Agenda
Planning Commission Worksession
Wednesday, March 05, 2025 at 5:30 PM
City Hall Cowles Council Chambers In-Person & Via Zoom Webinar

Homer City Hall	Zoom Webinar ID: 936 2815 3389 Password: 865591
491 E. Pioneer Avenue	https://cityofhomer.zoom.us
Homer, Alaska 99603	Dial: 346-248-7799 or 669-900-6833;
www.cityofhomer-ak.gov	(Toll Free) 888-788-0099 or 877-853-5247

CALL TO ORDER, 5:30 P.M.

AGENDA APPROVAL

DISCUSSION TOPIC(S)/PRESENTATION(S)

A. Presentation on the Landslide Hazard Susceptibility Mapping in Homer, Barrett Salisbury

Attachment from Ed Berg

CONSENT AGENDA ITEM(S)

REGULAR AGENDA ITEM(S)

COMMENTS OF THE AUDIENCE (3 minute time limit)

ADJOURNMENT

Next Regular Meeting is Wednesday, March 19, 2025 at 6:30 p.m. All meetings scheduled to be held in the City Hall Cowles Council Chambers located at 491 E. Pioneer Avenue, Homer, Alaska.

A Profile of the Coastal Bluff between West Hill Road and Crittenden Drive, Homer, Alaska v1.1

by Ed Berg PhD 12/17/2024

Abstract: The Homer coastal bluff along the Sterling Highway has two (possibly three) prominent slumps of glacial sand and gravel. Groundwater flow from the Homer bench is the primary driver of these slumps. Gravel Gully is a rapidly expanding notch in the bluff that has widened significantly since logging in the late 1990s. The post-beetle kill forest thinning on the Homer Bench reduced soil moisture transpiration to the atmosphere, which has allowed more groundwater flow into the underlying gravel and sand. Increased groundwater in the coastal bluff increases the risk of bluff collapse and slumping. Stormwater drainage and sump wells are suggested to reduce groundwater and the risk of further slumping.

Introduction. The Profile area. This report examines the geology of the coastal bluff where the Sterling Highway enters the west side of Homer, Alaska. A subdivision with 25 houses has been proposed for this area and there are geological concerns that need to be addressed if the area is to be developed. The report is based primarily on field observation and study of historical aerial photography. It is part of a larger study examining the coastal bluff geology from the Anchor River to the head of Kachemak Bay, which will be included in a book on the landscape history of the southwestern Kenia Peninsula.

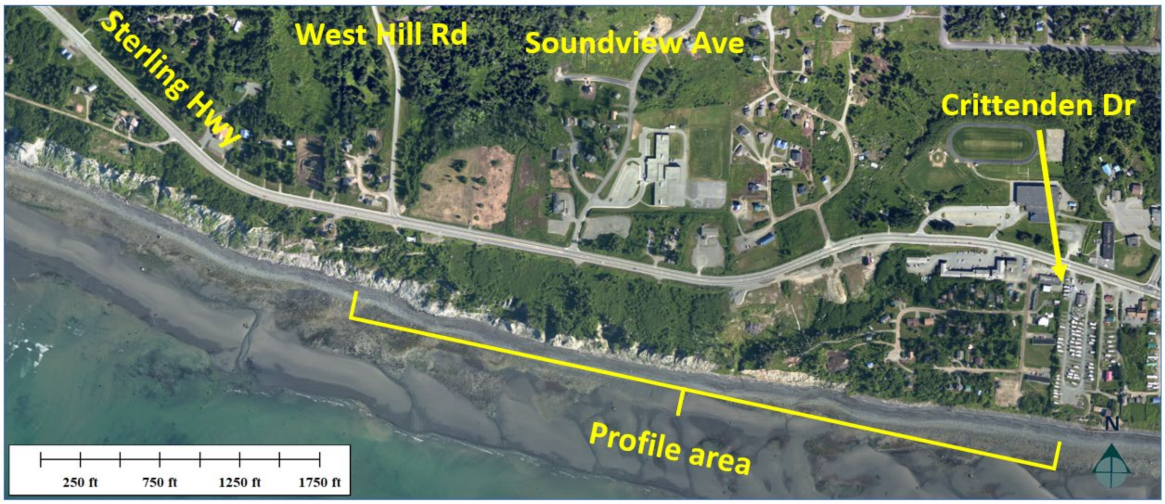

Fig. 1. The profile area. The forest in the western part of the profile area is mostly alder with very little spruce. This was a mature old-growth Sitka/Lutz spruce forest before the 1990s spruce bark beetle outbreak. The site was logged in the late 1990s and alders have since recruited vigorously. (2015 Hydropalooza NOAA imagery)

