King County Brightwater TREATMENT SYSTEM

Sampling and Analysis Plan for Intertidal Biota Surveys at the Brightwater Marine Outfall

November 2006

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1.0 Introduction

King County will be building a new wastewater treatment plant, the Brightwater Treatment System, which will discharge treated effluent to Puget Sound through a marine outfall located over a mile offshore near Point Wells (Figure 1). Outfall construction is expected to begin in 2008 and the outfall will traverse through three distinct areas: an onshore, nearshore, and offshore portion. The onshore, nearshore, and offshore portions of the outfall will be approximately 200 feet (ft), 700 ft, and 4,500 ft in length, respectively. Open-trench construction will be used through the onshore and nearshore areas to a depth of -80 ft Mean Lower Low Water (MLLW). Open-trench construction involves excavation of the trench, pipeline installation, trench backfilling, and restoration of the trench surface. Trench shoring (sheeting) will be used in the onshore area to minimize the excavation volume and in the nearshore area (to a depth of -30 ft MLLW) to minimize impacts to biological resources.

A comprehensive marine outfall siting process began in 1998 to identify environmental constraints and to locate the outfall in an area with as little disturbance as possible to key biological resources such as kelp, eelgrass beds, and forage fish spawning habitat. As it was not possible to site the outfall in a location totally devoid of eelgrass, the final outfall zone and subsequent outfall alignment were chosen in an area with as little eelgrass as possible to minimize impacts. However, all biological resources in the nearshore will be removed during trenching of the outfall corridor. The corridor width is expected to be approximately 20-ft (12-ft with an additional 4-ft impact area on either side of the trench shoring).

The purpose of this project is to monitor and document recovery of intertidal biota following construction of the Brightwater marine outfall. During construction, all intertidal biota will be lost. It will be necessary to monitor the intertidal biota community prior to construction to establish a baseline against which to assess recovery following construction. Previous intertidal biota surveys conducted in Puget Sound have shown there is substantial interannual variability in community structure, therefore, it is necessary to conduct at least two annual surveys prior to construction to address this issue. Epibiota and infauna will be documented at the site both prior to and following construction of the outfall. Two reference sites will also be monitored for comparison to the impacted site.

