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Via e-mail & 1st Class Mail

Mr. Robert J. Schaefer
Hazard Mitigation, DR-4086-NJ
307-309 Middletown Lincroft Road
Lincroft, NJ 07738

RE: FEMA Flood Map Revisions
Determination of V-Zones
Borough of Mantoloking, Ocean County

Dear Mr. Schaefer:

As you are aware, the Advisory Base Flood Elevations (ABFEs) made available to the public by FEMA following Hurricane Sandy have caused much concern among many of the coastal towns whose residents would be negatively impacted by the V-Zones delineated on the Advisory maps. Although FEMA has indicated at multiple venues throughout the state that these advisory V-Zones are conservative and will be reduced in many locations, we would argue that in some locations, such as the Borough of Mantoloking, the V-Zones on the leeward side (bay side) of the island should likely be significantly reduced or removed altogether.

The purpose of this letter is to present, for your consideration, our opinion that:

- due to its geographical position, Mantoloking's westerly shoreline will not likely be subject to waves exceeding three feet, and
- if the conditions were to exist that produced waves of that size impacting the westerly shoreline, the probability of their occurring simultaneous to the already-established one-percent-annual-chance stillwater elevation would logically be less than a one-percent-annual-chance event since those wind conditions are less likely to occur than the wind conditions that contributed to the one-percent-annual-chance storm surge.

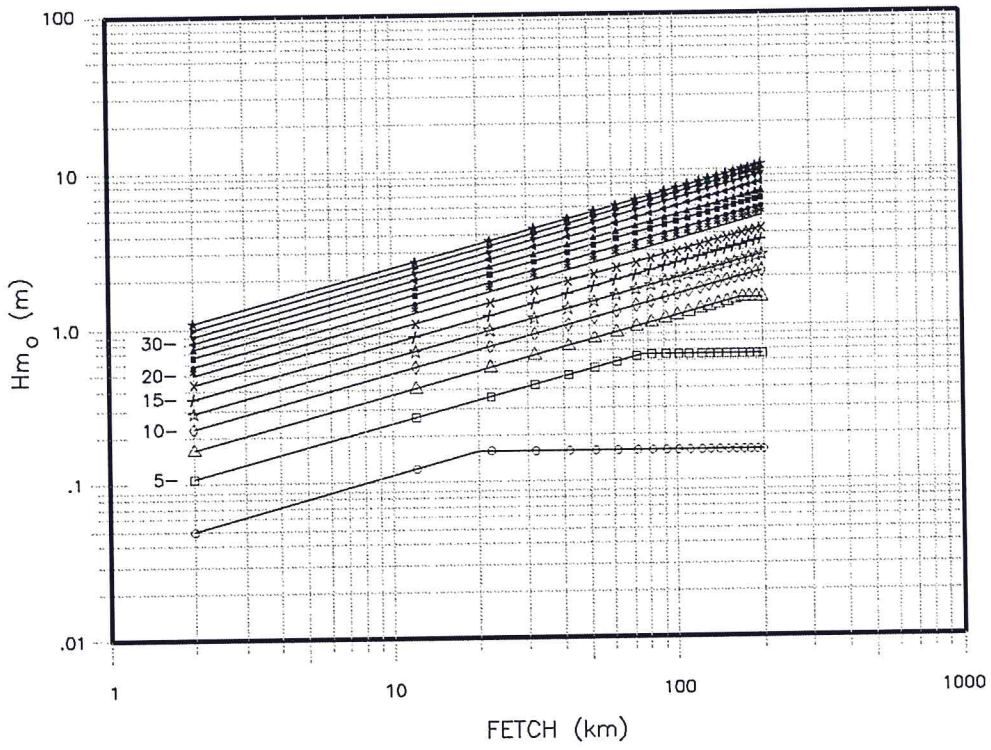
Geography and Physical Considerations

Mantoloking is located near the northerly end of the Barnegat Peninsula in Ocean County. Most of the Borough's two-mile-long bayside shoreline is separated from the mainland by the narrow, northerly throat of Barnegat Bay, which extends to the northerly portion of the Borough where the Metedeconk River enters the bay. Over most of its length, this water body is approximately one-half mile wide. Near the northerly end of the Borough, where the Metedeconk River enters from the west, the Borough's shoreline is protected by the tidal marsh (and partially wooded) island known as Herring Island. At the far northerly end of the Borough, the Borough-

proper is protected by the three-pronged peninsula containing Channel Lane and Lagoon Lane.

