

Memorandum



To: Mike Gross, PE, U.S. Army Corps of Engineers, Portland District
From: Jeff Wallace, R.G. and Brian McNamara, R.G.
Date: May 12, 2008
Subject: Post-Removal Sample Collection, Bradford Island Disposal Site
Bonneville Dam Forebay - Cascade Locks, Oregon

1.0 INTRODUCTION

In accordance with Contract No W9128F-04-D-0001, Task Order No. DT06, URS collected environmental samples of various media from the Columbia River near Bonneville Dam between February 11 and March 20, 2008. Sampled media included surface water, sediment, Asian clams, crayfish, and sculpin. The sampling procedures used were in general accordance with the *Quality Assurance Project Plan, River Operable Unit Remedial Investigation, Bradford Island, Bonneville Lock and Dam Project*, Cascade Locks, Oregon (URS 2007).

This report describes the field activities and provides information on the samples collected. Currently, all samples are being analyzed at laboratories specified in the QAPP. Laboratory results will be provided under in a separate report.

A total of 138 environmental samples were collected and submitted for laboratory analysis as a result of this field study. The samples to be analyzed are summarized below¹:

Total Number of Samples Analyzed to Date	Sample Media
10	High-volume surface water
10	Surface water grab samples (and 1 duplicate)
37	Sediment (co-located)
37	Asian clams (co-located)
8	Sediment <i>only</i> (Eagle Creek and downstream stations)
36	Crayfish
0	Sculpin

¹ Several stations targeted for collections yield insufficient mass of one or more media to meet the project objectives. The results of these unsuccessful stations are not described in this report, except as documented in the tables.

The sample stations coordinates are provided in Table 1. Table 2 describes the sampling success (i.e., sufficient volume for analysis) at each station location identified within the QAPP (URS 2007).

2.0 OVERVIEW

Sampling was conducted in three general areas: the Bonneville Dam Forebay, downstream of the Bonneville Dam, and at an upstream reference area. Except at stations near the confluence of Eagle Creek and the Columbia River, sampling was conducted from a boat provided and operated by Northwest Underwater Construction under subcontract agreement with URS. A small number of sediment stations were sampled using divers, after sampling with surface-deployed samplers proved ineffective.

Field work was generally conducted by two field sampling teams: one team collected collocated sediment and Asian clam samples, the second team would either trap for sculpin and crayfish, or perform high-volume water sampling. Sediment sampling without the collection of collocated Asian clams was conducted at stations downstream of Bonneville Dam and at two Eagle Creek stations.

A differential global positioning system (DGPS) unit was used to confirm that sampling occurred at the stations. When necessary, changes to these stations were recorded in the field logs and new coordinates were recorded with the DGPS.

3.0 SAMPLING TARGETS

3.1 High-Volume Water Sampling

3.1.1 Methods

High-volume water samples were collected using an Infiltrax 300 Organic Sampling System (Infiltrax) supplied by Axys Environmental Systems in Sidney, British Columbia, Canada. This method is used to concentrate trace levels of particulate-bound and dissolved-phase chemicals from a large volume of water for analysis by standard analytical methods. The Infiltrax pumps water through a wound-glass filter to remove particulate-bound chemicals, and then pumps the water through a column packed with macroreticular porous resin where dissolved-phase chemicals are absorbed. During this field effort, approximately 600 liters of water were pumped for each sample. A summary of field data collected during high-volume water sampling is located in Table 3.

Ten high-volume water samples were collected on 10 field days (one sample per day). Sample locations were accessed by boat, which was anchored at the sampling station. Once the boat was in place, intake tubing was lowered into the water until the inlet was approximately 3 above from the river bottom. Depth to bottom was determined using the boat's depth-finder and confirmed with weighted tape. The Infiltrax tubing intake was kept at the sampling depth using a weighted line, which was adjusted over the course of the sampling day as changes in the current or wind direction affected sample depth. Sampling took about 6 hours to complete. Depending on the amount of suspended particles in the water, a second wound-glass filter was sometimes needed. In these cases, the Infiltrax pump would be paused

while the flow was routed to the new filter. Both filters were composited and analyzed as one sample by the laboratory.

All concentration calculations were performed using the total volume from the digital flow meter. Flow rate was measured both on the Infiltrax's internal digital flow meter and verified periodically by hand using a graduated cylinder and a stopwatch. The particulate and dissolved-phase Infiltrax samples were analyzed by Axys Analytical Services, Ltd. (Axys Analytical) in Sidney, British Columbia, Canada for semi-volatile organic compounds (SVOCs) and PCB congeners.

At the end of each sampling day and after removal of the sample columns and filters, the Infiltrax was pumped dry and cleaned by pumping (1) Alconox®/water solution (2) deionized water and (3) 10% methanol/deionized water solution through the system in that order. Dedicated Teflon-lined tubing was used at each sample station. Therefore, cleaning the sample tubing between stations was not necessary.

In addition to operating the Infiltrax, water quality was periodically monitored for temperature, pH, conductivity, and dissolved oxygen using a YSI 556 water quality meter. Grab water samples were collected at each Infiltrax sampling location. These grab water samples were analyzed by Columbia Analytical Services (CAS) in Kelso, Washington for total and dissolved diesel, total and dissolved metals, total organic carbon, dissolved organic carbon and anions (chloride, nitrate and sulfate). Dedicated tubing was also used for the collection of these samples, eliminating the need for decontamination measures between sample locations.

3.2 Sediment Collection

A total of 27 field days were spent sampling for sediment using boat-deployed grab samplers, wading, or divers. Sediment sample characteristics are described in Table 4.

3.2.1 Sediment Collection Using Grab Samplers

Two sediment grab sampling devices were used over the course of the sampling effort: a box core sampler, and a Van Veen sampler.

The box core sampler weighs approximately 70 pounds and has dimensions of 12 inches (in) by 12 in by 18 in deep. Prior to deployment, the box core rested in a stand which was fastened to the aft deck of the sampling boat. The box core was deployed using an A-frame davit equipped with a winch, picking it up off its stand and then lowering over the stern of the boat and slowly winching it down into the water. Upon impact with the substrate, the box core snaps closed and is retrieved using a winch on the boat.

Following deployment, the box core sampler was winched back up, set on its stand, and its contents were inspected. If the box core filled with sediment, the retrieved sediment was sampled through the flaps in the top using a dedicated stainless steel spoon. The box core stand supported the sampler and allowed it to be emptied into a container placed below it. Although sediment was collected from the top of the box core, the stand was helpful for emptying the box core to search for Asian clams.

The Van Veen sampler was also used to collect sediment during this field effort. Sediment was most frequently collected using this sampler because the Van Veen sampler could be

deployed more rapidly than the box core. The Van Veen is a smaller than the box core and weighs approximately 40 lbs. This sampler was deployed using a winch-equipped davit on either the port or starboard side of the boat. Upon impact with the substrate, the Van Veen snaps closed and is retrieved.

Sediment sampling using both the box core and the Van Veen were performed with the boat engines turned off and the vessel was lying at anchor. Typically two, and some instances three, anchors were deployed at each sampling station. The sampling boat was able to move within the targeted grid box by alternating releasing rode on one or more anchors and tightening the other(s).

Sediment samples were collected from the top of the grab samplers using a decontaminated or dedicated stainless steel spoon. After filling a laboratory-supplied glass jar with sediment, the sediment grab sample would be emptied into a plastic tub where it could be inspected for Asian clams (see Section 3.3 for additional information on Asian clam collection).

The success of the box core and Van Veen samplers was highly dependent on the river current strength and river bottom conditions. Both samplers were very successful in areas with low current and flat, soft, silty or sandy bottoms. Where the river current was strong or the substrate sloped, the samplers would be pushed off vertical and were likely to turn over. Where the substrate was rocky, the samplers either had no recovery, or recovered coarse gravel and cobbles. Since the samplers were dropped semi-randomly within a station area, there was no way to aim the samplers at patches of sediment between rocks.

As described in the QAPP, either the box core or Van Veen (or a combination of both) were deployed a minimum of ten times at each sample station. A station was considered successful if two or more jars of sediment were collected from each station, and a sufficient number of clams were collected for analysis. Procedures outlined in the QAPP were followed for determining whether a grab sample, using either the box core or Van Veen, was acceptable or not. If the deployed grab sampler was deemed acceptable (as evidenced by even penetration and standing water in the sampler) then a laboratory-provided 8-ounce glass jar of sediment was collected.

Both the Van Veen and box core were rinsed in river water prior to and after each sample location. The grab samplers were inspected for visible presence of contamination (i.e grease, iridescent sheen, etc.) before each deployment.

3.2.2 Sediment Collection at Eagle Creek

Two sediment sample stations (43 and 44) were accessed by wading into the Columbia River at the mouth of Eagle Creek. These locations are frequented by fishermen who wade to a gravel bar in the mouth of the creek. To collect the samples, field personnel waded out to a water depth of approximately 3 feet and collected sediment by scooping up a shovelful of sediment and then scraping the sediment into a laboratory-provided 8-ounce glass jar. Similar to the other sediment sample stations, 8 to 10 jars of sediment were collected at each sample station and later homogenized by CAS (Kelso). As specified in the QAPP, no Asian clams were collected at the Eagle Creek stations.

3.2.3 Diver-Collected Sediment

Poor sediment and Asian clam recovery using the box core and Van Veen samplers occurred at 12 station locations. The reasons for poor recovery included poor sediment deposition, thin layers of sediment, presence of large rocks and/or rip rap. It was necessary to re-visit these areas to collect sediment and Asian clams to improve statistical robustness of the sampling dataset.

From March 17 to 19, 2008, U.S. Army divers re-sampled four previously attempted stations (5, 6, 13 and 14) and two new forebay stations (88 and 89). Sufficient quantities of sediment and Asian clams were successfully collected from all six stations.

Divers worked in dry suits with air supplied by an on-deck compressor. Each helmet was outfitted with a video camera, light, and audio communications which allowed those on board to view the substrate and audibly communicate with the diver. Divers descended to the river bottom at each station carrying mesh collection bags filled with sediment sampling jars flooded with river water. The flooded jars prevented the sample jars from floating and facilitated opening them underwater. The diver filled the sediment jars by scraping the jars through the sediment along the river bottom. The filled jars and any Asian clams the diver collected were placed in the diver's mesh collection bag. Once on deck, the jars were labeled, the Asian clams were counted, and all samples were placed in a cooler with ice.