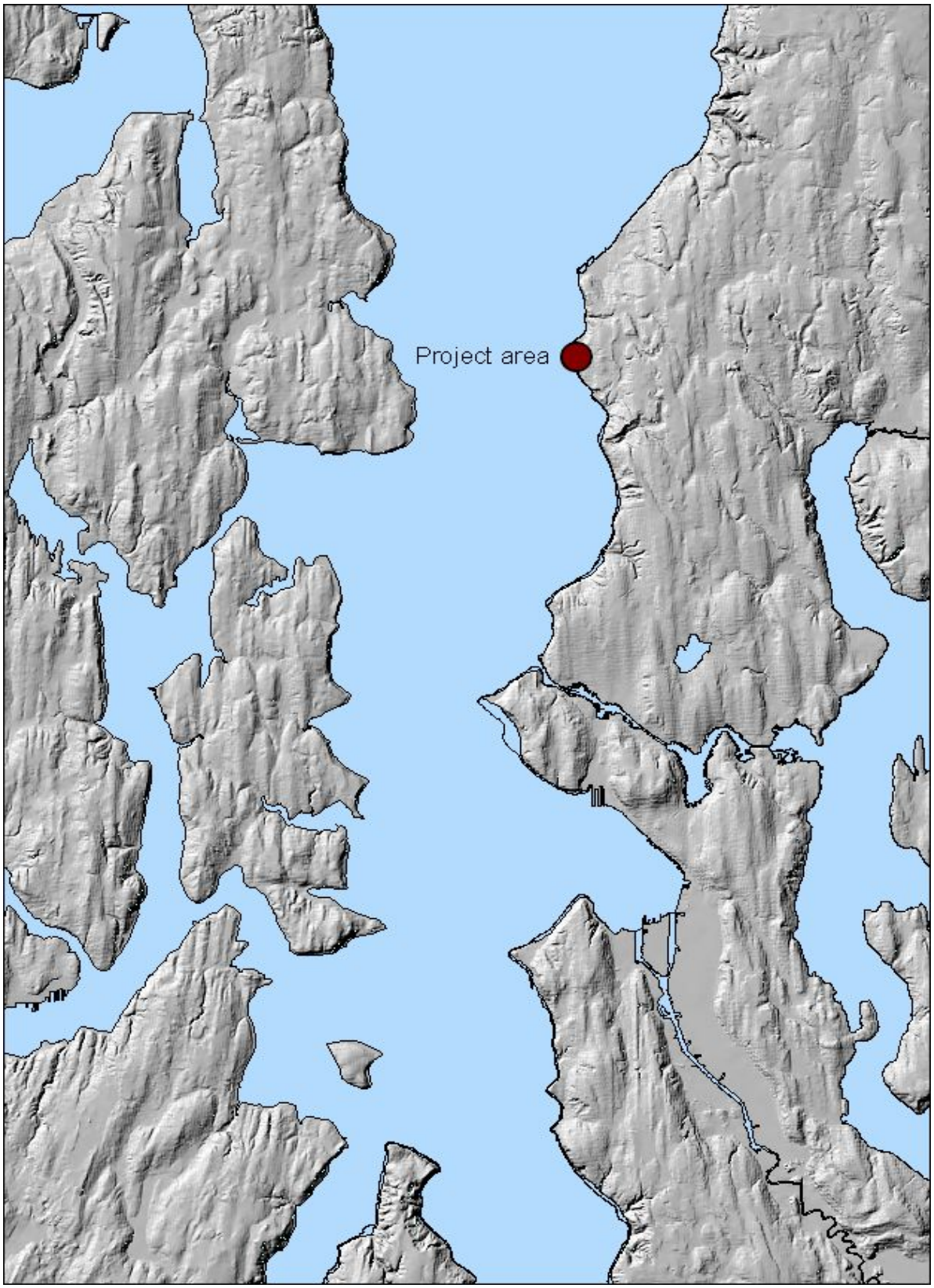

Figure 1. Project Area Located at Point Wells

2.0 Site Description

The site for the Brightwater Treatment System marine outfall is located in the southwest corner of unincorporated Snohomish County at Point Wells. Point Wells is composed of a natural point of land that was reinforced with a rubble seawall by the railroad more than 100 years ago. The site borders are Puget Sound to the west, the terminal dock for the Paramount Asphalt and Petroleum Storage Facility to the north, and the Burlington Northern Santa Fe railroad to the east. Other land uses within a 0.25-mile of radius of the outer perimeter of the site include single-family residences to the southeast, and a forested terrace and ravine to the east and northeast.

Three sites will be surveyed for this project: the marine outfall corridor, a reference site immediately north of the outfall corridor, and a second reference site south of the outfall at Richmond Beach Park (Figures 2 through 4). All three sites have a mix of cobble and pebble at Mean Lower Low Water (MLLW) and thus will be most physically similar at that height. The two sites (impact and reference) at Point Wells differ physically at other tidal heights; the outfall corridor has cobble extending further into the water (below MLLW) but the higher shore is mostly sand and pebble. The adjacent reference site north of the corridor has a substrate break from cobble to sand immediately below MLLW, but the cobble extends higher up the shore than at the impact site. The slope is also steeper at the impact site than at the control. At Richmond Beach, most of the shore is covered with large cobbles, intermixed with pebbles and sand; only near the high water mark does it change to smaller grain sizes.

