D.4.9 Mapping of Flood Hazard Zones and Base Flood Elevations

This section provides guidance to Mapping Partners on the delineation of coastal flood hazard zones and Base Flood Elevations (BFEs).

D.4.9.1 Review and Evaluation of Basic Results

Before mapping the flood elevations and flood hazard zones, the Mapping Partner shall review results from the models and assessments from a common-sense viewpoint and compare them to available observed historical flood data. When using models, there is the potential to forget that the transects represent real shorelines being subjected to high water, waves, and winds. Familiarity and experience with the coastal area being modeled or similar areas should provide an idea of what is a “reasonable” result.

The main point to be emphasized is that the results should not be blindly accepted. There are many uncertainties and variables in coastal processes during an extreme flood and many possible adjustments to methodologies for treating such an event. The validity of any model is demonstrated by its success in reproducing recorded events. Therefore, the model results must be in basic agreement with past flooding patterns, and historical data must be used to evaluate these results.

It would be very convenient if data from a storm closely approximating the 1% annual chance flood were available, but this is seldom the case. Although most historical flood data are for storms less intense than a 1% annual chance flood, these data will still indicate, at a minimum, the areas that should be within the flood zones. For instance, if a storm that produced a flood below the 1% annual chance flood elevation generally caused structural damage to houses 100 feet from the shoreline, a “reasonable” VE Zone width must be at least 100 feet. Similarly, houses that collected flood insurance claims for the same storm (without building foundation or structural damages) should be at least be located in an AE, AH, or AO Zone. If the analyses of the 1% annual chance flood produce flood zones and elevations indicating lesser hazards than those recorded for a more common storm, the analyses should be reevaluated. One possible explanation for change in flood patterns since the historical flood event, might be a new coastal structure acting to reduce flood hazards in the local area.

If there are indications that a reevaluation is needed, the Mapping Partner shall determine whether the results of the assessment are appropriate. The Mapping Partner shall attempt to compare all aspects of the coastal hazard assessment to past effects, whether in the form of data, profiles, photographs, or anecdotal descriptions. The Mapping Partner shall examine other data input to the assessments for wave effects (wave setup, wave height, wave runup, and wave overtopping). This includes checking that the still water levels (SWLs) and dynamic water levels are correct and that the results of wave analyses are consistent with the historical data. The Mapping Partner shall use judgment and experience to project previous storm effects to the 1% annual chance conditions and to ensure that the coastal assessment results are consistent with previous observed events.

D.4.9.2 Identification of Flood Insurance Risk Zones

The Mapping Partner shall identify the flood insurance risk zones and BFEs, including the wave effects to be identified on each transect plot, before delineating the flood insurance risk zones on the work maps. The existing topography, eroded topography, coastal structure effects, combined wave analyses (wave runup, overtopping and overland propagation) are all important to the proper identification of flood insurance risk zones, and coastal study technical documentation. The total water level (TWL) is the sum of SWL, wave setup, and wave runup. Hazard zones that are generally mapped in coastal areas include: VE, AE, AH, AO and X.[1]

D.4.9.2.1 VE Zone

VE Zones are coastal high hazard areas where wave action and/or high-velocity water can cause structural damage during the 1% annual chance flood. VE Zones are identified using one or more of the following criteria for the 1% flood conditions:

1. The ***wave runup zone*** occurs where the (eroded) ground profile is 3.0 feet or more below the TWL.
2. The ***wave overtopping splash zone*** is the area landward of the crest of an overtopped barrier, in cases where the potential wave runup exceeds the barrier crest elevation by 3.0 feet or more(ΔR>3.0 feet). The landward extent is defined by $y_{G,outer}$ (Section D.4.5.2)
3. The ***high-velocity flow zone*** is landward of the overtopping splash zone (or area on a sloping beach or other shore type), where the product of depth of flow times the flow velocity squared (hv^2) is greater than or equal to 200 ft^3/sec^2.
4. The ***breaking wave height zone*** occurs where 3-foot or greater wave heights could occur (this is the area where the wave crest profile is 2.1 feet or more above the static water elevation).
5. The ***primary frontal dune zone***, as defined in 44 CFR Section 59.1 of the National Flood Insurance Program (NFIP) regulations.

The actual VE Zone boundary shown on the Flood Insurance Rate Map (FIRM) is defined as the furthest inland extent of the five criteria. VE Zones are subdivided into elevation zones, and whole-foot BFEs shall be assigned. Four of the VE Zone mapping criteria (all except the high-velocity zone) were previously incorporated into the Atlantic and Gulf of Mexico sections of Appendix D, and can also be applied in Pacific coastal areas. In one case – wave overtopping splash zone – the applicability of the VE criterion has been expanded to include sloping barriers (the Atlantic and Gulf of Mexico sections of Appendix D presently limit use of the overtopping splash VE Zone to vertical walls).

The high-velocity flow zone mapping criterion was developed for these Pacific Coast *Guidelines and Specifications*, based on new knowledge of high-velocity flows caused by wave overtopping

[1] For a complete list of flood insurance risk zones, refer to Volume 1, Subsection 1.4.2.7 of the *Guidelines and Specifications*.

and overland flow in coastal areas, and can also be applied to Atlantic and Gulf of Mexico areas. This criterion can be applied on beaches, and on the seaward and landward sides of coastal dunes, structures, and barriers (see Figure D.4.9-1). Landward transitions from this VE Zone will normally be to the AO Zone, but this may vary depending upon the site and the conditions being mapped.

