

Oregon Beach and Shoreline Framework Theme

April 2009

Background:

The Coastal Hazards Workgroup, a sub-group of the Hazards Committee of the Framework Implementation Team (CHW-FIT), met in February 2009 to commence development of data standards for a variety of geospatial thematic layers that serve to define coastal hazards. The group identified several data elements for initial consideration, including:

- coastal erosion hazard layers,
- baseline beach profile information (i.e. topographic cross-sections),
- a contemporary datum-based shoreline (late 2000 era),
- historical shorelines derived from National Ocean Service (NOS) T-sheets,
- a shore protection (i.e. coastal engineering) geospatial database.

Of these, the historical T-sheet shorelines and the shore protection data elements are complete for the entire Oregon coast. The T-sheet shorelines were originally developed by staff from the Oregon Coastal Management Program of the Department of Land Conservation and Development agency (OCMP-DLCD) using standards established by NOAA; NOAA remains the steward of these data. The coastal engineering database were developed by the Oregon State Parks and Recreation Department (OPRD). Standards for these data were developed by an ad hoc committee in early 2000, and OPRD maintains these data for regulatory purposes. In contrast, information on coastal erosion hazard layers, beach and bluff profiles, and a contemporary shoreline feature are either incomplete or non-existent. For example, coastal erosion hazard layers have been developed for Lincoln, Tillamook and portions of Clatsop and Curry counties by the Oregon Department of Geology and Mineral Industries (DOGAMI). Baseline information on the morphology of Oregon's beaches and bluffs, information that is critical for the development of coastal erosion hazard zones and management of Oregon beaches, are presently available at only a few select sites on the northern Oregon coast (**Fig. 1, green boxes**). There is presently no complete statewide datum-based shoreline element for Oregon. The purpose of this proposal is to implement the establishment of a statewide geospatial beach and bluff profile observation network and shoreline layer for the Oregon coast. These data will provide important *baseline information* for assessments of future coastal erosion hazards, particularly erosion hazards stemming from accelerated sea level rise and the effects of extreme storms caused by earth's changing climate. The shoreline data are also required for planning and regulation of coastal development, and for assessments of geologic hazards on a site specific basis by geotechnical consultants.

Project Narrative:

Comprehensive beach monitoring programs are essential for monitoring short and long term changes in beach conditions and morphology and for providing consistent and accurate data for guiding coastal development planning, engineering and for erosion hazard mitigation. Where implemented, beach monitoring programs have enhanced decision-making in the coastal zones of states such as Florida (OBCS, 2001), South Carolina (Gayes and others, 2001), Texas (Morton, 1997), Washington state (Ruggiero and others, 2005), and in the United Kingdom (Bradbury, 2007). Recently, the British Government endorsed the expansion of a pilot beach and bluff monitoring program established in the south of England, to include much of the remaining English coastline in order to begin documenting the effects of climate variability and sea level rise around its coast (Bradbury, 2007).

To assist coastal managers and the public-at-large, DOGAMI initiated a "pilot" beach and shoreline monitoring effort in October 2004 to document beach and shoreline changes at 25 sites along the Rockaway littoral cell (Cape Meares to Neahkahnie Mountain) in Tillamook County. The success of the pilot study led the OCMP-DLCD, OPRD, and the NOAA-funded Integrated Ocean Observing System Initiative (IOOS) to expand the pilot program to include an additional 94 sites (**Fig. 1, green boxes**). Repeat observations are presently being carried out at a total of 119 sites, including 58 sites in the

Newport cell¹ (Yachats to Yaquina Head), 15 sites between Yaquina Head and Otter Rock (the Beverly Beach cell), 15 sites between Cascade Head and Pacific City (the Neskowin cell), 25 sites along the Rockaway littoral cell, and six sites along the Clatsop Plains. In all cases, results of the monitoring are made available on the web. More information about the Oregon Beach and Shoreline Mapping and Analysis program (OBSMAP) implemented by DOGAMI can be found at: <http://www.oregongeology.org/sub/Nanoos1/index.htm>.