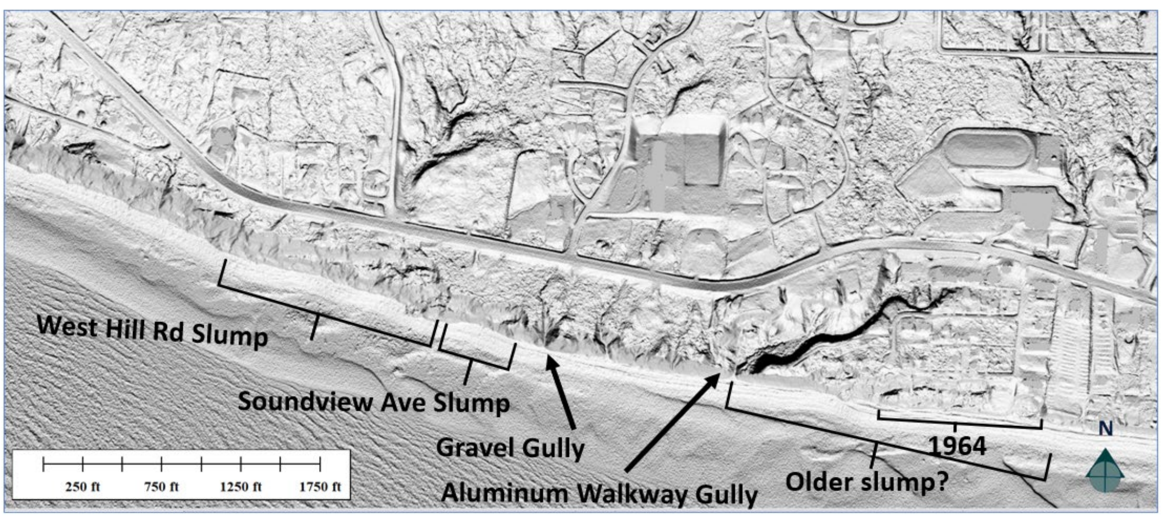

Fig. 2. The profile area (LiDAR). In this 2008 LiDAR bare-earth image the vegetation (trees and shrubs) has been digitally removed to create a view of the lowest visible surface (grass,

moss, forest floor litter, etc.). Buildings have similarly been removed; although described as “bare-earth,” the view is not actually of the mineral soil surface. The unusual character (wide but short) of the Aluminum Walkway Gully is clearly displayed in this image.

Fig. 3. 1951 aerial photo. This photo shows the newly constructed Sterling Highway. The dark trees are Sitka/Lutz spruce that are growing rapidly after being released from competition by the 1880s death of the dominant trees by spruce bark beetles (Berg et al. 2006). The Individual tree canopies are visible and have not yet closed. The fine gray texture is grass. Few alders are visible. The West Hill Rd and Soundview Ave Slumps can be seen and Gravel Gully is also present (circled).

Bluff collapse. Two massive slope failures dominate the western section of the profile: the West Hill Rd Slump and the Soundview Ave Slump. These slumps are failures of glacial materials that slid off the top of the Beluga Formation bedrock (sandstone and coal) and have been removed from the beach by surf erosion. These are not recent slumps; they are clearly visible (and not fresh) in the1951 aerial photograph.

The eastern section shows a large block of glacial material that may have slumped away from the bluff and opened up the Aluminum Walkway Gully. This remarkably wide but short gully has no headwater stream on the Homer Bench, unlike other gullies along the bluff. The lower part of this block (below the Ocean Shores Motel) slumped during the 1964 earthquake and would be a secondary slump if the larger block is an ancestral slump (Waller 1968).