3.2.4 Laboratory Analysis of Sediment Samples

The 45 sediment samples were sent to CAS in Kelso, Washington for analysis of PCBs as Aroclors, metals, SVOCs, total organic carbon, and percent solids. Samples are archived frozen for potential future PCBs congener analysis.

3.3 Asian Clam Collection

A total of 26 field days were spent sampling for Asian clams using boat-deployed grab samplers or divers. Asian clam sample characteristics are described in Table 5.

3.3.1 Asian Clam Collection Using Grab Samplers

Initial attempts to collect Asian clams were conducted using the box core and Van Veen grab samplers described in Section 3.2.1. Asian clams were collected after sediment had been collected directly from the sampling device. The remaining sediment would be deposited in a wide, plastic bin and then sifted using gloved hands to search for Asian clams. Once the Asian clams were collected, the sediment was disposed of overboard and the bin was rinsed with river water.

Collected Asian clams would be placed in a colander and rinsed with river water to remove gross sediment contamination. The rinsed Asian clams were then examined and live clams were picked out, counted, and placed into a gallon-sized, labeled zip-closure plastic bag. This bag would be stored in a cooler with ice, and clams collected from subsequent grabs at the same sample station would be added to it.

3.3.2 Diver-Collected Asian Clams

Divers collected Asian clams from six stations (Stations 5, 6, 13, 14, 88, and 89). Divers were able to collect sediment and Asian clams more efficiently than the semi-random drops of the grab samplers. The divers were able to find pockets of live clams and quickly discount areas where there were no Asian clams present. The divers also had the advantage of being able to recover Asian clams from areas that would not suit a grab sampler, such as under rock overhangs, between cobbles and boulders, and from relatively thin layers of sediment.

The Asian clams collected by the divers were placed in a colander and rinsed with river water to remove gross sediment contamination. The rinsed Asian clams were then examined and live clams were picked out, counted, and placed into a gallon-sized, labeled zip-closure plastic bag. This bag would be stored in a cooler with ice, and Asian clams collected from subsequent dives at the same sample station were added to it.

3.3.3 Asian Clam Shucking and Compositing

Asian clams collected from the field were delivered to the URS environmental laboratory for further processing. At our lab, trained staff removed the Asian clam tissues from their shells using a shucking knife. Once shucked, both the tissue weight and shell length (measured across the shell width) were recorded for each individual clam. The shucking knife, mesh protective glove, sample bowls, and scale surface were decontaminated between shucking Asian clams from different sample stations. Cleaning consisted of an Alconox® wash, deionized water rinse and a final 100% methanol rinse.

3.3.4 Asian Clam Characteristics

Table 5 provides a summary of the water depths and Asian clam sample characteristics at each sample station. Asian clam samples were successfully collected from 42 stations. The number of Asian clams collected from each station ranged from 14 to 198. The average clam size at each station ranged from 2.7 to 3.5 cm. The average clam weight at each station ranged from 1.8 to 3.5 grams (g).

3.3.5 Laboratory Analysis of Asian Clam Samples

The 37 selected Asian clam samples were sent to CAS in Kelso, Washington for analysis of PCBs as Aroclors, metals, SVOCs, methyl mercury, and percent lipids. Samples are archived frozen at CAS (Kelso) for potential future PCB congener analysis.

3.4 Crayfish and Sculpin Trapping

A total of 13 field days were spent deploying, checking, moving, and retrieving traps for crayfish and sculpin. Cumulatively, traps were deployed for a total of 382 days at the stations. Table 6 describes the trapping effort and success at each station.

Two to four traps were deployed at each station for periods ranging from one to four days. Generally, one trap at each station had a 0.5-inch entrance diameter (minnow trap) and one had a 1-inch entrance diameter (crayfish trap). The smaller diameter targeted sculpin while the larger diameter targeted crayfish. In actuality, however, no pattern was observed between trap opening size and capture of crayfish and sculpin. The traps were baited with cans of dog

food and cans of tuna in oil. The tops of the cans were pierced using a can opener in several places, which allowed the bait juices to seep from the cans. Weights (lead or river rock) were also placed in the traps to keep them from being carried off station by river currents. Traps were marked by attaching them to ropes and labeled buoys. No bait preference for target organisms was observed. Bait was analyzed for PCB Aroclors and no detectable levels were found.

3.4.1 Crayfish

Crayfish were often successfully captured by the traps and a total of 291 crayfish were collected during this effort. In some locations, crayfish could not be successfully collected, regardless of how long the traps were left in place or how much bait was present in the traps. This suggested that crayfish could only be successfully trapped in or near locations with acceptable crayfish habitat.

A total of 36 samples were sent to CAS in Kelso, Washington for analysis of PCBs as Aroclors, metals, SVOCs, methyl mercury, and percent lipids. Samples are archived frozen at CAS (Kelso) for potential future PCB congener analysis.

3.4.2 Sculpin

Sculpin were infrequently found in the traps. After 382 days of trapping effort, a total of 12 sculpin were collected. There are several possible explanations for this lack of trapping success. It may be that the traps were set too deeply to catch most sculpin, a minimum trap depth of 8 feet was set by the Oregon permit. Alternately, sculpin may not be very attracted to baited traps and that the more labor-intensive angling may be a better method of capture. Also, water temperatures and time of year may play a role in the sculpin activity. Due to insufficient tissue mass at any station, no sculpin tissue samples were analyzed. We understand that the Corps plans additional effort to capture sculpin later this year.

3.4.3 Crayfish/Sculpin Characteristics and Compositing

Following each day's field activities, sample coolers were transported to the URS environmental laboratory and topped off with ice. Crayfish and sculpin were subsequently frozen until dead then measured and weighed. This information established whether the minimum sample mass had been achieved and whether sample compositing would be necessary. The characteristics of each crayfish and sculpin were recorded to help ensure that tissue collected from different stations are comparable.

Table 7 provides a summary of the crayfish sample characteristics at each sample station. At least one crayfish was collected from 36 sample stations. The collected crayfish were present in a gender ratio of 65% males to 35% females. The number of crayfish collected at each station ranged from 2 to 21 crayfish. The average length of crayfish (measured from front of carapace to end of tail) at each station ranged from 5.8 to 10.5 cm. The average crayfish weight at each station ranged from 7.6 to 42.6 g.

Table 8 provides a summary of the sculpin characteristics at each sample station. At least one sculpin was collected from 8 stations. The number of sculpin collected at each station

ranged from 1 to 4 sculpin. The lengths of the collected sculpin ranged from 6.5 to 14.5 cm. The masses of the collected sculpin ranged from 6.5 to 42.2 g.

4.0 BY-CATCH

Neither sediment grab sampling or trapping was expected to result in high quantities of by-catch. Sediment grab sampling did result in the capture of a number of non-target organisms including native freshwater mussels, red worms, one lamprey, and a number of small snails. All by-catch collected by the sediment grab samplers was returned to the river at approximately the location where it was collected. In addition to these non-target organisms, one small crayfish was captured using the Van Veen grab sampler at Station 5. This crayfish was discovered inside an empty freshwater mussel shell. The crayfish was collected in a clean soil jar and added to the crayfish sample from Station 5.

The construction of the minnow and crayfish traps used for aquatic organisms trapping were such that organisms that were mobile and small could exit through the trap openings. This sampling method resulted in very little by-catch, and the only non-target organisms collected were one smallmouth bass (*Micropterus dolomieu*) and one salmonid fingerling (species unknown). Each fish was approximately 4 inches long, and both were alive when returned to the river.

5.0 VARIANCES FROM QAPP

The realities of the field required a few changes from the proposed work described in the QAPP. Most of these variances stemmed from inadequate sampling success at the pre-established sampling stations. More specifically the variances are as follows:

- **Volume of water pumped:** The QAPP predicted that approximately 700 liters of river water would be pumped through the Infiltrax for each high-volume water sample. On average, only 608 liters were actually pumped. *This QAPP variance is not anticipated to adversely affect sample results.*
- **Trap locations:** At stations where trapping remained unsuccessful after repeated attempts, trap locations were shifted to areas that appeared more promising. Generally this direction was shoreward, but in some cases, entirely new trap stations were established. *This QAPP variance is not anticipated to adversely affect sample results.*
- **Sediment locations:** In an effort to obtain collocated sediment and clam tissue samples, sediment locations were moved. Also, in areas where crayfish and sculpin could not be successfully collected, sediment locations were moved. *This QAPP variance is not anticipated to adversely affect sample results.*
- **Diver Collection Method:** The QAPP specified that divers would use a stainless steel spoon to collect sediment samples. Spoons ended up being awkward to handle with the thick gloves the diver's wore. For this reason, the divers did not use spoons but rather scooped up the sediment using the edge of the jar. *This QAPP variance is not anticipated to adversely affect sample results.*
- **Trap configuration:** The QAPP specified that one minnow trap and one crayfish trap would be used at each trapping station. Field observations, however, suggested that

the trap opening size had little effect on whether crayfish and sculpin were collected. That is, crayfish were found in both types of traps and sculpin were found in the crayfish trap. Due to this observation and the availability of additional crayfish traps, traps were deployed in configurations different than those specified in the QAPP. For example, two crayfish traps would sometimes be deployed together, or more than two traps, up to four traps, would be deployed together in an attempt to increase the tissue collected from that location. *This QAPP variance is not anticipated to adversely affect sample results.*

- **Crayfish Samples:** The QAPP specifies compositing a minimum of 10 crayfish per sample station. Table 7 identifies which samples met these criteria. Crayfish samples were composites of 2 to 21 crayfish depending on the success at each sample station. Compositing of adjacent sample stations was done to try to maximize the total number of crayfish in each sample, resulting in varying sizes of sample stations represented by the yellow polygons show in Figures 1 and 2. *This QAPP variance is not anticipated to adversely affect sample results, however it should be considered during data evaluation.*
- **Crayfish Samples:** Insufficient tissue volume was collected at Stations 2, 3, and 105 to run all planned analyses. As a result, no SVOC analyses were conducted on the tissue samples from these three stations.

6.0 REFERENCES

URS 2007. *Quality Assurance Project Plan, River Operable Unit Remedial Investigation, Bradford Island, Bonneville Lock and Dam Project, Cascade Locks, Oregon.* September 7, 2007.

