

BAYSHORE FOREDUNE MANAGEMENT PLAN

MANAGEMENT STRATEGY



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LIMITATIONS

This document was prepared for, and in conjunction with, the Lincoln County Planning Department, Newport, Oregon. Technical aspects of this document were prepared by Terra Firma Geologic Services, following the DLCD document: *Dune Management Planning; A Guide to Preparing a Dune Management Plan as Provided for in Statewide Planning Goal 18* and methodologies used to prepare other foredune management plan strategies. This document is intended only to provide a general framework and foundation for implementing a foredune management plan at Bayshore through Statewide Planning Goal 18, it is not intended to serve as a site specific plan for grading individual management unit subareas. Portions of this document may be used in planning documents, any changes have not necessarily been reviewed/approved by Terra Firma Geologic Services.

The ocean front residences in the southern part of Bayshore are located within a foredune on a sand spit adjacent to an uncontrolled outlet for Alsea River. Because of that setting the beach adjacent to many of the residences has an elevated risk to be eroded by ocean waves during large wave erosion events. The area has an abundance of sand available for transport and the location of the homes within the foredune makes them conducive to accumulation of wind transported sand during periods of accretion. Preparation of this document does not imply that we condone the location of the residences in the southern part of Bayshore. The document was prepared to enable the residents at Bayshore to proceed with implementation of a foredune management plan, as allowed under Statewide Planning Goal 18. No warranties, either expressed or implied are provided. This report is submitted with the limitation that damages related to ocean wave erosion, tsunamis or even deposition of wind transported sand is borne by the property owners and is an inherent risk of having property located in such a geologically active environment.

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EXECUTIVE SUMMARY

The Bayshore community, located on the Alsea Spit, has been in existence since the mid to late 1960's. The spit has been subject to ongoing cycles of erosion and accretion. Historically these cycles have either required shoreline protection during erosion periods, or removal of sand around residences deposited by wind during accretion periods. In the absence of a Fore-dune Management Plan, only remedial sand grading and removal are allowed on a lot by lot basis. Revegetation and stabilization efforts are difficult to implement in this piecemeal fashion, and in recent years, the sand accretion problem has increased substantially, causing damage to structures and adversely impacting public roads and water lines in the area. Several property owners, as well as the road maintenance and water districts, approached the county requesting assistance to develop a dune management plan in an effort to resolve the problem.

Development of a Fore-dune Management Plan, and implementing documents, addresses Goal 18, Implementation Requirement #7. A consulting geologist having expertise in coastal processes was retained to identify the extent of the area to be included, and perform the necessary analysis to develop the plan, including maintenance and monitoring programs.

The plan identifies appropriate strategies and measures for: stabilization of graded areas and areas of deposition, including use of appropriate fire-resistant vegetation; avoiding or minimizing adverse impacts on surrounding properties by wind blown sand accretion, ocean erosion and flooding; and preserving and maintaining public and emergency accesses to the beach.

This project is supported by a number of stakeholders. The Oregon Coastal Management Program (OCMP), through the Department of Land Conservation and Development, provided a grant to the County to assist in this effort. Bayshore property owners provided additional cash resources and the County provided staff time and resources.

The consultant geologist developed the technical background report, fore-dune management strategy (with management/implementation strategies), together with monitoring and maintenance program documents. The county developed associated policies, standards and regulations, from the materials prepared by the consultant, to be included within the County's Comprehensive Plan and implementing ordinances. The County provided meeting coordination, including logistics, preparation of agendas and duplication of materials for the Project Advisory Committee, and assisted in draft preparation and adoption of applicable comprehensive plan and code provisions elements.

Project partners include Lincoln County; property owners; Bayshore Homeowners Association; Oregon Parks & Recreation Department; Department of State Lands; Department of Land Conservation & Development; Bayshore Road Maintenance District; Seal Rock Water District; underground utility providers.

Final products of the Fore dune Management Plan include 4 major components: the Background Report, Management Strategy Report , the Monitoring and Maintenance program and amendments to the Lincoln County Comprehensive Plan and Zoning Ordinance.

The Bayshore fore dune management area includes an 8,000 foot-long stretch of beach extending north from the outlet of Alsea Bay in Lincoln County, Oregon. The beach at Bayshore has been subjected to major erosion episodes separated by prolonged periods of accretion since development occurred in the 1960's. Currently the beach at Bayshore is accreted and fore dune growth has inundated homes and blocked views. Bayshore qualifies for fore dune grading through a fore dune management plan Under Statewide Planning Goal 18.

Statewide Planning Goal 18 does not authorize dune grading without an approved dune grading plan consistent with the goal. The only sand movement allowed without such a plan is very prescriptive remedial grading, subject to specific existing permit requirements, designed only to attempt to keep sand from inundating an existing structure. This plan does not further restrict remedial grading which can be currently authorized. Adoption of this plan may however, authorize more comprehensive dune grading and stabilization efforts necessary to address the root issues of chronic sand deposition and erosion in this area. These more comprehensive efforts, as outlined in this fore dune management strategy, will require cooperation of multiple property owners and potentially significant combined resources but ultimately should prove more effective in addressing these sand inundation impacts.

Once the plan is adopted, establishment of a Bayshore Dune Management Plan Steering committee and various sub-area plan sub-committees can facilitate and better enable plan preparation, implementation, maintenance and monitoring activities through active citizen involvement.

This fore dune management strategy at Bayshore balances the ability of the fore dune to protect properties from ocean flooding and wave erosion with the needs to minimize inundation accumulation of wind-blown sand, maintain and improve public access to the beach and maintain or restore ocean views. Four types of grading are addressed including: 1) preventative grading to minimize inundation, 2) view grading to maintain or restore ocean views, 3) infrastructure grading to remove accumulated sand from utilities, septic systems and roadways and 4) remedial grading to remove sand accumulated against and alongside structures.

With an approved fore dune management plan fore dune grading is possible. Grading could be allowed where the elevation of the dune exceeds the FEMA 100-year Base Flood Elevation by 4 feet. The fore dune elevation in the northern third of the Bayshore fore dune management planning area is currently insufficient to allow grading to occur but could be graded if the dune height exceeded that height. View grading is possible in the middle third of the planning area and the southern third is a candidate for preventative grading. Infrastructure and remedial

grading will occur in the southern third of the planning area. Preventative and view grading will occur within individual management sub-areas that include minimum contiguous beach lengths of 400 feet. The plan calls for grading of vacant lots where sand accumulations adversely impact adjoining properties.

View and preventative grading are restricted between late October and late March and disturbed areas must be planted with European beachgrass and fertilized between November 1 and April 1. Large infrastructure grading projects should ideally be done with other dune grading projects. Smaller infrastructure grading projects removing sand deposited by southerly winds should be done between late October through March.

Monitoring is needed to identify maintenance needs and to evaluate implemented management practices, ultimately leading to improvement in the management strategy. Maintenance is expected to consist of local grading or shaping of the foredune or foreslope, re-planting sparsely vegetated areas, and sand fence installation or adjustment.

OVERVIEW AND OBJECTIVES

The Bayshore foredune management area (Figures 1 & 2) extends from the southerly tip of Alsea Spit approximately 8,000 feet north to the northern edge of the Bayshore development in Lincoln County, Oregon. The beach at Bayshore has undergone accretion and sand accumulation since the area was developed in the 1960's. During that period the beach was subjected to two major erosion periods, causing significant impacts to properties in the southern part of the planning area and resulting in installation of rip rap to protect the southern half of the management area.

Erosion events lasting up to a few years have been separated by periods of accretion lasting more than a decade. The beach at Bayshore is currently in a state of accretion. Foredune growth resulting from the accretion has inundated homes and blocked ocean views. Bayshore was developed prior to January 1, 1977 and, thus, qualifies for foredune grading through a dune management plan. This document is the management strategy for implementation of a dune management plan at Bayshore.

The overall objectives of the proposed foredune management strategy at Bayshore, listed in order of decreasing priority are:

- To maintain or improve on the ability of the foredune to protect properties from ocean flooding and wave erosion.
- To minimize inundation by accumulation of wind-blown sand.
- To maintain and improve public access to the beach.
- To maintain or restore ocean views.

VIEW AND PREVENTATIVE GRADING

Overall Strategy

View and preventative grading can only be authorized within Bayshore as part an approved dune management plan which must be adopted by Lincoln County. This foredune management plan strategy balances the need to protect structures from ocean flooding and erosion with the needs to minimize inundation by wind-blown sand and to provide for views and access. The objective of the management strategy is to stabilize the sand in the existing foredune and encourage sand deposition on the seaward part of the foredune and seaward of the foreslope, resulting in a wider foredune that provides greater flood protection and erosion prevention than currently exists and retains wind-transported sand rather than allowing it to accumulate on and inland of the existing homes.

Portions of the beach at Bayshore are very susceptible to erosion, evidenced by past erosion events and the existence of riprap installed to protect properties in the southern half of the management area. The erosion that historically impacted this area is not due to extremely rare “Acts of God” but is the result of natural processes that will re-occur, probably sometime within the next decade or two. This susceptibility to erosion is due to the fact that much of the development is located on Alsea Spit, adjacent to a bay with an uncontrolled outlet.

Alsea Spit is not only susceptible to erosion but is also an area where sand accumulates between erosion events, resulting in beach accretion. The oceanfront homes in the southern part of the Bayshore development are located within the foredune. Not only are the homes located where sand naturally accumulates but the presence of the homes themselves encourages deposition and accumulation of wind-blown sand. The current inundation problem at Bayshore is very severe because the beach is in an accreted state and the area has been subjected to several consecutive winters with an abundance of strong southerly winds and summers with extended periods of moderate to strong northwesterly winds.

Foredune management at Bayshore is complicated by the dynamic setting of Alsea Spit and the fact that homes in the southern part of the development are located within the foredune instead of landward of the foredune. At Bayshore, particularly the southern part, there are two certainties: 1) there will be major erosion events that locally erode the beach and foredune all the way to the rip rap, and 2) between those erosion events the beach foredune system will accrete and during strong southerly and northwesterly winds there will be a risk for inundation problems to occur. The implications of this are that foredune management is not a permanent cure for the issues that face Bayshore but can only provide a set of mitigation tools to help reduce existing and future impacts.

Conditions at Bayshore vary spatially and will change over time. The beach at Bayshore is currently accreted and inundation problems in the southern part are locally severe, thus, the management strategy is to stabilize the foredune and encourage sand deposition seaward of it. When portions of the foredune ultimately erode the strategy will need to focus on rebuilding and restoring portions of the eroded foredune.

The planning area is divided into eight management units (MU1-8) shown in Figures 2 and 3. The delineation of the management units is based primarily on differences in the FEMA 100-year base flood elevations (BFE) for the velocity zone except for MU4 and MU5 which have the same BFE.

Under the proposed management strategy foredune lowering through grading is only allowed where the elevation of the dune exceeds the 100-year BFE by 4 feet to comply with Goal 18 requirements. In MU1-4 the foredune grading that occurs will consist of view grading. Within

and south of MU5 potential foredune grading consists of both view grading and preventative grading to minimize inundation of homes and infrastructure. Preventative grading becomes more important in the southern half of MU5 through MU8. Preventative and view grading should occur within individual management sub-areas that include minimum contiguous beach lengths of 400 feet (except MU6 which is only 350 feet wide and MU8 which includes only two residences).

The 2009 topographic data shows that MU1-3 did not qualify for foredune grading at that time. Limited elevation data gathered in 2011 indicates that dune growth was sufficient to barely qualify the foredune in portions of MU3 and, perhaps, MU2 for grading. MU1 is not expected to qualify for foredune grading for several years.

The amount of foredune that “qualifies” for view grading in portions of MU4 and MU5 is quite large and grading these relatively wide areas to the 100-year BFE + 4 feet elevation has the potential to expose large areas of sand to wind transport, possibly contributing to inundation during strong northwesterly winds. The benefit of improving views over the risk for possible inundation impacts must be carefully considered when preparing individual sub-area management plans for view grading.

FEMA Flood Insurance Rate Maps in portions of coastal Oregon have recently been updated and Lincoln County is scheduled to be updated in 2014. Changes made to the BFE during the update will affect the minimum heights that dunes may be lowered to and this plan will require modification, in the form of an amendment, to address that need. The datum for all elevations referred to in this plan is the North American Vertical Datum of 1988 (NAVD88). Elevations are referred to extensively in this plan and, for the sake of brevity, the datum is not included.

Desired Foredune Configuration

The objective of foredune management at Bayshore is to have a foredune crest of sufficient height and width to protect dwellings from ocean flooding and to minimize the risk for them to be impacted by ocean wave erosion. Where the foredune is lowered by grading the dune must maintain a minimum elevation of the FEMA BFE+4 feet to comply with Statewide Planning Goal 18 requirements for flood protection. The recommended minimum foredune width to protect homes from ocean wave erosion is 100 feet, based on the width of the high erosion hazard zone calculated using the geometric foredune erosion model for the Bayshore area (Witter and others, 2007). The width of the design foredune should be measured relative to the location of the Statutory Vegetation Line (SVL).

Once a foredune width of 100 feet is achieved the foredune can either continue to be widened or sand can be transferred to other locations within the foredune management area. For erosion prevention the priority should be to transfer sand to where the width of the foredune seaward of

the homes is minimal (i.e. in MU5-MU7) and for flood protection the priority should be to transfer sand to where the elevation of the foredune is well below the design elevation of BFE+4 feet (i.e. MU1). However, transferring sand mechanically more than a few hundred feet along the beach could prove cost prohibitive and not practical. This has particular relevance to Bayshore because the area with the greatest sand surplus consists of a 900 foot long segment of beach in MU4 and MU5 that is located 500 to 2500 feet from the area in need of sand for erosion protection and 4000 feet from the area in apparent need for flood protection.

Unless it is transferred to another area, sand that is graded from the foredune crest should be placed on the foreslope at a slope gradient that does not exceed 2:1 (H:V) and preferably at a slope gradient that is much gentler (i.e. on the order of 5:1 or less). Sand placed on the beach at elevations lower than about 18 feet in the northern half and 14 feet in the southern half will be within reach of typical winter storm waves, thus, sand placed below those elevations should be considered to be sacrificial. Because of that it is not recommended to construct foredunes seaward of that location.

Depending on the location within the planning area the graded dune will have a different appearance. In the northern half of the management area, beginning in the middle of MU4, the foredune is relatively narrow and separated from homes by a trough. Where portions of the foredune are tall enough to qualify for grading the crest of the dune can be graded flat and the excavated material placed on the foreslope to widen the crest of the foredune. This is depicted in Figure 12.

In the southern part of MU4 and the northern part of MU5 a significant amount of the foredune exceeds the minimum elevation by several feet and has a width in excess of 100 feet. Ideally, the excess sand should be transferred north or south to widen the foredune where it is narrower. It is possible that the foredune in much of that area will just be widened seaward to minimize costs. This could ultimately result in a flat foredune crest that has a width of 200+ feet, a configuration that will lack aesthetics. That portion of the foredune which is wider than 100 feet could be lowered by several feet, resulting in a lower bench area seaward of the crest to encourage sand deposition at a lower elevation seaward of the crest. It is also possible to add variability to graded surfaces to improve the appearance of the grading. Figures 13 and 18 show view grading scenarios for portions of MU4 and MU5 where the existing foredune exceeding BFE+4 feet is quite wide. At some time the foredune in this area is expected to reach the maximum recommended width, particularly if it is widened during grading. Once this occurs the situation should be evaluated to determine whether additional widening is appropriate, whether or not sand will need to be transferred to another area in need of a wider foredune or whether excess sand can be spread out on the beach to be re-distributed by winter waves.

The foredune seaward of the vegetation line in MU6 and adjacent portions of MU5 and MU7 is very narrow and, fortunately, rip rap helps protect that vulnerable area. Figures 19 and 22 show possible grading scenarios relevant to this area, both scenarios require sand transfer. Widening the foredune in that area to a width of 100 feet will require transport of an enormous amount of sand at a very high cost. A likely scenario is that not nearly enough sand will be available to construct the desired foredune up to an elevation equivalent to BFE+4ft. In that situation it would be desirable to build a lower foredune area to provide some additional protection over what exists and encourage sand to be deposited in that area. It appears that sand fences could help to build up the elevation of such a feature.

The design elevation for the graded dune crest differs at management unit boundaries, except for MU4 and MU5 which have the same elevation. Where this occurs it will be necessary to taper the grading to accommodate these differences. The slope connecting graded areas with different elevations should have a maximum ratio of 2:1. Similarly, graded areas will need to appropriately transition into ungraded areas.

Vegetation Planting

Successful establishment of sand stiling vegetation is critical to success of foredune management at Bayshore. It is recommended that disturbed areas and areas with sparse vegetative cover be planted in European beachgrass (*Ammophillia arenaria*). Beachgrass is recommended to be planted in two densities: Low and High. The low density planting consists of 18" hill spacing with 3 culms per hill, and the high density planting consists of 12" hill spacing with 3 culms per hill. High density planting is recommended for the foredune crest and areas seaward of the crest. Low density planting is recommended for areas inland of the foredune crest. Planting and fertilization should occur between November 1 and April 1 following guidelines in the Appendix. If sufficiently wet conditions do not exist prior to November 1 then planting should be delayed until suitable moisture conditions exist. Appropriate signage should be placed to discourage beach users from entering and trampling planted areas.

The planting recommendations are based on available published information and other foredune management plans. Discussions with individuals involved in projects at Canon Beach indicate that transplanted clumps of beachgrass salvaged from foredune areas that are lowered for view grading have had greater survival, more rapid growth and can be less costly than more traditional plantings (Tom Horning and Rainmar Bartl, personal communication, 2011). It is recommended that this method be pursued in areas where a source of beachgrass can be salvaged during the grading process.

Secondary stabilizing vegetation should ultimately be established in areas that are inland from the foredune crest and are surface stabilized in beachgrass. The purpose of the secondary stabilizing vegetation is to ultimately replace the beachgrass with more fire resistant vegetation.

Timing

Foredune management practices at Bayshore will initially focus on area wide grading accompanied by vegetative stabilization. Vegetation planting should occur between November 1 and April 1. Planting earlier in the fall may be possible, depending on the existing weather conditions. Sites should be graded shortly before they are planted. Depending on where it occurs grading of the foredune will consist of view grading, preventative grading or both. Grading will also consist of access route grading, remedial grading, infrastructure grading and grading of vacant lots. All of the sand moved during the grading process will be used to enlarge the existing foredune adjacent to the graded area or transferred to other appropriate locations within the beach foredune system at Bayshore. The first few years of plan implementation are expected to consist of multiple grading projects of management sub-areas that include minimum contiguous beach lengths of 400 feet. Plans will need to be prepared that are specific to these sub-areas. Vegetative stabilization of areas disturbed during grading and existing sparsely vegetated areas will occur shortly after grading to encourage sand collection seaward of the lowered foredune. Sand collection may also occur with sand fences. Sand fencing installed near or seaward of the foredune toe should initially be done on a trial basis in one management sub-area so that issues related to the sand fencing can be evaluated by Oregon Department of State Parks and Recreation.

Monitoring and maintenance will begin once areas are graded and is expected to continue for several years. Monitoring is expected to consist of periodic inspections, photographic documentation and profile surveys within the managed areas. At a minimum, profiles are expected to be measured prior to grading, after grading has occurred and after the graded areas have been subjected to a winter season. Graded areas should be inspected at least annually for a period of 5 years after grading. Maintenance will consist of additional plantings in graded areas that have poor survival and/or are sparsely vegetated, application of fertilizer, repair/adjustment of sand fences, grading to maintain access routes, foreslope shaping, and maintenance grading of the foredune crest. Sand fences are expected to require extensive and frequent maintenance. Recommended project monitoring and maintenance measures are discussed in greater detail in the Monitoring and Maintenance Program sections.

The need for additional grading projects will depend on how effective the initial phase of dune reconstruction is and future changes that occur. The elevation of the foredune crest in the northern management units is likely to increase sufficiently such that portions of MU2 and MU3, which currently do not qualify for grading will qualify, thus, additional projects are likely there. The sand inundation problem in the southern management units is severe and the sand source is

very large. Additional projects may be necessary, depending on the effectiveness of the original projects. The beach in the southern part of Bayshore has a dynamic erosion history which will repeat itself. When that occurs portions of the foredune will erode to expose the riprap shore protection structures that are currently buried. Such an event will essentially reset the clock requiring implementation of new projects to capture sand, rebuild and stabilize the foredune at Bayshore as the beach recovers and accretes.

Plan Implementation

This plan provides the general guidelines and conceptual approach to foredune grading and management at Bayshore but it is not intended to provide designs for specific areas within the planning area. Plans specific to individual management sub-areas that include minimum contiguous beach lengths of 400 feet (except MU6 which is only 350 feet wide and MU8 which includes only two residences) need to be prepared which design grading and sand transfer activities specific to the areas proposed for work. Such plans should be based on and include current topographic information. Surveyed profiles will be necessary to design the grading and establish a baseline for monitoring. Sub-area plans should be prepared by a qualified professional with experience working on Pacific Northwest beaches.

When sub-areas are proposed for grading it is important for designs to consider the existing or proposed grading configuration in adjacent and/or nearby sub-areas. Adjoining projects should be designed to blend in with one another to improve both function and appearance. It is also important to consider the risk for offsite inundation impacts which could result from grading large areas for view improvement.

Nearly all of the items discussed in this document will require work seaward of the Statutory Vegetation Line (SVL), requiring permit(s) from Oregon Parks and Recreation Department (OPRD). Enforcing dune management plan activities east of the SVL will be the responsibility of a private organization such as the Bayshore Beach Club Home Owners Association (HOA) through existing bylaws or additions to bylaws. The HOA should consider adding language to the bylaws for voluntary “Consent to Grade” documents for all existing homeowners within the management plan and make it a mandatory requirement for future owners.

Dune management activities will be privately funded. Affected property owners should research and consider a variety of options including development of a taxing district or local improvement district.

Formation of a Bayshore Dune Management Plan Steering Committee, or some other similar organization, is needed. Such a committee, made up of a group of affected property owners, is needed for a variety of tasks including: organizing dune grading projects; assisting property owners to collect revenue for sub-area plan preparation, monitoring and maintenance projects;

coordinate with HOA on potential violations or other issues such as access clearing and grading of vacant lots; education and public awareness efforts, and assisting in completion of foredune grading permit requirements. The Steering Committee should also provide relevant and needed information to the qualified professional responsible for project plan preparation, monitoring and maintenance.