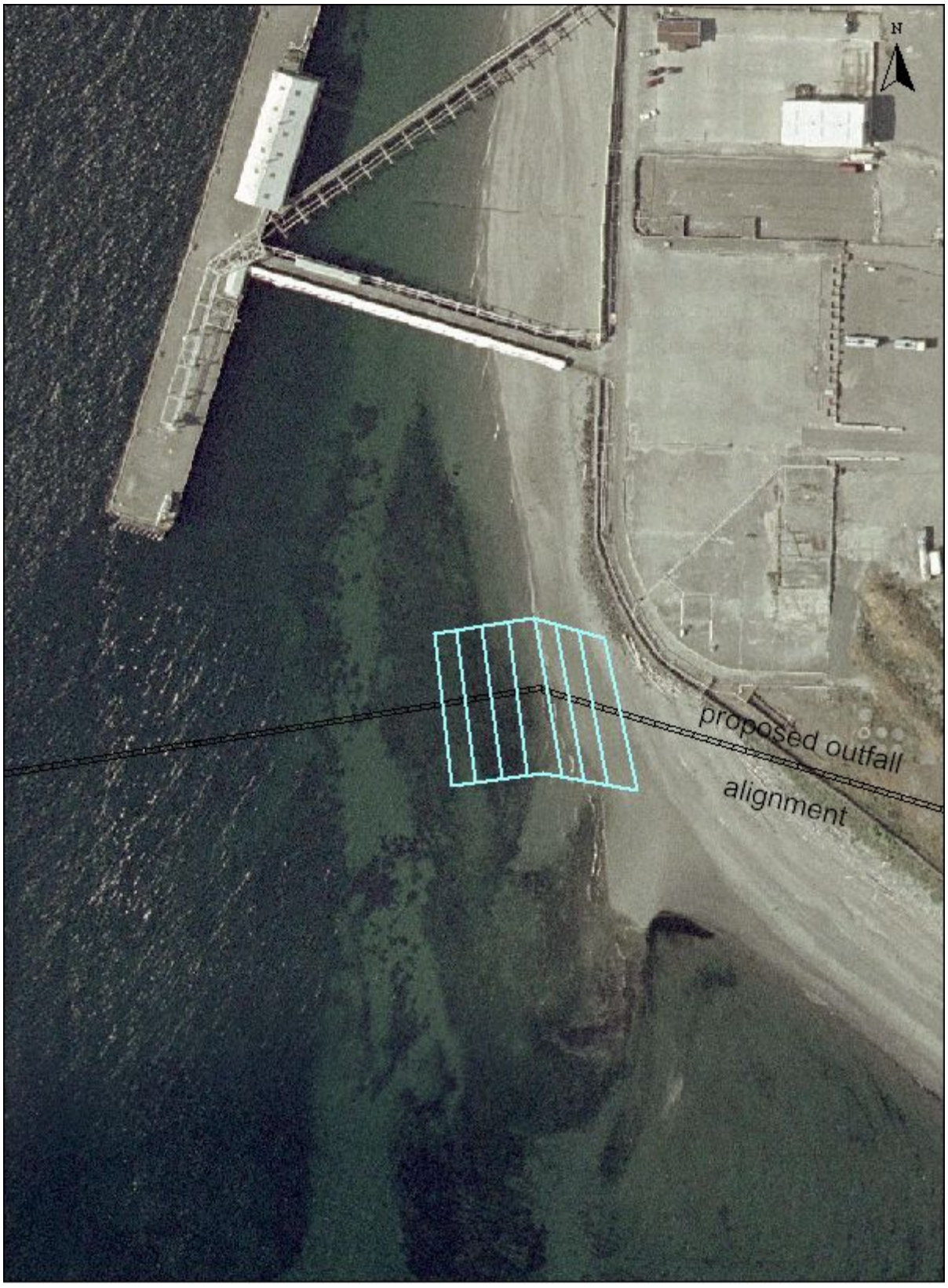

Figure 2. Survey Area Along Anticipated Outfall Alignment

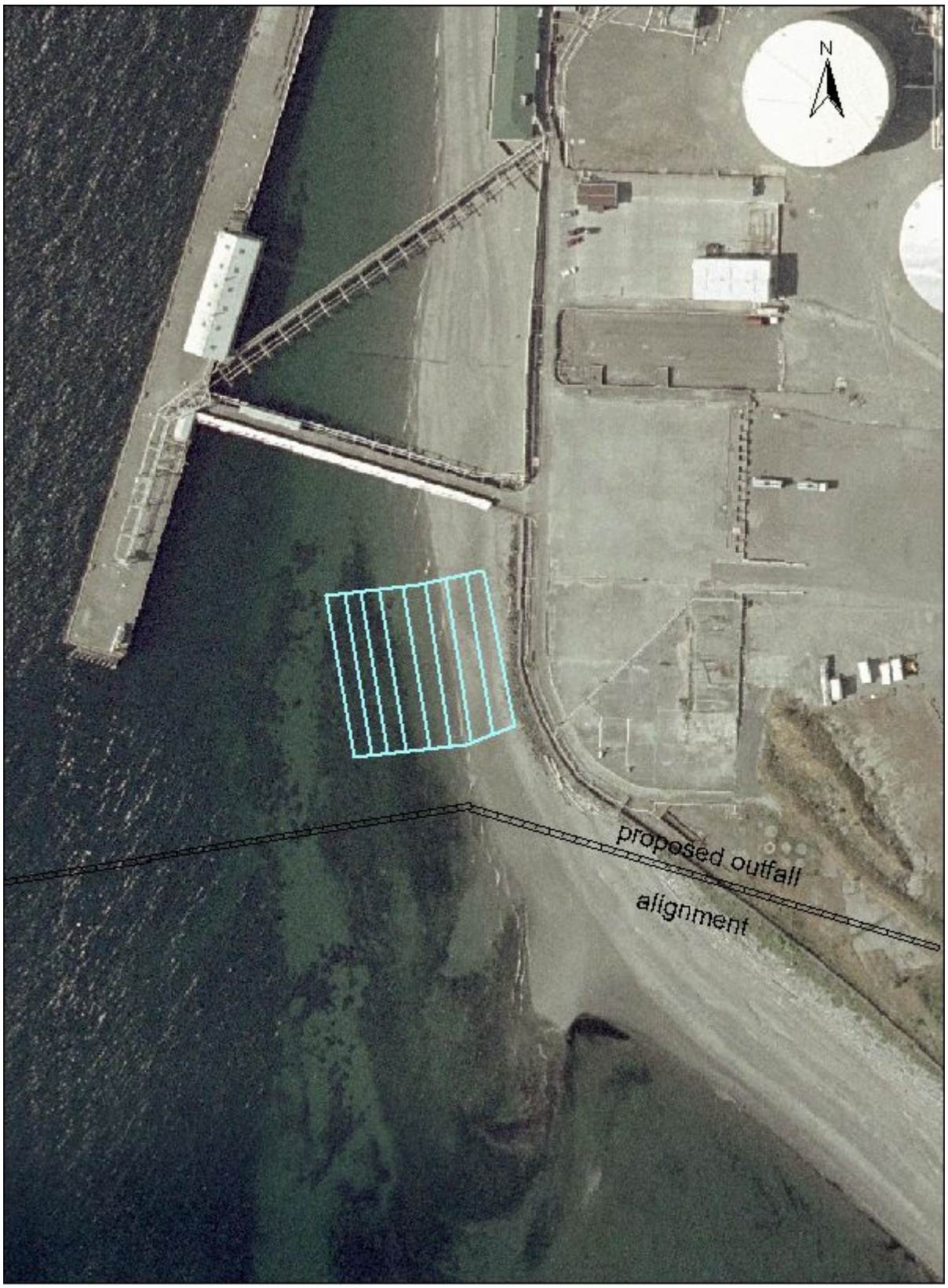

Figure 3. Survey Area for Point Wells Northern Reference Site

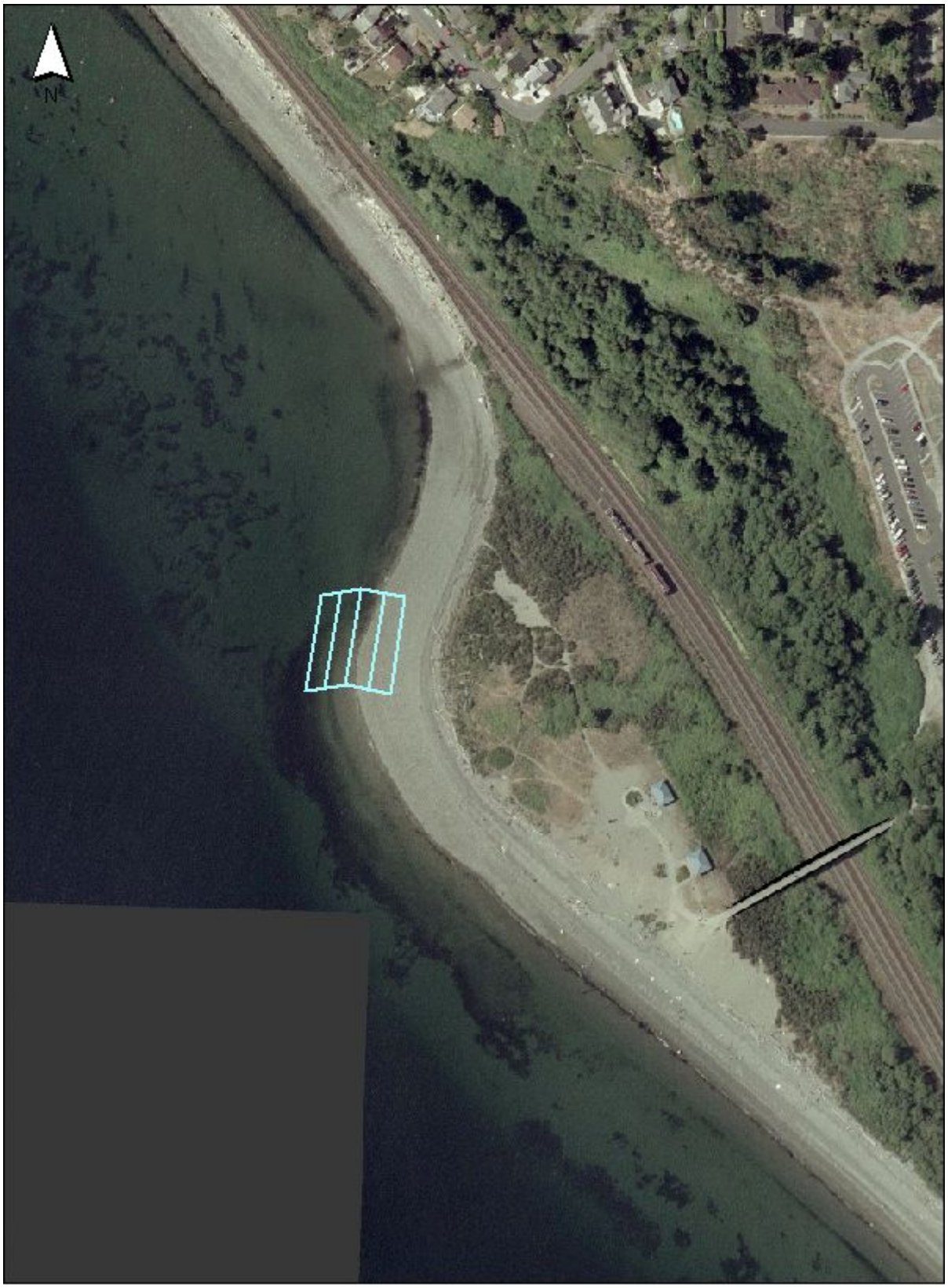

Figure 4. Survey Area for Richmond Beach Park Southern Reference Site

3.0 Sampling Design and Methods

3.1 Field Methods

A series of four intertidal transects will be established at each of the three beaches described above. To make data as consistent as possible with other WDNR Nearshore Habitat Program monitoring data, the SCALE sampling protocol for intertidal organisms, described below, will be followed. To more fully characterize the intertidal biota than is done in most of the SCALE surveys, transects will be established at four intertidal levels rather than just at MLLW. Each site will have biota sampled at: -2 ft MLLW, MLLW (0), Mean Low Water (+2.8 ft), and Mean Sea Level (+6.6 ft). This design concentrates sampling at the lower levels where the biota are much more diverse but provides a sufficient overview of impacts to higher–shore organisms as well. Tidal elevations