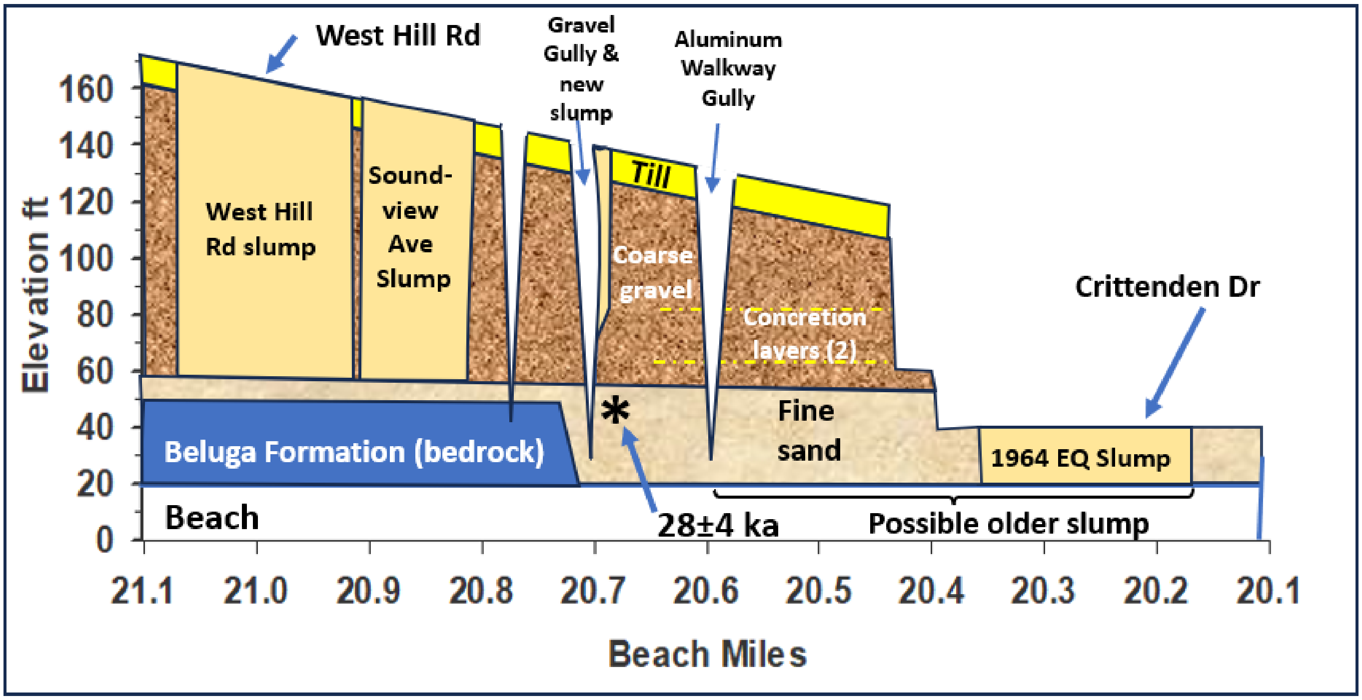

Fig. 4. Bluff Stratigraphy. This diagram shows details of the three layers of glacial material that overlie the bedrock of the Miocene-age Beluga Formation (sandstone, mudstone (shale), and coal). The steepness of the bluff and the thick cover of soil (colluvium)and vegetation tend to obscure the view of these features from the beach. Geologic mapping is by the author. The subsurface depth of the Beluga Formation bedrock east of the indicated terminus is unknown and has not been determined to the best of the author's knowledge: the next beach outcrop is along the east shore of Kachemak Drive. Elevations (mean sea level) are from 2008 LiDAR imagery. Distances are from Google Earth 2024 imagery. The Luminescence Lab at Utah State University (2020) determined the fine sand date of 28,000 ± 4000 years (28 ± 4 ka), using Optically stimulated luminescence (OSL) dating. The scale of miles along the beach starts at Kachemak Celo at the head of Kachemak Bay. (Graphic by the author)

Mechanisms of bluff loss. Examination of the aerial imagery from 1951 to the present suggests three quite different mechanisms of bluff loss :

(1) Erosion of the bluff edge by water, wind, frost heaving, and treefall, with an estimated rate of retreat at 1.0 ft/yr (Buzard & Overbeck 2022, Table 12),

2) Gully notching: when the sod coverer is disturbed (say by landslides or treefall), gullies can form and advance rapidly, as is well-known in agricultural situations. Gravel Gully is an example of this process, as discussed below.

