenzene	0	2	2.2	110	2.16	108	-1.8	

STL Seattle
5755 8th Street East
Tacoma, WA 98424

Tel: 253 922 2310
Fax: 253 922 5047
www.stl-inc.com

SEVERN TRENT SERVICES

DATA QUALIFIERS AND ABBREVIATIONS

B1: This analyte was detected in the associated method blank. The analyte concentration was determined not to be significantly higher than the associated method blank (less than ten times the concentration reported in the blank).

B2: This analyte was detected in the associated method blank. The analyte concentration in the sample was determined to be significantly higher than the method blank (greater than ten times the concentration reported in the blank).

C1: Second column confirmation was performed. The relative percent difference value (RPD) between the results on the two columns was evaluated and determined to be $\leq$ 40%.

C2: Second column confirmation was performed. The RPD between the results on the two columns was evaluated and determined to be > 40%. The higher result was reported unless anomalies were noted.

M: GC/MS confirmation was performed. The result derived from the original analysis was reported.

D: The reported result for this analyte was calculated based on a secondary dilution factor.

E: The concentration of this analyte exceeded the instrument calibration range and should be considered an estimated quantity.

J: The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quantity.

MCL: Maximum Contaminant Level

MDL: Method Detection Limit

N: See analytical narrative.

ND: Not Detected

PQL: Practical Quantitation Limit

X1: Contaminant does not appear to be "typical" product. Elution pattern suggests it may be __________ .

X2: Contaminant does not appear to be "typical" product.

X3: Identification and quantitation of the analyte or surrogate was complicated by matrix interference.

X4: RPD for duplicates was outside advisory QC limits. The sample was re-analyzed with similar results. The sample matrix may be nonhomogeneous.

X4a: RPD for duplicates outside advisory QC limits due to analyte concentration near the method practical quantitation limit/detection limit.

X5: Matrix spike recovery was not determined due to the required dilution.

X6: Recovery and/or RPD values for matrix spike(/matrix spike duplicate) outside advisory QC limits. Sample was re-analyzed with similar results.

X7: Recovery and/or RPD values for matrix spike(/matrix spike duplicate) outside advisory QC limits. Matrix interference may be indicated based on acceptable blank spike recovery and/or RPD.

X7a: Recovery and/or RPD values for this spiked analyte outside advisory QC limits due to high concentration of the analyte in the original sample.

X8: Surrogate recovery was not determined due to the required dilution.

X9: Surrogate recovery outside advisory QC limits due to matrix interference.

[redacted]

Chain of Custody Record

STL-8274 (0102)

STL Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.stl-inc.com

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SEVERN TRENT SERVICES

Severn Trent Laboratories, Inc.

Client: WSDOT Safety + Health Svcs	Project Manager: David Hamachiev	Date: 5/10/02	Chain of Custody Number: 2703
Address: 310 Maple Park Ave	Telephone Number (Area Code)/Fax Number: 360-705-7746	Lab Number: 105888	Page 1 of 1
City: Olympia State: WA Zip Code: 98504-7311	Site Contact:	Lab Contact:	
Project Name and Location (State): SR-2 Mp 030	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.: WSDOT - Contract 30600			

Matrix; Containers & Preservatives; Analysis (Attach list if more space is needed)

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	$Na_2S_2O_3$	MPN - bacteria	Hardness	TSS	BOD	Cu, Pb, Zn, As	VOC-8260	Priority Metals (Diss)	lab to filter + preserve	Special Instructions/ Conditions of Receipt
1 #2 SR-2 mp 030	5/10/02			✓									✓	X								
2 #7 " "				✓									✓	X								
3 #12 " "				✓									✓	X								
4 River		6:55A		✓			✓						✓	X	X	X		X				3 containers
5 Tanker		6:30A		✓			✓								X			X				2 containers
6 #3 and #8 analyze as a composite				✓			~~✓~~			X									X			6 containers 40ml
7 VOC-blank				✓			~~✓~~			X									X			3 containers
8 Metals - Blank				✓			✓											X				1 container
9 Discharge - composite	↓			✓			✓								X	X	X			X		7 containers

Cooler: ☒ Yes ☐ No Cooler Temp: ______

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☒ Other Standard

QC Requirements (Specify)

1. Relinquished By: [signature]	Date: 5/10/02	Time:	1. Received By: [signature]	Date: 5/10/02	Time:
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Stays with the Samples; CANARY - Returned to Client with Report; PINK - Field Copy

amec

29 May 2002

Dale Hamacher
WSDOT
310 Maple Park Ave.
Olympia, WA 98504-7311

Subject: May 2002 Acute Bioassay Tests

Dear Dale,

Enclosed are two copies of the bioassay report for the acute toxicity tests conducted on a discharge sample collected May 10, 2002. Tests were conducted using *Pimephales promelas* (Fathead minnow) and *Ceriodaphnia dubia*. Test procedures followed EPA and Washington Department of Ecology guidelines.

Please do not hesitate to call if you have any questions.

Sincerely,

Karen L. Bergmann
NW Bioassay Laboratory Manager
AMEC Earth & Environmental, Inc.

Dept. of Transportation
MAY 31 2002
Safety and Health

AMEC Earth & Environmental, Inc.
San Diego Bioassay Laboratory
5550 Morehouse Drive
San Diego, CA 92121
Tel (858) 458-9044
Fax (858) 458-0943
www.amec.com

AMEC Earth & Environmental, Inc.
Northwest Bioassay Laboratory
5009 Pacific Highway East, Suite 2
Fife, WA 98424
Tel (253) 922-4296
Fax (253) 922-4296
www.amec.com

Chain of Custody Record

STL-8274 (0102)

STL Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.stl-inc.com

SEVERN TRENT SERVICES
Severn Trent Laboratories, Inc.

Client: Washington State Department of Transport	Project Manager: [illegible] David Harracher	Date: 6/3/02	Chain of Custody Number: 2597
Address: 310 Maple Park Ave (P.O. box 47311)	Telephone Number (Area Code)/Fax Number: 360-705-7746	Lab Number:	Page 1 of [illegible]
City: Olympia WA / State: / Zip Code: 98504-7311	Site Contact: / Lab Contact:		
Project Name and Location (State): SR 432 bridge	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No: See State Contract			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	$NaOH$	$ZnAc/NaOH$		Analysis (Attach list if more space is needed)												Special Instructions/ Conditions of Receipt
[illegible]	[illegible]	[illegible]		✓				✓							X	X	X	X	X								[illegible]
[illegible]	[illegible]	[illegible]		✓				✓													X						[illegible]
[illegible]	[illegible]	[illegible]		✓				✓										X	X		X						
[illegible]	[illegible]	[illegible]		✓							✓									X	X						[illegible]
[illegible]	[illegible]	[illegible]		✓							✓									X							[illegible]
[illegible]	[illegible]	[illegible]		✓				✓										X	X		X						
																											[illegible]
																											[illegible]
																											[illegible]

Cooler: ☒ Yes ☐ No Cooler Temp: ____

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For 1 Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☒ Other [illegible]

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By: [signature]	6/3/02	1:15 pm	1. Received By: [signature] M. NEWBY	6-4-02	1:15 pm
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Stays with the Samples; CANARY - Returned to Client with Report; PINK - Field Copy amec Earth & Environmental

Chain of Custody

AMEC Northwest Bioassay Laboratory
5009 Pacific Highway East, Suite 2-0
Fife, WA 98424
253-922-4296

Date [illegible] Page 1 of 1

COMPANY [illegible]
ADDRESS [illegible]
CITY [illegible] STATE [illegible] ZIP [illegible]
PHONE NO. [illegible]

ANALYSIS REQUIRED

PROJECT MANAGER [illegible]
SAMPLERS (SIGNATURE) [illegible]
PHONE NUMBER

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	[illegible]												CONCENTRATIONS/COMMENTS	NUMBER OF CONTAINERS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	X												[illegible]	2
																	[illegible]	

PROJECT INFORMATION	SAMPLE RECEIPT	
CLIENT	TOTAL NO. OF CONTAINERS	
P.O. NO.	CHAIN OF CUSTODY SEALS	
	REC'D. GOOD CONDITION/COLD	
SHIPPED VIA:	CONFORMS TO RECORD	

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY		RELINQUISHED BY	
(Signature) [illegible]	(Time) [illegible]	(Signature)	(Time)
(Printed Name) [illegible]	(Date) [illegible]	(Printed Name)	(Date)
(Company) [illegible]		(Company)	

RECEIVED BY		RECEIVED BY (LABORATORY)	
		[illegible]	
(Signature)	(Time)	(Signature) [illegible]	(Time)
(Printed Name)	(Date)	(Printed Name)	(Date)
(Company)		Ogden Bioassay Lab Log-in No.	

Additional disposal charges may apply.

DISTRIBUTION: WHITE, CANARY - AMEC Bioassay Lab, PINK - Originator

amec

FAX

• SENDING 5 PAGES, INCLUDING COVER •

DATE: 29 MAY 2002

TO: DALE HAMACHER

LOCATION: WSDOT

FAX NO.: 360-705-6837

FROM: KAREN BERGMANN
MANAGER NW BIOASSAY LAB

Dale,

The following is a summary of the bioassay test results for the discharge sample collected May 10. I have also included the raw data in the fax. I'll send a full report out today.

To summarize, the Fathead minnow survived better than the Ceriodaphnia. There was 56.7 percent survival in 100 percent sample in the Fathead minnow test. All the Ceriodaphnia died in concentrations 12.5 percent and higher.

It is difficult to tell whether the turbidity of the sample contributed to mortality in these tests. We could conduct a side-by-side test with the next sample and see if letting the sample settle or filtering it makes a difference.

We can discuss this when you pick up containers for the next sampling event.

Thank you.

Karen

AMEC Earth & Environmental
Northwest Bioassay Lab
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Fife, WA 98424
Tel & FAX 253-922-4296

WSDOT
Bridge Washing Discharge 051002

SUMMARY REPORT
Prepared: 29 May 2002

ACUTE TOXICITY TESTING

Sample Information

Sample Date / Time:	10 May 2002 / 1030
Sample Receipt Date / Time:	10 May 2002 / 1355
Receipt Temperature	6°C
Dissolved Oxygen (mg/L)	11.5
pH	7.57
Conductivity (µS/cm)	176
Hardness (mg/L $CaCO_3$)	80
Alkalinity (mg/L $CaCO_3$)	48
Chlorine (mg/L)	0.12
Ammonia (mg/L)	1.3

Test Conditions

<u>Fathead minnow 96-Hour Survival Test</u>

Test Period:	05/10/20 – 05/14/02
Test Organism:	*Pimephales promelas* (Fathead minnow)
Test Organism Source	Aquatic Biosystems, Fort Collins, CO
Test Organism Age:	12 days post hatch
Test chamber:	250 milliliter plastic cup
Test temperature:	25°C
Test concentrations:	Control, 6.25, 12.5, 20, 50, 100
Dilution water:	Moderately Hard Synthetic Water
Test solution volume:	200 milliliters
Number of organisms/ chamber:	10
Number of replicates/concentration:	3
Feeding:	*Artemia* nauplii 2 hours before test initiation and solution renewal at 48 hours
Endpoint:	Mortality or 96 hours
Photoperiod:	16 hours light/ 8 hours dark
Test Acceptability:	$\geq$ 90% control survival
Test Protocol:	EPA/600/4-90/027F

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WSDOT
Bridge Washing Discharge 051002

SUMMARY REPORT
Prepared: 29 May 2002

Ceriodaphnia 48-Hour Survival Test

Test Period:	05/10/20 – 05/12/02
Test Organism:	*Ceriodaphnia dubia*
Test Organism Source	In-house Cultures
Test Organism Age:	< 24 hours old
Test chamber:	30 milliliter plastic cup
Test temperature:	25°C
Test concentrations:	Control, 6.25, 12.5, 20, 50, 100
Dilution water:	Moderately Hard Synthetic Water
Test solution volume:	15 milliliters
Number of organisms/ chamber:	5
Number of replicates/concentration:	4
Feeding:	YTC and Selenastrum during holding; no feeding during test
Endpoint:	Mortality or 48 hours
Photoperiod:	16 hours light/ 8 hours dark
Test Acceptability:	$\geq$ 90% control survival
Test Protocol:	EPA/600/4-90/027F

Summary Bioassay Results

Species	Test ID	Concentration (% effluent)	Percent Survival	NOEC*	LC_{50} (% effluent)
Fathead minnow	0205-12NW	0	100	25	>100
		6.25	100		
		12.5	93.3		
		25	93.3		
		50	60		
		100	56.7		
Ceriodaphnia	0205-13NW	0	100	<6.25	NA
		6.25	40		
		12.5	0		
		25	0		
		50	0		
		100	0		

* No observed effect concentration

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Client: WSDOT
Sample ID: 5/10/02 Discharge
Contact:
Test #: 0205-12NW

96 Hour Toxicity Test Data Sheet
Freshwater 96-hr Acute with Renewal

Start Date & Time: 5/10/02 1645
End Date & Time: 5/14/02 1720
Test Organism: P. promelas
Test Protocol:

Sample Conc. or %	D.O. (mg/L) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96	pH (mg/L) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96
C	8.5	7.8	6.7	7.9	7.3	7.4	7.26	7.95	7.58	7.99	8.01	7.67
6.25	7.9	7.6	6.4	8.2	7.3	7.3	7.84	7.84	7.57	8.00	7.93	7.73
12.5	7.9	7.7	6.6	8.3	7.2	7.2	7.86	7.98	7.59	7.96	7.88	7.68
25	7.8	7.2	6.6	8.5	6.8	6.8	7.83	7.79	7.59	7.87	7.76	7.62
50	7.9	6.6	5.8	9.1	6.0	6.3	7.15	6.66	7.46	7.72	7.53	7.51
100	8.0	5.7	4.7	9.2	4.0	6.0	7.47	7.45	7.46	7.58	7.20	7.37

*7.66

Sample Conc. or %	Conductivity µS/cm Init. 0	Fin. 48	Init. 48	Fin. 96	Test Temperature (°C) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96
C	276	342	298	319	25.0	25.1	25.1	25.1	25.0	25.1
6.25	356	344	244	315	25.0	25.4	25.4	25.0	25.1	25.3
12.5	275	328	289	319	25.0	25.3	25.1	25.0	25.0	25.0
25	269	340	381	305	25.0	25.3	25.4	25.1	25.1	25.0
50	257	339	361	303	25.0	25.7	25.2	25.0	24.9	25.1
100	236	318	327	279	25.0	25.6	25.3	25.0	25.0	25.0

Conc.	Alkalinity* *(mg/L as CaCo3)	Hardness*	Chlorine Resid. (mg/L)	Ammonia (mg/L)
control	60	80	.12	1.3
highest conc.	48	80		

Comments:

Analysts: TD, ET

Sample Conc. or %	Rep #	Cont #	Number of Live Organisms 0	24	48	72	96
C	1	8	10	10	10	10	10
	2	2	10	10	10	10	10
	3	4	10	10	10	10	10
6.25	1	9	10	10	10	10	10
	2	15	10	10	10	10	10
	3	18	10	10	10	10	10
12.5	1	14	10	10	10	10	9
	2	5	10	10	10	10	10
	3	12	10	10	10	10	9
25	1	1	10	10	10	10	9
	2	10	10	10	10	10	9
	3	16	10	10	10	10	10
50	1	17	10	9	9	9	6
	2	13	10	9	9	9	7
	3	6	10	8	8	8	5
100	1	11	10	8	8	8	6
	2	3	10	8	8	8	6
	3	7	10	7	7	7	5
Tech. Initials			ET	ET	ET	TD	TD

Sample Description: Sample was ~~a~~ medium ~~dark~~ brown liquid was a wet part suspended silty material.

Animal Source: ABS
Date Received: 5/10/02
Date of Hatch: 4/28/02

Freshwater Acute
48 Hour Toxicity Test Data Sheet
Northwest Bioassay Lab

Client: WSDOT
Sample ID: 5/10/02 Discharge
Contact:
Test #: 0205-13NW

Start Date & Time: 5/10/02 1715
End Date & Time: 5/12/02 1745
Test Organisms: Ceriodaphnia dubia

Conc. or %	Cont. #	Rep. #	Number of Live Organisms 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	pH (units) 0	24	48	Conductivity (µS/cm) 0	48	Temperature (°C) 0	24	48	Mean Percent Survival
0	4	1	5	5	5	8.1	7.9	8.1	7.76	7.55	8.13	276	340	25.0	25.1	25.2	
	2	2	5	5	5	5.5											
	21	3	5	5	5												100%
	7	4	5	5	5												
6.25	13	1	5	5	4	8.1 7.6		8.1	7.86	7.84	8.09	356	304	25.0	25.4	25.3	
	16	2	5	3	2	7.9											
	5	3	5	2	1												40%
	8	4	5	1	1												
12.5	10	1	5	2	0	8.2	7.7	8.2	7.86	7.88	8.07	275	298	25.0	25.3	25.1	
	18	2	5	0	0	7.9											
	6	3	5	0	0												0
	1	4	5	0	0												
25	23	1	5	1	0	7.8	7.2	8.0	7.83	7.71	8.04	269	289	25.0	25.3	25.7	
	11	2	5	1	0												
	14	3	5	1	0												0
	3	4	5	0	0												
50	12	1	5	0	0	7.9	6.6	6.0	7.75	7.65	7.91	257	280	25.0	25.7	25.1	
	9	2	5	0	0												
	19	3	5	0	0												0
	15	4	5	0	0												
100	24	1	5	0	0	8.0	5.7	7.6	7.67	7.45	7.85	230	273	25.0	25.6	25.4	
	22	2	5	0	0												
	20	3	5	0	0												0
	17	4	5	0	0												
Technician Initials			KB	KB	KB												

Conc.	Alkalinity (mg/L)	Hardness (mg/L as CaCO3)	Chlorine (mg/L)	Ammonia (mg/L)
control	60	80	—	—
highest conc.	48	80	.12	1.3

Sample Description: Sample was medium brown liquid w/ suspended silty material

Analyst Initials: KB

Comments: 0 hrs:
24 hrs.
48 hrs.

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Chain of Custody

Date 5/10/02 Page 1 of 1

COMPANY WSDOT
ADDRESS 310 Maple Park Ave
CITY Olympia STATE WA ZIP 98504-7311
PHONE NO. 360-705-7706

ANALYSIS REQUIRED

PROJECT MANAGER
SAMPLERS (SIGNATURE)
PHONE NUMBER

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	Acute												CONCENTRATIONS/COMMENTS	NUMBER OF CONTAINERS
Discharge	5/10	7:00A 10:30A	Comp	2 [illegible]	✓													

PROJECT INFORMATION

CLIENT

P.O. NO.

SHIPPED VIA:

SAMPLE RECEIPT

TOTAL NO. OF CONTAINERS	
CHAIN OF CUSTODY SEALS	
REC'D. GOOD CONDITION/COLD	
CONFORMS TO RECORD	

SPECIAL INSTRUCTIONS/COMMENTS:

RELINQUISHED BY
(Signature) (Time)
(Printed Name) (Date)
(Company) WSDOT

RELINQUISHED BY
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) (Time)
(Printed Name) (Date)
Ogden Bioassay Lab Log-in No.

Additional disposal charges may apply.

DISTRIBUTION: WHITE, CANARY - AMEC Bioassay Lab, PINK - Originator

Skykomish River Bridge (SR-2 Gold Bar) – Field Measurements

Sample ID	Sample Type	Dissolved Oxygen (mg/L)	pH (units)	Visual Oil & Grease	Conductivity mS/cm	Temp (Celsius)	Salinity (%)	Total Coliform (MPN/100ml)
#1	grab	11.62	7.95	No	0.34	7.7	ND	
#2	grab	11.65	7.96	No	0.20	7.7	ND	50
#3	grab	11.58	8.00	No	0.23	7.9	ND	
#4	grab	11.64	7.98	No	0.16	7.9	ND	
#5	grab	11.64	7.95	No	0.19	7.7	ND	
#6	grab	11.52	7.95	No	0.25	8.0	ND	
#7	grab	11.47	7.98	No	0.22	8.4	ND	140
#8	grab	NA	NA	No	NA	NA	ND	
#9	grab	11.66	8.16	No	0.22	8.4	ND	
#10	grab	11.65	8.18	No	0.27	8.4	ND	
#11	grab	11.75	8.24	No	0.24	8.4	ND	
#12	grab	11.91	8.30	No	0.23	8.8	ND	
#13	grab	12.22	8.10	No	0.37	8.8	ND	400
River	grab	12.11	7.91	No	0.07	6.9	ND	7

Pressure washing work activities at the Skykomish River Bridge (Gold Bar) started at approximately 7:15 am and were completed at approximately 10:45 am. Highly representative samples of the discharge water (water filtered through the belly-tarp) were collected during all critical periods of the pressure-wash work activities. All field measurements were collected usi ng calibrated equipment (Horiba U-10). Water is discharged from the belly-tarp at approximately 3.5 to 4.0 gpm; comparatively, flow rates in ¾" pipe is approximately 10 gpm.

Skykomish River Bridge (SR-2 Gold Bar) – Bridge Washing Water Quality Results

Sample Identification	Biochemical Oxygen Demand (BOD mg/L)	Total Suspended Solids (TSS mg/L)	Arsenic mg/L	Copper mg/L	Lead mg/L	Zinc mg/L
Screened Discharge 1	33	403	0.0011	0.178	0.130	1.06
DOE	NA	NA	0.360	0.0027	0.0072	0.0216
MCL	NA	NA	0.005	1.3	0.015	5.0
DOE – Department of Ecology, water quality standards "acute freshwater calculated" (reference WAC 173-201A-040)						
MCL – maximum contaminant level (reference DOE CLARC II spreadsheet)						
River water hardness = 14mg/L						
All metals were analyzed via dissolved methodologies (EPA Methodologies 6010/6020)						
BOD 33mg/Lx1.0L/0.26gal x Kg/1x10^6mg x 2.21lb/Kg x 800gal/event x 5events = 1.1 lb BOD discharged for bridge cleaning.						
TSS 403mg/Lx1.0L/0.26gal x Kg/1x10^6mg x 2.21lb/Kg x 800gal/event x 5events = 13.7lb TSS discharged for bridge cleaning.						
1,600lbs of waste (solids) were disposed at an upland facility. 13.7lb/1600lb x 100% =0.856%. Filter fabric was 99.14% efficie nt at screening materials from being discharged to environment.						

Water Quality Sampling Plan for Skykomish (002/035) River Bridge Painting Project

Pressure Washing Work Activities

Non preserved - 2 headspace 40 ml vials

Sample Identification/Location	Sample Type	Parameters
Filtered washwater, directly below filter tarp.	Composite and grab	2 1 - MPN (fecal coli) Laboratory analysis - BOD, TSS. Metals --(Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn), Chronic and Acute fish bioassay, fecal Coliform. Hardness 2 jugs fish bioassay 2 - 250 3 - 500ml (non preserved) In the field analysis (pH, DO, NTU, EC, temp, visual oil and grease)
Receiving water 50' upstream (background sample).	grab	Laboratory analysis - TSS. Metals --(As, Cu, Pb, Zn), fecal Coliform. 2-500ml (non preserved) 2-250 In the field analysis (pH, DO, NTU, EC, temp, visual oil and grease)
Receiving water 25' downstream (during washing event).	grab	Laboratory analysis - BOD, TSS. Metals --(Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn), Chronic and Acute fish bioassay, fecal Coliform. 3-500ml 2-250 In the field analysis (pH, DO, NTU, EC, temp, visual oil and grease)
????Washwater collected from inside the containment during active pressure washing??? Requires additional personnel. See note below. Any volunteers.	Composite and grab	Laboratory analysis - BOD, TSS. Metals --(Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn), Chronic and Acute fish bioassay, fecal Coliform. 3 In the field analysis (pH, DO, NTU, EC, temp, visual oil and grease)
QAQC - field blank	grab	Laboratory analysis - TSS. Metals --(As, Cu, Pb, Zn). 2-500ml
QAQC - Tanker truck, pre washwater.	grab	Laboratory analysis - BOD, TSS. Metals --(Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn), Chronic and Acute fish bioassay, fecal Coliform. 3-500ml In the field analysis (pH, DO, NTU, EC, temp, visual oil and grease) 2-250
QAQC - representative paint samples from steel structures	grab	Laboratory analysis - Metals --(Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn)

NOTES:

4 bottles fecal coli (MPN)

8-zero headspace 40ml vials

14-500ml non preserved

DO - dissolved oxygen
BOD - biochemical oxygen demand
TSS - total suspended solids
NTU - Turbidity
EC - electroconductivity
The lowest possible detection limits (graphic furnace/ICAP) will be used for all parameters
The selected metal parameters are from DOE's "priority pollutants list"
All samples will be delivered to a certified DOE laboratory under chain-of-custody protocols and procedures
All field instrumentation used for measuring water quality analysis will be calibrated and tested per manufacturer recommendations
All efforts will be made to prevent cross contamination
Composite - collected during all critical periods of washwater filtration and very representative of total discharge
Grab - a single "dip and take"
To show how much debris is captured by the tarp. I will be taking pictures of the tarp, pre and post pressure washing
QAQC - quality assurance/quality control
Metal samples will be analyzed using "dissolved" methodologies
NOTE: on paint chip samples I will have laboratory try and separate paint layers for analysis (outer layer versus bottom layer)
NOTE 2: it would be good to have a person sampling water inside the containment during pressure washing, that way I/we could better determine the effectiveness of the filtering tarps (collecting water as it washes from the steel and prior to filtration).

[redacted]

Chain of Custody Record

STL-8274 (0102)

STL Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.stl-inc.com

SEVERN TRENT SERVICES
Severn Trent Laboratories, Inc.

Client: WSDOT Safety Health [illegible]	Project Manager: David Hamacher	Date: 5/10/02	Chain of Custody Number: 2703
Address: 310 Maple Park Ave	Telephone Number (Area Code)/Fax Number: 360-705-7746	Lab Number:	Page 1 of 1
City: Olympia / State: WA / Zip Code: 98504-7311	Site Contact: / Lab Contact:		
Project Name and Location (State): SR-2 MP 030	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.: WSDOT - Contract 30600			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	$Na_2S_2O_3$	Analysis: MiN-[illegible]	Hardness	TSS	BOD	Cu Pb Zn As	VOC-8260	[illegible] (Diss)	lab tot. [illegible]	Special Instructions/ Conditions of Receipt
#2 SR-2 mp030	5/10/02			✓										✓	X								
#7 " "				✓										✓	X								
#12 " "				✓										✓	X								
River		6:55A		✓				✓						✓	X	X	X		X				3 containers
Tanker		6:30A		✓				✓								X			X				2 containers
#3 and #8 analyze as a composite				✓				X			X									X			6 containers 40ml
VOC-Blank				✓				X			X									X			3 containers
Metals-Blank				✓				✓											X				1 container
Discharge - composite	↓			✓				✓								X	X	X			X		7 containers

Cooler: ☒ Yes ☐ No Cooler Temp: ______

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☒ Other Standard

QC Requirements (Specify):

1. Relinquished By: [signature]	Date: 5/10/02	Time:	1. Received By: [signature]	Date: 5/10/02	Time:
2. Relinquished By:	Date:	Time:	2. Received By:	Date:	Time:
3. Relinquished By:	Date:	Time:	3. Received By:	Date:	Time:

Comments

DISTRIBUTION: *WHITE - Stays with the Samples; CANARY - Returned to Client with Report; PINK - Field Copy*

Washington State Department of Transportation

Bioassay Report

Bridge Washing Discharge

May 2002

Prepared by

AMEC Earth & Environmental
Northwest Bioassay Lab

amec

BIOASSAY REPORT

May 2002

Prepared for

Washington State Department of Transportation

310 Maple Park Ave.
Olympia, WA 98504-7311

Prepared by

AMEC Earth & Environmental

Northwest Bioassay Laboratory
5009 Pacific Hwy. East, Suite 2-0
Fife, WA 98424
(253) 922-4296

Submitted: 29 May 2002

INTRODUCTION

Acute bioassays using the test organisms *Ceriodaphnia dubia* and *Pimephales promelas* (Fathead minnow) were conducted on a discharge sample collected May 10, 2002. Dale Hamacher managed the project for WSDOT. All tests were conducted at AMEC Earth & Environmental's Northwest Bioassay Laboratory located in Fife, Washington.

MATERIALS AND METHODS

The discharge sample was delivered to the laboratory in a 10-liter plastic cubitainer the day of collection and stored at 4°C in the dark until use. Detailed sample information is in Table 1.