In addition to the “Steering Committee” mentioned above, a subarea subcommittee should be established for each subarea to provide information relevant to the qualified professionals regarding plan preparation, plan implementation, monitoring and maintenance.

Implementation of a subarea plan shall require a minimum participation and approval of 60 percent of the property owners within the subarea. Prior to commencement of grading activities all of the property owners within a subarea must provide permission in the form of a “consent to grade” document to allow grading on their property.

Monitoring

Monitoring is a necessary part of the Bayshore Foredune Management Plan. It is needed to identify maintenance needs and to evaluate implemented management practices. Feedback from monitoring can be used to improve upon the management strategy.

Monitoring of sub-areas after they have been modified by grading should last for a period of five years and consist of annual profile and dune crest elevation measurements, photographic documentation and an overall inspection of the managed sub-area. A summary report should be prepared. A qualified professional with experience working on Pacific Northwest beaches should be responsible for the monitoring. The monitoring should occur shortly after grading and then annually in the spring. If no significant change is discerned in the measured profile for 2 years after grading then the profile measurement frequency can be decreased accordingly, however, the site should at least be visited and inspected annually for the five year period.

It is likely that multiple projects will be implemented within the first couple of years and it should be possible to monitor them together. After the initial five years the management strategy should be re-evaluated and recommendations made regarding appropriate modifications to the management strategy and the need for continued monitoring.

Planted sites should be monitored by a qualified individual to evaluate success of the plantings and determine the need for additional plantings. Monitoring of these sites should be timed to allow for planting during the current spring or fall season. For example, sites should be inspected by early March so that relevant areas can be re-planted before the recommended April 1 deadline and sites should be inspected in the fall so that they can be replanted in November.

Sites planted in beachgrass should not have to be inspected for more than a couple of years if the plantings are successful.

Regular observations by community members concerning beach erosion, general sand movement and beachgrass planting success can provide important information to the monitoring program. That information can be provided to the professional(s) responsible for preparing monitoring reports through the Bayshore Dune Management Plan Steering Committee or appropriate management unit subarea sub-committee.

Maintenance

Maintenance is an important component of the foredune management program at Bayshore. Regular maintenance will consist of fertilization of beachgrass and may consist of planting additional grass where the planted vegetation was not successful. Maintenance may also consist of foreslope shaping, foredune crest shaping, remedial grading, infrastructure grading, and grading for access management.

Vegetation Maintenance - Some level of repair to vegetation planting is likely due to erosion, blow outs, excessive burial, trampling or simply poor plant survival. Additional plantings should replicate the density that was originally prescribed for the area of concern (i.e. high density and low density planted areas should be planted to those levels). If a large blow-out develops, the most effective maintenance procedure is to replant with beach grass and then spread brush on the steep edges. Re-fertilizing weak areas can bring back sufficient cover if the plant root systems have not been uncovered. Planted areas should be given an annual application of 200 lbs/acre of 21-0-0 fertilizer in March for two years after planting. Fertilizer should be applied during a period of light wind and steady rain to dissolve the fertilizer.

Vegetation maintenance can also consist of secondary planting in the backslope to encourage establishment of successional, more fire resistant vegetation that will ultimately replace the beach grass. Secondary species include: Salal, Evergreen Huckleberry, Purple Beach Pea, Seashore Lupine, and Tree Lupine. Secondary species should be planted directly in the beachgrass. Currently the area where this is relevant is in Management Units 1-4. For additional information regarding vegetation maintenance refer to Carlson and others, 1991.

Foreslope Shaping - In areas it may be necessary to shape the foreslope to establish an even slope for maximum accretion of sand and foredune growth. Shaping should only be done when the present foreslope is so dissected and uneven that it impedes growth of the foredune. Foreslope shaping should be done very carefully to minimize disturbance. The shaping should be restricted to the material existing on the foreslope, sand should not be mined off of the beach or foredune crest to shape the foreslope with. The foreslope should be graded to slope gradients between 3:1 and 4:1 (H:V). Foreslope shaping should occur from November through March.

Vegetated areas where the depth of cut or fill is less than 3 feet should be immediately fertilized, areas that are excavated or filled deeper should be immediately planted and fertilized. If a large amount of sand accumulates against the foreslope during the summer from northerly winds this material could be shaped and planted in an attempt to stabilize the foreslope and encourage seaward growth of the foredune.

Maintenance Grading of the Foredune Crest - The amount of sand movement at Bayshore is very high and there may be a need to perform maintenance grading of the foredune crest in areas which have been previously graded under existing sub-area management plans. This type of grading should not necessarily require an entirely new sub-area plan if it is done within 5 years of the original permit being issued and the work is limited in scope. However, at a minimum, an update should be prepared to document conditions, describe the extent of proposed grading and justify the need. The proposed work should be carefully reviewed. All maintenance grading of the foredune crest should be accompanied by appropriate planting and fertilization following guidelines in the management strategy. The goal of foredune management at Bayshore is to create a foredune seaward of the homes that is densely vegetated with sand stiling vegetation (i.e. beachgrass). What should be avoided is for maintenance grading of the foredune crest to be treated like remedial grading and have the same large area be disturbed every year which will not allow vegetation to become established. This is essentially what has been happening in portions of Bayshore for many years.

Maintenance of Sand Fences - Sand movement at Bayshore is extreme and the amount available for transport is very large. Under the current conditions it is likely not going to be possible to force a large amount of sand deposition at the seaward edge of the foredune to minimize inundation of the foredune crest area without an aggressive program of sand fence installation. Sand fences will require significant maintenance and adjustment. There may be a need to install sand fences on the foredune crest to stabilize graded areas and to minimize sand inundation of residences due to sand being transported by both southerly and northwesterly winds.

Maintenance of Access Route Grading - Access routes will periodically need to be cleared and grading is likely to be locally necessary to removed accumulated sand. If accesses become eroded it may be necessary to install stabilization measures such as sand fences, grade stabilization measures, etc.

GRADING TO MITIGATE FOR INUNDATION IMPACTS

Sand inundation impacts at Bayshore have been severe and there is a need to remove sand immediately adjacent to structures as well as sand that buries roadways and utilities. The terms remedial grading and infrastructure grading are used to mitigate for each of those, respectively. Remedial grading is currently allowed by Lincoln County but is subject to very prescriptive

permit requirements, designed only to address allowable efforts to keep sand from inundating an existing structure. Infrastructure grading is generally broader in scope and may not fall within that which can be authorized in this area without an approved dune management plan. However, under this adopted plan infrastructure grading can be authorized subject to the dune management strategy requirements below.

Remedial Grading

The removal of sand that inundates structures and driveways is termed remedial grading and is currently permitted by Lincoln County.

Bare sand areas adjacent to structures that are exposed by remedial grading can be susceptible to wind erosion. This can be minimized or prevented in the short term by punching in rye grass straw, application of an appropriate wind resistant mulch (i.e. bark or gravel) or covering with an adequately anchored erosion control matting. Areas cleared through remedial grading that are susceptible to wind erosion can be stabilized in the long term through establishment of appropriate vegetation.

Infrastructure Grading

Remedial grading, as described above, is restricted to the removal of sand around a building to prevent sand inundation impacts and allow safe ingress. Sand inundation has resulted in significant impacts to the roadways, septic systems and utilities and the term infrastructure grading is used for the removal of that material. Infrastructure grading should ideally be done in conjunction with a larger foredune grading project but sometimes it will not be practical to wait to combine these activities and there will be a need to occasionally perform infrastructure grading separately. Hauling sand removed by infrastructure grading to an area out of the beach foredune system is not in compliance with Goal 18, thus, sand moved during infrastructure grading should be transported to an appropriate beach access and placed on the foreslope of the foredune. Beach Accesses 3-7 are likely routes to transport sand from infrastructure grading onto the beach. Transferring sand to the foreslope during the middle of the winter runs a risk of the transferred material being mobilized by strong southerly winds. Sand transferred to the foreslope from and north of beach access 5 is expected to be transported along shore and have less potential inundation impacts from southerly winds than sand transferred through beach accesses 6 and 7. Sand transferred to the beach through any of the accesses has the potential to be mobilized by summer northerly winds and may contribute to inundation of properties by northerly winds. Significant amounts of sand from infrastructure grading that are transferred to the foreslope of the foredune should be planted with beach grass at high densities and be appropriately fertilized. It is recommended that large infrastructure grading projects do not occur near the end of the recommended planting season to facilitate vegetation establishment. An alternative to building a foredune seaward with sand transferred from infrastructure grading is to spread it out thin on the beach below high tide during the late fall or winter where it can be re-distributed by winter waves. Areas bared during infrastructure grading that are susceptible to

being eroded by wind should be planted in beach grass at low densities, some other appropriate vegetation, or protected with suitable mulch.

Vacant Lots

Vacant lots exist in management units 1, 3, 4, 5 and 7. A significant amount of sand has accumulated on vacant lots in management units 5 and 7. The vacant lots which have accumulated significant sand are higher than surrounding areas and, during large wind events, wind-transported sand is deposited on adjacent lower areas on their leeward sides. This process has resulted in the build-up of large deposits of sand on adjacent areas. Sand has also locally built up to a point where it can slough and fall onto adjacent lower lying portions of lots that have been cleared.

The vacant lots that are significantly taller than adjoining properties and have resulted in impacts to those properties should be graded to lessen the impacts. To minimize sand deposition on adjoining properties the vacant lots should be graded to elevations that are similar to the lots or to an elevation which is 4 feet above the 100-year BFE for the relevant management unit, whichever is greater. Sand accumulations locally result in sloughing hazards to adjacent properties. Grading the vacant lots as described will eliminate the sloughing hazards. If it is not possible to grade the vacant lots to the level described above then the hazard could be adequately reduced by grading the sideslopes of the vacant lots to a slope gradient of 2:1 above the area that is threatened, however, if that approach is used it will likely require periodic grading to maintain that slope because sand will likely to continue to be deposited.

Vacant lots that are graded need to be stabilized with vegetation. It is recommended that beach grasses at low densities be planted on vacant lots that are graded to the approximate elevation of adjoining lots. If lots are graded just to minimize failure risk then the area disturbed during grading should be planted at high density. Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix. Barriers should be constructed around graded vacant lots to prevent trampling of the planted areas. Beachgrass could be salvaged from the graded vacant lots and used for clump transplanting. Vacant lot grading has the potential to generate a large amount of sand. Sand graded from vacant lots cannot be removed from the beach foredune system, thus a site-specific plan should be prepared specifying where the sand will be placed on the beach. Sand disposal sites for vacant lots will require planting at high densities and planted between November 1 and April 1.

Remedial and Infrastructure Grading Requirements

All Remedial/Infrastructure Grading Permits shall be subject to the following conditions:

- (A) All remedial and infrastructure grading activities shall be performed in a manner that avoids alteration of the existing height of the foredune and does not significantly damage existing vegetation.
- (B) All sand removed from a property during remedial grading shall be moved up and over the foredune seaward of the building and shall be accomplished in a manner that minimizes disturbance to existing dune height, vegetation, and the beach.
- (C) Only one disposal access shall be allowed on the property for the purpose of pushing sand up and over the foredune seaward of the structure. The access shall be limited to the minimum width necessary to accommodate the equipment being used and in no case wider than 8 feet. Upon completion of the project, the access shall be re-contoured to the height of the existing adjacent dune.
- (D) On properties where the foredune has been previously lowered below the undisturbed foredune height on the rear (seaward) yard, the foredune shall be allowed to build up and no grading is allowed.
- (E) Permanent stabilization of any portion of the foredune disturbed by remedial sand removal activities shall be accomplished through planting, fertilization, and maintenance of European beachgrass. Beach grass shall be planted at a spacing of 18 inches and carried out between November 1 and April 1. After initial planting and fertilization, stabilization shall include follow-up fertilization. Planting shall also include the re-contoured area used for the disposal access road. Documentation of revegetation efforts shall be provided to the Planning & Development Department within 10 days after planting has been completed.
- (F) Remedial grading adjacent to structures shall be limited to the following:
 - a) Rear yard: (Rear yard is the yard seaward of the structure). Sand may be removed to the level of the top of the sill of the foundation within 10 feet of the building, or the base of an existing deck. From the 10-foot line, all grading shall slope upward to where it intersects the ground surface of the existing dune at a ratio of 2:1 (horizontal:vertical).
 - b) Side yards: Sand may be removed to the level of the top sill of the foundation within 10 feet of the building (if possible). From the 10-foot line, sand grading shall slope upward at a ratio of 2:1.
 - c) Front yard: All sand that is landward of the building may be removed down to the sill level of the foundation, provided removal does not create slopes of more than 2:1 with adjacent properties. Grading may not lower the front yard below the level of adjacent streets or roads except to clear sidewalks or driveways.
- (G) Remedial grading on vacant lots shall conform to the following requirements:
 - i. Vacant lots shall, at a minimum, be graded to alleviate sand sloughing hazards to adjoining properties by grading the slopes of the vacant lots so they do not exceed gradients of 2:1 (horizontal:vertical). Such minimal grading is expected to require regular maintenance to maintain a maximum slope of 2:1.
 - ii. Vacant lots should optimally be graded to elevations that are similar to adjoining lots but in no case shall be lowered below an elevation which is 4 feet above the BFE for the relevant management unit.

- iii. A site-specific plan should be prepared specifying where the sand will be placed on the beach or lower seaward side of the foredune.
- iv. Vegetation Stabilization: Graded areas shall be stabilized with vegetation after completion of grading as indicated below:
 - 1. Planting and fertilization for vacant lots and associated disposal areas shall be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Bayshore Dune management Plan, except that approved disposal areas within the typical tidal range need not be vegetated..
 - 2. Barriers should be constructed around graded vacant lots to prevent trampling of the planted areas.

(H) Remedial grading shall authorize grading on a single lot or parcel only, except for infrastructure grading within dedicated road right of ways which may be authorized for all or any portion of a road right of way.

Maintenance

Remedial and Infrastructure Grading - Remedial and infrastructure grading are defined and discussed above in greater detail. There will likely be a need for both remedial and infrastructure grading to occur during the winter after major wind events. It is best if large infrastructure grading projects are combined with view and preventative grading projects. If it is not possible or practical to incorporate sand disposal and stabilization with other grading projects then sand removed from occasional infrastructure and remedial grading projects could be disposed of on the beach below the high tide line by spreading it out in a relatively thin layer (≤ 2 foot deep) to be re-distributed by winter storm waves.

Maintenance of Sand Fences - Sand movement at Bayshore is extreme and the amount available for transport is very large. Any sand fences proposed at part of any remedial or infrastructure project will require significant maintenance and adjustment. When sand fences fill up additional sand fences may need to be constructed. If sand fences are constructed to mitigate for southerly winds they should be removed by late March and the accumulated sand planted with beachgrass by April 1.

Maintenance of Access Route Grading - Access routes will periodically need to be cleared and grading is likely to be locally necessary to removed accumulated sand. If accesses become eroded it may be necessary to install stabilization measures such as sand fences, grade stabilization measures, etc.

MISCELLANEOUS PLAN COMPONENTS

Surveying Needs

The ability to perform foredune grading and the amount of dune lowering that may occur is dependent on the elevation of the foredune crest. In order to easily determine foredune elevations at Bayshore it is recommended that some sort of control network be established so

that elevations relative to NAVD88 can be readily determined. The number and location of elevation monuments that are to be established at Bayshore can vary considerably. A suggested minimum distance between monuments is 500 feet but monuments could be located closer or farther apart. More closely spaced elevation control will facilitate easier elevation measurements by laypersons. Establishment of easily identifiable elevation monuments can reduce future elevation surveying costs and increase property owner awareness and participation in dune height requirements. A licensed surveyor should be consulted for establishing an elevation control network at Bayshore. Monument elevations and locations should be documented so they can easily be recovered and used by a variety of individuals. The design foredune width is referenced to the Statutory Vegetation Line. Thus, in areas where grading is proposed the Statutory Vegetation Line should also be located.

Potential Inundation Impacts Related to Dune Management

There is a risk that graded areas will not become sufficiently stabilized by vegetation to prevent them from being eroded by wind and this could contribute to inundation problems, particularly in MU7, MU6 and the southern part of MU5. This is also a potential consequence of sand transfer to MU5-7. Inundation impacts that occur will depend on the frequency and timing of large wind events relative to when grading projects occur and how well vegetation becomes established after grading. Sand fences located much closer to the homes than at the toe of the foredune may be able to control this, however, sand fences are likely to require considerable maintenance to be effective and sites will need to be addressed on a site specific basis. The benefit of increasing the foredune width in MU5-7 to increase that area's resistance to erosion must be weighed against the risk of causing potential inundation impacts from both southerly and northerly winds. The risk for inundation impacts during southerly winds from sand transfer (particularly sand removed from infrastructure grading) can be minimized by transferring the sand north of MU5 where sand naturally accumulates in the foredune farther seaward from the homes than to the south, however, that area has built out seaward the most and continued widening will ultimately encroach into the beach.

The amount of foredune that qualifies for view grading in the southern part of MU4 and northern part of MU5 is quite large. Areas graded for view improvement that do not become adequately stabilized have a risk to be eroded by northwesterly summer winds, potentially contributing to inundation impacts of downwind properties, particularly in MU5-7. Potential inundation impacts related to grading projects must be carefully considered when sub-area management grading plans are prepared.

Beach Access

Beach accesses provide pedestrian access to the beach and, in the case of Beach Access #4, emergency vehicle access. Beach accesses are important for transporting sand to the beach from areas that undergo infrastructure grading and possibly remedial grading. The most important

beach accesses for sand management will be accesses # 4-7 in MU4-7. Accesses should be adequately cleared and graded to allow passage of equipment, where appropriate. Access #6 is bounded to the south by a vacant lot that has a crest elevation of 40+ feet. Grading access #6 to the BFE+4 feet elevation of 35 feet will require some grading on the adjacent vacant lot to prevent sloughing of sand into the access if the vacant lot is not graded as described in the earlier section. Beach access trails are currently not a major erosion concern. If beach access routes experience an unacceptable amount of erosion then they can be covered with wind resistant matting or mulches. Sand fencing staggered to allow pedestrian traffic can also help to minimize erosion of access routes. There may be a need to construct grade control on access routes that are used extensively by heavy equipment to transport sand to the beach that is removed from roadways and elsewhere.

Replacement Homes

There is little consistency of the height and elevation of homes in portions of Bayshore. Many of the older homes were constructed before the foredune had significantly accreted and are lower than more recently constructed homes on adjacent lots. This difference has resulted in sand being deposited on structures that are lower lying and are not as tall as adjacent structures. When older homes are eventually replaced it is recommended that the lot be filled to even out elevation differences between adjacent lots. New homes could also be designed to reduce sand deposition on adjoining structures.

Public Outreach and Citizen Involvement

Public outreach and citizen involvement are very important for implementation of a successful foredune management plan. Large scale foredune grading can result in significant public concern and an effective public outreach and education program can help to minimize that and facilitate implementation of an effective dune management program. Dune management plans have been in place for a considerable amount of time and much can be learned from various individuals who have actively participated in their implementation. Establishment of a Bayshore Dune Management Plan Steering committee and various subarea plan sub-committees can facilitate and better enable plan preparation, implementation, maintenance and monitoring activities through active citizen involvement.

Oregon State Parks Permits

Appropriate permits must be acquired from Oregon Parks and Recreation Department prior to any activity that results in an alteration to the beach.

A “Motor Vehicle on the Ocean Shore” permit from Oregon Parks and Recreation Department is required prior to any grading activities that occur seaward of the Statutory Vegetation Line (SVL). This includes all activities involving vehicle use seaward of the SVL associated with

view and preventative grading, remedial grading, deposition of material related to infrastructure grading and permitted maintenance activities.

MANAGEMENT UNIT STRATEGIES

Management Unit 1 (MU1)

This management unit includes the northern 500 feet of the Bayshore development. Figure 4 is a topographic map of MU1 and Figure 5 is a profile across MU1. The map is based on 2009 topographic data and the profile is based on data from 1998 to 2009.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The elevation of the foredune crest in most of this area had an elevation in 2009 less than 28 feet, well below the FEMA 100-year BFE + 4 feet which is 35 feet. Although some growth of the foredune crest in this area is expected to have occurred since 2009 it is doubtful that there has been sufficient growth to qualify for lowering through grading and it is unlikely to grow sufficiently to qualify for grading for several more years.

When this area qualifies for foredune grading the foredune crest could simply be topped off and widened by placement of the graded sand onto the foreslope. Any grading that ultimately occurs in this management unit will need to consider, and not impact unless authorized by Oregon Department of State Lands (DSL) permit, a wetland area that exists in the northern half of the management unit area. The wetland area is located between the active foredune and a conditionally stable dune ridge.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. MU1 has not been an area of major historic sand accumulation. The foredune in this area is lower than elsewhere in the planning area and sand transferred to the foredune in MU1 has the potential to enhance erosion/flood protection potential of this foredune area. Growth of the hummock dune area and its ultimate development into a new foredune can increase the width of the protective dune area seaward of the homes in MU1. A shift in the loci of sand deposition seaward of the existing foredune would decrease vertical enlargement of the current foredune and help to maintain views, extending the time before dune lowering becomes necessary.

Mechanical transport of sand to this area is not expected to be practical. The wetland area that must be crossed at beach access #1 constrains the ability to cross that area with equipment and transporting sand in dump trucks along the beach from the other beach

accesses will be extremely costly. It is possible that sand transfer could occur indirectly through establishment of sand-stilling vegetation and/or construction of sand fences on the foreslope (seaward slope of the foredune) and in the hummock dune area seaward of the foredune. Prior to installing sand fences to physically trap sand and build up the foredune in MU1 it is recommended that additional study be conducted to examine and evaluate sand transport by both southerly and northerly winds. Sand fence construction in MU1 may require shaping of the foreslope and/or hummock dunes and is likely to be controversial.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope and on the crest of the foredune can enhance flood/erosion protection potential.

On the foreslope and hummock dune area seaward of the foreslope plant beach grasses at high densities to an elevation of about 18 feet which is the approximate elevation of the seaward edge of the hummock dunes. Planting of vegetation below an elevation of about 18-20 feet has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis.

On the foredune crest plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix.