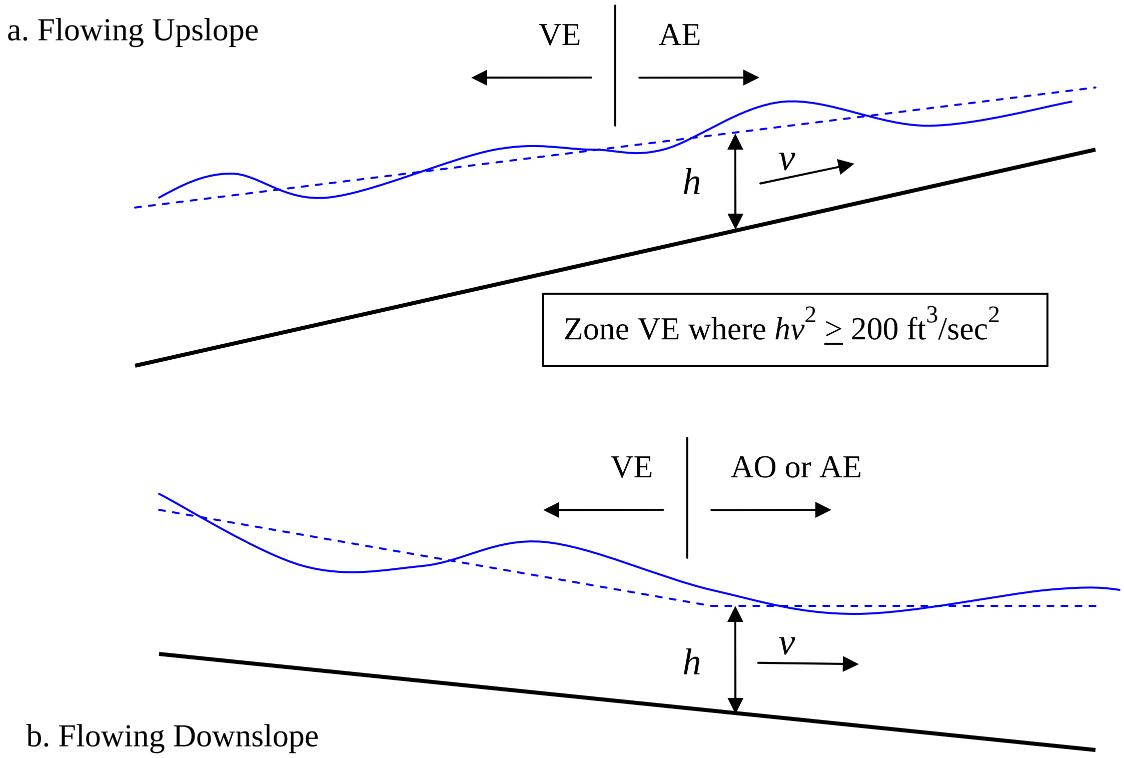

Figure D.4.9-1. Example Designation of High-velocity Flow VE Zones Based on Flood Depth and Velocity

It should be noted that other mapping differences exist between these guidelines and the Atlantic and Gulf of Mexico sections of Appendix D. In these guidelines, the VE runup elevation is not limited to 3.0 feet above the barrier crest, and the Atlantic and Gulf of Mexico sections of Appendix D simplified runup procedure (AO Zone) shown in Figure D-15 of Appendix D has been modified to delineate a VE Zone landward of the barrier when the potential runup is at least 3.0 feet above the barrier crest, as shown in Figure D.4.9-2.

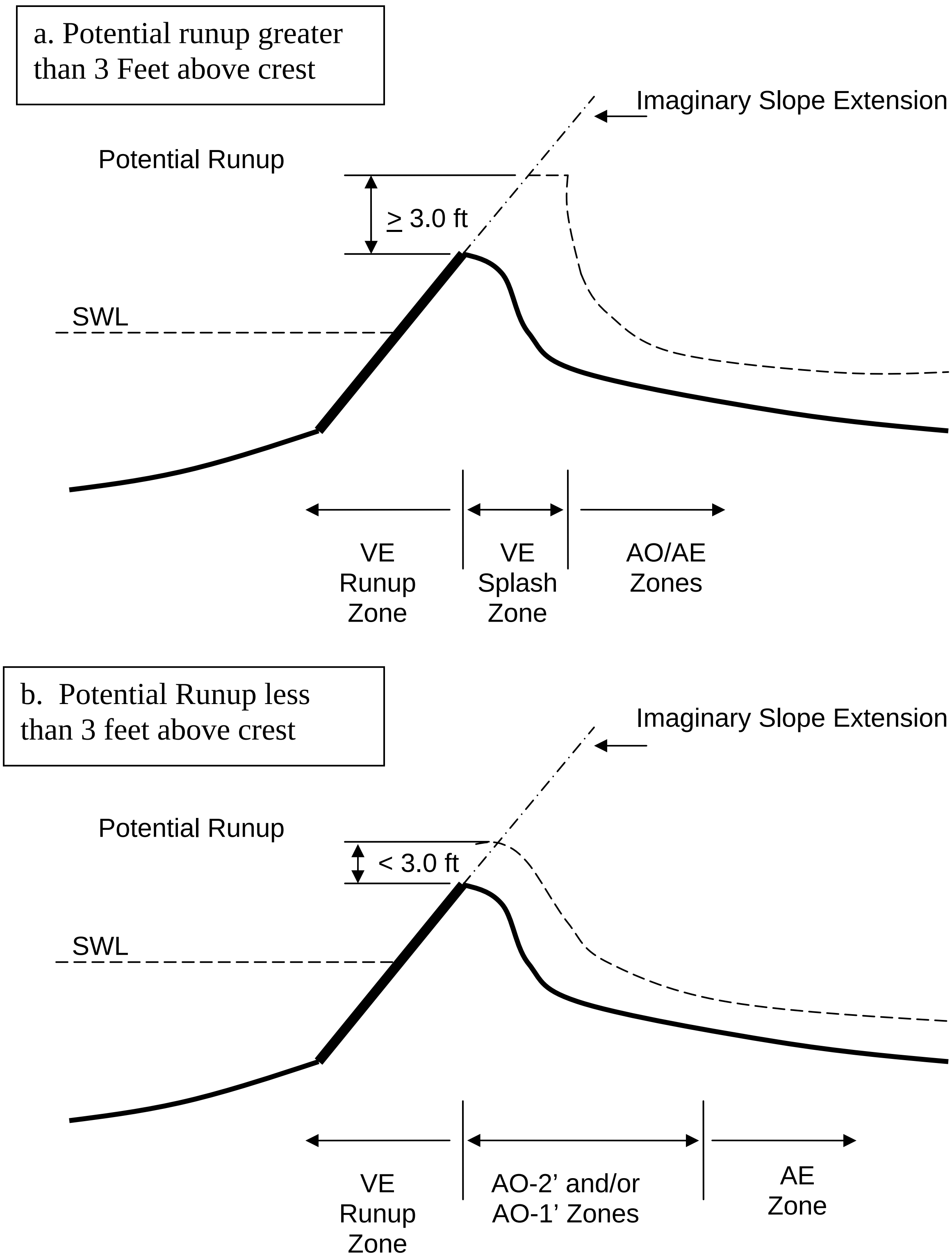

Figure D.4.9-2. Simplified Mapping Procedure for Overtopped Barrier

D.4.9.2.2 AE Zone

AE Zones are areas of inundation by the 1% annual chance flood, including areas with TWL less than 3.0 feet above the ground, or areas with wave heights less than 3.0 feet. These areas are also subdivided into elevation zones with BFEs assigned. The AE Zone generally will extend inland to the limit of the 1% annual chance flood still water elevation or TWL, whichever dominates.