Table 1. Sample Information

	Sample ID Discharge
AMEC Log-In No.	02-180
Sample date	5/10/02
Sample time	0700 - 1030
Receipt Date	5/10/02
Receipt Time	1355
Receipt Temp.	6.0°C
Dissolved Oxygen (mg/L)	11.5
pH	7.57
Conductivity (μS/cm)	176
Hardness (mg/L $CaCO_3$)	80
Alkalinity (mg/L $CaCO_3$)	48
Chlorine (mg/L)	0.12
Ammonia (mg/L)	1.3

Summary of Fathead Minnow Acute Survival Test Conditions

Test ID:	0205-12NW
Test Initiation	
Date:	5/10/02
Time:	1645
Test Termination	
Date:	5/14/02
Time:	1720
Test animal:	*Pimephales promelas* (Fathead minnow)
Animal source:	Aquatic Biosystems, Fort Collins, CO
Animal age:	12 days post hatch
Feeding:	*Artemia* nauplii 2 hours before test initiation and solution renewal at 48 hours
Test chamber:	250 milliliter plastic cup
Test solution volume:	200 milliliters
Test temperature:	25°C
Dilution water:	Moderately Hard Synthetic Water
Test concentrations (%):	100, 50, 25, 12.5, 6.25, 0
Number of organisms/ chamber:	10
Number of replicates/conc:	3
Endpoint:	Mortality or 96 hours
Photoperiod:	16 hours light/ 8 hours dark
Aeration:	None
Deviations:	None
Statistical Software:	ToxCalc 5.0
Test Protocol:	EPA/600/4-90/027F
Test Acceptability:	$\geq$ 90% survival in the control

Summary of Ceriodaphnia Acute Survival Test Conditions

Test ID:	0205-13NW
Test Initiation	
Date:	5/10/02
Time:	1715
Test Termination	
Date:	5/12/02
Time:	1745
Test animal:	*Ceriodaphnia dubia*
Animal source:	In-house culture
Animal age:	<24 hours
Feeding:	50:50 mixture YTC:Selenastrum 2 hours prior to test initiation
Test chamber:	30 milliliter plastic cup
Test solution volume:	15 milliliters
Test temperature:	25°C
Dilution water:	Moderately Hard Synthetic Water
Test concentrations (%):	100, 50, 25, 12.5, 6.25, 0
Number of organisms/ chamber:	5
Number of replicates/conc.:	4
Endpoint:	Mortality or 48 hours
Photoperiod:	16 hours light/ 8 hours dark
Aeration:	None
Deviations:	None
Statistical Software:	ToxCalc 5.0
Test Protocol:	EPA/600/4-90/027F
Test Acceptability:	$\geq$ 90% survival in the control

RESULTS

A summary of results for the Fathead minnow and *Ceriodaphnia* acute toxicity tests is contained in Table 2. There was 56.7 percent survival in 100 percent sample in the Fathead minnow test. The concentration lethal to 50 percent of the fish (LC_{50}) was greater than 100 percent sample. The Ceriodaphnia test exhibited high mortality and there was no survival in concentrations of 12.5 percent sample or higher.

Table 2. Acute Toxicity Results

Species	Test ID	Concentration (% Effluent)	Percent Survival	NOEC* (% Effluent)	LC_{50} (% Effluent)
Fathead minnow	0205-12NW	0	100	25	>100
		6.25	100		
		12.5	93.3		
		25	93.3		
		50	60		
		100	56.7		
Ceriodaphnia	0205-13NW	0	100	<6.25	NA
		6.05	40		
		12.5	0		
		25	0		
		50	0		
		100	0		

* No Observed Effect Concentration, NA- Not available

Test data and individual statistical summaries for each test are contained in the appendices.

QUALITY ASSURANCE

Results from reference toxicant tests used to monitor laboratory performance using the test species Fathead minnow and *Ceriodaphnia dubia* are summarized in Table 3. The results are acceptable based on control charting for the laboratory. The coefficients of variation for the last 20 tests are also listed in Table 3.

Table 3. Reference Toxicant Results

Species	Date Initiated	Test ID	LC_{50} (g/L NaCl)	CV (%)
Fathead minnow	05/02/02	RA050202PP	5.68	14.8
Ceriodaphnia dubia	04/23/02	RA042302CD	2.16	17.4

REFERENCES

EPA. 1994. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms. EPA/600/4-91/002, July 1994.

Tidepool Scientific Software. 1992-1994. TOXCALC Comprehensive Toxicity Data Analysis and Database Software, Version 5.0.

WADOE. 1998. Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria. Washington State Department of Ecology. Water Quality Program. Publication number: WQ-R-95-80, Revised December 2001.

Appendix A

Fathead minnow Acute Toxicity Test

Test Data and Statistical Summary

Acute Fish Test-96 Hr Survival

Start Date:	05/10/2002	Test ID:	0205-12NW	Sample ID:	Washington State Dept of Transportatic
End Date:	05/14/2002	Lab ID:	WAAEE-AMEC NW Bioassa	Sample Type:	Bridge Washing Discharge
Sample Date:	05/10/2002	Protocol:	EPAF 93-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3
D-Control	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000
12.5	0.9000	1.0000	0.9000
25	0.9000	0.9000	1.0000
50	0.6000	0.7000	0.5000
100	0.6000	0.6000	0.5000

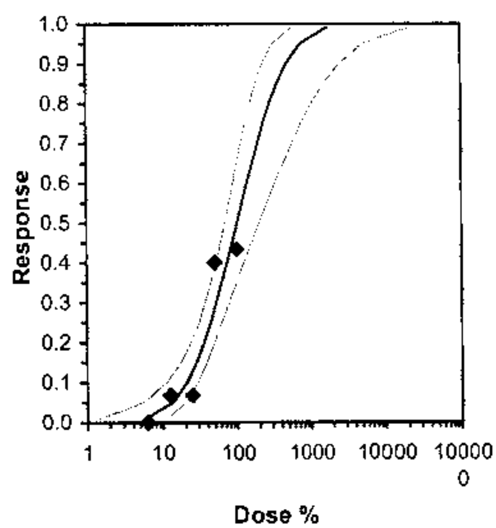
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
D-Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	3				0	30
6.25	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	3	0.000	2.500	0.1483	0	30
12.5	0.9333	0.9333	1.3034	1.2490	1.4120	7.219	3	1.832	2.500	0.1483	2	30
25	0.9333	0.9333	1.3034	1.2490	1.4120	7.219	3	1.832	2.500	0.1483	2	30
*50	0.6000	0.6000	0.8875	0.7854	0.9912	11.592	3	8.841	2.500	0.1483	12	30
*100	0.5667	0.5667	0.8525	0.7854	0.8861	6.818	3	9.432	2.500	0.1483	13	30

Auxiliary Tests					Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)					0.90087		0.858		0.50731	-0.2285
Equality of variance cannot be confirmed										
Hypothesis Test (1-tail, 0.05)	**NOEC**	**LOEC**	**ChV**	**TU**	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test	25	50	35.3553	4	0.06637	0.06807	0.1977	0.00528	6.5E-07	5, 12

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	1.88506	0.38545	1.12958	2.64054	0	4.21974	7.81472	0.24	2.00334	0.53049	3
Intercept	1.22359	0.64392	-0.0385	2.48567							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	5.87812	1.45812	11.0558
EC05	3.355	13.5133	5.62743	20.8199
EC10	3.718	21.0615	11.2736	29.9184
EC15	3.964	28.4133	17.5683	39.1832
EC20	4.158	36.0469	24.3388	49.862
EC25	4.326	44.2108	31.3541	62.9547
EC40	4.747	73.9502	53.1625	126.485
EC50	5.000	100.771	69.4605	202.365
EC60	5.253	137.32	89.1407	329.631
EC75	5.674	229.692	132.334	756.403
EC80	5.842	281.713	154.224	1055.67
EC85	6.036	357.398	184.049	1559.5
EC90	6.282	482.152	229.49	2552.61
EC95	6.645	751.468	317.47	5311.99
EC99	7.326	1727.57	580.743	21104.8

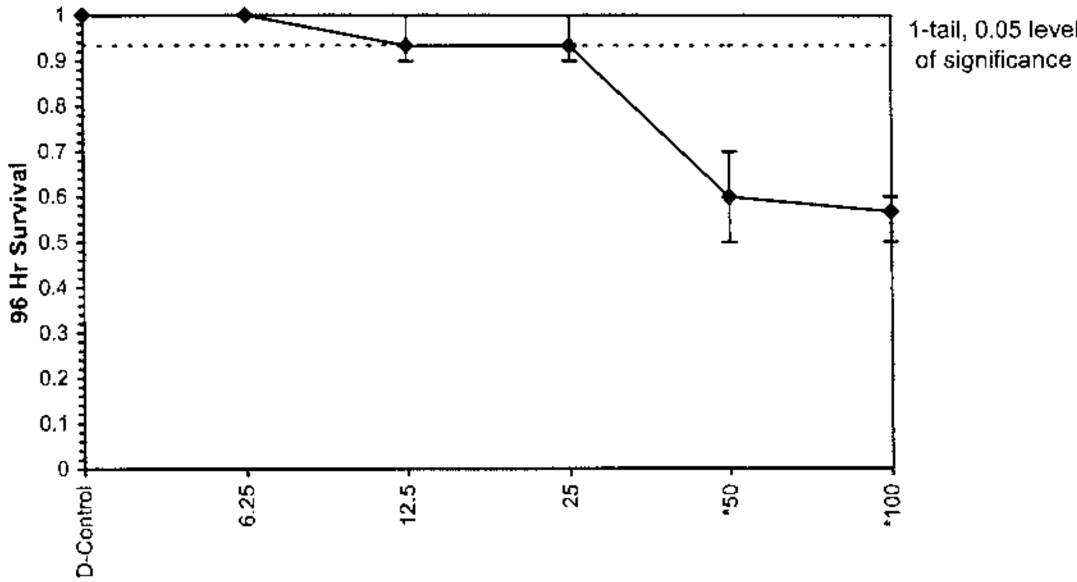


 ToxCalc v5.0.23 Reviewed by: KS

Acute Fish Test-96 Hr Survival

Start Date:	05/10/2002	Test ID:	0205-12NW	Sample ID:	Washington State Dept of Transportatic
End Date:	05/14/2002	Lab ID:	WAAEE-AMEC NW Bioassa	Sample Type:	Bridge Washing Discharge
Sample Date:	05/10/2002	Protocol:	EPAF 93-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by:_____

AMEC Earth Environmental
Northwest Bioassay Lab
5009 Pacific Hwy. E. Suite 2-0
Fife, WA 98424

96 Hour Toxicity Test Data Sheet
Freshwater 96-hr Acute with Renewal

Client: WSDOT
Sample ID: 5/10/02 Discharge
Contact:
Test #: 0205-12NW

Start Date & Time: 5/10/02 16:45
End Date & Time: 5/14/02 17:20
Test Organism: P. promelas
Test Protocol:

Sample Conc. or %	D.O. (mg/L) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96	pH Init. 0	24	Fin. 48	Init. 48	72	Fin. 96
C	8.5	7.8	6.7	7.9	7.3	7.4	7.70	7.95	7.58	7.99	8.01	7.67
6.25	7.9	7.6	6.4	8.2	7.3	7.3	7.86	7.84	7.57	8.00	7.93	7.73
12.5	7.9	7.7	6.6	8.3	7.2	7.2	7.86	7.98	7.59	7.96	7.88	7.68
25	7.8	7.2	6.6	8.5	6.8	6.8	7.83	7.79	7.59	7.87	7.76	7.62
50	7.9	6.6	5.8	9.1	6.0	6.5	7.75	6.68	7.46	7.72	7.53	7.51
100	8.0	5.7	4.7	9.2	4.0	6.0	7.67	7.45	7.26	7.58	7.20	7.37

*7.65

Sample Conc. or %	Conductivity µS/cm Init. 0	Fin. 48	Init. 48	Fin. 96	Test Temperature (°C) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96
C	276	342	298	319	25.0	25.1	25.2	25.1	25.0	25.1
6.25	326	344	294	319	25.0	25.4	25.4	25.0	25.1	25.3
12.5	275	328	289	319	25.0	25.3	25.3	25.0	25.0	25.0
25	269	340	281	305	25.0	25.3	25.4	25.1	25.1	25.0
50	251	339	263	303	25.0	25.7	25.2	25.0	24.9	25.1
100	230	318	227	279	25.0	25.6	25.3	25.0	25.0	25.0

Conc.	Alkalinity* *(mg/L as CaCo3)	Hardness*	Chlorine Resid. (mg/L)	Ammonia (mg/L)
			—	—
control	60	80	.12	1.3
highest conc.	48	80		

Sample Conc. or %	Rep #	Cont #	Number of Live Organisms 0	24	48	72	96
C	1	8	10	10	10	10	10
	2	2	10	10	10	10	10
	3	4	10	10	10	10	10
6.25	1	9	10	10	10	10	10
	2	15	10	10	10	10	10
	3	18	10	10	10	10	10
12.5	1	14	10	10	10	10	9
	2	5	10	10	10	10	10
	3	12	10	10	10	10	9
25	1	1	10	10	10	10	9
	2	10	10	10	10	10	9
	3	16	10	10	10	10	10
50	1	17	10	9	9	9	6
	2	13	10	9	9	9	7
	3	6	10	8	8	8	5
100	1	11	10	8	8	8	6
	2	3	10	8	8	8	6
	3	7	10	7	7	7	5
Tech. Initials			EL	EL	EL	TD	TD

Sample Description: Sample was ~~a~~ medium ~~dark~~ brown liquid was a lot of ~~part~~ suspended silty material.

Animal Source: ABS
Date Received: 5/10/02
Date of Hatch: 4/28/02

Comments:

Analysts: TD, EL

Appendix B

Ceriodaphnia dubia Acute Toxicity Test

Test Data and Statistical Summary

Ceriodaphnia acute-48 Hr Survival

Start Date:	05/10/2002	Test ID:	0205-13NW	Sample ID:	WA State Dept of Transportation
End Date:	05/12/2002	Lab ID:	WAAEE-AMEC NW Bioassay	Sample Type:	Bridge Washing Discharge
Sample Date:	05/10/2002	Protocol:	EPAF 93-EPA Acute	Test Species:	CD-Ceriodaphnia dubia
Comments:					

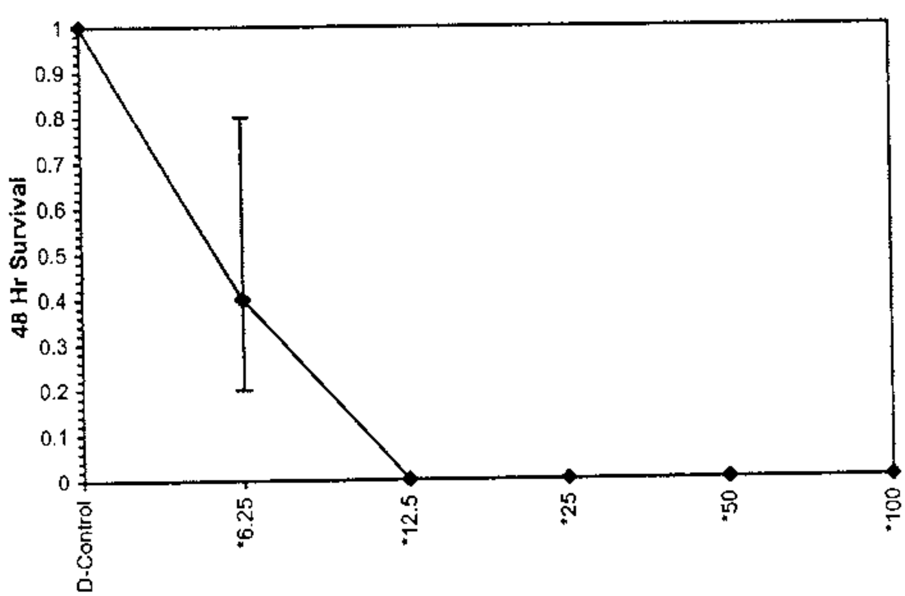
Conc-%	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
6.25	0.8000	0.4000	0.2000	0.2000
12.5	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
D-Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4		
*6.25	0.4000	0.4000	0.6798	0.4636	1.1071	44.627	4	10.00	10.00
*12.5	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	10.00	10.00
*25	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	10.00	10.00
*50	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	10.00	10.00
*100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	10.00	10.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.4632	0.884	2.08644	11.3458
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	<6.25	6.25		

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by: LB

Freshwater Acute
48 Hour Toxicity Test Data Sheet
Northwest Bioassay Lab

Client: WSDOT
Sample ID: 5/10/02 Discharge
Contact:
Test #: 0205-BNW

Start Date & Time: 5/10/02 1715
End Date & Time: 5/12/02 1745
Test Organisms: Ceriodaphnia dubia

Conc. or %	Cont. #	Rep. #	Live 0	Live 24	Live 48	DO 0	DO 24	DO 48	pH 0	pH 24	pH 48	Cond. 0	Cond. 48	Temp 0	Temp 24	Temp 48	Mean Percent Survival
0	4	1	5	5	5	8.1	7.8	8.1	7.76	7.95	8.13	276	340	25.0	25.1	25.2	
	2	2	5	5	5	8.5											
	21	3	5	5	5												100%
	7	4	5	5	5												
6.25	13	1	5	5	4	8.1	7.6	8.1	7.86	7.84	8.09	356	304	25.0	25.4	25.3	
	16	2	5	3	2	7.9											
	5	3	5	2	1												40%
	8	4	5	1	1												
12.5	10	1	5	2	0	8.1	7.7	8.2	7.86	7.88	8.07	275	298	25.0	25.3	25.1	
	18	2	5	0	0	7.9											
	6	3	5	0	0												0
	1	4	5	0	0												
25	23	1	5	1	0	7.8	7.2	8.0	7.83	7.79	8.04	269	289	25.0	25.3	25.3	
	11	2	5	1	0												
	14	3	5	1	0												0
	3	4	5	0	0												
50	12	1	5	0	0	7.9	6.6	8.0	7.75	7.65	7.91	257	280	25.0	25.7	25.1	
	9	2	5	0	0												
	19	3	5	0	0												0
	15	4	5	0	0												
100	24	1	5	0	0	8.0	5.7	7.6	7.67	7.45	7.85	230	273	25.0	25.6	25.4	
	22	2	5	0	0												
	20	3	5	0	0												0
	17	4	5	0	0												
Technician Initials			KB	KB	KB												

Units: Dissolved Oxygen (mg/L); pH (units); Conductivity (µS/cm); Temperature (°C)

Conc.	Alkalinity (mg/L)	Hardness (mg/L as $CaCO_3$)	Chlorine (mg/L)	Ammonia (mg/L)
control	60	80	—	—
highest conc.	48	80	.12	1.3

Sample Description: Sample was medium brown liquid w/ suspended silty material

Analyst Initials: KB

Comments: 0 hrs:
24 hrs.
48 hrs.

AMEC Earth & Environmental
Northwest Bioassay Laboratory
5009 Pacific Hwy. E. Suite 2-0
Fife, WA 98424
(253) 922-4296

Appendix C

Chain-of-Custody Form

amec Earth & Environmental

6°C

Chain of Custody

AMEC Northwest Bioassay Laboratory
5009 Pacific Highway East, Suite 2-0
Fife, WA 98424
253-922-4296

Date 5/10/02 Page 1 of 1

COMPANY WSDOT
ADDRESS 310 Maple Park Ave
CITY Olympia STATE WA ZIP 98504-7331
PHONE NO. 360-705-7746

David Hamacher
PROJECT MANAGER

SAMPLERS (SIGNATURE)
360-705-7746
PHONE NUMBER

ANALYSIS REQUIRED: Acute

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	Acute												CONCENTRATIONS/COMMENTS	NUMBER OF CONTAINERS
Discharge	5/10	7:00A 10:30A	Comp	5g-1	✓													1

PROJECT INFORMATION

CLIENT

P.O. NO.

SHIPPED VIA: WSDOT

SAMPLE RECEIPT

TOTAL NO. OF CONTAINERS	1
CHAIN OF CUSTODY SEALS	N
REC'D. GOOD CONDITION/COLD	Y
CONFORMS TO RECORD	Y

SPECIAL INSTRUCTIONS/COMMENTS:

Recp Temp 6°C

RELINQUISHED BY
(Signature) (Time) 1:55pm
(Printed Name) David Hamacher (Date)
(Company) WSDOT

RELINQUISHED BY
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) (Time) 155
(Printed Name) TARIN DEJARDINE (Date) 5/10/02
Ogden Bioassay Lab Log-in No. 02-180

Additional disposal charges may apply.

DISTRIBUTION: WHITE, CANARY - AMEC Bioassay Lab, PINK - Originator

Cowlitz River Bridge Painting Project
Near Kelso, Washington
June 2002

Contents:

- Field Report
- Summary Spreadsheets of Water Quality Monitoring Results
- Data Calculations and Interpretations
- Analytical and Bioassay Laboratory Reports

NOTE: Third of Three Bridge Washing Monitoring Projects

Submitted
12/24/02
dk

Washington State Department of Transportation (DRAFT)
Cowlitz River Bridge (432N) Bridge Painting Project
Pressure Washing Discharge -- Analytical Results Data Summary
June 3, 2002

Sample Identification	Sample Type	Biochemical Oxygen Demand (BOD) (mg/L)	Total Suspended Solids (TSS) (mg/L)	Hardness (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Beryllium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)	Toluene (mg/L)	Comments
Screened Discharge #1 thru #5 "dissolved"	composite	57	959	139	ND <0.005	ND <0.0025	ND <0.002	ND <0.0025	ND <0.01	0.0253	0.0645	ND <0.0002	ND <0.01	ND <0.0025	ND <0.0025	ND <0.0025	1.34	0.0006	Metals were analyzed using "dissolved" and "total" USEPA approved methodologies
Screened Discharge #1 thru #5 "total"	composite	—	—	—	0.0367	0.0061	ND <0.002	0.0611	0.568	0.128	10.5	ND <0.0002	0.023	ND <0.003	ND <0.01	ND <0.005	4.47	—	
Upstream 50 to 100 "dissolved"	grab	—	86	28	—	ND <0.0025	—	—	—	ND <0.01	ND <0.0025	—	—	—	—	—	ND <0.01	—	
Upstream 50 to 100 "total"	grab	—	—	—	—	0.0012	—	—	—	ND <0.01	ND <0.005	—	—	—	—	—	ND <0.01	—	
Downstream 50 to 100 "dissolved"	grab	—	52	25	—	ND <0.010	—	—	—	ND <0.01	ND <0.005	—	—	—	—	—	ND <0.01	—	
Downstream 50 to 100 "total"	grab	—	—	—	—	ND <0.0025	—	—	—	ND <0.01	ND <0.0025	—	—	—	—	—	ND <0.01	—	
Tanker Water "dissolved"	grab	—	—	—	—	ND <0.0025	—	—	—	ND <0.01	ND <0.0025	—	—	—	—	—	0.017		
Tanker Water "total"	grab	—	—	—	—	ND <0.001	—	—	—	ND <0.01	0.00580	—	—	—	—		0.038	—	
Field Blank "dissolved"	grab	—	—	—	—	ND <0.0025	—	—	—	ND <0.01	ND <0.0025	—	—	—	—	—	0.010	—	
Field Blank "total"	grab	—	—	—	—	0.0010	—	—	—	ND <0.01	ND <0.005	—	—	—	—	—	ND <0.01	—	
VOC – Field Blank	grab	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0006	
DOE Water Quality Standard	—	—	—	—	—	0.36	—	—	—	0.00513	0.0157	—	—	—	—	—	0.0385	—	
Primary* or Secondary** Standards – (MCL)	—	—	—	Soft Water – <125**	0.006*	0.05*	0.004*	0.005*	0.1*	1.3*	0.015*	0.002*	0.1*	0.05*	0.1**	0.002*	5**	1.0*	

MCL - maximum contaminant level limit. The MCL is the safe drinking water standards as established by the Clean Water Act. Reference - Department of Ecology CLARC version 3.1 spreadsheet

Department of Ecology (DOE) - dissolved criteria water quality standards "calculated acute freshwater standards" (reference WAC 173-201A-040)

NA - Not Applicable/Available

Except for toluene detected in the discharge composite and blank samples, no other VOCs were detected

Volatile Organics (VOCs) - were analyzed using USEPA method 5030/8260

Dissolved and total metals (except mercury) were analyzed using USEPA methods 6010 and 6020

ND - Not detected beyond analytical detection limits

All units are expressed in mg/L unless otherwise noted

< = Less than

USEPA - United States Environmental Protection Agency

Accredited laboratory analyses were completed by STL Seattle and Ameс Earth & Environmental Analytical Laboratories

Additional Notes:

A total of 5 grab samples were collected during "worse-case" periods of pressure washing and discharge through the belly tarp; the 5 grab samples were composited into a single sample (screened discharge)

Personnel from AA Coatings, Inc. estimated that 5000 gallons of water would be used to wash the Southwest section of steel; altogether approximately 20,000 gallons of water is required to wash the structure. Water for the tanker was taken from the WSDOT Kelso yard hydrant

TSS 959mg/L x 1 L/0.2642gal x Kg/1x10^6mg x 2.205lb/Kg x 20,000gal to wash bridge = Approximately 155lb TSS discharged through tarp for entire bridge pressure wash

As a comparison, there is approximately 2,400lbs in 1.5yd^3 of washed sand (i.e. TSS). Also as a comparison, and via discharge permits, large manufactures can discharge upwards of 5,000 lbs to 22,000lbs of TSS into Washington State Water daily

BOD 57mg/L x 1 L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 20,000gal to wash bridge = Approximately 11.3lb BOD discharged through tarp for entire bridge pressure washing

As a comparison, a waste water treatment plant (several hundred across the state) can discharge approximately 500lb to 600lb of BOD into Washington State waters per day

Dissolved Lead 0.0645mg/L x 1 L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 20,000gal to wash bridge = Approximately 0.0.11lb dissolved lead discharged through tarp for entire bridge pressure washing

Total Lead 10.5mg/L x 1 L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 500gal wash event = Approximately 1.75lb total lead discharged through tarp for entire bridge pressure washing

As a comparison, several manufacturing companies (point source discharge) located on prime salmonid and recreational areas of Washington State waterways are allowed to discharge 2-15lb lead/day

Need to collect more water quality data from up coming bridge painting projects to establish a more representative "baseline"

Specifications for nonwoven geotextile belly-tarp used for this project are shown below (Synthetic Industries 401):		
Grab tensile (lbs) = 100	Elongation (%) = 50	Water Flow (gpm/ft^2) = 140
Tear (lbs) = 45	Puncture (lbs) = 65	Weight (oz/yd^2) = NA
Mullen burst (psi) = 225	AOS (sieve size) = 70	Thickness (mil) = NA
Permittivity (sec^-1) = 2.0	Permeability (cm/sec) = 0.22	UV resistance = 70

Bioassay Testing Results

	Concentration						
Species	Control	6.25	12.5	25	50	100	
Fathead Minnow	100	100	93.3	53.3	20	0	Percent
Ceriodaphnia	100	60	50	0	0	0	Survival

Concentration is the percentage of the screened discharge composite sample mixed with control water; represented as 6.25% through 100%

Tarp specs for Skykomish River Bridge Painting Project

Specifications for nonwoven geotextile belly-tarp used for this project are shown below (Layfield LP7):

Washington State Department o
Cowlitz River Bridge (432N)
Pressure Washing Discharge -- An
June 3, 2

Sample Identification	Sample Type	Biochemical Oxygen Demand (BOD) (mg/L)	Total Suspended Solids (TSS) (mg/L)	Hardness (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Beryllium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Co (m
Screened Discharge #1 thru #8 "dissolved"	composite	67	930	130	ND <0.0025	ND <0.0025	ND <0.002	ND <0.0025	ND <0.01	0.0
Screened Discharge #1 thru #8 "total"	composite	-----	-----	-----	0.0067	0.0061	ND <0.002	0.0011	0.368	0.
Upstream 50' to 100' "dissolved"	grab	-----	88	28	-----	ND <0.0025	-----	-----	-----	ND
Upstream 50' to 100' "total"	grab	-----	-----	-----	-----	0.0012	-----	-----	-----	ND
Downstream 50' to 100' "dissolved"	grab	-----	82	25	-----	ND <0.001	-----	-----	-----	ND
Downstream 50' to 100' "total"	grab	-----	-----	-----	-----	ND <0.0025	-----	-----	-----	ND
Tanker Water "dissolved"	grab	-----	-----	-----	-----	ND <0.0025	-----	-----	-----	ND
Tanker Water "total"	grab	-----	-----	-----	-----	ND <0.001	-----	-----	-----	ND
Field Blank "dissolved"	grab	-----	-----	-----	-----	ND <0.0025	-----	-----	-----	ND
Field Blank "total"	grab	-----	-----	-----	-----	0.0010	-----	-----	-----	ND
VOC -- Field Blank	grab	-----	-----	-----	-----	-----	-----	-----	-----	
DOE Water Quality Standard	-----	-----	-----	-----	-----	0.36	-----	-----	-----	0
Primary* or Secondary** Standards -- (MCL)	-----	-----	-----	Soft Water -- <125**	0.006*	0.05*	0.004*	0.005*	0.1*	

MCL - maximum contaminant level/limit. The MCL is the safe drinking water standards as established by the Clean Water Act. Reference - Department of Ecology CLARC version 3.1 spread

Department of Ecology (DOE) -- dissolved criteria water quality standards "calculated acute freshwater standards" (reference WAC 173-201 A-040)

NA Not Applicable/Available

Except for toluene detected in the discharge composite and blank samples, no other VOC's were detected.

