

**FINAL  
FIELD SAMPLING PLAN  
CYANIDE SURFACE WATER INVESTIGATION  
GASCO GROUNDWATER SOURCE EVALUATION**

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## Table of Contents

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1	INTRODUCTION.....	1
1.1	Background.....	1
1.2	Objectives.....	2
2	SCOPE OF WORK.....	4
2.1	Sampling Locations.....	5
2.1.1	Cyanide Locations – Shallow Depth.....	5
2.1.2	Cyanide Locations – Mid-depth.....	5
2.1.3	Cyanide Locations – Near Bottom.....	6
2.2	Sampling Frequency.....	6
2.2.1	Ebb Tide Cyanide Sampling.....	7
2.2.2	Slack High Tide Cyanide Sampling.....	8
2.2.3	Slack Low Tide Cyanide Sampling.....	8
3	SAMPLE COLLECTION, PROCESSING, AND HANDLING.....	9
3.1	Sampling Schedule.....	9
3.2	Sampling Platform.....	9
3.3	Horizontal Positioning and Vertical Control.....	9
3.4	Station and Sample Identification.....	10
3.5	Sampling Methods.....	10
3.5.1	Water Grab Samples.....	11
3.5.2	Unfiltered Sampling Procedure.....	12
3.5.3	Filtered Sampling Procedure.....	13
3.5.4	Field Parameters.....	13
3.6	Field Quality Assurance and Quality Control.....	14
3.6.1	Field Replicates.....	15
3.6.2	Rinsate and Field Blanks.....	15
3.6.3	Filter Blanks.....	15
3.6.4	Field Documentation.....	16
3.6.5	Equipment Calibration.....	16
3.7	Sample Handling.....	17
3.7.1	Field Equipment Decontamination.....	17
3.7.2	Sample Disposal and Waste Handling Practices.....	17
3.7.3	Sample Transport and Chain-of-Custody Procedures.....	18
4	SAMPLE LABORATORY ANALYSIS.....	19
5	DATA QUALITY ASSURANCE AND REPORTING.....	20
6	REFERENCES.....	22

## Table of Contents

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### List of Tables

Table 1	Station Locations, Depths, and Tidal Period Sample Summary
Table 2	Container Size, Holding Time, and Preservation for Physical/Chemical Analysis
Table 3	Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits
Table 4	Data Quality Objectives
Table 5	Laboratory Quality Control Sample Analysis Summary

### List of Figures

Figure 1	Vicinity Map
Figure 2	Cyanide Surface Water Sampling Stations
Figure 3	Proposed Cyanide Surface Water Sampling Schedule
Figure 4	Van Dorn Sampler Schematic

### List of Appendices

Appendix A	Responses to DEQ's Comments on the Draft Cyanide Surface Water Field Sampling Plan
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## 1 INTRODUCTION

This *Cyanide Surface Water Investigation Field Sampling Plan* (FSP) provides the Oregon Department of Environmental Quality (DEQ) with the sampling approach for the collection of Willamette River (river) surface water samples for the analysis of speciated cyanide at the NW Natural “Gasco” Site in Portland, Oregon (Site; Figure 1). This assessment supports the overall evaluation of potential groundwater sources and development of the Groundwater Focused Feasibility Study, which will assess groundwater source control options for the former Manufactured Gas Plant (MGP) at the Site. This Final FSP incorporates comments on the Draft FSP made by DEQ. For completeness, NW Natural’s responses to DEQ comments are provided as Appendix A.

### 1.1 Background

Recent analytical results from Site investigations indicate concentrations of cyanide exist in a portion of the shoreline groundwater samples above DEQ Joint Source Control Strategy (JSCS) screening values. However, relatively elevated total cyanide concentrations in groundwater are not representative indicators of the actual exposure of human or ecological receptors to bioavailable free cyanide in surface water, which is by far the most toxic form of cyanide. Cyanide’s relative toxicity is determined by the distribution of its different species or forms. Site water investigations utilize three categories of analytical methods to evaluate the following cyanide species: free, amenable, and total.

The forms of cyanide that exist at a site are linked both to the nature of the source and site-specific geochemical characteristics. Free cyanide, the most biologically available and toxic form, is a measure of the sum of the cyanide anion (CN<sup>-</sup>) and hydrogen cyanide (HCN). Amenable cyanides are those cyanides “amenable to chlorination” that undergo oxidation and dissociation to free cyanide when exposed to chlorine. The amenable cyanides method may represent a reasonable measure of the cyanide that could become available as free cyanide under certain environmental conditions that are not necessarily present at the Site. Total cyanide encompasses all cyanide categories including free, amenable, available (another measure of cyanide used in some studies) and strong acid dissociable (e.g., iron cyanide).

At the Site, free cyanide has been measured to be typically 2 percent of measured total cyanide in shoreline groundwater (results presented in *Phase 1 Report and Phase 2 Field Sampling Approach*; Anchor 2007). Due to iron levels in the groundwater, a large portion of the measured total cyanide is complexed with iron in a stable iron cyanide form.

Anchor is currently reviewing existing information to evaluate the potential for migration of free cyanide in groundwater to the Willamette River surface water. (Note that all references to surface water in this document refer to the river water.) This information review will be coupled with data from the shoreline groundwater sampling (Phase 1 Offshore Groundwater Investigation), collection of transition zone water (ongoing Phase 2 Offshore Groundwater Investigation) farther out in the river, and the results of surface water sampling proposed in this document. Results of these studies will be used to confirm whether conversion of some iron-cyanide and amenable cyanide to free cyanide is occurring within the surface water at levels that present a potentially unacceptable risk to river receptors and will provide a better understanding of the transport and fate of cyanide into the river's surface water. Modeling or other estimates of conversion of iron-cyanide or amenable forms of cyanide to free cyanide from groundwater to surface water would be complex and potentially uncertain. Consequently, the proposed scope of work described in this FSP is the simplest and most efficient approach to understanding the potential for groundwater contribution of cyanide at levels of concern to surface water.

## 1.2 Objectives

Results of this sampling will aid in understanding cyanide species in surface water and the potential connection of any measured surface water cyanide concentrations with the concentrations identified in upland groundwater and transition zone water. The potential Gasco-related sources of cyanide in surface water include: 1) discharge from sediment transition zone water; and 2) resuspension of sediments impacted by historical direct discharges of cyanide-containing materials. It is also possible that surface water contains cyanide from naturally occurring sources and/or upstream industrial/urban sources. Coupled with the Phase 2 Offshore Investigation sediment transition zone water quality data currently being collected, the objectives of the cyanide surface water investigation described in this FSP are:

- Primary objectives:

- Evaluate the potential for transport of cyanide measured in Site groundwater and transition zone water to surface water and any conversion to free cyanide under select river conditions.
- Collect data that may be useful for assessing in-river risks from cyanide (i.e., low tide versus high tide conditions and/or river current velocity and direction).  
Secondary objectives supporting the primary objectives:
- Determine the concentration of cyanides in surface water near potential groundwater discharge zones identified in the transition zone water study conducted by the Lower Willamette Group (LWG).
- Compare concentrations of cyanide measured in surface water to shoreline groundwater, with a focus on those monitoring wells showing elevated cyanide concentrations, to determine if a correlation exists.
- Assess the relative contribution of cyanide sources (i.e., contaminated sediment resuspension versus transition zone water) to be the cause of cyanide concentrations observed in surface water.
- Evaluate cyanide measured in surface water in conjunction with uplands groundwater data.

## 2 SCOPE OF WORK

Surface water samples will be collected at 20 sampling stations (GSW01 through GSW20). Proposed sample stations are shown in Figure 2 and listed in Table 1. As agreed with DEQ for other site investigations, samples will be tested to evaluate concentrations of the three cyanide forms noted in Section 1 (free, amenable, and total) under various river conditions and water depths.

The basic components of the surface water sampling effort will include:

- Analysis of free, amenable, and total cyanide (by methods previously approved by DEQ and already employed at the Site) as well as total suspended solids (TSS), iron, and sulfides to assist in bioavailability and toxicity evaluations.
- Collection of pH, Eh, and other conventional field measurements (i.e., turbidity, dissolved oxygen, conductivity, and temperature) at approximately the same location and depth as where surface water chemistry samples are collected.
- From each station, collection of three water column samples: 1) shallow depth (top 2 feet below water surface), 2) mid-depth, and 3) and near bottom (approximately 1 foot above mudline). These three sample depths will allow for examination of potential discharge concentrations and potential surface water mixing and conversion in the mid-depth and upper photic zone of the water column.
- Collection during approximately high slack tide, low slack tide, and ebb tide conditions at every station over a course of several days to assess the influence of tidal conditions on water quality.
- Sampling at some stations co-located with the Phase 2 Offshore shallow sediment/groundwater borings (sampling described in Anchor 2007) and some locations near potential groundwater discharge zones identified by the LWG.
- Sampling at two locations upstream<sup>1</sup> of the Site to evaluate background levels.
- Sampling at two locations downstream of the Site to determine dilution of potential sources from the Site.
- Collection of filtered and unfiltered water samples to assist in understanding the potential for contaminated sediment resuspension sources.

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<sup>1</sup> Note that the determination of which stations are upstream vs. downstream of the Site will be made based on the river current directions observed at each sampling event. Thus, due to tidal flow reversals, upstream stations during one event may be downstream stations during another event if the overall current direction changes between these two events.

## 2.1 Sampling Locations

As described in Section 1, previous investigations determined that detectable levels of cyanide exist in shoreline groundwater at concentrations exceeding JSCS levels. The LWG prepared a draft report, *Portland Harbor RI/FS Round 2 Groundwater Pathway Assessment Transition Zone Water Site Characterization Summary Report* (Integral 2006). The Round 2 Groundwater Pathway Report describes the results of a transition zone water assessment conducted in the nearshore area adjacent to the Gasco Site. Results of that assessment suggest the possible presence of a groundwater discharge zone near the toe of the slope that defines the navigation channel.

Twenty proposed river water sample stations are indicated by green triangle symbols on Figure 2. Most of the sample stations are located along transects B and C of the Phase 2 offshore groundwater investigation currently being conducted (i.e., relatively close to shore). Transects B and C cover the same general area identified by the LWG as a potential groundwater discharge zone. Many of the locations on Transect B are located directly offshore from the Phase 1 Transect A "GS" borings where cyanide was measured in shoreline groundwater. The map inset on Figure 2 shows two upstream sample stations and two downstream sample stations.

Surface water samples will be collected at three depth intervals at each station sampled as described in the following sections.