7.0 ATTACHMENTS

Please find the following documents attached:

Tables

Table 1	Coordinates for Sample Stations
Table 2	Sampling Success Summary
Table 3	High-Volume Water Sample Summary
Table 4	Sediment Sample Summary Table
Table 5	Asian Clam Sample Summary
Table 6	Trapping Summary
Table 7	Crayfish Sample Characteristics
Table 8	Sculpin Sample Characteristics

Figures

Figure 1	Forebay Sampling Stations
Figure 2	Reference Sampling Stations
Figure 3	Downstream Sampling Stations
Figure 4	Sculpin Stations

Photolog

TABLES

Table 1. Coordinates for Sample Stations
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

General Location	Station Location	Northing	Easting
Bonneville Dam Forebay	1 center	724834.27	7834521.26
	2 center	724806.96	7834166.78
	3 center	724829.88	7833926.55
	4 center	723704.97	7834226.95
		723667.22	7834220.30
	5 center	723508.79	7835226.32
		723368.03	7835136.87
	6 center	723176.13	7834987.06
		723215.40	7835016.46
	7 center	722959.02	7834359.01
		722994.72	7834349.81
	8 center	722832.67	7833775.08
		722853.18	7833775.77
	9	722967.91	7833037.12
	10	723056.52	7832607.37
	11	722308.27	7832384.69
	12	722286.95	7833064.34
	13 center	721935.84	7833297.56
		721913.63	7833307.34
	14 center	722017.62	7833699.47
		722015.78	7833697.17
	15 center	722269.90	7834567.38
		722238.98	7834567.14
	16 center	722445.69	7834912.03
		722440.35	7834919.75
	17 center	722742.43	7835482.32
		722726.64	7835495.90
	18 center	723348.73	7835736.61
		723346.70	7835754.20
19 center	723732.73	7836150.97	
20 center	724074.74	7836564.31	
21 center	724345.84	7837083.92	
	724342.98	7837093.40	
52	724731.75	7834445.39	
53	723823.42	7834854.63	
54	722786.02	7833211.90	
55	722463.70	7834802.63	
56	724405.46	7837075.95	
63	723332.25	7835110.41	
64	722127.83	7834130.42	
65	723858.35	7836366.01	
66	723027.75	7834700.08	
67	723585.89	7835908.51	
68	724235.03	7836825.50	
88	724871.43	7834693.30	
89	724858.99	7834415.31	
Reference Area	22 point polygon	736286.43	7842476.99
		737177.50	7844264.54
	23	736798.25	7844328.76
	24	737112.98	7844162.39
	25	736541.26	7843896.96
	26	736332.97	7843618.76
	27	736124.49	7843335.28
	28	736025.57	7843284.45
	29	734361.43	7846500.40
	30	734642.79	7846713.51

Table 1. Coordinates for Sample Stations
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

General Location	Station Location	Northing	Easting
Reference Area (continued)	31	734748.47	7846819.97
	32	734889.37	7846961.91
	33 center	734988.13	7847070.81
	34	735451.90	7847606.69
	35	735670.01	7847743.72
	36	735735.95	7847814.77
	37	735806.94	7847956.84
	38	736014.90	7848098.95
	38 center	735917.87	7848085.98
	39	736298.93	7848383.14
	40	736369.94	7848454.18
	41	736613.39	7848702.85
	42	736719.90	7848809.41
	42 center	736375.23	7848709.91
	57	735961.09	7842542.87
	58	734992.42	7842405.70
	59	734662.74	7846531.69
	60	735398.83	7847292.76
	61	736584.06	7848465.55
	62 (dup of 57)	735961.09	7842542.87
	72 center	735574.03	7844394.91
	73	735767.28	7843512.81
	74 center	735895.34	7843347.92
	75 center	736146.18	7843122.71
	76 center	733734.38	7843086.29
	78 center	733908.80	7842229.69
	79 center	733515.18	7842481.53
	82 center	736353.98	7843440.03
	85	737199.49	7844663.48
	86	737782.03	7844911.22
87	738075.16	7845036.00	
90 center	736121.17	7842884.95	
91 center	736720.52	7843815.60	
92 center	732472.80	7843048.31	
94 center	733861.30	7845283.29	
98 center	733733.49	7844829.85	
100 center	733556.51	7844715.54	
105 center	737071.43	7850490.11	
Eagle Creek	43	722998.52	7835875.64
	44	723094.20	7835817.52
	45	723348.73	7835736.61
Downstream of Bonneville Dam	46	714065.53	7812443.27
	47	714990.82	7814893.76
	48	714596.39	7819247.95
	49	721227.56	7829112.62
	50	722347.33	7830505.87
	51	715334.50	7813626.91

Notes:

Coordinates are in North American Datum (1983), State Plane Oregon North (US Feet)

Unless noted all coordinates indicate a single sample location.

Center coordinates indicate the center of polygon. The polygon represent the crayfish/sculpin sampling station:

Table 2. Sampling Success Summary
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

General Location	Station Location	Sediment Sample?	Clam Sample?	Collocated Sed/Clam?	Crayfish Sample?	Sculpin Sample?	Surface Water and Grab Water Sample?	Summary
Forebay	1	No	No	No	Yes	No	--	19 collocated sediment/clam samples analyzed 17 crayfish samples analyzed 0 sculpin samples analyzed 5 high-volume water samples analyzed
	2	No	Yes	No	Yes	No	--	
	3	No	No	No	Yes	No	--	
	4	Yes	Yes	Yes	Yes	No	--	
	5	Yes	Yes	Yes	Yes	Insufficient	--	
	6	Yes	Yes	Yes	Yes	No	--	
	7	Yes	Yes	Yes	Yes	No	--	
	8	Yes	Yes	Yes	Yes	No	--	
	9	Yes	Yes	Yes	No	No	--	
	10	Yes	Yes	Yes	Insufficient	Insufficient	--	
	11	Yes	Yes	Yes	No	No	--	
	12	No	Yes	No	No	No	--	
	13	Yes	Yes	Yes	Yes	No	--	
	14	Yes	Yes	Yes	Yes	No	--	
	15	Yes	Yes	Yes	Yes	No	--	
	16	Yes	Yes	Yes	Yes	No	--	
	17	Yes	Yes	Yes	Yes	Insufficient	--	
	18	Yes	Yes	Yes	Yes	Insufficient	--	
	19	Insufficient	Yes	No	Yes	No	--	
	20	No	No	No	Yes	No	--	
	21	Yes	Yes	Yes	Yes	No	--	
	52	--	--	--	--	--	Yes	
	53	--	--	--	--	--	Yes	
	54	--	--	--	--	--	Yes	
	55	--	--	--	--	--	Yes	
	56	--	--	--	--	--	Yes	
	63	No	No	No	--	--	--	
	64	No	Insufficient	No	--	--	--	
	65	Yes	Yes	Yes	--	--	--	
66	Insufficient	No	No	--	--	--		
67	Yes	Yes	Yes	--	--	--		
68	Insufficient	No	No	--	--	--		
88	Yes	Yes	Yes	--	--	--		
89	Yes	Yes	Yes	--	--	--		
Reference Area	22	Yes	Yes	Yes	Yes	Insufficient	--	18 collocated sediment/clam samples analyzed 19 crayfish samples analyzed 0 sculpin samples analyzed 5 high-volume water samples analyzed 1 field duplicate of grab surface water sample
	23	No	No	No	No	No	--	
	24	Yes	Yes	Yes	No	No	--	
	25	Insufficient	No	No	No	No	--	
	26	Yes	Yes	Yes	No	No	--	
	27	Yes	Yes	Yes	No	No	--	
	28	Yes	Yes	Yes	Insufficient	No	--	
	29	Yes	Yes	Yes	No	No	--	
	30	Yes	Insufficient	No	No	No	--	
	31	Yes	No	No	No	No	--	
	32	Yes	No	No	No	No	--	
	33	Yes	No	No	Yes	Insufficient	--	
	34	Yes	Yes	Yes	--	No	--	
	35	Yes	Yes	Yes	--	Insufficient	--	
	36	Yes	Yes	Yes	--	No	--	
	37	Yes	Yes	Yes	--	Insufficient	--	
	38	Yes	Yes	Yes	Yes	No	--	
	39	Yes	Yes	Yes	--	No	--	
	40	Yes	Yes	Yes	--	No	--	
	41	Yes	Yes	Yes	--	No	--	
42	Yes	Yes	Yes	Yes	No	--		
57	--	--	--	--	--	Yes		
58	--	--	--	--	--	Yes		

Table 2. Sampling Success Summary
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

General Location	Station Location	Sediment Sample?	Clam Sample?	Collocated Sed/Clam?	Crayfish Sample?	Sculpin Sample?	Surface Water and Grab Water Sample?	Summary
Reference Area (continued)	59	--	--	--	--	--	Yes	<i>(continued)</i> 18 collocated sediment/clam samples analyzed 19 crayfish samples analyzed 0 sculpin samples analyzed 5 high-volume water samples analyzed 1 field duplicate of grab surface water sample
	60	--	--	--	--	--	Yes	
	61	--	--	--	--	--	Yes	
	62 (dup of 57)	--	--	--	--	--	Yes	
	69	--	--	--	No	No	--	
	70	--	--	--	No	No	--	
	72	--	--	--	Yes	No	--	
	73	--	--	--	Yes	No	--	
	74	--	--	--	Yes	No	--	
	75	--	--	--	Yes	No	--	
	76	--	--	--	Yes	No	--	
	77	--	--	--	No	No	--	
	78	--	--	--	Yes	No	--	
	79	--	--	--	Yes	No	--	
	81	--	--	--	No	No	--	
	82	--	--	--	Yes	No	--	
	83	--	--	--	No	No	--	
	84	--	--	--	No	No	--	
	85	Yes	Yes	Yes	No	No	--	
	86	Yes	Yes	Yes	No	No	--	
87	Yes	Yes	Yes	No	No	--		
90	--	--	--	Yes	No	--		
91	--	--	--	Yes	Insufficient	--		
92	--	--	--	Yes	No	--		
94	--	--	--	Yes	No	--		
98	--	--	--	Yes	No	--		
100	--	--	--	Yes	No	--		
105	--	--	--	Yes	No	--		
Eagle Creek	43	Yes	--	--	--	--	--	2 sediment samples analyzed
	44	Yes	--	--	--	--	--	
	45	--	--	--	--	--	--	
Downstream	46	Yes	--	--	--	--	--	6 sediment samples analyzed
	47	Yes	--	--	--	--	--	
	48	Yes	--	--	--	--	--	
	49	Yes	--	--	--	--	--	
	50	Yes	--	--	--	--	--	
51	Yes	--	--	--	--	--	--	

Notes:

-- = Not applicable or sampling not attempted at this location.

Insufficient = Sample media was collected at this station, but the mass collected was insufficient to run analyses.