Volatile Organics (VOC) - were analyzed using USEPA method 530/8260B

Dissolved and total metals, except mercury, were analyzed using USEPA methods 6010 and 6020

ND Not detected (beyond analytical detection limits)

All units are expressed in mg/L unless otherwise noted

< -- Less than

USEPA - United States Environmental Protection Agency

Accredited laboratory analyses were completed by STL Seattle, and Amec Earth & Environmental Analytical Laboratories

Additional Notes:

A total of 8 grab samples were collected during "worse-case" periods of pressure washing and discharge through the belly-tarp, the 8 grab samples were composited into a single sample (screen

Personnel from AA Coatings, Inc. estimated that 5000 gallons of water would be used to wash the Sourwest section of steel. altogether approximately 20,000 gallons of water is required to wa

TSS 930mg/L x 1.0L/0.2642gal x Kg/1x10^6mg x 2.205lb/Kg x 20,000gal/to wash bridge = Approximately 155lb TSS discharged through tarp for entire bridge pressure wash.

As a comparison, there is approximately 2,490lbs in 1.0yd^3 of washed sand (I.e., TSS) Also, as a comparison, and via discharge permits, large manaufactures can discharge upwards of 8,00

BOD 67mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 20,000gal/to wash bridge =Approximately 11.1lb BOD discharged through tarp for entire bridge pressure washing

As a comparison, a waste water treatment plant (several hundred across the state) can discharge approximately 300lb to 600lb of BOD into Washington State waters per day.

Dissolved Lead 0.0645mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 20,000/to wash bridge = Approximately 0.011lb dissolved lead discharged through tarp for entire bridge press

Total Lead 10.5mg/L x 1.0L/0.2642gal X Kg/1x10^6mg x 2.205lb/Kg x 800gal/wash event = Approximately 1.75lb total lead discharged through tarp for entire bridge pressure washing

As a comparison, several manufacturing companies (point source discharge) located on prime salmonid and recreational areas of Washington State waterways are allowed to discharge 2.0lb L

Need to collect more water quality data from up coming bridge painting projects to establish a more representative "baseline".

Specifications for nonwoven geotextile belly-tarp used for this project are shown below (Synthetic industries 401):

Grab tensile (lbs) = 100	Elongation (%) = 50	Water Flow (gpm/ft^2) = 140
Tear (lbs) = 45	Puncture (lbs) = 65	Weight (oz/yd^2) = NA
Mullen burst (psi) = 225	AOS (sieve size) = 70	Thickness (mil) = NA
Permittivity (sec^1) = 2.0	Permeability (cm/sec) = 0.22	UV resistance = 70

Tarp specs for Skykomish River Bridge Painting Project

Specifications for nonwoven geotextile belly-tarp used for this project are shown below (Layfield LP7):

Cowlitz River Bridge (432) – Field Measurements

Sample ID	Sample Type	Dissolved Oxygen (mg/L)	pH (units)	Visual Oil & Grease	Conductivity mS/cm	Temp (Celsius)	Salinity (%)	Turbidity (ntu)
Upstream 50' to 100'	grab	11.75	7.40	No	0.07	11.0	ND	80-85
#1	grab	10.11	7.72	No	0.17	13.8	ND	NA
#2	grab	9.80	7.75	No	0.18	14.4	ND	NA
#3	grab	10.23	7.26	No	0.34	13.3	ND	NA
#4	grab	10.70	7.48	No	0.14	14.0	ND	NA
#5	grab	10.05	7.23	No	0.39	13.4	ND	NA
#6	grab	10.78	7.33	No	0.18	13.7	ND	NA
#7	grab	10.01	7.53	No	0.13	13.8	ND	NA
#8	grab	10.24	7.49	No	0.17	13.9	ND	NA
Downstream 50' to 100'	grab	11.57	7.65	No	0.07	11.0	ND	80-85

Pressure washing work activities at the Cowlitz River Bridge (432) started at approximately 7:00 pm and representative "worse-case" discharge samples were collected until 9:15 pm. The contractor estimated that pressure washing would be completed at 5:00 am the following morning. All field measurements were collected using calibrated equipment (Horiba U-10).

A+A coatings used ~ 5000 gal to wash the SW section of the bridge. Washing started @ ~7:00pm, 6/3/02, and was completed @ ~ 5:00am 6/4/02.

Water discharge rate is ~ 7gpm to 9gpm

Field Report → 6/3/02

Cowlitz River Bridge
432-North
C-6300

Prior to entering the field I made arrangements w/ the SWR to use thier boat/equipment and have someone from maintenance (bridge) assist w/ the monitoring, Jerry Winters arranged for Rex Smith to provide assistance, and arranged for Rex and I to use the boat.

6/3/02

@ 4:30pm arrived at 432-North bridge – under abutment @ Talley Way. I proceeded to calibrate & test monitoring field equipment. Also to label the sampling containers

@ 4:55pm – Rex Smith arrived on site, Rex and I proceeded to Kelso yard to get the boat and discussing tonights sampling strategies. While at the Kelso yard the painting contractor (AA coatings, Inc.) was filling the water/tanker truck from the Kelso yard hydrant. I proceeded to collect a QAQC "grab" sample from the tanker truck.

@ 6:00pm proceeded to Cowlitz River boat launch adjacent/near the 432N bridge. Next proceeded to collect upstream grab samples ≈ 50'-100' directly upstream from the discharge location. Field water quality measurements from upstream sampling location:

Dissolved oxygen = 11.75 ppm
Conductivity = 0.074 mS/cm
Turbidity = ≈80-85 ntu's
pH = ≈7.40 units
Temp = 11.0°C
Salinity = 0.0%

@ ≈7:00 pm – The contractor began pressure washing work activities. Rex and I positioned the boat directly in the discharge using an anchor setup. water discharge from the tarp is being collected into a couple 5 gallon buckets.

next

6/3/02 - continued

Water from the buckets will be poured into the sample containers so that a total representation of the discharge can be collected. Field measurement will be collected during discharge

Note! some of the discharge water was splashing off the boat motor. there is a possibility of some minor cross-contamination

The contractor estimated that ~5000 gallons of water will be needed to clean "this" section of bridge (SW corner - upper & bottom steel structures). Also ~20,000 gallons would be needed to wash the entire bridge.

During the time Rex & I were on site the contractor was mostly washing the upper structural steel. The upper steel is the dirtiest section of the bridge. A lot of pigeon droppings & dust/debris contained in the "closed" trusses.

Rex & I were not allowed to collect water samples throughout the wash event, only during the 1st 2-2.5 hours. According to the contractor washing would start @ or around 7:00 pm & end the following morning around 5-5:30 am.

The samples Rex & I collected are "worse case", and are probably "high" as compared to collecting samples throughout a total-wash event.

Field water quality measurements collected during discharge:

Parameter	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th		
DO	10.11	9.80	10.23	10.70	10.05	10.78	10.01	10.24				
pH	7.72	7.75	7.26	7.98	7.23	7.33	7.53	7.49				
EC	0.17	0.18	0.34	0.14	0.39	0.18	0.13	0.17				
Temp °C	13.8	14.9	13.3	14.0	13.4	13.7	13.8	13.9				
Obs visual	None	No	No	No	No	No	No	No				

sample container filled during 2-field measurement samples.

Field Measurements collected downstream during active discharge ~50'-100': DO = 11.57, pH = 7.65, Turb = 280-85, Temp: 11.0°C, EC = 0.071

next

6/3/08 cont.

All samples collected are being kept on ice during sampling & overnight. Samples will be delivered under C-O-C protocols on 6/4/08 to laboratories.

Project follow-up - Contacted Lynn Harris @ Chehalis PEO.

Lynn informed me that contractor switched pressure-washing techniques to "roto-tips". Rototips significantly more clean the steel.

Cowlitz River - Water quality standards calculations

Lead

$CF = 1.46203 - [\ln(\text{hardness})(0.145712)]$

$= 1.46 - [\ln(28)](0.146)$

$CF = 1.46 - 0.485542$

$\boxed{CF = 0.97446}$

0.022
0.041
0.0048
1.3

Acute Lead fresh water $= (CF)\left(e^{1.273[\ln(\text{hardness})] - 1.460}\right)$

$= (0.97446)\left(e^{1.273[\ln(28)] - 1.460}\right)$

$= (0.97446)\left(2.718^{2.782}\right)$

$= 15.73\ \mu g/L$

$\boxed{= 0.01573\ mg/L}$ surface water quality Lead

Copper

Acute copper $= (0.96)\left(e^{(0.9422)[\ln(28)] - 1.464}\right)$

$= (0.96)\left(2.718^{1.676}\right)$

$= 5.13\ \mu g/L$

$\boxed{= 0.00513\ mg/L}$ Copper surface water quality

$\boxed{\text{Arsenic} \rightarrow 0.36\ mg/L}$

Zinc

Acute Zinc freshwater $= (0.978)\left(e^{(0.8473[\ln(28)] + 0}\right)$

$= (0.978)\left(2.718^{3.684}\right)$

$= 38.9\ \mu g/L$

$\boxed{= 0.0389\ mg/L}$ Zinc surface water

Dept. of Transportation

JUN 26 2002

Safety and Health

SW solid waste 6010 + 200.7 identical - QC differences

SEVERN TRENT SERVICES

STL Seattle
5755 8th Street East
Tacoma, WA 98424

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Fax: 253 922 5047
www.stl-inc.com

TRANSMITTAL MEMORANDUM

DATE: June 24, 2002

TO: David Hamacher
WSDOT - Safety
P. O. Box 47311
Olympia, WA 98504

PROJECT: SR 432 bridge

REPORT NUMBER: 106400

TOTAL NUMBER OF PAGES: 98

Enclosed are the test results for six samples received at STL Seattle on June 4, 2002.

The report consists of this transmittal memo, analytical results, quality control reports, a copy of the chain-of-custody, a list of data qualifiers and analytical narrative when applicable, and a copy of any requested raw data.

Should there be any questions regarding this report, please contact me at (253) 922-2310.

Sincerely,

Dawn Werner
Project Manager

STL Seattle

Sample Identification:

Lab. No.	Client ID	Date/Time Sampled	Matrix
106400-1	Discharge - Comp	06-03-02 19:00	Liquid
106400-2	Tanker	06-03-02 17:45	Liquid
106400-3	Upstream 50' - 100'	06-03-02 18:30	Liquid
106400-4	Blank	06-03-02 16:00	Liquid
106400-5	#2 and #4	06-03-02 19:00	Liquid
106400-6	Downstream 50'	06-03-02 21:00	Liquid

STL Seattle

Client Name	WSDOT - Safety
Project Name	SR 432 bridge
Date Received	06-04-02

✓ - QA/QC reviewed and entered on spreadsheet

General Chemistry Parameters

Client Sample ID	Discharge - Comp
Lab ID	106400-01

Parameter	Method	Date Analyzed	Units	Result	PQL
BOD (5-day)	EPA 405.1	06-10-02	mg/L	67	22
Hardness	SM 2340C	06-11-02	mg/L	130	5
Total Coliform, MPN	SM 9221B	06-04-02	MPN/100	≥ 1,600	N/A
Total Suspended Solids	EPA 160.2	06-06-02	mg/L	930	10

Client Sample ID	Upstream 50' - 100'
Lab ID	106400-03

Parameter	Method	Date Analyzed	Units	Result	PQL
Hardness	SM 2340C	06-11-02	mg/L	28	5
Total Coliform, MPN	SM 9221B	06-04-02	MPN/100	130	N/A
Total Suspended Solids	EPA 160.2	06-12-02	mg/L	88	2

Client Sample ID	Downstream 50'
Lab ID	106400-06

Parameter	Method	Date Analyzed	Units	Result	PQL
Hardness	SM 2340C	06-11-02	mg/L	25	5
Total Coliform, MPN	SM 9221B	06-04-02	MPN/100	500	N/A
Total Suspended Solids	EPA 160.2	06-12-02	mg/L	82	2

STL Seattle

Client Name	WSDOT - Safety
Client ID:	BLANK
Lab ID:	106400-04
Date Received:	6/4/2002
Date Prepared:	6/13/2002
Date Analyzed:	6/13/2002
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

Surrogate	% Recovery	Flags	Recovery Limits Low	Recovery Limits High
Dibromofluoromethane	102		80	120
Fluorobenzene	105		80	120
Toluene-D8	103		80	120
Ethylbenzene-d10	102		80	120
Bromofluorobenzene	95.1		80	120

Analyte	Result (ug/L)	PQL	MRL	Flags
Dichlorodifluoromethane	ND	1	0.5	
Chloromethane	ND	1	0.5	
Vinyl chloride	ND	1	0.5	
Bromomethane	ND	2	1	
Chloroethane	ND	1	0.5	
Trichlorofluoromethane	ND	1	0.5	
1,1-Dichloroethene	ND	1	0.5	
Methylene chloride	ND	1	0.5	
trans-1,2-Dichloroethene	ND	1	0.5	
1,1-Dichloroethane	ND	1	0.5	
2,2-Dichloropropane	ND	1	0.5	
cis-1,2-Dichloroethene	ND	1	0.5	
Bromochloromethane	ND	1	0.5	
Chloroform	ND	1	0.5	
1,1,1-Trichloroethane	ND	1	0.5	
Carbon Tetrachloride	ND	1	0.5	
1,1-Dichloropropene	ND	1	0.5	
Benzene	ND	1	0.5	
1,2-Dichloroethane	ND	1	0.5	
Trichloroethene	ND	1	0.5	
1,2-Dichloropropane	ND	1	0.5	
Dibromomethane	ND	1	0.5	
Bromodichloromethane	ND	1	0.5	
cis-1,3-Dichloropropene	ND	1	0.5	
Toluene	0.517	1	0.5	J
trans-1,3-Dichloropropene	ND	1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for 106400-04 continued...

Analyte	Result (ug/L)	PQL	MRL
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1,2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	ND	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	ND	2	1
o-Xylene	ND	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	ND	1	0.5
4-Chlorotoluene	ND	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	ND	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

Client Name	WSDOT - Safety
Client ID:	#2 AND #4
Lab ID:	106400-05
Date Received:	6/4/2002
Date Prepared:	6/17/2002
Date Analyzed:	6/17/2002
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

Surrogate	% Recovery	Flags	Recovery Limits Low	Recovery Limits High
Dibromofluoromethane	102		80	120
Fluorobenzene	96.5		80	120
Toluene-D8	106		80	120
Ethylbenzene-d10	103		80	120
Bromofluorobenzene	94.2		80	120

Analyte	Result (ug/L)	PQL	MRL	Flags
Dichlorodifluoromethane	ND	1	0.5	
Chloromethane	ND	1	0.5	
Vinyl chloride	ND	1	0.5	
Bromomethane	ND	2	1	
Chloroethane	ND	1	0.5	
Trichlorofluoromethane	ND	1	0.5	
1,1-Dichloroethene	ND	1	0.5	
Methylene chloride	ND	1	0.5	
trans-1,2-Dichloroethene	ND	1	0.5	
1,1-Dichloroethane	ND	1	0.5	
2,2-Dichloropropane	ND	1	0.5	
cis-1,2-Dichloroethene	ND	1	0.5	
Bromochloromethane	ND	1	0.5	
Chloroform	ND	1	0.5	
1,1,1-Trichloroethane	ND	1	0.5	
Carbon Tetrachloride	ND	1	0.5	
1,1-Dichloropropene	ND	1	0.5	
Benzene	ND	1	0.5	
1,2-Dichloroethane	ND	1	0.5	
Trichloroethene	ND	1	0.5	
1,2-Dichloropropane	ND	1	0.5	
Dibromomethane	ND	1	0.5	
Bromodichloromethane	ND	1	0.5	
cis-1,3-Dichloropropene	ND	1	0.5	
Toluene	0.612	1	0.5	J
trans-1,3-Dichloropropene	ND	1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for 106400-05 continued...

Analyte	Result (ug/L)	PQL	MRL
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1,2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	ND	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	ND	2	1
o-Xylene	ND	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	ND	1	0.5
4-Chlorotoluene	ND	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	ND	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Received:	6/4/02
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Beryllium	ND	0.002	
Chromium	0.368	0.01	
Copper	0.128	0.01	
Lead	10.5	0.01	
Nickel	0.0227	0.01	
Silver	ND	0.01	
Zinc	4.47	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Received:	6/4/2002
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.0061	0.001	
Antimony	0.00669	0.003	
Cadmium	0.00107	0.0005	
Selenium	ND	0.003	
Thallium	ND	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Received:	6/4/02
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	TANKER
Lab ID:	106400-02
Date Received:	6/4/02
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	0.0179	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	TANKER
Lab ID:	106400-02
Date Received:	6/4/2002
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.001	
Lead	0.000808	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	UPSTREAM 50' - 100'
Lab ID:	106400-03
Date Received:	6/4/02
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	UPSTREAM 50' - 100'
Lab ID:	106400-03
Date Received:	6/4/2002
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.00124	0.001	
Lead	ND	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	BLANK
Lab ID:	106400-04
Date Received:	6/4/02
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	BLANK
Lab ID:	106400-04
Date Received:	6/4/2002
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.00104	0.001	
Lead	ND	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DOWNSTREAM 50'
Lab ID:	106400-06
Date Received:	6/4/02
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DOWNSTREAM 50'
Lab ID:	106400-06
Date Received:	6/4/2002
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.001	
Lead	ND	0.0005	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Beryllium	ND	0.002	
Chromium	ND	0.01	
Copper	0.0263	0.01	
Nickel	ND	0.01	
Zinc	1.34	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
Dilution Factor	5

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0025	
Antimony	ND	0.0025	
Cadmium	ND	0.0025	
Lead	0.0645	0.0025	
Selenium	ND	0.0025	
Silver	ND	0.0025	
Thallium	ND	0.0025	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Received:	6/4/02
Date Prepared:	6/20/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	TANKER
Lab ID:	106400-02
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	0.0173	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	TANKER
Lab ID:	106400-02
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
Dilution Factor	5

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0025	
Lead	ND	0.0025	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	UPSTREAM 50'-100'
Lab ID:	106400-03
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Copper	ND	0.01 ✓	
Zinc	ND	0.01 ✓	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	UPSTREAM 50' - 100'
Lab ID:	106400-03
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
Dilution Factor	5

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0025	
Lead	ND	0.0025	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	BLANK
Lab ID:	106400-04
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Copper	ND	0.01	
Zinc	0.0103	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	BLANK
Lab ID:	106400-04
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
Dilution Factor	5

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0025	
Lead	ND	0.0025	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DOWNSTREAM 50'
Lab ID:	106400-06
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Copper	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Client Name	WSDOT - Safety
Client ID:	DOWNSTREAM 50'
Lab ID:	106400-06
Date Received:	6/4/02
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
Dilution Factor	5

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0025	
Lead	ND	0.0025	

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID:	Batch QC
Lab ID:	N/A
QC Batch Number:	1089-25

Method Blank

Parameter	Result (mg/L)
BOD (5-day)	0.04

QC Check Standard

Parameter	Result (mg/L)	Mean Value (mg/L)	%D
Glucose	185	198	6.6

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID: Batch QC
Lab ID: 106423-1
QC Batch Number: 856-80

Method Blank

Parameter	Result (mg/L)	PQL
Hardness	ND	2

Duplicate

Parameter	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD (%)	Flag
Hardness	15	14	6.9	

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID:	Discharge - Comp
Lab ID:	106400-01
QC Batch Number:	1071-94

Method Blank

Parameter	Result (mg/L)	PQL
Total Suspended Solids	ND	2

Duplicate

Parameter	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD (%)	Flag
Total Suspended Solids	930	926	0.4	

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID: Batch QC
Lab ID: 106497-1
QC Batch Number: 1071-97

Method Blank

Parameter	Result (mg/L)	PQL
Total Suspended Solids	ND	2

Duplicate

Parameter	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD (%)	Flag
Total Suspended Solids	28	25	11.3	

STL Seattle

Lab ID:	Method Blank - ITS1630
Date Received:	-
Date Prepared:	6/13/2002
Date Analyzed:	6/13/2002
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

Surrogate	**% Recovery**	**Flags**	**Recovery Limits Low**	**Recovery Limits High**
Dibromofluoromethane	99.6		80	120
Fluorobenzene	99.5		80	120
Toluene-D8	98.7		80	120
Ethylbenzene-d10	111		80	120
Bromofluorobenzene	104		80	120

Analyte	**Result (ug/L)**	**PQL**	**MRL**	**Flags**
Dichlorodifluoromethane	ND	1	0.5	
Chloromethane	ND	1	0.5	
Vinyl chloride	ND	1	0.5	
Bromomethane	ND	2	1	
Chloroethane	ND	1	0.5	
Trichlorofluoromethane	ND	1	0.5	
1,1-Dichloroethene	ND	1	0.5	
Methylene chloride	ND	1	0.5	
trans-1,2-Dichloroethene	ND	1	0.5	
1,1-Dichloroethane	ND	1	0.5	
2,2-Dichloropropane	ND	1	0.5	
cis-1,2-Dichloroethene	ND	1	0.5	
Bromochloromethane	ND	1	0.5	
Chloroform	ND	1	0.5	
1,1,1-Trichloroethane	ND	1	0.5	
Carbon Tetrachloride	ND	1	0.5	
1,1-Dichloropropene	ND	1	0.5	
Benzene	ND	1	0.5	
1,2-Dichloroethane	ND	1	0.5	
Trichloroethene	ND	1	0.5	
1,2-Dichloropropane	ND	1	0.5	
Dibromomethane	ND	1	0.5	
Bromodichloromethane	ND	1	0.5	
cis-1,3-Dichloropropene	ND	1	0.5	
Toluene	ND	1	0.5	
trans-1,3-Dichloropropene	ND	1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for ITS1630 continued...

Analyte	**Result (ug/L)**	**PQL**	**MRL**
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1,2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	ND	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	ND	2	1
o-Xylene	ND	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	ND	1	0.5
4-Chlorotoluene	ND	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	ND	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

Lab ID:	Method Blank - ITS1634
Date Received:	-
Date Prepared:	6/17/2002
Date Analyzed:	6/17/2002
% Solids	-
Dilution Factor	1

Volatile Organics by USEPA Method 5030/8260B

Surrogate	**% Recovery**	**Flags**	**Recovery Limits Low**	**Recovery Limits High**
Dibromofluoromethane	114		80	120
Fluorobenzene	107		80	120
Toluene-D8	104		80	120
Ethylbenzene-d10	104		80	120
Bromofluorobenzene	97.2		80	120

Analyte	**Result (ug/L)**	**PQL**	**MRL**	**Flags**
Dichlorodifluoromethane	ND	1	0.5	
Chloromethane	ND	1	0.5	
Vinyl chloride	ND	1	0.5	
Bromomethane	ND	2	1	
Chloroethane	ND	1	0.5	
Trichlorofluoromethane	ND	1	0.5	
1,1-Dichloroethene	ND	1	0.5	
Methylene chloride	ND	1	0.5	
trans-1,2-Dichloroethene	ND	1	0.5	
1,1-Dichloroethane	ND	1	0.5	
2,2-Dichloropropane	ND	1	0.5	
cis-1,2-Dichloroethene	ND	1	0.5	
Bromochloromethane	ND	1	0.5	
Chloroform	ND	1	0.5	
1,1,1-Trichloroethane	ND	1	0.5	
Carbon Tetrachloride	ND	1	0.5	
1,1-Dichloropropene	ND	1	0.5	
Benzene	ND	1	0.5	
1,2-Dichloroethane	ND	1	0.5	
Trichloroethene	ND	1	0.5	
1,2-Dichloropropane	ND	1	0.5	
Dibromomethane	ND	1	0.5	
Bromodichloromethane	ND	1	0.5	
cis-1,3-Dichloropropene	ND	1	0.5	
Toluene	ND	1	0.5	
trans-1,3-Dichloropropene	ND	1	0.5	

STL Seattle

Volatile Organics by USEPA Method 5030/8260B data for ITS1634 continued...