### 2.1.1 Cyanide Locations – Shallow Depth

For the purposes of this investigation, shallow depth is defined as the top of the water column from the 0-to-2-foot water depth zone. This water depth interval was selected based on a review of literature (e.g., Dzombak et al. 2006) of the mostly likely zone of photodissociation of iron cyanide to free cyanide.

### 2.1.2 Cyanide Locations – Mid-depth

The purpose of sampling the mid-depth is to measure concentrations of cyanide forms and associated parameters as an assessment of cyanide exposure within the water column. This depth will represent the typical exposure area for some ecological

receptors such as pelagic fish. The exact water depth will vary depending on flow, tide, and station conditions. It will be targeted at half of the water depth at that particular location given the water levels at the time of sampling, and thus, the target water depth will vary between sampling stations.

### **2.1.3 Cyanide Locations – Near Bottom**

In this sampling program, near bottom will be targeted within 1 foot of the mudline to the extent possible without collecting potentially suspended sediment from the nearby sediment surface. Typically, for many studies near bottom is defined as being within 3 feet (or 1 meter depending on the study) of the mudline for characterization purposes. The basis of the 1-foot depth for this study is to sample as close to the point of groundwater discharge to surface water as logistically possible without interferences from the sediment bed. The results of sampling this zone are intended to assist in evaluating the potential for transition zone water discharge to river water, as well as potentially developing exposure scenarios for infaunal and epifaunal ecological receptors in combination with sediment and transition zone water data, which could support the LWG in assessing in-water risks.

## **2.2 Sampling Frequency**

Although the Willamette River is a freshwater system, it is affected by the ocean-driven tides in Portland Harbor; for example, sometimes resulting in upstream flows during incoming tidal conditions. Given the tide's influence on the river's flow, cyanide surface water sampling events (chemistry and co-located water quality readings) will be conducted during each of three approximate tidal events: ebb tide (on an outgoing tide), slack high tide (the time surrounding the peak of the tide), and slack low tide (the time surrounding the nadir of the tide). It is during the slack high and slack low tides when tidal currents should be minimal.

It is not possible for all 20 sampling stations to be sampled at each of the three depth intervals during one complete tidal cycle (i.e., one day). Therefore, to optimize the available time within each tide event over several consecutive tidal cycles, groups of stations will be sampled over the course of several consecutive sampling days. Thus, on any given sampling day, one station in the subset sampled for that day will be sampled for only one

tidal event that day. However, each of the three depth intervals will be sampled for each specific station on the same day during the same tidal condition. For any one station, the three tidal events for that station will be collected on 3 different days over a period of approximately 7 days. Given that the tidal and river flow conditions would not be expected to typically vary substantially over 7 days at this time of year, this is the most logistically feasible way to obtain three comparable events from each station. The resulting dataset will provide cyanide concentrations in surface water over a range of conditions, as outlined in the objectives of this study.

Sampling will be conducted following the schedule depicted in Figure 3. The exact number and order of the samples collected will depend on current tide schedules and other site-specific factors that contribute to sampling speed (e.g., weather). The station groups will be chosen in a semi-random order so as not to bias the sampling towards one area at one tidal event. That is, rather than sampling all downstream stations during one event, or all nearshore stations during an event, a group of stations from downstream to upstream, as well as inshore and offshore, will be sampled on each day to increase the area covered by that event.

NW Natural has installed a water level transducer on a river piling adjacent to the Site shoreline. This transducer is being used to monitor river level changes during the groundwater pilot program and during the Phase 2 Offshore sampling. The current plan is to install a telemetry system that will transmit river water level data to a remote monitoring system. The telemetry system is planned to be installed by the time this proposed surface water sampling plan is implemented. The surface water sampling team will be able to monitor the tidal cycle in real time while in the field to facilitate scheduling of surface water sampling relative to the tidal cycle.

### **2.2.1 Ebb Tide Cyanide Sampling**

Ebb tide is the time period during which the tide is falling. Sampling at ebb tide will occur during the approximately 3-hour period prior to the point of low tide, while the tide is falling.

**2.2.2 Slack High Tide Cyanide Sampling**

Slack high tide is the point of a tidal sequence near when the tide is at its highest point (high tide). Sampling at the slack high tide will occur within the period prior to and following the high tide (approximately a 3-hour window).

**2.2.3 Slack Low Tide Cyanide Sampling**

Slack low tide is the point of a tidal sequence during which the tide is at its lowest point (low tide). Sampling at the slack low tide will occur within the period prior to and following the low tide (approximately a 3-hour window).

### 3 SAMPLE COLLECTION, PROCESSING, AND HANDLING

This section addresses the sample collection, processing, and handling procedures that will be used to ensure data quality.

#### 3.1 Sampling Schedule

Surface water sampling activities will occur during the summer work window (July 1 through October 31) when listed fish species are expected to be in low numbers in the project area. Note that this type of surface water sampling is expected to have no impact of fish even were they present. The target sampling time is September to mid-October 2007, because this is likely when the river flows will be at or near seasonal lows, when groundwater discharges should be measurable if they are occurring. The goal of the sampling time is collect the samples before the river starts coming back up for the season and to minimize the potential for rain events to change river conditions over the course of a few days. The sampling will take approximately 7 field days, depending upon field conditions. The target days will be determined based on predicted river height and tide schedules.

#### 3.2 Sampling Platform

River water sampling equipment will be deployed from the side of a shallow draft vessel.

#### 3.3 Horizontal Positioning and Vertical Control

Horizontal positioning at each sampling location will be determined using a differential global positioning system (DGPS) with a handheld global positioning system (GPS) unit as backup if necessary. Station positions will be based on target coordinates shown in Table 1. Measured station positions will be recorded in latitude and longitude to the nearest 0.01 second in the North American Datum (NAD) 1983. The accuracy of the horizontal coordinates will be within 3 meters.

The mudline elevation of each sampling station will be determined by measuring the water depth as described in Section 3.5.1. Water depths will be corrected to various potential vertical datum (depending on the data evaluation need) after sampling based on Site transducer water level measurements. As described above, a pressure transducer has been placed in the river offshore of the Site at a surveyed location to provide real-time river

elevations at the Site. These elevations will be compared to the elevations reported by the Morrison Street elevation gauge located approximately 6.5 miles upstream from the sampling area.

### 3.4 Station and Sample Identification

All samples will be assigned a unique identification number based on a sample designation scheme designed to meet the needs of the field personnel, laboratory and Gasco data management, validation chemists, and data users. The unique code will be assigned to each sample as part of the data record and will indicate the project phase, sample location, sample type, sampling event, and level of replication/duplication. Sample identifiers will consist of three components separated by dashes. The first component, GSW, identifies the data as belonging to the Gasco Surface Water sampling. The second component will begin with the sample number location designation followed by A, B, or C to indicate shallow depth water, mid-depth, or near bottom sample respectively, followed by either an E, S<sub>h</sub>, or S<sub>l</sub> for Ebb, Slack high, or Slack low tide sampling events, respectively. The final component will be the date in yy/mm/dd format.

Example sample identifiers are:

- GSW-01AE-070515: surface water grab sample from the shallow depth interval during an ebb (near low tide) event at station 01 collected on May 15, 2007
- GSW-02CS<sub>h</sub>-070515: surface water grab sample from the near bottom interval during a slack high (surrounding a high tide) event at station 02 collected on May 15, 2007

### 3.5 Sampling Methods

Methods for collection of surface water and field measurements are described in this section. The collection of both filtered and unfiltered samples at each location will assist in understanding the potential for contaminated sediment resuspension sources and to assess the potential for sample contamination caused by sediment resuspension during the collection of the near bottom sample. The collection of both filtered and unfiltered samples will increase the required number of deployments of the water sampler. Section 3.5.1 provides general procedures for collecting surface water. Specific procedures for collecting unfiltered and filtered surface water samples are described in Sections 3.5.2 and 3.5.3, respectively.

### **3.5.1 Water Grab Samples**

Water samples will be collected using a 5-liter (L) horizontal van Dorn bottle. Samples will be collected from shallowest to deepest water depth, in order to minimize the potential for cross-contamination. The sampler will be lowered to the target water depth on a rope, allowed to sit at the target depth for a short period to allow any mudline particulates potentially disturbed during the deployment to settle out, and will be triggered to close by the deployment of a messenger.

Water samples will be collected at three water depths at each sampling station as described below:

- Shallow Depth – Samples will be collected within the top 2 feet of the water column.
- Mid-depth – The mid-depth is defined as the approximate mid-point between the bottom and shallow samples at each location. The mid-depth will be determined using the onboard fathometer or a lead line.
- Near Bottom – Field crew will utilize three methods to determine mudline depth: 1) fathometer readings; 2) a remote camera attached to the sampling equipment; and 3) a lead-line. These methods are further described below.

Based on the findings of the Phase 2 offshore work using the same three depth finding techniques, the camera is considered to be the most sensitive measure of actual mudline depth. The water depth at each station will first be identified using a fathometer (i.e., fish finder or equivalent). This depth will be used during deployment of the van Dorn sampler to minimize potential disturbance of the mudline during near bottom sampling. Though the weight of the individual sampling equipment will assist in stabilizing the unit, a 10-pound weight will be attached to the unit to ensure stabilization during deployment and retrieval of the unit. A second weight will be on board and can be used if currents are unexpectedly stronger than anticipated. The 10-pound weight and attached camera will be affixed to the van Dorn sampler such that the camera lens extends approximately 1 foot away from the bottom of the sampler and is farther away from the bottom of the sampler than any other equipment (Figure 4). This measurement from the camera to the sampler is an approximate estimate to explain relative

positioning. The actual distance between the devices will depend on their behavior in the river at the time of use and on field conditions. This apparatus will be slowly lowered to the fathometer-identified mudline elevation maintaining tension on the rope during the descent. Near the approximated depth, the camera will go completely dark and the line may go slack as well, indicating the camera lens is resting on the mudline and the van Dorn is sitting approximately 1 foot above the mudline elevation. The sampler will not be triggered for 3 minutes to allow any resuspended sediments caused by disturbance of the mudline to settle and/or be transported away from the sampling location by the current. If the line did not go slack when the camera went dark, then after the van Dorn is triggered, additional line will be let out until the line goes slack to create the third measurement of depth via lead line. If the line did go slack when the camera went dark, the lead line and camera depth measurements will be considered identical and recorded as such in field notes.