Management Unit 2 (MU2)

This management unit extends from MU1 south approximately 1300 feet. Figure 6 is a topographic map of MU2 and Figure 7 is a profile across MU2. The map is based on 2009 data and the profile includes data from 1998 to 2009.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The elevation of the foredune crest in this area had an elevation in 2009 between 27 and 35 feet, below the FEMA 100-year BFE + 4 feet which is 38 feet. The foredune crest in MU2 has grown since 2009 but the growth has probably not been sufficient

to qualify for lowering through grading, particularly the northern part which is lower than the southern part. When this area qualifies for foredune grading the foredune crest could simply be topped off and widened by placement of the graded sand onto the foreslope.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. The foredune in much of MU2 is lower than the 100-year BFE +4 feet and sand transferred to the foredune in this area has the potential to enhance erosion/flood protection potential of this foredune area.

Mechanical transport of sand to this area will likely prove cost prohibitive. It is possible that sand transfer could occur indirectly through construction of sand fences or establishment of sand-stilling vegetation on the foreslope (seaward slope of the foredune) and in the hummock dune area seaward of the foredune. It may be necessary to shape the foreslope and hummock dune area to install sand fences. Sand transfer could result in a wider foredune which would shift sand deposition seaward and decrease the growth rate of the height of the current foredune, lessening the need to lower the foredune crest through grading. Prior to installing sand fences to physically trap sand and build up the foredune in MU2 it is recommended that additional study be conducted to examine and evaluate sand transport by both southerly and northerly winds.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope in the hummock dunes through vegetation planted seaward of the foreslope and on the crest of the foredune can enhance flood/erosion protection potential.

On the foreslope and hummock dune area seaward of the foreslope plant beach grasses at high densities to an elevation of about 18 feet which is the approximate elevation of the seaward edge of the hummock dunes. Planting of vegetation below an elevation of about 18-20 feet has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis.

On the foredune crest plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix.

Management Unit 3 (MU3)

Management unit 3 extends from MU2 south approximately 2000 feet to the north edge of the clubhouse property. Figure 8 is a topographic map of MU3 and Figure 9 is a profile across MU3. The map is based on 2009 data and the profile includes data from 1997 to 2011.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The elevation of most of the foredune crest in this area had an elevation in 2009 between 30 and 32 feet, below the FEMA 100-year BFE + 4 feet which is 36 feet. The elevation of the foredune crest in this management unit has grown since 2009. Measurements in 2011 indicate that the foredune crest at least locally had an elevation of 36+ feet (see profile in Figure 9). It is likely that the elevation of the foredune crest will increase sufficiently to make it practical to grade portions of it in within the next few years. When this area qualifies for foredune grading the foredune crest could simply be topped off and widened by placement of the graded sand onto the foreslope.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. Sand transferred to the foredune in this area has the potential to enhance erosion/flood protection potential of this foredune area.

Mechanical transport of sand to this area will likely prove cost prohibitive. It is possible that sand transfer could occur indirectly through construction of sand fences or establishment of sand-stilling vegetation on the foreslope (seaward slope of the foredune) and in the hummock dune area seaward of the foredune. It may be necessary to shape the foreslope and hummock dune area to install sand fences. Sand transfer could result in a wider foredune which would shift sand deposition seaward and decrease the growth rate of the height of the current foredune, lessening the need to lower the foredune crest through grading. Prior to installing sand fences to physically trap sand and build up the foredune in MU3 it is recommended that additional study be conducted to examine and evaluate sand transport by both southerly and northerly winds.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope, in the hummock dunes seaward of the foreslope and on the crest of the foredune can enhance flood/erosion protection potential.

On the foreslope and hummock dune area seaward of the foreslope plant beach grasses at high densities to an elevation of about 18 feet which is the approximate elevation of the

seaward edge of the hummock dunes. Planting of vegetation below an elevation of 18-20 feet has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis.

On the foredune crest plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix.

Management Unit 4 (MU4)

This management unit extends from the north edge of the clubhouse area south approximately 1400 feet. Figure 10 is a topographic map of MU4 and Figure 11 is a profile across MU4. The map is based on 2009 data and the profile includes data from 1998 to 2009.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The foredune crest in this management unit had an elevation in 2009 between 34 and 41 feet and the FEMA 100-year BFE + 4 feet is 35 feet. The foredune in the southern part of this management unit is higher and wider than in the northern part. At least the southern part of the foredune in MU4 qualifies for grading and it is possible that the foredune in the northern part may also qualify. In the northern part of MU4 it would be possible to simply top the foredune crest and place the excavated material on the foreslope but in the southern half to third of MU4 larger scale grading is possible, similar to what would occur in MU5. Figures 12 and 13 show the two different grading scenarios in MU4. Areas that are graded for views in MU4 have the potential to be mobilized during strong northerly winds and may contribute to inundation from northerly winds.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. Transferring sand to the foreslope of this management unit is most likely to occur during the winter when sand is removed during infrastructure grading.

It is possible that sand transfer could occur indirectly through construction of sand fences or establishment of sand-stilling vegetation on the foreslope and in the hummock dune area seaward of the foredune.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope in the hummock dunes seaward of the foreslope and on the crest of the foredune can enhance flood/erosion protection potential in the northern part of MU4.

On the foreslope and hummock dune area seaward of the foreslope plant beach grasses at high densities to an elevation of about 18 feet which is the approximate elevation of the seaward edge of the hummock dunes. Planting of vegetation below an elevation of 18-20 feet has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis.

On the foredune crest plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix. MU4 is a candidate for planting transplanted clumps salvaged from grading the vegetated foredune crest.

Management Unit 5 (MU5)

Management unit 5 extends from MU4 south approximately 2400 feet. Figure 14 is a topographic map of MU5 and Figures 15-17 are profiles across the northern and southern parts of MU5, respectively. The map is based on 2009 data. The profiles include data from 2007 to 2011.

The shoreline and dunes at the northern end of MU5 trend to the north while at the southern end these features trend to the northwest. In the northern third of MU5 the dune system is wide and most of the sand is deposited well seaward of the homes but in the southern two thirds of MU5 the foredune is much narrower and significant inundation impacts occur. The foredune configuration in the different portions of the management unit also controls the erosion hazard. In the northern third of MU5 the homes are located in the low hazard area delineated by DOGAMI but in the southern two thirds the homes are located in the moderate and high erosion

hazard areas, coinciding with where riprap permits were issued in 1999. Hummock dunes are not present between the foreslope and the beach in the southern 500 feet of MU5.

The 2009 elevation of the foredune crest in the northern part of MU5 was 41 to 50 feet, the width was 60 to 70 feet and portions of it had been graded to an elevation of about 42 feet. Most of the remainder of MU5 had been graded below the 100-year BFE + 4 feet elevation which is 35 feet. The amount of foredune seaward of the vegetation line in the southern part of MU5 is very narrow and the foredune provides minimal protection from wave erosion.

Because of the morphologic differences stated above the management strategy in the northern third of MU5 is different from the southern part. In the northern part of MU5 the need for dune grading is for views but in the remainder of MU5 both view grading and preventative grading are expected. The width of foredune seaward of the homes in the southern part of MU5 is narrow. Sand transfer could widen the foredune and enlarge it seaward to increase its resiliency to wave erosion. An obvious source of sand for transfer to this area is located in the northern part of MU5, however, sand transfer to this area to lower the erosion hazard must balance the risk for inundation impacts to occur. Areas that are graded for views in MU5 have the potential to be mobilized during strong northerly winds and may contribute to inundation from northerly winds.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The foredune crest in the northern part of this management unit had an elevation in 2009 (where it had not been graded) between 41 and 50 feet and the FEMA 100-year BFE + 4 feet is 35 feet. Most of the foredune seaward of the homes in the southern two thirds of MU5 has been graded below the 100-year BFE + 4 feet. In the southern part of MU5 the homes are located on the foredune crest and the amount of foredune seaward of the homes is minimal. The foredune in the northern part of MU5 is very wide seaward of the homes. Sand could be transferred from the northern part of MU5 to the southern part to move the foredune seaward in the southern part of MU5 and elevate it to the 100-year BFE+4 feet. Figures 18 and 19 show different grading scenarios in MU5.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. The foredune in the southern part of MU5 is very narrow and sand transferred to the foredune in this area has the potential to enhance the erosion protection potential of this foredune area. However, sand transfer to this area to lower the erosion hazard must balance the risk for inundation impacts to occur.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope in the hummock dunes seaward of the foreslope and on the crest of the foredune can enhance flood/erosion protection potential. The foreslope in much of MU5 is currently very steep and essentially consists of sand that has been sidecast to a slope gradient between 1.5:1 and 2:1. If sand cannot be mechanically transferred to this area to sufficiently widen the foredune seaward sand fences could be constructed seaward of the current foredune toe on the upper part of the beach to increase the width of the foredune in the southern half of MU5. The area where sand fences can be installed has an elevation of between 14 and 22 feet. Sand fences should ideally be installed by November 1 but could be installed throughout the winter. Sand fences will require extensive maintenance and adjustment to be effective and will require regular monitoring and maintenance throughout the winter. When sand fences fill up additional sand fences should be constructed. If sand fences are constructed to mitigate for southerly winds they should be removed by late March and the accumulated sand planted with beachgrass by April 1.

On the foreslope and hummock dune area seaward of the foreslope plant beach grasses at high densities to the toe of the foreslope or the seaward edge of the hummock dunes, if present. This is essentially where the beach slope flattens and has an elevation between 14 and 18 feet. Planting of vegetation seaward of that location has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis.

On the foredune crest plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix. The northern part of MU5 is a candidate for planting transplanted clumps salvaged from lowering the vegetated foredune crest.

Management Unit 6 (MU6)

This management unit extends from MU5 southeast about 350 feet. Figure 20 is a topographic map of MU6 and Figure 21 is a profile across MU6. The map is based on 2009 data and the profile includes data from 1998 to 2009. MU6 is very similar to the southern part of MU5 and the northern part of MU7. The foredune in MU6 has been graded flat into a narrow bench that extends 10 to 20 feet seaward of the vegetation line and the slope from the outer edge of the bench to the beach is sidecast with a gradient of about 1.5:1. The homes in

MU6 are located in DOGAMI's high erosion hazard area. The 2009 elevation of the graded foredune in MU6 was 32 to 35 feet and current elevations are expected to be similar. The FEMA 100-year BFE + 4 feet elevation in MU6 is 33 feet.

In MU6 the need for dune grading is preventative, to minimize inundation. An important objective of dune management in MU6 is to widen the foredune to increase its resiliency to wave erosion. There is only a minimal amount of sand available to grade in MU6, thus, sand to build out the foredune in MU6 must either be mechanically transferred from another management unit or trapped through sand fences and establishment of vegetation.

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The foredune crest in this management unit had been graded to an elevation between 32 and 35 feet in 2009 and the FEMA 100-year BFE + 4 feet is 33 feet. Future grading is expected to maintain an elevation of 33 feet which is expected to involve both lowering and local filling to achieve the design elevation. Figure 22 is a profile showing a grading scenario at MU6.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. A possible source of sand for transfer to this site is the material removed during infrastructure grading from the roadway and adjacent areas. Sand transferred to MU6 has a risk of being mobilized by both southerly and northerly winds and may contribute to inundation problems this area unless it can be adequately stabilized with vegetation. The foredune in much of this area is very narrow and sand transferred to the foredune in this area has the potential to enhance the erosion protection potential of this foredune area. However, sand transfer to this area to lower the erosion hazard must balance the risk for inundation impacts to occur. It is unlikely that the amount of sand transferred to MU6 will be sufficient to elevate a constructed foredune to the FEMA 100-year BFE+4 elevation. If that is the case then a lower bench could be constructed with the sand that is available. Sand could be transferred to that area periodically to continue building it up and seaward.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope, in the hummock dunes seaward of the foreslope, and on the crest of the foredune can enhance flood/erosion protection potential. The foreslope in much of MU6 is currently very steep and consists of sand that has been sidecast to a slope gradient of about 1.5:1. If sand cannot be mechanically transferred to this area to significantly widen the foredune sand fences could be constructed on the upper part of the beach to

increase the width of the foredune in MU6. The area where sand fences can be installed has an elevation ranging between 14 and 20 feet. Sand fences should ideally be installed by November 1 but could be installed throughout the winter. Sand fences will require extensive maintenance and adjustment to be effective and will require regular monitoring and maintenance throughout the winter. When sand fences fill up additional sand fences should be constructed. If sand fences are constructed to mitigate for southerly winds they should be removed by late March and the accumulated sand planted with beachgrass by April 1. More information regarding sand fences can be found in the Appendix.

On the foreslope and beach seaward of the foreslope plant beach grasses at high densities to the toe of the foreslope or the seaward edge of the hummock dunes, if present. This is essentially where the beach slope flattens and has an elevation between 14 and 18 feet. Planting of vegetation seaward of that location has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis. If sand fences are constructed they should be removed by late March and the accumulated sand planted with beach grass.

On the foredune crest and graded areas plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix.

Management Unit 7 (MU7)

Management unit 7 extends from beach access 7, at the south edge of MU6, southeast about 1000 feet. Figure 23 is a topographic map of MU7 (based on 2009 data) and Figures 24 and 25 are profiles across MU7. The northern profile (Figure 24) includes data from 1997 to 2011 and the southern profile includes data from 1998 to 2009. The northern part of MU7 is very similar to MU6 with a narrow graded bench. In 2009 the graded bench did not even extend past the vegetation line before descending to the beach as a foreslope in one area. Farther south there is a 100 to 150 foot wide bench area with an elevation of 20 to 25 feet that blends into hummock dunes. The homes in the northern part of MU7 are located in DOGAMI's high erosion hazard area and the homes in the southern part are located in the moderate hazard area. The 2009 elevation of the foredune in MU7 varies from 26 to 40+ feet. The 100-year BFE + 4 feet elevation in MU7 is 28 feet.

Homes in MU7 are severely impacted by inundation and the objective is to create a configuration that is less prone to sand mobilization and inundation. The foredune in most of MU7 is fairly wide and provides a significant buffer to wave erosion, thus, widening the foredune for erosion protection in the southern part is not as important as in the northern part.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading The foredune crest in this management unit in 2009 ranged from 26 to 40+ feet and current elevations are likely to be similar, if not higher. The FEMA 100-year BFE + 4 feet is 28 feet, thus, much of it qualifies for grading. Grading is expected to lower the higher areas and build up the areas which are lower than the 100-year BFE + 4 feet. Figure 27 is a profile across the southern part of MU7 showing a likely grading configuration. Some of the homes in MU7 are significantly lower relative to the 100-year BFE + 4 feet than shown in Figure 26.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. We do not anticipate significant mechanical transfer of sand to the foredune of this management unit from other management units except in the northern part where the amount of foredune seaward of the existing homes is very small. Sand transferred to the foredune in the northern part of MU7 has the potential to enhance the erosion protection potential of this foredune area but could contribute to inundation problems if it does not become adequately stabilized.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope in the hummock dunes seaward of the foreslope and on the crest of the foredune can enhance flood/erosion protection potential. This management unit faces southwesterly and sand on the beach is readily mobilized towards this area during strong southerly winds. MU7 would be an excellent area to try out sand fences at Bayshore. It is recommended that sand fences be installed on the upper part of the beach below the foreslope to trap sand before it builds up onto the foredune. This area has an elevation ranging between 14 and 20 feet. Two or three sand fences should be constructed 30 feet apart beginning at the toe of the foreslope or seaward edge of the hummock dunes extending onto the beach using guidelines in the Appendix. Sand fences could also be constructed on the foredune seaward of the homes to reduce inundation, however, the sand fences are expected to result in vertical growth of the foredune if they prove effective, effectively blocking views. Sand fences will require extensive maintenance and adjustment to be effective and will require regular monitoring and maintenance. When sand fences fill up additional sand fences

should be constructed. If sand fences are constructed to mitigate for southerly winds they should be removed by late March and the accumulated sand planted with beachgrass by April 1. More information regarding sand fences can be found in the Appendix.

On the foreslope and hummock dune area seaward of the foreslope plant beach grasses at high densities to the seaward edge of the hummock dunes or foreslope, if hummock dunes are absent. This area will have an elevation between 14 and 20 feet. Planting of vegetation below that elevation has a relatively high risk of being lost during normal winter storms and as a result may need to be re-planted on a regular basis.

On the foredune crest and graded areas plant beach grasses at high densities to fill in areas that are not vegetated.

On the backslope plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated and plant secondary stabilizing vegetation where appropriate.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix.

Management Unit 8 (MU8)

Management unit 8 includes two homes at the tip of Alsea Spit. Figure 27 is a topographic map of MU8. These homes are located within the planning area to allow grading that is more extensive than typical remedial grading allows for. The northern home has minimal inundation impacts but impacts to the southern home are greater, requiring periodic sand removal. The 2009 elevation of the dunes near the south home are 22 to 30+ feet and 18 to 24 feet near the north home. The FEMA velocity zone is currently not designated in MU8 and the 100-year BFE is 14 feet. It is possible that a velocity zone may be established for part of this management unit when the FEMA flood hazard zones are revised in a few years. In the interim we recommend that grading not lower the properties below an elevation of 18 feet. Graded sand can either be pushed out onto the beach and stabilized with vegetation or mechanically transported to one of the beach access areas and placed on the foreslope in another management unit. Management Unit 8 should be a separate management sub-area.

Management Activities

Sand Removal Under the proposed dune management strategy the removal of sand from the management area is prohibited.

Foredune Grading This management unit is located at the terminus of the foredune and technically is adjacent to the bay rather than the beach, thus, there is no foredune crest present. The FEMA 100-year BFE + 4 feet is 18 feet, thus, portions of the management unit

qualify for grading since much of the unit has dunes with elevations between 22 and 30+ feet. Grading should not lower the property to an elevation less than 18 feet. Graded sand that is moved towards the bay should be placed on the beach adjacent to the current toe of the slope to build out the deposit of sand that has accumulated there.

Sand Transfer Under the proposed dune management strategy the transfer of sand within and between the management units is permitted. There is no need to transfer sand to this management unit from other management units but it is possible that sand graded from this management unit may be transferred to other management units, particularly sand removed from the landward side of the homes.

Vegetative Stabilization and Sand Collection Under the proposed management strategy the selective planting of sand-stilling grasses within this management unit is a permitted activity. The capture of sand in the foreslope, in the hummock dunes seaward of the foreslope, and on the crest of the foredune can enhance flood/erosion protection potential. This management unit faces south to southeast and sand on the beach is mobilized towards this area during strong southerly winds. Sand fences installed on the upper part of the beach below the toe of the foreslope may help to trap sand and build up a dune on the beach and help to reduce inundation impacts adjacent to the homes. Sand fences will require regular monitoring and maintenance throughout the winter. When sand fences fill up additional sand fences should be constructed. If sand fences are constructed to mitigate for southerly winds they should be removed by late March and the accumulated sand planted with beachgrass by April 1. More information regarding sand fences can be found in the Appendix.

On the foreslope plant beach grasses at high densities to an elevation of about 14 feet which is the approximate elevation of the back edge of the gently sloping beach area.

On the foredune crest and graded areas plant beach grasses at high densities to fill in areas that are not vegetated.

On other areas plant beach grasses at low densities to fill in areas that are not vegetated or are sparsely vegetated.

Planting and fertilization should be carried out during rainy months between November 1 and April 1 in accordance with specifications in the Appendix.

REFERENCES

Carlson, J., Reckendorf, F., and TERNYIK, 1991. Stabilizing Coastal Sand Dunes in the Pacific Northwest. USDA Soil Conservation Service Handbook 687, 53p.

Witter, R. C, J. C. Allan and G. R. Priest, 2007, Evaluation of Coastal Erosion Hazard Zones Along Dune and Bluff Backed Shorelines, Southern Lincoln County, Oregon: Seal Rock to Cape Perpetua, Oregon Department of Geology and Mineral Industries Technical Report O-07-03.

DEFINITIONS

Access: The way or means by which pedestrians or vehicles enter and leave property.

Accretion: The build-up of land along a beach or shore by deposition of waterborne or airborne sand, sediment, or other material.

Base flood: A flood having a one percent chance of being equaled or exceeded in any given year.

Base Flood Elevation (BFE): The computed elevation to which floodwater is anticipated to rise during the base flood. Base Flood Elevations (BFEs) are shown on Flood Insurance Rate Maps (FIRMs) and on the flood profiles. The BFE is the regulatory requirement for the elevation or floodproofing of structures. The relationship between the BFE and a structure's elevation determines the flood insurance premium.

Building: A structure, other than a mobile home, built for the support, shelter, or enclosure of persons, animals, chattels, or property of any kind and having a fixed connection to the ground.

Coastal flood zone: Areas subject to high velocity ocean waters, including but not limited to storm surge or tsunamis. Coastal flood zones are identified on FIRM maps as V zone.

Deflation Plain: The broad interdune area which is commonly scoured to the level of the summer water table.

Dune: A hill or ridge of sand built up by the wind along sand coasts.

Dune, Active: A dune that migrates, grows, and diminishes from the effect of wind and supply of sand. Active dunes include all open sand dunes, active hummocks, and active foredunes.

Dune, Conditionally Stable: A dune presently stable from wind erosion, but vulnerable to becoming active due to fragile vegetation cover.

Dune, Hummock: Partially vegetated, elevated mound of sand that is actively growing in size.

Dune Grading: Reconfiguration of existing dune areas using earth-moving equipment.

Dune Nourishment: Augmentation of the natural sediment supply within a foredune area.

Foredune, Active: An unstable barrier ridge of sand paralleling the beach and subject to wind erosion, water erosion, and growth from new sand deposits. Active foredunes may include areas with beach grass, and occur in sand spits and at river mouths as well as elsewhere.

Foredune, Conditionally Stable: An active foredune that has ceased growing in height and that has become conditionally stable with regard to wind erosion.

Foredune Grading: The alteration of the foredune area through sand transfer or removal of sand by mechanical means in order to accomplish view grading and/or preventative grading.

Foredune Management Plan: A plan that has been adopted as part of the comprehensive plan and implementing code comprised of a background report, management strategy, and maintenance and monitoring programs for a specific plan area consistent with Statewide Planning Goal 18.

Foredune, Older: A conditionally stable foredune that has become wind stabilized by diverse vegetation and soil development.

Foreslope: Sloping face of dune on the seaward/windward side of the foredune.

Foreslope Shaping: Minor redistribution of sand in the crest and foreslope areas in order to maintain a regular, gently-sloping foredune.

Infrastructure Grading: Removal of sand which is physically inundating roadways, beach accesses, septic systems, and underground utilities, thereby causing damage, impeding vehicular and pedestrian movements, and otherwise interfering with service provision and operations related to the impacted infrastructure systems. Infrastructure grading may be permitted in sand areas subject to Lincoln County Remedial Sand Grading and Removal Permit standards and conditions for infrastructure grading and removal.