Analyte	Result (ug/L)	PQL	MRL
1,1,2-Trichloroethane	ND	1	0.5
Tetrachloroethene	ND	1	0.5
1,3-Dichloropropane	ND	1	0.5
Dibromochloromethane	ND	1	0.5
1,2-Dibromoethane	ND	1	0.5
Chlorobenzene	ND	1	0.5
Ethylbenzene	ND	1	0.5
1,1,1,2-Tetrachloroethane	ND	1	0.5
m,p-Xylene	ND	2	1
o-Xylene	ND	1	0.5
Styrene	ND	1	0.5
Bromoform	ND	1	0.5
Isopropylbenzene	ND	1	0.5
Bromobenzene	ND	1	0.5
n-Propylbenzene	ND	1	0.5
1,1,2,2-Tetrachloroethane	ND	1	0.5
1,2,3-Trichloropropane	ND	1	0.5
2-Chlorotoluene	ND	1	0.5
1,3,5-Trimethylbenzene	ND	1	0.5
4-Chlorotoluene	ND	1	0.5
t-Butylbenzene	ND	1	0.5
1,2,4-Trimethylbenzene	ND	1	0.5
sec-Butylbenzene	ND	1	0.5
1,3-Dichlorobenzene	ND	1	0.5
4-Isopropyltoluene	ND	1	0.5
1,4-Dichlorobenzene	ND	1	0.5
n-Butylbenzene	ND	1	0.5
1,2-Dichlorobenzene	ND	1	0.5
1,2-Dibromo-3-chloropropane	ND	1	0.5
1,2,4-Trichlorobenzene	ND	1	0.5
Hexachlorobutadiene	ND	1	0.5
Naphthalene	ND	1	0.5
1,2,3-Trichlorobenzene	ND	1	0.5

STL Seattle

Blank Spike/Blank Spike Duplicate Report

Lab ID:	ITS1630
Date Prepared:	6/13/2002
Date Analyzed:	6/13/2002
QC Batch ID:	ITS1630

Volatile Organics by USEPA Method 5030/8260B

Compound Name	Blank Result (ug/L)	Spike Amount (ug/L)	BS Result (ug/L)	BS % Rec.	BSD Result (ug/L)	BSD % Rec.	RPD	Flag
1,1-Dichloroethene	0	2	2.34	117	2.25	113	-3.5	
Benzene	0	2	2.48	124	2.44	122	-1.6	N
Trichloroethene	0	2	1.92	96.1	2.08	104	7.9	
Toluene	0	2	2.31	115	2.25	112	-2.6	
Chlorobenzene	0	2	2.23	111	2.23	111	0	

STL Seattle

Blank Spike/Blank Spike Duplicate Report

Lab ID:	ITS1634
Date Prepared:	6/17/2002
Date Analyzed:	6/17/2002
QC Batch ID:	ITS1634

Volatile Organics by USEPA Method 5030/8260B

Compound Name	Blank Result (ug/L)	Spike Amount (ug/L)	BS Result (ug/L)	BS % Rec.	BSD Result (ug/L)	BSD % Rec.	RPD	Flag
1,1-Dichloroethene	0	2	2.33	116	2.28	114	-1.7	
Benzene	0	2	2.36	118	2.18	109	-7.9	
Trichloroethene	0	2	2.09	105	2.11	106	0.95	
Toluene	0	2	2.13	106	2.12	106	0	
Chlorobenzene	0	2	2.24	112	2.16	108	-3.6	

STL Seattle

Lab ID:	Method Blank - TP596
Date Received:	-
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	PQL	**Flags**
Beryllium	ND	0.002	
Chromium	ND	0.01	
Copper	ND	0.01	
Lead	ND	0.01	
Nickel	ND	0.01	
Silver	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Matrix Spike Report

Client Sample ID:	CD-A103801
Lab ID:	106399-01
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
QC Batch ID:	TP596

Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Beryllium	0	0.1	0.0946	95	
Chromium	0	0.4	0.373	93	
Copper	0	0.5	0.449	90	
Lead	0	1	0.918	92	
Nickel	0	1	0.918	92	
Silver	0	0.6	0.55	92	
Zinc	0	1	0.919	92	

STL Seattle

Duplicate Report

Client Sample ID:	CD-A103801
Lab ID:	106399-01
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
QC Batch ID:	TP596

Metals by ICP - USEPA Method 6010

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Beryllium	0	0	NC	
Chromium	0	0	NC	
Copper	0	0	NC	
Lead	0	0	NC	
Nickel	0	0	NC	
Silver	0	0	NC	
Zinc	0	0	NC	

STL Seattle

Lab ID:	Method Blank - TP596
Date Received:	-
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.001	
Antimony	ND	0.003	
Cadmium	ND	0.0005	
Lead	ND	0.0005	
Selenium	ND	0.003	
Thallium	ND	0.0005	

STL Seattle

Matrix Spike Report

Client Sample ID:	CD-A103801
Lab ID:	106399-01
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
QC Batch ID:	TP596

Metals by ICP-MS - USEPA Method 6020

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Arsenic	0.00523	4	4.32	108	
Antimony	0	3	3.19	106	
Cadmium	0	0.1	0.115	115	
Lead	0.00077	1	1.08	108	
Selenium	0	4	4.7	117	
Thallium	0	4	3.68	92	

STL Seattle

Duplicate Report

Client Sample ID:	CD-A103801
Lab ID:	106399-01
Date Prepared:	6/5/2002
Date Analyzed:	6/6/2002
QC Batch ID:	TP596

Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Arsenic	0.0052	0.0048	8.0	
Antimony	0	0	NC	
Cadmium	0	0	NC	
Lead	0.00077	0.00078	-1.3	
Selenium	0	0	NC	
Thallium	0	0	NC	

STL Seattle

Lab ID:	Method Blank - ZT1013
Date Received:	-
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	Result (mg/L)	PQL	Flags
Mercury	ND	0.0002	

STL Seattle

Matrix Spike Report

Client Sample ID:	MW-13A-5-02
Lab ID:	106394-01
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
QC Batch ID:	ZT1013

Mercury by CVAA - USEPA Method 7470

Parameter Name	**Sample Result (mg/L)**	**Spike Amount (mg/L)**	**MS Result (mg/L)**	**MS % Rec.**	**Flag**
Mercury	0	0.002	0.00165	83	

STL Seattle

Duplicate Report

Client Sample ID:	MW-13A-5-02
Lab ID:	106394-01
Date Prepared:	6/5/02
Date Analyzed:	6/5/02
QC Batch ID:	ZT1013

Mercury by CVAA - USEPA Method 7470

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Mercury	0	0	NC	

STL Seattle

Lab ID:	Method Blank - DP643
Date Received:	-
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Beryllium	ND	0.002	
Chromium	ND	0.01	
Copper	ND	0.01	
Nickel	ND	0.01	
Zinc	ND	0.01	

STL Seattle

Matrix Spike Report

Client Sample ID:	DISCHARGE-COMP
Lab ID:	106400-01
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
QC Batch ID:	DP643

Dissolved Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Beryllium	0	0.1	0.0987	99	
Chromium	0	0.4	0.405	101	
Copper	0.026	0.5	0.527	100	
Nickel	0	1	0.98	98	
Zinc	1.3	1	2.18	84	

STL Seattle

Duplicate Report

Client Sample ID:	DISCHARGE-COMP
Lab ID:	106400-01
Date Prepared:	6/19/02
Date Analyzed:	6/20/02
QC Batch ID:	DP643

Dissolved Metals by ICP - USEPA Method 6010

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Beryllium	0	0	NC	
Chromium	0	0	NC	
Copper	0.026	0.028	-7.4	
Nickel	0	0	NC	
Zinc	1.3	1.3	0.0	

STL Seattle

Lab ID:	Method Blank - DP643
Date Received:	-
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
Dilution Factor	1

Dissolved Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0005	
Antimony	ND	0.0005	
Cadmium	ND	0.0005	
Lead	ND	0.0005	
Selenium	ND	0.0005	
Silver	ND	0.0005	
Thallium	ND	0.0005	

STL Seattle

Matrix Spike Report

Client Sample ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
QC Batch ID:	DP643

Dissolved Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Spike Amount (mg/L)**	**MS Result (mg/L)**	**MS % Rec.**	**Flag**
Arsenic	0	4	3.68	92	
Antimony	0	3	2.3	77	
Cadmium	0	0.1	0.0956	96	
Lead	0.064	1	1.08	102	
Selenium	0	4	3.78	95	
Silver	0	0.6	0.553	92	
Thallium	0	4	3.6	90	

STL Seattle

Duplicate Report

Client Sample ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Prepared:	6/19/02
Date Analyzed:	6/19/02
QC Batch ID:	DP643

Dissolved Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Arsenic	0	0	NC	
Antimony	0	0	NC	
Cadmium	0	0	NC	
Lead	0.064	0.066	-3.1	
Selenium	0	0	NC	
Silver	0	0	NC	
Thallium	0	0	NC	

STL Seattle

Lab ID:	Method Blank - ZD1027
Date Received:	-
Date Prepared:	6/20/02
Date Analyzed:	6/20/02
Dilution Factor	1

Dissolved Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Matrix Spike Report

Client Sample ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Prepared:	6/20/02
Date Analyzed:	6/20/02
QC Batch ID:	ZD1027

Dissolved Mercury by CVAA - USEPA Method 7470

Parameter Name	**Sample Result (mg/L)**	**Spike Amount (mg/L)**	**MS Result (mg/L)**	**MS % Rec.**	**Flag**
Mercury	0	0.002	0.00181	91	

STL Seattle

Duplicate Report

Client Sample ID:	DISCHARGE - COMP
Lab ID:	106400-01
Date Prepared:	6/20/02
Date Analyzed:	6/20/02
QC Batch ID:	ZD1027

Dissolved Mercury by CVAA - USEPA Method 7470

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Mercury	0	0	NC	

STL Seattle
5755 8th Street East
Tacoma, WA 98424

Tel: 253 922 2310
Fax: 253 922 5047
www.stl-inc.com

SEVERN TRENT SERVICES

DATA QUALIFIERS AND ABBREVIATIONS

B1: This analyte was detected in the associated method blank. The analyte concentration was determined not to be significantly higher than the associated method blank (less than ten times the concentration reported in the blank).

B2: This analyte was detected in the associated method blank. The analyte concentration in the sample was determined to be significantly higher than the method blank (greater than ten times the concentration reported in the blank).

C1: Second column confirmation was performed. The relative percent difference value (RPD) between the results on the two columns was evaluated and determined to be ≤ 40%.

C2: Second column confirmation was performed. The RPD between the results on the two columns was evaluated and determined to be > 40%. The higher result was reported unless anomalies were noted.

M: GC/MS confirmation was performed. The result derived from the original analysis was reported.

D: The reported result for this analyte was calculated based on a secondary dilution factor.

E: The concentration of this analyte exceeded the instrument calibration range and should be considered an estimated quantity.

J: The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quantity.

MCL: Maximum Contaminant Level

MDL: Method Detection Limit

N: See analytical narrative.

ND: Not Detected

PQL: Practical Quantitation Limit

X1: Contaminant does not appear to be "typical" product. Elution pattern suggests it may be __________ .

X2: Contaminant does not appear to be "typical" product.

X3: Identification and quantitation of the analyte or surrogate was complicated by matrix interference.

X4: RPD for duplicates was outside advisory QC limits. The sample was re-analyzed with similar results. The sample matrix may be nonhomogeneous.

X4a: RPD for duplicates outside advisory QC limits due to analyte concentration near the method practical quantitation limit/detection limit.

X5: Matrix spike recovery was not determined due to the required dilution.

X6: Recovery and/or RPD values for matrix spike(/matrix spike duplicate) outside advisory QC limits. Sample was re-analyzed with similar results.

X7: Recovery and/or RPD values for matrix spike(/matrix spike duplicate) outside advisory QC limits. Matrix interference may be indicated based on acceptable blank spike recovery and/or RPD.

X7a: Recovery and/or RPD values for this spiked analyte outside advisory QC limits due to high concentration of the analyte in the original sample.

X8: Surrogate recovery was not determined due to the required dilution.

X9: Surrogate recovery outside advisory QC limits due to matrix interference.

106400 58

Chain of Custody Record

STL-8274 (0102)

STL Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.stl-inc.com

N4

SEVERN TRENT SERVICES

Severn Trent Laboratories, Inc.

Client: Washington State Department of Transportation	Project Manager: David Hamacher	Date: 6/3/02	Chain of Custody Number: 2597
Address: 310 Maple Park Ave (P.O. box 47311)	Telephone Number (Area Code)/Fax Number: 360-705-7746	Lab Number:	Page 1 of 1
City: Olympia State: WA Zip Code: 98504-7311	Site Contact:	Lab Contact:	
Project Name and Location (State): SR 432 bridge	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.: See State Contract			

	Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH		Analysis: Priority Metals	BOD	TSS	Hardness	MPN-fecal	VOC 8260	Cu, Pb, Zn, As	Special Instructions/ Conditions of Receipt
1	Discharge-Comp	6/3/02	7p-10p		✓				✓							X	X	X	X	X			5 containers
2	Tanker	6/3/02	5:45p		✓				✓													X	2 containers
3	Upstream 50'-100'	6/3/02	6:30p		✓				✓										X	X		X	2 containers
4	Blank	6/3/02	4:00p		✓							✓									X	X	3 containers (2 ...)
5	#2 and #4	6/3/02	7p-10p		✓							✓									X		analyze #2 & #4 as a composite (4 ...)
6	Downstream 50'	6/3/02	~9:30p		✓				✓										X	X		X	3 containers

Note - analyze all metals as dissolved. Thanks

Cooler: ☒ Yes ☐ No Cooler Temp: ______

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☒ Archive For 1 Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☒ Other Standard

QC Requirements (Specify):

	Date	Time		Date	Time
1. Relinquished By: [signature]	6/3/02	1:15pm	1. Received By: [signature] M. NEWBY	6-4-02	1:15pm
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Stays with the Samples; CANARY - Returned to Client with Report; PINK - Field Copy

3 July 2002

David Hamacher
WSDOT
310 Maple Park Ave.
Olympia, WA 98504-7311

Subject: June 2002 Acute Bioassay Tests

Dear David,

Enclosed are two copies of the bioassay report for the acute toxicity tests conducted on a discharge sample collected June 3, 2002. Tests were conducted using *Pimephales promelas* (Fathead minnow) and *Ceriodaphnia dubia*. Test procedures followed EPA and Washington Department of Ecology guidelines.

Sincerely,

Matthew Liebl
NW Bioassay Laboratory Supervisor
AMEC Earth & Environmental, Inc.

Dept. of Transportation
JUL 09 2002
Safety and Health

AMEC Earth & Environmental, Inc.
San Diego Bioassay Laboratory
5550 Morehouse Drive
San Diego, CA 92121
Tel (858) 458-9044
Fax (858) 458-0943
www.amec.com

AMEC Earth & Environmental, Inc.
Northwest Bioassay Laboratory
5009 Pacific Highway East, Suite 2
Fife, WA 98424
Tel (253) 922-4296
Fax (253) 922-4296
www.amec.com

BIOASSAY REPORT

June 2002

Prepared for

Washington State Department of Transportation
310 Maple Park Ave.
Olympia, WA 98504-7311

Prepared by

AMEC Earth & Environmental
Northwest Bioassay Laboratory
5009 Pacific Hwy. East, Suite 2-0
Fife, WA 98424
(253) 922-4296

Submitted: 3 July 2002

INTRODUCTION

Acute bioassays using the test organisms *Ceriodaphnia dubia* and *Pimephales promelas* (Fathead minnow) were conducted on a discharge sample collected June 3, 2002. David Hamacher managed the project for WSDOT. All tests were conducted at AMEC Earth & Environmental's Northwest Bioassay Laboratory located in Fife, Washington.

MATERIALS AND METHODS

The discharge sample was delivered to the laboratory in a 10-liter plastic cubitainer the day after collection and stored at 4°C in the dark until use. Detailed sample information is in Table 1.

Table 1. Sample Information

	Sample ID Discharge
AMEC Log-In No.	02-300
Sample date	6/3/02
Sample time	2200
Receipt Date	6/4/02
Receipt Time	1300
Receipt Temp.	5.5°C
Dissolved Oxygen (mg/L)	10.5
pH	6.82
Conductivity (µS/cm)	184
Hardness (mg/L $CaCO_3$)	64
Alkalinity (mg/L $CaCO_3$)	48
Chlorine (mg/L)	< 0.03
Ammonia (mg/L)	14.2

Summary of Fathead Minnow Acute Survival Test Conditions

Test ID:	0206-07NW
Test Initiation	
Date:	6/5/02
Time:	1000
Test Termination	
Date:	6/9/02
Time:	1100
Test animal:	*Pimephales promelas* (Fathead minnow)
Animal source:	Aquatox Inc.; Hot Springs, AR
Animal age:	11 days post hatch
Feeding:	*Artemia* nauplii 2 hours before test initiation and solution renewal at 48 hours
Test chamber:	250 milliliter plastic cup
Test solution volume:	200 milliliters
Test temperature:	25°C
Dilution water:	Moderately Hard Synthetic Water
Test concentrations (%):	100, 50, 25, 12.5, 6.25, 0
Number of organisms/ chamber:	10
Number of replicates/conc:	3
Endpoint:	Mortality or 96 hours
Photoperiod:	16 hours light/ 8 hours dark
Aeration:	None
Deviations:	None
Statistical Software:	ToxCalc 5.0
Test Protocol:	EPA/600/4-90/027F
Test Acceptability:	$\geq$ 90% survival in the control

Summary of Ceriodaphnia Acute Survival Test Conditions

Test ID:	0206-06NW
Test Initiation	
Date:	6/5/02
Time:	1000
Test Termination	
Date:	6/7/02
Time:	100
Test animal:	*Ceriodaphnia dubia*
Animal source:	In-house culture
Animal age:	<24 hours
Feeding:	50:50 mixture YTC:Selenastrum 2 hours prior to test initiation
Test chamber:	30 milliliter plastic cup
Test solution volume:	15 milliliters
Test temperature:	25°C
Dilution water:	Moderately Hard Synthetic Water
Test concentrations (%):	100, 50, 25, 12.5, 6.25, 0
Number of organisms/ chamber:	5
Number of replicates/conc.:	4
Endpoint:	Mortality or 48 hours
Photoperiod:	16 hours light/ 8 hours dark
Aeration:	None
Deviations:	None
Statistical Software:	ToxCalc 5.0
Test Protocol:	EPA/600/4-90/027F
Test Acceptability:	$\geq$ 90% survival in the control

RESULTS

A summary of results for the Fathead minnow and *Ceriodaphnia* acute toxicity tests is contained in Table 2. There was 0 percent survival in 100 percent sample in the Fathead minnow test. The concentration lethal to 50 percent of the Fathead minnow (LC_{50}) was 28.7 percent sample. The Ceriodaphnia test exhibited high mortality and there was 0 percent survival in 100 percent sample. The concentration lethal to 50 percent of the *Ceriodaphnia* (LC_{50}) was 10.8 percent sample.

Table 2. Acute Toxicity Results

Species	Test ID	Concentration (% Effluent)	Percent Survival	NOEC* (% Effluent)	LC_{50} (% Effluent)
Fathead minnow	0206-07NW	0	96.7	12.5	28.7
		6.25	100		
		12.5	93.3		
		25	53.3		
		50	20		
		100	0		
Ceriodaphnia	0206-06NW	0	100	<6.25	10.8
		6.05	60		
		12.5	50		
		25	35		
		50	5		
		100	0		

* No Observed Effect Concentration

Test data and individual statistical summaries for each test are contained in the appendices.

QUALITY ASSURANCE

Results from reference toxicant tests used to monitor laboratory performance using the test species Fathead minnow and *Ceriodaphnia dubia* are summarized in Table 3. The results are acceptable based on control charting for the laboratory. The coefficients of variation for the last 20 tests are also listed in Table 3.

Species	Date Initiated	Test ID	LC_{50}	CV (%)
Fathead minnow	05/31/02	RA053102PP	4.47g/L NaCl	12.8
Ceriodaphnia dubia	05/28/02	RC052802CD	11.3µg/L $CuSo_4$	24.4

REFERENCES

EPA. 1994. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms. EPA/600/4-91/002, July 1994.

Tidepool Scientific Software. 1992-1994. TOXCALC Comprehensive Toxicity Data Analysis and Database Software, Version 5.0.

WADOE. 1998. Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria. Washington State Department of Ecology. Water Quality Program. Publication number: WQ-R-95-80, Revised December 2001.

Appendix A

Fathead minnow Acute Toxicity Test

Test Data and Statistical Summary

Acute Fish Test-96 Hr Survival

Start Date:	06/05/2002	Test ID: 0206-07NW		Sample ID:	WSDOT
End Date:	06/09/2002	Lab ID: WAAEE-AMEC NW Bioassay		Sample Type:	Bridge Washing Discharge
Sample Date:	06/03/2002	Protocol: EPAF 93-EPA Acute		Test Species:	PP-Pimephales promelas
Comments:					

Conc-%	1	2	3
D-Control	1.0000	0.9000	1.0000
6.25	1.0000	1.0000	1.0000
12.5	0.9000	0.9000	1.0000
25	0.7000	0.4000	0.5000
50	0.2000	0.1000	0.3000
100	0.0000	0.0000	0.0000

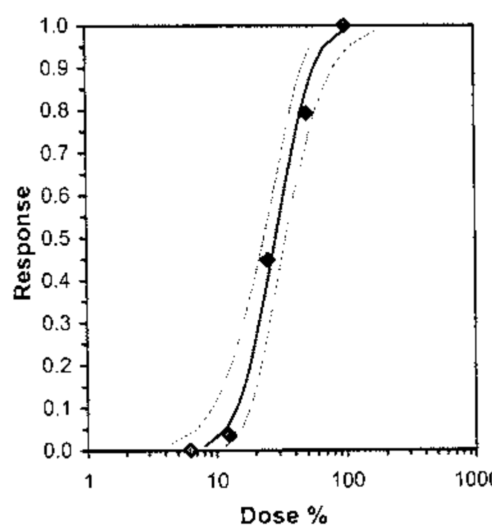
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
D-Control	0.9667	1.0000	1.3577	1.2490	1.4120	6.930	3				1	30
6.25	1.0000	1.0345	1.4120	1.4120	1.4120	0.000	3	-0.672	2.500	0.2020	0	30
12.5	0.9333	0.9655	1.3034	1.2490	1.4120	7.219	3	0.672	2.500	0.2020	2	30
*25	0.5333	0.5517	0.8204	0.6847	0.9912	19.038	3	6.648	2.500	0.2020	14	30
*50	0.2000	0.2069	0.4550	0.3218	0.5796	28.386	3	11.169	2.500	0.2020	24	30
*100	0.0000	0.0000	0.1588	0.1588	0.1588	0.000	3	14.835	2.500	0.2020	30	30

Auxiliary Tests					Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)					0.94648		0.858		0.23063	-0.0014
Equality of variance cannot be confirmed										
Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	12.5	25	17.6777	8	0.11794	0.12347	0.83171	0.0098	6.1E-09	5, 12

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.24635	0.6934	2.88729	5.60542	0.03333	1.92622	7.81472	0.59	1.4576	0.2355	8
Intercept	-1.1895	1.04011	-3.2281	0.84913							
TSCR	0.01623	0.01723	-0.0175	0.04999							

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	8.12368	4.14484	11.6817
EC05	3.355	11.7555	7.05562	15.6346
EC10	3.718	14.3152	9.33597	18.3276
EC15	3.964	16.3502	11.2506	20.451
EC20	4.158	18.1719	13.0221	22.3581
EC25	4.326	19.8957	14.7338	24.1826
EC40	4.747	24.9998	19.8708	29.8259
EC50	5.000	28.6813	23.4986	34.2539
EC60	5.253	32.9049	27.453	39.8202
EC75	5.674	41.3464	34.6024	52.5509
EC80	5.842	45.2686	37.643	59.1157
EC85	6.036	50.3123	41.3644	68.0749
EC90	6.282	57.4644	46.3691	81.6599
EC95	6.645	69.977	54.5928	107.583
EC99	7.326	101.262	73.3709	182.375

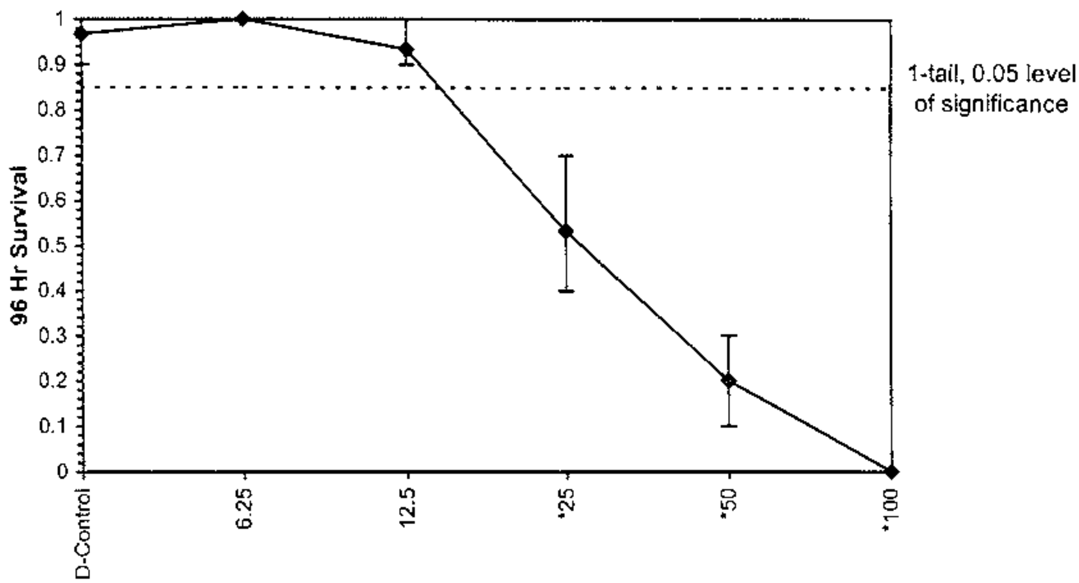


 ToxCalc v5.0.23 Reviewed by: [signature]

Acute Fish Test-96 Hr Survival

Start Date:	06/05/2002	Test ID:	0206-07NW	Sample ID:	WSDOT
End Date:	06/09/2002	Lab ID:	WAAEE-AMEC NW Bioassay	Sample Type:	Bridge Washing Discharge
Sample Date:	06/03/2002	Protocol:	EPAF 93-EPA Acute	Test Species:	PP-Pimephales promelas
Comments:					

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by:

AMEC Earth Environmental
Northwest Bioassay Lab
5009 Pacific Hwy. E. Suite 2-0
Fife, WA 98424

96 Hour Toxicity Test Data Sheet
Freshwater 96-hr Acute with Renewal

Client: WA DoT
Sample ID: June 3 Discharge
Contact:
Test #: 0206-07 NW

Start Date & Time: 6/5/02 10:00
End Date & Time: 6/9/02 1100
Test Organism: P promelas
Test Protocol:

Sample Conc. or %	D.O. (mg/L) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96	pH (mg/L) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96
0	8.0	7.7	7.6	8.0	7.7	6.3	8.06	7.99	8.06	8.02	8.00	7.75
6.25	7.9	6.7	7.3	8.0	7.7	6.2	7.79	7.72	7.93	7.80	7.89	7.31
12.5	7.8	6.4	7.3	7.7	7.6	6.2	7.64	7.62	7.86	7.60	7.79	7.72
25	7.7	6.1	6.8	7.1	7.0	5.9	7.40	7.52	7.74	7.35	7.66	7.65
50	7.6	4.6	5.7	5.5	5.3	5.5	7.11	7.29	7.51	6.97	7.40	7.53
100	6.8	3.2	—			—	6.72	7.11	—			—

Sample Conc. or %	Conductivity µS/cm Init. 0	Fin. 48	Init. 48	Fin. 96	Test Temperature (°C) Init. 0	24	Fin. 48	Init. 48	72	Fin. 96
0	319	313	312	~~303~~ 316	24.2	25.2	25.1	25.0	25.0	25.2
6.25	320	306	314	311	25.0	24.8	25.0	25.0	25.0	25.2
12.5	314	298	305	300	25.0	24.9	25.1	25.0	25.0	25.2
25	310	297	307	301	25.0	25.3	25.1	25.0	25.0	25.2
50	292	280	297	284	24.7	24.9	25.2	25.0	25.0	25.2
100	249	270	308	—	24.3	24.8	—			—

Conc.	Alkalinity* *(mg/L as CaCo3)	Hardness*	Chlorine Resid. (mg/L)	Ammonia (mg/L)
			—	—
control	60	92	<.03	14.2
highest conc.	48	64		

Sample Conc. or %	Rep #	Cont #	Number of Live Organisms 0	24	48	72	96
0	1	17	10	10	10	10	10
	2	9	10	10	10	10	9
	3	16	10	10	10	10	10
6.25	1	11	10	10	10	10	10
	2	13	10	10	10	10	10
	3	4	10	10	10	10	10
12.5	1	15	10	9	9	9	9
	2	12	10	9	9	9	9
	3	18	10	10	10	10	10
25	1	7	10	7	7	7	7
	2	1	10	4	4	4	4
	3	6	10	5	5	5	5
50	1	14	10	2	2	2	2
	2	10	10	1	1	1	1
	3	8	10	3	3	3	3
100	1	3	10	0	0		
	2	5	10	0	0		
	3	2	10	0	0		
Tech. Initials			Et	Et	Et	RS	ML

Sample Description:

Animal Source: Aquatox
Date Received: 6/5/02
Date of Hatch: 5/25/02

Comments:

Analysts: Et RS ML

Appendix B

Ceriodaphnia dubia Acute Toxicity Test

Test Data and Statistical Summary

Ceriodaphnia acute-48 Hr Survival

Start Date:	06/05/2002	Test ID:	0206-06NW	Sample ID:	WSDOT
End Date:	06/07/2002	Lab ID:	WAAEE-AMEC NW Bioassay	Sample Type:	Bridge Washing Discharge
Sample Date:	06/03/2002	Protocol:	EPAF 93-EPA Acute	Test Species:	CD-Ceriodaphnia dubia

Comments:

Conc-%	1	2	3	4
D-Control	1.0000	1.0000	1.0000	1.0000
6.25	0.6000	0.8000	0.8000	0.2000
12.5	0.6000	0.2000	0.6000	0.6000
25	0.2000	0.6000	0.6000	0.0000
50	0.0000	0.0000	0.0000	0.2000
100	0.0000	0.0000	0.0000	0.0000

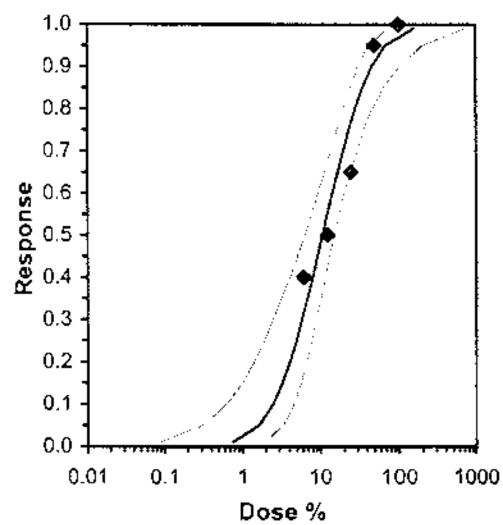
			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
D-Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4			0	20
*6.25	0.6000	0.6000	0.8910	0.4636	1.1071	34.048	4	10.00	10.00	8	20
*12.5	0.5000	0.5000	0.7805	0.4636	0.8861	27.063	4	10.00	10.00	10	20
*25	0.3500	0.3500	0.6153	0.2255	0.8861	53.207	4	10.00	10.00	13	20
*50	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	10.00	10.00	19	20
*100	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4	10.00	10.00	20	20

