

# **Baseline Monitoring Cliffside Beach Wood Removal Phase II Project**

## **Sampling Plan**

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## **Field Sampling Plan**

Cliffside Beach is a low-slope, sandy beach just south of the Nooksack River in the northern end of Bellingham Bay. Currently, large areas of the upper intertidal beach at that location are covered with a deep layer of fine woody debris. The woody debris deposited there is probably a result of historical milling operations in Bellingham Bay and of natural deposition from the Nooksack River.

The accumulation of wood undoubtedly impacts the community of invertebrates that would normally live in the underlying sediments. This, in turn, is likely to decrease use of the habitat by marine fish and birds. In an effort to improve the site, the Whatcom County Marine Resources Committee, the Whatcom County Public Works and the Washington State Department of Ecology have proposed the Cliffside Beach Wood Removal Project. The project will entail removal of the woody debris from the 2000 feet of Cliffside Beach owned by the Washington Department of Natural Resources. The hope is that removal of the wood layer will improve the site, promoting use of the habitat by marine invertebrates, fish and birds.

To document effects of wood removal on the habitat and the resident invertebrate community, pre-project monitoring will be done. Samples taken before the wood is removed will create a baseline to which post-project samples can be compared. Statistical analysis will allow us to eventually test the hypothesis that removal of the wood layer changed the Cliffside Beach sediments and the underlying invertebrate community.

## **Objectives**

- Quantify the benthic invertebrate community in the upper intertidal beachface at Cliffside Beach
- Document use of the beachface habitat by marine forage fish
- Measure the physical profile of the beach
- Measure the grain size composition of the beach sediments
- Quantify the organic content of the beach sediments

- Statistically describe the physical and biological conditions at the beach as a baseline for future sampling

## **Sampling and sample analysis**

### *Biological characteristics*

Benthic sampling will be done along 6 equally-spaced transects on the Washington DNR-owned portion of the Cliffside Beach. These sites are identified as W3, E1, E5, E9, E13 and E17 in the Cliffside Beach Wood Debris Removal Project – Phase 1 report (Fig.1, Table 1). Benthic samples will be taken along these transects at tidal heights of +3 feet, +5 feet and +7 feet. Samples will be taken with a 10.2 cm (4”) diameter PVC corer to a depth of 20 cm. The samples will be transferred to a bucket of seawater where the floating woody debris will be vigorously washed (to dislodge invertebrates), removed, fixed in 10% buffered formalin and later transferred to 70% ethanol. Material remaining in the bucket will be washed through a 0.5-mm sieve then preserved in the same way.

In the laboratory, invertebrates in the sieved samples will be identified to the lowest possible taxonomic level and the number of each invertebrate species will be recorded. The wood samples will be non-quantitatively examined to ensure we have not missed invertebrates or other biological material (e.g., fish eggs) in those samples. If there are significant numbers of invertebrates or eggs on the washed woody debris, we will quantitatively count a subsample of those materials.

It is expected that the Lummi Natural Resources beach seine program will coordinate beach seine sets during the salmon migration period to coincide with the sample area to assist in providing a baseline of fish presence in the habitat.

### *Physical characteristics*

Beach profiles will be determined by measuring horizontal distances between +3, +5, +7, +9 and +11 foot tidal heights along the sampling transects. We will use GPS starting location (Table 1) combined with transit surveys to mark the tidal heights. GPS coordinates of these locations will later be compared to a high-resolution 2006 LIDAR dataset to get actual elevations (accuracy: 0 – 6 inches). These data will create a baseline to which we can compare future profiles. This sampling will require differential GPS and access to the LIDAR dataset (both provided by the Whatcom County Marine Resources Committee).

Sediment samples will be collected with 5 cm (2 inch) PVC corers to a depth of 20 cm. The samples will be taken at the same locations as the biological samples. Half of the sample will be used for determination of organic content; the other half will be used for sediment grain size analysis.