D.4.9.2.3 AH Zone

AH Zones are areas of shallow flooding or ponding with water depths generally limited to 1.0 to 3.0 feet. These areas are usually not subdivided, and a BFE is assigned.

D.4.9.2.4 AO Zone

AO Zones are areas of sheet-flow shallow flooding where the product of hv^2 is less than 200 ft^3/sec^2, or where the potential runup is less than 3.0 feet above an overtopped barrier crest (ΔR<3.0 feet). Sheet flow in these areas will either flow into another flooding source (AE Zone), result in ponding (AH Zone), or deteriorate because of ground friction and energy losses to merge into the X Zone. AO areas are designated with 1-, 2-, or 3-foot depths of flooding.

D.4.9.2.5 X Zone

X Zones are areas above the 1% annual chance flood level. On the FIRM, a shaded X Zone area is inundated by the 0.2% annual chance flood, and an unshaded X Zone area is above the 0.2% annual chance flood.

D.4.9.3 Wave Envelope

The seaward portion of the wave envelope is a combination of the potential wave runup elevation with the controlling wave crest elevation profile. The wave crest elevation profile is plotted along a transect (from the 0.0 map datum elevation landward) based on results of the Wave Height Analysis for Flood Insurance Studies (WHAFIS) model or other methodology output. A horizontal line is extended seaward from the potential wave runup elevation to its intersection with the wave crest profile to obtain the wave envelope, as shown in Figure D.4.9-3. If the runup elevation is greater than the maximum wave crest elevation, the wave envelope will be represented as a horizontal line (extending to the elevation 0.0 location on the transect) at the runup elevation, and the BFE for mapping purposes will be based on that elevation. Conversely, if the wave runup is negligible, the wave crest elevation profile becomes the wave envelope.

The landward portion of the wave envelope (landward of the bluff edge, crest of eroded dune, or seaward edge of a coastal structure) will be a combination of an overtopping bore or splash area and sheet flow.

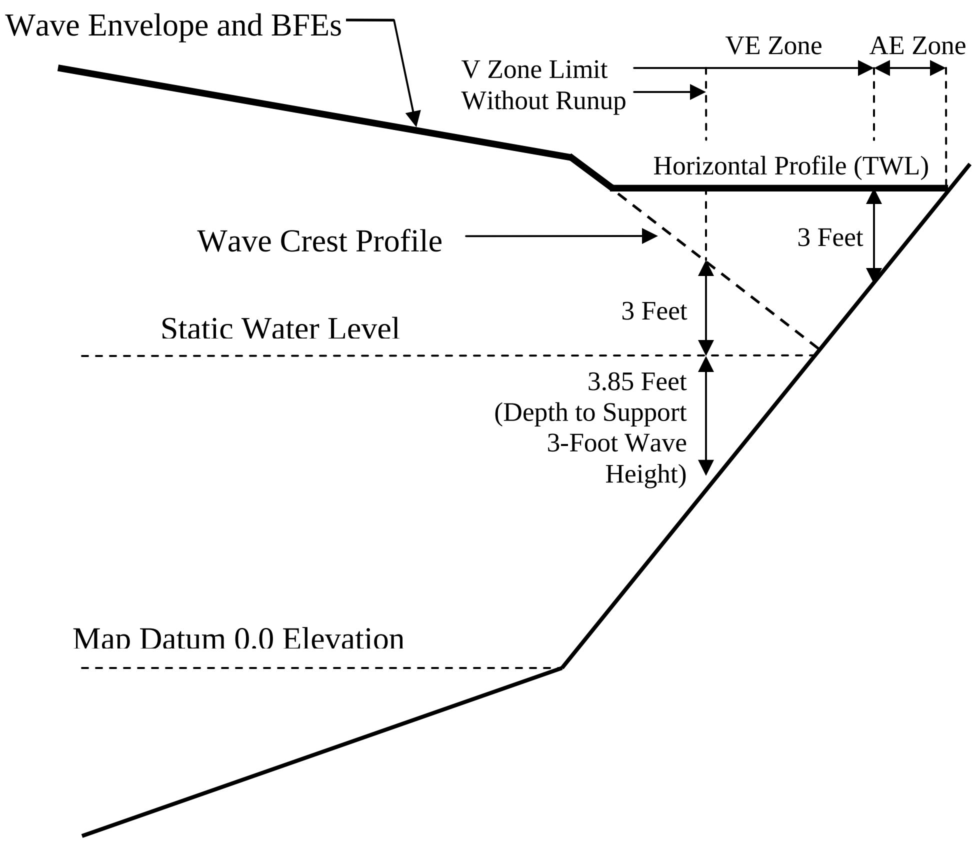

Figure D.4.9-3. Seaward Portion of Wave Envelope based on Total Water Level and Wave Crest Elevation

D.4.9.4 Criteria for Flood Boundary and Hazard Zone Mapping

The first step in identifying the flood insurance risk zones along a transect is locating the inland extent of the VE Zone, also known as the VE/AE boundary. The mapped VE/AE Zone boundary is based on the most landward limit of the five criteria outlined in Subsection D.4.9.2.1. The Mapping Partner shall extend the AE Zone from the VE/AE boundary to the inland limit of the 1% annual chance inundation, which is a ground elevation equal to the potential runup elevation, or the 1% annual chance SWL or static water level (still water plus static wave setup) if runup is negligible. The Mapping Partner may designate additional areas of 1% annual chance flooding because of wave overtopping sheet flow and shallow flooding or ponding as the AH Zone or the AO Zone. The Mapping Partner shall label all areas above the 1% annual chance inundation as the X Zone (shaded for the 0.2% annual chance flood or unshaded for areas outside of all flooding effects).

The Mapping Partner shall then subdivide the VE and AE Zone areas into elevation zones with whole-foot BFEs assigned according to the wave envelope. Generally, the VE Zone is subdivided first. Initially, the Mapping Partner shall mark the location of all elevation zone boundaries on a transect. Because whole-foot BFEs are being used, these should always be mapped at the location of the half-foot elevation on the wave envelope. However, the Mapping Partner shall not subdivide the horizontal runup portion of the seaward wave envelope (see Figure D.4.9-3), if any; the BFE shall be the runup elevation, rounded to the nearest whole foot.