Fetch

In considering the possible wind conditions that could contribute to waves exceeding three feet in height, only winds out of a portion of the southwesterly quadrant have the potential to produce any sizable waves that could impact Mantoloking's bayside shoreline. The narrow width of Barnegat Bay along Mantoloking's entire length would preclude the generation of any sizable waves from westerly winds. Chapter Two of Part II of the United States Army Corps of Engineers' Coastal Engineering Manual (CEM) includes a chart (Figure II-2-23, inserted below) that provides the fetch-limited deepwater wave heights under varying wind conditions and fetch lengths. The fetch lengths of less than one-half mile (0.8 km) that would exist in the Barnegat Bay during westerly wind conditions fall outside the limits of this chart. Furthermore, if the most extreme wind conditions are extrapolated to the actual half-mile fetch limits, they correspond to wave heights of less than three feet.



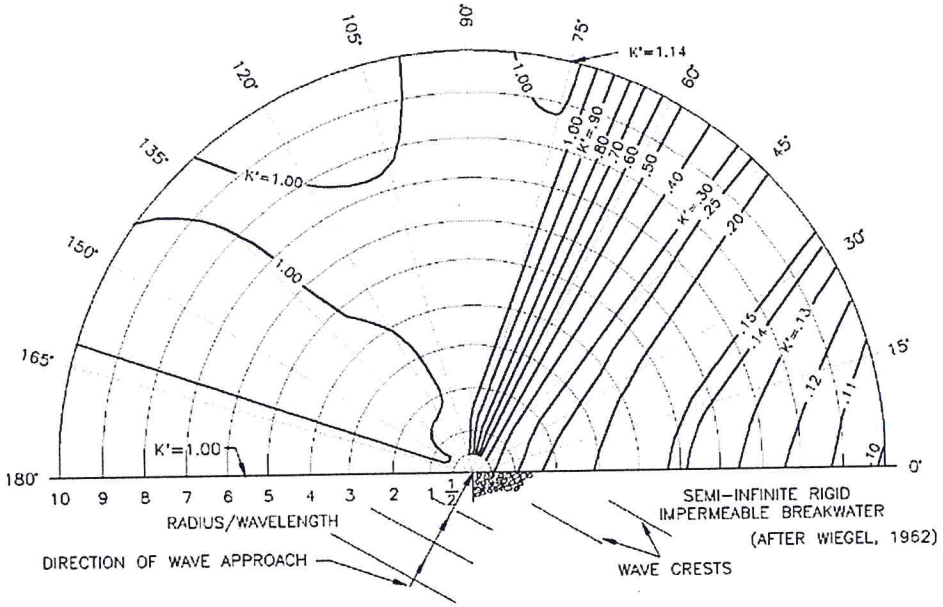
Diffraction

The largest waves that would develop within Barnegat Bay impacting Mantoloking's bayside shoreline would result from sustained winds out of the southwest or south, where there may be sufficient fetch to generate three-foot-or greater waves under certain ideal sustained wind conditions. However, before

the waves generated from these wind conditions would impact Mantoloking's bayside shoreline, they would have undergone significant diffraction due to the presence of multiple natural and man-made landforms or structures. Mantoloking's sheltered geographical position places most of its bayside shoreline in the diffraction shadow zone of all but the most narrow band (approximately 20 degrees) of wind directions out of the south-southwest. Only sustained winds originating from that direction would have an undiffracted impact on a portion of the Borough's shoreline.

Most of the bayside shoreline south of the Route 528 bridge falls within the diffraction shadow zone of waves generated from virtually all wind directions. The portion of the bayside shoreline north of the Route 528 bridge is further protected by the narrow (1,000-foot wide) gap spanned by bridge. The infrastructure of this bridge consists of closely spaced structural supports that act as a porous groin, significantly attenuating both the previously-diffracted waves as well as the wind.

Chapter Seven of Part II of the CEM discusses the impact of diffraction. (It is worth noting that this section is discussed in the Chapter on *Harbor* Hydrodynamics). Figure II-7-3 (inserted below) provides an example of a wave diffraction diagram. In order to properly analyze the impact of diffraction on Mantoloking's bayside shoreline using this method, a series of similar templates would be required, each successively further reducing the height of the waves impacting the shoreline. The CEM's discussion on diffraction and the accompanying figures demonstrate that diffraction can significantly reduce the wave size in the shadow zone.