Monitoring of beaches and bluffs on the Oregon coast is undertaken using a survey-grade Trimble 5700/5800 Real-Time Kinematic Differential Global Positioning System (RTK-DGPS), owned and operated by DOGAMI. This enables the project team to undertake both rapid and precise measurements of beach/bluff changes and shorelines, with horizontal accuracies of about ± 1 cm and vertical accuracies of about ± 2 cm (**Fig. 2A**) (note: these survey accuracies are typically achieved under ideal conditions characterized by >6 satellites with limited obstructions overhead). Furthermore, this approach has allowed DOGAMI staff to accurately measure beach responses over a period of hours following major events (**Fig. 2B**), as opposed to having to undertake surveys lasting weeks or longer using conventional survey instruments (e.g. surveying theodolites). Hence, use of GPS technology has revolutionized the collection of geospatial information and the development of coastal monitoring programs both here in the US and around the world, allowing for the collection of large amounts of data at costs far lower than would have been possible 10-15 years ago.

As part of this funding request, we propose to develop a complete coastwide beach/bluff shoreline observation network that would span the full length of the Oregon coast (**Fig. 1, red boxes**), encompassing 15 additional littoral cells presently not covered by existing monitoring efforts. A variety of geologic datasets described below will be measured along each of the shore sections, which will ultimately form the basis of a *statewide coastal hazard geospatial database*. These data will include:

1. The establishment of beach and bluff profile (cross-sections) monitoring networks spaced approximately 500 m to 1,000 m (1,600 to 3,200 ft) apart along each of the pocket beach littoral cells. The profile network will exclude rocky headlands and cliffed shores, where access is either difficult or too dangerous to safely operate.
2. Measurement of two shoreline contours. The first contour will reflect the Mean Higher High Water tidal shoreline that is analogous to the Mean High Water (MHW) shoreline position measured by early NOS surveyors, and most closely approximates the wet/dry sand line depicted in aerial photographs. Thus, the MHHW shoreline feature will depict a modern shoreline position that may be compared against earlier NOS shoreline positions. The second shoreline contour will be established at an elevation of 5 m (16 ft). This latter contour is essentially analogous to the statutory vegetation line that was surveyed by ODOT in the mid 1960s, which spans portions of the Oregon coast; Note, the statutory vegetation line does not cover the entire coast as it excluded those beaches that are publicly owned (i.e. a large part of the coast). Furthermore, the 5 m (16 ft) contour has not been re-measured since the 1960s. Accordingly, updating the position of the 5 m (16 ft) contour would represent an important update on the previous 1960s era survey, and would fill in the gaps where there is presently no information. In all cases, measurement of the shorelines will be carried out in mid to late summer 2010, when the beaches are in their most accreted state, and will be consistent with approaches used by early NOS surveyors. This allows for direct comparison between the modern shorelines and earlier shorelines measured by the NOS.
3. Develop an inventory of the geomorphic characteristics of beaches and bluffs at each of the profile locations. The inventory will utilize a classification scheme presently being developed by DOGAMI staff and Dr. Paul Komar at OSU that would provide a systematic approach for documenting a range of variables including sediment characteristics (e.g. composition (i.e. sand, gravel, boulders) and mean sediment size), presence or absence of dunes/bluffs, and backshore characteristics (e.g. presence or absence of vegetation etc.).

¹ Littoral cells are headland bounded stretches of shore, where sediments are moved along the beach (longshore transport) as well as between the offshore sand bars and the active beach face (i.e. on-offshore sediment movement). However, sediment exchange between adjacent littoral cells is either limited or is non-existent due to the presence of the headlands.

4. Synthesize information derived from Lidar measurements of the coast undertaken in 1997, 1998, 2002, and most recently in 2008, and integrate these data into the beach/bluff profile spatial database.

