Appendix C. Summary of eyewitness observations from 1964 Alaska Tsunami in Seaside, Oregon (compiled by Tom Horning)

The 1964 Good Friday Alaska far-field tsunami struck Seaside on Friday, March 27, at 11:35 PM, approximately 1 hr before an approximate +5.4 ft MLLW high tide. It took about 4 hr for the tsunami to reach Seaside from its source area near Prince William Sound, arriving 15 min after the wave struck Neah Bay, Washington, and 5 min before it reached Crescent City, California. The first surge caused the greatest damage. A second surge probably occurred prior to 1 AM, but caused significantly less damage. Surges continued for at least 12 hr. Surf was exceptionally low, averaging about 3 ft high, at a time of year when 8 to 20 ft waves are common. The moon was full on a balmy windless night and the night sky was cloudless, permitting good illumination. Damage totaled $276,000 from flooded homes, damaged bridges, and ruined cars. Two houses were damaged beyond repair. Evacuation sirens were not blown until the first surge was spreading through neighborhoods and up rivers. The decision to evacuate the city was withheld until urgent radio messages from the Mendocino County (California) sheriff's office were received recommending evacuation of the coast. One fatal heart attack occurred during the sirens.

C1. Initial Drawdown

The first surge was preceded by a negative phase that drew down the tide to an inferred elevation of less than minus 2 ft MLLW. The Necanicum River was observed at two locations to be lower and narrower than ever seen before. Near the Avenue A bridge, the river was observed to be only about 45 ft wide in a 135-ft-wide channel that is always filled with water, even during tides of minus 2.0 ft MLLW. A police observer crossing the river at the 12th Avenue Bridge during his evacuation claims that the mud bottom of the river was visible. These observations have not been corroborated. Sand flats in the bay were exposed immediately prior to the beginning of the first surge, according to another police observer along the north side of the bay. The flats normally would have been covered by the high tide.

C2. First Surge on the Beach

Few people observed the first surge arriving on the ocean beach on the west side of Seaside. Near the Cove, at the south end of town, the ocean was seen to withdraw and develop a trough-like depression about 1200 yards west of the beach. Beyond the trough, the ocean rose higher than normal, as judged by the elevation of breakers along the boulder beach of Tillamook Head. As the trough deepened, small breakers between the trough and Seaside diminished until the ocean surface became smooth and glassy, apparently as water withdrew off the strand. Large waves then surged past observers on Tillamook Head and toward the beach, much like 20-ft winter storm waves. It appears that the first surge arrived along the Cove as a breaking bore, in contrast to its more passive arrival farther to the north, perhaps due to effects from the headland. The water surged over the cobble berm and passed between houses south of Avenue W, carrying large driftwood against houses and filling basements with water.

According to newspaper accounts in the Seaside Signal, the arrival of the first surge on the beach near Broadway, midway between Tillamook Head and the river mouth, was characterized by waves running up the beach, followed by additional waves rapidly overtaking the first, all of which chased strollers off the beach. There are no eyewitness reports of a prior drawdown of the ocean along this part of the beach, but it probably occurred, based on the reduction of water elevation observed in the estuary. Apparently, a bore advanced onto the beach near 12th Avenue, just south of the estuary at the north end of town, because the police observer there heard the roar of very loud surf, felt an anomalous strong wind from the west, and observed wads of foam blowing over his head from out of the darkness. At this point, he departed in haste, sped eastward across the 12th Avenue Bridge, and observed the unusual drawdown of the river, apparently beating the incoming tsunami to the Necanicum River.