Auxiliary Tests					Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)					0.89624	0.884	-0.7997	0.73247
Equality of variance cannot be confirmed								
Hypothesis Test (1-tail, 0.05)	**NOEC**	**LOEC**	**ChV**	**TU**				
Steel's Many-One Rank Test	<6.25	6.25						

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.01917	0.41409	1.20755	2.83078	0	3.36177	7.81472	0.34	1.03514	0.49525	3
Intercept	2.90987	0.53306	1.86506	3.95468							
TSCR											

Point	Probits	%	95% Fiducial Limits	
EC01	2.674	0.76386	0.09016	1.94975
EC05	3.355	1.66159	0.326	3.44258
EC10	3.718	2.5145	0.64408	4.68132
EC15	3.964	3.32542	1.01663	5.77724
EC20	4.158	4.15268	1.45739	6.84628
EC25	4.326	5.02459	1.97982	7.94058
EC40	4.747	8.12219	4.20593	11.7529
EC50	5.000	10.8429	6.46395	15.2338
EC60	5.253	14.4749	9.61043	20.411
EC75	5.674	23.3985	16.7084	36.9148
EC80	5.842	28.3113	20.1015	48.3453
EC85	6.036	35.3542	24.524	67.3192
EC90	6.282	46.756	30.9771	103.816
EC95	6.645	70.7561	42.9558	201.133
EC99	7.326	153.913	77.1104	715.314

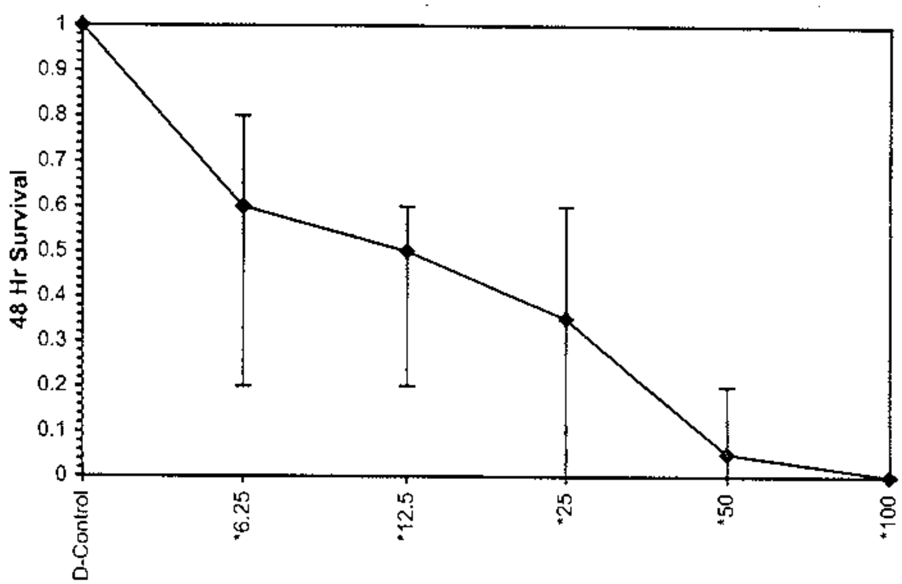


 ToxCalc v5.0.23 Reviewed by:

Ceriodaphnia acute-48 Hr Survival

Start Date:	06/05/2002	Test ID: 0206-06NW		Sample ID:	WSDOT
End Date:	06/07/2002	Lab ID: WAAEE-AMEC NW Bioassay		Sample Type:	Bridge Washing Discharge
Sample Date:	06/03/2002	Protocol: EPAF 93-EPA Acute		Test Species:	CD-Ceriodaphnia dubia
Comments:					

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by: [signature]

Freshwater Acute
48 Hour Toxicity Test Data Sheet
Northwest Bioassay Lab

Client: WA DOT
Sample ID: June 3, 2002 Discharge
Contact:
Test #: 0206-06NW

Start Date & Time: 6/5/02 1000
End Date & Time: ~~6/6/6~~ 6/7/02 10:00
Test Organisms: Ceriodaphnia dubia

Conc. or %	Cont. #	Rep. #	Number of Live Organisms 0	24	48	Dissolved Oxygen (mg/L) 0	24	48	pH (units) 0	24	48	Conductivity (µS/cm) 0	48	Temperature (°C) 0	24	48	Mean Percent Survival
0	6	1	5	5	5	8.0	7.7	7.6	8.06	7.99	8.06	319	312	24.2	25.2	25.1	
	9	2	5	5	5												
	14	3	5	5	5												
	13	4	5	5	5												100%
6.25	11	1	5	~~5~~ 3	3	7.9	6.7	7.3	7.79	7.72	7.93	320	314	25.0	24.8	25.0	
	1	2	5	4	4												
	7	3	5	4	4												
	16	4	5	1	1												60%
12.5	24	1	5	4	3	7.8	6.4	7.3	7.64	7.62	7.86	314	305	25.0	24.9	25.1	
	10	2	5	1	1												
	3	3	5	3	3												
	15	4	5	3	3												50%
25	17	1	5	1	1	7.7	6.1	6.8	7.40	7.52	7.74	310	307	25.0	25.3	25.1	
	22	2	5	3	3												
	23	3	5	3	3												
	2	4	5	0	0												35%
50	18	1	5	0	0	7.6	4.6	5.7	7.11	7.29	7.51	292	297	24.7	24.9	25.2	
	20	2	5	0	0												
	21	3	5	1	0												
	5	4	5	1	1												5%
100	19	1	5	0	0	6.8	3.2		6.72	7.11		249		24.3	24.8	25.1	
	8	2	5	0	0												
	12	3	5	0	0												
	4	4	5	0	0												0%
Technician Initials			WM	ET	ET												

Conc.	Alkalinity (mg/L)	Hardness (mg/L as CaCO3)	Chlorine (mg/L)	Ammonia (mg/L)
control	60	92	—	—
highest conc.	48	64	<.03	14.2

Sample Description:

Analyst Initials: WM ET

Comments: 0 hrs:
24 hrs.
48 hrs.

AMEC Earth & Environmental
Northwest Bioassay Laboratory
5009 Pacific Hwy. E. Suite 2-0
Fife, WA 98424
(253) 922-4296

Appendix C

Chain-of-Custody Form

Chain of Custody

amec Earth & Environmental

AMEC Northwest Bioassay Laboratory
5009 Pacific Highway East, Suite 2-0
Fife, WA 98424
253-922-4296

Date 6/4/02 Page 1 of 1

COMPANY WSDOT Safety & Health Services
ADDRESS P.O. Box 47311
CITY Olympia STATE WA ZIP 98504-7311
PHONE NO. 360-705-7746

ANALYSIS REQUIRED: Acute toxicity

PROJECT MANAGER: David Hamacher
SAMPLERS (SIGNATURE): [signature]
PHONE NUMBER: same

SAMPLE ID	DATE	TIME	MATRIX	CONTAINER TYPE	Acute toxicity	CONCENTRATIONS/COMMENTS	NUMBER OF CONTAINERS
Discharge composite	6/3/02	10:00p	H_2O	10L	X	2 containers - perform a "side-by-side"?	2

PROJECT INFORMATION	
CLIENT	
P.O. NO.	
SHIPPED VIA:	Client

SAMPLE RECEIPT	
TOTAL NO. OF CONTAINERS	2
CHAIN OF CUSTODY SEALS	N
REC'D. GOOD CONDITION/COLD	Y
CONFORMS TO RECORD	Y

SPECIAL INSTRUCTIONS/COMMENTS:
Temps 5.5°C

RELINQUISHED BY
(Signature) [signature] (Time) 1300
(Printed Name) David Hamacher (Date) 6/4/02
(Company) WSDOT

RELINQUISHED BY
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY
(Signature) (Time)
(Printed Name) (Date)
(Company)

RECEIVED BY (LABORATORY)
(Signature) [signature] (Time) 1300
(Printed Name) Matthew ... 6/4/02 (Date)
Ogden Bioassay Lab Log-in No. 02-300

Additional disposal charges may apply.

DISTRIBUTION: WHITE, CANARY - AMEC Bioassay Lab, PINK - Originator

Washington State Department of Transportation

Memorandum

September 23, 2003

OCT - 1

TO: David Crisman, P.E.

FROM: David R. Hamacher drh 9/23/03

SUBJECT: Nooksack River Bridge (539/860) -- Monitoring Report

The Washington State Department of Transportation (WSDOT), Northwest Region, is involved with a bridge painting project on the Nooksack River Bridge (539/860). The bridge painting project is operating under contract C6482 and the Contractor hired to paint the bridge is Americoat Painting Company, Inc.

The Maintenance and Operations Programs, Safety and Health Services Office, cooperating with the Northwest Region and Headquarters Environmental Offices, continues to be involved with an ongoing study of environmental and occupational hazard exposures. The study involves an extensive amount of site reconnaissance, investigation, study, project participation, communication, and data collection and interpretation. Work happening on the Nooksack River Bridge allowed for an opportune time to monitor on-site environmental exposures. Exposure monitoring on the Nooksack River Bridge project was performed during representative pressure washing of the structural steel and of the subsequent discharge of water through a specified "belly tarp system".

During the evening of August 17, 2003, the Contractor performed pressure washing work activities of the bridge super-structure (above deck) on the southbound lane and shoulder. A total of three pressure-washer using "rototips" at approximately 3200 psi were used to clean and wash the super-structure. Approximately 2200 gallons of potable water (obtained from nearby concrete company hydrant) was used to clean the steel on the bridge structure. Pressure-washing work activities started at approximately 8:30pm and were completed around 4:00am the following morning. The Contractor estimated he would use approximately 8,000 to 10,000 gallons of water to clean the entire bridge. Containment and filtration of the wash-water consisted of non-porous side tarps, and a porous and non-porous belly tarp system.

Prior to the monitoring performed on August 17, 2003, background water quality samples were collected from the Nooksack River and in proximity to the bridge structure on August 13, 2003. All analytical environmental water quality data and information collected from the project site is contained herein and in the attachments of this report

During representative and critical periods of the pressure washing conducted on August 17, 2003, composite discharge water samples were collected. The water samples, designated as "pressure washing discharge", were collected after belly-tarp filtration and prior to discharge to the environment. In addition to the collection and analyses of the pressure washing discharge samples and for quality assurance/control, composite and grab samples of the raw-water, receiving water (upstream/downstream), wash water, and blank samples were collected.

All samples were collected in accordance with industry and EPA guidelines and recommendations, and to prevent cross contamination. All samples collected at the project site were submitted to Severn Trent (STL Seattle) Analytical Laboratories, Inc. (an accredited laboratory) via chain of custody protocols. Parameter analyses of the water samples consisted of select heavy metals, total suspended solids (TSS), total settleable solids, and hardness. Select metals were analyzed using dissolved, total, and total recoverable analytical methodologies. Dissolved metal samples were filtered, preserved and tested at STL.

Shown in attachment No. 1 is a complete data summary of the analytical testing results. The spreadsheet shows the sample identification, type of sample, parameter test results, analytical methodology, detection limits and other pertinent information and notes.

Shown in attachment No. 2 are site pictures of the work operations, and other project pertinent information.

Shown in attachment No. 3 is site-specific Nooksack River flow/discharge data from the United States Geological Service (USGS). At the time of bridge washing and sample collection, Nooksack River flow rates were approximately 1650 to 1700 cubic feet per second.

Shown in attachment No. 4 is a copy of the field reports and calculations/interpretation of the analytical data and information.

NOTE: complete analytical reports will be maintained in my office files.

As evidenced by the analytical data collected from the Noosack River Bridge project, and from the site reconnaissance, field observations, and post project follow up and data interpretation, the following findings and recommendations are provided:

- Comparing total suspended solid concentration in the raw water sample (13200 mg/L) to the discharge sample (184 mg/L), the containment was 98.6% efficient at containing bridge debris and lead paint during washing activities.
- Dissolved concentrations of chromium (Cr), copper (Cu), lead (Pb), and zinc (Zn) in the pressure washing discharge water were 0.0227 mg/L, 0.059mg/L, 0.0775 mg/L, and 1.02 mg/L, respectively.
- Referencing WAC 173-201A-040, the dissolved metals surface water quality standards for chromium (Cr), copper (Cu), lead (Pb), and zinc (Zn) were 0.242 mg/L, 0.0067 mg/L, 0.0213 mg/L, and 0.0493 mg/L, respectively.
- Dissolved metals in the discharge water exceed Washington State Department of Ecology water quality standards.

- With three (3) pressure washers working, and considering 480 minutes of washing and the total discharge of approximately 2200 gallons of water during the wash event (08/17/03), water was discharged from the containment at approximately 4.6 gallons per minute, and each pressure washer discharged at approximately 1.5 gpm.
- On average for the entire bridge pressure wash work activities, approximately 15lb to 16lb of total suspended solids (TSS) was discharged to the environment. As a comparison, there are approximately 2,490lbs in 1.0 yd^3 of washed sand. Washed sand is a good example of a suspended solid.
- Extrapolating the analytical data, approximately 0.0066lb of dissolved lead and 0.102 lb of total lead was discharged for the entire bridge washing project.
- Extrapolating the analytical data, approximately 0.087lb of dissolved zinc and 0.136 lb of total zinc was discharged for the entire bridge washing project.
- Concentrations of zinc and copper in the discharge water were well below secondary maximum contaminant levels (MCL). The MCL are drinking water standards established by the Clean Water Act.
- Nooksack River flow rates at the time of pressure washing were approximately 1650 to 1700 cubic feet per second. At these flow rates and 200 feet downstream from the discharge location, metals (Cr, Cu, Pb, and Zn) were not detected above background metal concentrations.
- Settleable solids were not detected in the pressure washing discharge sample. From this data it appears as though most of the water discharged will remain in solution and will not cause a significant sediment impact on the receiving water body.
- Monitoring data collected from the Nooksack River Bridge painting project is essential for WSDOT permit streamlining efforts and compliance with the applicable codes. I strongly recommend developing a monitoring program that continues to evaluate and test water qualities from bridge washing projects and monitors the efficiency of containments.
- Bridge painting and maintenance is an essential element for bridge preservation efforts, and maintaining a safe mode of transportation. Painting and washing the Nooksack River Bridge will prolong the life of the structure, protect the traveling public, and as evidenced herein, have a minimal impact on the environment.

As always, it is a pleasure working with you and the WSDOT Northwest Region. I look forward to a continued professional working relationship. If you have any questions or require any additional information please contact me at 360-705-7746.

DRH: drh

CC: Richard Tveten/Mike Stephens/Ken Stone – one copy of report
Gregor Myhr/Patty Lynch/Megan White P.E, -- one copy of report
Gary Bailey/Penny Kelley/Melodie Selby P.E., -- one copy of report
Sandy Stephens/Doug Pierce – one copy of report

ATTACHMENT No. 1

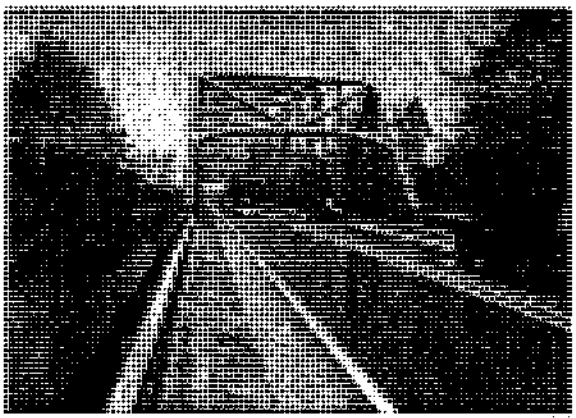
Steel Bridge Paint Info (with pictures)

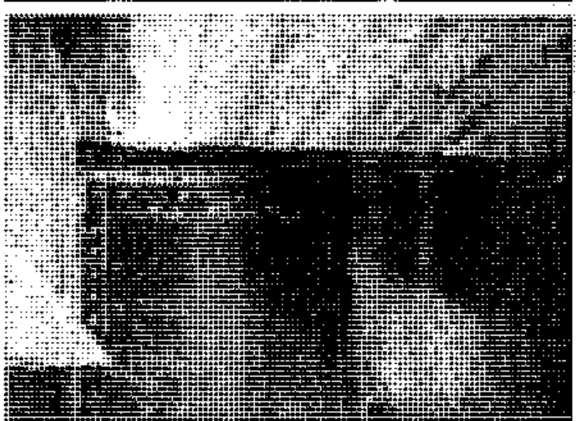
Bridge Number:	Bridge Name:	Milepost:	Region:
539 / 860	NOOKSACK R	9.43	Northwest

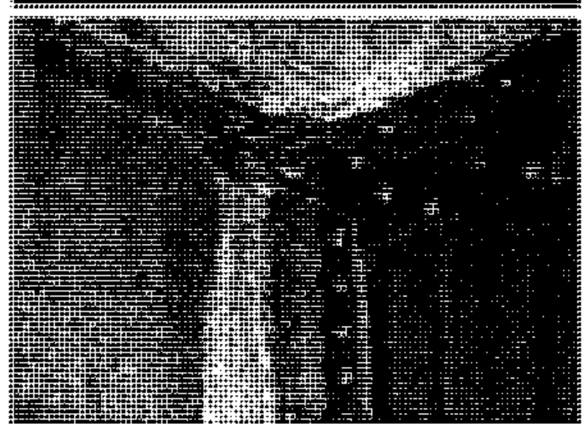
Year Built	Bridge Type:	Steel Span Length:	Width (curb-curb):	Steel Tonnage:
1950	ST CTB	340 ft.	28 ft.	465

Paint Age:	Paint Color:	Steel Surf. Area:	BMS Cond State 2:	BMS Cond State 3:
18	Evergreen	69,750 sqft	68,750 sqft	1,000 sqft

Next Paint Year:	2003-05 Bien Priority:	CPMS Ad date:	Paint Pin Number:	Contract Number:	Future Paint Cost:
2003	8	12/2002	153905P	16482	$558,000







Inspection Notes:

STRINGERS - There is pack rust on 90% of the top flange. there is 2-3% section loss mostly at the floorbeam connections. Span L8-L9@L9 stringer B has 20-25% section loss in the web due to pack rust.
FLOORBEAMS - Mud stained with rusty top flanges. There is up to 10% section loss in the top flange.
TRUSS - Peeling paint on the truss members exposing the primer and in some areas exposing the steel.
TRUSS BOTTOM CHORD - The paint system is no longer effective. The paint is flaking off with pack rust at the gusset plate causing the plate to bow at the bottom. Rivets in this area are showing 2-5% section loss.

Washington State Department of Transportation
Nooksack River Bridge (539/860) Bridge Painting Project
Pressure Washing Discharge – Analytical Results Data Summary
August 17, 2003

Sample Identification	Sample Type	Analytical Methodology	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)	Comments/Notes
Nooksack River Background August 13, 2003	Grab	Dissolved ICP-MS	ND <0.001	ND <0.001	ND <0.0005	0.0066	Gary Bailey on-site during sample collection. No work happening on-site
		Total Recoverable ICP-MS	0.0017	0.0041	ND <0.001	0.0023	
Nooksack River Background August 17, 2003	grab	Dissolved ICP/MS	ND <0.001	0.0011	ND <0.0005	0.0088	Collected approximately 150' upstream during active pressure washing work.
		Total Recoverable ICP/MS	0.0014	0.0027	ND <0.001	0.0041	
Pressure Washing Discharge	composite	Dissolved ICP-MS	0.0227	0.659	0.0775	1.02	Sample collected post tarp filtration and prior to environmental discharge
		Total Recoverable ICP/MS	0.993	0.0315	1.22	1.65	
		Total ICP/MS	1.03	0.0829	1.28	1.57	
Downstream 200' -- 10:50pm	grab	Dissolved ICP/MS	ND <0.001	0.0039	ND <0.0005	0.0080	Downstream samples collected during active pressure washing and discharge
		Total Recoverable ICP/MS	0.0017	0.0027	ND <0.001	0.0055	
Downstream 200' -- 11:35pm	grab	Dissolved ICP/MS	ND <0.001	0.0012	ND <0.0005	0.0075	Downstream samples collected during active pressure washing and discharge
		Total Recoverable ICP/MS	0.0018	0.0024	ND <0.001	0.0097	
Raw-water	composite	Total Recoverable ICP/MS	6.18	0.679	657	242	Collected during active pressure washing and prior to tarp filtration - steel super-structure washing
		Total ICP/MS	9.79	0.944	1370	406	
QA/QC -- Field Blank	grab	Total Recoverable ICP/MS	ND	ND	ND	ND	Carried throughout field visit
QA/QC -- Tanker Water	grab	Total Recoverable ICP/MS	ND	ND	0.0062	0.1100	Sample collected from 500 gallon tanker container spigot
Calculated Ecology surface water quality standards	grab	NA	0.2420	0.0067	0.0213	0.0493	Reference - WAC 173-201A-040
MCL - drinking water standards	grab	NA	0.1	Secondary, 1.3 ppm	0.015	secondary, 5.0 ppm	Reference - CLARC 3.1 spreadsheet

MCL - maximum contaminant level/limit. The MCL is the safe drinking water standards as established by the Clean Water Act. Reference - Department of Ecology CLARC version 3.1 spreadsheet.

Department of Ecology (Ecology) -- dissolved criteria water quality standards "calculated acute freshwater standards" (reference WAC 173-201A-240)

ND: Not detected (beyond analytical detection limits)

NA: Not Applicable/Available

ICP/MS - inductively coupled plasma mass spectrometry

Dissolved - 0.45um laboratory filtered, preserved,and tested.

Total Recoverable - reference 40 CFR - Part 136, Appendix C (weaker acid digestion)

Total - reference 40 CFR - Part 136, Appendix C (strong/aggressive acid digestion)

Dissolved and total metals were analyzed using USEPA methods 6010 and 6020 - reference as a comparison EPA method 200.7

ND: Not detected (beyond analytical detection limits)

All units are expressed in mg/L unless otherwise noted.

< -- Less than

USEPA - United States Environmental Protection Agency

Accredited laboratory analyses were completed by STL Seattle, Fife, Washington

Washington State Department of Transportation
Nooksack River Bridge (539/860) Bridge Painting Project
Analytical Results Data Summary
August 17, 2003

Sample Identification	Sample Type	Total Suspended Solids (TSS) (mg/L)	Total Settleable Solids (mg/L)	Hardness (mg/L)
Nooksack River Background August 13, 2003	Grab	NA	NA	39
Pressure Washing Discharge	composite	184	ND <0.2	105
Downstream 200' -- 10:50pm	grab	46	NA	36
Downstream 200' -- 11:35pm	grab	44	NA	34
Nooksack River Background August 17, 2003	grab	48	NA	37
Raw-water	composite	13200	97	450

All values reported in mg/L (ppm) unless noted otherwise

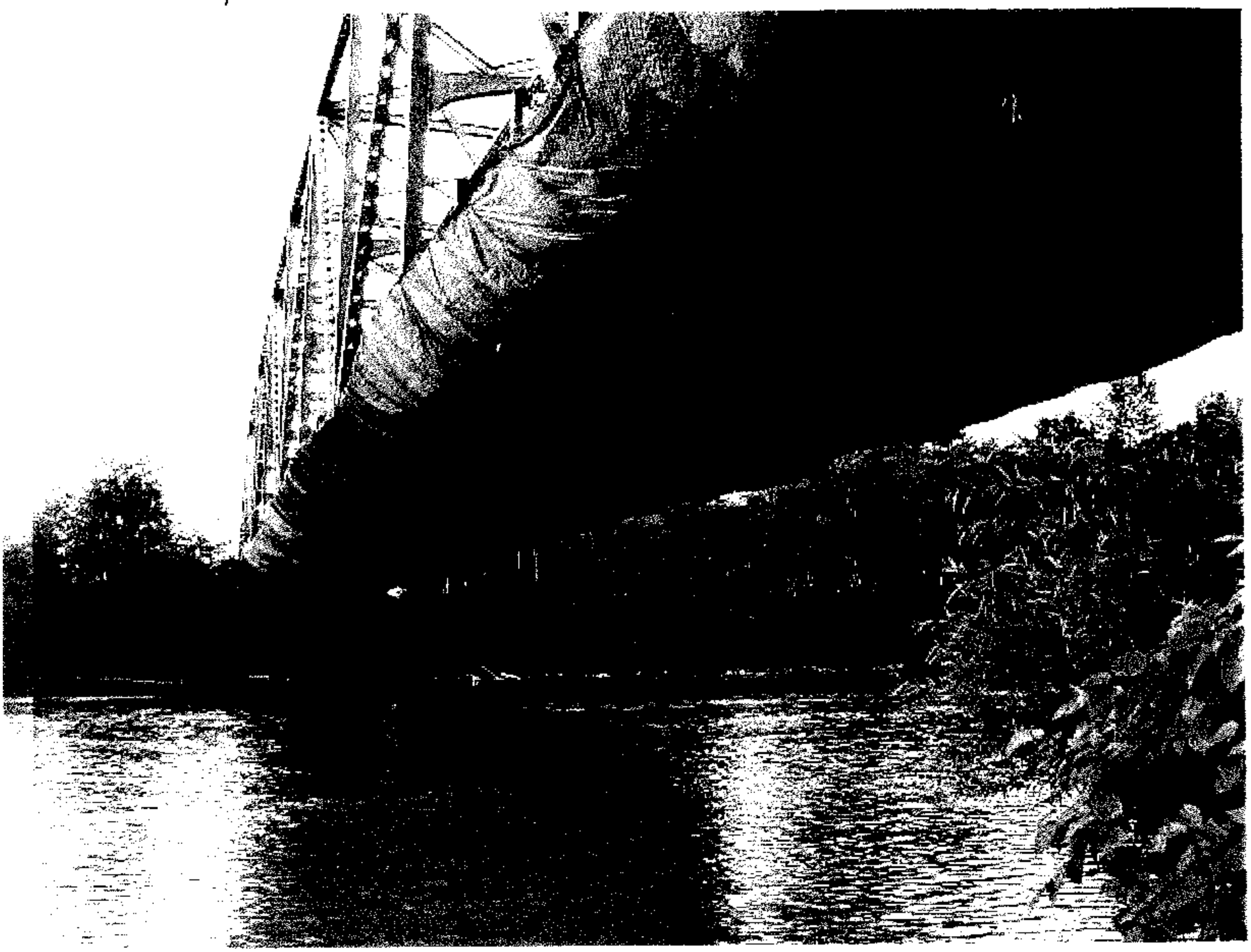
NA - Not Available/Applicable

All samples were collected on August 17, 2003, unless noted otherwise

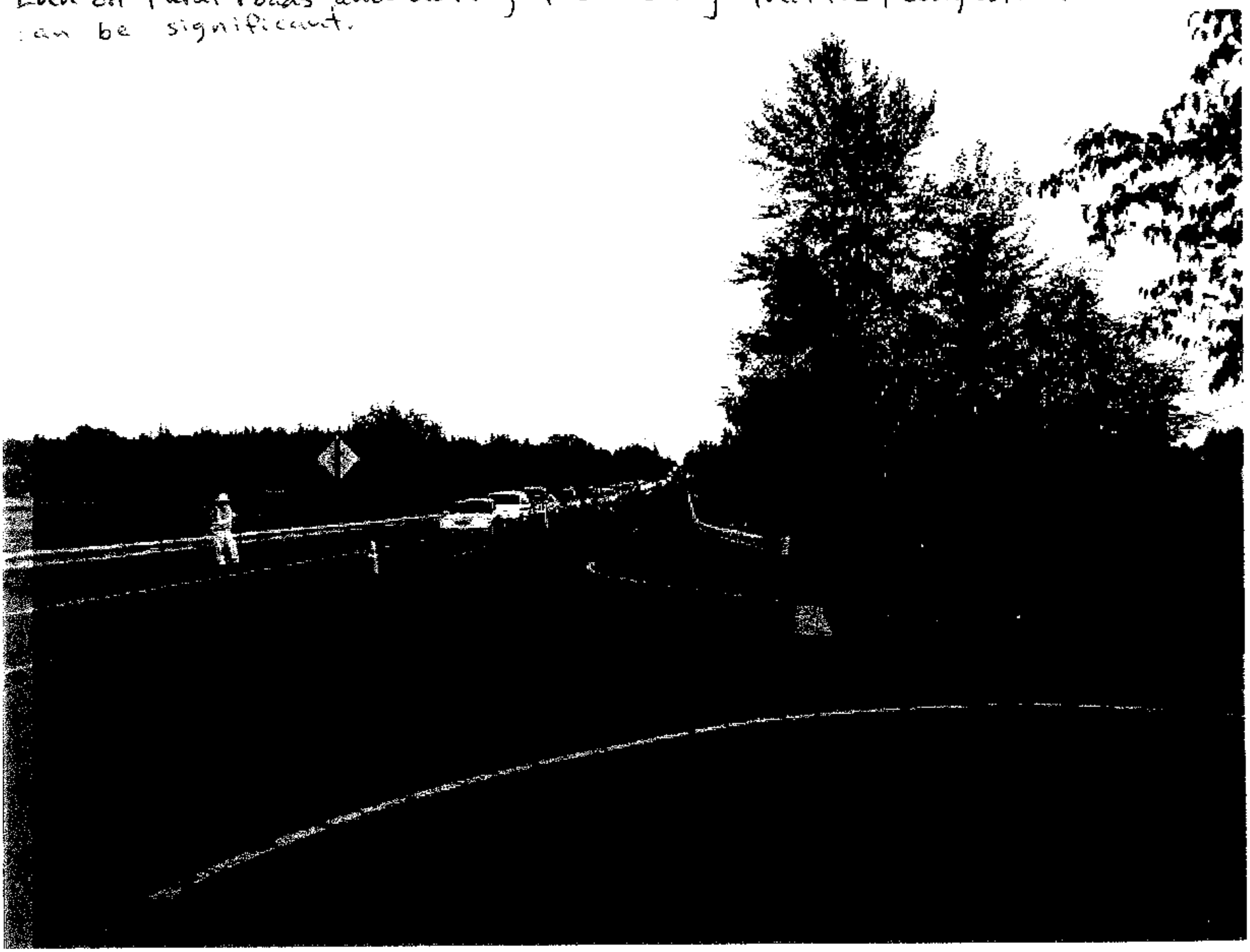
184/13200 x 100% = 1.4% or 98.6% filter-tarp efficiency

ATTACHMENT No. 2

New technology containment using galvanized fencing + geotextile tarps.