will be determined relative to predicted water levels for the first field sampling day, and will be marked at all three sites simultaneously to ensure that the same elevations are used at each site. Other tidal levels will be located (relative to the marked level) using a surveyor's transit and telescoping pole.

At each site and each elevation, a 50 meter (m) transect tape running parallel to the water's edge will be placed from north to south and end coordinates recorded with a GPS. Along each transect, 10 locations will be intensively sampled for intertidal organisms using 0.25 m^2 quadrats. Prior studies have shown that 95% of the richness per transect is captured in 10 samples, with approximately 80% encountered in the first 6 samples. Quadrat locations will be placed at pre-determined random distances along each transect. Five quadrats will be placed on the landward (high) side of the tape and five on the waterward (low) side (Table 1). All macroscopic surface flora and fauna (and percent cover of cobbles and sand) will be identified and enumerated for each quadrat and recorded on field sheets. Sample location names will be designated prior to the first survey according to the locator names in Table 2. Whenever possible, biological identifications will be made down to the species level. The exception to this sampling design is that following outfall construction, the 10 samples will be taken along shorter transects at the impact site. This will enable most samples to be contained within the impacted (trenched) section of the beach, which is anticipated to be considerably less than 50 m wide.

A 10 centimeter (cm) diameter x 15 cm deep core will be collected for each of the 10 sampling locations. The infaunal core will be collected on the opposite side of the transect line from where surface flora and fauna are enumerated (i.e., if the quadrat is placed on the high side of the transect, infauna will be collected from the low side). Infaunal cores will be sieved on four and two millimeter(mm) sieves and organisms retained in vials containing seawater. At the end of each day, the seawater will be discarded and the vials filled with 7% formalin. Infauna will be enumerated and identified down to species level at the UW Friday Harbor Laboratories.