Runup elevations along the ocean front ranged from 19 to 23 ft NGVD. Allowing for about 3.4 ft between MLLW and 0.0 ft NGVD, and given that the tide was predicted to be at 4.9 ft MLLW (+1.5 ft NGVD) at the 12th Avenue Bridge at that time, the first surge was from about 17 to 21 ft in height (there is some question as to MLLW versus NGVD in the Seaside area). Water crossed the ocean front Promenade at 12th and 9th Avenues, at Broadway and Avenue A, at locations where elevations ranged from 20 to 23 ft. It rose to 19.5 ft at Avenue S, but did not cross the boardwalk. There is an anecdotal account of foam on the boardwalk one or two blocks farther to the north. Water was observed flowing down 12th Avenue and Broadway, perhaps 6 inches deep, for a distance of about one block. One eyewitness directly observed water less than 6 inches deep quietly flowing onto the Promenade near Avenue A. To the west, the ocean surface was glassy with minor roiling “like a full glass of water just poured”; free of significant foam and without any expression of the prevailing 3 ft surf. The water stood for “a few moments,” and then withdrew rapidly into the moonlit darkness to well beyond standard low tide. Abundant debris, small logs, sticks, and other detritus were left on the concrete walk of the Promenade and in front yards. Larger stumps and logs were stranded on access ramps to the beach, several feet below the Promenade surface.

Water flowed onto Ocean Vista Drive south of Avenue W, near the Cove, establishing runup at about 21 ft NGVD. Accounts are inconsistent as to whether water crossed Sunset Boulevard along the south side of the Cove. From the most conservative accounts, water appears to have risen to at least 19 ft NGVD. Possibly it may have been 2 to 3 ft higher and may have carried large logs and boulders onto the road, which some observers remember blocking the road. One neighbor noted that the ocean surface was largely free of foam and appeared ready to break over the berm, but then withdrew into the night. Confusion arises with memories for residents of this area after 30 to 40 years, because winter storms frequently have surged onto the road and into the marshes on the lee side of the cobble berm on which the road is built. There are no newspaper accounts of debris on this road, nor do emergency responders and public works employees recall clearing debris. In general, it appears that runup generally may have been limited south of Avenue S, as compared to points farther north along the beach. In part, this can be explained by direct observation that the tsunami water readily drained into the rounded cobble deposits that underlie the south part of Seaside, in contrast to less permeable dune sands and organic soils farther to the north. This enhanced drainage prevented more extensive inundation of the upland terrain in the southern part of the city.

C3. Surge Enters the Bay

The primary surge apparently entered the estuary as waves propelled by a rapid rise in sea level, but it became focused as a series of bores within the narrow confines of the river channels. Observers along the east side of the bay, at Mason Street and 25th Avenue, recount that water elevations rose over a period of several minutes, allowing time to evacuate. Card-players near 24th Avenue heard the growl of cobbles in the river channel west of their house, like a distant jet engine, and observed wild and chaotic conditions in the estuary with waves and foam moving incomprehensively in the moonlight. Water and foam barely surmounted the forested dune on which their residence was built, establishing runup at about 21 ft NGVD from about 20th to 24th Avenues.

C4. Surge Enters Neawanna Creek and Venice Park Neighborhood

An observer at 26th Avenue and Queen Street observed a bore heading straight toward his house up the lower channel of Neawanna Creek. The family dog first heard the dull roar of the water. The family had less than 1 min to evacuate upstairs before water and 5-ft diameter driftwood logs crashed through the west side of their house, filling it 7 ft deep, pushing out the back wall, and carrying away their cars. The surge banked against Highway 101 north of the Neawanna Creek Bridge, partly flooding over it, depositing sand on the highway and running between houses to the east. The surge spread back to the southwest, inundating the eastern two-thirds of the Venice Park neighborhood

under 1 to 3 ft of water from 24th to 26th Avenues, and lapping onto a low dune ridge on the west side of the neighborhood. Freezers, coolers, furniture, and spewing propane tanks were consistently found southwest of their homes of origin. Similarly, large driftwood logs floated into the neighborhood on southwesterly directed currents. Several families put their children into attic spaces and onto roofs to avoid the swift rise of water. Surges constrained by dense forest vegetation and brush along narrow roads rose as high as 7 ft, only to drop to less than 3 ft in open intersections. Many heard the evacuation sirens and stepped out of their homes to find swift currents in the streets. Several mobile homes were swept into the highways or into the river. In this neighborhood, static water runup averaged about 12.5 ft NGVD, or about 2.5 ft higher than the elevation of highest flooding due to storm surge in the following 40 years. Surges locally increased runup by 6 to 12 in, primarily near the river channel.