If excessive turbidity (relative to the natural turbidity of the river for that day) is observed in a collected sample, the sample will be discarded, and the sampler will be redeployed and allowed additional time for the disturbed bottom sediment to clear before triggering the sampler. Turbidity meter readings will be used to help determine what is “excessively” turbid as compared to normal bottom conditions. In addition, if the van Dorn sampler shows visual signs that it came into contact with the mudline, the sample will be discarded and the sampler will be decontaminated and redeployed. If these methods cannot yield non-turbid water on a consistent basis, alternate methods may be explored and discussed with DEQ prior to use in the field.

### **3.5.2 Unfiltered Sampling Procedure**

Because less than 5 L of sample is needed per station to fill all sample containers for unfiltered analyses, only one grab is proposed for a single unfiltered sample. The van Dorn bottle may require a second deployment to each target depth at each station if the sampler does not return with full volume on the first grab.

If two grabs are needed to collect the necessary volume for unfiltered analyses (approximately 3.75 L), approximately 250 milliliters (mL) from the first deployment will be poured directly into the sulfide container containing preservative as specified in

Table 2. The remainder of the collected sample volume will be placed into a decontaminated container. Another 250 mL collected from the second co-located deployment will be poured into the sulfide container, creating a single representative 500 mL sulfides sample. The remaining sample volume collected from the second co-located deployment will be combined into the decontaminated container with the first grab sample volume. The composite volume in the container will be mixed briefly using a decontaminated utensil such as a stainless steel stir rod to ensure the sample volume is adequately homogenized. The homogenized sample volume will then be decanted into the sample containers described in Table 2.

### **3.5.3 Filtered Sampling Procedure**

As noted above, at each sample station and water depth the van Dorn sampler will need to be deployed twice at each station to obtain sufficient sample to fill all sample containers for both unfiltered and filtered samples.

The unfiltered samples will be collected as described in Section 3.5.1. For the filtered analyses, the general procedure is also as described in Section 3.5.1. However, TSS and sulfides will not be analyzed for and therefore volume for those analyses is not required. Approximately 2.25 L is suggested for all filtered analyses). It is not expected that two grabs will be necessary. A Geotech peristaltic pump will force water through a 0.45-micron filter dedicated to each sample directly into each sample container identified in Table 2. A small amount of sample water will be purged through the filter and outlet hose prior to sample collection.

If a second deployment is necessary, the two grabs will be composited directly in a decontaminated container and homogenized. Sample volume will then be removed from the composite container using silicon tubing and the peristaltic pump directly into each sample container identified in Table 2.

### **3.5.4 Field Parameters**

Field parameters will be measured at each sample location (at approximately the same sample depth as the surface water sample is collected from) in the field using a water-column-deployed Hydrolab MS5 Water Quality Multiprobe. Measurements of water

depth will be documented for each sample location as noted above on log sheets. At each measurement location, the water quality multiprobe will be lowered to the target depth and allowed to equilibrate for 30 seconds or until readings have stabilized. Measurements of pH, temperature, turbidity, oxidation reduction potential (ORP or Eh), conductivity, and dissolved oxygen will be recorded on a field measurement log sheet.

Using an independent field crew, current speed will be measured at three cyanide surface water stations (GSW-04, GSW-13, and GSW-18; Figure 2) to establish the general direction and velocity of water concurrent with each sampling event during the time surface water sampling is being conducted. One location upstream within the Site (GSW-18), one approximately in the middle of the shoreline of the Site (GSW-13), and one downstream within the Site (GSW-04) will be measured at all three sampling depths during each sampling event. The current measurements at these three locations will provide an indication of any large scale changes in currents over the course of the sampling event. Current speed will be determined by deployment of a velocity meter (with a calibrated propeller and surface readout) from a vessel to each target sampling depth (shallow, mid-depth, and near bottom) and the measured speed and current direction will be recorded on the field form. The meter will be deployed and allowed to come to a visually consistent speed. Readings will be taken for 2 minutes to allow variations in the range of current speeds and directions to be recorded. The minimum and maximum velocities and directions (in terms of degrees) will be recorded in the field note book for each location and depth. The velocity meter will be mounted and deployed from the side of the vessel using a telescoping rod (or comparable alternative). At each station, the vessel will be stabilized prior to current measurements either by anchoring on two points or tying off to a stationary object such as a piling or dock. In the latter case, care will be taken to collect current measurements from the opposite side of the vessel and as far away from any structures as possible to minimize the effects of eddies around such structures. The velocity meter used will be capable of reporting both current speed and direction at the surface readout.

### **3.6 Field Quality Assurance and Quality Control**

Field QA/QC samples will be collected and used to evaluate the variability resulting from sample handling and the efficiency of field decontamination procedures (Section 3.7.1). All

field QC samples will be documented in the Site logbook. Table 1 summarizes field QC sampling.

### **3.6.1 Field Replicates**

Field replicates will be collected (5 percent frequency) from the sampling locations and will be apportioned equally between shallow depth, mid-depth, and near bottom samples. It is expected, by using a 5-L Van Dorn, that one grab will be required for unfiltered samples and one grab for filtered samples. Therefore, the field replicate will consist of deploying the sampler a third (replicate for unfiltered) and fourth (replicate for filtered) time at the sample location. If additional grabs are needed to complete the initial sample set, a duplicate number of grabs will be required to complete the replicate set. The replicate sample will be processed in exactly the same way as the original sample, including the filtering process for filtered samples, and will be submitted to the laboratory as blind samples. The samples will be analyzed for the same parameters as the other field samples. Because the river is a dynamic environment with continually moving water, it is not possible to sample the same water with the replicate sample. Therefore, there will likely be some variation in water quality that is not due to the sampling method.

### **3.6.2 Rinsate and Field Blanks**

Rinsate and field blank samples will be collected to evaluate the efficiency of field decontamination procedures, described below in Section 3.7.1. One rinsate blank and one field blank will be collected for water sampling methods. The rinsate blank will consist of rinsing down the collection equipment with laboratory supplied deionized water after sample collection and decontamination with distilled water and collecting the rinsate. The field blank will be collected by pouring laboratory supplied deionized water directly into the appropriate sampling containers.

### **3.6.3 Filter Blanks**

A filter blank sample will be collected to evaluate the potential for cross-contamination during the field filtration procedure. The filter blank will consist of filtering laboratory supplied deionized water directly into a complete set of sampling containers using a

separate unused dedicated filter and tubing assembly. One filter blank sample will be collected for each sampling event.

#### **3.6.4 Field Documentation**

A complete record of field activities will be maintained including the following:

- Documentation of field activities in a field logbook
- Documentation of samples collected for analysis

The field coordinator will maintain the field logbook, which will consist of bound, numbered pages. On-site activities, including health and safety entries and field observations will be documented in the logbook. Entries will be made in indelible ink. The field logbook is intended to provide sufficient data and observations to enable readers to reconstruct events that occurred during the sampling period. These entries will include the following:

- Date and sample collection time
- Sampling personnel
- Weather
- Sampling location
- Number, type, and preservative of containers
- Water depth
- Sample depth
- Tidal cycle
- River flow speed and direction
- Agreements reached with DEQ project manager on field decisions, including the time and method of agreement (e.g., telephone, email, etc.)
- Other comments

#### **3.6.5 Equipment Calibration**

Either at the end of each day or prior to the start of each day's field sampling, the Hydrolab Multiprobe will be calibrated using methods outlined by the manufacturer in the Hydrolab user's manual. The Hydrolab calibration will be checked additionally twice a day (at well spaced intervals such as mid-morning and mid-afternoon) using standard reference materials to assess whether any calibration drift has occurred.

Calibration checks will consist of placing the meters in the calibration solutions to ensure that the meters read within an acceptable accuracy. If readings are not within acceptable accuracy, the Hydrolab will be recalibrated immediately using the methods described in the user's manual for the parameter that needs recalibration. The velocity meter will be calibrated (and maintained) per the manufacturer's instructions. A separate log book will be used to document the calibration of each piece of equipment.

### **3.7 Sample Handling**

This section describes the sample containers, sample handling and storage, chain-of-custody forms, and sample shipping procedures for all sampling activities.

All sample containers received from the analytical lab will be laboratory pre-cleaned, certified, and U.S. Environmental Protection Agency (EPA) -approved for each particular EPA analytical method. Prior to shipping, the analytical laboratory will add preservative, where required. Sample container types and sizes and sample preservation methods are listed in Table 2.

#### **3.7.1 Field Equipment Decontamination**

To prevent sample contamination, water sampling equipment will undergo the following decontamination procedures between each sampling station:

- Wash with phosphate-free detergent and tap water using a scrub brush
- Rinse with deionized water

For all filtered water samples, a dedicated filter will be used for each sample and discarded after each sample is filtered. In addition, dedicated pump tubing will be used for each station. Between samples at a station, the tubing will be flushed with deionized water prior to each sample being pumped, and a small amount of sample volume will be purged to ensure that all deionized water has been removed from the tube.

#### **3.7.2 Sample Disposal and Waste Handling Practices**

Excess water from grab sample collection will be returned to the river. All remaining disposable wastes (e.g., gloves, paper towels, foil, etc.) will be placed into appropriate

containers and staged on site for disposal. All disposable wastes will be placed into heavy duty plastic bags and disposed at a permitted off-site solid waste disposal facility.

### **3.7.3 Sample Transport and Chain-of-Custody Procedures**

All samples will be transported in appropriate containers to the analytical laboratory after preparation is completed (Table 2). Specific sample shipping procedures will be as follows:

1. The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
2. Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
3. Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage.
4. Ice will be placed in separate plastic bags and sealed.
5. A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
6. The cooler lids will be secured by wrapping the coolers in strapping tape.
7. Signed and dated chain-of-custody seals will be placed on all coolers prior to shipping.
8. Each cooler or container containing the samples for analysis will be either shipped to Columbia Analytical Services (CAS) for overnight delivery or picked up at the Gasco facility by a CAS courier.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples recorded by the recipient. Chain-of-custody forms will be used internally in the lab to track sample handling and final disposition.

#### **4 SAMPLE LABORATORY ANALYSIS**

Samples will be analyzed by the laboratory for free cyanide, amenable cyanide, total cyanide, iron, sulfides, and conventionals (i.e., TSS and total organic carbon). Table 3 summarizes the details of the analysis methods and practical quantitation limits. The analytical laboratory selected for this project is CAS located in Kelso, Washington. All sample analyses will be conducted in accordance with DEQ-approved methods.

Iron and sulfides will readily complex with cyanide into less toxic forms. Consequently, iron (total and dissolved) and sulfides will be analyzed in support of cyanide bioavailability and toxicity assessments. Other metals also complex with cyanide but usually in minor amounts, particularly when elevated iron and sulfide concentrations are present.