Project Deliverables:

The key deliverable from this project will be the development of a *coastal hazard geospatial database* that will be complete for the entire Oregon coast. The coastal hazard database will assimilate a suite of geologic geospatial information including:

1. The establishment of a beach/bluff profile network for the entire Oregon coast spaced at 500 m to 1,000 m (1,600 to 3,200 ft) apart, which will establish the *baseline* theme layer against which future assessments may be compared. Collection of these data will utilize RTK-DGPS techniques now considered the standard for undertaking coastal beach and bluff observations and for assessments of shorelines (e.g. Ruggiero and others, 2005; Allan and Hart, 2008);
2. Two shoreline contours: a modern 2010 era shoreline and a 2010 era update on the original statutory vegetation line measured in the 1960s;
3. Synthesis of a variety of geologic data parameters (grain-size, beach composition, backshore characteristics, slope etc.) into the beach/bluff profile database. The latter will provide for the first time a complete coastwide geomorphic classification of the beaches and bluffs of Oregon, information that is in demand by geotechnical consultants, and more recently by the Governors natural resource team for evaluation of sea level rise effects;
4. Lidar profile and shoreline plots for 1997, 1998, 2002, 2008, and 2009 aerial surveys will be derived for each of the beach/bluff profile sites and will be linked to the GPS data plots for comparison; and,
5. Contemporary photos taken at every transect site that will allow for comparisons in the future.

Due to the length of the Oregon coast, we propose to complete this proposal in two phases.

Phase 1 would focus on the northern Oregon coast from Heceta Head to the mouth of the Columbia River and will leverage existing resources from ongoing monitoring efforts currently underway in the Newport, Beverly, Neskowin, Rockaway, and Clatsop littoral cells. Funding is therefore being requested to expand the monitoring network to five new littoral cells, commence development of the coastal hazard geospatial database, leverage existing Lidar data analyses undertaken by DOGAMI in 2004 (Allan and Hart, 2005), implement the coastal geomorphic classification assessment, and synthesize all of these data into the coastal hazard geospatial database. Phase 1 would commence in March 2010 and would be completed by June 2011.

Phase 2 would focus on the southern Oregon coast from Heceta Head south to Crissey Field located at the Oregon/California border. Phase 2 would require more time to complete due to its complex geomorphology and because there is presently no systematic observation effort underway on the south coast. To that end, significant effort will be required to establish a new monitoring network on the south coast and the collection of the same data layer themes described above. Phase 2 would commence in late summer 2011 and would be completed by late summer 2012.

Amount Requested:

Phase 1: \$120,497

Phase 2: \$160,376

Importance of a Coastwide Coastal Hazard Geospatial Data Theme:

Statewide Coastal Hazard geospatial data developed in a consistent and standardized GIS format will meet many important needs for Oregon. It is essential for undertaking coastal erosion hazard mapping used by coastal planners for guiding the safe establishment of new development on the coast, in the determination of base flood elevations for the purposes of FEMA's flood Insurance mapping, and for site specific studies of coastal hazards undertaken by practicing geologists and engineering geologists. Coastal hazard information is also used by State Agencies including OPRD, DLCD and ODOT, and by Federal Agencies such as the Bureau of Land Management and US Fish and Wildlife for the purposes of Snowy Plover habitat restoration activities. To that end, a considerable amount of funding has been

invested to date to establish existing beach/bluff monitoring efforts on the Oregon coast. For example, approximately \$300,000 has been invested in the establishment of the existing beach monitoring program on the central to northern Oregon coast, where data is presently being collected every three months. For example, recent measurements of coastal change in the Rockaway littoral cell indicate ongoing erosion problems that commenced in the late 1990s, with no sign of change today (e.g. http://www.oregongeology.com/sub/Nanoos1/Beach%20profiles/Rockaway/Rockaway_Rck4.htm). To mitigate the erosion hazard, home owners have invested approximately \$6.4 million in the construction of coastal engineering structures in the Rockaway littoral cell alone, with little appreciation that these costs are likely to escalate due to sea level rise. DOGAMI is also investing approximately \$150,000 in FEMA funds to develop new coastal flood insurance maps in Coos County. Accordingly, the development of a coastwide coastal hazard theme, comprised of both profiles, shorelines, sediment and backshore characteristics, and photos will form an integral data layer that will assist coastal engineers and geologists with the development of future flood maps along the remainder of the Oregon coast.