It is likely that runup was increased a small amount by debris dams lodged against bridges. Runup elevations upstream from the Neawanna Creek (Hwy 101) Bridge were about 1.5 ft lower than in Venice Park, below the blockage. Pilings beneath the Seattle, Portland, and Spokane train trestle, just upstream from the Highway 101 Bridge, were washed away by the floodwaters, leaving the ties and rails, which hung as a suspension bridge between the riverbanks. Apparently, debris dams against the pilings forced water to accelerate near the bed of the river, and this washed away sand into which the pilings had been driven, allowing them to be swept away with the logjam.

Heavy foam and strong, groaning currents were observed by evacuees who crossed the 12th Avenue Bridge over Neawanna Creek, but residents along the river bank at the bridge did not observe evidence of flooding out of the flood plain. Between 12th Avenue and Broadway, water did not rise any higher than typical winter floods. Runup in this vicinity appears not to have been higher than about 9 ft NGVD. There is very little evidence of the extent of flooding south of Broadway due to the absence of damage. Water is inferred to have flooded at least to the Avenue S Bridge, primarily within the channel. In general, flooding affected marshland of the Neawanna Creek drainage for a distance of about 1 mile upstream from the bay.

C5. Surge in the Necanicum River

Inundation within the Necanicum River extended from its mouth more than 2 miles upstream to at least the ninth fairway of the Seaside Golf Course, just south of Avenue U. An eye-witness between Broadway and Avenue A observed multiple bores advancing over the nearly empty river bottom, each about 2 ft high and each followed by another within 10 to 30 sec, until the 14-ft-deep river channel was filled flush to the edge of its banks by a final 4-ft culminating bore. The culminating bore was observed sweeping up the Necanicum Channel near 4th Avenue beneath a thick mantle of dense foam, essentially as a quiet plateau of water moving at about 10 miles per hour. The bore struck the main timber decking of the abandoned 4th Avenue Bridge and tore it from its pilings with the sound of “giant eggshells cracking.” The decking broke into multiple pieces

and floated upstream, the largest to lodge beneath the east end of the First Avenue Bridge and tip up to erect a cofferdam to the on-rushing water. As a result, water and foam were directed beneath the west end of the bridge and beyond. Water flowed over the bridge railings and flooded westward across First Avenue and Necanicum Boulevard, filling parking lots and streets, and blocking evacuation by many who thought it would be a safer crossing than farther down stream. Water was several inches deep in Broadway west of the river. Foam was as high as 7 ft along the sides of buildings along North Edgewood, apparently having been skimmed off by the deck of the Broadway Bridge. As the foam broke down later, only silt from the river was left in the streets, in contrast to beach and bay sands in neighborhoods closer to the river mouth.

Debris from the 4th Avenue Bridge, or large driftwood, continued upstream beneath the Broadway Bridge to the First Avenue Bridge, where it struck the bridge railings and knocked them into the street. Swift currents, possibly with the assistance of debris dams, swept two sets of pilings from beneath the Avenue G Bridge, farther to the south. The concrete decking of the bridge fortunately was able to span the gap and support the loads of evacuating cars without collapsing. Low areas on the west side of the river flooded with several inches of water from about Avenue I to about Avenue N, and as far west as South Downing Street.

Water and/or foam stood on the decks of all bridges from 12th Avenue to Avenue G. Runup reached more than 14 ft NGVD at 12th Avenue, about 13 ft at 1st Avenue, and about 12 ft at Avenue A. Water entered the first floor of the hospital at Avenue S, flooding only several inches deep and establishing runup at about 10.5 ft. Runup reached 9.8 ft NGVD on the ninth green of the golf course at Avenue U. Runup near bridges tended to be higher than farther from the channel, apparently because of surges and splashing related to higher velocities in the channels.