Structures

The V-Zones delineated on the Advisory Map extend, in several areas, landward of the residential structures fronting the water. It is our understanding, based on our previous conversations, that the overland wave analysis will account for structures and physical features (such as buildings and vegetation) that would dramatically reduce the height and energy of waves that impact the barrier island. We expect that the overland wave model will demonstrate significant attenuation from both submerged vegetation and other nearshore bottom interactions, buildings, trees, and other obstructions. As described below, we do not expect that waves greater than three feet in height would occur during the storm surge. However, should sustained wind conditions occur at other times during the storm, due to the attenuation from physical obstructions we would expect that any significant impact would be limited to the waterfront structures.

Conformance with FEMA Guidance Manual

It is our understanding that the FEMA document entitled *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update*, dated February 2007, also known as Appendix D.2, or the "guidelines", is authoritative as to the methodology that is to be used in developing FEMA flood maps along the Atlantic Ocean.

As we have written in previous correspondence, it is our opinion that the FEMA guidelines (backed up by common sense and sound engineering judgment) require that only those wind and wave conditions most likely to accompany the one-percent-annual-chance (1% chance) storm surge should be used to determine V-Zones. As discussed above, the only winds capable of generating three-foot high waves impacting Mantoloking's bayside shoreline are those out of a very narrow band width out of the south or southwest. Neither nor'easters nor hurricanes would likely generate these wind conditions during the time of the storm surge. We offer the following points in support of this position, citing the relevant sections of the above referenced FEMA guidelines:

Section D.2.1.2.3 (Sheltered Waters)

Sheltered waters are defined as "water bodies or regions that experience diminished forces from wind and/or wave action relative to the open coast." As described above, Barnegat Bay, and more specifically the narrow portion of Barnegat Bay adjacent to Mantoloking, meets this definition.

According to this section, the timing (not just the magnitude) of the hydrodynamic conditions should be considered, and wind data (including seasonal direction and duration) should be based on historical local wind conditions.

Section D.2.1.2.6.1 (Stillwater Elevations)

This section states that it is "of particular importance" in the determination of the stillwater elevation that the model study "provide estimates of the wind and water levels likely to occur over the course of the one-percent-annual-chance flood". We note that the wind levels referred to are not those that occur throughout the duration of the storm, but only during the 1% chance flood. Since the stillwater elevations have already been determined, we trust that the RAMPP team has already determined those wind conditions, and that only those wind conditions will be used to determine the V-Zone delineations on the final map.

Section D.2.1.2.6.6 (Storm Meteorology)

This section makes clear that, whether the 1% chance flood is caused by a hurricane or a northeaster, the wave conditions that are to be considered in developing the flood maps are those that are most likely to accompany the flood. It follows then, that wave conditions other than those most likely to accompany the 1% chance flood should not be considered.

This is not to say that the wind and wave conditions that result in 3-foot waves impacting the bay side of barrier islands cannot exist. Rather, we would argue that the guidelines and common sense require that these wave conditions only be considered along with the stillwater elevation that, when combined with these wave conditions, results in a 1% chance *event*, and that the stillwater elevation associated with that event would, necessarily, be significantly lower than the stillwater elevation that was used to determine the ABFEs.

Section D.2.1.2.6.7 (Storm Wave Characteristics)

This section states that for shores behind "protective islands" the assumption of onshore waves coincident with the 1% chance flood may require detailed justification, and notes that further analysis of wave conditions should only proceed "once it is confirmed that sizable waves ***likely*** travel onshore at a site ***during*** the one-percent-annual-flood" [emphases added]. Therefore, the burden of proof falls on the RAMPP team to demonstrate that sizable waves would impact the bayside shoreline of Mantoloking simultaneous to the 1% chance flood.

The section also discusses the three different criteria that should be considered in "estimating wave conditions expected to ***accompany*** the one-percent-annual-chance flood" [emphasis added]. These criteria include:

1) actual wave measurements,
2) wave hindcasts or numerical computations based on historical effects, and
3) specific calculations based on assumed storm meteorology, all of which are recommended in estimating wave conditions.

Section D.2.2.2.1 (Open Ocean Coasts, Inland Bays, and Sheltered Waters)

This section reiterates that the timing of wave conditions with peak surge events is required for analysis of sheltered waters.