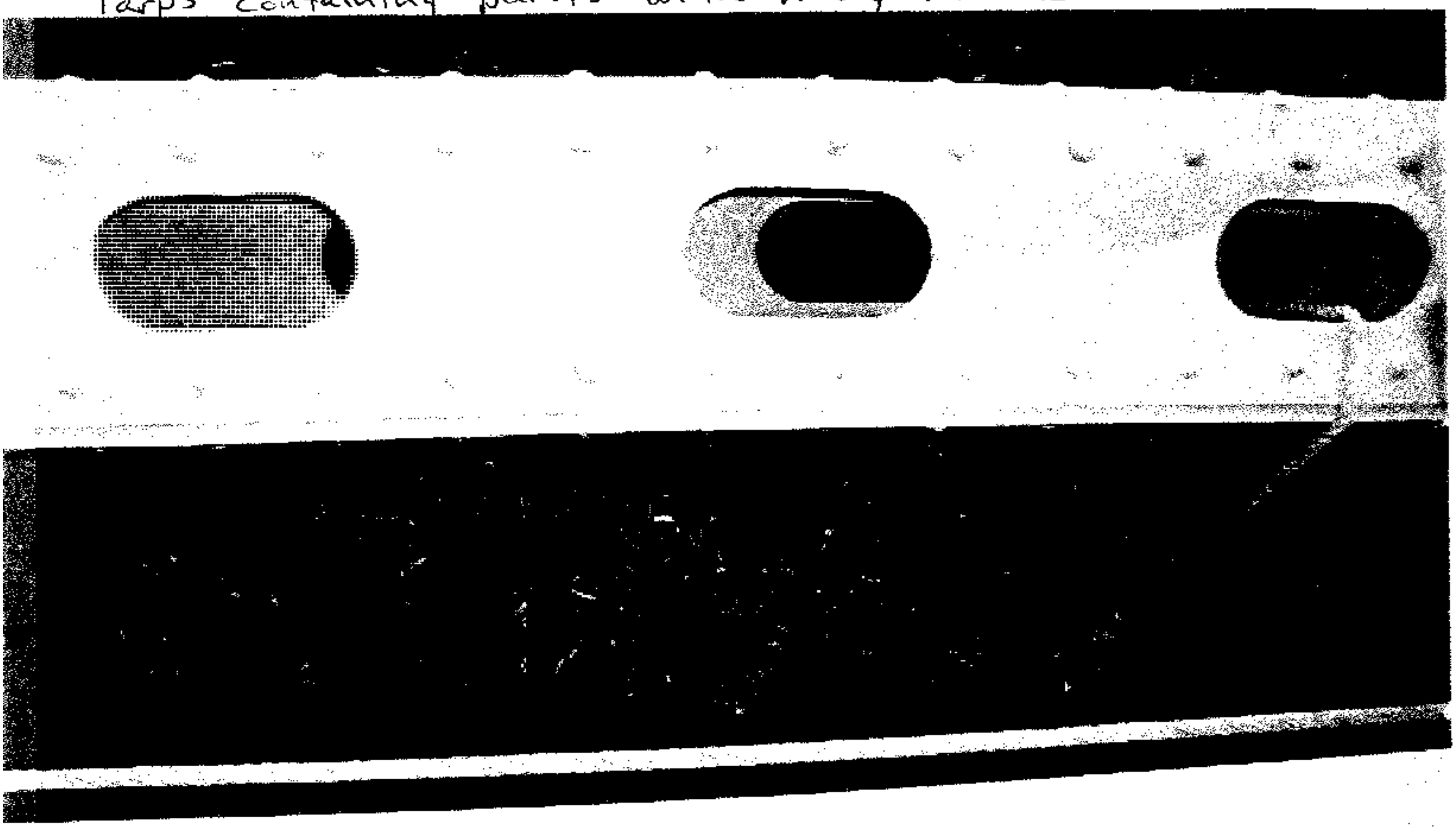


Even on rural roads and during the evening traffic / congestion
can be significant.



Containment set up - Very hazardous work

Tarps containing paints with heavy metals

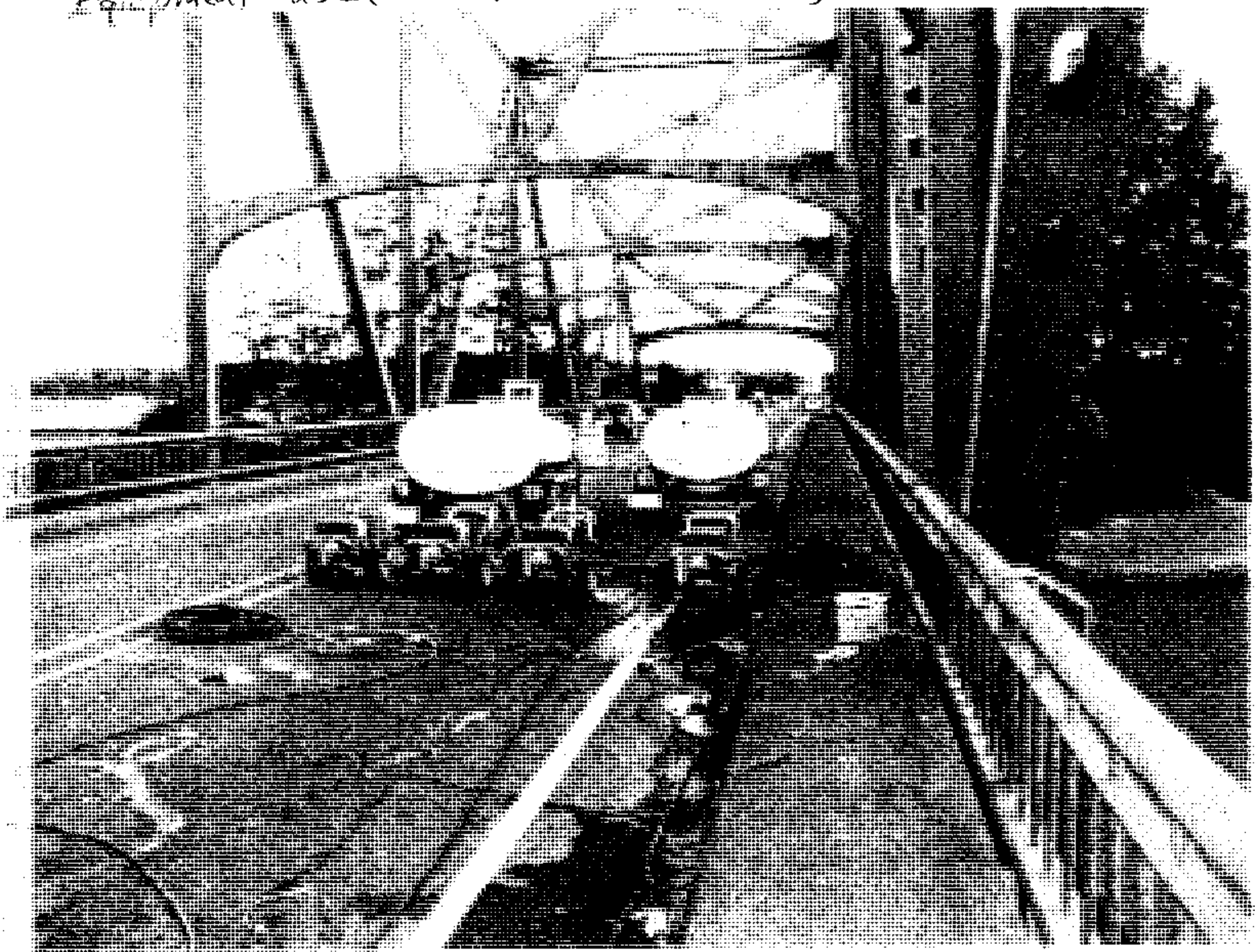


The orange color indicate leaf-shaped points in the fore

Inside containment

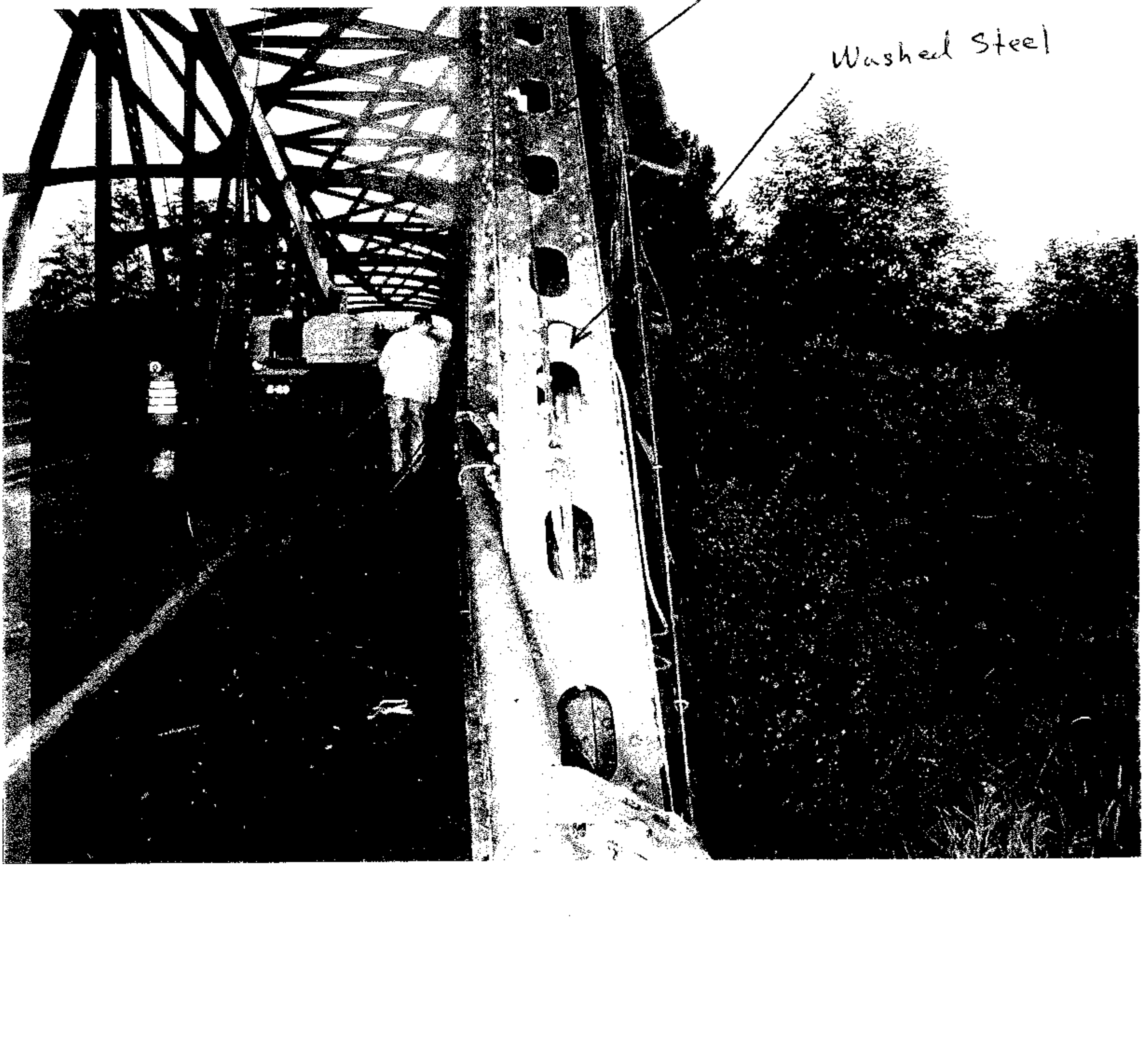
Tarps are very good a collecting all bridge debris

Equipment used for pressure washing the steel



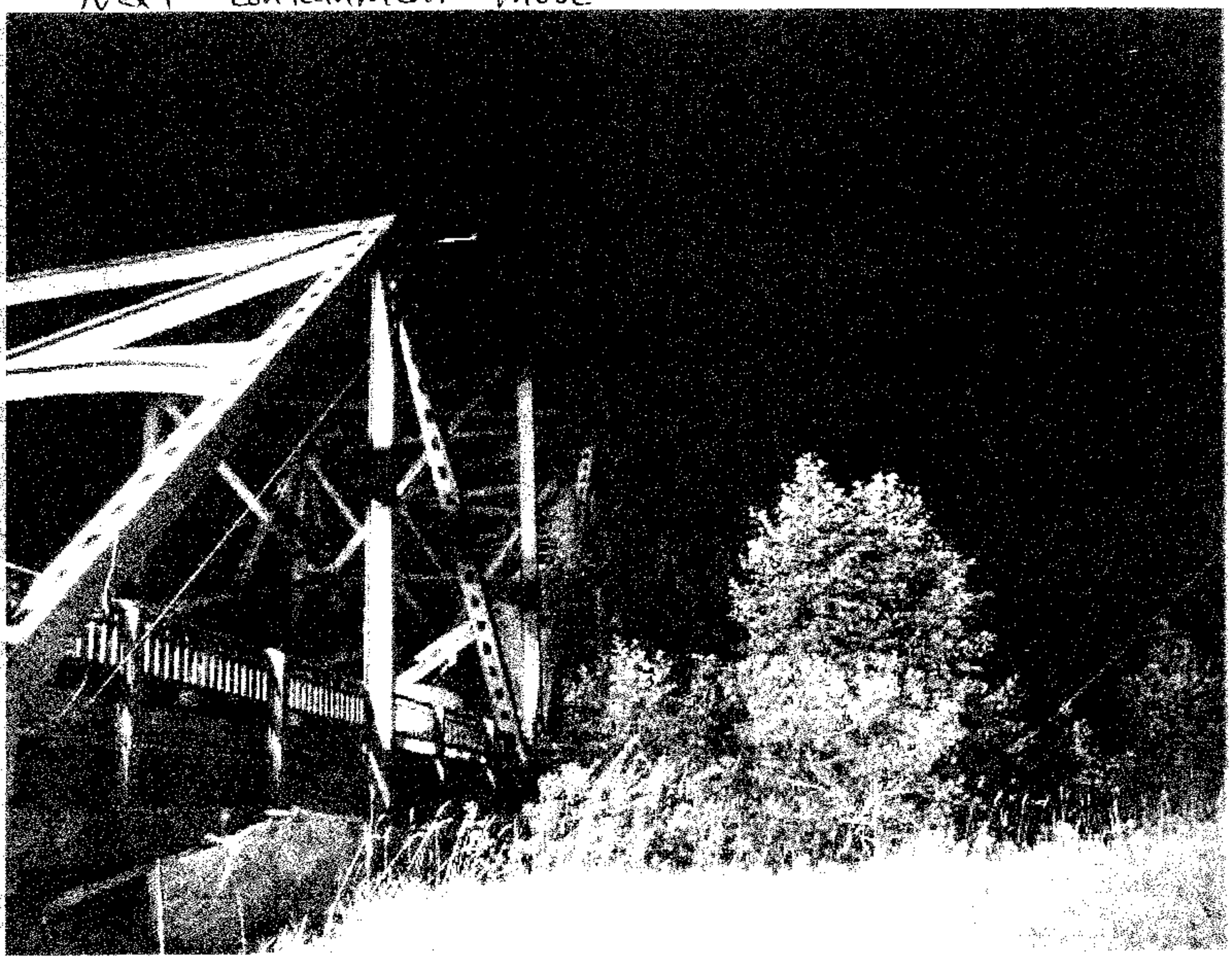
Dirty Steel

Washed Steel

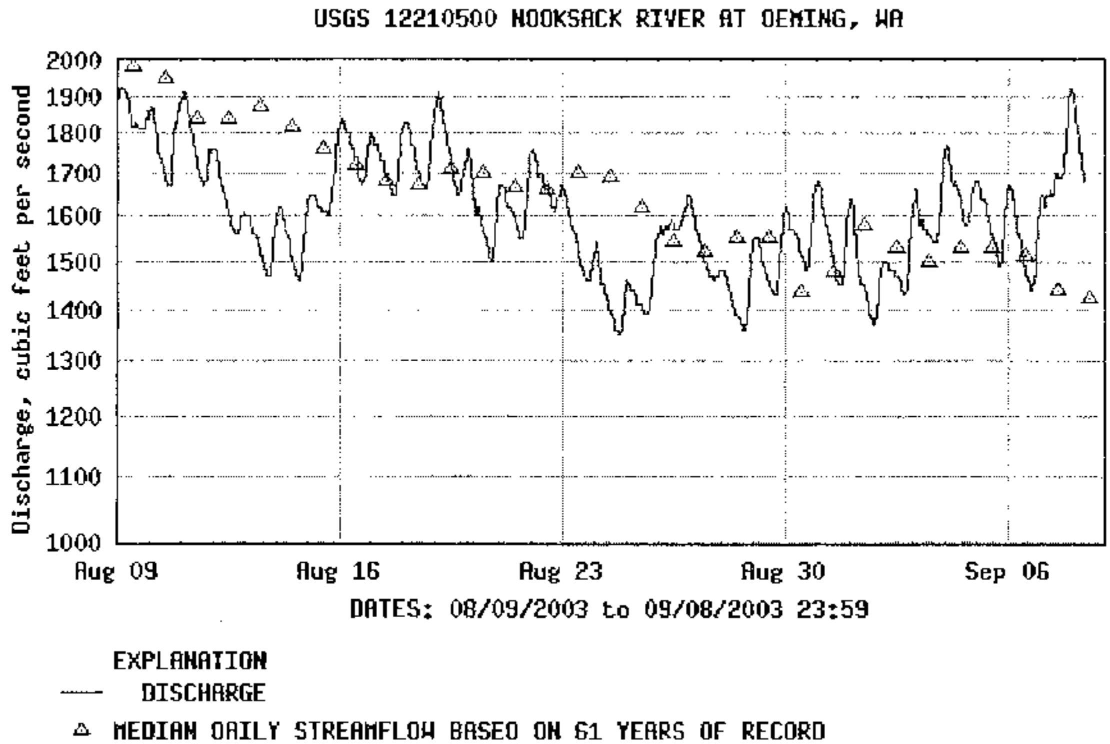


Moving containment after 1st wash

Next containment move



ATTACHMENT No. 3



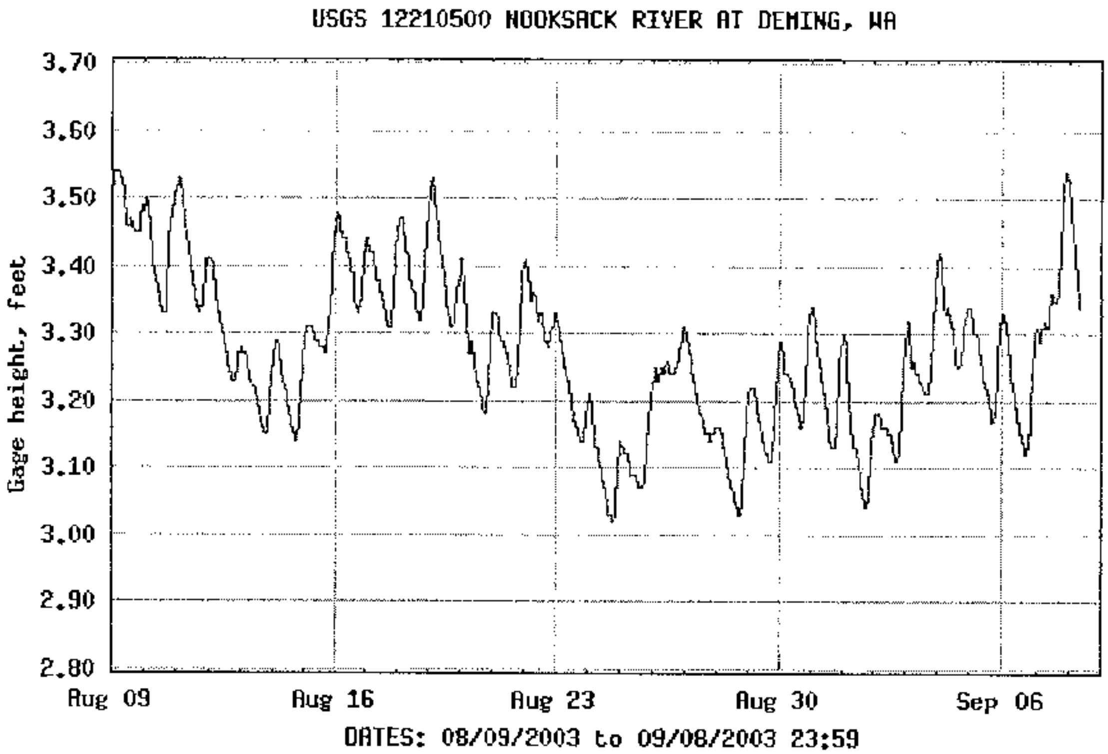
Download a presentation-quality graph Parameter Code 00060; DD 07

Daily mean flow statistics for 9/8 based on 62 years of record in ft^3/sec

Current Flow	Minimum	Mean	Maximum	80 percent exceedance	50 percent exceedance	20 percent exceedance
1,680	894	1,749	7,610	1,166	1,424	1,991
Percent exceedance means that 80, 50, or 20 percent of all daily mean flows for 9/8 have been greater than the value shown.						

Gage height, feet

Most recent value: 3.34 09-08-2003 07:45



Download a presentation-quality graph Parameter Code 00065; DD 08

Questions about data gs-w-wa_NWISWeb_Data_Inquiries@usgs.gov Top
Feedback on this websitegs-w-wa_NWISWeb_Maintainer@usgs.gov Explanation of terms
Real-time Data for Washington
http://waterdata.usgs.gov/wa/nwis/uv?

Retrieved on 2003-09-08 13:46:29 EDT
Department of the Interior, U.S. Geological Survey
USGS Water Resources of Washington
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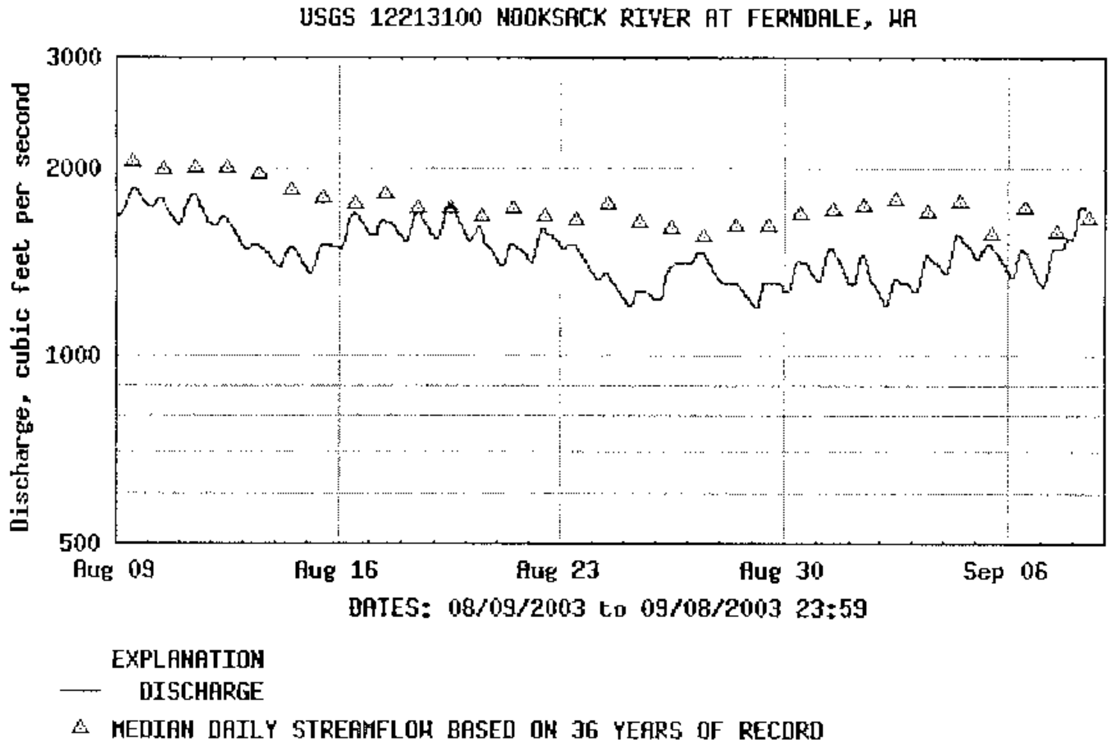
5.2 4.86



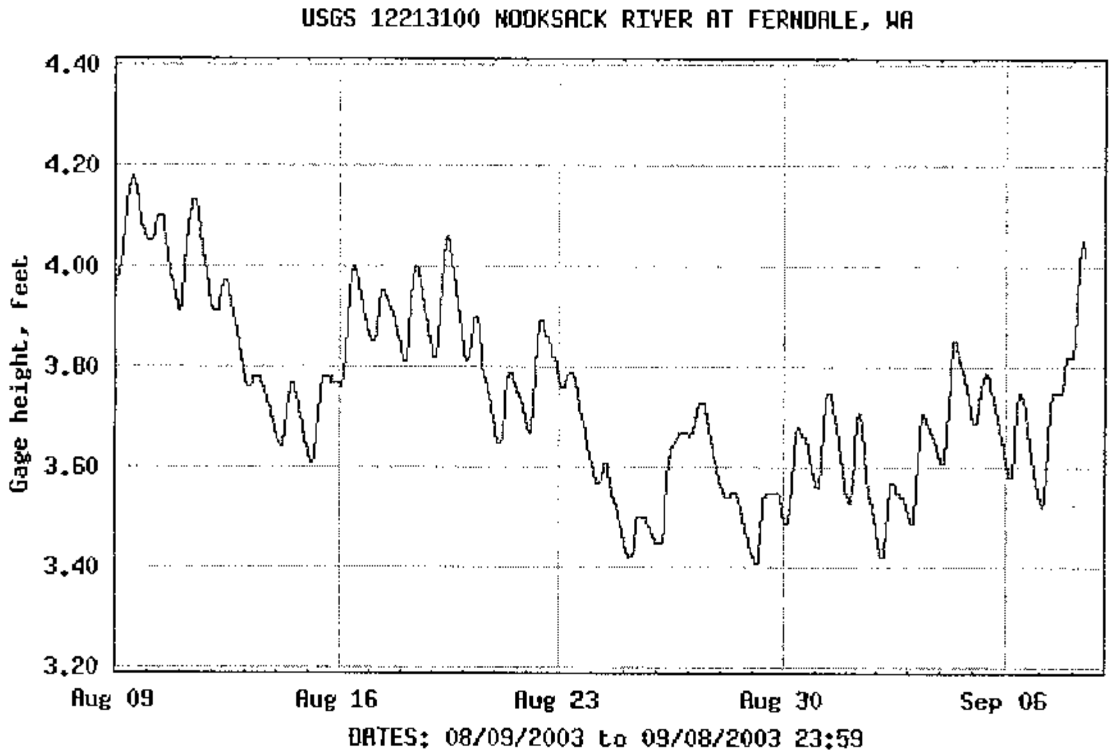
Download a presentation-quality graph Parameter Code 00060; DD 03

Daily mean flow statistics for 9/8 based on 36 years of record in ft^3/sec

Current Flow	Minimum	Mean	Maximum	80 percent exceedance	50 percent exceedance	20 percent exceedance
1,720	1,040	1,822	3,440	1,202	1,655	2,268
Percent exceedance means that 80, 50, or 20 percent of all daily mean flows for 9/8 have been greater than the value shown.						