Ideally, the Mapping Partner would establish an elevation zone for every BFE in the wave envelope; however, because these zones are mapped on the FIRM, so buildings or property can be located in a flood insurance risk zone, the Mapping Partner shall use a minimum width for the mapped zone to provide a usable FIRM. For coastal areas, the general guidance is to have a minimum zone width of 0.2 inch on the FIRM. The mapping criteria and ability to map all coastal BFEs and hazard zones changes is dependent upon the map scale of the FIRM. Because digital FIRM data can be easily enlarged, the map scale limitations should be reviewed by the Mapping Partner with the FEMA study representative and community officials.

The Mapping Partner shall combine elevation zones that do not meet the minimum width with an adjacent zone or zones to yield an elevation zone equal to or wider than the minimum width. The BFE for this combined zone is a weighted average of the combined zones. When combining VE Zones, the Mapping Partner shall not reduce the maximum BFE at the shoreline, by averaging.

The AE Zone, if wide enough, shall be subdivided in the same manner. If the total AE Zone width is less than the minimum width, the lowest elevation VE Zone is usually assigned to that area. This situation typically occurs for steep or rapidly rising ground profiles, and it is not unreasonable to designate the entire inundated area as a VE Zone. In some cases, however, it may be appropriate for the Mapping Partner to extend the AE Zone slightly into the next zone seaward to satisfy the minimum width requirement.

Relatively low areas landward of zones subject to wave effects may be subject to shallow flooding or ponding of flood water; the Mapping Partner shall designate these areas as AH or AO Zones. Such designations can be relatively common landward of coastal structures, bluffs, ridges, and dunes, where wave overtopping occurs.

Identifying appropriate zones and elevations may require particular care for dunes, given that the entire primary frontal dune is defined as coastal high hazard area. Although the analyses may have determined a dune will not completely erode and wave action should stop at the retreated duneface with only overtopping possibly propagating inland, the Mapping Partner shall designate the entire dune as a VE Zone as defined in the NFIP regulations. The Mapping Partner shall assign the last calculated BFE at the open coast duneface (whether VE or AE Zone) to be the dominant VE Zone BFE for the entire primary frontal dune and extended to the landward limit of the primary frontal dune. It may seem unusual to use a BFE that is lower than the ground elevation, although this is fairly common. Most of the BFEs for areas where the dune was assumed to be eroded are also below existing ground elevations. In these cases, it is the VE Zone designation that is most important to the NFIP where, under current regulations, structures in VE Zones must be built on pilings and alterations to the dunes are prohibited.

D.4.9.5 Transect Examples

Settings occurring along the open coastlines and sheltered waters of California, Oregon, and Washington include the following:

1. Sandy beach backed by a low sand berm or high sand dune formation.
2. Sandy beach backed by shore protection structures.
3. Cobble, gravel, shingle, or mixed grain sized beach and berms.
4. Erodible coastal bluffs.
5. Non-erodible coastal bluffs or cliffs.
6. Tidal flats and wetlands.

The examples discussed below depict idealized transects for these beach settings, where erosion, wave runup, and overtopping are the dominant coastal processes, to illustrate common flood hazard zonations in a quantitative way. BFEs shown are arbitrary and included for illustrative purposes only.

- **Example 1.** Figures D.4.9-4a and D.4.9-4b illustrate flood hazard mapping for a non-erodible coastal bluff which is high enough to prevent overtopping during 1% flood conditions. The area seaward of the bluff will be mapped as the VE Zone, with a BFE set at the potential runup elevation. The area landward of the bluff face will be mapped as X Zone (unshaded).

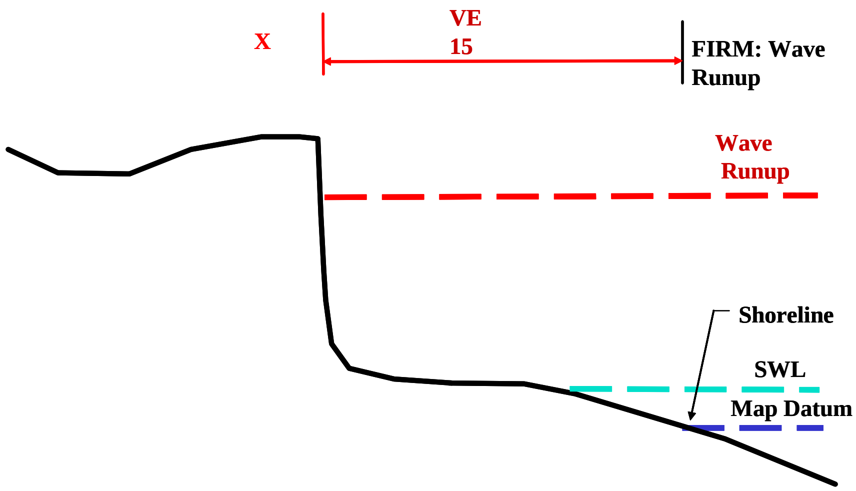

Figure D.4.9-4a. Non-erodible High Coastal Bluff with VE Zone Controlled by Wave Runup (No Overtopping)

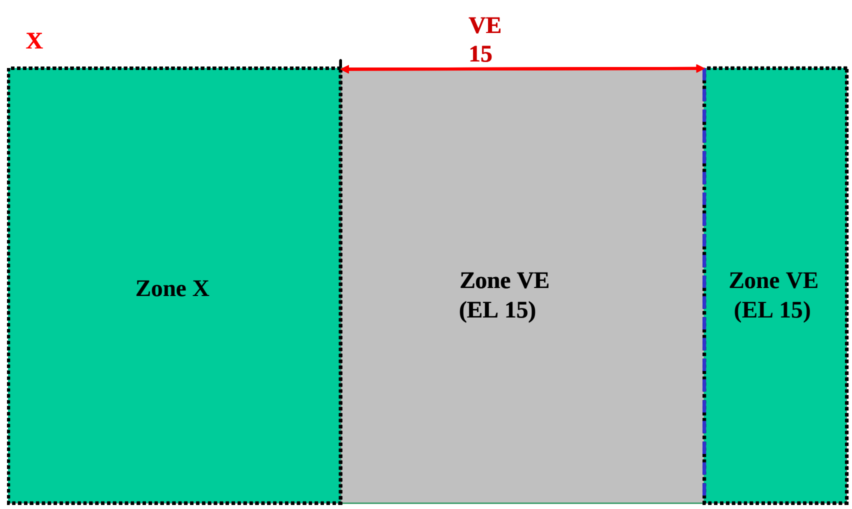

Figure D.4.9-4b. Plan View of Flood Hazard Zones and BFEs, Non-erodible High Coastal Bluff with VE Zone Controlled by Wave Runup (No Overtopping)