Table 1. Placement of Quadrats Along Each Transect

Distance (m)	Placement	Designation
1.3	landward	A
5.7	waterward	B
15.5	landward	C
19.2	waterward	D
23.5	landward	E
28.5	waterward	F
30.6	landward	G
36.2	waterward	H
41.2	landward	I
48.1	waterward	J

At each of the four elevation levels at each sampling site, three sediment samples will be taken for analyses of grain sizes following standard Puget Sound Estuary Program (PSEP) grain size protocols (PSEP, 1997). Samples will be collected along each transect at the B (waterward), E (landward), and I (landward) locations, however, samples will be offset by 0.5 meter to avoid disturbance from the quadrat sampling. Therefore, sediment samples will be collected along the transects at 5.2, 23.0, and 40.7 meters. Samples will be placed in plastic storage bags and transported to the King County Environmental Laboratory for analysis.

3.2 Laboratory Methods

All organisms not identifiable to the species level in the field will be identified in the lab using microscopes. Taxonomic references include Kozloff (1996) and Blake et al. (1997) for invertebrates, and Gabrielson et al. (2000) for macroalgae. All surface flora and fauna as well as infauna will be entered into a species database.

Grain size data will be processed following ASTM D422 methodology (ASTM, 2002), which is a combination of sieve and hydrometer analyses. Individual phi sizes and percent sand, gravel, silt, and clay will be enumerated by the King County Environmental Laboratory and entered into the lab's LIMS database following quality control procedures. Grain size results are presented in units of percent on a dry-weight basis. The method detection limit is 0.1% and the reporting limit is 1.0%. Quality control will consist of triplicate analysis with the relative percent difference being ≤ 20%.

Table 2. Locator Names for Each Site

Impact site-outfall				
Transect 1 + 6.6 MSL	**Transect 2** + 2.8 MLW	**Transect 3** 0 (MLLW)	**Transect 4** -2 MLLW	Distance (m)
OUT1A	OUT2A	OUT3A	OUT4A	1.3
OUT1B	OUT2B	OUT3B	OUT4B	5.7
OUT1C	OUT2C	OUT3C	OUT4C	15.5
OUT1D	OUT2D	OUT3D	OUT4D	19.2
OUT1E	OUT2E	OUT3E	OUT4E	23.5
OUT1F	OUT2F	OUT3F	OUT4F	28.5
OUT1G	OUT2G	OUT3G	OUT4G	30.6
OUT1H	OUT2H	OUT3H	OUT4H	36.2
OUT1I	OUT2I	OUT3I	OUT4I	41.2
OUT1J	OUT2J	OUT3J	OUT4J	48.1
Reference site-Point Wells				
Transect 1 + 6.6 MSL	**Transect 2** + 2.8 MLW	**Transect 3** 0 (MLLW)	**Transect 4** -2 MLLW	Distance (m)
PTW1A	PTW2A	PTW3A	PTW4A	1.3
PTW1B	PTW2B	PTW3B	PTW4B	5.7
PTW1C	PTW2C	PTW3C	PTW4C	15.5
PTW1D	PTW2D	PTW3D	PTW4D	19.2
PTW1E	PTW2E	PTW3E	PTW4E	23.5
PTW1F	PTW2F	PTW3F	PTW4F	28.5
PTW1G	PTW2G	PTW3G	PTW4G	30.6
PTW1H	PTW2H	PTW3H	PTW4H	36.2
PTW1I	PTW2I	PTW3I	PTW4I	41.2
PTW1J	PTW2J	PTW3J	PTW4J	48.1
Reference site-Richmond Beach				
Transect 1 + 6.6 MSL	**Transect 2** + 2.8 MLW	**Transect 3** 0 (MLLW)	**Transect 4** -2 MLLW	Distance (m)
RBP1A	RBP2A	RBP3A	RBP4A	1.3
RBP1B	RBP2B	RBP3B	RBP4B	5.7
RBP1C	RBP2C	RBP3C	RBP4C	15.5
RBP1D	RBP2D	RBP3D	RBP4D	19.2
RBP1E	RBP2E	RBP3E	RBP4E	23.5
RBP1F	RBP2F	RBP3F	RBP4F	28.5
RBP1G	RBP2G	RBP3G	RBP4G	30.6
RBP1H	RBP2H	RBP3H	RBP4H	36.2
RBP1I	RBP2I	RBP3I	RBP4I	41.2
RBP1J	RBP2J	RBP3J	RBP4J	48.1

4.0 Project Organization and Schedule

The tasks involved in conducting intertidal biota characterization for the Brightwater outfall project and the primary personnel responsible for those tasks are shown below.