C6. A Second Surge

There are few recollections of the second surge of the Good Friday tsunami and no reference to it can be found in the news clippings from that event. Hearsay accounts of disaster responders suggest that barrels had moved about the Venice Park neighborhood during the night by waves; however, large driftwood logs were not affected and no residents of the neighborhood noticed anything unusual. The primary observation of a second surge was made at the Seaside Golf Course, where the owner observed, at about 1:30 AM, that a slightly lower runup debris line had formed on the ninth green well after the first surge had withdrawn.

An eyewitness who saw bores moving up the Necanicum channel later moved to the north side of the estuary in Gearhart. There he saw what must have been the second surge enter the estuary. Easily visible in the moonlight, he saw multiple waves pouring into the bay from the ocean to strike the east side of the bay near the high school, between 17th and 24th Avenues. The waves rebounded and met oncoming surges to amplify and explode upward

higher than the homes along the shore. Runup was as high as 21 ft NGVD in this area, or nearly 8 ft higher than runup to the north or south. One homeowner adjacent to the amplification zone observed that driftwood logs had floated into her glass-enclosed patio without any damage to the panes, implying gentle forces at the extreme edge of the runup. She also reported that considerable rock fill along the shore had been washed away and, further, that the bank had slumped enough to break irrigation pipes in the lawn and distort some walls in the house a tiny amount. Another resident at 24th Avenue estimated that the waves eroded the 15-ft-high bank of dune sand by about 10 ft.

C7. Sand and Debris Deposits

Although significant sand was transported by the tsunami into marshes and neighborhoods, there was little evidence of intense channel erosion or scouring. Noticeable scouring occurred only along shorelines where rock fill projected into the bay. These projections allowed eddying, which created shallow depressions of less than 2 ft deep and no more than 70 ft long and 15 ft wide. Sand deposition tended to occur along topographic shelves, such as riverbanks and yards, where water velocities slowed abruptly. Streets and wide level fields tended not to accumulate much sand, but yards adjacent to streets could accumulate up to 14 inches of sand. Sand suspended in 30 to 36 inches of water was able to settle out in houses to form layers of about 2 to 3.5 inches thick. Many ghost shrimp (*Callianassa californiensis*) were transported from the sand flats and river bottoms into yards and streets with the sand. The shrimp probably were sucked from their burrows by Venturi forces, rather than excavated by erosion, as their burrows can be more than 2 ft deep and such extensive erosion was generally not visible. However, significant erosion in sandy river channels could have occurred. Many fish were stranded as the water withdrew. Worms came to the surface of the ground to escape the salt water.

C8. Surges for Twelve Hours

Several surges entered the estuary the next day. They were perhaps as much as 2 to 4 ft high and appeared as rapid increases in the tide that took about 10 min to peak. Water sped up the main river channels at speeds of 5 to 10 miles per hour. Standing waves with breaking crests stood perhaps 2 to 3 ft high. Logs riding in on the water rose out of the water as they crossed the waves, slapping the water surface as they came back down. Stumps rolled and tumbled in the rapidly moving water. As water spilled out of the channels and onto the sand flats, it spread outward at a moderate walking pace without cessation as dark turbulent sand-filled water several inches deep, crossing about 150 yards in under 2 min. Shoaling occurred over sand bars in the channels and bores were observed as far up the Necanicum River as Broadway.

C9. Wrap-Up

Had the first surge arrived during low tide, much of the damage in Seaside would most likely not have occurred, as later surges in the tsunami train were apparently smaller than the earliest ones. It is important to note that had the tide, the first surge, or the ocean surf of that day been higher, the damage in Seaside would have resulted in significantly greater property damage. Water would have poured across the Promenade and into the core of town, flowing down nearly all streets. Many homes would have been swept from their foundations and many lives could have been lost. Large numbers of people evacuated across bridges and roads that were already flooded or were adjacent to raging rivers. Had the water been any higher, many would have been washed into deep, swift water, and most likely would have drowned.

This account of the 1964 tsunami in Seaside is based on interviews with over 75 people, personal observations, at least four sets of excellent photos, and clippings from various newspapers.