- **Example 2.** Figures D.4.9-5a and D.4.9-5b illustrate flood hazard mapping for an erodible coastal bluff that is not high enough to prevent overtopping and where the potential runup reaches higher than 3.0 feet above the crest. In the example shown, the eroded profile is calculated first using procedures described in Section D.4.6, then wave runup and overtopping are mapped against the eroded profile. The area seaward of the bluff will be mapped as the VE Zone, with a BFE set at the potential runup elevation. The area immediately landward of the eroded bluff face will be mapped as VE Zone based on the calculated splash zone width. The area landward of the splash zone will be mapped as a high-velocity flow VE Zone where $hv^2 \geq 200$ ft^3/sec^2 and as AO Zone where $hv^2 < 200$ ft^3/sec^2. BFEs in the VE splash zone and VE high-velocity flow zone will be based on the calculated water surface profile decay (see Subsection D.4.5.2.5).

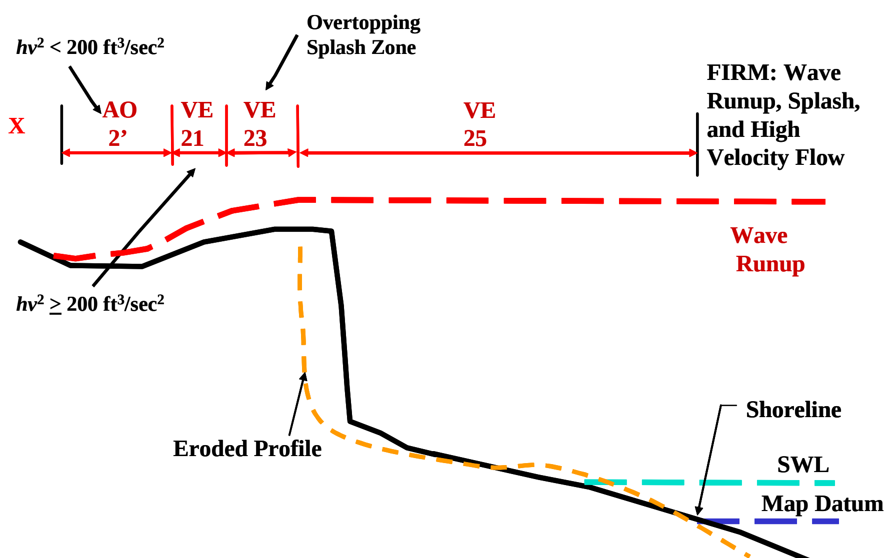

Figure D.4.9-5a. Erodible Low Coastal Bluff with VE Zone Controlled by Wave Runup, Overtopping Splash, and High-velocity Flow

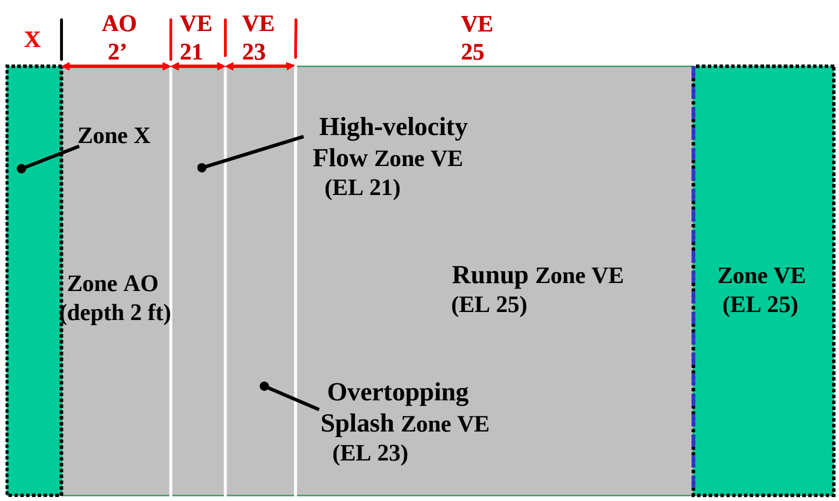

Figure D.4.9-5b. Erodible Low Coastal Bluff with VE Zone Controlled by Wave Runup, Overtopping Splash, and High-velocity Flow

- **Example 3.** Figures D.4.9-6a and D.4.9-6b illustrate flood hazard mapping for a primary frontal dune (PFD) that is large enough (in cross-section) to prevent removal and high enough to prevent overtopping during 1% flood conditions. In the example shown, the eroded profile is calculated first (see Section D.4.6), then wave runup is mapped against the eroded profile The area seaward of the eroded dune face would, except for the PFD designation, be mapped as the AE Zone (where the runup depth < 3.0 feet) and the VE Zone (where the runup depth ≥ 3.0 feet). The area landward of the eroded dune face would, except for the PFD designation, be mapped as X Zone. However, given the PFD designation, the area between the shoreline and the landward heel of the dune will be mapped as VE Zone; the BFE at the dune face (EL 13) will be continued landward to the PFD landward limit. Note that this is the only mapping scenario where the hazard zone (landward of the dune face) is based on coastal morphology, not on actual flood hazards during the 1% flood. Likewise, the BFE landward of the dune face is an extension of the BFE at the dune face, not representative of the actual flood profile.

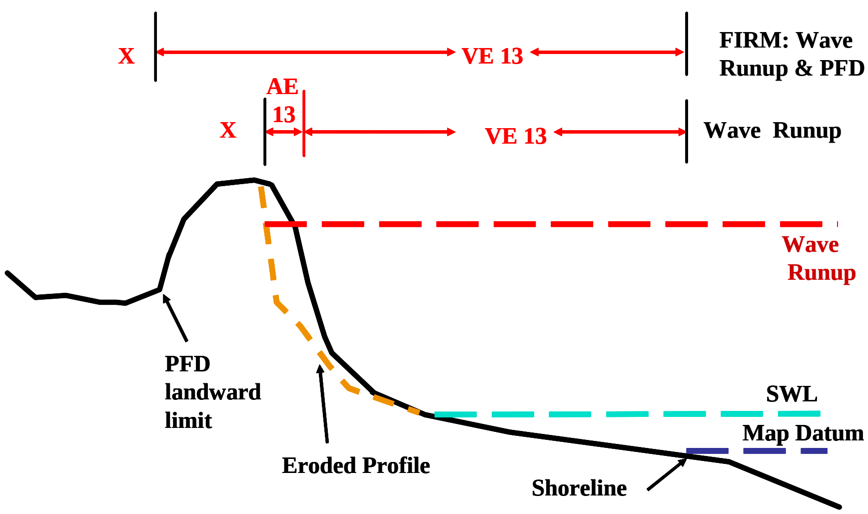

Figure D.4.9-6a. Sandy Beach Backed by High Sand Dune with PFD Controlling the VE Zone