Littoral Drift: The transport of non-cohesive sediments, i.e. mainly sand, moved alongshore in the shallow nearshore by waves and currents.

NAVD88: The North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established in 1991 by the minimum-constraint adjustment of the Canadian-Mexican-U.S. leveling observations. It held fixed the height of the primary tidal bench mark, referenced to the new International Great Lakes Datum of 1985 local mean sea level height value, at Father Point/Rimouski, Quebec, Canada. Additional tidal bench mark elevations were not used due to the demonstrated variations in sea surface topography, i.e., the fact that mean sea level is not the same equipotential surface at all tidal bench marks.

Preventative Grading: The removal of sand which threatens to inundate a structure from the immediate vicinity of the structure.

Qualified Professional: An Oregon Registered Geologist or Certified Engineering Geologist, with experience working on Pacific Northwest beaches.

Remedial Grading: The removal of sand from a developed lot which is physically inundating a structure and causing damage or preventing access to the structure, or removal of sand from a vacant lot which is threatening to inundate adjoining lots.

Sand Collection, Mechanical: Use of fences or brush mats to collect and hold sand.

Sand Removal: The mechanical movement of sand to alternative disposal areas outside the Foredune Management Area.

Sand Transfer: The mechanical or natural movement of sand within and between management units (e.g. low and narrow areas in the immediate vicinity of the area from which it has been removed or the fronting beach). Backpassing is the transfer of sand from the collection area back to its source area (updrift). Bypassing is the transfer of sand from the collection area to another collection area (downdrift).

Sub-area: A portion of a management unit or units. A subarea shall extend a minimum of 400 feet of continuous shoreline in length. The landward (eastern) boundary of a subarea corresponds to the landward (eastern) boundary of the Foredune Management Plan Area. The seaward (western) boundary corresponds to the western extent of proposed management activities but within the Foredune Management Plan Area

Vegetative Stabilization: Use of plants to secure bare sand surfaces against wind erosion.

View Grading: Grading of dune areas to the FEMA 100-year BFE (base flood elevation) + 4 foot level for the purpose of restoring, obtaining, or maintaining views from existing structures.



Figure 1. Map showing location of Bayshore Foreduene Management Planning Area.



Figure 2. Overview showing setting of Bayshore Foredune Management Planning Area and Management Units.

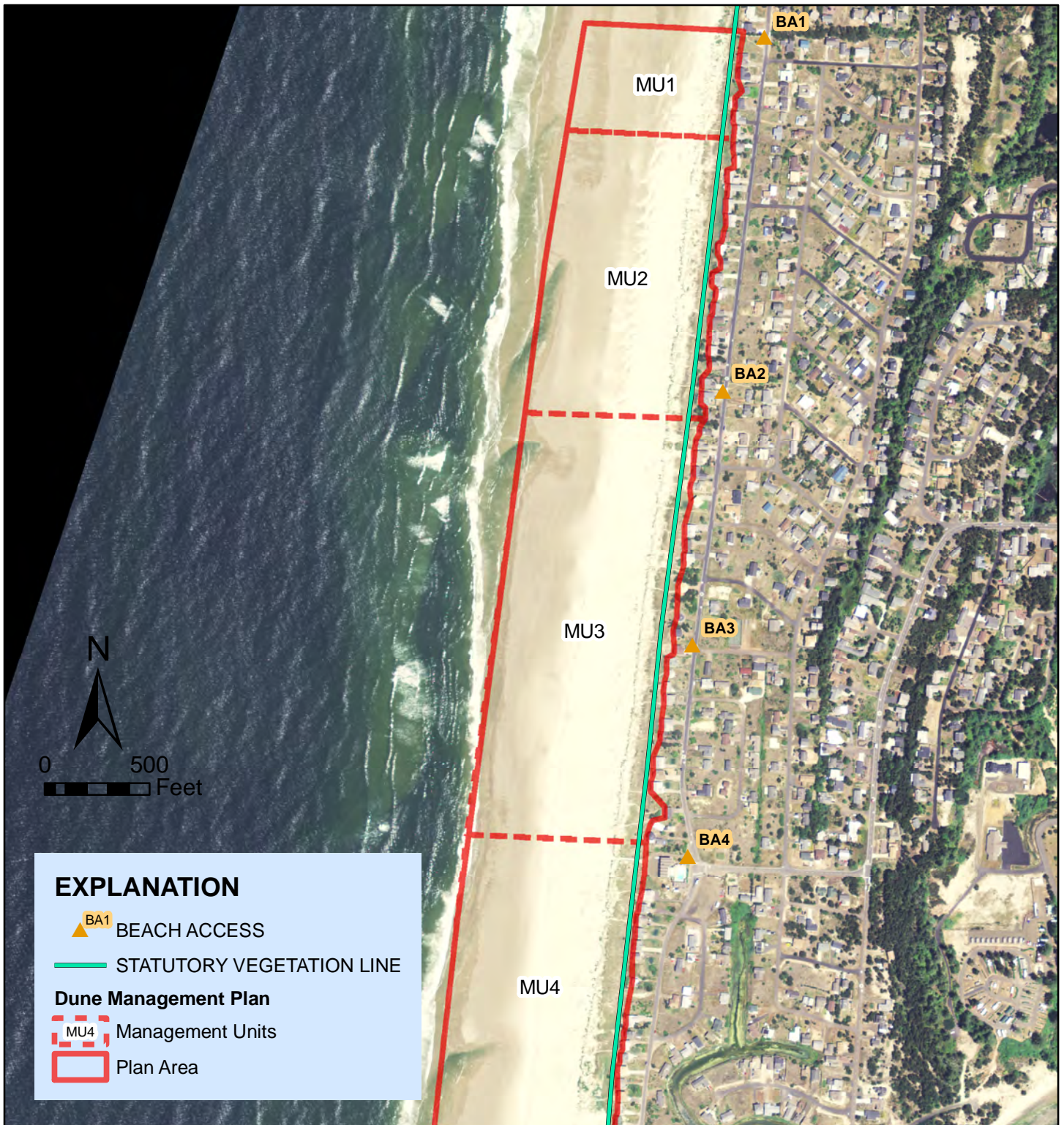


Figure 3A. Management units Beach Accesses and Statutory Vegetation Line location within northern half of Bayshore Fore dune Management Planning Area, 2009 imagery.

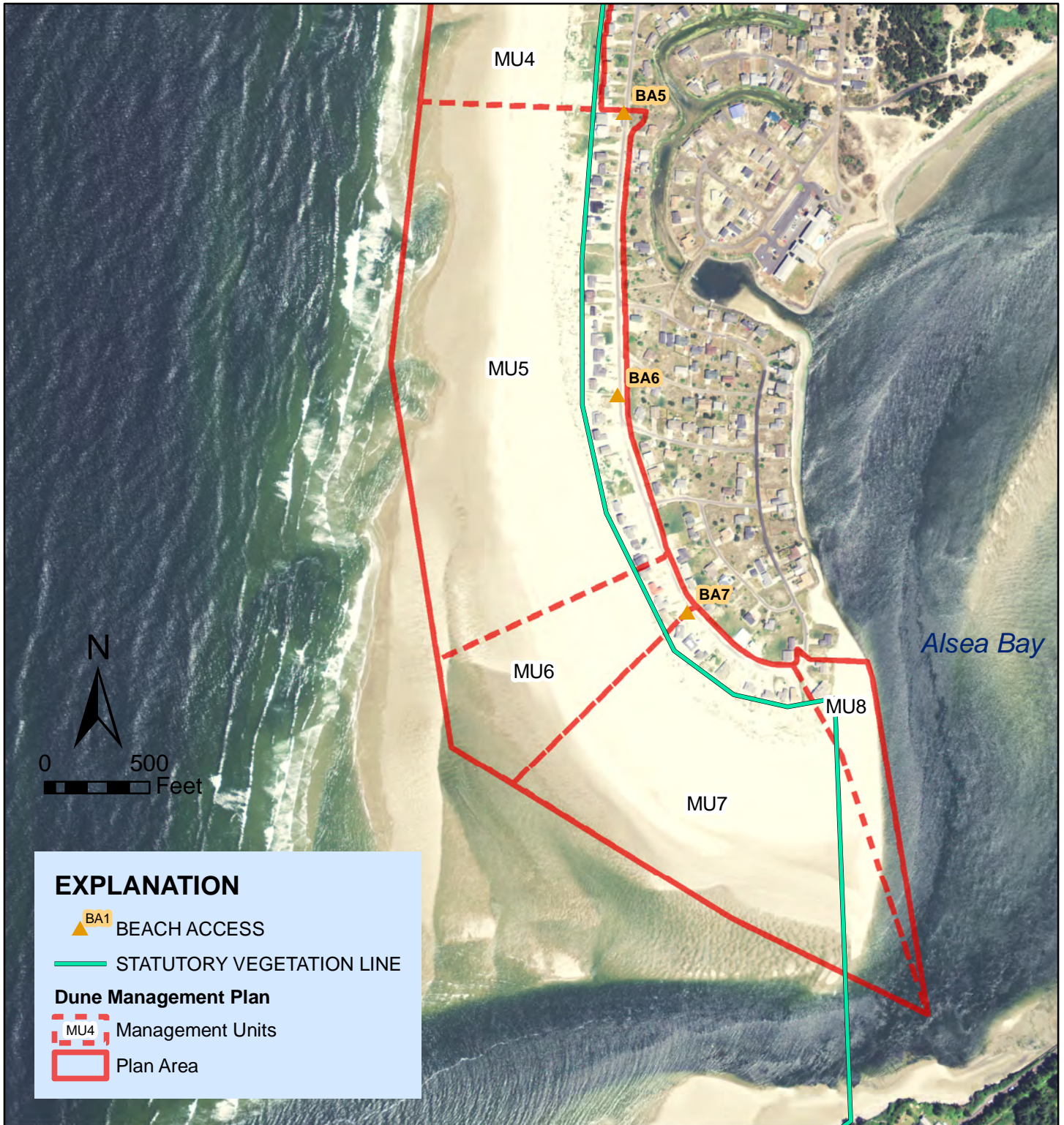


Figure 3B. Management units, Beach Accesses and Statutory Vegetation Line location within southern half of Bayshore Foredund Management Planning Area, 2009 imagery.

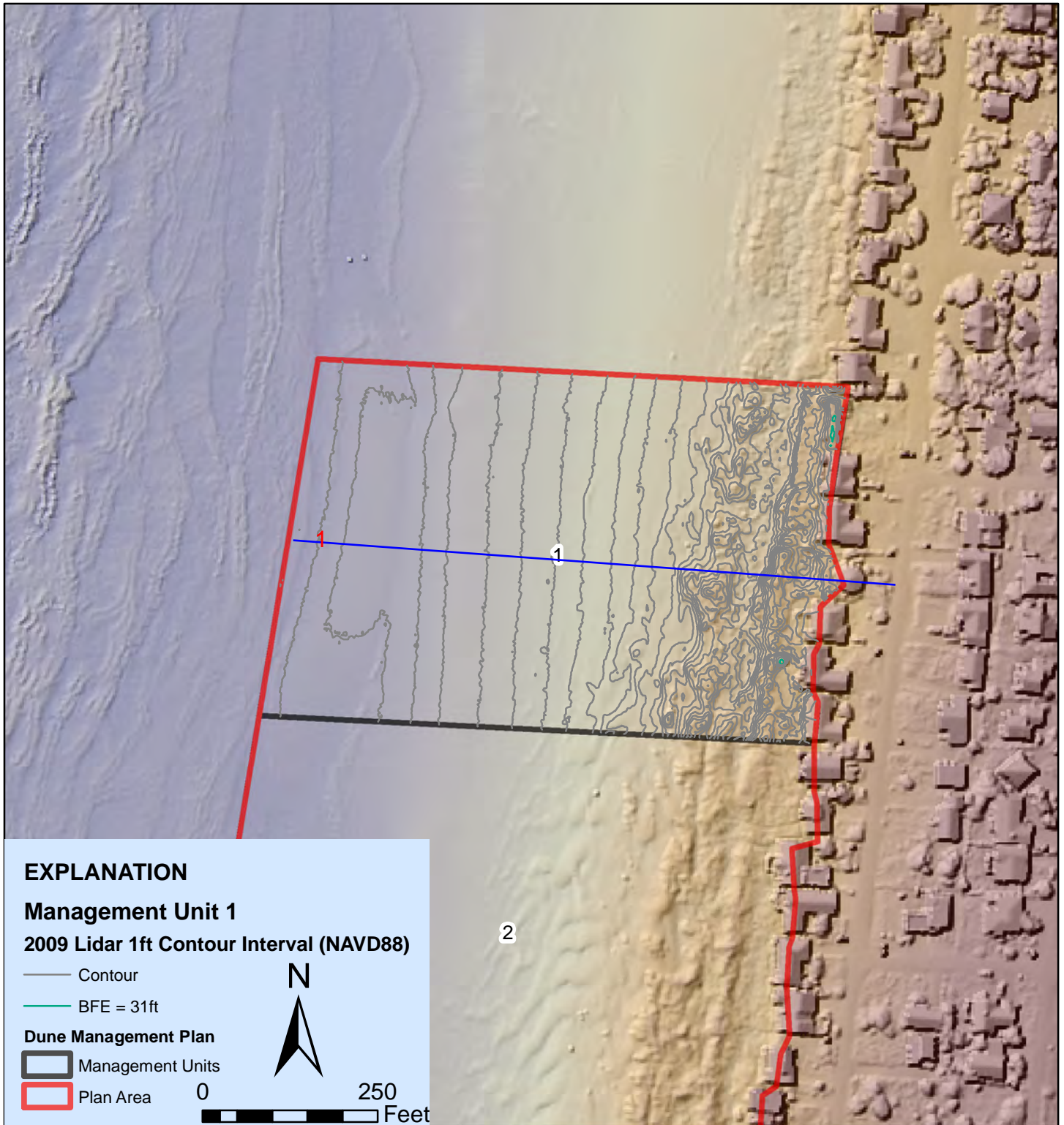


Figure 4. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 1 in Bayshore Fore dune Management Plan Area. FEMA 100 year BFE shown as green contour, blue line = Profile 1.

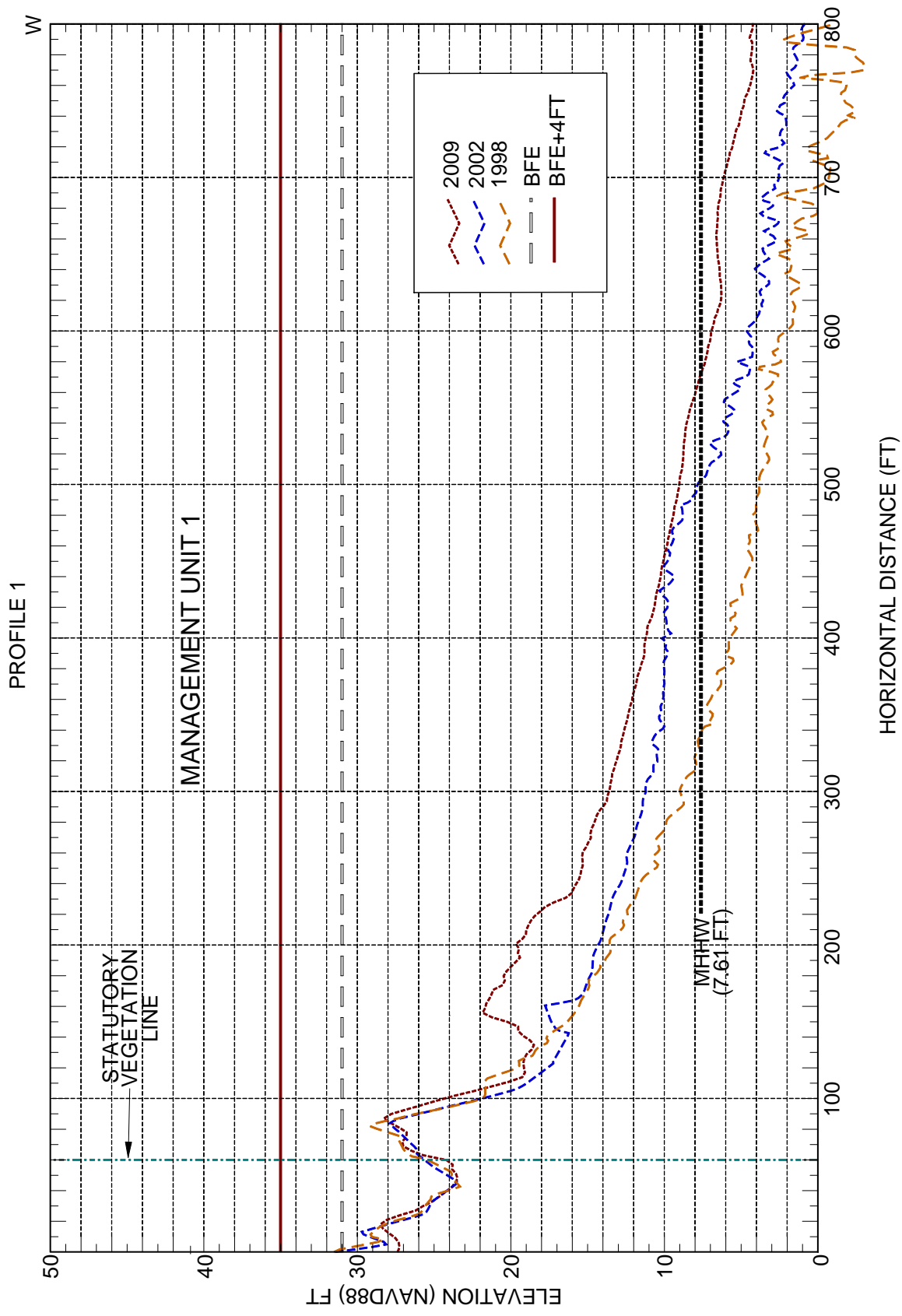


Figure 5. Beach profile 1 showing changes from 1998-2009, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

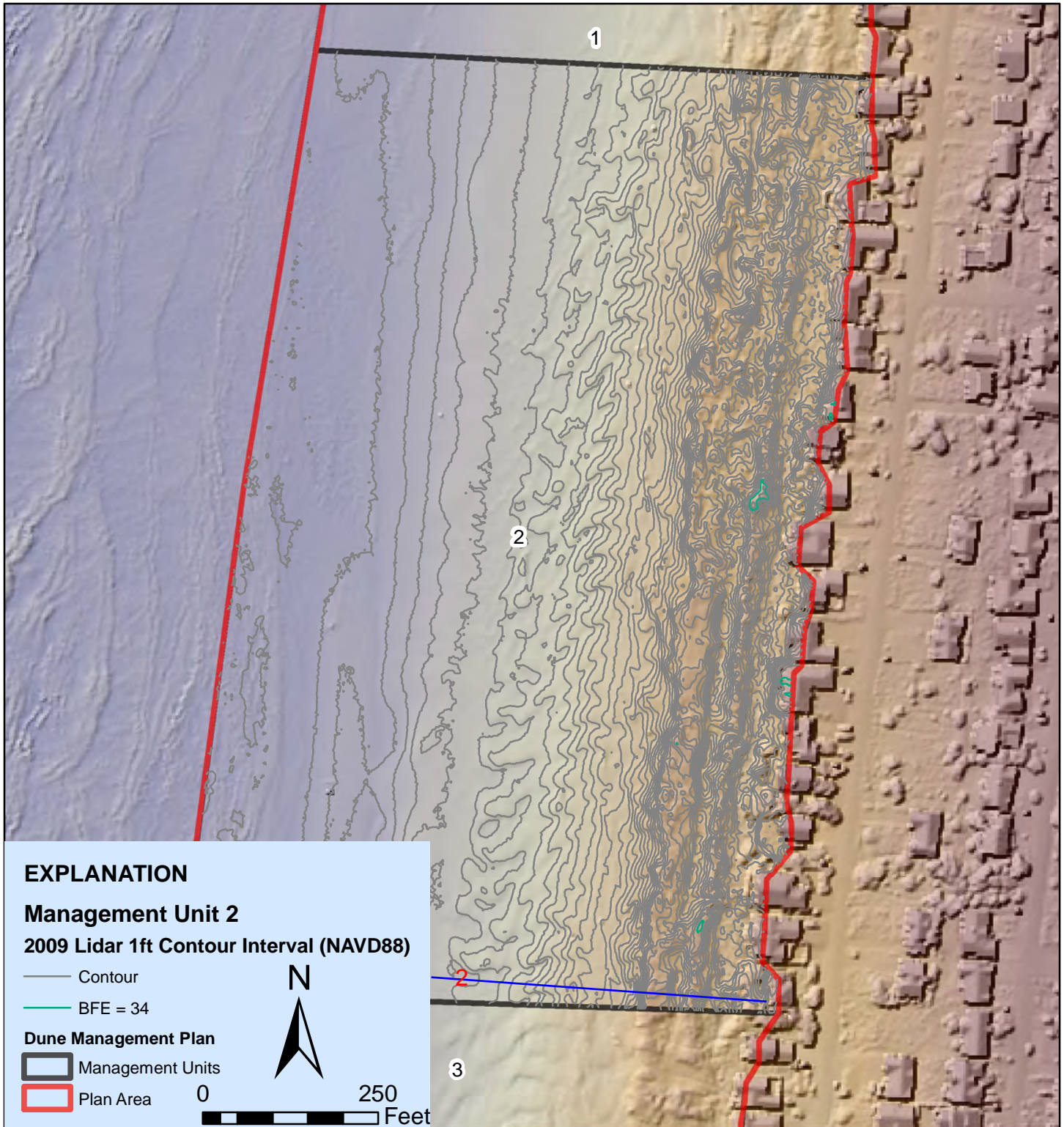


Figure 6. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 2 in Bayshore Fore-dune Management Plan Area. FEMA 100 year BFE shown as green contour, blue line = Profile 2.