(3) Rotational slumping: when a bluff fails as a block (as opposed to shattering), the failed block will move downward and rotate outward at the base, thus rotating the entire slumped mass. In the Bluff Point Landslide, for example, coal layers that were originally horizontal in the bluff can be seen on the beach tipped steeply upward and even overturned.

Gravel Gully and 1990s logging. Gravel Gully is a small steep-walled canyon, probably of recent origin, that provides a unique window into the hydrology of this coastal bench. Its three glacial strata (till, coarse gravel, and fine sand) are well displayed without any colluvium or vegetation. Fig, 5 shows the gully expansion after logging, and hydrology is a likely cause of this expansion. Foresters have long recognized that logged areas on poorly drained soils often become swampy (paludified) when the trees are no longer available to convey (transpire) soil moisture to the atmosphere. The swampy forest of the Calvin and Coyle Trail is an excellent example of such paludification following the death of the trees (albeit by spruce bark beetles, rather than logging).

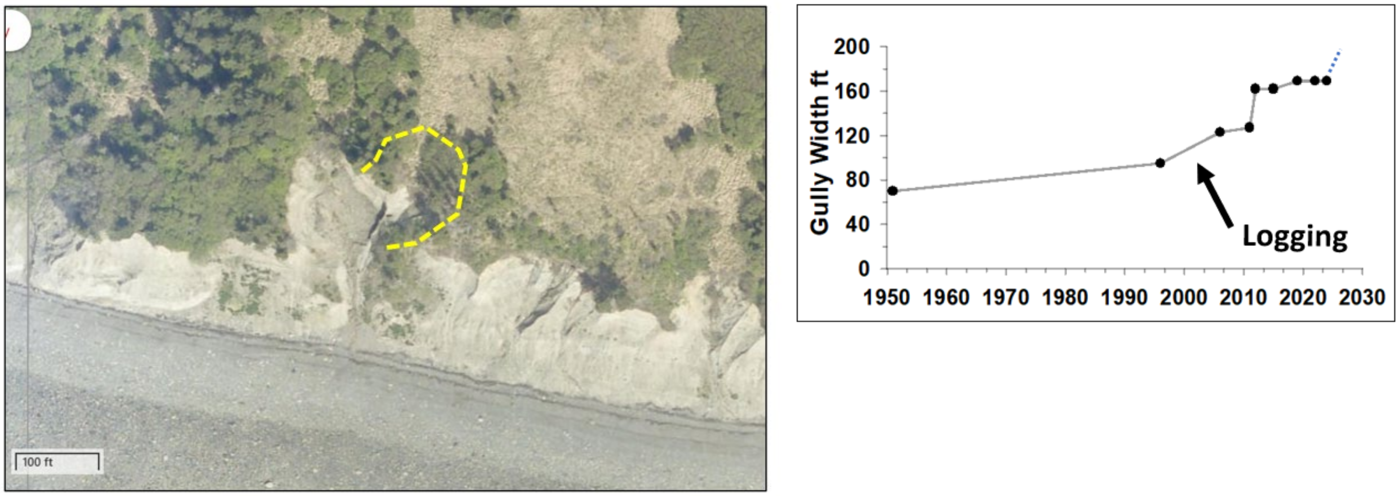

Fig 5. Gravel Gully. This notch in the bluff expanded significantly after the bench was logged in the late 1990s. The dashed line indicates a recent slump (KPB imagery 2020-21). Gully widths were measured on the 1951 aerial photograph and Google Earth 1996-2024. The width after the most recent (October 2024?) slump has not been determined.