If the dune in Figure D.4.9-6.a was not high enough to prevent overtopping and the potential runup extended more than 3.0 feet above the crest, an overtopping splash VE Zone would be indicated on the landward side of the eroded crest, and a high-velocity flow VE Zone would lie farther landward (if $hv^2 \geq 200$ ft^3/sec^2). If the high-velocity flow VE Zone terminates seaward of the PFD limit, the PFD designation would determine the VE/AE boundary. If the high-velocity flow zone extends landward of the PFD limit, the high-velocity flow VE Zone would determine the VE/AO boundary. If no high-velocity flow VE Zone exists in the example (if $hv^2 \leq 200$ ft^3/sec^2), then the VE/AO boundary would be set at the PFD limit or the overtopping splash limit, whichever is farther landward. In all cases, the BFEs landward of the eroded dune crest would be mapped at the higher of the PFD BFE, the splash zone BFE, and the high-velocity flow BFE at any given point along the transect.

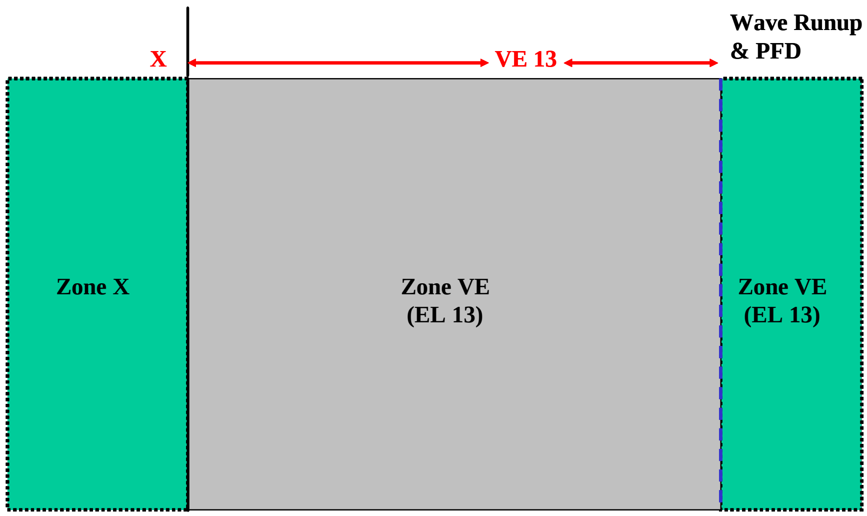

Figure D.4.9-6b. Sandy Beach Backed by High Sand Dune with PFD Controlling the VE Zone

- **Example 4.** Figures D.4.9-7a and D.4.9-7b illustrate flood hazard mapping for a low coastal dune where the dune cross-section is insufficient to prevent removal by the 1% flood. The eroded profile is calculated and adjusted (see Section D.4.6), then the resulting profile is checked for inundation, overland wave propagation, wave runup, and overtopping. In the example shown, the remnant dune crest is not inundated, so overland wave propagation is not mapped. Instead, hazard zones are mapped based on the combined effects of wave runup, overtopping splash (runup extends more than 3.0 feet above the crest in this example), high-velocity flow and PFD. The width of and BFE for the VE splash zone are calculated using the procedures described in Subsection D.4.5.2.5. In this example, the overtopping splash zone extends farther landward than the PFD, and determines the VE/AO boundary.

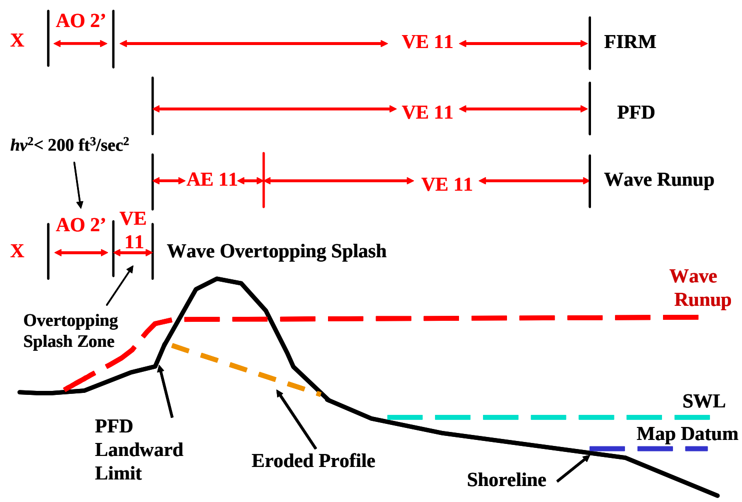

Figure D.4.9-7a. Sandy Beach Backed by Low Sand Dune with Overtopping Splash Controlling VE Zone

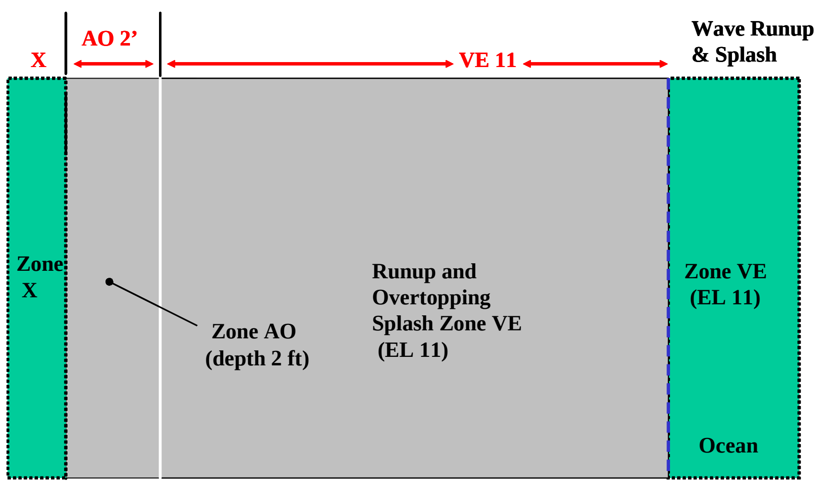

Figure D.4.9-7b. Sandy Beach Backed by Low Sand Dune with Overtopping Splash Controlling VE Zone