## 5 DATA QUALITY ASSURANCE AND REPORTING

Prior to laboratory analysis, all samples will be managed according to the appropriate holding times and temperatures for each analysis (Table 2). Table 3 presents the proposed analytes, the analytical methods to be used, and the targeted detection limits.

Prior to the analysis of the samples, the laboratory will calculate method detection limits for each analyte of interest, where applicable. Method detection limits will be below the water quality criteria specified in Table 3, if technically feasible. To achieve the required detection limits, some modifications to the methods may be necessary. These modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract, and will be submitted to DEQ prior to implementation. It should be noted that no commercial laboratory in the northwest (that Anchor is aware of) can achieve a 5.2 micrograms per liter ( $\mu\text{g/L}$ ) method reporting limit for any of the three cyanide analyses commensurate with the chronic ambient water quality criteria for cyanide. Consequently, the laboratory will be reporting cyanide results down to the method detection limit, which will have the target goal of 5  $\mu\text{g/L}$ .

In completing chemical analyses for this project, the contract laboratory is expected to meet the following minimum requirements:

- Adhere to the methods outlined in this FSP, including methods referenced for each analytical procedure (Table 3)
- Deliver facsimile, hard copy, and electronic data as specified
- Meet reporting requirements for deliverables
- Meet turnaround times for deliverables
- Implement QA/QC procedures, including data quality objectives presented in Table 4 and laboratory QC requirements listed in Table 5
- Notify the project QA/QC Manager of any QA/QC problems when they are identified to allow for quick resolution
- Allow laboratory and data audits to be performed, if deemed necessary

Once all data have been obtained from the laboratory and data validation is complete, a data report will be submitted to DEQ. This report will contain table summaries of lab testing results and summaries of field observations. The report will also contain a summary of data validation

results and a review of data quality determined from those results. Results may be useful to the LWG in assessing in-water risk to potential receptors. The results of this study will assist in understanding to what extent cyanide in groundwater is resulting in free cyanide exposures in the river.

## 6 REFERENCES

- Anchor. 2007. Phase 1 Report and Phase 2 Field Sampling Approach. Gasco Siltronic Groundwater Source Evaluation. Prepared by Anchor Environmental, .L.C. C., Portland OR. May.
- ASTM. 2005. Designation D 6696-05: Standard Guide for Understanding Cyanide Species. ASTM International, West Conshohocken, PA. Editorially revised January 2006.
- Dzombak, D.A., R.S. Ghosh, and G.M. Wong-Chong. 2006. Cyanide in Water and Soil. Chemistry, Risk and Management. CRC Press/Taylor & Francis, Boca Raton, FL.
- Integral. 2006. DRAFT. Portland Harbor RI/FS Round 2 Groundwater Pathway Assessment Transition Zone Water Site Characterization Summary Report. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting Inc., Mercer Island, WA. August.

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## TABLES

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**Table 1  
Station Locations, Depths, and Tidal Period Sample Summary**

Station ID	Station Coordinates (Oregon SP NAD 83 North Zone)		Estimated Number of Samples for Each Event			
	Northing (ft)	Easting (ft)	Ebb Tide Shallow, Mid-Depth, Near Bottom	Slack High Tide Shallow, Mid-Depth, Near Bottom	Slack Low Tide Shallow, Mid-Depth, Near Bottom	
GSW-01	706710	7622716	3	3	3	
GSW-02	706572	7622885	3	3	3	
GSW-03	706188	7623201	3	3	3	
GSW-04	706262	7623259	3	3	3	
GSW-05	706312	7623341	3	3	3	
GSW-06	706044	7623412	3	3	3	
GSW-07	706096	7623486	3	3	3	
GSW-08	706197	7623537	3	3	3	
GSW-09	705906	7623644	3	3	3	
GSW-10	706041	7623696	3	3	3	
GSW-11	705760	7623909	3	3	3	
GSW-12	705950	7624030	3	3	3	
GSW-13	705614	7624164	3	3	3	
GSW-14	705656	7624490	3	3	3	
GSW-15	705407	7624534	3	3	3	
GSW-16	705419	7624870	3	3	3	
GSW-17	705242	7624801	3	3	3	
GSW-18	705299	7625123	3	3	3	
GSW-19	704732	7625987	3	3	3	
GSW-20	704653	7626127	3	3	3	
Number of Characterization Samples Analyzed - Filtered			60	60	60	
Number of Characterization Samples Analyzed - Unfiltered			60	60	60	
Rinsate Blanks			1	1	1	
Field Blanks			1	1	1	
Number of Samples			122	122	122	
Total Number of Samples						366

Notes:

GSW Gasco Surface Water

**Table 2  
Container Size, Holding Time, and Preservation for Physical/Chemical Analysis**

<b>Parameter</b>	<b>Minimum Sample Size Required for Analysis</b>	<b>Requested Container Size and Type</b>	<b>Holding Time</b>	<b>Preservative</b>
<b>Water Samples</b>				
Total suspended solids	1 L	1 L poly	7 days	Cool/4° C
Total organic carbon	100 mL	250 or 500 mL glass	28 days	HCL to pH<2
Total cyanide	100 mL	1 L poly	14 days	NaOH to pH>12
Amenable cyanide	100 mL	1 L poly	14 days	NaOH to pH>12
Free cyanide	100 mL	1 L poly	24 hours to diffusion cell	NaOH to pH>12
Sulfide	100 mL	500 mL poly	28 days	Zinc acetate 2N
Iron	100 mL	1 L poly	6 months	HNO3 to pH<2

Notes:

L - liter

mL - milliliter

**Table 3  
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits**

Parameter	Unit	Lowest Human Health	Lowest Ecological	Portland Harbor Specific Fish Consumption Rate	Analytical Method	Method Detection Limit	Practical Quantitation Limit
Total suspended solids	mg/L	-	-	-	EPA 160.2	1	1
Total organic carbon	mg/L	-	-	-	EPA 415.1,9060	0.07	1.5
Cyanide, Total	µg/L	14	-	14	EPA 335.4	5	10
Cyanide, Amenable	µg/L	-	-	-	EPA 335.1	5	10
Cyanide, Free	µg/L	-	5.2	-	ASTM D4282	5	10
Sulfides	mg/L	-	-	-	EPA 9030	0.04	0.1
Iron	µg/L	-	-	-	EPA 6010B	20	20

Notes:

µg/L micrograms per liter

mg/L milligrams per liter

**Table 4**  
**Data Quality Objectives**

<b>Parameter</b>	<b>Precision</b>	<b>MS/MSD Accuracy</b>	<b>LCS Accuracy</b>	<b>Completeness</b>
Total suspended solids	+/- 20% RPD	NA	85-115 %R	95%
Total cyanide	+/- 20% RPD	75-125 %R	85-115 %R	95%
Amemable cyanide	+/- 20% RPD	75-125 %R	85-115 %R	95%
Free cyanide	+/- 20% RPD	75-125 %R	85-115 %R	95%
Sulfides	+/- 20% RPD	75-125 %R	85-115 %R	95%
Iron	+/- 20% RPD	75-125 %R	85-115 %R	95%
Total organic carbon	+/- 20% RPD	65-135 %R	75-135 %R	95%

Notes:

- RPD Relative percent difference
- %R Percent recovery
- MS/MSD Matrix spike/matrix spike duplicate
- LCS Laboratory Control Sample

**Table 5  
Laboratory Quality Control Sample Analysis Summary**

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes	Laboratory Control Samples
Total suspended solids	Daily <sup>c</sup>	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total organic carbon	Daily or each batch <sup>a</sup>	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA	1 per 20 samples
Total cyanide	Daily or each batch <sup>a</sup>	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA	1 per 20 samples
Amenable cyanide	Daily or each batch <sup>a</sup>	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA	1 per 20 samples
Free cyanide	Daily or each batch <sup>a</sup>	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA	1 per 20 samples
Sulfides	Daily or each batch <sup>a</sup>	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA	1 per 20 samples
Iron	As needed <sup>b</sup>	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA	1 per 20 samples

Notes:

- a Initial calibration verification and calibration blank must be analyzed at the beginning of each batch.
- b Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.
- c Scale should be calibrated with class 5 weights daily; weights must bracket the weight of sample and weighing vessel.

NA Not applicable



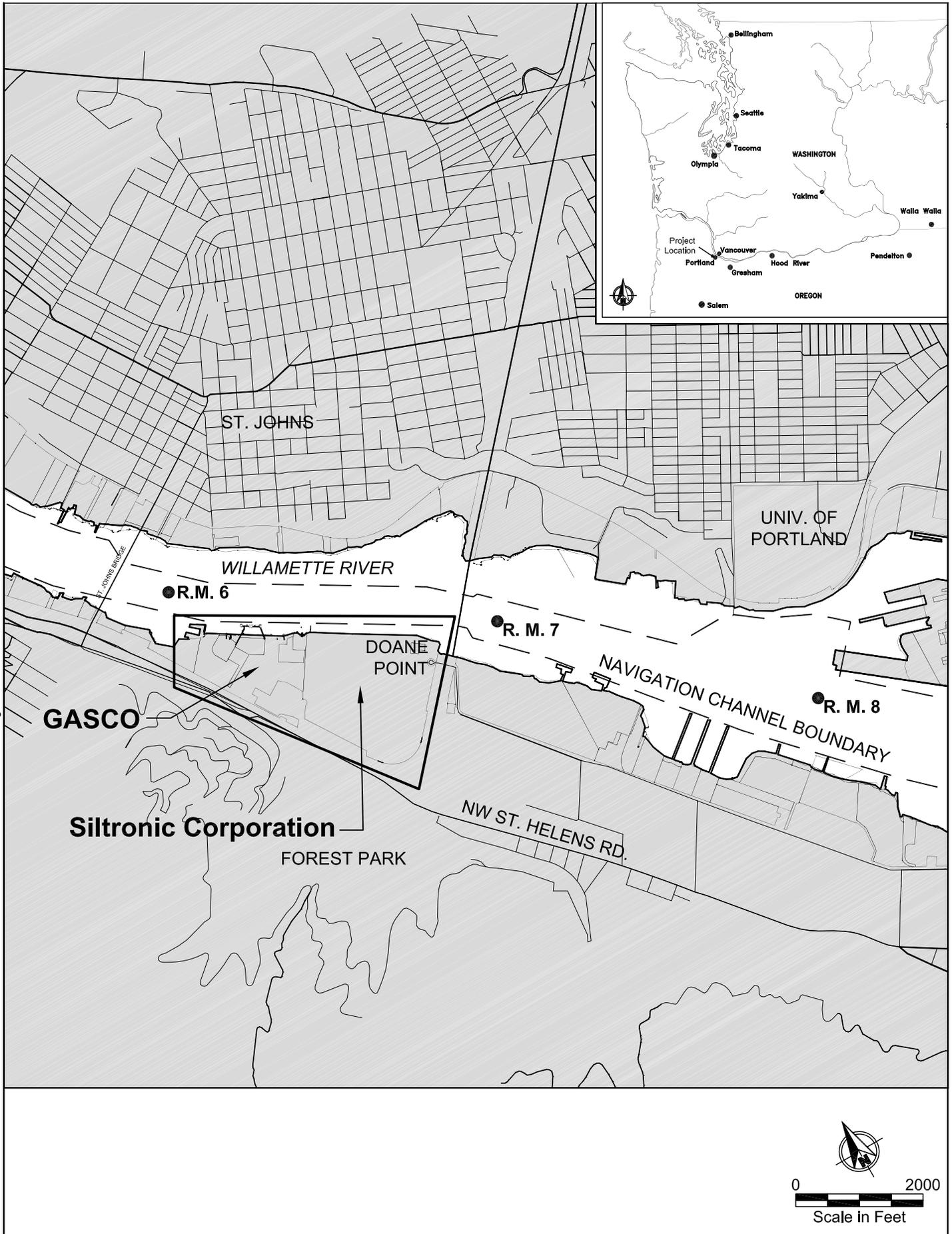
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## FIGURES