Sediment grain size will be determined by washing each sample through a series of sieves, separating fines (sediment passing through a 75- $\mu$ m sieve), sand (sediment passing through a 4,750- $\mu$ m sieve) and gravel (sediment retained on a 4,750- $\mu$ m sieve). If time and equipment permit, we may further break the sand

into fine, medium and coarse fractions and the gravel into fine and coarse fractions. Each fraction will be oven dried at 60° C for 48 hours and weighed. The dry weights will allow us to determine the percent of each sample composed of each grain-size.

To compare the amount of organic matter in the sediments, unsorted sediment samples will be oven dried for 96 hours at 60° C, weighed, and burned for 4 hours at 500° C in a muffle furnace. The drop in weight will be used to calculate percent organic content.

## **Statistical analysis**

### *Community analyses*

To compare the invertebrate communities in the treatment areas, we will calculate traditional univariate community indices (i.e., number of species, number of individuals, Shannon-Wiener diversity and Pielou's evenness). We can then use 1-way ANOVA to compare sites, tidal heights, etc. according to the goals of the Marine Resources Committee.

While such community indices are often used to compare invertebrate communities, they may give inaccurate impressions about community similarities because they ignore the identity of the animals that make up the samples. For example, it is possible for two samples to have identical numbers of species, numbers of individuals, diversity and evenness indices yet be composed of entirely different species.

To get a more complete view of the invertebrate community, and especially to permit powerful comparisons with post-debris-removal samples, we will also analyze the data using multivariate techniques. This approach allows us to simultaneously look at all of the abundance data without reducing them to indices. We will use multidimensional scaling (MDS) to look for patterns in the data. The MDS plots will allow us to visualize the distribution of samples from different tidal heights and different stations. More importantly, it will set a baseline against which we can compare similar samples taken in future monitoring years.

Analysis of hypothesized differences can be made with ANOSIM (Analysis of Similarity). SIMPER (Similarity Percentage) analysis will identify those species that contribute most to any observed differences among sites, tidal heights or years.

### *Sediment analyses*

Sediments will be described graphically through multidimensional scaling analysis. This will allow 1) comparison of sites along the beach front and 2) comparison with future samples taken after the woody debris has been removed. Beach profile data, taken from precisely located sites, will be presented as a table describing beach elevation change at each of our sampling locations. Precise identification of those locations will allow future post-wood removal resampling of the same locations to document any changes in sediment deposition.

## **Reporting**

When samples have been processed, we will provide a report to the Whatcom County MRC. The report will include 1) a species list of the invertebrates in the samples (identified to the lowest practical taxonomic level), 2) counts of all species 3) data on grain size composition and organic content of the beach sediments, 4) beach profile information, 5) statistical analysis of the data and 6) recommendations for future monitoring. We will also give an oral report to the MRC detailing our findings.