- **Example 5.** Figures D.4.9-8a and D.4.9-8b illustrate flood hazard mapping for an overtopped coastal structure that remains intact during the 1% flood (see Section D.4.7 for a discussion of structure failure and local scour considerations). In this example, the potential runup reaches an elevation greater than 3.0 feet above the crest of the structure therefore, an overtopping splash VE Zone is mapped landward of the structure; crest. (Note: If the potential runup was less than 3.0 feet above the crest, no VE overtopping splash zone would be mapped, and an AO sheet flow zone would be mapped instead.) The width of and BFE for the VE splash zone are calculated using the procedures described in Subsection D.4.5.2.5. The flow velocity and water surface profile landward of the structure are used to calculate hv^2 values landward of the crest, and a high-velocity flow VE Zone is mapped where $hv^2 \geq 200$ ft^3/sec^2, while AO Zone is mapped where $hv^2 < 200$ ft^3/sec^2. Note that the same basic procedure is used for vertical and sloping structures, the principal difference being the equations used to calculate wave runup and splash distances. Thus, if this particular structure was assumed to sustain total or partial failure during the 1% flood, a similar procedure would be applied, but with sloping structure equations rather than vertical structure equations.

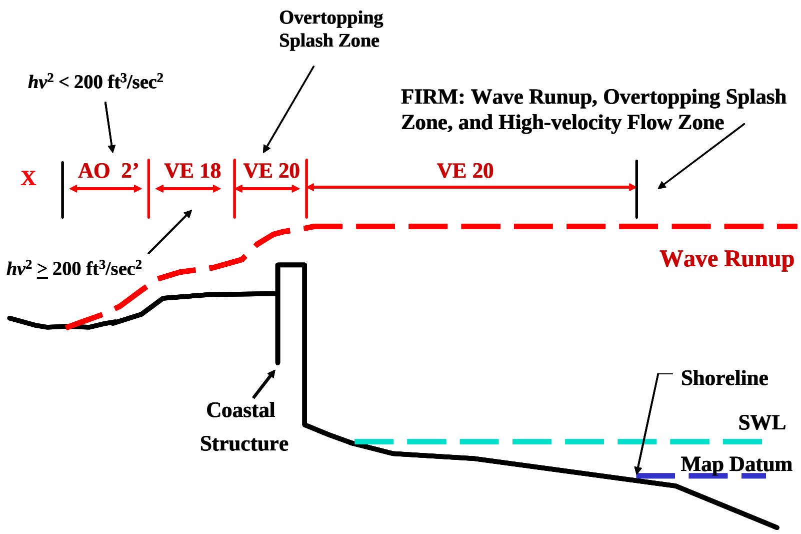

Figure D.4.9-8a. Sandy Beach Backed by Shore Protection Structure with VE Zone Controlled by the Splash Zone and High-velocity Flow from Wave Overtopping

With shore structures having steep slopes, runup elevations are relatively high and a wide range of wave hazards can occur, including erosion or scour near the structure. These circumstances may result in a variety of distinct and compact situations, where appreciable engineering judgment can be required for appropriate assessment of flood hazards.

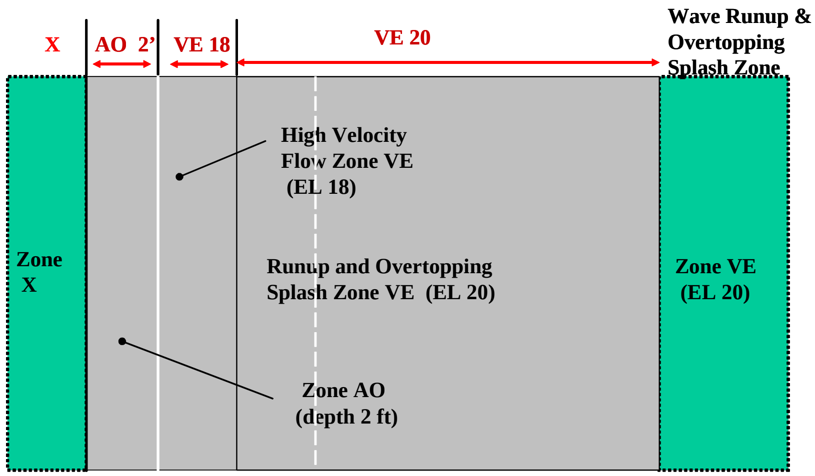

Figure D.4.9-8b. Sandy Beach Backed by Shore Protection Structure with VE Zone Controlled by the Splash Zone and High-velocity Flow from Wave Overtopping

- **Example 6.** Figures D.4.9-9a and D.4.9-9b illustrate flood hazard mapping for a beach profile composed of gravel, cobble, or mixed grain sizes. In this example, the Most Likely Winter Profile (MLWP) configuration should be determined in accordance with Section D.4.6, and the wave hazards should be modeled using the eroded profile. There will be no PFD designation for a gravel, cobble, or mixed grain size profile, so the mapped hazard zones and BFEs will reflect calculated flood hazards only.

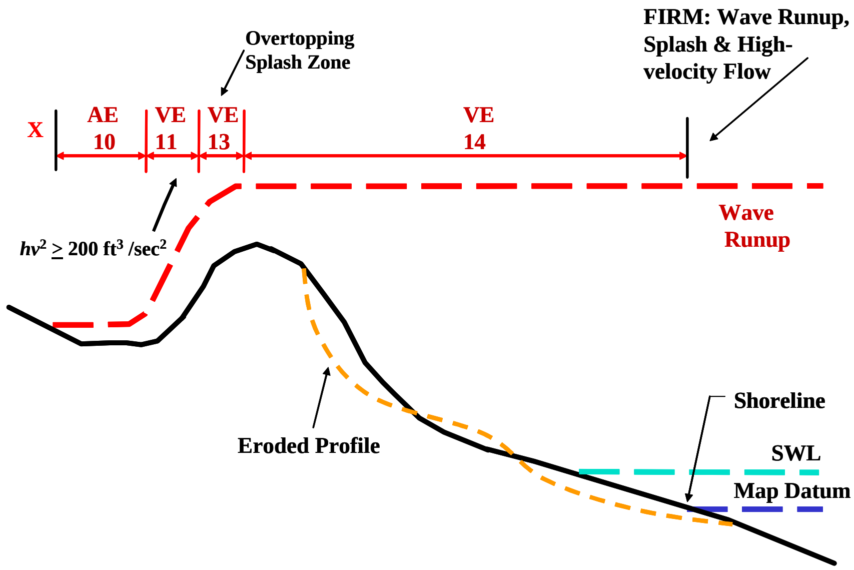

Figure D.4.9-9a. Cobble, Gravel, Shingle, or Mixed Grain Sized Beach with VE Zone Controlled by Wave Runup, Overtopping, and High-velocity Flow

In this example, the potential runup is assumed to reach more than 3.0 feet above the crest, so an overtopping splash zone is mapped landward of the profile crest, with a high-velocity flow VE Zone and AE Zone to the rear. The AE Zone is mapped instead of the AO Zones shown in Examples 2, 4, and 5 because the overtopping ponds in the area behind the crest in this case. The mean overtopping rate calculations (see Section D.4.5.2) shall be used to determine the volume of water overtopping the barrier during the 1% flood conditions, and the BFE in AE Zone shall be determined based on the overtopping volume and the local topography.