Like many poorly drained areas of the Homer Bench, a thick grass (*Calamagrostis*) cover has developed on this bluff site after the 11990s beetle kill of the spruce forest. The presence of standing pools of water in the grass of the bluff suggests limited downward transport of surface water through a relatively impermeable glacial till, so paludification would seem like an obvious possibility. The difference here, say from Calvin &Coyle, is that the glacial till is underlain by coarse gravel that should support good groundwater flow. For example, unfrozen groundwater from this gravel can be seen in the Aluminum Walkway Gully during the winter. This water flows out onto the beach to freeze and provides icy glaciation.

A very robust forest was growing on this part of the Homer Bench when beetle-kill logging began in 1994 on the Walli property between West Hill Rd and Soundview Ave. This forest had regrown rigorously after the Cook Inlet-wide beetle outbreak of the 1880s. It was situated on a site with optimal growing conditions (low elevation, south-facing, and abundant nurse logs and stumps for seedlings). The site did not paludify after the 1880s tree mortality, but a thick grass cover had developed by 1904 when forester William Langille surveyed the Kenai forest resources. Along with the grass and dead trees, an understory of smaller spruce (released from competition) was rapidly developing, becoming the mature forest that was harvested in the 1990s (Langille 1904, Berg et al. 2006).

It is likely that this coastal bluff site, and indeed all of the forested area of the Homer Bench has always been well-drained since spruce forest first established in Kachemak Bay ~4000 years ago

(Ager 2000). The presence of few streams on the Bench would support the idea that historically the forest has been the primary source of drainage for this area. With the landscape being cleared of forest in the 1990s, the drainage has shifted to ditches and stormwater drains. This drainage has been necessary on the sloped areas of the Bench which are underlain with thick glacial till of low permeability. The coastal bluff area, however, is distinctly different in that the glacial till is relatively thin (<5 ft thick) and underlain by highly permeable glacial lakebed sediments (coarse gravel and fine sand), These sediments are well exposed in Gravel Gilly, but elsewhere along the bluff are often covered with slopewash and vegetation that makes their character less discernible.

Fig. 6. Gravel Gully. (Left) A vertical wall of coarse gravel with a cap of glacial till. The view is looking north, up the gully. (Right). A massive (unlayered) fine sand underlies the coarse gravel. The OSL date of the sampled fine sand is 28±4 ka; the gravel is estimated to be 25-20 ka (see below). This site is now partially buried under recently slumped material. A very recent (October 2024?) slump has widened the east side of the gully, and stream erosion is actively transporting material to a new delta on the beach. The north headwall of the gully is unchanged from 1951 to 2024, indicating that the gully is expanding laterally, rather than cutting further north into the bluff. The view is south, down the gully to the beach. (Photos are by the author 9/8/2020).

Dirty gravel vs. clean gravel. In upland settings, subsurface gravel or sand is beneficial for well water and septic system drainage. In coastal bluffs, however, subsurface gravel or sand creates the risk of bluff failure because of groundwater. The simple presence of standing water in an unconsolidated medium of any kind raises the pore pressure in the medium, which lifts the particles and makes them less tightly packed. Such material is more likely to slide under the right conditions, such as an earthquake or additional water (hydrostatic) pressure.

The coarse gravel in this bluff site is dirty gravel, with lots of silt. It is not like a bag of well-washed marbles. In Fig 6 the eroded gravel in the streambed has been washed by streamflow and the fines (sand, silt, and clay) have been transported to the beach and beyond. The dense appearance of the gravel wall, however, is due to the matrix of fines that supports the larger rocks.

If the bluff gravel was well-washed (like a bag of marbles), groundwater would drain freely through it, and slumping would be less of a concern. Dirty gravel, however, retains groundwater and raises the water table and hence raises the risk of slumping.

Similar slumps north of Diamond Creek. There is a string of at least eighteen slumps along the coastal bluff between Diamond Creek and the Anchor River. Most of these slumps are slightly downslope from the extensive wetlands (peatlands) of the kettle moraine area between the Old Sterling Highway and the coast. Similar to the West Hill Rd and Oceanview Dr slumps, a bedrock foundation (the Sterling Formation) supports 75-150 feet of glacial lakebed deposits. The wetlands provide a steady water source, and the glacial deposits and upper bedrock slide readily off the bluff to the beach, where longshore currents transport them toward Kachemak Bay.