Yes = Sample media was collected at this station.

No = Sample media was unsuccessfully collected at this station.

Table 3. High-Volume Water Sample Summary ¹

Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

Station	Sample Date	Total Volume Pumped (L)	Duration (minutes)	Comments
52	2/12/2008	607.93	345	Water depth = 36 feet Pump intake depth = 30 feet
53	2/24/2008	613.0	360	Water depth = 45 feet Pump intake depth = 40 feet
54	2/13/2008	608.14	350	Water depth = 32 feet Pump intake depth = 28 ft
55	2/25/2008	602.0	360	Water depth = 35 feet Pump intake depth = 30 feet
56	2/21/008	606.0	355	Water depth = 23 feet Pump intake depth = 15 ft
57	2/27/2008	606.27	340	Water depth = 5.5 feet Pump intake depth = 3 feet
58	3/7/2008	607.0	348	Water depth = 9 to 10 feet Pump intake depth = 6 to 7 feet
59	2/29/2008	608.73	351	Water depth = 16 feet Pump intake depth = 13 feet
60	3/4/2008	610.11	363	Water depth = 29.5 feet Pump intake depth = 24 feet
61	3/6/2008	610.15	366	Water depth = 24 feet Pump intake depth = 21 feet
Blank	3/6/2008	6.91	--	--

Notes:

-- = Not Applicable

Water Depth = Water depth of Columbia River at sample station

Pump Intake Depth = Depth below the river surface for pump tubing intake

¹ High-volume water samples collected with Infiltrax 300 Organic Sampling System supplied by Axys Environmental Systems in Sidney, British Columbia, Canada.

Table 4. Sediment Sample Summary Table
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

Station	Date	Approximate Water Depth	Sediment URS Sample ID	Sediment Sample Characteristics			Non-clam Organisms
				Color	Texture	Odor/Sheen	
4	2/26/2008	20 to 25 ft	08022604SD	Dark olive gray to very dark grayish brown (5Y 3/2 to 2.5Y 3/2)	Poorly graded sand with silt, silty sand pockets	Strong organic odor	Snails, red worms, mussel
5	3/19/2008	25 to 35 ft	08031905SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt and gravel (coarse to medium grained sand)	None	Crayfish
6	3/18/2008	15 ft	08031806SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with gravel and silt. Trace organics. Sand is coarse to fine, gravel is fine to coarse arse grained.	None	None
7	2/15/2008	21 ft	08021507SD	Very dark grayish brown (2.5Y 3/2)	Silty sand with gravel. Sand is fine grained.	Slight organic odor	Stonefly, snails
8	2/15/2008	18 ft	08021508SD	Very dark grayish brown (2.5Y 3/2)	Silty sand with gravel. Sand is fine grained.	None	Snails
9	2/14/2008	10 ft	08021409SD	Dark olive gray to black (5Y 3/2 to 5Y 2.5/2)	Sandy silt, trace organics	Organic odor	Mussel
10	2/14/2008	12 ft	08021410SD	Dark olive gray to very dark grayish brown (5Y 3/2 to 2.5Y 3/2)	Silt with sand	Organic odor	None
11	2/14/2008	62.9 to 70 ft	08021411SD	Dark olive gray to very dark grayish brown (5Y 3/2 to 2.5Y 3/2)	Sandy silt, trace of organic matter	Slight organic odor	None
13	3/17/2008	16 to 23 ft	08031713SD	Very dark grayish brown (10YR 3/2)	Silty sand, trace organics. Sand is fine grained.	None	None
14	3/18/2008	40 to 53 ft	08031814SD	Very dark grayish brown (10YR 3/2)	Pockets of sediment: poorly graded sand with gravel and silt. Sand is coarse to medium grained, and gravel is fine to coarse.	None	None
15	2/20/08 02/21/08	20 to 28 ft	08022115SD	Very dark grayish brown (10YR 3/2)	Silty sand, trace gravel. Sand is fine grained	None	Snails, worms
16	2/21/2008	27 ft	08022116SD	Very dark grayish brown (10YR 3/2)	Sandy silt	None	None
17	2/21/2008	10.9 ft	08022117SD	Very dark grayish brown (10YR 3/2)	Silty sand. Sand is fine grained	Slight organic sheen and organic sheen	Worms
18	2/11/2008	15 to 24 ft	08021118SD	Very dark grayish brown (10YR 3/2)	Silty sand. Sand is fine to medium grained	None	Mussel
21	2/12/2008	25 to 40 ft	0802121SD	Very dark grayish brown (10YR 3/2)	Silty sand with gravel. Sand is fine grained.	None	None
22	3/5/2008	15 ft	08030522SD	Very dark grayish brown (10YR 3/2)	Sandy silt (fine grained sand).	Organic odor	Lamprey
24	3/5/2008	15 ft	08030524SD	Very dark grayish brown (10YR 3/2)	Sandy silt (fine grained sand).	Organic odor	None
26	3/4/2008	20 to 25 ft	08030426SD	Very dark grayish brown (10YR 3/2)	Silty Sand (sand is fine to coarse grained).	Strong organic odor	Worms, snails
27	3/4/2008	20 to 25 ft	08030427SD	Very dark grayish brown (10YR 3/2)	Gravelly silt with sand. Sand is fine grained.	Strong organic and fish odor	Mussels, worms, snails, crayfish
28	3/4/2008	15 to 20 ft	08030428SD	Very dark grayish brown (10YR 3/2)	Sandy silt. Sand is fine grained.	Some petroleum sheen in drops	Mussels, worms, snails
29	2/22/2008	7 ft	08022229SD	Very dark grayish brown (10YR 3/2)	Sandy silt. Sand is fine grained.	Slight organic odor	Snails
34	2/25/2008	6 ft	08022534SD	Very dark grayish brown (10YR 3/2)	Sandy silt. Sand is fine to medium grained.	Slight organic odor and sheen	Worms
35	2/25/2008	27 ft	08022535SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine grained sand)	None	Snails
36	2/25/2008	30 ft	08022536SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine grained sand)	None	Snails
37	2/26/2008	8 to 25 ft	08022637SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine grained sand)	Organic (clam-like) odor	Snails, red worms
38	2/27/2008	25 ft	08022738SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine grained sand)	Slight organic odor	Mussel
39	2/27/2008	25 ft	08022739SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine to medium grained sand)	Slight organic odor	None
40	2/27/2008	25 ft	08022740SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine to medium grained sand)	None	Snails
41	2/27/2008	25 ft	08022741SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine to medium grained sand)	None	None
42	2/27/2008	20 to 25 ft	08022742SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt (medium to fine grained sand)	None	Snails
43	3/20/2008	<4 ft	08032043SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with gravel. Tr organics. Sand is medium to coarse grained, gravel is fine grained.	Trace organic odor	None
44	3/20/2008	<4 ft	08032044SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt and gravel. Trace organics.	Organic (detritus) odor	None

Table 4. Sediment Sample Summary Table
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

Station	Date	Approximate Water Depth	Sediment URS Sample ID	Sediment Sample Characteristics			Non-clam Organisms
				Color	Texture	Odor/Sheen	
46	3/10/2008	7 to 11 ft	08031046SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with clay. Sand is fine grained.	None	None
47	3/10/2008	10 to 15 ft	08031047SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt. Sand is medium grained.	None	None
48	3/10/2008	5 to 10 ft	08031048SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine to medium grained sand)	None	None
49	3/10/2008	25 ft	08031049SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt (fine grained sand)	None	None
50	3/11/2008	17 ft	08031150SD	Very dark grayish brown (10YR 3/2)	Silty sand with pockets of poorly graded sand.	Organic odor	Snails
51	3/11/2008	5 to 10 ft	08031151SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt, trace gravel. Sand is fine to medium grained. Gravel is coarse, round, and smooth.	None	None
65	2/29/2008	30 to 57 ft	08022965SD	Very dark grayish brown (10YR 3/2)	Silty sand (fine grained sand)	None	None
67	3/3/2008	15 to 20 ft	08030367SD	Very dark grayish brown (10YR 3/2)	Silty sand with gravel. Sand is coarse to fine grained.	None	None
85	3/6/2008	10 to 25 ft	08030685SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt and some gravel (fine grained sand)	None	None
86	3/6/2008	10 ft	08030686SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt and gravel	Slight organic odor	Snails
87	3/6/2008	7 to 10 ft	08030687SD	Very dark grayish brown (10YR 3/2)	Poorly graded sand with silt and some fine gravel (fine grained sand)	Slight organic odor	Mussel, snail
88	3/17/2008	20 to 45 ft	08031788SD	Very dark grayish brown (10YR 3/2)	Poorly graded gravel with sand and silt.	None	None
89	3/17/2008	20 to 45 ft	08031789SD	Very dark grayish brown (10YR 3/2)	Poorly graded gravel with sand	Trace organic odor	None
Sediment Samples Collected But Not Analyzed							
1	2/26/2008	15 to 25 ft	No sample	NA	Poorly graded gravel, cobbles and boulders (fine to coarse grained gravel)	NA	Snails
2	2/19/2008	35 to 70 ft	No sample	NA	Poorly graded gravel with cobbles, coarse, subangular basalt gravel	NA	None
3	2/19/2008	30 to 85 ft	No sample	NA	NA	NA	NA
12	2/15/2008	40 to 50 ft	No sample	NA	NA	NA	NA
19	2/12/2008	25 to 35 ft	08021219SD	Very dark grayish brown (2.5Y 3/2)	Poorly graded gravel with sand (coarse grained sand and gravel)	None	None
20	2/12/2008	35 ft	No sample	Very dark grayish brown (2.5Y 3/2)	Poorly graded sand with gravel, trace silt, and a thin veneer of sand	None	None
23	3/5/2008	10 to 15 ft	No sample	NA	Riprap boulders and cobbles	NA	None
25	3/5/2008	50 to 60 ft	08030525SD	Very dark grayish brown (2.5Y 3/2)	Silty sand (fine grained sand).	None	None
30	2/22/2008	5 to 8 ft	08022230SD	Black (5Y 2.5/2)	Poorly graded sand, some silt with organics	Organic odor	Worms, snails
31	2/22/2008	5 to 7 ft	No sample	Black (5Y 2.5/2)	Silty sand with organics (fine grained micaceous sand)	organic odor	Red worms
32	2/25/2008	6 ft	08022532SD	Dark brown (10YR 3/3)	Poorly graded sand with silt (fine grained sand)	Strong organic odor/slight organic sheen	None
33	2/25/2008	7 ft	08022533SD	Dark brown (10YR 3/3)	Poorly graded sand with silt (fine grained sand)	Organic odor/slight organic sheen	None
45	2/11/2008	12 to 35 ft	08021145SD	Dark olive gray to black (5Y 3/2 to 5Y 2.5/2)	Poorly graded sand, trace silt and gravel (medium to coarse grained sand and coarse grained angular gravel)	None	None
63	2/28/2008 2/29/2008	30 to 40 ft	No sample	NA	NA	None	None
64	2/29/2008	NA	No sample	NA	NA	NA	NA
66	3/3/2008	20 to 30 ft	08030366SD	Brown to black (10YR 5/3 to 5Y 2.5/2)	Boulders and cobbles with trace gravel (coarse grained gravel)	None	None
68	3/3/2008	25 to 50 ft	08030368SD	Very dark grayish brown (2.5Y 3/2)	Boulders and cobbles with trace poorly graded sand (medium to coarse grained sand)	None	None