--**Dr. Megan Dethier** *University of Washington, Friday Harbor Laboratories*. Project management, survey design, collection of field data, identification of infauna, data entry into species database, and preparation of final survey report.
--**Dr. Jennifer Ruesink** *University of Washington, Department of Biology*. Collection of field data, identification of infauna, and report review.
--**Helen Berry** *Washington State Department of Natural Resources*. Project management, survey design, coordination of field activities, collection of field data, and report review.
--**Kimberle Stark** *King County Department of Natural Resources and Parks.* Project management and report review.
--**Laura Arber** *Washington State Department of Fish and Wildlife.* Review and approval of Sampling and Analysis Plan.
--**Sharon Holley** *Washington State Department of Natural Resources.* Review and approval of Sampling and Analysis Plan.
--**Katherine Bourbonais** *King County Environmental Laboratory.* Coordination of environmental laboratory activities, data validation, and data reporting for grain size analysis.

Surveys will be conducted in summer 2006, and repeated in summer of 2007, summer of 2008 if possible (dependent upon outfall construction), and for a minimum of two years after construction to follow the process of intertidal community recovery. At least two months prior to each survey, Laura Arber and Sharon Holley will be contacted. If any changes are anticipated to the sampling protocol or schedule, Laura Arber and Sharon Holley will be contacted as they occur.

5.0 Sample Documentation

Sampling information and sample metadata will be documented using the methods described below.

- Field sheets for biota sampling generated by Washington State Dept. of Natural Resources will include the following information:
  1. unique site identifier
  2. transect elevation
  3. quadrat position (letter designation and/or distance)
  4. date and time
  5. sampling personnel
  6. species type and number
  7. estimated percent cover of cobbles and boulders

Figure 5 provides an example of the biota sampling field sheet.

- Field sheets for grain size sampling generated by the King County Environmental Laboratory will include the following information:
  1. unique sample identification number
  2. unique station name (LIMS locator)
  3. date and time
  4. sampling personnel
  5. physical sediment characteristics
  6. tidal state (flood vs.ebb)
  7. sample depth
  8. GPS coordinates of sample locations
  9. GPS coordinates for start and end of each transect

Figure 6 provides an example of the grain size sampling field sheet.

2006 SCALE Quadrat Data Sheet % cover categories: 1, 5, 15, 25, 50, 75, 85, 95, 99

Date:_____ **Time start/stop:**_____ **Site Name:**_____ **Staff:**_____

	A (1.3 L)	B (5.7 H)	C (15.5 L)	D (19.2 H)	E (23.5 L)
FLORA (% cover)					
Zostera marina					
green filaments (Acrosiphonia, Cladophora)					
green blades and tubes					
Alaria sp.					
Laminaria spp.					
Desmarestia spp.					
Fucus spp.					
Punctaria/Porphyra					
Sargassum					
small brown blades and tubes (Scytosiphon, Petalonia)					
wirey branched reds (Endocladia, Gelidium, Caulacanthus)					
thin red filaments (Polysiphonia, Ceramium, Microcladia)					
branched red blades (Mastocarpus, Mazzaella spp., Prionitis)					
branched red tubes (Gracilaria, Sarcodiotheca)					
Tightly branched dark reds (Neorhodomela, Odonthalia)					
Fleshy crust (not corralline)					
MISC (% cover)					
% Sand					
% cobble					
Chain-forming diatoms					
BARNACLES % cover)					
Barnacles live (Class Cirripedia)					
Barnacles dead					
POLYCHEATES (count)					
Polynoidae (scaleworms)					
Sabellidae					
Serpulidae					
Spio Tubes					
CRUSTACEANS (count)					
Order Amphipoda					
Sphaeromid isopods					
Idoteid isopods					
Hippolytid shrimp					