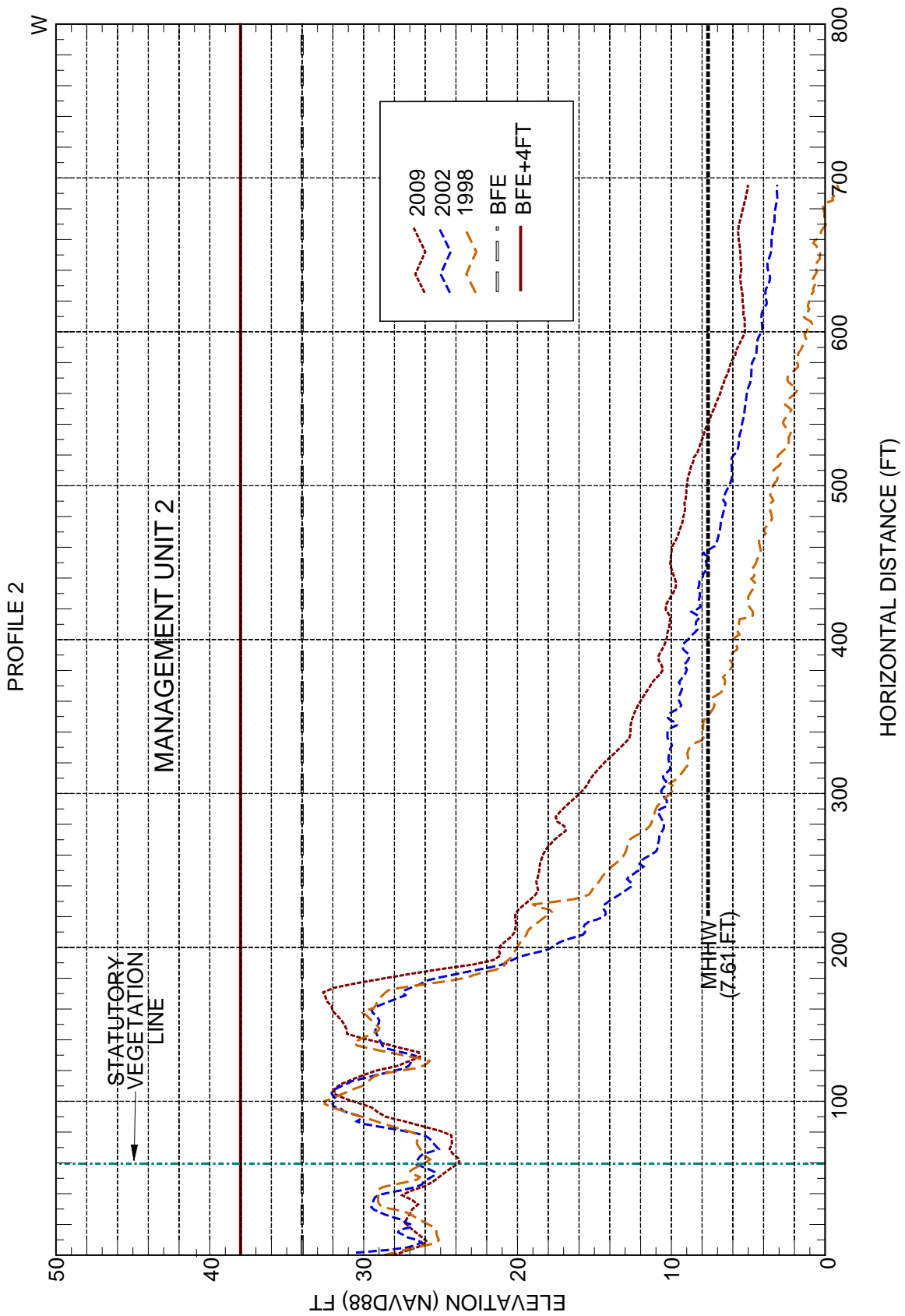


Figure 7. Beach Profile 2 showing changes from 1998-2009, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

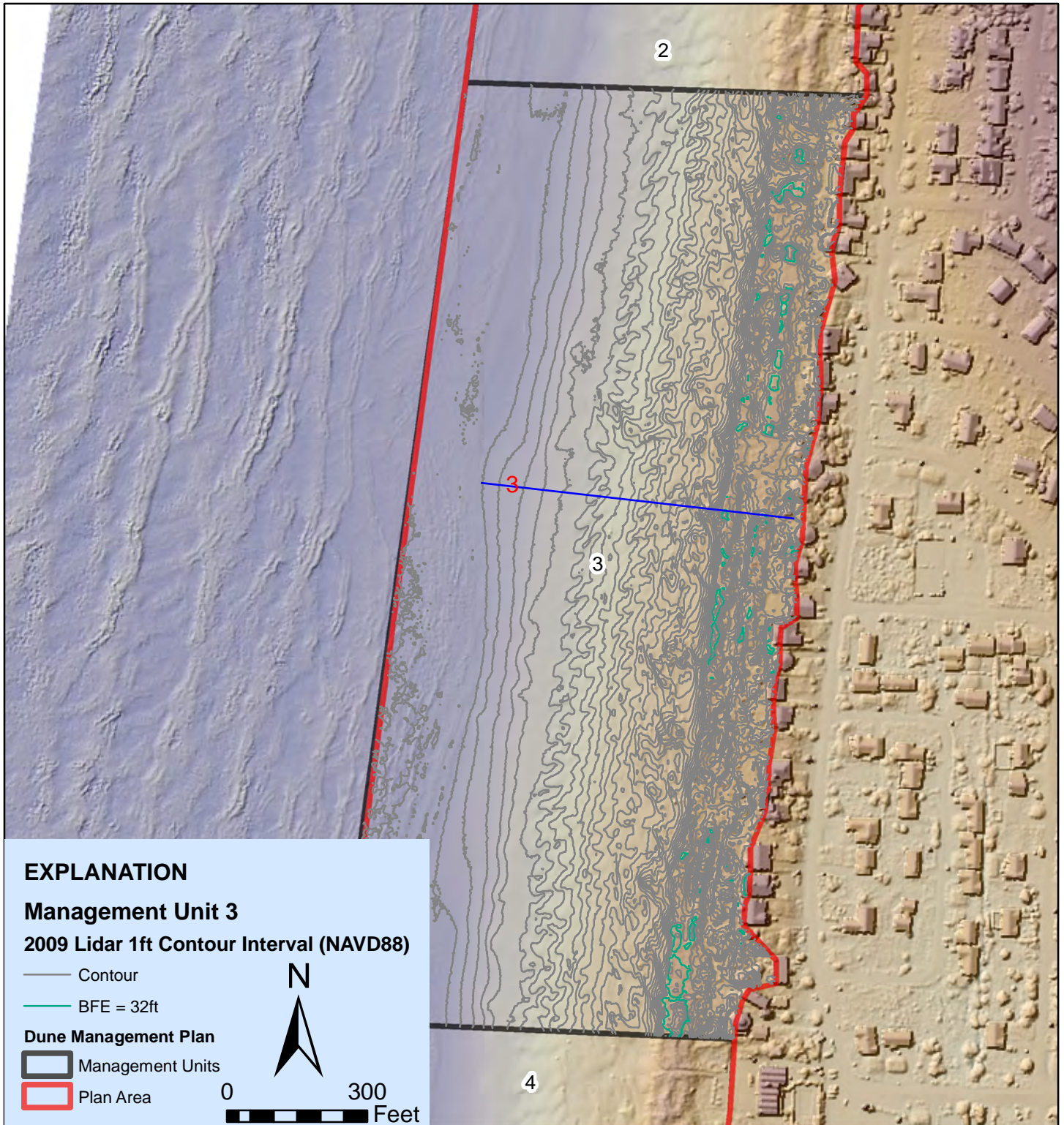


Figure 8. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 3 in Bayshore Fore dune Management Plan Area. FEMA 100 year BFE shown as green contour, blue line = Profile 3.

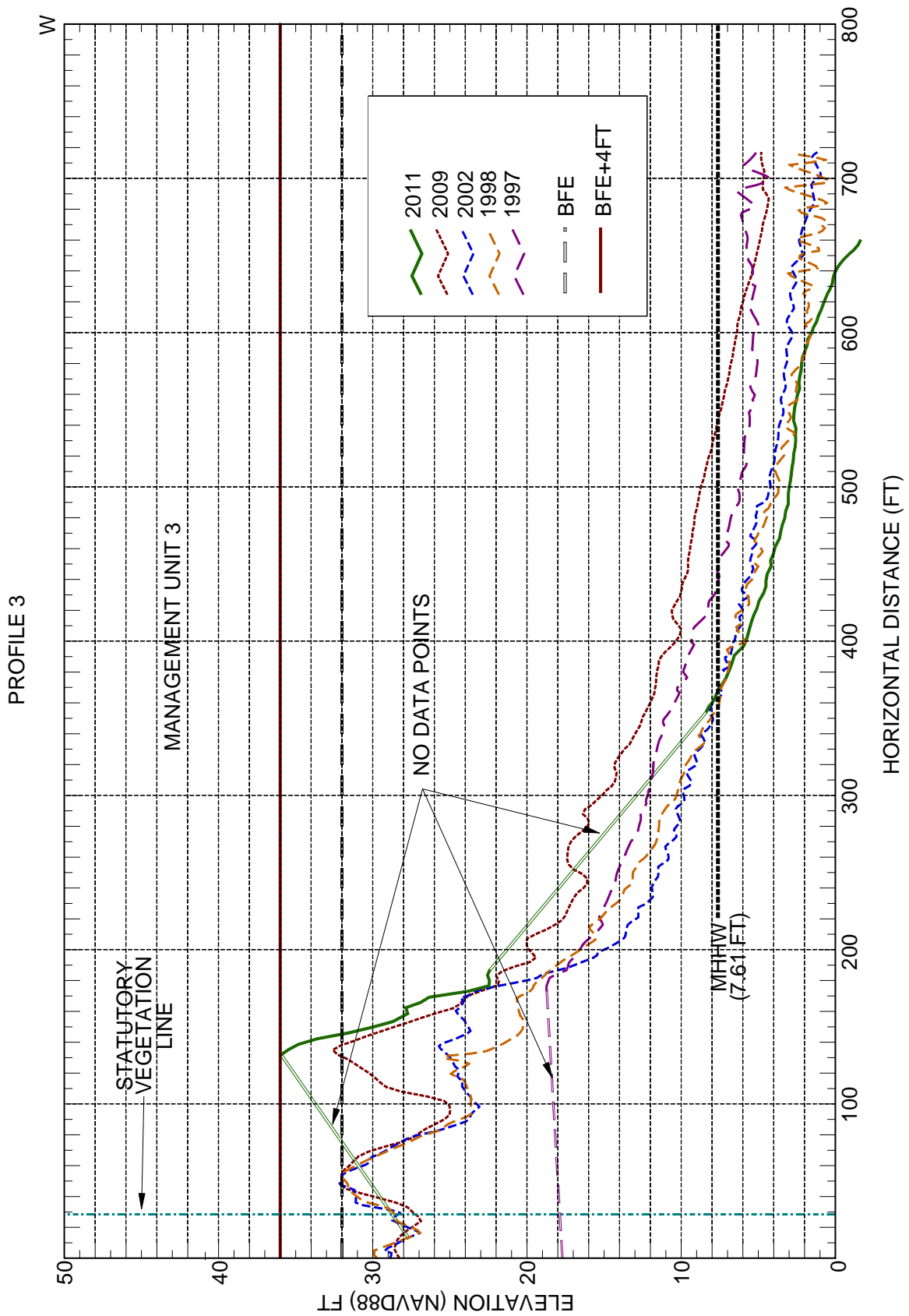


Figure 9. Beach Profile 3 showing changes from 1997-2011, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

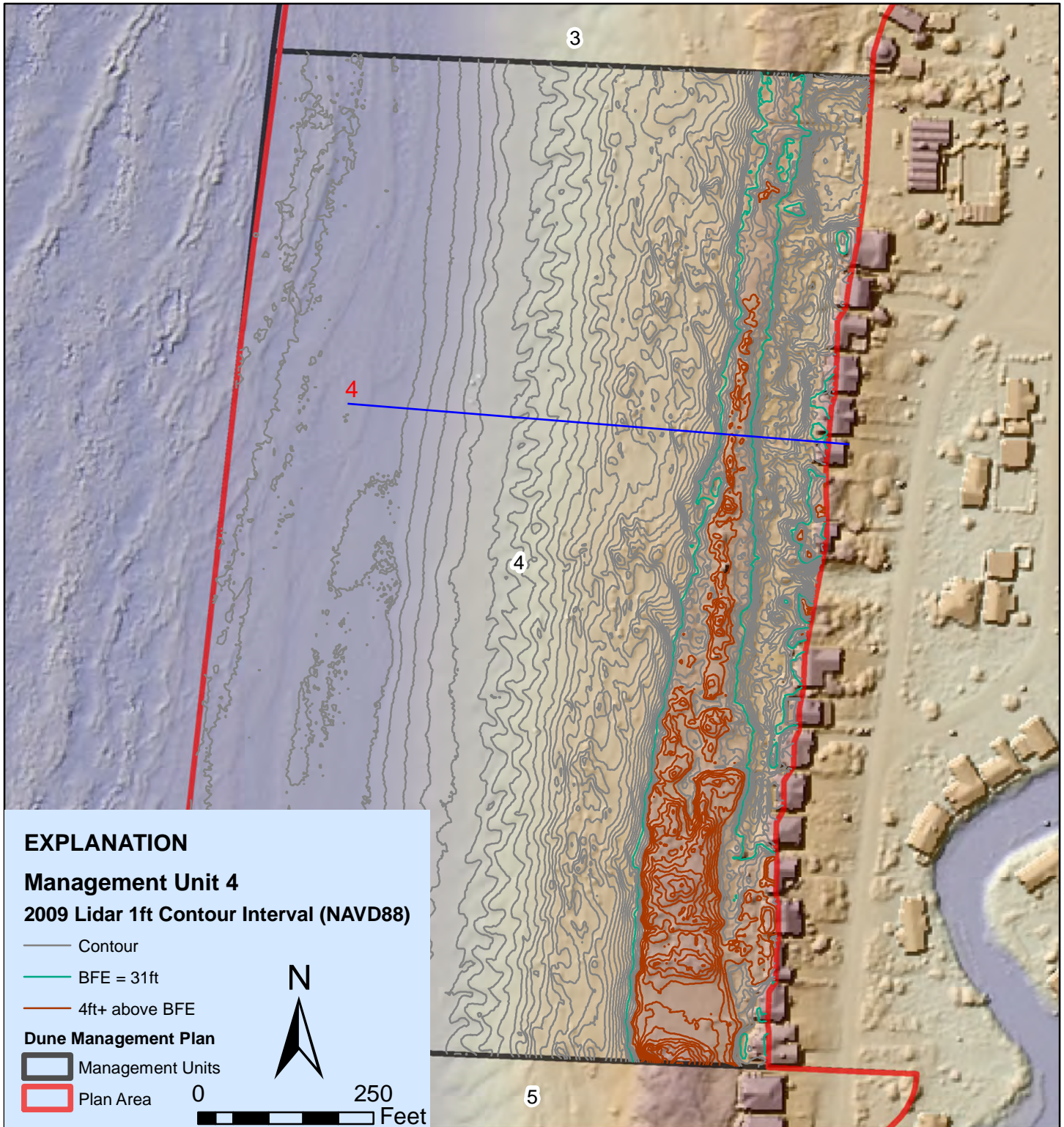


Figure 10. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 4 in Bayshore Dune Management Plan Area. FEMA 100 year BFE = green contour, red contours = BFE+4 feet, blue line = Profile 4.

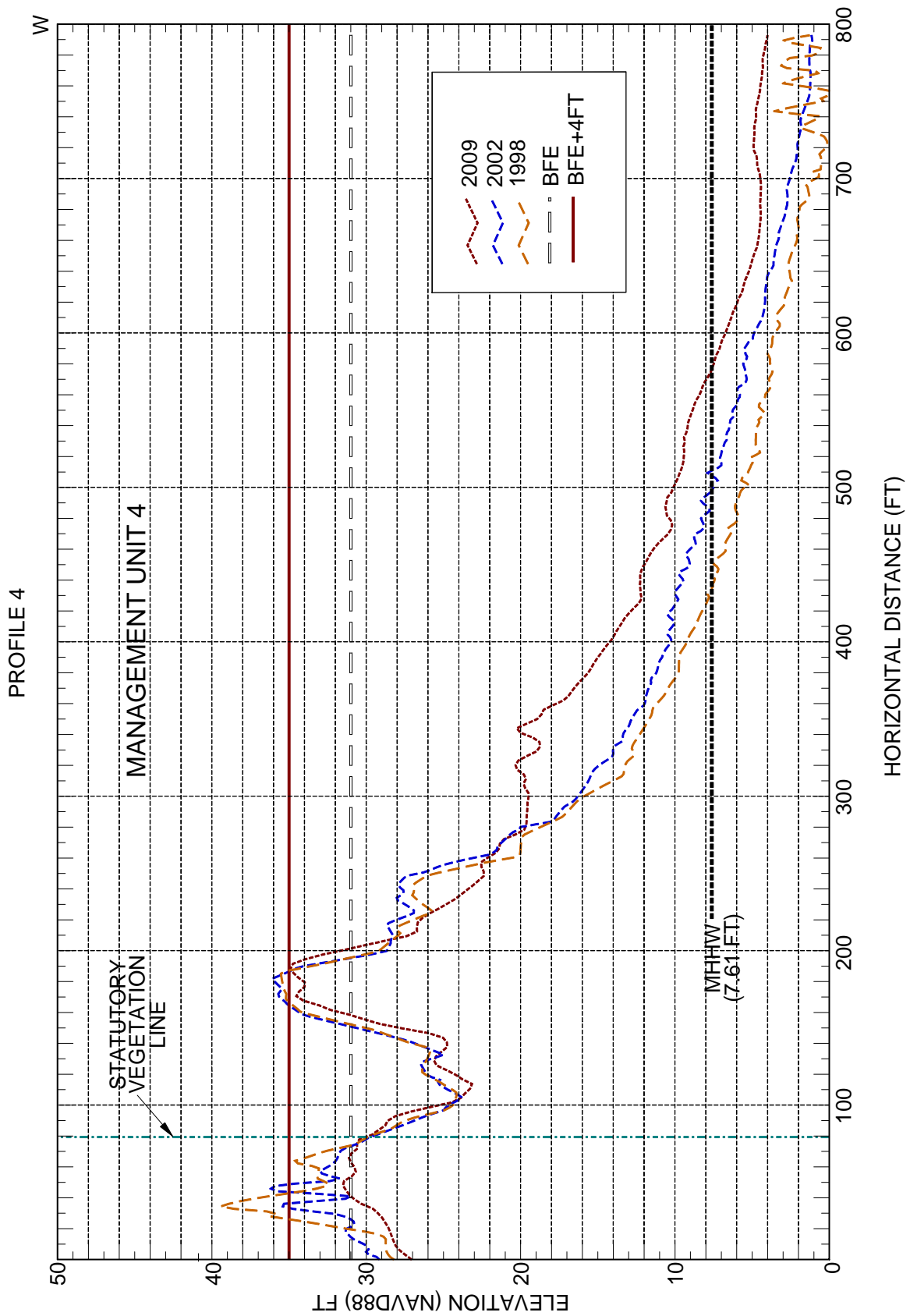


Figure 11. Beach Profile 4 showing changes from 1998-2009, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

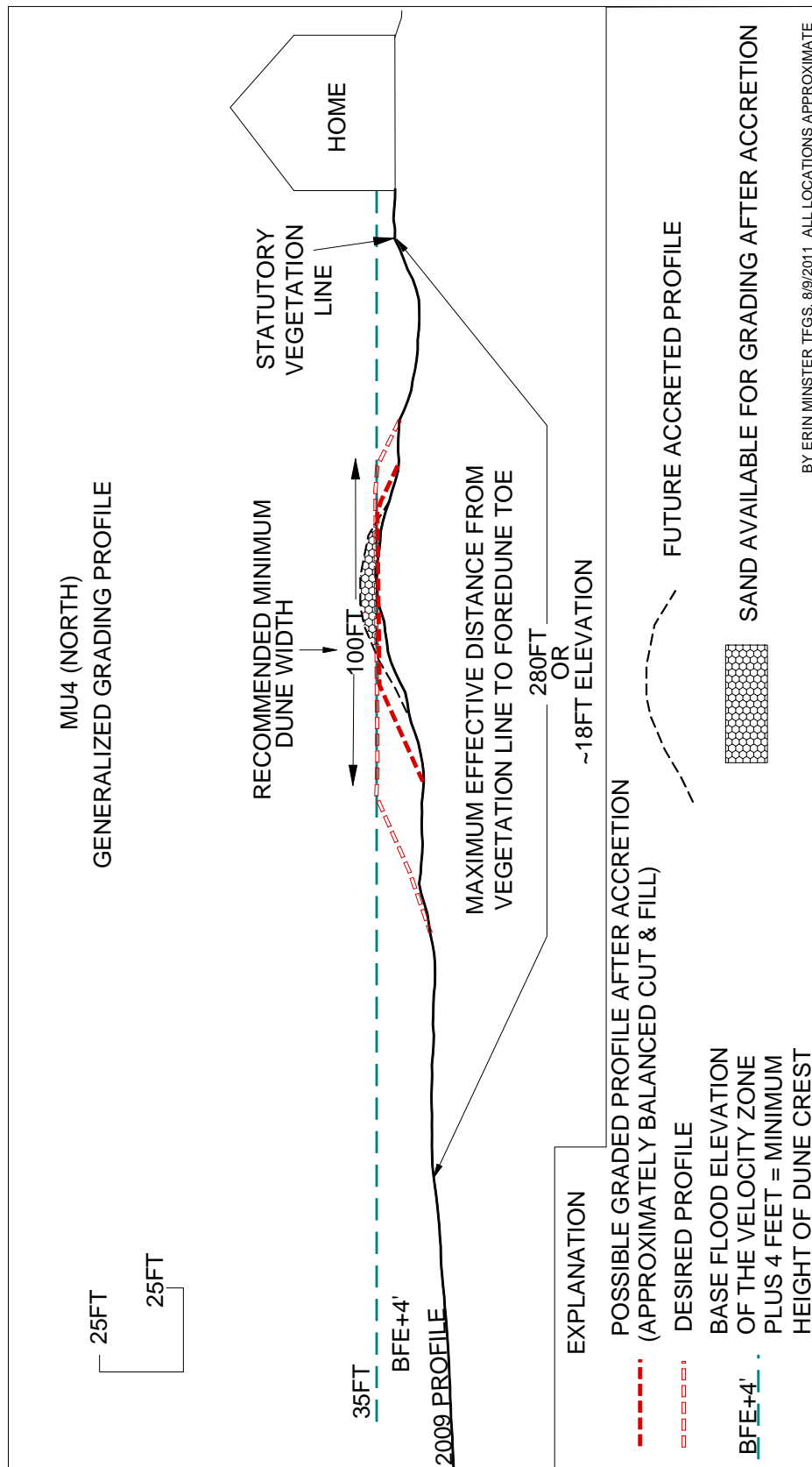


Figure 12. Possible grading scenario after accretion in northern part of Management Unit 4, Bayshore Fore dune Management Planning area. No vertical exaggeration.