Gage height, feet

Most recent value: 4.02 09-08-2003 09:00



Download a presentation-quality graph Parameter Code 00065; DD 04

Questions about data gs-w-wa_NWISWeb_Data_Inquiries@usgs.gov Top
Feedback on this websitegs-w-wa_NWISWeb_Maintainer@usgs.gov Explanation of terms
Real-time Data for Washington
http://waterdata.usgs.gov/wa/nwis/uv?

Retrieved on 2003-09-08 14:05:18 EDT
Department of the Interior, U.S. Geological Survey
USGS Water Resources of Washington
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14.1 5.06

ATTACHMENT No. 4

Project Nooksack River Bridge Sheet No .... of .... sheets
S. R. 539/860 Made by DRH Check by .... Date 8/17-18/03 Supv. ....

@7:50pm - Arrived on site met w/ Lloyd Chase (WSDOT) and painting contractor. Contractor had established containment tarps on west side of superstructure in south bound lane. Traffic control, flagging operation, was established for south bound lane.

Note obtained H_2O from hydrant @ [illegible]

@8:00pm - I began setting up for monitoring & sampling
@8:10pm - collect QA/QC tanker water sample - discolored "rust"
@8:15pm - Contractor began pressure washing activities
- pictures taken throughout washing
- Contractor using 3-13hp pressure washers w/ rotating nozzle tip.

@8:35pm - 1st grab sample of discharge water was collected (collected post tarp filtration and prior to env. discharge) - ~~east~~ North end of structure. Note - individual grabs at various times will be composited into a single discharge sample - will be collecting equal aliquots @ each grab sampling interval.

@8:42pm - 2nd grab collected, equal aliquot poured into composite sample containers

@9:00pm - 3rd grab - very slow discharge through tarps.

@9:00pm - contractor moving side tarps & washing superstructure over bridge deck

From ~ 9:00pm to 9:30pm, and using a 5 gallon bucket I collected "raw" water directly from the steel that was being washed above the bridge deck, Pictures.

@ 9:30pm - 4th grab of composite sample
@ 9:45pm - 5th grab of composite sample → Contractor has moved outward toward midspan minimal discharge near abutment.

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
BRIDGE & STRUCTURES BRANCH

Project .... Sheet No .... of .... sheets

S. R. .... Made by .... Check by .... Date .... Supv ....

@10:00pm - collected 6th & final grab of the composite discharge sample.
- More Picture

@10:35 pm - proceeded to River bank downstream of project site - Identified 200' downstream sampling location. Using waders to gain access to main current/flow and in relation to where discharge is happening from the structure. @10:50pm collected 200' downstream sample using "clean hands" grab "dip stake" techniques. (sample bottles submerged ~ 3-5" below surface and allowed to fill to ~ 7/8 full.
- Full washing made during downstream sampling.

@11:15pm - went ~100' upstream from the washing operation and collected background Nooksack River water samples.

@11:35pm - collected another 200' downstream sample during active pressure washing. Pictures taken.

@11:45 → proceeded to complete C-O-C & other paper work. Samples were/and remain on ice for duration of sampling & laboratory delivery.

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
BRIDGE & STRUCTURES BRANCH

Project Nooksack River Bridge Sheet No. 1 of 1 sheets
S. R. 9/15/03 Made by [illegible] Check by Date Supv

Reference 173-201A-240
Toxic Substance

Lead

$CF = 1.46203 - [\ln(\text{hardness})(0.145712)]$
$= 1.46 - [\ln(37)](0.146)$
$= 1.46 - 0.527$
$CF = 0.933$

37 mg/L - hardness of nooksack River

Acute Lead freshwater $= (CF)\left(e^{1.273[\ln(\text{hardness})] - 1.460}\right)$
$= 0.933\left(e^{1.273[\ln(37\text{ppm})] - 1.46}\right)$
$= 0.933\left(2.718^{3.13}\right)$
$\boxed{= 21.33\ \text{ug/L or } 0.0213\ \text{mg/L}}$

Lead surface water quality standard

Acute Cu freshwater $= 0.96\left(e^{(0.9422)[\ln(37)] - 1.464}\right)$
$= 0.96\left(2.718^{1.94}\right)$
$\boxed{= 6.68\ \text{ug/L or } 0.0067\ \text{mg/L}}$

Copper surface water quality standard.

Acute Zinc $= (0.978)\left(e^{(0.8473[\ln(37)] + 0.86}\right)$
$= 0.978\left(2.718^{3.92}\right)$
$\boxed{= 49.3\ \text{ug/L or } 0.0493\ \text{mg/L}}$

Zinc surface water quality standard

Acute Chromium $= (0.316)\left(e^{(6.819)[\ln 37] + 3.69}\right)$
$= 0.316\left(2.718^{6.64}\right)$
$\boxed{= 241.6\ \text{ug/L or } 0.242\ \text{mg/L}}$

Chromium surface water standard.

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
BRIDGE & STRUCTURES BRANCH

Project: Nooksack River Bridge — Sheet No. 1 of 2 sheets

S. R. ______ Made by: DRH — Check by: ______ — Date: 9/22-23/03 — Supv. ______

Notes: Total of 2200 gallon to wash south bound super structure
Note! Approximately 8000-10,000 gallons of water to wash entire structure - obtained info from contractor.

8/17/03

total wash time: $\frac{2200\,gal}{480\,min} = \boxed{4.58\,gpm}$ $\qquad \frac{4.58\,gpm}{3\text{ pressure washers}} = \boxed{1.53\,gpm/\text{pressure washer}}$

Calcs for dissolved metals

Formula

$$Cr\ 0.023\,mg/L \times \frac{1L}{0.26\,gal} \times \frac{kg}{1\times10^6\,mg} \times \frac{2.21\,lb}{kg} \times \frac{10{,}000\,gal}{\text{bridge wash}} = \boxed{\frac{0.0019\,lb\text{ dissolved Chromium}}{\text{bridge wash}}}$$

$$\boxed{Cu = \frac{0.005\,lb\text{ dissolved copper}}{\text{entire bridge wash}}}$$

~~pb dsb 0.077~~ $\boxed{Pb = \frac{0.0066\,lb\text{ diss pb}}{\text{entire bridge wash}}}$

$$\boxed{Zn = 0.0867\,lb\text{ dissolved zinc}/\text{entire bridge wash}}$$

TSS calcs

$$= 184\,mg/L\ TSS \times \frac{1L}{0.26\,gal} \times \frac{kg}{1\times10^6\,mg} \times \frac{2.21\,lb}{kg} \times \frac{10000\,gal}{\text{bridge wash}}$$

$$\boxed{= \frac{15.6\,lb\ TSS}{\text{bridge wash}}}$$

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
BRIDGE & STRUCTURES BRANCH

Project .... Sheet No. 2 of 2 sheets
S. R. .... Made by dh Check by .... Date 9/22-23/03 Supv ....

Total Lead = 1.2 mg/L in discharge

$$1.2\,mg/L\ \text{Lead} \times \frac{1L}{0.26\,gal} \times \frac{Kg}{1\times10^6\,mg} \times \frac{2.2\,lb}{Kg} \times \begin{cases} \frac{10{,}000\,gal}{\text{bridge wash}} = \boxed{0.102\,lb\ \frac{\text{lead}}{\text{bridge wash}}} \\ \frac{2{,}200}{\text{wash event}} = \boxed{0.022\,lb\ \frac{\text{lead}}{\text{wash event}}} \end{cases}$$

Total Zinc = 1.6 mg/L

$$\frac{1.6\,mg\ Zn}{L} \times \frac{1L}{0.26\,ga} \times \frac{Kg}{1\times10^6\,mg} \times \frac{2.2\,lb}{Kg} \times \begin{cases} \frac{16{,}000\,gal}{\text{bridge wash}} = \boxed{0.136\,lb\ \frac{\text{Zinc}}{\text{bridge wash}}} \\ \frac{2{,}200}{\text{wash event}} = \boxed{\cancel{0.299}\ 0.0299\,lb\ \frac{\text{zinc}}{\text{bridge event}}} \end{cases}$$

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Sheet No.

APPENDIX C

Summary Tables for River Water Quality Impact Analysis

Table C-1: Water quality impact analysis results for bridges washing operations over streams: Eastern Washington, total recoverable metals, acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	2	3	3	3
Maximum Total Recoverable Metal Conc. (mg/L)[b]:	0.993	2.05	10.5	4.47
Translator[c]:	1	0.996	0.466	0.996
Multiplier[d]:	3.79	3.00	3.00	3.00
Worst-Case Dissolved Metal Conc. (mg/L):	3.76	6.13	14.68	13.36

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[e]:	20	20	20	20
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[e]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards				
	Cr	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[f]:	0.1469	0.0037	0.0108	0.0293

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
42	26	**0.149**	**0.235**	**0.561**	**0.515**
895	558	0.012	**0.012**	**0.027**	**0.029**
2,340	1459	0.008	**0.006**	**0.011**	0.014
4,261	2656	0.006	**0.004**	0.006	0.010

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.

[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.

[c] Translator values for converting total recoverable metal concentrations to dissolved metal concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.

[d] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).

[e] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.

[f] Acute water quality standards from WAC 173 201A; see Table 4.

Table C-2: Water quality impact analysis results for bridges washing operations over streams: Western Washington, total recoverable metals, acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	2	3	3	3
Maximum Total Recoverable Metal Conc. (mg/L)[b]:	0.993	2.05	10.5	4.47
Translator[c]:	1	0.996	0.466	0.996
Multiplier[d]:	3.79	3.00	3.00	3.00
Worst-Case Dissolved Metal Conc. (mg/L):	3.76	6.13	14.68	13.36

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[e]:	14	14	14	14
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[e]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards				
	Cr	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[f]:	0.1097	0.0027	0.0072	0.0216

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
57	36	**0.111**	**0.174**	**0.414**	**0.381**
1,314	819	0.010	**0.009**	**0.019**	**0.022**
3,639	2268	0.007	**0.004**	**0.007**	0.011
7,928	4942	0.006	**0.003**	0.004	0.008

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.

[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.

[c] Translator values for converting total recoverable metal concentrations to dissolved metal concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.

[d] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).

[e] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.

[f] Acute water quality standards from WAC 173 201A; see Table 4.

Table C-3: Water quality impact analysis results for bridges washing operations over streams: Eastern Washington, dissolved metals, acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	5	5	5	5
Maximum Dissolved Metal Conc. (mg/L)[b]:	0.023	0.178	0.130	2.10
Multiplier[c]:	2.32	2.32	2.32	2.32
Worst-Case Dissolved Metal Conc. (mg/L):	0.053	0.413	0.302	4.87

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[d]:	20	20	20	20
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[d]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards	**Cr**	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[e]:	0.1469	0.0037	0.0108	0.0293

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
0.5	0.3	**0.158**	**1.322**	**0.966**	**15.619**
47	29	0.007	**0.015**	**0.011**	**0.171**
286	178	0.005	**0.004**	0.002	**0.033**
326	203	0.005	0.003	0.002	**0.029**

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.

[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.

[c] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).

[d] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.

[e] Acute water quality standards from WAC 173 201A; see Table 4.

Table C-4: Water quality impact analysis results for bridges washing operations over streams: Western Washington, dissolved metals, acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	5	5	5	5
Maximum Dissolved Metal Conc. (mg/L)[b]:	0.023	0.178	0.130	2.10
Multiplier[c]:	2.32	2.32	2.32	2.32
Worst-Case Dissolved Metal Conc. (mg/L):	0.053	0.413	0.302	4.87

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[d]:	14	14	14	14
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[d]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards				
	Cr	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[e]:	0.1097	0.0027	0.0072	0.0216

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
0.7	0.4	**0.114**	**0.945**	**0.690**	**11.158**
74	46	0.006	**0.010**	**0.007**	**0.111**
479	299	0.005	**0.003**	0.002	**0.022**
532	332	0.005	**0.003**	0.002	0.020

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.
[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.
[c] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).
[d] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.
[e] Acute water quality standards from WAC 173 201A; see Table 4.

Table C-5: Water quality impact analysis results for bridges washing operations over streams: Eastern Washington, total recoverable metals, WER adjusted acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	2	3	3	3
Maximum Total Recoverable Metal Conc. (mg/L)[b]:	0.993	2.05	10.5	4.47
Translator[c]:	1	0.996	0.466	0.996
Multiplier[d]:	3.79	3.00	3.00	3.00
Worst-Case Dissolved Metal Conc. (mg/L):	3.76	6.13	14.68	13.36

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[e]:	20	20	20	20
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[e]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards	**Cr**	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[f]:	0.1469	0.0037	0.0108	0.0293
WER[g]:	1.95	2.92	3.78	1.41
WER adjusted Acute Water Quality Standard[h]:	0.2864	0.0109	0.0408	0.0413

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
21	13	**0.292**	**0.469**	**1.122**	**1.025**
587	366	0.015	**0.018**	**0.041**	**0.042**
596	372	0.015	**0.018**	0.040	**0.041**
1,036	646	0.011	**0.011**	0.023	0.026

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.

[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.

[c] Translator values for converting total recoverable metal concentrations to dissolved metal concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.

[d] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).

[e] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.

[f] Acute water quality standards from WAC 173 201A; see Table 4.

[g] WERs derived from Dunbar (1997) and U.S. EPA (1992).

[h] Adjusted acute water quality standard = acute water quality standard x WER.

Table C-6: Water quality impact analysis results for bridges washing operations over streams: Eastern Washington, total recoverable metals, WER adjusted acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	2	3	3	3
Maximum Total Recoverable Metal Conc. (mg/L)[b]:	0.993	2.05	10.5	4.47
Translator[c]:	1	0.996	0.466	0.996
Multiplier[d]:	3.79	3.00	3.00	3.00
Worst-Case Dissolved Metal Conc. (mg/L):	3.76	6.13	14.68	13.36

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[e]:	14	14	14	14
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[e]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards				
	Cr	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[f]:	0.1097	0.0027	0.0072	0.0216
WER[g]:	1.95	2.92	3.78	1.41
WER adjusted Acute Water Quality Standard[h]:	0.2138	0.0078	0.0272	0.0305

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
28	17	**0.220**	**0.352**	**0.842**	**0.770**
851	530	0.012	**0.013**	**0.028**	**0.031**
888	554	0.012	**0.012**	**0.027**	0.029
1,543	962	0.009	**0.008**	0.016	0.019

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.

[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.

[c] Translator values for converting total recoverable metal concentrations to dissolved metal concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.

[d] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).

[e] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.

[f] Acute water quality standards from WAC 173 201A; see Table 4.

[g] WERs derived from Dunbar (1997) and U.S. EPA (1992).

[h] Adjusted acute water quality standard = acute water quality standard x WER.

Table C-7: Water quality impact analysis results for bridges washing operations over streams: Eastern Washington, dissolved metals, WER adjusted acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	5	5	5	5
Maximum Dissolved Metal Conc. (mg/L)[b]:	0.023	0.178	0.130	2.10
Multiplier[c]:	2.32	2.32	2.32	2.32
Worst-Case Dissolved Metal Conc. (mg/L):	0.053	0.413	0.302	4.87

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[d]:	20	20	20	20
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[d]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards				
	Cr	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[f]:	0.1469	0.0037	0.0108	0.0293
WER[g]:	1.95	2.92	3.78	1.41
WER adjusted Acute Water Quality Standard[h]:	0.2864	0.0109	0.0408	0.0413

Impact Analysis - Total dissolved metals concentrations by stream discharge rate

Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
0.2	0.1	**0.387**	**3.302**	**2.414**	**39.040**
12	7	0.011	**0.056**	**0.041**	**0.656**
69	43	0.006	**0.011**	0.008	**0.118**
217	135	0.005	0.004	0.003	**0.041**

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.
[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.
[c] Translator values for converting total recoverable metal concentrations to dissolved metal concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.
[d] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).
[e] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.
[f] Acute water quality standards from WAC 173 201A; see Table 4.
[g] WERs derived from Dunbar (1997) and U.S. EPA (1992).
[h] Adjusted acute water quality standard = acute water quality standard x WER.

Table C-8: Water quality impact analysis results for bridges washing operations over streams: Western Washington, dissolved metals, WER adjusted acute water quality standards.

Effluent Characteristics				
No. Pressure Washers[a]:	6	6	6	6
Effluent Discharge per Washer (gal/min)[a]:	3	3	3	3
Total Effluent Discharge (gal/min):	18	18	18	18
Total Effluent Discharge (cfs):	0.040	0.040	0.040	0.040
	Cr	**Cu**	**Pb**	**Zn**
Sample Size[b]:	5	5	5	5
Maximum Dissolved Metal Conc. (mg/L)[b]:	0.023	0.178	0.130	2.10
Multiplier[c]:	2.32	2.32	2.32	2.32
Worst-Case Dissolved Metal Conc. (mg/L):	0.053	0.413	0.302	4.87

Stream Characteristics				
Stream Hardness (mg/L as $CaCO_3$)[d]:	14	14	14	14
	Cr	**Cu**	**Pb**	**Zn**
Stream Dissolved Metal Conc. (mg/L)[d]:	0.0050	0.0014	0.0007	0.0053

Water Quality Standards				
	Cr	**Cu**	**Pb**	**Zn**
Acute Water Quality Standard (mg/L)[f]:	0.1097	0.0027	0.0072	0.0216
WER[g]:	1.95	2.92	3.78	1.41
WER adjusted Acute Water Quality Standard[h]:	0.2138	0.0078	0.0272	0.0305

Impact Analysis - Total dissolved metals concentrations by stream discharge rate					
Stream Discharge (cfs)	Dillution Factor	Cr (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
0.3	0.2	**0.260**	**2.2020**	**1.610**	**26.028**
18	11	0.009	**0.038**	**0.028**	**0.439**
103	64	0.006	**0.008**	0.005	**0.081**
310	193	0.005	0.004	0.002	**0.031**

[a] Data Source: WSDOT (2001, 2002b, 2002c,); see Table 1.

[b] Data Source: WSDOT (2001, 2002b, 2002c, 2003); see Table 2.

[c] Translator values for converting total recoverable metal concentrations to dissolved metal concentrations were obtained from Pelletier (1996). A translator is not required for the tri-valent form of Cr.

[d] Multipliers were calculated based on guidance from the Permit Writers Manual, Ecology (2002).

[e] Data source: Queries of the Environmental Information Management (Ecology 2003b) and STORET (EPA 2003) database systems; see Table 3.

[f] Acute water quality standards from WAC 173 201A; see Table 4.

[g] WERs derived from Dunbar (1997) and U.S. EPA (1992).

[h] Adjusted acute water quality standard = acute water quality standard x WER.

APPENDIX D

Supporting Documentation for the Determination of Hypothetical Water-Effect Ratios

Table D1. Acceptable water-effect ratios for based on a Synopsis of Effect-Ratios for Heavy Metals as derived for Site Specific Water Quality Criteria (U.S. EPA 1992).

Site	Species	LC50, EC50(mg/L)	Water Type	WER	Source of Laboratory Water
		Zinc			
Norwalk River, CT	Rainbow trout	1.50 1.00	Site Lab	1.5	Reconstituted
Norwalk River CT	*Daphnia magna*	0.91 0.40	Site Lab	2.3	Reconstituted
Boggy Creek, OK	Caddisfly	683 562	Site Lab	1.2[a]	Reconstituted
St. Louis River, MN	Fathead minnow	0.26 0.40	Site Lab	0.65[a]	Dechlorinated tap
St. Louis River, MN	Rainbow trout	0.26 0.24	Site Lab	1.1[a]	Dechlorinated tap
St. Louis River	*Daphnia magna*	0.47 0.16	Site Lab	2.9	Dechlorinated tap
St. Louis River	Amphipod	0.28 0.33	Site Lab	0.85[a]	Dechlorinated tap
Naugatuck River, CT	Fathead minnow	0.39 0.55	Site Lab	0.71[a]	Lake Superior
Naugatuck River, CT	*Ceriodaphnia dubia*	0.16 0.18	Site Lab	0.89[a]	Lake Superior
				Average: 1.34	
		Chromium			
Boggy Creek, OK	Caddisfly	0.31 0.26	Site Lab	1.2	Reconstituted
Leon Creek, TX	Amphipod	0.698 0.256	Site Lab	2.7	Reconstituted
				Average: 1.95	
		Lead			
St. Louis River, MN	Fathead minnow	5.20 2.70	Site Lab	1.9	Dechlorinated tap
St. Louis River, MN	Rainbow trout	2.00 0.58	Site Lab	3.4	Dechlorinated tap
St. Louis River, MN	*Daphnia magna*	2.10 0.37	Site Lab	5.7	Dechlorinated tap
St. Louis River, MN	Amphipod	0.90 0.22	Site Lab	4.1	Dechlorinated tap
				Average: 3.78	

[a] LC50/EC50 values not were not significantly different. Per U.S. EPA guidelines, the WER values were treated as 1.0.

APPENDIX E

7Q10 Low Flow Values From Selected Rivers in Western Washington

Table E1. Compilation of 7Q10 low flow discharge rates for selected rivers in Western Washington.

Station Location	Station No.	7Q10 Low Flow (cfs)	Data Source
Skagit River near Mount Vernon, WA	12200500	4730.3	USGS 1985b
Skagit River near Sedro Woolley, WA	12199000	3640.5	USGS 1985b
Skagit River near Concrete, WA	12194000	3601.2	USGS 1985b
Skagit River above Alma Creek near Marblemount, WA	12179000	1674.6	USGS 1985b
Snohomish River near Monroe, WA	12150800	1299.3	USGS 1985b
Skagit River at Newhalem, WA	12178000	1101.0	USGS 1985b
Nooksack River at Ferndale, WA	12213100	856.0	USGS 1985b
Sauk River near Sauk, WA	12189500	834.6	USGS 1985b
Nooksack River near Lynden, WA	12211500	797.7	USGS 1985b
Nooksack River at Deming, WA	12210500	687.9	USGS 1985b
Suiattle River near Mansford, WA	12189000	474.3	USGS 1985b
Skykomish River near Gold Bar, WA	12134500	472.9	USGS 1985b
Snoqualmie River near Carnation, WA	12149000	442.4	USGS 1985b
Skagit River below Ruby Creek; near Newhalem, WA	12174500	426.9	USGS 1985b
N.F. Nooksack River near Deming, WA	12207200	424.9	USGS 1985b
Skagit River near Newhalem, WA	12172500	410.0	USGS 1985b
Snoqualmie River near Snoqualmie, WA	12144500	385.9	USGS 1985b
Baker River below Anderson Creek near Concrete, WA	12191500	363.0	USGS 1985b
Sauk River at Darrington, WA	12187500	318.1	USGS 1985b
South Fork Skykomish River near Index, WA	12133000	286.4	USGS 1985b
Baker River at Concrete, WA	12193500	234.2	USGS 1985b
Cedar River near Landsburg, WA	12111500	199.3	USGS 1985b
Cascade River at Marblemount, WA	12182500	186.3	USGS 1985b
North Fork Stillaguamish River near Arlington, WA	12167000	180.9	USGS 1985b
Sauk River above Whitechuck River near Darrington, WA	12186000	160.1	USGS 1985b
Middle Fork Snoqualmie River near Tanner, WA	12141300	148.2	USGS 1985b
Middle Fork Snoqualmie River near North Bend, WA	12141500	130.9	USGS 1985b
South Fork Stillaguamish River about Jim Creek; near Arlington, WA	12162500	115.6	USGS 1985b
North Fork Skykomish River at Index, WA	12134000	104.7	USGS 1985b
South Fork Stillaguamish River near Granite Falls, WA	12161000	81.2	USGS 1985b
South Fork Snoqaulmie River at North Bend, WA	12144000	77.8	USGS 1985b
S.F. Nooksack River near Wickersham, WA	12209000	76.3	USGS 1985b
Thunder Creek near Newhalem, WA	12175500	71.9	USGS 1985b
Tolt River near Carnation, WA	12148500	70.6	USGS 1985b
Big Beaver Creek near Newhalem, WA	12172000	69.9	USGS 1985b
Sammamish River at Bothell, WA	12126500	69.1	USGS 1985b
Ruby Creek near Newhalem, WA	12174000	67.8	USGS 1985b
Ruby Creek below Panther Creek; near Newhalem, WA	12173500	67.2	USGS 1985b
Thunder Creek near Marblemount, WA	12176000	66.1	USGS 1985b
North Fork Snoqualmie River near North Bend, WA	12143000	58.9	USGS 1985b
Sultan River near Startup, WA	12137500	56.7	USGS 1985b
Cedar River near Renton, WA	12118500	50.6	USGS 1985b
Sammamish River near Redmond, WA	12125000	49.6	USGS 1985b
North Fork Tolt River near Carnation, WA	12147500	48.0	USGS 1985b
North Fork Snoqualmie River near Snoqualmie, WA	12142000	41.3	USGS 1985b
Sammamish River near Woodinville, WA	12125200	40.7	USGS 1985b
Pilchuck River near Granite Falls, WA	12152500	30.3	USGS 1985b
South Fork Snoqualmie River about Alice Creek; near Garcia, WA	12143400	29.0	USGS 1985b

Table E1. Compilation of 7Q10 low flow discharge rates for selected rivers in Western Washington.

Station Location	Station No.	7Q10 Low Flow (cfs)	Data Source
Newhalem Creek near Newhalem, WA	12178100	28.8	USGS 1985b
Cedar River near Cedar Falls, WA	12114500	25.3	USGS 1985b
Issaquah Creek near mouth; near Issaquah, WA	12121600	21.9	USGS 1985b
Dear Creek near Oso, WA	12166500	21.3	USGS 1985b
Samish River near Burlington, WA	12201500	19.9	USGS 1985b
Stetattle Creek near Newhalem, WA	12177500	19.2	USGS 1985b
Skookum Creek near Wickersham, WA	12209500	18.7	USGS 1985b
Taylor Creek near Selleck, WA	12117000	17.7	USGS 1985b
Cedar River below Bear Creek; near Cedar Falls, WA	12114500	16.1	USGS 1985b
Sulphur Creek near Concrete, WA	12191800	16.1	USGS 1985b
Cedar River near Cedar Falls, WA	12116500	15.5	USGS 1985b
South Fork Tolt River near Carnation, WA	12148000	15.4	USGS 1985b
Woods Creek near Monroe, WA	12141000	13.7	USGS 1985b
Squire Creek near Darrington, WA	12165000	13.0	USGS 1985b
Issaquah Creek near Issaquah, WA	12120500	12.1	USGS 1985b
Troublesome Creek near Index, WA	12133500	11.7	USGS 1985b
Wallace River near Gold Bar, WA	12135000	10.1	USGS 1985b
Day Creek near Lyman, WA	12196500	9.9	USGS 1985b
Raging River near Fall City, WA	12145500	7.8	USGS 1985b
Patterson Creek near Fall City, WA	12146000	7.5	USGS 1985b
Jim Creek near Arlington, WA	12164000	7.5	USGS 1985b
North Fork Cedar River near Lester, WA	12113500	7.3	USGS 1985b
Alder Creek near Hamilton, WA	12196000	6.3	USGS 1985b
Rex River near Cedar Falls, WA	12115500	5.9	USGS 1985b
Evans Creek (above mouth) near Redmond, WA	12124000	5.4	USGS 1985b
North Creek near Bothell, WA	12126000	5.4	USGS 1985b
Cottage Lake Creek near Redmond, WA	12123000	4.1	USGS 1985b
Mercer Creek near Bellevue, WA	12119700	3.7	USGS 1985b
Swamp Creek at Kenmore, WA	12127100	3.2	USGS 1985b
Quilceda Creek near Marysville, WA	12157000	3.2	USGS 1985b
South Fork Tolt River near Index, WA	12147600	2.8	USGS 1985b
South Fork Cedar River near Lester, WA	12114000	2.6	USGS 1985b
Fishtap Creek at Lynden, WA	12212000	2.4	USGS 1985b
Juanita Creek near Kirkland, WA	12120500	2.2	USGS 1985b
Griffin Creek near Carnation, WA	12147000	1.9	USGS 1985b
Pilchuck Creek near Bryant, WA	12168500	1.9	USGS 1985b
Whatcom Creek below Hatchery near Bellingham, WA	12203500	1.9	USGS 1985b
Rock Creek near Maple Valley, WA	12118500	1.7	USGS 1985b
S.F. Cascade River at So. Cascade Gl. near Marblemount, WA	12181100	0.9	USGS 1985b
Little Pilchuck Creek near Lake Stevens, WA	12153000	0.7	USGS 1985b
East Fork Nookachamps Creek near Big Lake, WA	12199800	0.4	USGS 1985b
Canyon Creek near Cedar Falls, WA	12116100	0.3	USGS 1985b
Boxley Creek near Cedar Falls, WA	12143700	0.2	USGS 1985b
Salix Creek at So. Cascade Gl. Near Marblemount, WA	12181200	0.0	USGS 1985b

APPENDIX F

CORMIX Input Parameters and Results for Marine Water Quality Impact Analysis

Table F1. CORMIX2 marine bridge copper model runs: input parameters and results.