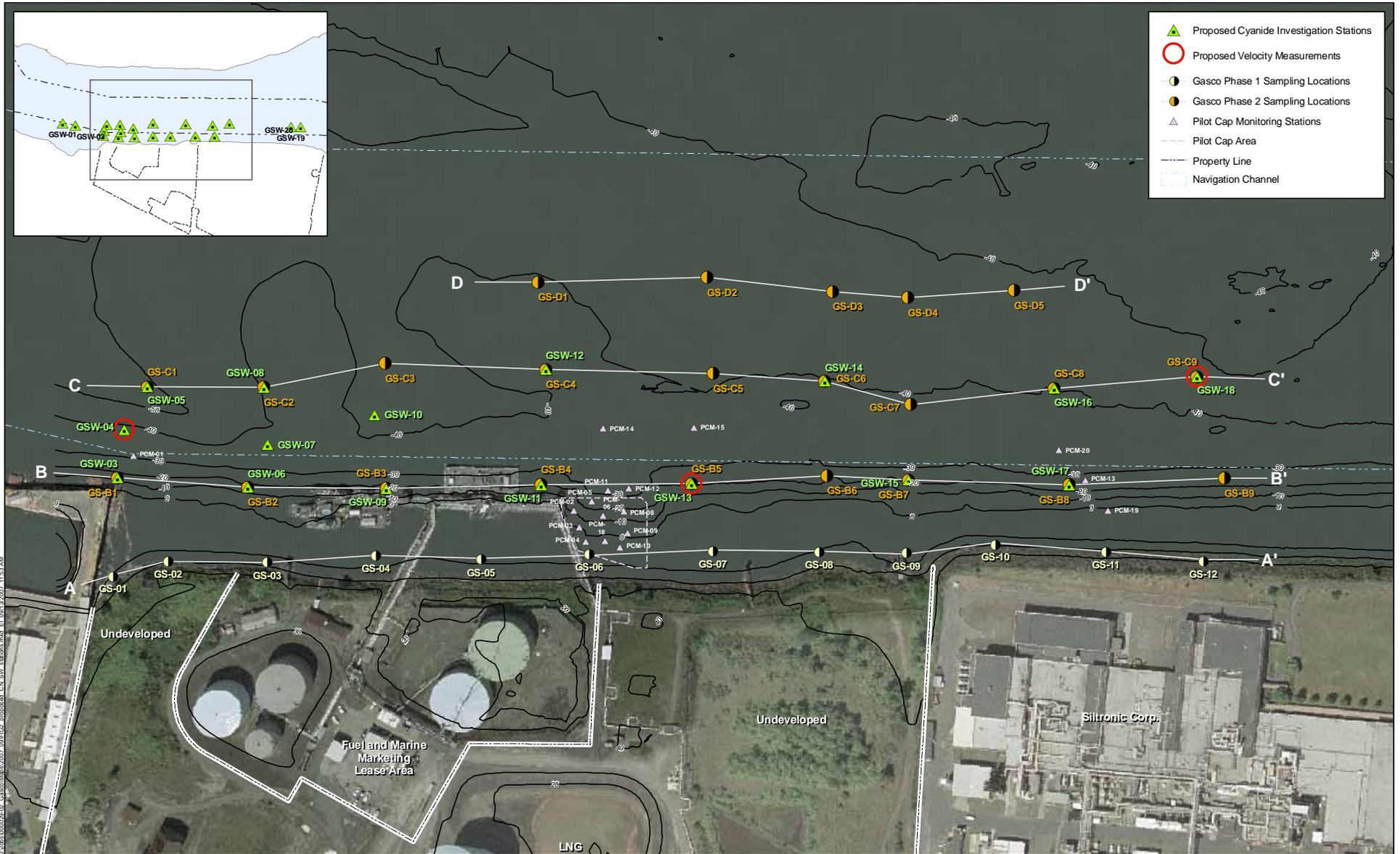
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Jul 03, 2007 9:25am cdavidson K:\Jobs\000029-GASCO\00002902-00002902-118.dwg FIG 1