Notes:

ft = feet

Water Depth = Water depth of Columbia River at sample station

Table 5. Asian Clam Sample Summary
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

Station	Date	Approximate Water Depth (ft)	Asian Clam Tissue URS Sample ID	Asian Clam Sample Characteristics			
				Number of Clams in Sample	Average Clam Length (cm)	Average Clam Mass (g)	Total Sample Mass (g)
4	2/26/2008	20 to 25 ft	08022604TC	--	--	--	--
5	2/20/2008	25 to 35 ft	08031905TC	79	3.0	2.6	207.3
6	3/18/2008	15 ft	08031806TC	117	2.8	2.1	247.4
7	2/15/2008	21 ft	08021507TC	178	3.0	3.1	558.7
8	2/15/2008	18 ft	08021508TC	198	3.0	2.9	568.2
9	2/14/2008	10 ft	08021409TC	16	3.0	3.0	48.2
10	2/14/2008	12 ft	08021410TC	33	3.0	3.2	104.1
11	2/14/2008	62.9 to 70 ft	08021411TC	151	2.9	2.4	365.2
13	3/17/2008	16 to 23 ft	08031713TC	74	3.1	2.5	186.2
14	3/18/2008	40 to 53 ft	08031814TC	61	3.0	2.5	154.3
15	2/20/2008 2/21/2008	20 to 28 ft	08020115TC 08022115TC	80	3.1	2.6	211.4
16	2/21/2008	27 ft	08022116TC	41	3.1	3.2	130.8
17	2/21/2008	10.9 ft	08022217TC	65	3.1	3.4	221.5
18	2/11/2008	15 to 24 ft	08021118TC	46	2.7	1.9	89.3
21	2/12/2008	25 to 40 ft	08021221TC	44	3	2.9	126.5
22	3/5/2008	15 ft	08030522TC	34	3.3	3.0	102.4
24	3/5/2008	15 ft	08030524TC	70	3.2	3.3	234.0
26	3/4/2008	20 to 25 ft	08030426TC	90	3.1	2.6	231.8
27	3/4/2008	20 to 25 ft	08030427TC	75	3.5	3.0	221.3
28	3/4/2008	15 to 20 ft	08030428TC	59	3.2	3.0	176.9
29	2/22/2008	7 ft	08022229TC	78	3.0	2.4	185.7
34	2/25/2008	6 ft	08022534TC	86	3.0	2.6	225.6
35	2/25/2008	27 ft	08022535TC	92	3.0	2.4	221.7
36	2/25/2008	30 ft	08022536TC	108	3.0	2.4	255.1
37	2/26/2008	8 to 25 ft	08022637TC	87	3.1	2.6	228.4
38	2/27/2008	25 ft	08022738TC	99	3.0	2.5	251.6
39	2/27/2008	25 ft	08022739TC	101	3.1	2.5	250.3
40	2/27/2008	25 ft	08022740TC	101	3.0	2.6	260.3
41	2/27/2008	25 ft	08022741TC	118	3.0	2.5	295.8
42	2/27/2008	20 to 25 ft	08022742TC	85	3.0	2.9	242.3
65	2/29/2008	30 to 57 ft	08022965TC	49	2.9	2.1	105.2
67	3/3/2008	15 to 20 ft	08030367TC	43	2.9	1.8	77.9
85	3/6/2008	10 to 25 ft	08030685TC	103	3.3	2.6	262.7
86	3/6/2008	10 ft	08030686TC	95	3.1	3.0	284.1
87	3/6/2008	7 to 10 ft	08030687TC	53	3.2	2.0	107.3
88	3/17/2008	20 to 45 ft	08031788TC	85	2.7	2.2	186.6
89	3/17/2008	20 to 45 ft	08031789TC	96	2.8	2.5	235.2
Clam Samples Collected But Not Analyzed							
2	2/19/2008	35 to 70 ft	08021902TC	69	2.8	2.3	157.1
12	2/15/2008	40 to 50 ft	08021512TC	36	3	2.2	80.7
19	2/12/2008	25 to 35 ft	08021219TC	57	3.1	3.5	198.3
25	3/5/2008	50 to 60 ft	08030525TC	87	3.0	2.6	222.5
30	2/22/2008	5 to 8 ft	08022230TC	--	--	--	--
31	2/22/2008	5 to 7 ft	08022231TC	--	--	--	--
32	2/25/2008	6 ft	08022532TC	--	--	--	--
33	2/25/2008	7 ft	08022533TC	--	--	--	--
45	2/11/2008	12 to 35 ft	08021145TC	43	2.9	2.7	114.9
66	3/3/2008	20 to 30 ft	08030366TC	--	--	--	--
68	3/3/2008	25 to 50 ft	08030368TC	--	--	--	--

Notes:

-- = Not Applicable

cm = centimeters

g = grams

ft = feet

Water Depth = Water depth of Columbia River at sample station

Table 6. Trapping Summary
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

Station Location	Dates Traps Deployed	Deployment Duration (days)	Number of Crayfish Caught	Number of Sculpin Caught
1	2/11/2008 to 2/26/2008	15	12	0
2	2/11/2008 to 2/26/2008	15	3	0
3	2/11/2008 to 2/26/2008	15	2	0
4	2/11/2008 to 2/22/2008	11	16	0
5	2/14/2008 to 2/20/2008	6	14	1
6	2/11/2008 to 2/19/2008	8	11	0
7	2/11/2008 to 2/19/2008	8	13	0
8	2/11/2008 to 2/19/2008	8	9	0
10	2/15/2008 to 2/22/2008	7	0	1
13	2/11/2008 to 2/19/2008	8	9	0
14	2/14/2008 to 2/26/2008	12	5	0
15	2/11/2008 to 2/20/2008	9	12	0
16	2/14/2008 to 2/26/2008	12	8	0
17	2/14/2008 to 2/22/2008	8	5	1
18	2/14/2008 to 2/22/2008	8	13	1
19	2/14/2008 to 2/22/2008	8	21	0
20	2/14/2008 to 2/22/2008	8	12	0
21	2/14/2008 to 2/22/2008	8	6	0
22	2/22/2008 to 3/14/2008	21	6	2
33	2/15/2008 to 3/12/2008	26	7	4
38	2/15/2008 to 3/10/2008	24	7	1
42	2/19/2008 to 3/14/2008	24	5	0
72	2/28/2008 to 3/12/2008	13	10	0
73	2/28/2008 to 3/10/2008	11	11	0
74	2/28/2008 to 3/5/2008	6	12	0
75	2/28/2008 to 3/10/2008	11	9	0
76	2/28/2008 to 3/12/2008	13	7	0
78	2/28/2008 to 3/10/2008	11	9	0
79	2/28/2008 to 3/10/2008	11	13	0
82	2/28/2008 to 3/10/2008	11	5	0
90	3/10/2008 to 3/14/2008	4	4	0
91	3/10/2008 to 3/14/2008	4	4	1
92	3/10/2008 to 3/14/2008	4	16	0
94	3/10/2008 to 3/14/2008	4	7	0
98	3/10/2008 to 3/14/2008	4	8	0
100	3/10/2008 to 3/14/2008	4	7	0
105	3/12/2008 to 3/14/2008	2	2	0

Total

382

320

12

Table 7. Crayfish Sample Characteristics
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