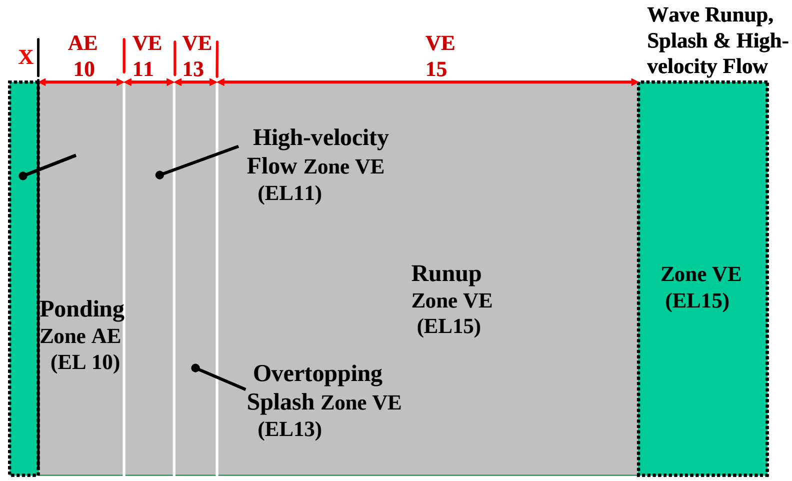

Figure D.4.9-9b. Cobble, Gravel, Shingle or Mixed Grain Sized Beach with VE Zone Controlled By Wave Runup, Overtopping and High Velocity Flow

- **Example 7 (no figure).** For the case where a profile is inundated by the static water level during the 1% flood – such as a tidal wetland, low sand beach or other flooded low-lying area – wave runup and overtopping need not be calculated and mapped. Instead, the hazard zones and BFEs shall be mapped based on the results of the WHAFIS model, as modified for use on the Pacific coast (see Section D.4.5.3), or other similar analysis, or similar analysis. The VE Zone shall be mapped where the vertical difference between the wave crest elevation and the static water level is equal to or greater than 2.1 feet; the AE Zone shall be mapped where the difference is less than 2.1 feet. BFEs shall be mapped at even-foot increments, in a stair-step fashion, following the wave crest profile.

D.4.9.6 Mapping Procedures

Properly integrated delineation of the results of flooding analyses involves judgment and skill in reading topographic and land cover maps. The time and effort put forth to determine the flood elevations and extents will be negated if the results of these analyses are not properly delineated on the FIRM. The FIRM is usually produced from the work maps. Therefore, the Mapping Partner shall transfer the flood zones and elevations identified on the transects to the work maps and interpolate boundaries between transects. The Mapping Partner shall set up the work maps with contour lines, buildings, structures, vegetation, and transect lines clearly located. Because roads are often the only fixed physical features shown on the FIRM, the Mapping Partner shall ensure that other features and the flood zone boundaries are properly located on the work maps in relation to the centerline of the roads as they will appear on the FIRM. The starting point (0 Station) for each transect should be clearly annotated on the work maps.

For each transect, the Mapping Partner shall transfer the identified elevation zones from the transect to the work maps, marking the location of the boundaries along the transect line, so boundary lines can be interpolated between transects. The Mapping Partner shall ensure that boundaries are marked at the correct location. Because of erosion assumptions, the location of the 0.0 foot elevation at the shoreline can change on the transect but the 0 Station will not change on the work map.

Using the transect profile, the Mapping Partner shall determine the location of the zone change in relation to a physical feature (e.g., ground contour, back side of a row of houses, 50 feet into a vegetated area) and delineate the boundary line for the area represented by that transect along this feature. The Mapping Partner shall measure the widths of the zones carefully; zones that narrow to less than 0.2 inch must be tapered to an end. Likewise, if the zone becomes much wider, it may be possible to break an averaged elevation zone into two mapped elevation zones.

One of the more difficult steps in delineating coastal flood zones and elevations is the transition between transect areas. Good judgment and an understanding of typical flooding patterns are the best tools for this job. Initially, the Mapping Partner shall locate the area of transition (an area not exactly represented by either transect) on the work maps. The Mapping Partner shall then delineate the floodplain boundaries for each transect up to this area. The Mapping Partner shall examine how a transition can be made across this area to connect matching zones and still have the boundaries follow logical physical features. Other transects similar to this area could give an indication of flooding. Sometimes the elevation zones for the two contiguous transects are not the same; in such cases, the Mapping Partner may have to taper the zones to an end or enlarge the zones and subdivide them in the transition area.

Transition zones may be necessary between areas with high runup elevations to avoid large differences in BFEs and to smooth the change in flood boundaries. These zones are to be fairly short and cover the shore segment with a slope not exactly typical of either area. The Mapping Partner shall determine the transition elevation using judgment in examining runup transects with similar slopes. The Mapping Partner shall not use transition zones if there is a very abrupt change in topography, such as the end of a structure.

Lastly, the Mapping Partner shall map the X Zone areas. The Mapping Partner shall show areas below the 0.2% annual chance TWL that are not covered by any other flood zone as the X Zone (shaded) on the FIRM. Often, the maximum runup elevation is higher than the 0.2% annual chance TWL; in such cases, the X Zone (shaded) designation will not be used in that area. All other areas are designated X Zone without shading.

Because flood elevations are rounded to the nearest whole foot, the Mapping Partner does not need to spend hours resolving a minor elevation difference. Also, because coastal structures must be located on the FIRM, the Mapping Partner shall attempt whenever possible to smooth the boundary lines and to follow a fixed feature such as a road. In preparing the FIRM, the Mapping Partner shall ensure that the mapped results are technically correct and that the FIRM is easy for the community official, engineer or surveyor, and insurance agent to use.