Executive Summary

Full report available at: https://www.ci.cannon-beach.or.us/planning/page/city-council-foredune-management

State of Oregon
Oregon Department of Geology and Mineral Industries
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SPECIAL PAPER 49

BEACH AND SHORELINE DYNAMICS IN THE CANNON BEACH LITTORAL CELL: IMPLICATIONS FOR DUNE MANAGEMENT

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EXECUTIVE SUMMARY

This study provides an assessment of the physical process contributing to changes in the morphology of beaches and dunes in the Cannon Beach littoral cell, located in southern Clatsop County, Oregon. The work presented here updates an earlier investigation by Rosenfeld (1997). Since 1939, the City of Cannon Beach has experienced significant accumulation of sand along its beaches, especially in its dunes north of Haystack Rock (Figure 1 and Figure 33). In particular, north of Ecola Creek, the combination of a large sand supply and the proliferation of European beach grass (A. arenaria) has contributed to the formation of dunes that have reached heights of 16 m (53 ft, relative to the North American Vertical Datum of 1988 [NAVD88]). In response to considerable sand buildup north of Ecola Creek, the City of Cannon Beach initiated a process to evaluate their existing dune management plan on the basis of updated scientific information on physical processes and coastal geomorphology occurring along the Cannon Beach littoral cell. The overarching objective is to use the updated information to help establish new guidelines for the relocation of excess sand that periodically builds up along the coastline. This sand buildup within the dune is presently affecting the views of local residents, while sand blowing inland has become a nuisance, migrating where it has begun to inundate buildings and properties. The broad findings of this study include the following:

- Since 1997 the Cannon Beach littoral cell has gained ~209,220 m³ (273,649 yards³) of sand.
- Large positive sediment gains have occurred in all areas north of Tolovana Park, with the largest accumulation having occurred north of Ecola Creek in the Chapman Point dune management region. This region alone has accumulated ~225,080 m³ (294,390 yards³) of sediment since 1997.
- Sand volume gains have also occurred in the Presidential dune management area (south of Ecola Creek and north of Haystack Rock), which accumulated ~24,287 m³ (31,767 yards³) of sand since 1997.
- Minor sand gains were also observed in the Haystack Rock (~1,770 m³ [2,315 yards³]) and Arch Cape (~9,180 m³ [~12,000 yards³]) sub-region areas.
- Net sand losses since 1997 have dominated all other sub-regions including:
  - Tolovana North — lost ~4,350 m³ (5,690 yards³);
  - Tolovana South — lost ~17,500 m³ (22,890 yards³);
  - Silver Point — lost ~1,660 m³ (2,170 yards³);
  - Arcadia Beach — lost ~9,670 m³ (12,650 yards³);
  - Hug Point — lost ~5,070 m³ (6,630 yards³); and
  - Falcon Cove — lost ~12,800 m³ (16,740 yards³).
- The total volume of sand contained in the entire Cannon Beach littoral cell measured between the 6 m (19 ft) contour (approximately the dune or bluff toe) and mean lower low water (MLLW), is ~3.6 million m³ (4.67 million yards³). Incorporating the volume of sand contained in the dunes increases the total volume to ~4.2 million m³ (5.4 million yards³) of sand.
- In the Chapman Point dune management area, we found that ~195,600 m³ (~255,900 yards³) of sand is located at elevations greater than the 10 m (33 ft) contour; ~63,000 m³ (~82,400 yards³) is located in the southern portion of Chapman Point (i.e., ~one third of the total sand volume is located south of 5th Street).
- Our assessment of wind and wave processes over the past two to three decades suggests that the combination of persistent El Niño conditions since the early 1980s coupled with the prevalence of strong southerly winds have contributed to a net northward drift in beach sand within the littoral cell.
The formation of dunes north of Haystack Rock is thus a function of three main factors:
- A sufficiently large supply of sand that is transported by nearshore processes;
- A prevailing wind—of particular importance is the wind speed, which needs to be strong enough to entrain and mobilize sand within the intertidal zone and at the back of the beach, and their subsequent landward and northward transport; and,
- Obstacles to trap the sand such as woody debris, vegetation, and micro-topography.

Because the volume of sand released from erosion of dunes in the Cannon Beach cell account for ~38% of the total sand that accumulated north of Haystack Rock, this strongly suggests that much of the sand is locally derived from the nearshore region (i.e., the surf zone to depths of 10 to 15 m [30 to 45 ft]) and from erosion of the beach (particularly south of Haystack Rock).

The introduction European beach grass (*Ammophila arenaria*) to the Oregon coast in the 1900s has profoundly changed the morphology of the dunes. At Cannon Beach, *A. arenaria* was introduced sometime in the 1950s, and major plantings occurred in the 1960s. These initial efforts effectively stabilized the dunes at Chapman Point and by 1967 had greatly increased its capacity to retain sand.

From a management standpoint, an effective dune scraping management plan must adhere to the following principles:
- Minimize the height at which the dune is lowered, thereby avoiding the potential for wave overtopping during an extreme storm(s). Analyses of extreme 100-year total water levels (TWL, the combined effect of wave runup superimposed on tides) undertaken in the Cannon Beach cell indicate the potential for storms to generate wave runup is on the order of 7 to 7.5 m (23 to 25 ft). Incorporating a 1.2 m (4 ft) factor of safety adopted by the City of Cannon Beach yields design dune crest elevations that potentially could range from 8.2 to 8.7 m (27 to 28.5 ft);
- Retain the sand that is removed from the crest of the dune by placing it back onto the beach, thereby retaining a sufficient buffering capacity against future storms; and,
- Replant the scraped area in order to quickly stabilize the dune, minimizing the subsequent entrainment of sand by wind processes and their landward incursion into backshore properties.

Following dune scraping, it is imperative that steps be taken to stabilize the exposed area as quickly as possible, in order to minimize the transport of exposed dune sand back in among properties located behind the dunes.

We recommend NOT using European beach grass (*A. arenaria*) to stabilize the dune, because this species is directly contributing to the buildup of higher dunes at Cannon Beach, affecting the view from shorefront homes.

A more effective approach is to plant either the non-native American (*A. breviligulata*) or Pacific Northwest native dune grass (*E. mollis*), or some combination of both grasses; both species have been demonstrated to build lower, broader dunes.

Because of the variability in the forces that both sustain and erode beaches and dunes on the Oregon coast and our uncertainty in changes that will likely affect the beach over longer time scales (10 to 30 years), an adaptive management approach based on a sound knowledge of beach and dune processes, guided by systematic monitoring and evaluation of the system as a whole is essential.
Figure 33. Beach sand volume compartments identified for the Cannon Beach littoral cell showing the net sand volume change from 1997 to 2016. Green indicates accretion, red denotes erosion. Sand volumes are calculated for the area above the 4 m (13 ft) contour to the back edge of the dunes, physical features such as concrete paths, back edge of gravel berms, or the bluff toe.
Cannon Beach's Altered Shore - Photos additional to Executive Summary

Sand dunes - 2019

Sand dunes - 1980

Sand dunes - 2019

Sand dunes - 1987

Note steps leading down to beach below the turnaround at left and at end of walk in center.
Aereal photo - 1984