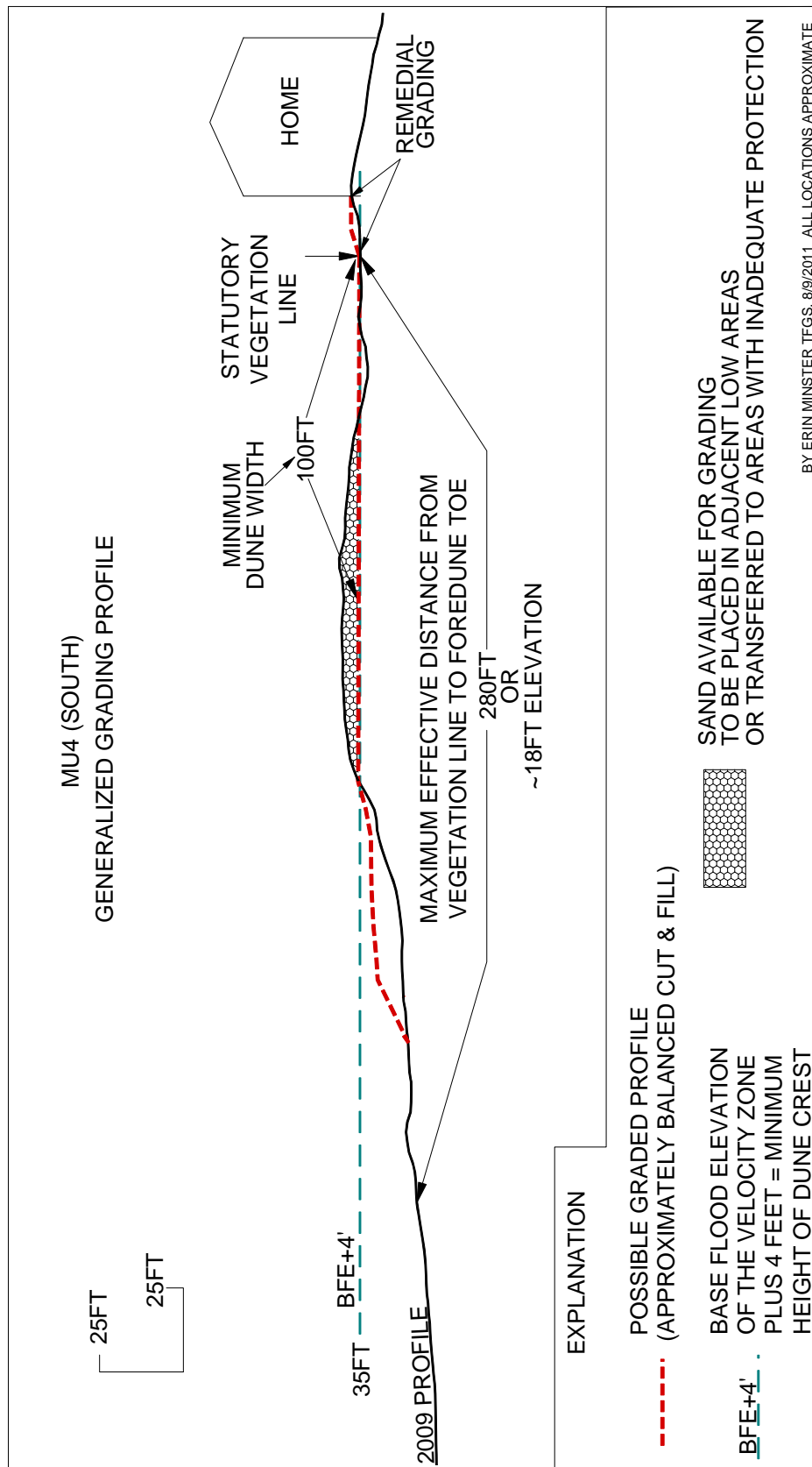


Figure 13. Possible grading scenario in southern part of Management Unit 4, Bayshore Foredune Management Planning area. No vertical exaggeration.

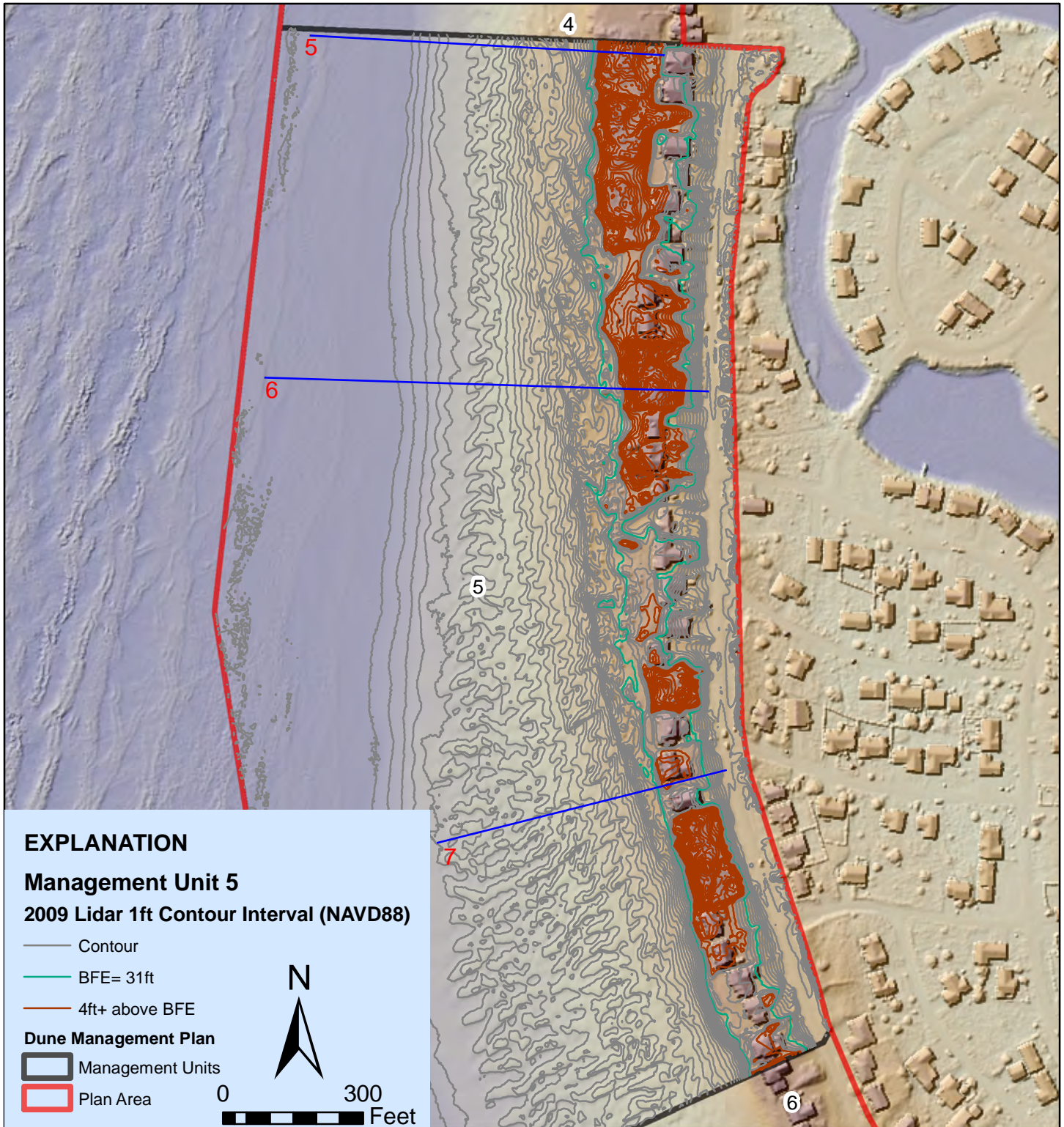


Figure 14. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 5 in Bayshore Dune Management Plan Area. FEMA 100 year BFE = green contour, red contours = BFE+4 feet, blue lines = Profiles 5-7.

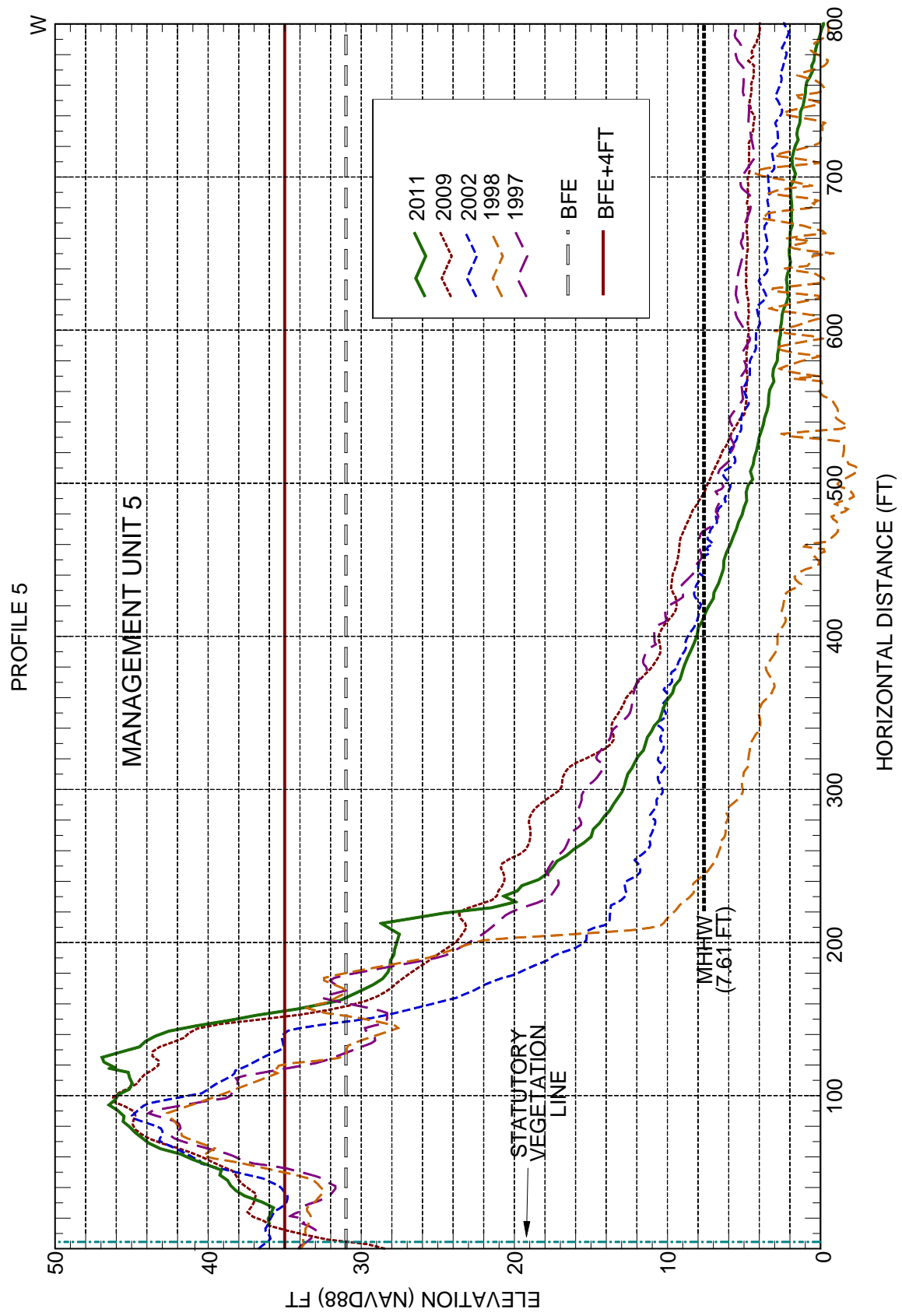


Figure 15. Beach Profile 5 showing changes from 1997-2011, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

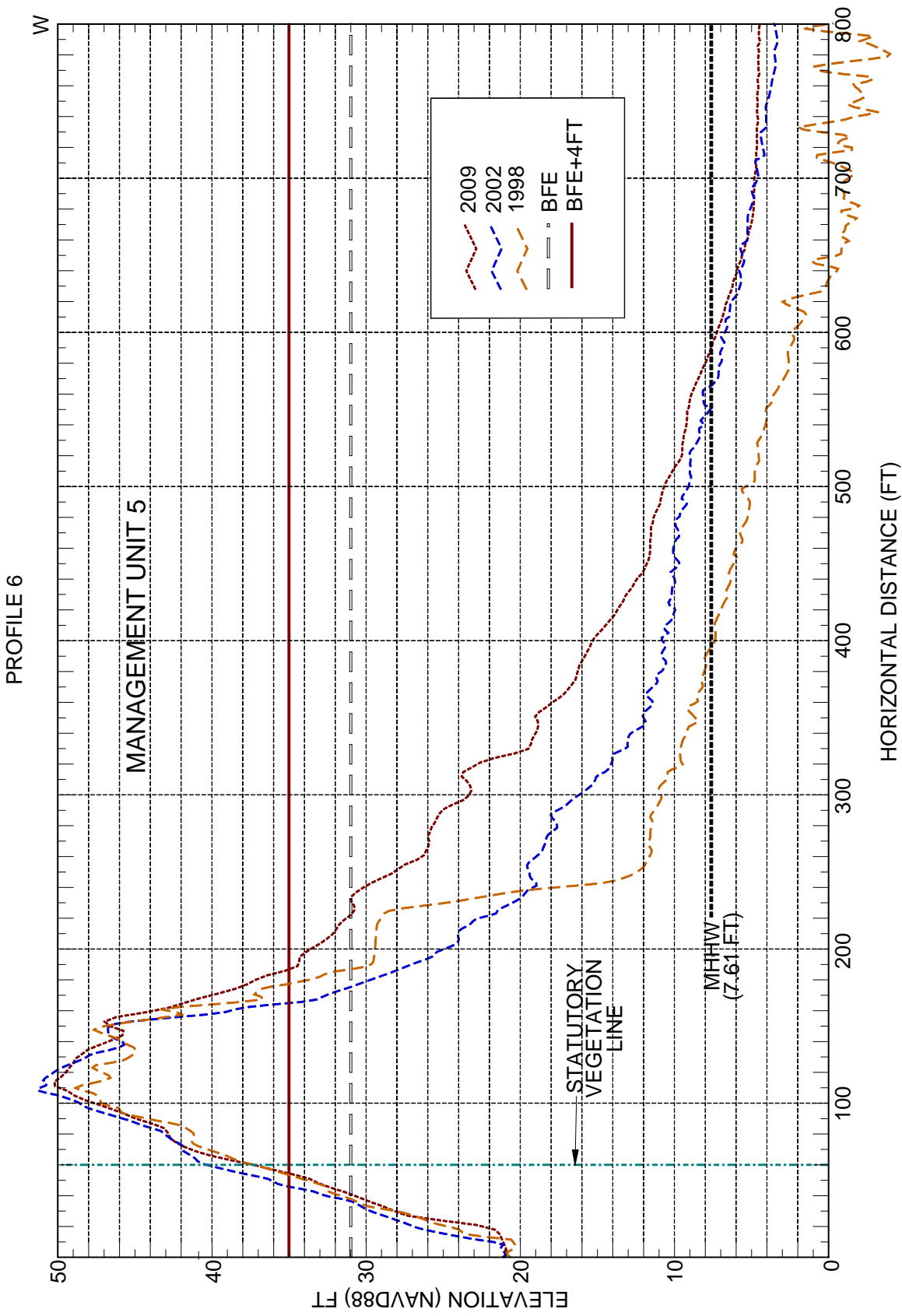


Figure 16. Beach Profile 6 showing changes from 1998-2009, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

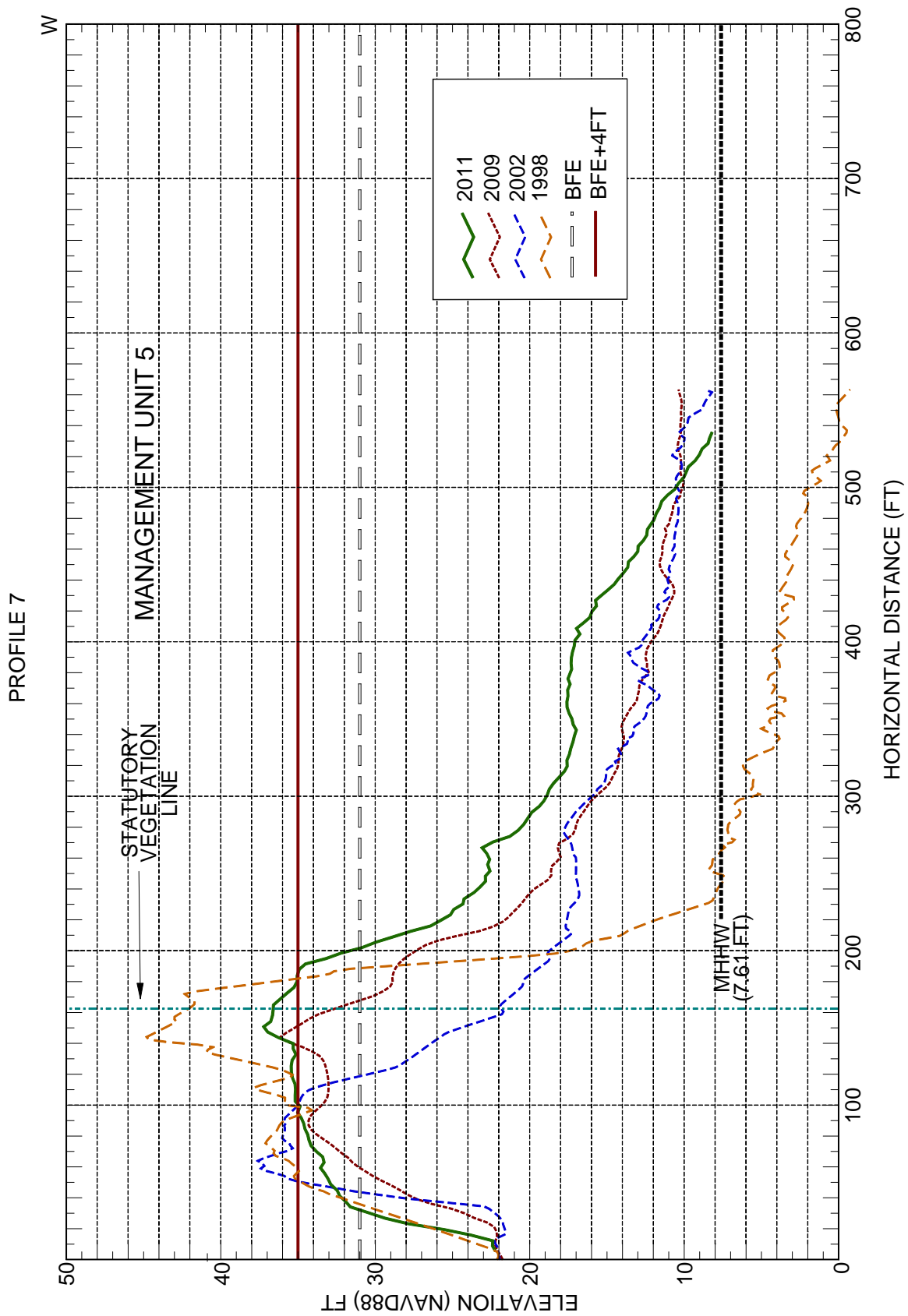


Figure 17. Beach Profile 7 showing changes from 1998-2011, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

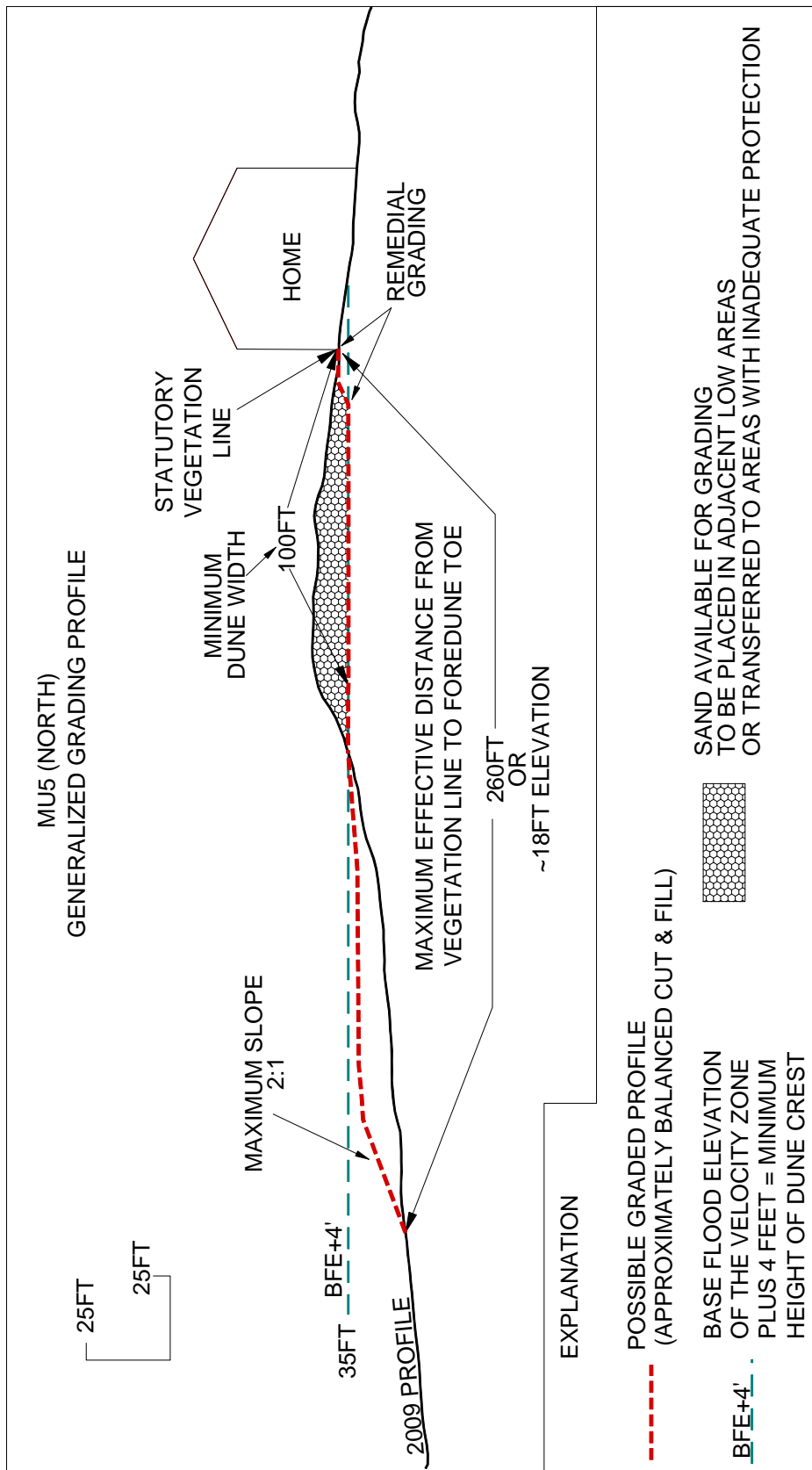


Figure 18. Possible grading scenario in northern part of Management Unit 5, Bayshore Foredune Management Planning area. No vertical exaggeration.