Figure 5. Example of Field Sheet for Biota Samples

2006 SCALE Quadrat Data Sheet % cover categories: 1, 5, 15, 25, 50, 75, 85, 95, 99

Date:_____ **Time start/stop:**_____ **Site Name:**_____ **Staff:**_____

	A (1.3 L)	B (5.7 H)	C (15.5 L)	D (19.2 H)	E (23.5 L)
Cancrid crabs (list species if possible)					
Hemigrapsus (list species if possible)					
Majid (spider) crabs					
Pagurid (hermit) crabs					
Xanthid crabs (Lophopanopeus)					
ANEMONES (% cover)					
Anthopleura spp.					
Metridium					
ECHINODERMS (count)					
Leptasterias					
Evasterias					
Dendraster					
Strongylocentrotus					
MOLLUSCS (count OR % cover)					
Mopalia spp.					
Tonicella					
Haminoea slugs					
Hermissenda					
Onchidoris spp.					
Alia spp.					
Bittium spp.					
Crepidula (list species if possible)					
Lacuna spp.					
Littorina spp.					
Lottiid limpets					
Nassarius spp.					
Nucella (list species if possible)					
Odostomia spp.					
Polinices					
Calliostoma					
Lirularia					
Pododesmus (jingle shells) - (COUNT)					
Mytilus spp. (% cover)					
oysters (% cover)					
Pholadidae (boring clams)					
Ph. Nemertea (ribbon worms)					
Ph. Platyhelminthes (flatworms)					
VERTEBRATES					
Cottidae (sculpins)					
Stichaeidae (gunnels and pricklebacks)					

Figure 5 (cont.). Example of Field Sheet for Biota Samples

Page: 1

BRIGHTWATER INTERTIDAL BIOTA SURVEY PSD SAMPLES

Project Number: 423575-300-2 Personnel: _____

Sample Number	P39378-1	P39378-2	P39378-3
Locator	OUT1A	OUT1B	OUT1C
Short Loc. Desc.	Temploc	Temploc	Temploc
Locator Desc.	Temporary locator	Temporary locator	Temporary locator
Site			
Start Date/Time			
Client Loc.			
Sample Depth			
Collect Date			
Comments	Pt.wells biota survey	Pt.wells biota survey	Pt.wells biota survey
Personnel			
Sed Type			
Tide Cond.			
Time			
Dept., Matrix	Saltwtrsed/PSD	Saltwtrsed/PSD	Saltwtrsed/PSD

Chain of Custody Stamp/Information :

Figure 6. Example of Field Sheet for Grain Size Samples

6.0 Data Analysis, Reporting and Record Keeping

6.1 Data Analysis

Two years of prior data, 1999 and 2001, exist for one intertidal level (0 MLLW) at the impact site and at the southern Richmond Beach Park reference site. These data can provide a partial pre-impact baseline dataset. Obtaining data from multiple years both prior to and following outfall construction at both the impact and control sites will strengthen the change analyses.

Multivariate statistical analyses of the entire community (species present and relative abundances) at each elevation level, testing how the communities shift over time both naturally (pre-construction at the impact and reference sites) and post-construction will be conducted. If some individual species are sufficiently abundant in the samples, univariate analyses of their changes in abundance with time will also be conducted. In addition, spatial and temporal patterns of species richness will be evaluated. Observed changes in the biotic community over time relative to changes in sediment grain size will be compared.

6.2 Reporting

All species and site data will be entered into a species database maintained by Helen Berry at WDNR. Grain size data will be entered into a linked physical database. Grain size data will also be entered into the King County Environmental Laboratory LIMS database following appropriate quality assurance/quality control procedures.

A summary report will be prepared once laboratory species identifications are completed for each survey year. The summary report will include tables listing number of each species identified at each site, grain size data, and pertinent information regarding data collection (survey dates, survey personnel, coordinates, and maps). Electronic versions of the species tables will also be generated following each survey. Results from multivariate statistical analyses will be included in the 2007 summary report, following two years of data collection. A final survey report will be completed after the last sampling event following outfall construction. The final report will include results from statistical analyses of the intertidal community over time and how the community changed and/or recovered following construction. The final report will also include tables listing all the species surveyed throughout the entire project.

Project reports will be distributed to the following agencies:

- Washington Department of Natural Resources
- Washington Department of Fish & Wildlife
- University of Washington
- King County Department of Natural Resources and Parks.

7.0 References

ASTM. 2002. Standard Test Method for Particle-size Analysis of Soils D422-63. American Society for Testing and Materials. West Conshohocken, Pennsylvania.

Blake, J.A., Hilbig, B. & Scott, P.H. 1997. Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Gabrielson, P.W., Widdowson, T.B., Lindstrom, S.C., Hawkes, M.W. & Scagel, R.F. 2000. Keys to the Benthic Marine Algae and Seagrasses of British Columbia, Southeast Alaska, Washington and Oregon. Phycological Contribution Number 5, University of British Columbia, Vancouver, B.C.

Kozloff, E.N. 1996. Marine Invertebrates of the Pacific Northwest. Univ. of Washington Press, Seattle, WA.

PSEP (Puget Sound Estuary Program). 1997. Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA and Puget Sound Water Quality Authority, Olympia, WA.