On September 18, 2006 the Governors of California, Oregon and Washington established a cooperative agreement on ocean health, which eventually led to the development of a US West Coast action plan. A key outcome of this plan is the need to mitigate and plan for climate change effects along the coast. In order to do this, the action plan calls for an assessment of anticipated impacts of climate change over the next several decades (WCGA, 2007). Integral to these types of assessments is up-to-date geospatial information on the state of beaches along the Oregon coast (similarly along the Washington and California coasts), including an inventory of the geomorphic character of the coast, information on both historical and modern shorelines, presence or absence of coastal engineering, and backshore characteristics. Presently these latter datasets are either incomplete or non-existent for the Oregon coast. Hence, this proposal would represent a significant step forward by collecting and synthesizing these thematic data layers into one coherent coastal hazard geospatial database that would span the entire Oregon coast.

Preliminary Budget Breakdown:

Because of the complexity and time required for completing this work, we recommend a phased approach spread over two biennia. DOGAMI is requesting \$120,497 to implement Phase 1 (i.e. collection of relevant information to meet the five deliverables described previously) for the central to northern Oregon coast. Phase 2 would focus on the remainder of the coast. DOGAMI requests \$160,376 for completion of the coastal hazard data theme. With support from the IOOS initiative and from OCMP-DLCD, additional matching support of \$70,000 will be leveraged against funds provided by OGIC.

The geospatial data will encompass the following:

-Spatial data: (*ESRI shape files, including profile location lines linked to a geophysical database, and shorelines*) Installation of a coast-wide beach and bluff profile observation network along the Oregon coast (excluding rocky headlands), thereby establishing baseline conditions for studies of future climate change impacts. Beach and bluff profile surveys will be carried out using a survey grade RTK-DGPS system owned by DOGAMI. The GPS data will undergo a rigorous QA/QC process to determine relative accuracy and will be assessed initially using Trimble Geomatics Office software, calibrated against National Geodetic Survey (NGS) benchmark monuments, via the On-line Positioning User Service (OPUS) maintained and operated by the NGS, and against survey monuments established by Watershed Sciences LTD for the purposes of calibrating Lidar data. Additional QA/QC will be carried out in MATLAB to ensure GPS data are within specific tolerances (e.g. ± 0.5 m (1.6 ft) either side of the profile line)

Data output will be appropriately attributed, with metadata, and released in the Oregon Lambert Statewide projection. Vertical datums will be tied to the North American Vertical Datum of 1988. Additional spatial data will include shoreline contours (MHHW and 5 m (16 ft)), point data linked to the database depicting along coast sediment grain-size statistics and beach slopes, and polygons derived from the geomorphic classification. In all cases, these datasets will be freely available via the web.

Furthermore, DOGAMI will commit to being the steward of these data and will periodically update the datasets as needed.

-Tabular data: (*Ascii delimited text files*) Beach and bluff profiles (xyz location/elevation for both the GPS and Lidar data components), and grain-size statistics (xyz location/elevation, size and sorting characteristics).

-Images: (PNG and JPEG files) Reduced beach profiles in portable network graphics format. Site specific photos in JPEG format.

Additional Information:

As principal investigator on this proposal, I have not applied or been awarded Framework funding in the past.

However, in the 2005-2007 biennium, DOGAMI received \$50,000 for support of the first two parts of a six part statewide digital geologic map compilation. The NE and SE compilation areas were both completed on time, and published as OGDC-1 and OGDC-2 respectively.