Section D.2.2.4 (Event and Response Analysis Considerations)

Simply determining the 1% chance storm event and transforming it to the shoreline may not be appropriate for sheltered waters, where wave conditions are often driven by local weather conditions. This section makes clear that the 1% response at the shoreline should be determined by analyzing combinations of wave and water level conditions, not by simply determining the maximum wave conditions that could exist and arbitrarily assigning those conditions to the previously-determined 1% stillwater elevation.

Section D.2.3.3.1 (Elementary Probability Theory)

The stillwater elevation has already been determined, and is defined as the level reached by the 1% chance flood, absent wave considerations. Therefore, based on elementary concepts of probability, the simultaneous occurrence of the stillwater elevation and sustained southerly wind generating three-foot waves in Barnegat Bay would have less than a one percent annual chance of occurring (since the more likely wind conditions during the surge would have an easterly component). Only those wave conditions most likely to accompany the surge (i.e. waves generated by the offshore winds) should be considered.

It is not known which of the guidelines' various statistical and probability rules the RAMPP team will use. A simple application of the multiplication rule, which states that the probability of the joint occurrence of two independent events can be determined by multiplying their individual probabilities, would result in significantly less than a one percent chance of occurrence using the previously-determined stillwater elevation. Since the stillwater elevation itself has only a one percent annual chance of occurrence, introducing any additional event – even one with a 99% chance of occurrence – would result in a combined likelihood of less than one percent.

However, we recognize that, since the wave conditions are not independent of the storm that causes the surge, the multiplication rule would not apply. We assume that the RAMPP team will choose the probabilistic method most appropriate to the situation. Since southerly or south-westerly winds generating three-foot waves across a limited fetch are less likely to occur during the duration of the 1% chance flood than the open ocean winds that generated the surge, we expect that, regardless of the method used (e.g. Joint Probability Method, Maximum Likelihood Method), the results will show that the simultaneous occurrence of these events has less than a one-percent chance of occurring.

Section D.2.4.5 (1-Percent-Annual-Chance Stillwater Levels)

It is important to distinguish between the 1% chance *flood* and the 1% chance *stillwater elevation*. The 1% flood includes factors other than the stillwater elevation, such as wave setup and wave height. Therefore, if the 1% stillwater elevation has already been determined without considering wave input, the 1% flood, which considers both, will likely be based on a stillwater elevation with more than a one percent chance of occurring. This will be a lower elevation, which will in turn reduce the impact from waves (e.g. setup, attenuation, and height), thereby eliminating or at a minimum significantly reducing the V-Zone designation from the bay side of the barrier island.

Section D.2.11.1 (Review and Evaluation of Basic Results)

This section includes the following statements:

- *The Mapping Partner should review results from the models and assessments from a common-sense viewpoint and compare them to available historical flood data.*
- *Therefore, the model results must be in basic agreement with past flooding patterns, and historical data must be used to evaluate these results.*
- *The Mapping Partner should use judgment and experience to project previous storm effects onto the one-percent-annual-chance conditions and to ensure that the coastal assessment results are consistent with previous observed events.*

We trust that the RAMPP team will diligently apply these principles in their review and evaluation of their results prior to mapping the flood elevations and flood insurance risk zones.

Conclusion

In summary, the FEMA guidelines are clear that V-Zones should be determined by evaluating the *combined* wave and surge conditions that result in a 1% chance response and not by simply applying the maximum possible wave conditions to the previously-determined 1% chance stillwater elevation. The stillwater elevations on which the current ABFEs are based were developed from the hurricane or northeaster winds that cause the storm surge. Therefore, these are the most likely wind conditions to occur during the 1% chance flood. It is unlikely that wind and wave conditions causing three-foot waves impacting the backshore zone along the westerly shoreline of Mantoloking would occur during the 1% chance stillwater elevation. While other scenarios may be considered that include sustained southerly or south-westerly winds that could generate three-foot waves, those conditions would not likely occur during the 1% chance storm and if they did, would, by elementary principles of probability, necessarily result in less than a 1% chance event.

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Should the RAMPP team maintain that 1% chance storm surge would remain at its peak throughout the time that it would take winds to shift to a south-westerly direction and persist at speeds and duration that would generate easterly-directed waves exceeding three feet that impact the bayside of Mantoloking, we look forward to reviewing the historical data that would provide the basis for this assumption. Otherwise, we expect that the preliminary maps will reveal that no V-Zones exist along the sheltered shoreline of Mantoloking.

Thank you for your attention to this matter. Should you have any questions, please do not hesitate to contact our office.

Very truly yours,

Hatch Mott MacDonald

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