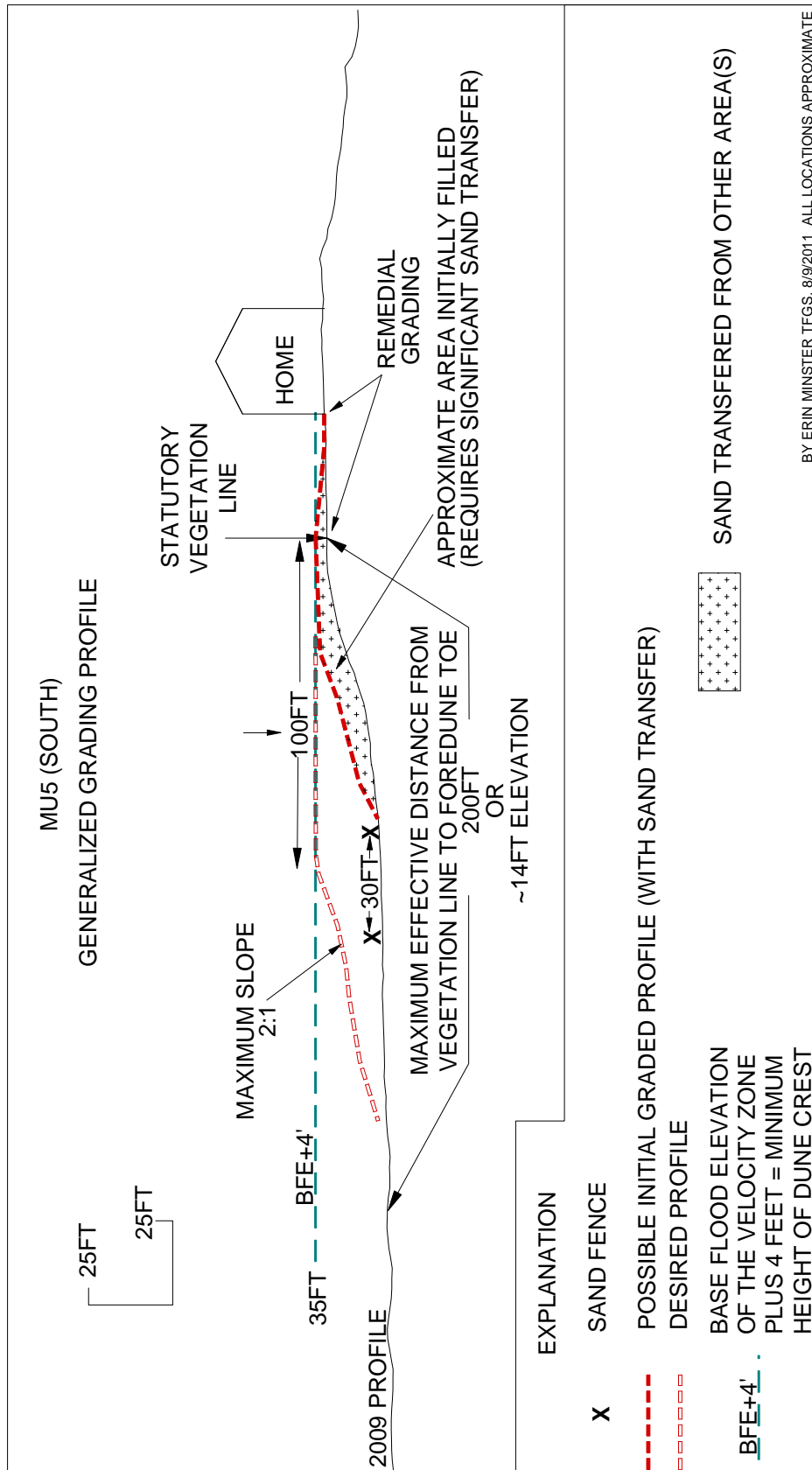


Figure 19. Possible grading scenario in southern part of Management Unit 5, Bayshore Foredune Management Planning area. No vertical exaggeration.

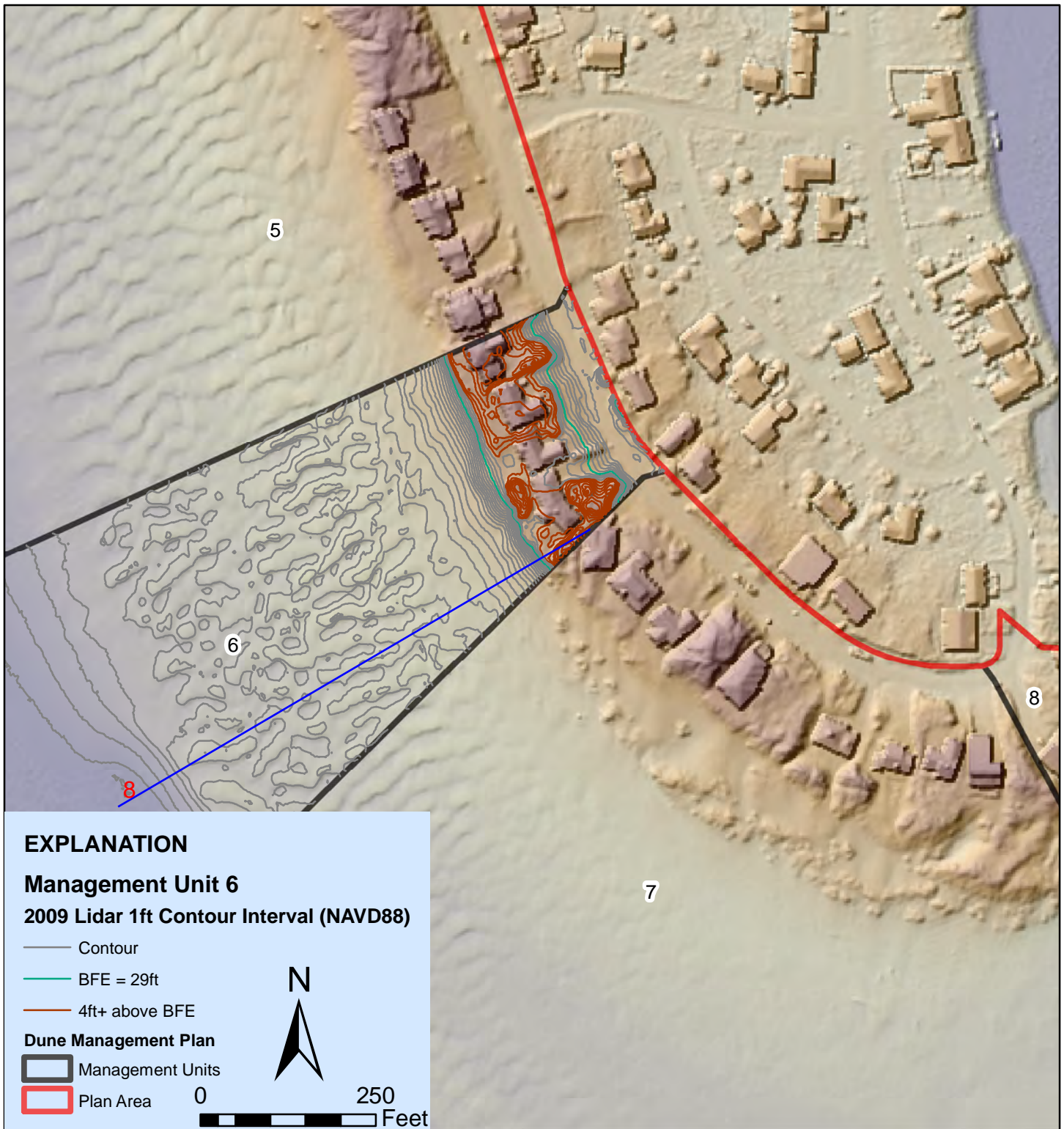


Figure 20. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 6 in Bayshore Foredune Management Plan Area. FEMA 100 year BFE = green contour, red contours = BFE + 4ft, blue line = Profile 8.

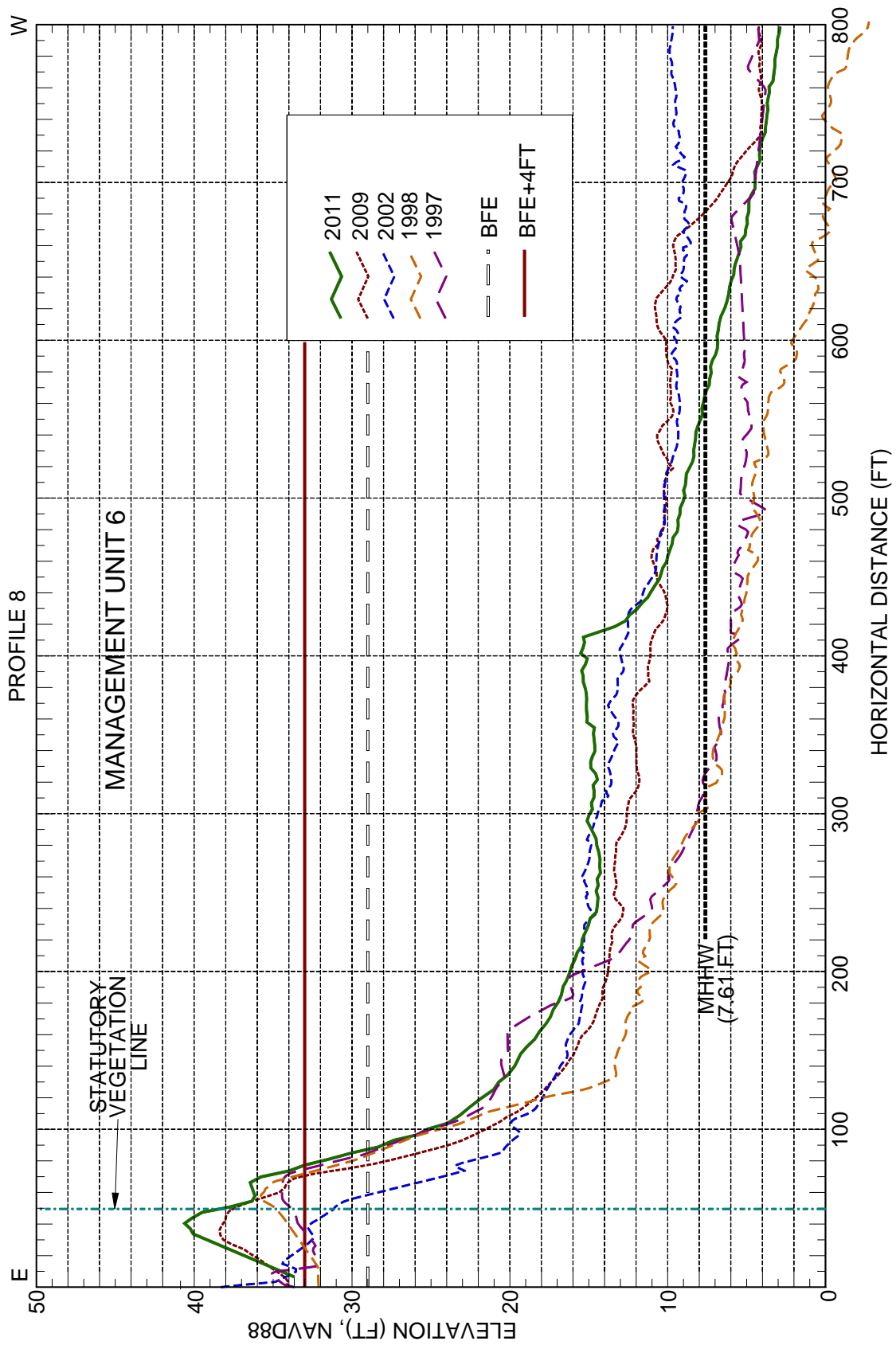


Figure 21. Beach Profile 8 showing changes from 1997-2011, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

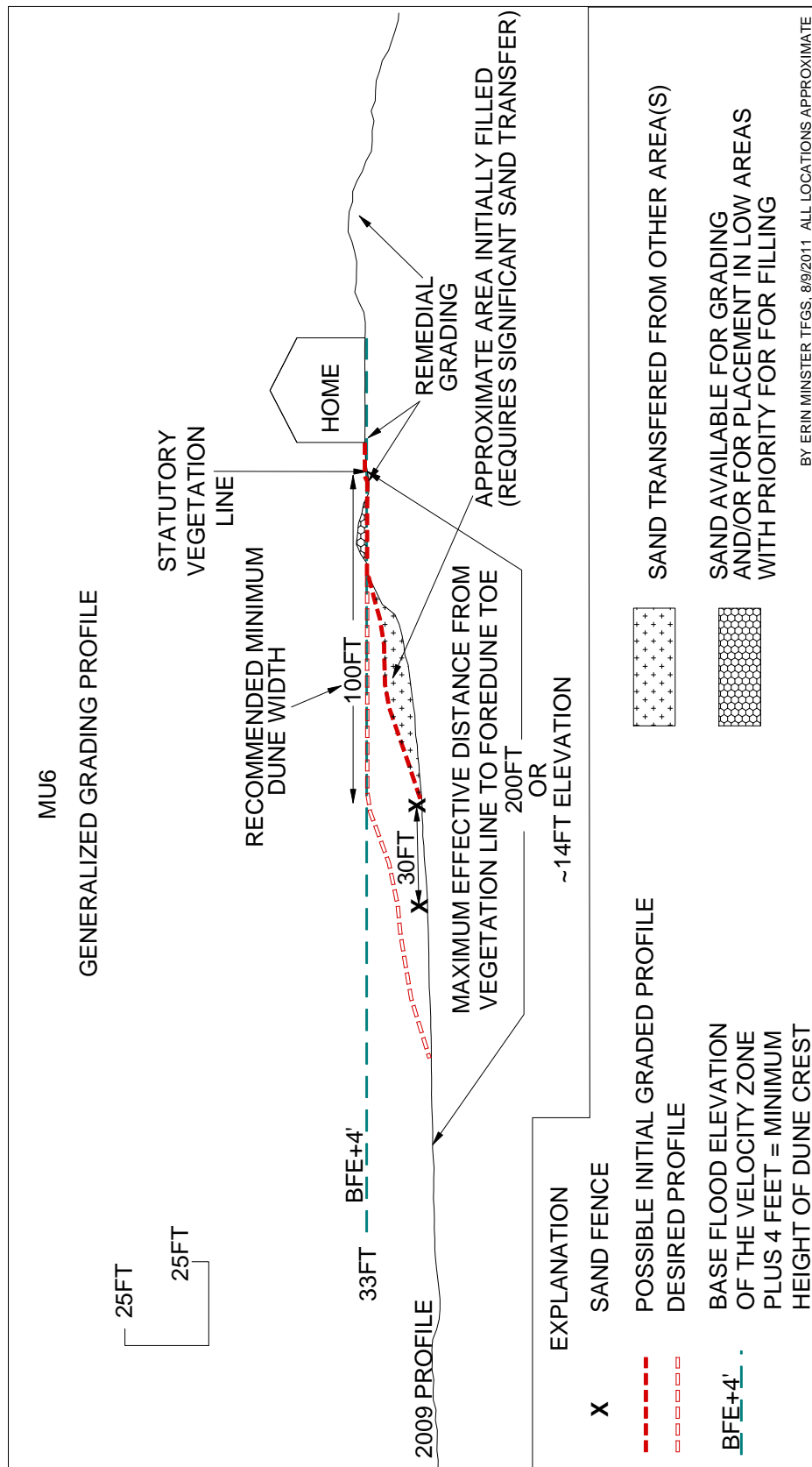


Figure 22. Possible grading scenario in Management Unit 5, Bayshore Fore dune Management Planning area. No vertical exaggeration.

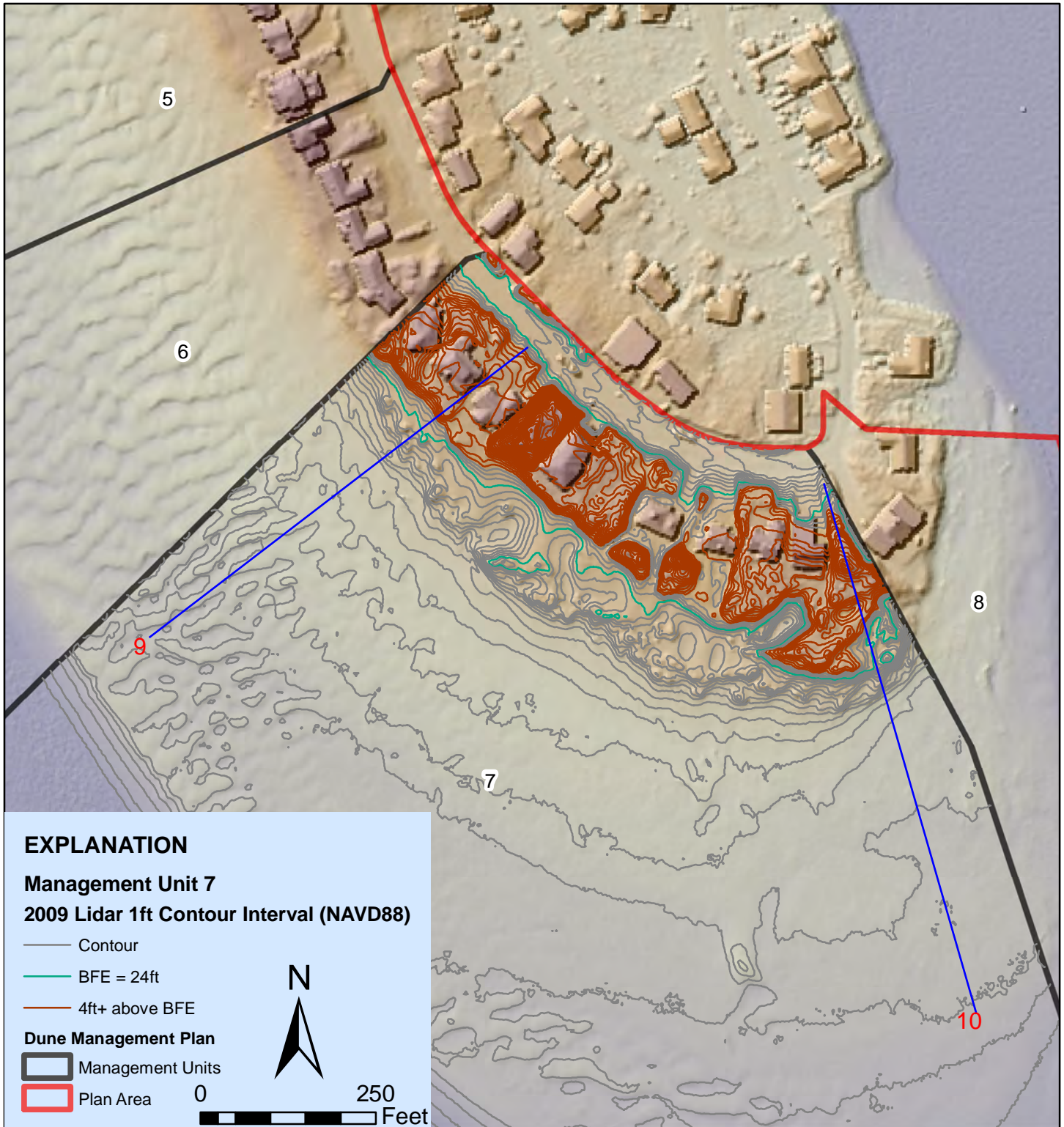


Figure 23. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 7 Bayshore Fore dune Management Plan Area. FEMA 100 year BFE = green contour, red contours = BFE+4ft, blue line = Profiles 9 & 10.