	Input - Ambient Data						Input - Effluent Data			Input - Discharge Data											Input - Mixing Zone Data			Output
Run	Average Depth	Discharge Depth	Velocity	Wind Speed	Friction Factor	Density	Flow Rate	Density	Concentration[1]	Distance to Bank	Diffuser Length	Port Height	Port Diameter	Alignment Angle	Horizontal Angle	Vertical Angle	Relative Orientation	Contraction Ratio	Number of Openings	Nozzle Direction	WQ Standard[1]	WQ Standard with WER[1]	MZ Distance	Conc. at MZ[1]
	m	m	m/s	m/s	--	kg/m^3	m^3/s	kg/m^3	mg/L	m	m	m	m	deg	deg	deg	deg	--	--	--	mg/L	mg/L	m	mg/L
Total Copper Model Runs																								
TCu1	2	2	0.025	2	0.025	1024	0.000189	1049	5.0976	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0477**
TCu2	2	2	*0.01*	2	0.025	1024	0.000189	1049	5.0976	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0407**
TCu3	2	2	*0.1*	2	0.025	1024	0.000189	1049	5.0976	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0128**
TCu4	2	2	0.025	2	0.025	1024	0.000189	1049	5.0976	10	2	0	*0.00108*	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0356**
TCu5	2	2	0.025	2	0.025	1024	0.000189	1049	5.0976	*0*	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0518**
TCu6	*1*	*1*	0.025	2	0.025	1024	0.000189	1049	5.0976	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0144**
TCu7	2	2	0.025	*0*	0.025	1024	0.000189	1049	5.0976	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0484**
TCu8	2	2	0.025	2	*0.02*	1024	0.000189	1049	5.0976	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0476**
Dissolved Copper Model Runs																								
DCu1	2	2	0.025	2	0.025	1024	0.000189	1049	0.4108	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0038**
DCu2	2	2	*0.01*	2	0.025	1024	0.000189	1049	0.4108	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0033**
DCu3	2	2	*0.1*	2	0.025	1024	0.000189	1049	0.4108	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	0.0010
DCu4	2	2	0.025	2	0.025	1024	0.000189	1049	0.4108	10	2	0	*0.00108*	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0029**
DCu5	2	2	0.025	2	0.025	1024	0.000189	1049	0.4108	*0*	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0042**
DCu6	*1*	*1*	0.025	2	0.025	1024	0.000189	1049	0.4108	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	0.0012
DCu7	2	2	0.025	*0*	0.025	1024	0.000189	1049	0.4108	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0039**
DCu8	2	2	0.025	2	*0.02*	1024	0.000189	1049	0.4108	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0026	0.007813	6.1	**0.0038**

[1] The background pollutant concentration is subtracted from effluent concentrations and water quality standard values for the purposes of CORMIX analysis.
These values will therefore vary from actual concentrations by the value of the background concentration.

Italicized values represent variations for sensitivity analysis

Boldface values represent exceedences of the acute water quality standard (not including WER adjustment)

Table F2. CORMIX2 marine bridge lead model runs: input parameters and results.

	Input - Ambient Data						Input - Effluent Data			Input - Discharge Data											Input - Mixing Zone Data			Output
Run	Average Depth	Discharge Depth	Velocity	Wind Speed	Friction Factor	Density	Flow Rate	Density	Concentration[1]	Distance to Bank	Diffuser Length	Port Height	Port Diameter	Alignment Angle	Horizontal Angle	Vertical Angle	Relative Orientation	Contraction Ratio	Number of Openings	Nozzle Direction	WQ Standard[1]	WQ Standard with WER[1]	MZ Distance	Conc. at MZ[1]
	m	m	m/s	m/s	--	kg/m^3	m^3/s	kg/m^3	mg/L	m	m	m	m	deg	deg	deg	deg	--	--	--	mg/L	mg/L	m	mg/L
Total Lead Model Runs																								
TPb1	2	2	0.025	2	0.025	1024	0.000189	1049	29.950	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	**0.2804**
TPb2	2	2	*0.01*	2	0.025	1024	0.000189	1049	29.950	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	**0.2389**
TPb3	2	2	*0.1*	2	0.025	1024	0.000189	1049	29.950	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0723
TPb4	2	2	0.025	2	0.025	1024	0.000189	1049	29.950	10	2	0	*0.00108*	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	**0.2093**
TPb5	2	2	0.025	2	0.025	1024	0.000189	1049	29.950	*0*	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	**0.3046**
TPb6	*1*	*1*	0.025	2	0.025	1024	0.000189	1049	29.950	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0848
TPb7	2	2	0.025	*0*	0.025	1024	0.000189	1049	29.950	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	**0.2841**
TPb8	2	2	0.025	2	*0.02*	1024	0.000189	1049	29.950	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	**0.2797**
Dissolved Lead Model Runs																								
DPb1	2	2	0.025	2	0.025	1024	0.000189	1049	0.292	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0027
DPb2	2	2	*0.01*	2	0.025	1024	0.000189	1049	0.292	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0023
DPb3	2	2	*0.1*	2	0.025	1024	0.000189	1049	0.292	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0007
DPb4	2	2	0.025	2	0.025	1024	0.000189	1049	0.292	10	2	0	*0.00108*	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0020
DPb5	2	2	0.025	2	0.025	1024	0.000189	1049	0.292	*0*	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0030
DPb6	*1*	*1*	0.025	2	0.025	1024	0.000189	1049	0.292	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0008
DPb7	2	2	0.025	*0*	0.025	1024	0.000189	1049	0.292	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0028
DPb8	2	2	0.025	2	*0.02*	1024	0.000189	1049	0.292	10	2	0	0.00125	90	0	90	90	1	23	Same	0.2000	n.a.	6.1	0.0027

[1] The background pollutant concentration is subtracted from effluent concentrations and water quality standard values for the purposes of CORMIX analysis. These values will therefore vary from actual concentrations by the value of the background concentration.

Italicized values represent variations for sensitivity analysis.

Boldface values represent exceedences of the acute water quality standard.

Table F3. CORMIX2 marine bridge zinc model runs: input parameters and results.

Run	Input - Ambient Data						Input - Effluent Data			Input - Discharge Data											Input - Mixing Zone Data			Output
	Average Depth	Discharge Depth	Velocity	Wind Speed	Friction Factor	Density	Flow Rate	Density	Concentration[1]	Distance to Bank	Diffuser Length	Port Height	Port Diameter	Alignment Angle	Horizontal Angle	Vertical Angle	Relative Orientation	Contraction Ratio	Number of Openings	Nozzle Direction	WQ Standard[1]	WQ Standard with WER[1]	MZ Distance	Conc. at MZ[1]
	m	m	m/s	m/s	--	kg/m^3	m^3/s	kg/m^3	mg/L	m	m	m	m	deg	deg	deg	deg	--	--	--	mg/L	mg/L	m	mg/L
Total Zinc Model Runs																								
TZn1	2	2	0.025	2	0.025	1024	0.000189	1049	12.674	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	**0.1187**
TZn2	2	2	*0.01*	2	0.025	1024	0.000189	1049	12.674	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	**0.1011**
TZn3	2	2	*0.1*	2	0.025	1024	0.000189	1049	12.674	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0306
TZn4	2	2	0.025	2	0.025	1024	0.000189	1049	12.674	10	2	0	*0.00108*	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	**0.0886**
TZn5	2	2	0.025	2	0.025	1024	0.000189	1049	12.674	*0*	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	**0.1289**
TZn6	*1*	*1*	0.025	2	0.025	1024	0.000189	1049	12.674	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0359
TZn7	2	2	0.025	*0*	0.025	1024	0.000189	1049	12.674	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	**0.1202**
TZn8	2	2	0.025	2	*0.02*	1024	0.000189	1049	12.674	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	**0.1184**
Dissolved Zinc Model Runs																								
DZn1	2	2	0.025	2	0.025	1024	0.000189	1049	4.854	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0455
DZn2	2	2	*0.01*	2	0.025	1024	0.000189	1049	4.854	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0387
DZn3	2	2	*0.1*	2	0.025	1024	0.000189	1049	4.854	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0117
DZn4	2	2	0.025	2	0.025	1024	0.000189	1049	4.854	10	2	0	*0.00108*	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0339
DZn5	2	2	0.025	2	0.025	1024	0.000189	1049	4.854	*0*	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0494
DZn6	*1*	*1*	0.025	2	0.025	1024	0.000189	1049	4.854	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0137
DZn7	2	2	0.025	*0*	0.025	1024	0.000189	1049	4.854	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0460
DZn8	2	2	0.025	2	*0.02*	1024	0.000189	1049	4.854	10	2	0	0.00125	90	0	90	90	1	23	Same	0.0740	n.a.	6.1	0.0453

[1] The background pollutant concentration is subtracted from effluent concentrations and water quality standard values for the purposes of CORMIX analysis. These values will therefore vary from actual concentrations by the value of the background concentration.

Italicized values represent variations for sensitivity analysis.

Boldface values represent exceedences of the acute water quality standard.

APPENDIX G

Sediment Velocity Calculations – Rivers and Marine Waters

Table G-1. Vertical velocity calculations for settling sediments in freshwater.

Simple Stoke's Law Calculation for Largest Particle (#40 sieve)			
Parameter	**symbol**	**value [d]**	**units**
Viscosity	u	0.0000209	lbf - sec / ft^2
Viscosity	u	0.000672353	lb / (ft - sec)
Accelleration of gravity	g	32.17	ft/s^2
Density - particle	P_{part}	165	lbs/ft^3
Density - water	P_w	62.4	lbs/ft^3
Particle Diameter	d	0.425	mm
Particle Radius	r	0.000697178	ft
Velocity (settling)	V_{vert}	0.530244905	ft/sec

Velocity (V_{vert}) = [2 g r^2 (P_{part} - P_w)] / [9 u]

Stokes and Newtons Law Calculations for Sediemnt Gradation

Diameter[a] (mm)	Radius (ft)	Velocity[b] (Stokes) (ft/sec)	Reynolds Number (Re)	Crag Coefficient (CD)	Velocity[c] (estimate) (ft/sec)	Velocity (iterative calc) (ft/sec)
0.363	0.000595	0.38576	22.33	2.050	0.20229	0.20229
0.265	0.000435	0.20615	10.67	3.508	0.13220	0.13220
0.215	0.000353	0.13570	6.33	5.326	0.09664	0.09664
0.150	0.000246	0.06605	2.45	12.045	0.05368	0.05368
0.075	0.000123	0.01651	0.35	74.104	0.01530	0.01530
0.035	0.000057	0.00360	0.04	657.636	0.00351	0.00351
0.0125	0.000021	0.00046	0.00	11107.839	0.00057	0.00051

Velocity (V_{vert}) = SQRT [4 g (P_{part} - P_w) d] / [3 C_D P_w]

Drag Coefficient (C_D) = 24 / R_e + 3 / SQRT R_e + 0.34

Reynolds Number (R_e) = P_w V d / u

Notes:
[a] Particle diameters taken from Table 7 (mean diamters from sediment gradation)
[b] Stokes velocity used as initial estimate for Reynold calculation
[c] Velocity estimate is manually adjusted to calcualte Reynolds Number and particle velocity (iterative solution)
[d] Values and constants obtained from online data conversion ()

Table G-2. River velocity calculations.

Group[b]	Bridge[a] ID #	Length	Location	River Name	USGS ID[c]	7Q10 Low Flow [d] (cfs)	Estimated Depth [e] (ft)	Average Velocity [f] (ft/s)
10th percentile length	507/008	149	Bucoda	Skookumchuck	12026400	28.7	4.65	0.0457
	006/008	162	Willapa	Willapa	12013500	18.3	2.65	0.0448
	900/020	104	Renton	Cedar	12119000	50.6	6.5	0.0921
50th percentile length	005/140	309	Castle Rock	Toutle	14242500	303.3	3.42	0.2969
	203/106	340	Gold Bar	Skykomish	12134500	472.9	3.3	0.4341
	014/201	296	Underwood	White Salmon	14123500	431.7	3.3	0.4572
90th percentile length	101/204	1060	Queets	Queets	12040500	426.9	6.5	0.0631
	542/010	930	Cedarville	Nooksack	12210500	687.9	1.93	0.3857
	395/545	1051	Kettle falls	Columbia	12472800	40000	91	0.5650

Notes:
[a] Bridge crossings were chosen based on lengths and availability of both 7Q10 data and depth gauge data from USGS website
[b] The 10th percentile bridge length = 104 feet, 50th percentile = 309 feet, and 90th percentile = 1064 feet
[c] "USGS ID" refers to the ID number of the nearest flow gauging station.
[d] A 7Q10 value was not available for the Columbia site. The value shown is the lowest flow recorded over the past 18 months
[e] Depths obtained from USGS website. Depths for the Skookumchuck and Nooksack estimated given that recent data did not include lower flows near the 7Q10 value. Depths for these two stations were estimated with Mannings equation using variuos flows and depths
[f] Average velocity = Q/A, where A is calculated assuming 3:1 sideslopes and the river width equals the full length of the bridge

Table G-3. Vertical velocity calculations for settling sediments in marine environment.

Simple Stoke's Law Calculation for Largest Particle (#40 sieve)

Parameter	symbol	value [d]	units
Viscosity	u	0.0000209	lbf - sec / ft^2
Viscosity	u	0.000672353	lb / (ft - sec)
Accelleration of gravity	g	32.17	ft/s^2
Density - particle	P_{part}	165	lbs/ft^3
Density - water	P_{sw}	64.0	lbs/ft^3
Particle Diameter	d	0.425	mm
Particle Radius	r	0.000697178	ft
Velocity (settling)	V_{vert}	0.521975979	ft/sec

Velocity (V_{vert}) = [2 g r^2 (P_{part} - P_{sw})] / [9 u]

Stokes and Newtons Law Calculations for Sediemnt Gradation

Diameter[a] (mm)	Radius (ft)	Velocity[b] (Stokes) (ft/sec)	Reynolds Number (Re)	Crag Coefficient (CD)	Velocity[c] (estimate) (ft/sec)	Velocity (iterative calc) (ft/sec)
0.363	0.000595	0.37974	22.90	2.015	0.20229	0.19989
0.265	0.000435	0.20294	10.94	3.441	0.13220	0.13079
0.215	0.000353	0.13358	6.49	5.216	0.09664	0.09567
0.150	0.000246	0.06502	2.51	11.776	0.05368	0.05319
0.075	0.000123	0.01626	0.36	72.323	0.01530	0.01518
0.035	0.000057	0.00354	0.04	641.396	0.00351	0.00348
0.0125	0.000021	0.00045	0.00	10830.951	0.00057	0.00051

Velocity (V_{vert}) = SQRT [4 g (P_{part} - P_w) d] / [3 C_D P_w]

Drag Coefficient (C_D) = 24 / R_e + 3 / SQRT R_e + 0.34

Reynolds Number (R_e) = P_w V d / u

Notes:

[a] Particle diameters taken from Table 7 (mean diamters from sediment gradation)

[b] Stokes velocity used as initial estimate for Reynold calculation

[c] Velocity estimate is manually adjusted to calcualte Reynolds Number and particle velocity (iterative solution)

[d] Values and constants obtained from "online data conversion" website

APPENDIX H

Sediment Quality Calculations – Rivers and Marine Waters

Table H-1. Sediment distribution and Concentration increase for Heavy Metals at 10th Percentile Bridges

Bridge ID	River			Sediment Transport				Sediment Concentration Increase[c]			
	Name	velocity[a] (ft/s)	depth[a] (ft)	Size (mm)	Settling Velocity[b] (ft/s)	Settling Time (sec)	Settling Distance (ft)	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
507/008	Skookumchuck	0.0457	4.65	0.3625	0.2023	23.0	1.1	4.53	6.98	17.56	10.36
				0.265	0.1322	35.2	1.6	**9.94**	**15.30**	**38.51**	**22.73**
				0.215	0.0966	48.1	2.2	2.70	4.15	10.45	6.17
				0.15	0.0537	86.6	4.0	1.09	1.67	4.20	2.48
				0.075	0.0153	303.9	13.9	0.10	0.16	0.39	0.23
				0.035	0.0035	1325.1	60.6	0.01	0.01	0.04	0.02
				0.0125	0.0005	9112.6	416.5	0.01	0.01	0.03	0.02
006/008	Willapa	0.0448	2.65	0.3625	0.2023	13.1	0.6	7.46	11.48	28.90	17.05
				0.265	0.1322	20.0	0.9	**16.35**	**25.18**	**63.36**	**37.39**
				0.215	0.0966	27.4	1.2	4.44	6.83	17.19	10.15
				0.15	0.0537	49.4	2.2	1.79	2.75	6.92	4.08
				0.075	0.0153	173.2	7.8	0.17	0.26	0.64	0.38
				0.035	0.0035	755.2	33.9	0.02	0.02	0.06	0.04
				0.0125	0.0005	5193.2	232.8	0.01	0.02	0.06	0.03
900/020	Cedar	0.0921	6.5	0.3625	0.2023	32.1	3.0	2.30	3.55	8.93	5.27
				0.265	0.1322	49.2	4.5	**5.05**	**7.78**	**19.58**	**11.55**
				0.215	0.0966	67.3	6.2	1.37	2.11	5.31	3.14
				0.15	0.0537	121.1	11.2	0.55	0.85	2.14	1.26
				0.075	0.0153	424.8	39.1	0.05	0.08	0.20	0.12
				0.035	0.0035	1852.3	170.6	0.00	0.01	0.02	0.01
				0.0125	0.0005	12738.1	1173.5	0.00	0.01	0.02	0.01

Notes:

[a] River velocities and depths taken from Table G-2 in Appendix G

[b] Settling velocity calculated in Table G-2 of Appendix G.

[c] Sediment concentration increase refers to the increase in sediment concentration and does not include background sediment concentrations

Sediment mass loadings taken from Table 10 and divided by sample mass to calculate sediment concentrations

Sample mass assumes sample includes the top 2cm of river sediments as per the sediment sampling guidelines in Section 7 of Ecology's "*Technical Guidance for Assessing the Quality of Aquatic Environments* "

Bold concentrations represent zone downstram of bridge with worst case concentrations

Sediment release assumes one wash event for the 10th percentile length bridges

Table H-2. Sediment distribution and Concentration increase for Heavy Metals at 50th Percentile Bridges

Bridge ID	River			Sediment Transport				Sediment Concentration Increase[c]			
	Name	velocity[a] (ft/s)	depth[a] (ft)	Size (mm)	Settling Velocity[b] (ft/s)	Settling Time (sec)	Settling Distance (ft)	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
005/140	Toutle	0.2969	3.42	0.3625	0.2023	16.9	5.0	1.37	2.11	5.32	3.14
				0.265	0.1322	25.9	7.7	**3.01**	**4.63**	**11.66**	**6.88**
				0.215	0.0966	35.4	10.5	0.82	1.26	3.16	1.87
				0.15	0.0537	63.7	18.9	0.33	0.51	1.27	0.75
				0.075	0.0153	223.5	66.3	0.03	0.05	0.12	0.07
				0.035	0.0035	974.6	289.3	0.00	0.00	0.01	0.01
				0.0125	0.0005	6702.2	1989.6	0.00	0.00	0.01	0.01
203/106	Skykomish	0.4341	3.3	0.3625	0.2023	16.3	7.1	0.88	1.36	3.43	2.02
				0.265	0.1322	25.0	10.8	**1.94**	**2.98**	**7.51**	**4.43**
				0.215	0.0966	34.1	14.8	0.53	0.81	2.04	1.20
				0.15	0.0537	61.5	26.7	0.21	0.33	0.82	0.48
				0.075	0.0153	215.6	93.6	0.02	0.03	0.08	0.04
				0.035	0.0035	940.4	408.2	0.00	0.00	0.01	0.00
				0.0125	0.0005	6467.0	2807.5	0.00	0.00	0.01	0.00
014/201	White Salmon	0.4572	3.3	0.3625	0.2023	16.3	7.5	0.96	1.48	3.74	2.20
				0.265	0.1322	25.0	11.4	**2.11**	**3.25**	**8.19**	**4.83**
				0.215	0.0966	34.1	15.6	0.57	0.88	2.22	1.31
				0.15	0.0537	61.5	28.1	0.23	0.36	0.89	0.53
				0.075	0.0153	215.6	98.6	0.02	0.03	0.08	0.05
				0.035	0.0035	940.4	430.0	0.00	0.00	0.01	0.00
				0.0125	0.0005	6467.0	2957.0	0.00	0.00	0.01	0.00

Notes:

[a] River velocities and depths taken from Table G-2 in Appendix G

[b] Settling velocity calculated in Table G-2 of Appendix G.

[c] Sediment concentration increase refers to the increase in sediment concentration and does not include background sediment concentrations

Sediment mass loadings taken from Table 10 and divided by sample mass to calculate sediment concentrations

Sample mass assumes sample includes the top 2cm of river sediments as per the sediment sampling guidelines in Section 7 of Ecology's "*Technical Guidance for Assessing the Quality of Aquatic Environments* "

Bold concentrations represent zone downstram of bridge with worst case concentrations

Sediment release assumes three wash events for the 50th percentile length bridges

Table H-3. Sediment distribution and Concentration increase for Heavy Metals at 90th Percentile Bridges

Bridge ID	River			Sediment Transport				Sediment Concentration Increase[c]			
	Name	velocity[a] (ft/s)	depth[a] (ft)	Size (mm)	Settling Velocity[b] (ft/s)	Settling Time (sec)	Settling Distance (ft)	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
101/204	Queets	0.0631	6.5	0.3625	0.2023	32.1	2.0	1.65	2.54	6.39	3.77
				0.265	0.1322	49.2	3.1	**3.62**	**5.57**	**14.02**	**8.27**
				0.215	0.0966	67.3	4.2	0.98	1.51	3.80	2.24
				0.15	0.0537	121.1	7.6	0.40	0.61	1.53	0.90
				0.075	0.0153	424.8	26.8	0.04	0.06	0.14	0.08
				0.035	0.0035	1852.3	116.9	0.00	0.01	0.01	0.01
				0.0125	0.0005	12738.1	804.0	0.00	0.00	0.01	0.01
542/010	Nooksack	0.3857	1.93	0.3625	0.2023	9.5	3.7	1.04	1.60	4.02	2.37
				0.265	0.1322	14.6	5.6	**2.27**	**3.50**	**8.81**	**5.20**
				0.215	0.0966	20.0	7.7	0.62	0.95	2.39	1.41
				0.15	0.0537	36.0	13.9	0.25	0.38	0.96	0.57
				0.075	0.0153	126.1	48.6	0.02	0.04	0.09	0.05
				0.035	0.0035	550.0	212.1	0.00	0.00	0.01	0.00
				0.0125	0.0005	3782.2	1458.6	0.00	0.00	0.01	0.00
395/545	Columbia	0.5650	91	0.3625	0.2023	449.9	254.2	0.013	0.020	0.051	0.030
				0.265	0.1322	688.3	388.9	**0.029**	**0.045**	**0.113**	**0.067**
				0.215	0.0966	941.6	532.0	0.008	0.012	0.031	0.018
				0.15	0.0537	1695.2	957.8	0.003	0.005	0.012	0.007
				0.075	0.0153	5946.5	3359.7	0.000	0.000	0.001	0.001
				0.035	0.0035	25931.7	14651.1	0.000	0.000	0.000	0.000
				0.0125	0.0005	178333.3	100756.1	0.000	0.000	0.000	0.000

Notes:

[a] River velocities and depths taken from Table G-2 in Appendix G

[b] Settling velocity calculated in Table G-2 of Appendix G.

[c] Sediment concentration increase refers to the increase in sediment concentration and does not include background sediment concentrations

Sediment mass loadings taken from Table 10 and divided by sample mass to calculate sediment concentrations

Sample mass assumes sample includes the top 2cm of river sediments as per the sediment sampling guidelines in Section 7 of Ecology's "*Technical Guidance for Assessing the Quality of Aquatic Environments* "

Bold concentrations represent zone downstram of bridge with worst case concentrations

Sediment release assumes five wash events for the 90th percentile length bridges

Table H-4. Sediment Distribution and Concentration increase for Marine Environment

Flow		Sediment Transport				Sediment Concentration Increase[d]			
velocity[a] (ft/s)	depth[b] (ft)	Size (mm)	Settling Velocity[c] (ft/s)	Settling Time (sec)	Settling Distance (ft)	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Zn (mg/Kg)
0.3281	2	0.3625	0.1999	10.0	3.3	4.35	6.70	16.87	9.96
		0.265	0.1308	15.3	5.0	**9.58**	**14.74**	**37.10**	**21.90**
		0.215	0.0957	20.9	6.9	2.60	4.00	10.07	5.94
		0.15	0.0532	37.6	12.3	1.05	1.61	4.05	2.39
		0.075	0.0152	131.8	43.2	0.10	0.15	0.38	0.22
		0.035	0.0035	574.5	188.5	0.01	0.01	0.04	0.02
		0.0125	0.0005	3950.5	1296.1	0.01	0.01	0.03	0.02
0.3281	5	0.3625	0.1999	25.0	8.2	1.60	2.47	6.21	3.66
		0.265	0.1308	38.2	12.5	**3.52**	**5.42**	**13.65**	**8.06**
		0.215	0.0957	52.3	17.1	0.96	1.47	3.70	2.19
		0.15	0.0532	94.0	30.8	0.38	0.59	1.49	0.88
		0.075	0.0152	329.5	108.1	0.04	0.06	0.14	0.08
		0.035	0.0035	1436.3	471.2	0.00	0.01	0.01	0.01
		0.0125	0.0005	9876.2	3240.2	0.00	0.00	0.01	0.01
0.3281	10	0.3625	0.1999	50.0	16.4	1.25	1.92	4.83	2.85
		0.265	0.1308	76.5	25.1	**2.74**	**4.22**	**10.63**	**6.27**
		0.215	0.0957	104.5	34.3	0.74	1.15	2.89	1.70
		0.15	0.0532	188.0	61.7	0.30	0.46	1.16	0.69
		0.075	0.0152	658.9	216.2	0.03	0.04	0.11	0.06
		0.035	0.0035	2872.6	942.4	0.00	0.00	0.01	0.01
		0.0125	0.0005	19752.4	6480.5	0.00	0.00	0.01	0.01

Notes:

[a] Tidal velocity = 0.1m/s (see Marine water quality section - Cormix Model inputs)

[a] Various depths used to assess impacts in deeper waters

[c] Settling velocity calculated in Table G-3 of Appendix G.

[d] Sediment concentration increase refers to the increase in sediment concentration and does not include background sediment concentrations

Sediment mass loadings taken from Table 10 and divided by sample mass to calculate sediment concentrations

Sample mass assumes sample includes the top 2cm of marine sediments as per the sediment sampling guidelines in Section 7 of Ecology's "*Technical Guidance for Assessing the Quality of Aquatic Environments* "

Bold concentrations represent zone downstram of bridge with worst case concentrations

Sediment release assumes three wash events