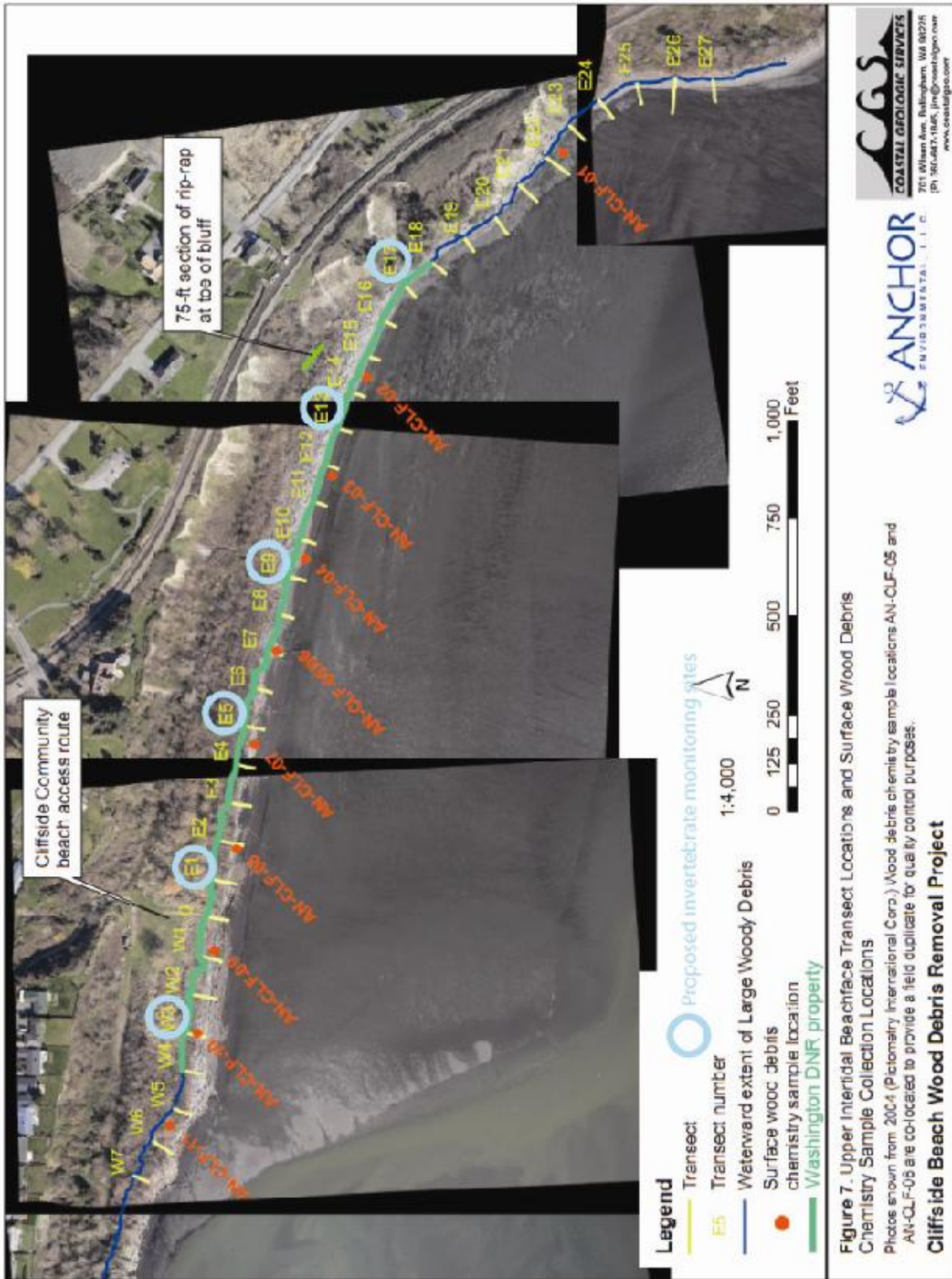


Figure 1. Invertebrate sampling sites on Cliffside Beach. Map is adapted from a 2007 Anchor Environmental Report titled, “Wood debris assessment and removal options report: Cliffside Beach Wood Debris Removal Project Phase I”, prepared for Whatcom County Public Works.

Table I. Locations of upper ends of transects to be sampled. Data are extracted from a 2007 Anchor Environmental Report titled, “Wood debris assessment and removal options report: Cliffside Beach Wood Debris Removal Project Phase I”, prepared for Whatcom County Public Works.

Site	Latitude	Longitude	Elevation (feet)
W3	48° 46' <b>36.839</b> ”	122° 32' <b>34.997</b> ”	+10.5
E1	48° 46' <b>36.264</b> ”	122° 32' <b>29.111</b> ”	+11
E5	48° 46' <b>35.504</b> ”	122° 32' <b>23.248</b> ”	+10.5
E9	48° 46' <b>34.530</b> ”	122° 32' <b>17.485</b> ”	+11
E13	48° 46' <b>33.287</b> ”	122° 32' <b>11.768</b> ”	+9.5
E17	48° 46' <b>31.692</b> ”	122° 32' <b>06.230</b> ”	+10