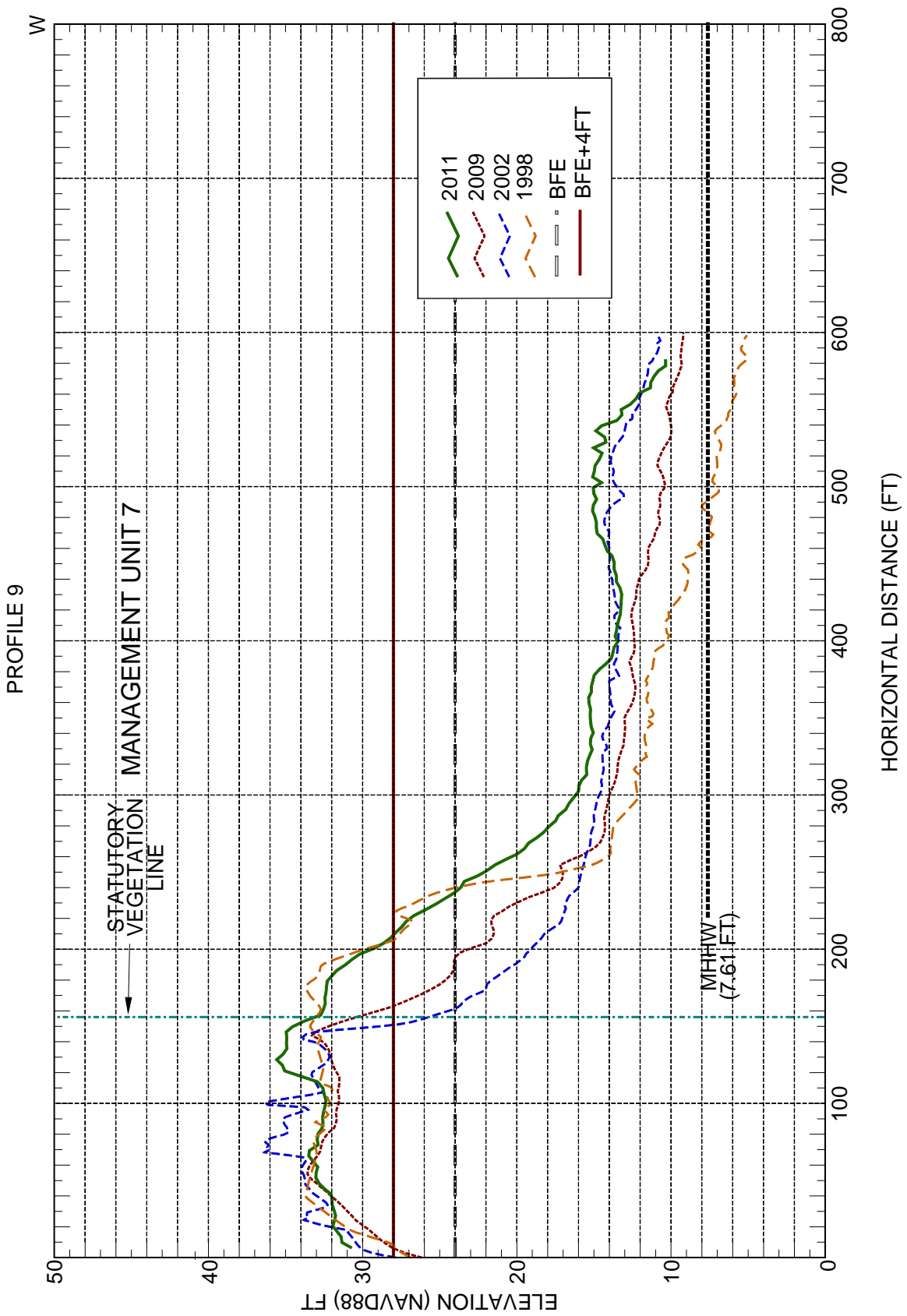


Figure 24. Beach Profile 9 showing changes from 1998-2011, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

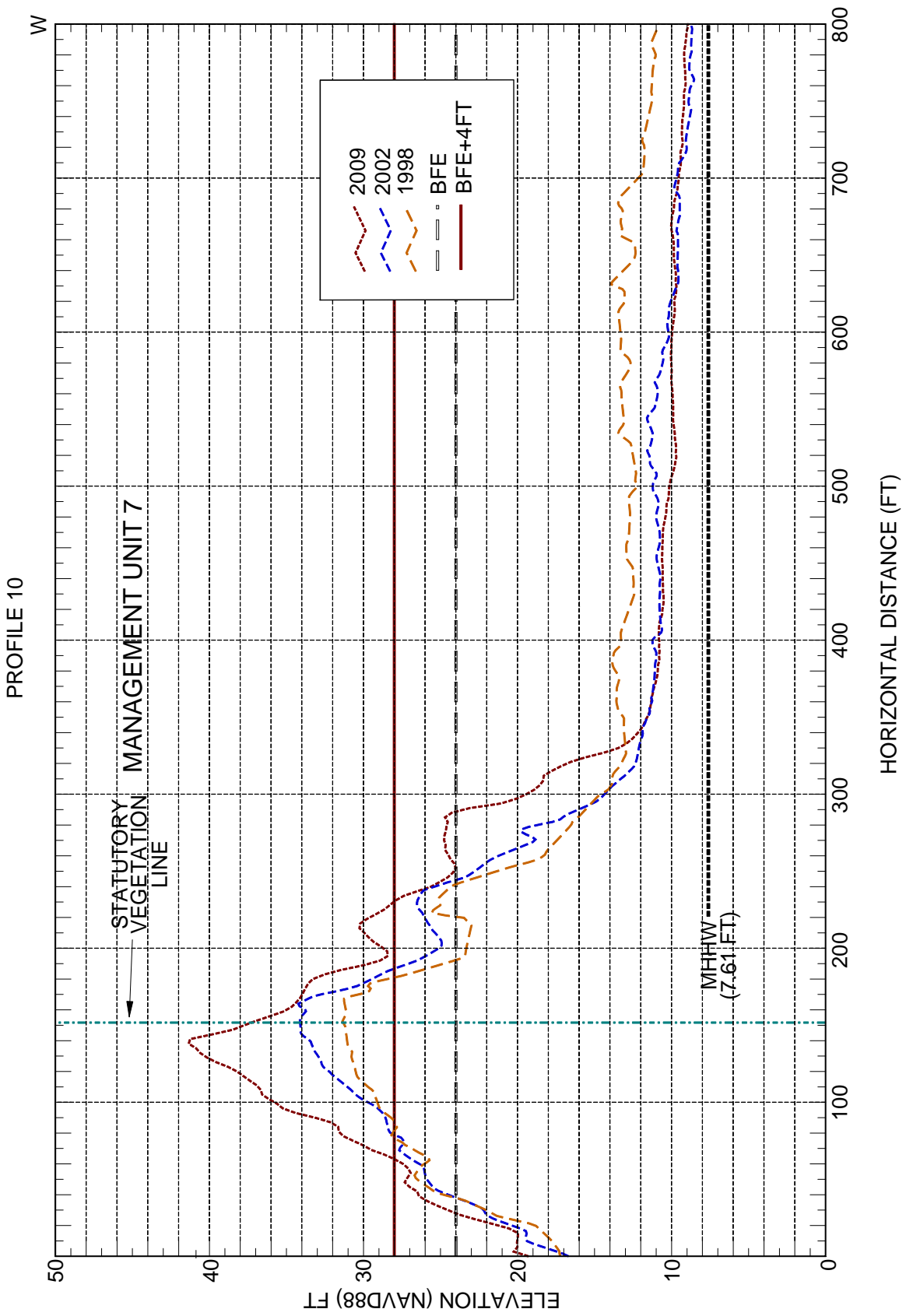


Figure 25. Beach profile 10 showing changes from 1998-2009, also shown are 100-year BFE and BFE +4 feet. Statutory Vegetation Line shown for reference. 10X Vertical exaggeration.

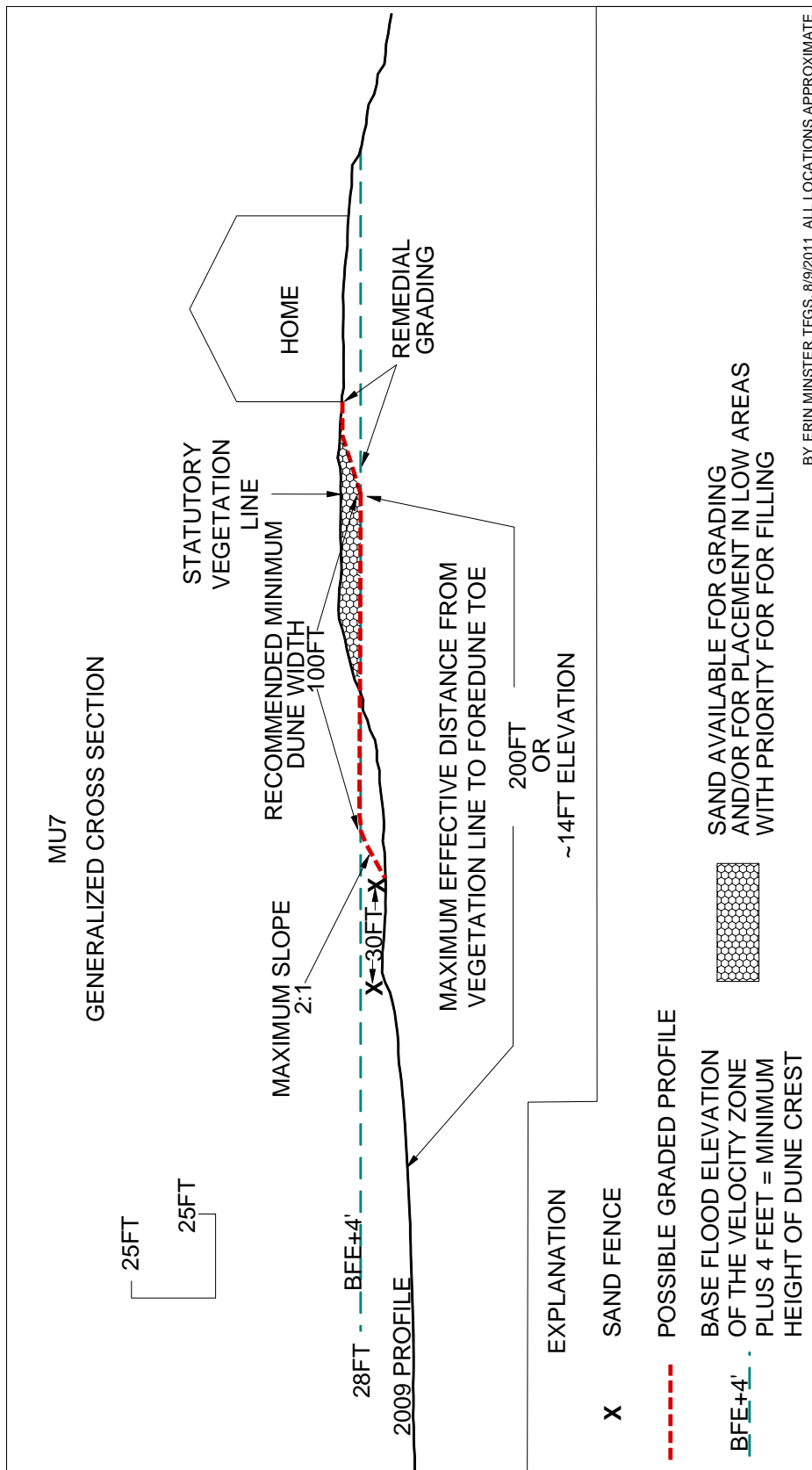


Figure 26. Possible grading scenario in southern part of Management Unit 7, Bayshore Fore dune Management Planning area. Northern part of MU7 will be similar to scenarios in MU5 & 6.

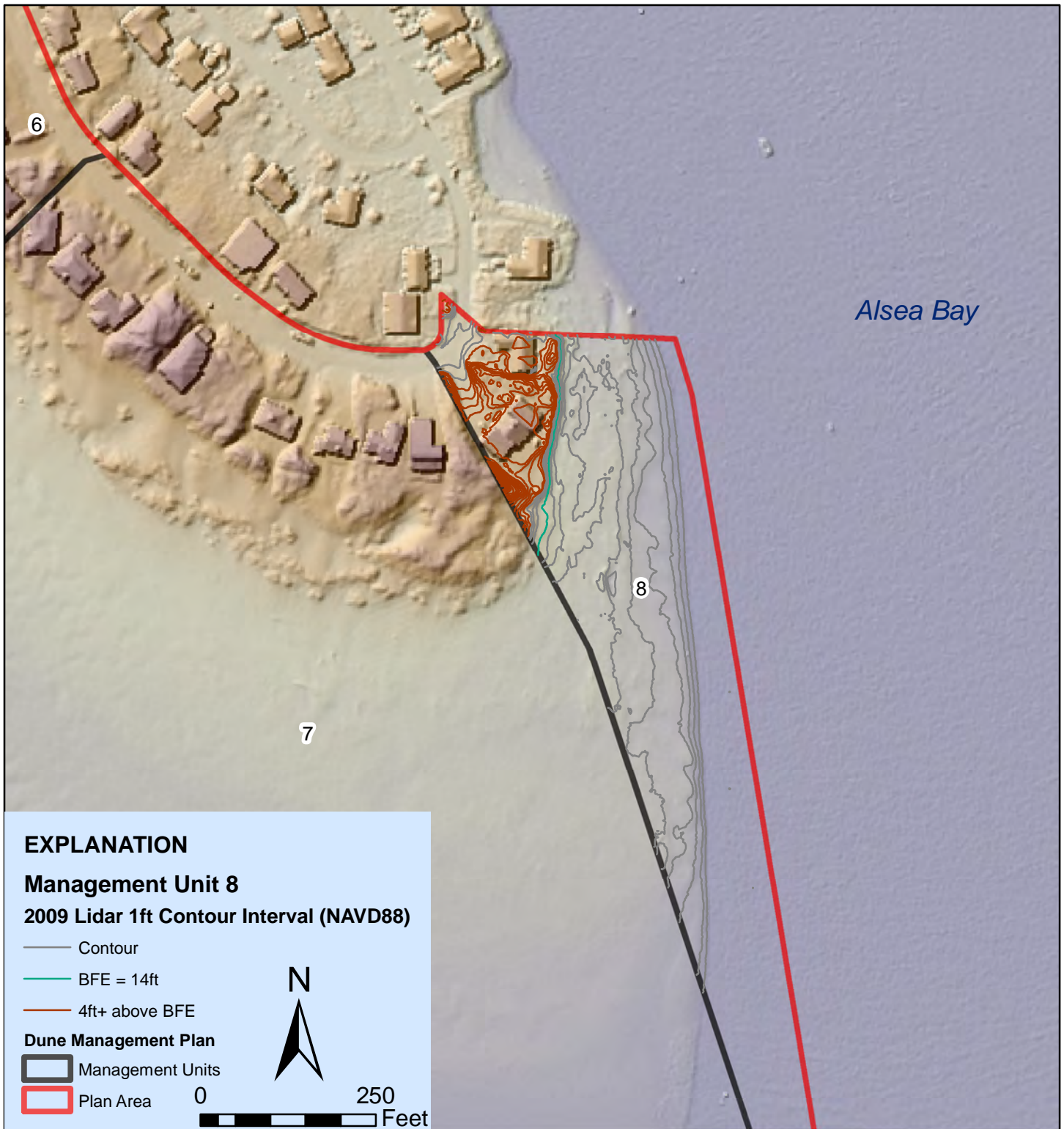


Figure 27. Contours (1 foot interval) with hillshade view from 2009 LIDAR. Management unit 8 in Bayshore Fore dune Management Plan Area. FEMA 100 year BFE = green contour, red contours = BFE + 4 feet.

APPENDIX 1

SAND FENCES

Sand fences are used to control and direct the deposition of windblown sand. At Bayshore there is a need to trap sand seaward and on the foreslope of the foredune to encourage seaward growth of the foredune. In general, fences should be placed at right angles to the prevailing or sand transporting winds and should consist of a minimum of two rows spaced 30 feet apart. It is important to keep the top of the fence as even as possible so that the resulting crest is uniform. Wooden slat fencing should be used rather than plastic fencing. Sand fences can be installed at Bayshore to trap sand transported by both southerly and northerly winds.

Permission from OPRD is needed prior to installing sand fences seaward of the Statutory Vegetation Line. Sand fences are not routinely installed on beaches in Oregon and their installation has the potential to be controversial. It is likely that some sort of a pilot project will be necessary prior to installing them on a large scale. Sand fences are expected to require a significant amount of maintenance during the winter. Sand fences at Bayshore have the potential to become quickly buried and it may be necessary to install additional sand fences to result in continued growth of the seaward edge of the foredune. Sand fences installed to mitigate for southerly winds that are capable of being removed should be removed by the end of March and the accumulated sand planted with beachgrass at high densities by April 1. If sand fences are constructed to mitigate for northerly winds they should be removed by late October and the accumulated sand planted with beachgrass shortly after November 1. Sand fences damaged by waves must be removed from the beach.

Specifications:

- Minimum 4 foot wooden lath attached to seaward side of steel support posts (T or U post) with double wire wrap.
- Steel posts on 8 foot centers with end posts 6 feet or less from the adjacent post. Posts should be embedded a minimum of 2 feet.
- End posts should be guy wired in at least 3 directions and additional guy wires will be necessary for fence lengths greater than 100 feet. Additional guy wires should be placed at front and back of posts every 40 feet.
- A bottom gap of not more than 6 inches can increase the capacity of the fence and reduce deposition close to the fence. The taller the gap the further from the fence the deposition will begin while placing the fence flush with the ground will cause the bottom of the fence to be buried.
- Following installation approximately 4 inches of rye-grass straw mat 2 feet wide should be placed along the bottom of the fence and partially buried with sand to prevent scour around posts and disturbed sand.
- It is important to ensure that all materials are pulled taught and securely fastened. Fencing should be attached to each post at the top, middle and bottom. Fence

installations at Bayshore will be subject to intense winds and proper anchoring is key to the success of the installation. Where two lengths of fence need to be joined the ends should be overlapped at least 6 inches and joined by wiring the lath together. Ideally overlapped joins would be supported with an additional support post.

- Where gaps are needed for access management an additional short row should be placed seaward of the gap and overlap the gap by half the gap width on both sides
- Sand fences are meant to be a temporary means of controlling blowing sand until stabilizing vegetation can be established. Maintenance will be necessary through the life of the fence and should be repaired if damaged by erosion or vandalism.

APPENDIX 2

VEGETATION PLANTING

Planting Stock:

The stock to be planted is European beachgrass, *Ammophila arenaria*. European beachgrass is commercially available and should be the primary vegetation used for stabilizing bare and/or graded sand areas. The planting stock should be inspected and approved by the contracting officer or authorized representative. The following information was adapted from the Oregon Department of Land Conservation and Development's publication *Dune Management Planning; A Guide to Preparing a Dune Management Plan as Provided for in Statewide Planning Goal 18 (Beaches and Dunes)* and the USDA Soil Conservation Service's publication *Stabilizing Coastal Sand Dunes in the Pacific Northwest (Carlson and others, 1991)*.

Preparation and Storage:

The plants should be thoroughly cleaned by shaking sand and silt from the roots. Dead stalk and trash should be removed from the culms by stripping. The underground stems should be broken back so that one or two nodes remain. The grass culms should be sorted and tied into bundles weighing approximately 10 pounds; tops should be cut back so that the overall length of the planting stock measures about 20 inches.

The planting stock should be planted within eight hours of removal from the nursery or heeling-in beds. The heeling-in beds should be a well-drained damp trench with roots (nodes) covered to a depth of at least 8 inches. Stock should not be held in the heeling-in beds for a period exceeding two weeks. The supply of stock at the planting site must be kept in a cool shady place or otherwise protected against damage from excessive drying. Cold storage at 34-38°F for periods of up to 2 months is also acceptable.

The planting stock should be handled and transported by any method that does not damage the planting stock or area.

Planting:

1. The grass is planted in hills with an average of 3 live culms (stems) per hill with no fewer than 2 live culms in up to 10% of the hills.
2. The spacing between hills should average 12 x 12 inches in areas recommended for high density planting and 18 x 18 inches for low density plantings. See table below for plant requirements.
3. The grass should be planted to a depth of 12 inches, with sand compacted to exclude air from the roots (nodes). The top of the plant should be upright and extend approximately eight inches above the ground.

4. No planting should be done on any area until the moisture is within 3 inches of the ground surface. Nor should any planting be done when the temperature exceeds 60°F or when freezing conditions prevail.
5. Plants should be kept in water immediately prior to planting to maintain root moisture and proper temperature. Plants should be watered after planting and fertilizing.
6. All areas planted should be fertilized with coarse particle ammonium sulfate commercial fertilizer (21-0-0), applied at a rate of 200 lbs/acre (one pound of available nitrogen per 1,000 ft²). Fertilizer should be applied when the wind is calm and the rain is steady; irrigation may be substituted for rain. Application of fertilizer depends on timing of planting, the above factors, and how long it has been since the grass was planted.
7. Any area with pre-existing beachgrass graded more than 3 feet deep or any area with less than 30% cover should also be re-planted.

STOCK TYPE	RELATIVE DENSITY	SPACING	PLANTS NEEDED PER 1,000 SQFT	PLANTS NEEDED PER 1 ACRE
Beachgrass: 3 culms/hill	High	12"x12"	3,004	130,680
Beachgrass: 3 culms/hill	Low	18"x18"	1,335	58,080
Note: Always order 3% more to offset heavy planting				

Table 1. Plant requirements for low and high density beachgrass plantings.

Maintenance

Maintenance is required on beach grass for about the first two years; after that only periodic maintenance is required. If a large blow-out develops, the most effective maintenance procedure is to replant with beach grass and then spread brush on the steep edges. Re-fertilizing any weak areas can bring back sufficient cover if the plant root systems have not been uncovered. Planted areas should be given an annual application of 200 lbs/acre of 21-0-0 fertilizer.

Transplanting Beachgrass as Clumps

Discussions with individuals involved in projects at Canon Beach indicate that transplanted clumps of beachgrass salvaged from foredune areas that are lowered for view grading have had greater survival, more rapid growth, and can be less costly than more traditional plantings. The process involves removing large clumps of beach grass from areas that are to be graded. The clumps are “heeled-in” on site in moist, protected areas while the grading occurs. When the graded area is ready to plant the large clumps are divided into 6”-8” clumps and transplanted to a depth of approximately a foot. Planted clumps should be spaced 18 inches apart for high density plantings and 24 inches apart for low density plantings. No published specifications regarding this process were found. Prior to implementing this method a qualified landscaper should be retained to refine the process, prepare more detailed specifications, and supervise its implementation. Plantings associated with dune grading projects in the city of Canon Beach are

exclusively done using this method and the planning department of that city can provide additional information or refer people to appropriate resources.

SECONDARY STABILIZATION

Plantings of secondary stabilizing vegetation which is more fire resistant is appropriate in well-vegetated areas between the foredune crest and homes but not on the foredune crest or foreslope. Detail guidelines for planting secondary vegetation can be found in the Soil Conservation Service's publication *Stabilizing Coastal Sand Dunes in the Pacific Northwest*. Plants capable of growing taller than six feet should be avoided to comply with CC&Rs at Bayshore. Below is a sample of possible species:

- Salal (*Gaultheria shallon*)
- Evergreen Huckleberry (*Vaccinium ovatum*)
- Purple Beach Pea (*Lathyrus japonicas*)
- Seashore Lupine (*Lupinus littoralis*)
- Tree Lupine (*Lupinus arboreas*)

Conditions

1. Secondary stabilization should only be done when initial stabilizing vegetation, European beachgrass, is well established.
2. Secondary plantings should occur directly in existing stands of beachgrass. Beachgrass should not be destroyed or removed prior to planting, so that it can continue to stabilize the area as secondary plants are establishing themselves. Succession should occur without destruction since beachgrass tends to thin out and die where it is cut off from sand accretion.