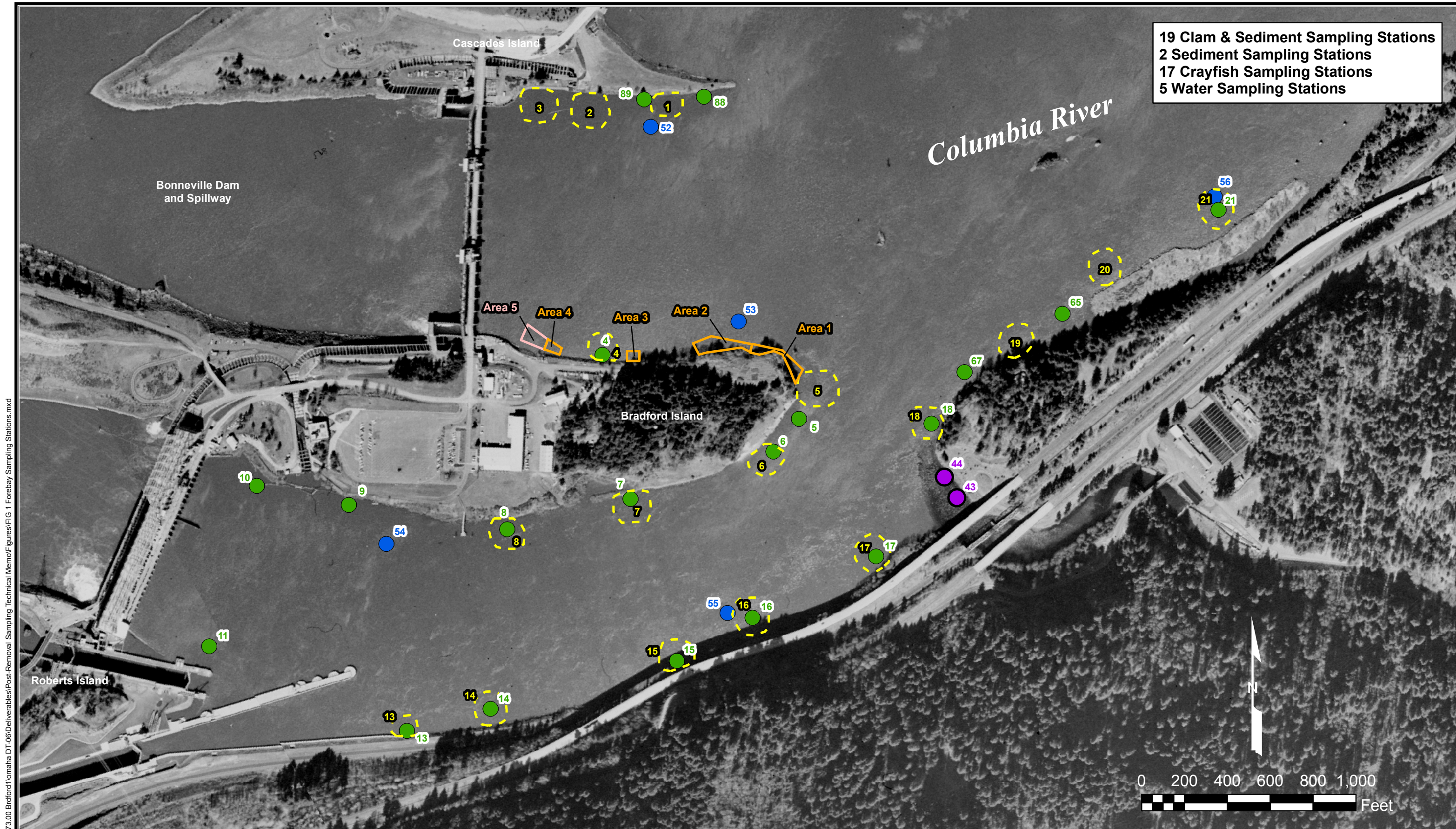
Station Location	Number of Crayfish in Sample	Number of Males	Number of Females	Average Crayfish Length (cm)	Average Crayfish Mass (g)	Total Sample Mass (g)
1	12	8	4	7.3	12.5	149.9
2	3	1	2	6.8	10.2	30.7
3	2	2	0	8.5	19.7	39.4
4	16	13	3	7	11.9	190.9
5	14	10	4	6.7	9.9	138.5
6	11	4	7	5.9	8.1	88.6
7	13	11	2	5.8	10.0	130.2
8	9	6	3	6.7	10.4	93.7
13	9	7	2	6.4	11.9	107.0
14	5	5	0	8.2	18.3	91.3
15	12	8	4	7.0	11.4	136.3
16	8	5	3	6.1	7.6	60.6
17	5	4	1	7.4	14.5	72.7
18	13	5	8	6.3	10.3	133.9
19	21	12	9	6.3	9.7	203.1
20	12	8	4	7.0	11.6	138.9
21	6	3	3	6.8	13.7	82.4
22	6	4	2	7.8	16.1	96.7
33	7	4	3	8.5	19.1	133.4
38	7	3	4	6.2	11.6	81.3
42	5	2	3	7.7	15.9	79.5
72	10	4	6	6.2	8.7	43.3
73	11	8	3	6.7	11.0	121.0
74	12	10	2	7.9	20.5	245.6
75	9	1	8	8.5	22.4	201.5
76	7	6	1	6.6	12.1	84.6
78	9	5	4	6.3	10.5	94.8
79	13	8	5	6.0	7.7	99.9
82	5	3	2	8.2	22.7	113.3
90	4	3	1	10.5	42.6	170.3
91	4	1	3	7.4	14.4	57.7
92	16	13	3	6.5	11.5	183.6
94	7	6	1	6.6	10.9	76.6
98	8	8	0	7.1	15.2	121.2
100	7	6	1	6.6	12.7	88.9
105	2	2	0	7.3	13.7	27.3

Notes:
cm = centimeter
g = grams

Table 8. Sculpin Sample Characteristics
Post-Removal Sampling
Bradford Island Disposal Site
Bonneville Dam Forebay

Station Location	Number of Sculpin in Sample	Sculpin Length (cm)	Sculpin Mass (g)	Total Mass Weight (g)
5	1	8.0	6.5	6.5
10	1	11.0	13.3	13.3
17	1	12.5	27.3	27.3
18	1	12.5	27.2	27.2
22	2	12.0 12.5	24.8 26.1	50.9
33	4	6.5 9.0 10 12.5	4.1 7.9 11.8 27.9	51.7
38	1	14.5	42.2	42.2
91	1	10.0	12.4	12.4

FIGURES



19 Clam & Sediment Sampling Stations
 2 Sediment Sampling Stations
 17 Crayfish Sampling Stations
 5 Water Sampling Stations

C:\25692709_USACE\153-F0072173-00_Brdford\1\omaha_DT-06\Deliverables\Post-Removal_Sampling_Technical_Memo\Figures\Fig 1 Forebay Sampling Stations.mxd

Explanation	
● 10	Clam & Sediment Sampling Station
20	Crayfish Sampling Station
● 50	Water Sampling Station
● 44	Sediment Sampling Station
20	Clam & Sediment Pre-Removal Sampling Station (Sept 2007)
20	Sediment Only Pre-Removal Sampling Station (Sept 2007)
Only samples submitted for chemical analysis are presented	

JOB No. 25696528	DESIGNED: CW	PROJ. ENGINEER: -
Imagery provided by USACE	DRAWN BY: SB	APPROVED BY: JTW
	CHECKED BY: -	DATE: MAY 2008

URS

111 S.W. Columbia, Suite 1500
 Portland, Oregon 97201
 (tel) 503-222-7200
 (fax) 503-222-4292

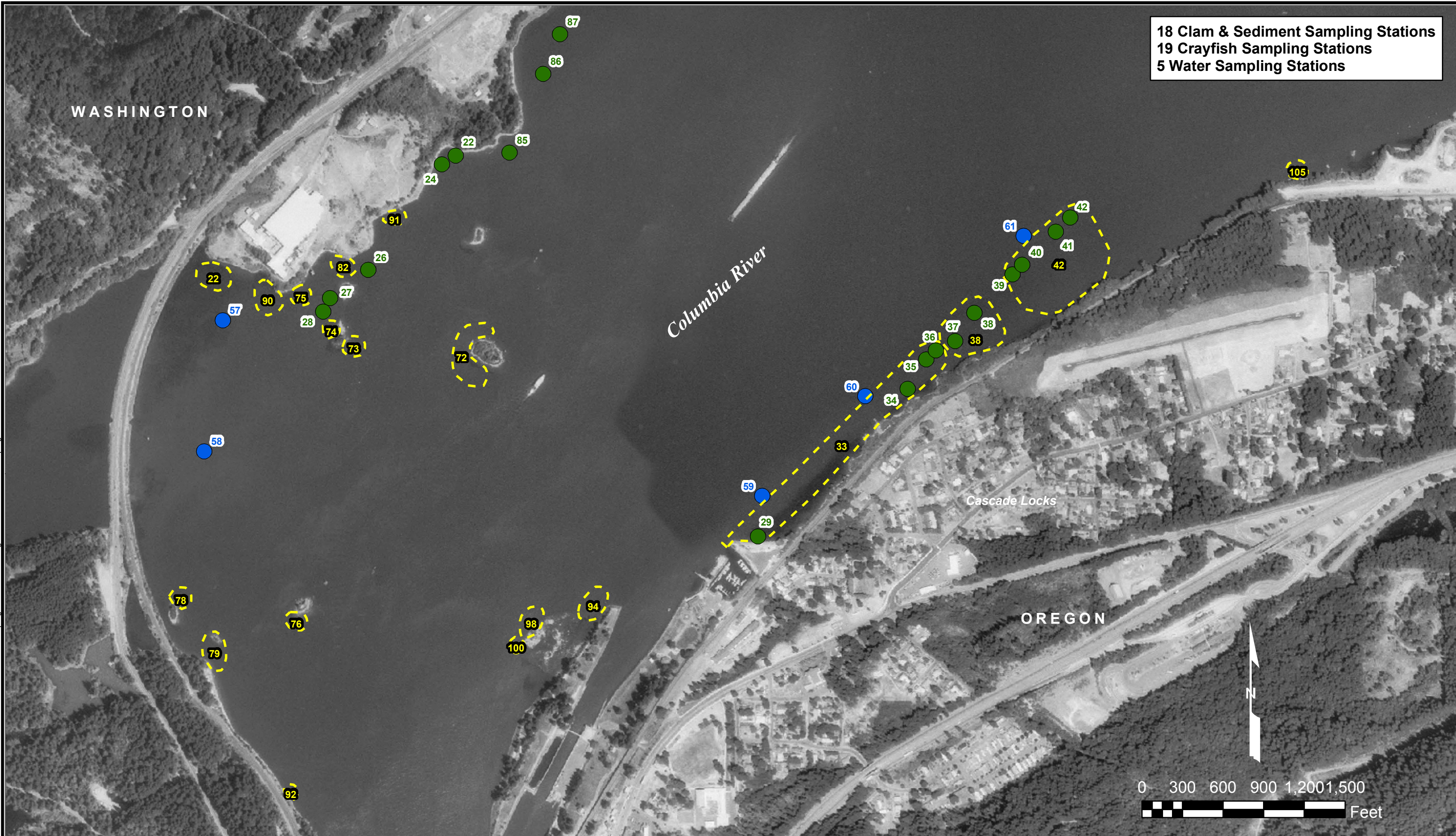
BRADFORD ISLAND

CASCADE LOCKS, OREGON

FOREBAY SAMPLING STATIONS

DRAWING NUMBER: FIGURE 1	
GIS FILE NUMBER: Fig 1	
SHEET:	REV.

18 Clam & Sediment Sampling Stations
 19 Crayfish Sampling Stations
 5 Water Sampling Stations



O:\25692709 USACE\ES3-F0072173.00 Bradford\1omaha DT-06\Deliverables\Post-Removal Sampling Technical Memo\Figures\Fig 2 Reference Sampling Stations.mxd

Explanation	
● 10	Clam & Sediment Sampling Station
20	Crayfish Sampling Station
● 50	Water Sampling Station

Only samples submitted for chemical analysis are presented

JOB No. 25696528	DESIGNED: CW	PROJ. ENGINEER: -
Imagery provided by USACE	DRAWN BY: SB	APPROVED BY: JTW
	CHECKED BY: -	DATE: MAY 2008

URS

111 S.W. Columbia, Suite 1500
 Portland, Oregon 97201
 (tel) 503-222-7200
 (fax) 503-222-4292


BRADFORD ISLAND
CASCADE LOCKS, OREGON

REFERENCE SAMPLING STATIONS

DRAWING NUMBER: FIGURE 2	
GIS FILE NUMBER: Fig 2	
SHEET:	REV.