In the 2007-2009 biennium, DOGAMI received \$50,000 for support of the next two parts of a six part statewide digital geologic map compilation. The Central and SW compilation areas were both completed on time, and published as OGDC-3 and OGDC-4 respectively.

In the 2009-2011 biennium, DOGAMI received \$150,000 for support of the final two parts of the six part statewide digital geologic map compilation. The W and NW compilation areas are essentially complete, and will be published by the end of the biennium as OGDC-5.

By submitting this application I understand and agree that all members of the project team shall recuse themselves from participation in the current proposal evaluation process.

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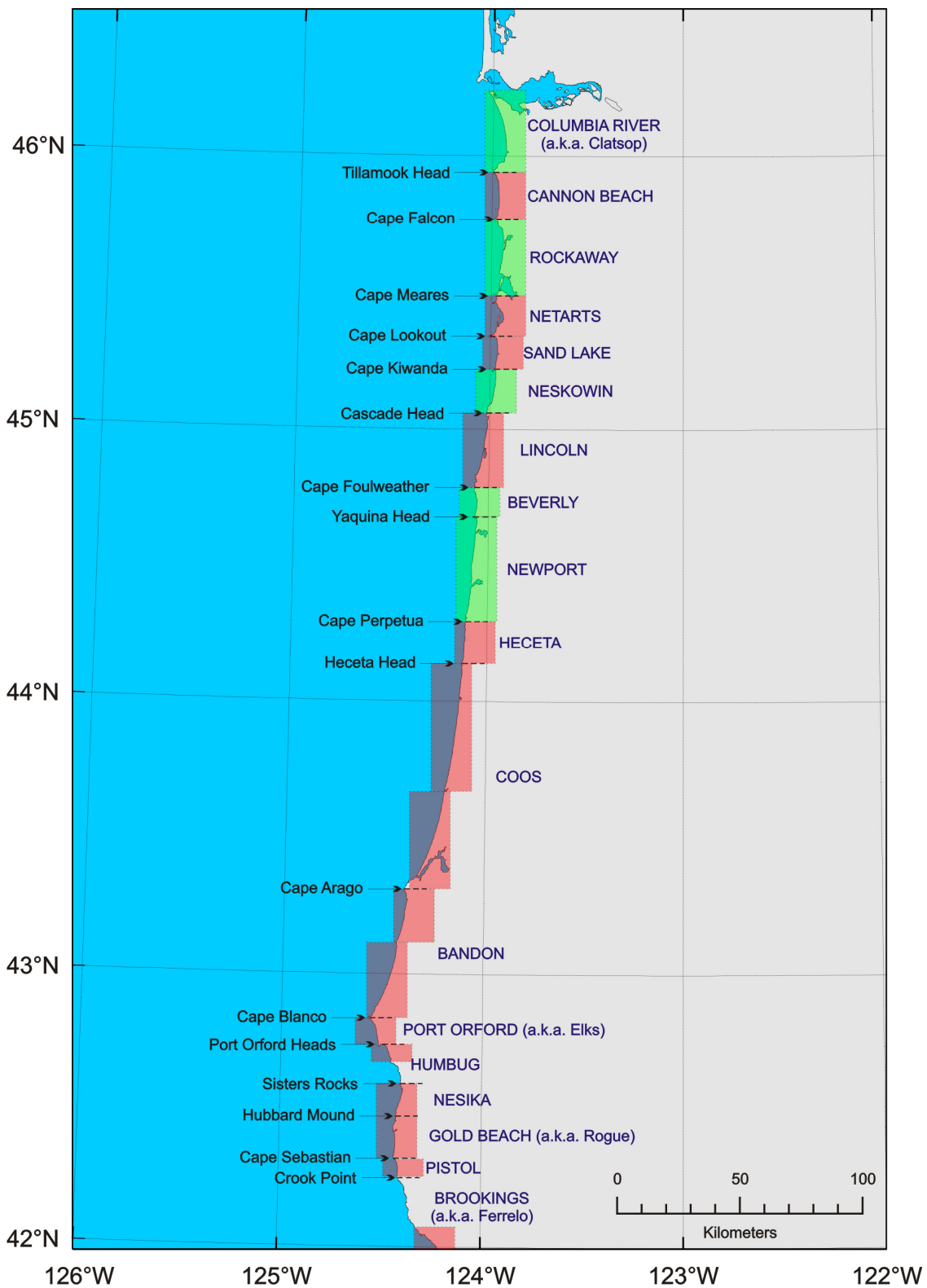