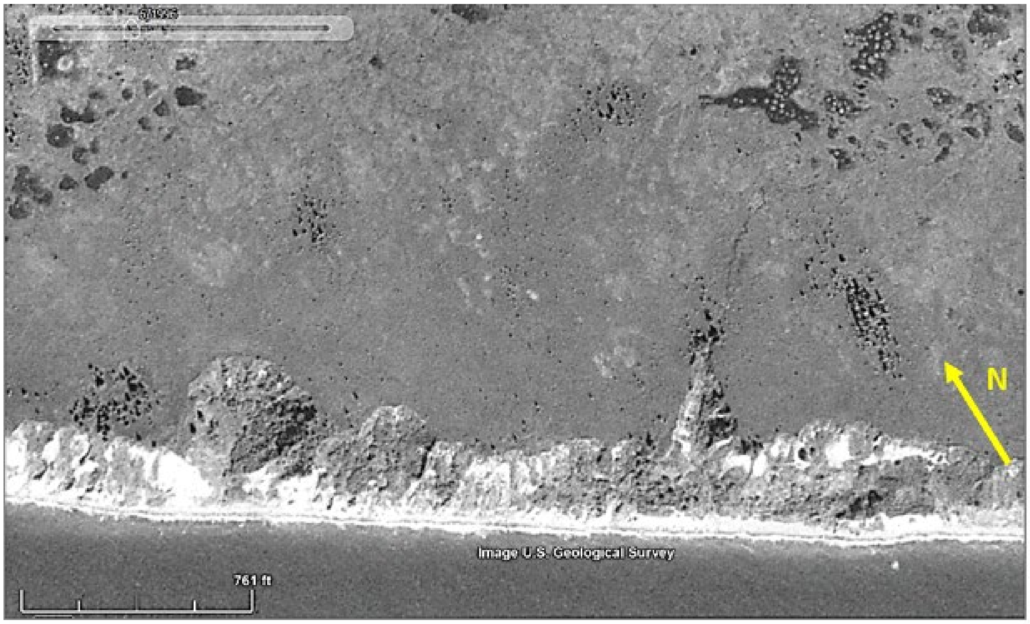

Fig. 7. Coastal bluff slumps along the coast north of Diamond Creek. Black areas are open water in wetlands. The bedrock of the Sterling Formation (mudstone, sandstone, and coal) forms the base of the bluff. Bluff height is~!180 ft. Slumps are numbered northward from Diamond Creek (Berg 2024). The image is Google Earth 1996. The view is looking northeast.

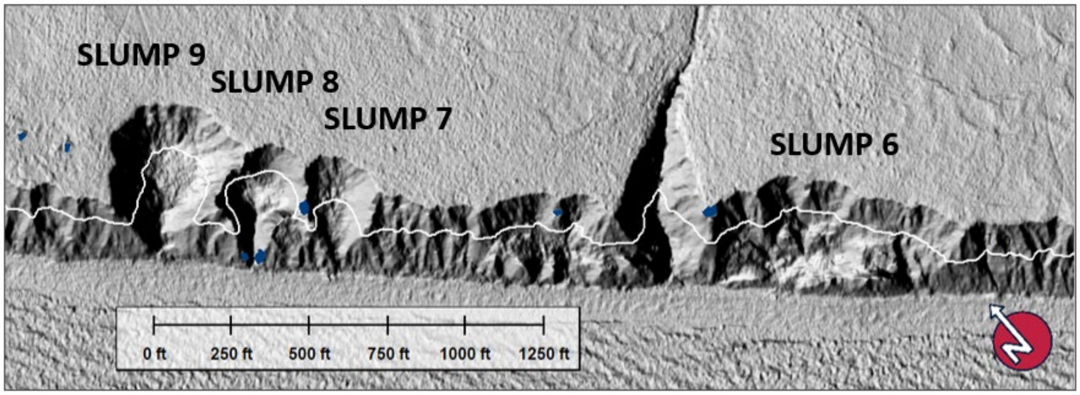

Fig. 8. As above, bare-earth LiDAR image. The white line shows the top of the Sterling Formation bedrock (elevation 110 ft). The slumps occur in both the overlying glacial lakebeds and the upper bedrock.