6 Sediment Sampling Stations



Explanation
 Sediment Sampling Station

Only samples submitted for chemical analysis are presented

JOB No. 25696528	DESIGNED: CW	PROJ. ENGINEER: -
Imagery provided by USACE	DRAWN BY: SB	APPROVED BY: JTW
	CHECKED BY: -	DATE: MAY 2008

URS
 111 S.W. Columbia, Suite 1500
 Portland, Oregon 97201
 (tel) 503-222-7200
 (fax) 503-222-4292

BRADFORD ISLAND
CASCADE LOCKS, OREGON

DOWNSTREAM SAMPLING STATIONS


DRAWING NUMBER: FIGURE 3	
GIS FILE NUMBER: Fig 3	
SHEET:	REV.


O:\25692709 USACE\53-F0072\73.00 Bradford\omaha DT-06\Deliverables\Post-Removal Sampling Technical Memo\Figures\FIG 3 Downstream Sampling Stations.mxd

O:\25692709 USACE\163-F0072\73.00 Bradford\1\omaha DT-06\Technical\Post-Removal Sampling Event\Post-Removal Sampling Technical Memo\Figures\Fig 4 Sculpin Stations.mxd



Explanation

 2008 Sculpin Station

JOB No. 25696528 Imagery provided by USACE	DESIGNED: CW	PROJ. ENGINEER: —	 111 S.W. Columbia, Suite 1500 Portland, Oregon 97201 (tel) 503-222-7200 (fax) 503-222-4292	BRADFORD ISLAND CASCADE LOCKS, OREGON	SCULPIN STATIONS	DRAWING NUMBER: FIGURE 4	
	DRAWN BY: SB	APPROVED BY: JTW				GIS FILE NUMBER: Fig 4	
	CHECKED BY: —	DATE: MAY 2008				SHEET:	REV.

PHOTOLOG

Client Name: United States Army Corps of Engineers	Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
--	--	------------------------------------

Photo No. 1	Date: 02/28/08
-----------------------	--------------------------

Direction Photo Taken:

View to north of Station 5

Description:

Photograph of the sampling boat (*Wolf Eel*) used for sediment and clam sample collection. The A-frame on the stern was used to deploy the box core sampler. The two davits on port and starboard were used to deploy the Van Veen sampler.



Photo No. 2	Date: 02/20/28
-----------------------	--------------------------

Direction Photo Taken:

View to south-southeast from Station 1

Description:

Photograph of the sampling boat (*Stanley*) used primarily for trapping and water sample collection. The *Stanley* was also used for sediment sampling at Stations 46 through 51, which are located downstream of Bonneville Dam. For sediment sampling, a davit was affixed to the *Stanley* to facilitate Van Veen deployment.




Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 3	Date: 02/19/08		
Direction Photo Taken: View to east of the locations for Stations 1, 88, 89, and 52.			
Description: South shore of Cascades Island. Note the rip rap along the riverbank. Divers were used to collect sediment and clams at Stations 88 and 89 due to the rocky substrate.			

Photo No. 4	Date: 03/20/08	
Direction Photo Taken: View to west-southwest of locations for Stations 13 through 17 and Station 55		
Description: Photograph of the Columbia River taken from Eagle Creek Overlook at the mouth of Eagle Creek. A fly fisherman is wading near the center of the photograph.		


Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 5	Date: 03/10/08		
Direction Photo Taken: View to northeast of Station 49			
Description: Photograph of Station 49, located at the downstream end of Robins Island, below Bonneville Dam.			

Photo No. 6	Date: 03/11/08	
Direction Photo Taken: View to north		
Description: Photograph of Station 51, located at the downstream tip of Pierce Island. Beacon Rock State Park is visible in the background.		


Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 7	Date: 02/28/08		
Direction Photo Taken: View to north			
Description: Photograph of reference area location along north bank of Columbia River.			

Photo No. 8	Date: 02/22/08		
Direction Photo Taken: View to southwest of locations for Stations 29, 33, and 59			
Description: Photograph of reference area location along south bank of Columbia River. Cascade Locks Marina is visible in the background. The box core used for sediment and clam sampling is in the sample processing stand located in the foreground to the right of center.			

Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 9	Date: 02/26/08		
Direction Photo Taken: View to southwest of Station 4			
Description: Photograph of sediment sampling with box core.			

Photo No. 10	Date: 02/27/08	
Direction Photo Taken: View to northeast of Station 42		
Description: Photograph of sediment sampling with Van Veen. The chain is caught in the flap of the Van Veen, indicating an unacceptable grab.		

Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 11	Date: 02/26/08		
Direction Photo Taken: View to south of Station 4			
Description: Photograph of Van Veen sample collection procedures.			

Photo No. 12	Date: 02/27/08	
Direction Photo Taken: N/A		
Description: Photograph of acceptable Van Veen grab. Note the presence of standing water and relatively flat sediment surface within the Van Veen.		

Client Name:

United States Army Corps of Engineers

Site Location:

Bonneville Lock and Dam – Oregon/Washington

URS Project No.

25696528

Photo No.
13**Date:**
02/27/08**Direction Photo Taken:**

N/A

Description:

Photograph of acceptable Van Veen grab. Note the presence of standing water and relatively flat sediment surface within the Van Veen. An Asian clam is partially exposed in the lower right corner of the Van Veen.

**Photo No.**
14**Date:**
02/29/08**Direction Photo Taken:**

N/A

Description:

Close up photograph of sediment sampling process.




Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 15	Date: 02/26/08		
Direction Photo Taken: N/A			
Description: Close up photograph of clam sampling process. The grab sampler was emptied into the tub following sediment sample collection. Clams were then collected from the tub by hand and placed in plastic bags.			

Photo No. 16	Date: 02/26/08	
Direction Photo Taken: View to south.		
Description: Close up photograph of clam sampling process. The grab sampler was emptied into the tub following sediment sample collection. Clams were then collected from the tub by hand and placed in plastic bags.		

Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 17	Date: 02/27/08		
Direction Photo Taken: N/A			
Description: Photograph of sediment jars and clams during sample processing at Station 40.			

Photo No. 18	Date: 02/29/08	
Direction Photo Taken: View to west upstream of Navigation Lock and Powerhouse 1		
Description: Photograph of an unacceptable grab sample.		

Client Name: United States Army Corps of Engineers	Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
--	--	------------------------------------

Photo No. 19	Date: 03/17/08
------------------------	--------------------------

Direction Photo Taken:
View to east of Station 13

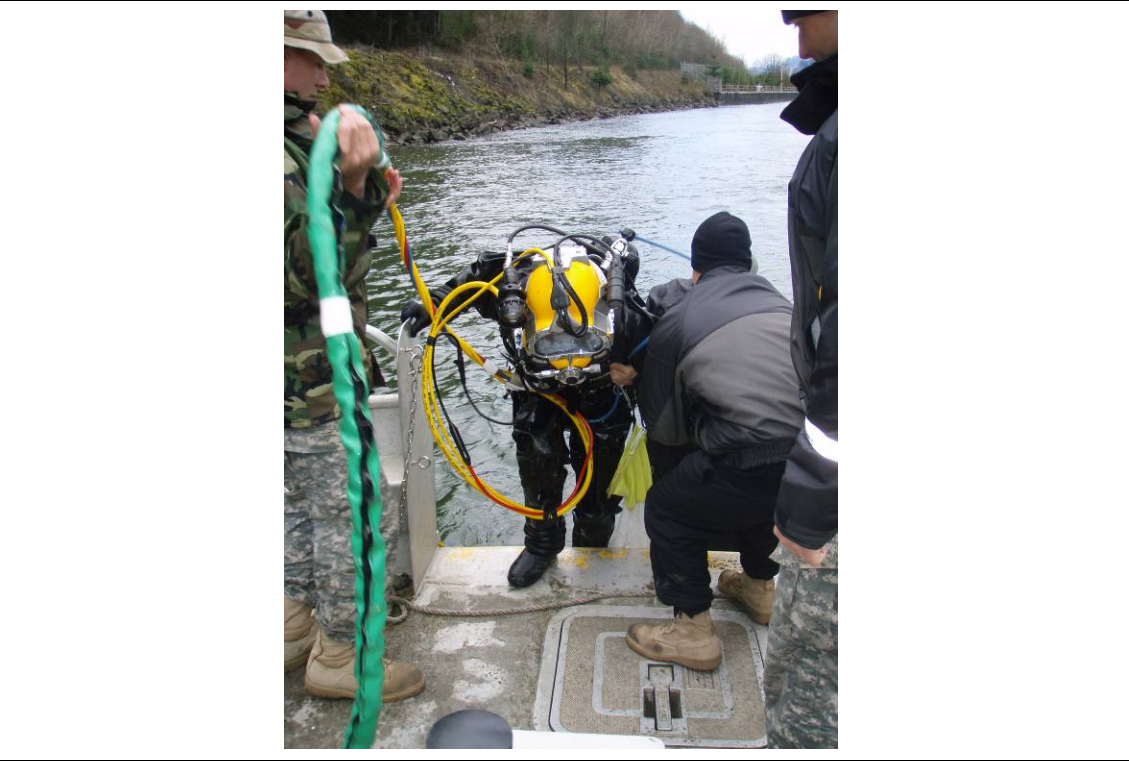
Description:
Photograph of Army Dive Team preparing on the sampling boat Wolf Eel.



Photo No. 20	Date: 03/18/08
------------------------	--------------------------

Direction Photo Taken:
View to west of Station 14.

Description:
Photograph of Army diver entering Columbia River.




Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 21	Date: 03/20/08		
Direction Photo Taken: View to south of Station 44 location			
Description: Photograph of the confluence of Eagle Creek and the Columbia River. River sediment was collected from the sandbar in the center of the photograph (Station 44).			

Photo No. 22	Date: 03/20/08	
Direction Photo Taken: View to west of Station 43		
Description: Photograph of sediment collection at Station 43. Sediment was collected by wading into the river and using a steel trowel to scoop sediment into glass jars. Bradford Island is visible in the upper right-hand corner of the photograph.		


Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 23	Date: 03/03/08		
Direction Photo Taken: View to the north of Station 76.			
Description: Photograph of crayfish and sculpin trap retrieval process.			

Photo No. 24	Date: 03/10/08	
Direction Photo Taken: View to northeast of Station 72.		
Description: Photograph of crayfish and sculpin trap retrieval process.		


Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 25	Date: 02/15/08		
Direction Photo Taken: N/A			
Description: Close up photograph of baited crayfish and sculpin traps.			