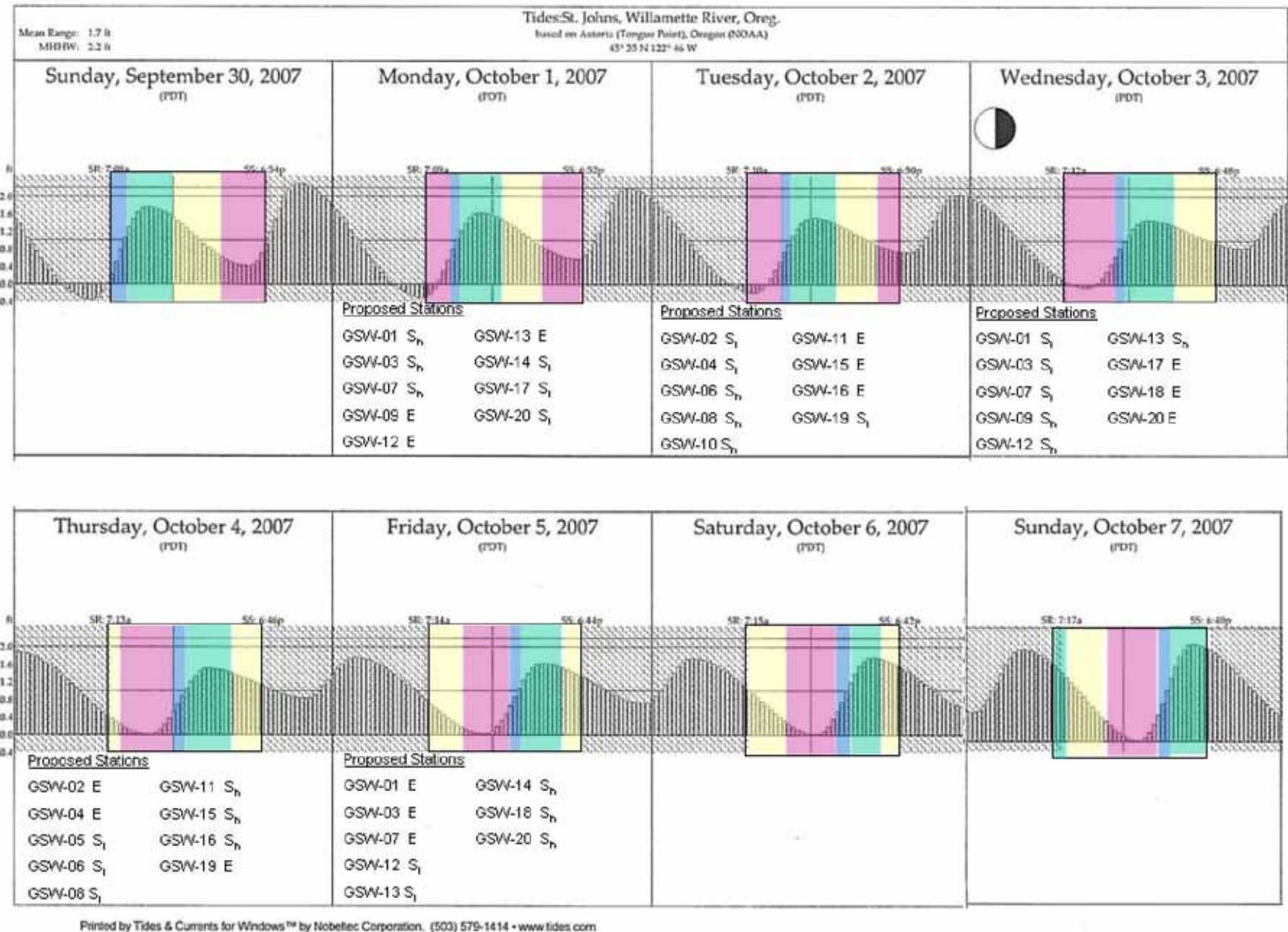


**Figure 1**  
Vicinity Map  
NW Natural Gasco Site  
Portland, Oregon



**Figure 2**  
Proposed Cyanide Surface Water Stations  
NW Natural - Gasco Site  
Portland, Oregon

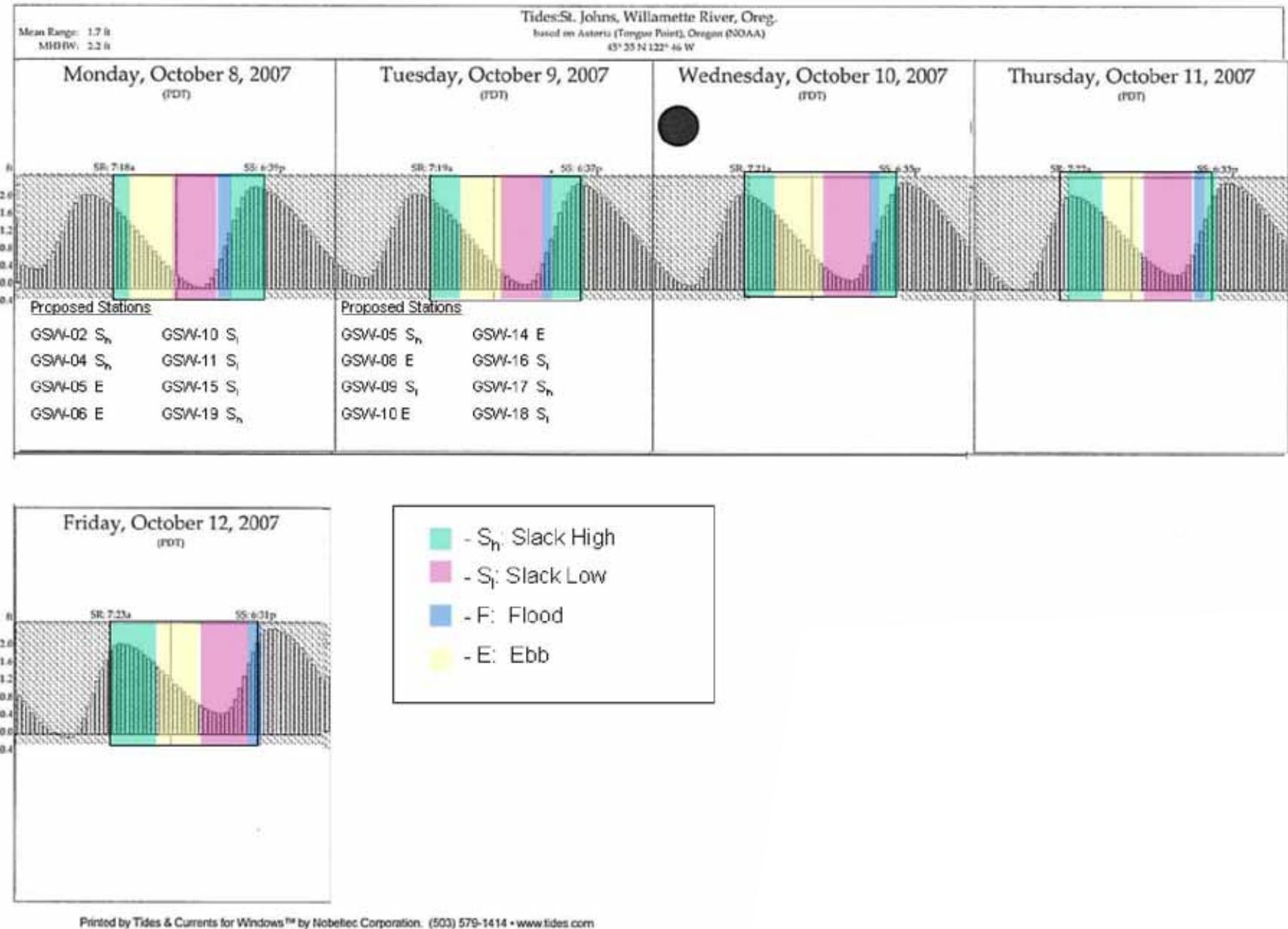
9/13/07 henriksen K:\jobs\000029-GASCO\00002902AA.cdr



**Figure 3 (1 of 2)**  
 Proposed Cyanide Surface Water Sampling Schedule  
 NW Natural - Gasco Site  
 Portland, Oregon

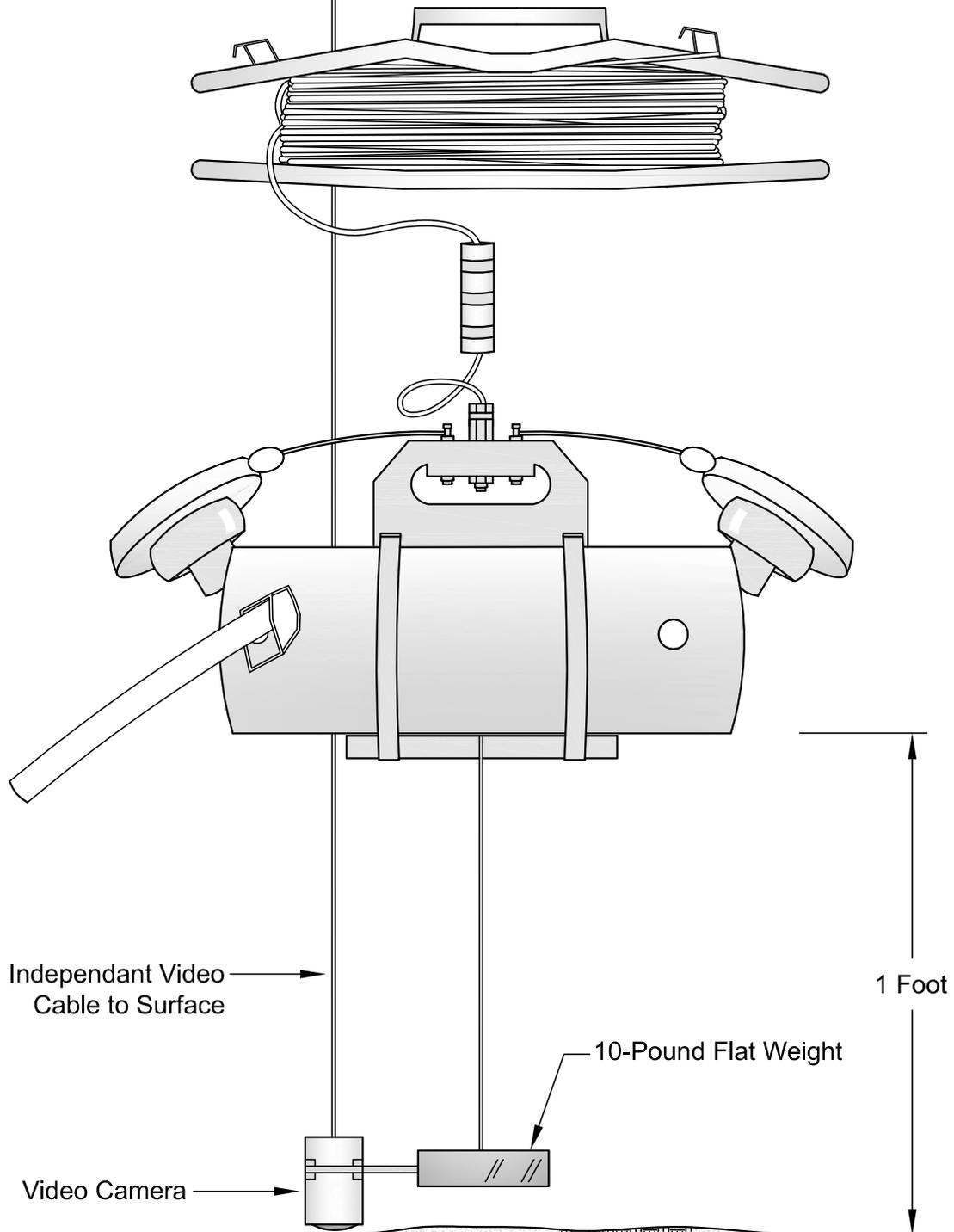


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**Figure 3 (2 of 2)**  
 Proposed Cyanide Surface Water Sampling Schedule  
 NW Natural - Gasco Site  
 Portland, Oregon

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**Figure 4**  
Van Dorn Sampler Schematic  
NW Natural Gasco Site  
Portland, Oregon



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**APPENDIX A**  
**RESPONSES TO DEQ'S COMMENTS ON THE DRAFT CYANIDE**  
**SURFACE WATER FIELD SAMPLING PLAN**

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**Responses to DEQ August 30, 2007 Comments on  
July 2007 Draft Cyanide Surface Water Field Sampling Plan  
Northwest Natural Gas Company Site  
Portland, Oregon  
ECSI #84**

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**GENERAL COMMENTS**

**Oregon DEQ General Comment 1**

DEQ understands from reviewing the document that over a 3-day period, three surface water samples (i.e., shallow depth, mid-depth, near bottom) will be collected at each sampling location during ebb, flood, and slack tides. It appears from Table 1 that during the sampling program NWNG's goal is to collect one sample at each location during each tidal event. The Surface Water FSP does not include information about how sampling will proceed in the field so that comparable representative samples are collected within the timeframes indicated (i.e., three hours prior to low and high tides, or one hour before or after low and high tide).

Response to General Comment 1: Clarification on sampling logistics is provided in the revised Sections 2.2 (frequency) and 3.1 (schedule) of the FSP. To assist DEQ in visualizing the sampling schedule, a figure has been included in the revised FSP (Figure 3) depicting the proposed approach.

However, we are unclear whether DEQ's concern is regarding the comparability of results from samples collected during one tide event (e.g., ebb tide) at different times within that event (e.g., the first hour versus the second hour). Results collected from similar tidal periods over consecutive days will be comparable. Though the time of day the tides peak will change slightly within a several day period, river conditions are not expected to change dramatically enough to completely alter the comparability of the results.

We believe that the draft FSP was lacked enough clarity regarding the number of sampling stations that can be logistically sampled over several consecutive days. We appreciate that DEQ understands that it is not possible to collect three sets of samples at 20 stations within one flood tide event, or within one 24-hour period for that matter. Nor is it possible for all 20 stations (with all three depths) to be sampled at each tide event in 3 days.

The goal of the sampling is to obtain a better understanding of cyanide concentrations in the river under various conditions. The sample collection frequency is defined to provide a window within which samples collected from that time period represent locations under similar conditions. We understand that over the course of an outgoing tide, the velocity of the river may increase and/or decrease. However, samples collected during this time period best represent outgoing tide conditions more than any other tidal conditions. The FSP will explain the revised strategy, specifically in Section 2.2.

**Oregon DEQ General Comment 2**

DEQ considers the overall data collection objective of the surface water sampling program to be obtaining comparable data representative of the range of conditions operating in the river. To meet this objective DEQ expects the sampling approach to be modified so samples are collected

at or near slack high tide and slack low tide, and during either the flood or ebb tides. Of the three tidal events identified for sampling in the Surface Water FSP, DEQ considers the slack tide sampling to be of particular interest as it represents tidal extremes. The lowest and highest potential groundwater flux into the river presumably occurs at high and low slack tides respectively. Furthermore, given the approximate symmetry of the tidal cycle, DEQ considers samples collected during the ebb and flood tides to be duplicative. As such, DEQ considers focusing sampling efforts on the slack tides (i.e., collecting samples during both slack tides) to be warranted.