The section of Homer coastal bluff with the West Hill Rd and Soundview Ave slumps has virtually identical geology to that shown north of Diamond Creek, with glacial lake beds on top of coal-bearing bedrock. The key difference between the two sites is the hydrology: The Homer bluff had a protective (transpiring) forest to keep water away from the bluff and its permeable glacial sediments. The forest was not entirely successful in stopping the water flow, as shown by the two bluff slumps and the hypothesized slump between the Aluminum Walkway Gulley and Crittenden Ave. Nevertheless, these slumps are minor compared to those north of Diamond Creek, many of which are recent enough to not be well vegetated by forest (Berg 2024).

Groundwater control and monitoring. Landowners along the bluff should understand that the future of the land between the bluff and the Sterling Highway has issues that need to be considered if any development is undertaken. On a scale of decades, rising sea level will whittle the bluff back as it has done in the past, but at a more aggressive rate as sea level rise accelerates. Of more immediate concern is the elevated water table in the post-logging period and the prevention of hydrologicallydriven slumps. Climate models forecast increased rainfall in southern Alaska (UAF SNAP, reviewed in Buzard and Overbeck 2022), so more groundwater flow can be expected from the slopes above the Sterling Highway. This groundwater will flow under the Sterling Highway into the gravel and sand units of the bluff, where it will facilitate slumping at a greater rate than it has in the past.

Landowners and the City of Homer may want to explore engineering approaches to reducing the groundwater in the sand and gravel of the bluff. One approach would be to route all water from north of the highway into drains that carry it past the bluff area straight to the beach. A second approach would be to install drainage mechanisms within the permeable material, perhaps by horizontal drilling from the bluff face or a series of vertical sump pumps. A low-budget first step would be to install some monitoring wells with pressure transducers to assess the current groundwater level in the bluff and obtain a baseline of seasonal fluctuations. These wells could provide a warning of high water levels and impending failure of the bluff.

Geological setting

The coal-bearing bedrock along the northwest shore of Kachemak Bay is the Beluga Formation of Miocene age (15-8 million years ago) (LePain et al.2013) This bedrock is prominent in the bluffs south of Diamond Creek and Bluff Point, but its surface exposure terminates on the east side of the Soundview Ave slump, It is no doubt present at some undetermined depth under Bishops Beach, Beluga Slough, and the Ocean Drive area, and is visible again along the east bluff of Kachemak Drive, where its coal ledges run hundreds of yards out on the tidal mud flats.

In this report's profile area, glacial lake beds (fine sand and coarse gravel) overlie the Beluga Formation; these lakebeds are capped with a thin (<5') layer of glacial till. Only one date has been determined for any glacial deposits in this part of Kachemak Bay – the 28±4 ka on the massive fine sand layer at the bottom of Gravel Gulley. This date would place this sand as a proglacial lake deposit alongside the first glacier in Kachemak Bay during the last major glaciation (Early Moosehorn stade of the Late Wisconsin glaciation).

The fine sand is overlain by coarse cobble-bearing gravel that represents a period of vigorous landscape denudation, probably in Late Moosehorn time (19-20 ka). This denudation occurred as the Moosehorn glacier pulled back from the flanks of the Caribou Hills, leaving the ancestral Homer Bench exposed to intense erosion. There are similar lakebed deposits between Diamond Creek and Clam Gulch from Glacial Lake Cook that contain sand and gravel brought down from the Caribou Hills by Deep Creek and the Anchor River; these sediments date to 25-20 ka (Berg 2024).

The topmost layer is glacial till, which was likely deposited by the Killey glaciation, the second and much smaller glacial advance into Kachemak Bay that dates to c.18 ka. Glacial till is the unsorted sediment left on land as a glacier melts; it has a matrix of sand and silt that supports rocks of sizes from pebbles to boulders. The thick blanket of till on the Homer Bench is considered Killey in age, although no age measurements have been made (Reger et al. 2007).

Literature Cited

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