Fig. 1 Status Graphic. Current beach and bluff coastal monitoring sites (green boxes) and proposed new beach profile observatories (red boxes).

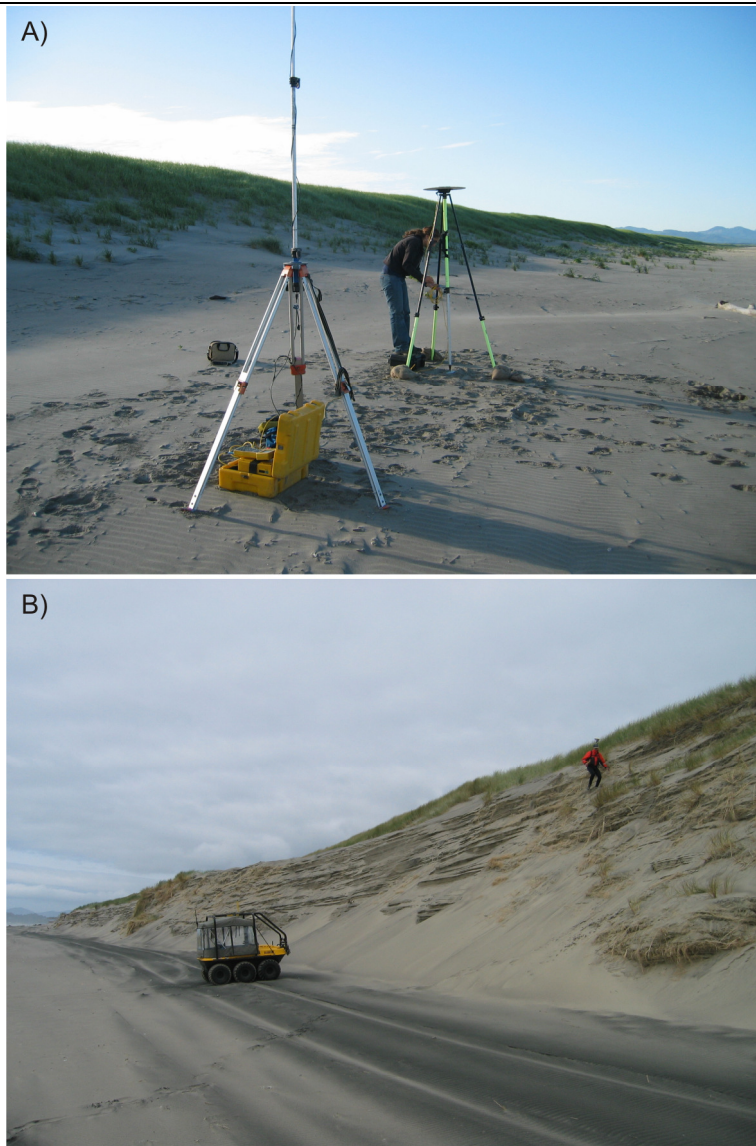


Fig. 2 A) Setup of the 5700 GPS base station on the Clatsop Plains in 2005. **B)** Measuring beach and dune erosion on Nestucca Spit. Storms over the 2007/08 winter eventually eroded a 20 ft high vertical scarp on the dune. Future erosion events such as this could result in breaching of the dune along Nestucca Spit and elsewhere such as at Netarts Spit.