Response to General Comment 2: We appreciate that it would appear high and low slack tide would be the time where groundwater “flux” would be lowest and highest, respectively. However, we do not agree with DEQ’s statement that sampling surface water at both flood and ebb tides would be duplicative. Potential exposure to transition zone water is important to evaluate in context with the volume and velocity of the above surface water. During the outgoing “ebb” tide, the force of the outgoing tide adds to the river flow, while during an incoming “flood” tide, this force is counter to river flow. Thus, in terms of river velocities, directions, and currents in general these two conditions are very different. Moreover, as mentioned in the FSP, reverse flow has been observed in the river during flood tides, which will be demonstrably different than ebb tide conditions with flow in the normal river direction.

We agree to collect surface water at both slack high and slack low tides and have revised Sections 1.2 (Objectives) and 2.2.3 (Slack Tide Cyanide Sampling) to clarify this. We have removed Section 2.2.1 (formerly Flood Tide Sampling) and have split Section 2.2.3 into two separate sections for slack high tide (Section 2.2.2) and slack low tide (Section 2.2.3).

However, the time of days available for slack conditions, if strictly defined, are very brief. Thus, it will be impossible to collect all samples at truly full slack conditions and still have the surface water samples collected over a relatively short (and therefore similar flow conditions) number of days. We have added Figure 3 that shows the planned condition of the tidal cycle for every station for each of three events at each station. The result is that a slack high, slack low, and ebb condition is sampled at every station, with some minor variations in the exact tidal conditions occurring during each slack sample taken.

## **SPECIFIC COMMENTS**

### **Oregon DEQ Specific Comment 1**

**Section 1.1.** The Surface Water FSP concludes that, “Due to iron levels in the groundwater, a large portion of measured total cyanide is complexed with iron in a stable iron cyanide form”. DEQ consider it premature to draw conclusions regarding the stability and forms of cyanide in groundwater, TZW, or surface water without completing the Offshore FSA and Surface Water FSP.

In the last paragraph, NWNG indicates that existing information will be reviewed to evaluate the potential for migration of free cyanide in groundwater to surface water. In addition to the data generated by the Offshore FSA and Surface Water FSP, uplands groundwater information should be included in the data review and analysis. Additionally, the text indicates that data from this work will be used to assess the potential unacceptable risk of exposure to receptors in the river from cyanide. DEQ understands this to mean that the surface water data will support the in-water ecologic risk assessment to be prepared by the LWG.

Response to Specific Comment 1: First, we believe that DEQ will have the necessary information to better understand the iron complexed statement in the FSP after reviewing a recently submitted memorandum on cyanide fate, transport, and potential toxicity. Anchor submitted that memorandum to DEQ August 17, 2007. To briefly summarize the cyanide memorandum, several pieces of information, including Site data, suggest that the majority of total measured cyanide is in a form other than free and is likely complexed with iron, as with other MGP sites and given the high iron levels measured at the Site.

Second, Section 1.2 (Objectives) of the revised FSP has been revised to include upland groundwater as part of the data review.

Regarding the last portion of Specific Comment 1, in addition to in-water risk evaluations, NW Natural plans to utilize the results of this sampling in evaluating the utility of groundwater source controls in Segment 2 proposed in the GWFFS. Depending on the results, we believe this cyanide sampling may provide important insight to the details of the robustness of upland groundwater controls design in this segment. It is unfortunate that this sampling cannot be completed in time for the submittal of the draft GWFFS. However, as with other ongoing investigations (such as vibration studies under discussion with Siltronic and DEQ), the GWFFS will discuss the potential for more detailed information to impact the design of the upland source controls evaluated in the GWFFS.

### **Oregon DEQ Specific Comment 2**

**Section 2.** DEQ understands from Table 1 that during each of the three tidal events measurements of field water quality parameters (2<sup>nd</sup> bulleted item) will be made, and three water column samples (3<sup>rd</sup> bulleted item) will be collected at each sampling location. This information should be clearly stated in the referenced bulleted items.

The 6<sup>th</sup> and 7<sup>th</sup> bulleted items indicate that relative to the NWNG property lines, two downstream (GSW-01, GSW-02) and two upstream (GSW-19, GSW-20) sampling locations have been included in the sampling program. According to the text of the bullets, downstream locations GSW-01 and GSW-02 are intended to “determine dilution of potential sources from the site”, and upstream sites GSW-19 and GSW-20 are going to be used to “evaluate background levels”. The footnote associated with these two bulleted items indicates that “downstream” and “upstream” relative to the NWNG Property depend on the direction of the

river current at the time of sampling (e.g., GSW-19 and GSW-20 are “downstream” when the current is to the south). The text and footnote are confusing and appear to be contradictory. NWNG should clarify the specific data collection objectives of these four sampling locations.

Response to Specific Comment 2: We have clarified the second bullet in Section 2 and Section 3.5.3 (Field Parameters) to explain that water quality measurements (pH, Eh, turbidity, dissolved oxygen, conductivity, and temperature) will be collected from each sampling station and depth where water is collected for chemistry.

We are not clear on the basis of DEQs confusion regarding the upstream/downstream footnote. Sampling stations GSW-19 and GSW-20 would be considered downstream from a surface water exposure perspective when the current is reversed and flowing upriver. DEQ is correct about how we plan to utilize the data collected from upstream and downstream stations. However, in the FSP, GSW-01 and GSW-02 are not identified in the sixth or seventh bullet as being the downstream stations, which we believe the footnote explains. Under non-reverse flow conditions, it is expected that GSW-01 and GSW-02 are the representative downstream stations. Regardless, it is important to understand the implications from a transport and toxicity basis of evaluating results of the reference locations in connection with current directions.

If needed, we will gladly provide any further clarification to DEQ on this issue, but we do not feel the Section 2 bullets of the FSP need revision based on this comment.

### **Oregon DEQ Specific Comment 3**

**Section 2.1.** The text of the Surface Water FSP indicates that sampling stations will be located along transects A and B, while Figure 2 shows that sampling will occur along transects B and C. The document should be reviewed and revised as appropriate.

Response to Specific Comment 3: The text in Section 2.1 has been revised to read Transects B and C. Figure 2 correctly depicts the location of the proposed transects.

### **Oregon DEQ Specific Comment 4**

**Section 2.1.3.** It is unclear to DEQ as to how surface water data will be used to develop exposure concentrations for “infaunal” ecological receptors. In general, DEQ considers it more appropriate to use sediment and TZW data to assess the potential risk of exposure to infaunal organisms by MGP-related contamination. The risk of exposure to epifaunal organisms should utilize sediment, TZW, and “near-bottom” surface water data. In any case, prior to developing exposure concentrations DEQ expects NWNG to provide the proposed approach for our review and approval.

Response to Specific Comment 4: The text in Section 2.1.3 has been revised in order to clarify that the results of the cyanide “near bottom” surface water sampling may be used in combination with sediment and transition zone water (TZW) to evaluate both infaunal and

epifaunal receptors. Exposure concentrations that might be derived for epifaunal receptors would utilize near bottom results. Infaunal exposure concentrations would utilize sediment, transition zone water and to the extent appropriate, the near bottom surface water results. Results may be useful to the LWG in assessing in-water risk to potential receptors. The results of this study will assist in understanding to what extent cyanide in groundwater is resulting in free cyanide exposures in the river. NW Natural is not proposing an approach for a risk assessment

NW Natural looks forward to discussing and coming to agreement on data usage.

### **Oregon DEQ Specific Comment 5**

**Section 2.2.** DEQ's comments to the second and third bulleted items in Section 2 apply here.

Response to Specific Comment 5: As stated in our response to DEQ's Section 2 comment, we have clarified Section 2.2 to discuss how often and at which locations chemistry and water quality samples will be collected.

### **Oregon DEQ Specific Comment 6**

**Section 3.4.** DEQ recommends that symbols representing flood (F), ebb (E), slack high (S<sub>h</sub>), and slack low (S<sub>l</sub>) tides be incorporated into the sample identifiers. DEQ considers this nomenclature to be more informative than the symbols proposed (i.e., "H" and "L" for samples collected at near high or near low tides respectively). The nomenclature is also consistent with the surface water sampling scope of work.

Response to Specific Comment 5: Anchor will modify the sampling location nomenclature and Section 3.4 has been revised to document the change.

### **Oregon DEQ Specific Comment 7**

**Section 3.5.1.** For clarification and completeness, the first paragraph should indicate that the general protocol for collecting "unfiltered" surface water samples is provided in this section and that Section 3.5.2 describes procedures for collecting "filtered" samples. DEQ also recommends that surface water samples be collected from shallowest to deepest to minimize the potential for cross-contamination.

DEQ requests that NWNG confirm our understanding of the following items discussed in the last paragraph of the section.

- The van Dorn sampler is of a horizontal type;
- The configuration of the surface water sampling equipment includes from lowermost to uppermost, 1) a 10-pound weight, 2) the camera, and 3) the 3-liter van Dorn sampler;
- The distance from the bottom of the 10-pound weight to the van Dorn sampler is approximately 2-feet; and
- NWNG considers the 10-pound weight to be sufficient for minimize drifting of the sampling equipment with the current at each of three proposed sampling depths.

A figure illustrating the sampling equipment set-up would be useful for communicating the information items listed above.

Additionally, NWNNG indicates that samples exhibiting “excessive turbidity” will be discarded and the sampler will be redeployed. Samples exhibiting “excessive turbidity” are most likely to be those collected “near bottom”. The goal of the field program is to collect water column samples that are representative of natural conditions. DEQ expects water turbidity will be measured to establish ambient conditions prior to collecting the “near bottom” samples. This data will be compared to sample turbidity to determine whether the sample is representative and should be retained for analysis. Similarly, DEQ understands “non-turbid” to mean that a sample has measurable turbidity comparable to natural conditions.

Response to Specific Comment 7: First, we have clarified the introduction to Section 3.5 to explain that general procedures for collecting surface water samples are provided in Section 3.5.1. In addition, we have added a new section (now Section 3.5.2) detailing specific collection of unfiltered samples, while Section 3.5.3 now describes filtered sample collection. Field Parameters are now discussed in Section 3.5.4.

Second, NW Natural agrees to sample from shallowest to deepest. To calculate the appropriate mid-depth position, the bottom depth must be measured prior to sampling. Text has been added to Section 3.5.1 documenting this.

Third, in this comment, DEQ requests confirmation on several issues discussed in Section 3.5.1. For clarity, each DEQ statement is repeated here in italics, with our response beneath.