Photo No. 26	Date: 02/14/08	
Direction Photo Taken: N/A		
Description: Photograph of crayfish trapped at Station 7. Crayfish were removed from the traps by hand, temporarily placed in a bucket, wrapped in methanol-washed foil, and placed on ice.		

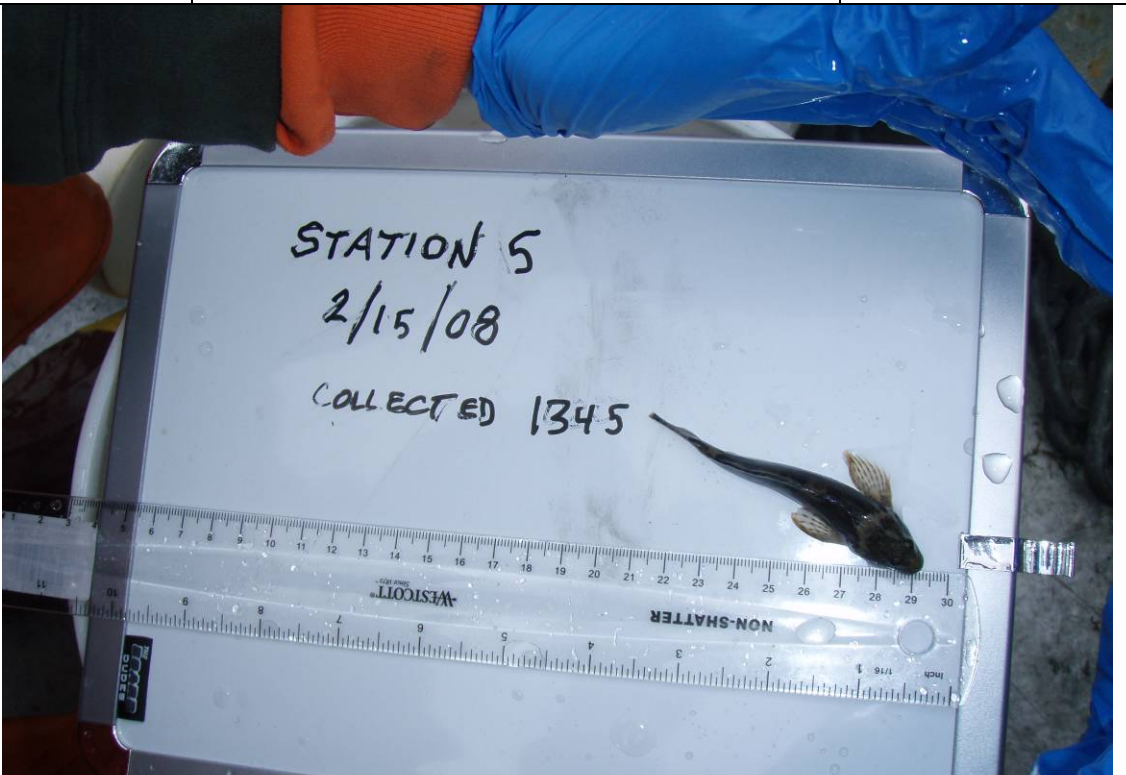
Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 27	Date: 02/15/08		
Direction Photo Taken: N/A			
Description: Photograph of sculpin trapped at Station 5. Sculpin were removed from the traps by hand, temporarily placed in a bucket, wrapped in methanol-washed foil, and placed on ice.			

Photo No. 28	Date: 02/26/08	
Direction Photo Taken: N/A		
Description: Photograph of sculpin trapped at Station 22.		



Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 29	Date: 02/19/08		
Direction Photo Taken: N/A			
Description: Photograph of by-catch (small-mouth bass) found in crayfish trap at Station 37. The fish was released to the Columbia River shortly after the photograph was taken.			

Photo No. 30	Date: 02/26/08	
Direction Photo Taken: N/A		
Description: Photograph of by-catch (fresh-water muscle) collected by grab sampler. The mussel was released to the Columbia River shortly after the photograph was taken.		

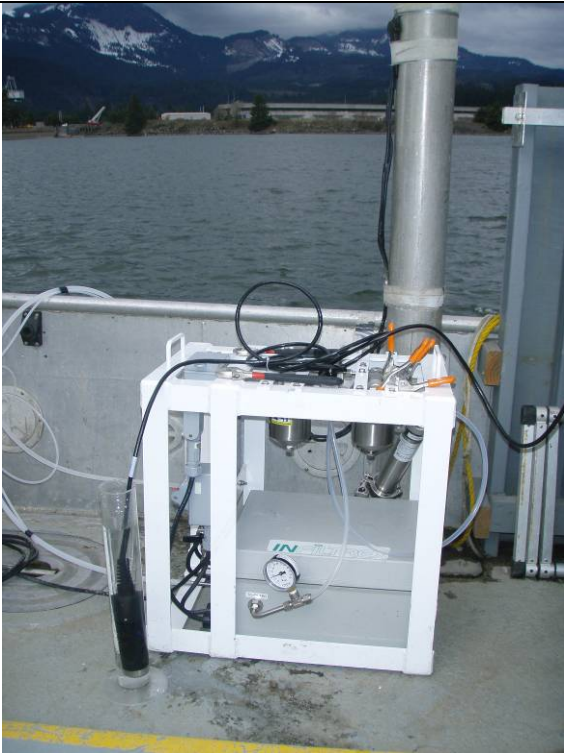
Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 31	Date: 02/24/08		
Direction Photo Taken: View to the northwest from Station 53			
Description: Photograph of high-volume water sampling pump (<i>Infiltrax 300 Organic Sampling System</i>).			

Photo No. 32	Date: 02/24/08	
Direction Photo Taken: N/A		
Description: Close up of Infiltrax pump. The graduated cylinder on the right was used to periodically check flow rates against pump flow meter. A water quality meter was periodically used to monitor river water pH, conductivity, temperature, dissolved oxygen concentration, and oxidation-reduction potential.		

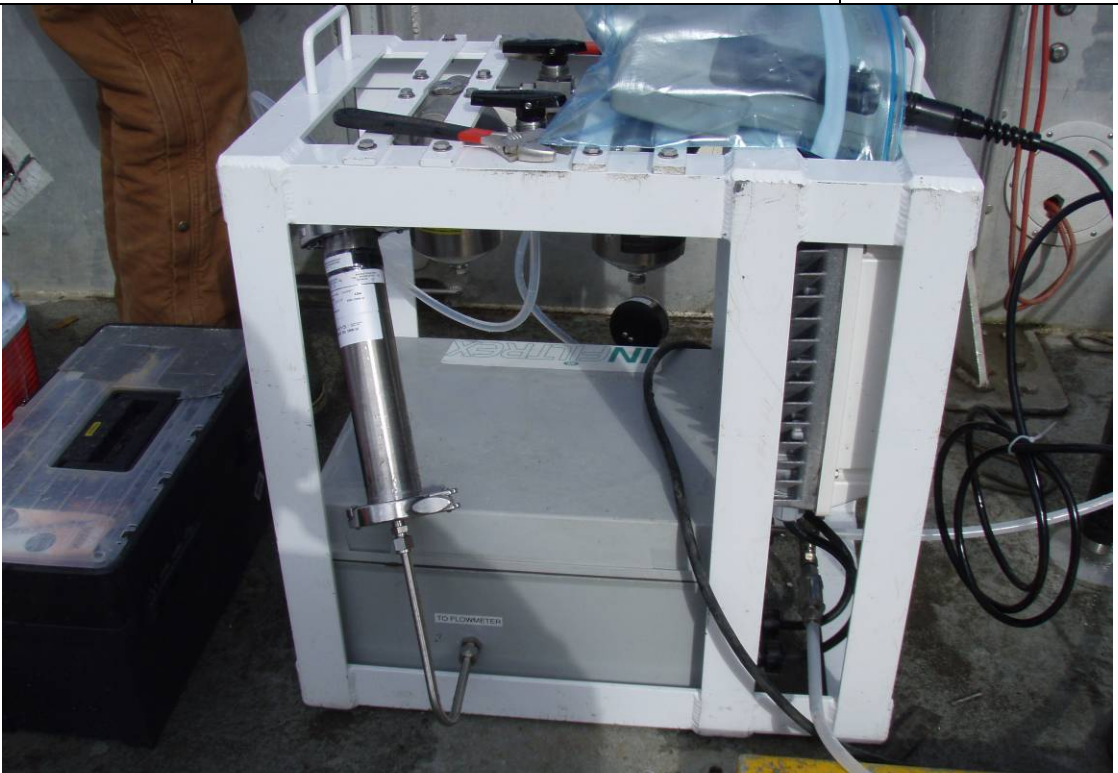
Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 33	Date: 02/13/08		
Direction Photo Taken: N/A			
Description: Close up of Infiltrix pump. The XAD column is the stainless steel cylinder to the left of center.			

Photo No. 34	Date: 02/24/08		
Direction Photo Taken: N/A			
Description: Close up of Infiltrix pump. The two stainless steel cylinders at the top of the photograph house the wound-glass filters. The XAD column is visible on the right.			

Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 35	Date: 02/21/08		
Direction Photo Taken: N/A			
Description: Photograph of URS laboratory. Biological specimens (clam, crayfish, and sculpin) were processed in the URS laboratory prior to shipping to the analytical laboratory.			

Photo No. 36	Date: 02/21/08	
Direction Photo Taken: N/A		
Description: Photograph of frozen crayfish in URS laboratory during sample processing. These crayfish from Station 6 are being measured prior to being weighed. Notice black roe on female crayfish.		

Client Name: United States Army Corps of Engineers		Site Location: Bonneville Lock and Dam – Oregon/Washington	URS Project No. 25696528
Photo No. 37	Date: 02/21/08		
Direction Photo Taken: N/A			
Description: Photograph of frozen crayfish in URS laboratory during sample processing. These crayfish from Station 7 are being weighed to determine tissue mass.			

Photo No. 38	Date: 02/21/08	
Direction Photo Taken: N/A		
Description: Photograph of frozen crayfish in URS laboratory during sample processing.		

Client Name:

United States Army Corps of Engineers

Site Location:

Bonneville Lock and Dam – Oregon/Washington

URS Project No.

25696528

Photo No.
39**Date:**
09/28/07**Direction Photo Taken:**

N/A

Description:

Photograph of clam shucking process at URS laboratory.

**Photo No.**
40**Date:**
09/28/07**Direction Photo Taken:**

N/A

Description:

Photograph of clam shucking process at URS laboratory.