- *The van Dorn sampler is of a horizontal type;*
  - Yes; clarification has been added to this section.
- *The configuration of the surface water sampling equipment includes from lowermost to uppermost, 1) a 10-pound weight, 2) the camera, and 3) the 3-liter van Dorn sampler;*
  - No; the diagram that has been added to the revised FSP clarifies this issue. The order, as we are proposing is: 1) camera; 2) 10-pound weight; 3) sampler.
- *The distance from the bottom of the 10-pound weight to the van Dorn sampler is approximately 2-feet; and*
  - No; the proposed distance from the camera lens to the bottom of the sampler will be approximately 1 foot. These are approximate estimates to explain relative positioning. Actual distance measurements between the devices will depend on field conditions and their behavior in the river at the time of use. This is also clarified in the text.
- *NWNNG considers the 10-pound weight to be sufficient for minimize drifting of the sampling equipment with the current at each of three proposed sampling depths.*
  - Yes; the weight of the individual sampling equipment will also assist in stabilizing the unit. However, a second weight will be on board and can be used

if currents are unexpectedly stronger than anticipated. This is clarified in the text.

Fourth, a figure depicting the sampling equipment set-up has been added to the revised FSP as Figure 4 (Figure 3 is the proposed sampling schedule that we are adding based on DEQ comments).

Lastly, the text of Section 3.5.1 has been clarified to discuss that “excessively turbid” refers to conditions atypical of natural conditions. Excessively turbid samples suggest to NW Natural, that the sampler unit has hit bottom, which would disturb the natural conditions being targeted for sampling. Turbidity meter readings will be used to help determine what is excessively turbid as compared to normal bottom conditions and this has also been added to the text.

#### **Oregon DEQ Specific Comment 8**

**Section 3.5.2.** The filtered sample collection procedure calls for flushing the peristaltic pump tubing with a “small amount” of sample water prior to collecting the sample. The procedure should also include running sample water through the filter until discharge is observed at the outlet and before the sample is collected.

Response to Specific Comment 8: The section discussing field filtration procedures (now Section 3.5.3) has been revised to document the agreed upon procedure of running sample water through the pump before any is collected.

#### **Oregon DEQ Specific Comment 9**

**Section 3.5.3.** DEQ does not approve the procedures for measuring water quality parameters and current velocity described in this section of the Surface Water FSP. The text does not adequately discuss how the depth of parameter/velocity measurements will be correlated to the sample collection depth. In addition, given that all surface water sample collection stations are located greater than 100 feet from the shoreline, NWNG’s proposal to only measure current velocity/direction at three sites between 50 and 100 feet from the shoreline is not sufficient to inform the sampling program.

Thoughts:

DEQ recommends that methods for measuring water quality parameters and current velocity be modified so that measurements are made: 1) at depths approximately equal to the depth of surface water sample collection; and 2) concurrently at every surface water sampling station. These data collection objectives could be achieved by attaching the multiprobe and velocity meter to a calibrated telescoping rod or 10-pound weighted line.

Response to Specific Comment 9: Clarification has been provided in the section discussing field parameters (now Section 3.5.4 of the revised FSP) to explain that water quality parameters will be collected at approximately the same time, location, and depth from

where a surface water sample is collected for cyanide analysis. Once the sample depth is determined via the methods described in the FSP, field crew will have the approximate depth of the sampler and can deploy the Hydrolab to the same approximate depth.

However, we will not collect velocity measurements in conjunction with each surface water sample. Velocity measurements are not necessary at every sampling station. The measurements were originally proposed to allow for general observations on river current characteristics in this general region of the river during the sample collections. Thus, we are interested in knowing whether velocities during sampling:

- Generally show downstream or upstream flow conditions so that we can understand which bounding stations may be considered “background.”
- Are relatively high or low in the general vicinity of the Site and how that compares to river stage information.
- Show any large scale eddies causing potential regional upstream flow conditions occurring.
- Are generally lower nearer to shore as would be expected.

We do not expect to use these results in any way to correlate velocity on a sample-by-sample basis with cyanide concentrations. Given the known variability of any constituent concentrations in moving surface waters over time, even under identical velocity conditions, we do not think that any such attempted correlation is technically valid.

NW Natural appreciates the point DEQ makes regarding the proposed offshore distance for velocity measurements compared to the offshore distance of the surface water samples. We agree with DEQ’s comment and propose to add an independent crew that will concurrently collect velocity measurements at three surface water collection stations over the three depth intervals. The measurements will be collected concurrently with surface water collection. The three velocity measurement stations will be GSW-04, GSW-13, and GSW-18. Section 3.5.3 text (now Section 3.5.4) has been revised to modify the velocity measurement procedures and locations.

#### **Oregon DEQ Specific Comment 10**

**Section 3.6.1.** NWNG indicates that replicate samples will require the van Dorn sampler to be deployed twice. DEQ understands that the field replicates are intended to provide duplicate unfiltered and filtered sample sets from selected sampling locations. If this is the case then the van Dorn sampler will be deployed 4 times for the replicate (twice for unfiltered plus twice for filtered). Alternatively, NWNG may be referring to the number of sampler deployments to collect two complete sets filtered and unfiltered samples. The text should be reviewed and revised as appropriate to clarify NWNG’s intentions.

Response to Specific Comment 10: The section (3.6.1) has been revised to clarify that two deployments (in addition to the initial grabs) will be made to collect enough water for the quality assurance/quality control samples for replicate analysis. We have also proposed

using a 5 liter van Dorn, rather than a 3 liter van Dorn, and will therefore need only one grab for unfiltered and one grab for filtered for a sample set. Therefore, two additional grabs will be required for replicate samples.

#### **Oregon DEQ Specific Comment 11**

**Section 3.6.4.** NWNG indicates that field activities will be documented in a field logbook. Section 3.5.3 further indicates that field measurements will be recorded on a field measurement log sheet. Neither the list of logbook entries nor the log sheet includes all of the information typically needed to document sample collection (e.g., sample collection time, sampling method, number of containers, container type/size, use and type of preservative). The section should be revised accordingly.

Response to Specific Comment 11: Sampling information that is included in standard Chain of Custody forms will be documented for each sample collected. This information includes sample collection time, sampling method, number and type of containers, and preservatives. Section 3.6.4 has been revised to clarify the documentation of this information.

#### **Oregon DEQ Specific Comment 12**

**Section 3.6.5.** DEQ recommends that field equipment calibration checks be performed at least twice per day according to manufacturer's specifications (e.g., once prior to initiating sampling and once at the end of the day). Calibrating the meters twice is needed to assess probe sensor drift that can occur over time, particularly with pH and dissolved oxygen sensors. DEQ further recommends that field equipment calibration measurements be recorded in log books dedicated to each instrument.

Response to Specific Comment 12: Calibration checks are different than calibration. Calibration checks, testing the meter against standard reference solutions that can be used to assess sensor drift, will be conducted twice a day. The actual calibration of the meter will occur once at the beginning of the day regardless, or immediately after a calibration check that indicates unacceptable drift in the sensor or meter. The text has been revised to clarify this. The field crew will use dedicated calibration log books for each piece of equipment. Section 3.6.5 will be revised to incorporate these changes.

#### **Oregon DEQ Specific Comment 13**

**Section 3.7.1.** DEQ recommends the following regarding field equipment decontamination:

- The van Dorn sampler should be washed with phosphate-free detergent and tap water, and rinsed with deionized water prior to each sampling event and between each sampling station.
- In addition to using a new filter to collect samples for dissolved analyte analysis, DEQ recommends using dedicated peristaltic pump tubing at each sampling station.

Response to Specific Comment 13: NW Natural agrees to DEQ's recommendations for field

equipment decontamination of the van Dorn between each sampling station and the use of dedicated tubing for each sampling station. Section 3.7.1 has been revised to document this change in procedures.

#### **Oregon DEQ Specific Comment 14**

**Section 4.** Given the information provided, it is unclear how the sulfide data will be used in interpreting sampling results and evaluating risk. NWNG indicates that complexes of iron, sulfide, and cyanide result in less toxic forms of cyanide. DEQ anticipates that additional supporting information will be provided in the report documenting the results of the surface water sampling work.

Response to Specific Comment 14: As DEQ suggests, supporting information has been provided in the data report. Sulfides results will assist in evaluating bioavailability and toxicity of cyanide. Revision to the text is not required based on this comment.

#### **Oregon DEQ Specific Comment 15**

**Table 2.** DEQ understands that: 1) the second column provides the minimum sample size needed to complete the specified analysis; and 3) the third column indicates the volume of sample that will be collected during the field program. NWNG should confirm this is the case and revise the column headings accordingly.

Response to Specific Comment 15: DEQ is correct in their understanding. The column headers of Table 2 have been revised to clarify the purpose of the volume and container requirements.

#### **Oregon DEQ Specific Comment 16**

**Table 3.** The method detection limit (MDL) and the practical quantitation limit (PQL) listed for total, amenable, and free cyanide is 0.005 milligrams per liter (mg/l) is 0.010 mg/l. NWNG indicates that these may be the lowest values achievable for these parameters. For NWNG's information, DEQ is aware of a laboratory achieving a "method reporting limit" for free cyanide of 0.003 mg/l. DEQ will expect that to the maximum extent practicable, the PQL and MDL for free cyanide will be the lowest value achievable with the goal being less than 0.005 mg/l.

Response to Specific Comment 16: We are aware of and appreciate the importance in achieving an MDL below 5.2 ppb (DEQ's ecological screening value). DEQ has recently informed us that the laboratory referred to in their comment is Test America. We have since reviewed preliminary information received from Test America regarding the cyanide methods. We are currently not convinced that the suggested free cyanide reporting limit of 3 ppb is achievable consistently given the limits of the analytical technology being utilized for analysis (i.e., Spec 20). Generally, a reporting limit is a reflection of the accuracy of the instruments performing the analysis. To our knowledge, a reporting limit of 3 ppb appears to be stretching the ability of the instrument to accurately and consistently report results. We are currently working with Test America to see if they can provide us with evidence of

their ability to consistently meet the low level standard. We have not revised the FSP based on this comment and at this time, continue with proposing to use CAS. If Test America can convince us of their abilities, we may switch laboratories for the cyanide program. If we do switch to Test America, we will inform DEQ of the change prior to submitting the samples for analysis.

**Oregon DEQ Specific Comment 17**

**Figure 2.** For comparison purposes and completeness, the Offshore FSA Step 1 sampling locations should be labeled for reference.

Response to Specific Comment 17: Figure 2 has been revised to show the Offshore FSA Step 1 sampling location labels, as well as the proposed locations for velocity measurements, as discussed in Response to Specific Comment 9.