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Hull Conservation Commission
Hull, Massachusetts

Re: 51 Harborview Road, Hull, Massachusetts
Response to Commission inquiries

Commissioners:

I am writing to provide responses to the inquiries from Mr. Krahforst in his March 7 email about the above project. His email listed the following questions:

1. A response on how the applicants will come into compliance with the EO
2. Detailed analysis on alternatives including consideration of hard vs. soft solutions;
3. Sea level rise and its effect on the proposed project;
4. Coastal engineering expertise on how to protect the abutter(s);
5. Examples where soil-nail stabilization in coastal settings are being used.

This letter will address items 2, 3, 4 and 5. Attorney Watsky has written separately to address item #1.

Item #2: Several varieties of semi-soft bank stabilization have been used in recent decades where appropriate, in Massachusetts. In general, most instability of coastal banks in Massachusetts is related to wave erosion of the base of the bank which leads to oversteepening and failure of the slope. These approaches attempt to protect the lower bank, which gives the upper bank time to stabilize, generally with vegetation.

These approaches include beach dewatering, backbeach nourishment, slope restoration/protection, and use of a range of geotextile applications.

Beach Dewatering: Beach dewatering, used for over a decade on Nantucket, attempted to lower beach groundwater by pumping. A less saturated shoreface was believed to allow for greater swash infiltration, leading to accretion of sand on the beach. During storms, this greater beach sand volume/elevation will protect the base of the adjacent coastal bank. This innovative system, even in theory, can only function on a sandy beach and nearshore. The system was not effective in

Nantucket. It has been successful in Europe in sheltered areas. I have considered that approach here, and conclude that the composition of the Harborview Road shoreline and wave exposure precludes its use.

Backbeach Nourishment: Backbeach nourishment can, where used in the appropriate context, provide protection to the base of the coastal bank. An innovative project in Hull placed sediment at the base of a coastal bank. The sediment was specified to be mostly the largest material within the range of sediment transported on that beach, so it was permittable under the Wetlands Regulations. This emplacement was proposed to protect the toe of the bank, and therefore stabilize the bank, until the next major north or northwesterly storm, which would redistribute the material across the beach. Where beach nourishment is used, additional sediment must be placed on the beach regularly to restore the volume of sediment after storm events On Harborview Road, I have concluded that back beach nourishment is not the appropriate solution. First, the base of the coastal bank above the back beach is a vertical stone seawall. Second, to use this method one must have ready access to the beach to repeatedly transport the large volumes of sediment and equipment to move and place that sediment. Third, the coastal change maps do not evidence a long-term recession of the beach due to erosion – the maps show this shoreline has remained remarkably stable over the past 50 to 100 years. Fourth, the recent slope failure, though not directly the result of shoreline change, was exacerbated by the loss of support at the base of the bank by the failure of the vertical wall at the base of the bank. Beach nourishment is not the answer here.

Use of Geotextile Materials: Three main geotextile materials have been used in Massachusetts, geotextile (plastic) fiber cloth, jute, and coir (coconut fiber). These materials have been fabricated into bags and tubes in a large range of sizes. In recent years, coir has been most readily used because of regulatory restrictions. It decays rapidly and is a natural fiber, and thus it likely will not have the longer-term impacts associated with tradition fabrics and man-made materials. There have been issues, especially on Nantucket, with geotextiles constructed from traditional cloth. When the application fails, the cloth fragments are dispersed by waves and may impact marine life. Considerable effort was spent recovering failed devices and the success rate, as well as the impacts, is unknown. Inherent weaknesses of geotextile fabric is photodegradation (which has improved, but is still a factor) and abrasion, both of which weaken the fabric. The life of these fabrics is largely dependent on burial; apparently the geotextile fabric life is indefinite if it can be kept buried. Of course, in a coastal bank application that is problematic.

Regardless of the material chosen, the fabrics are most commonly used to form tubes which are laid in courses moving up the face of a sandy coastal bank. The largest use of tubes has been near Sankaty Beach, Nantucket. In this area, very large diameter tubes at the base of the coastal bank responded like the general experience of small tubes; the lower courses gradually settled into the underlying sand so successive layers became unstable and shift, leading to failure.

As an alternative to tubes, several applications of sand bags have been attempted on the Massachusetts coast, including Nantucket and Plum Island. Presumably, installation of discrete bags is simpler and faster, and shifting of sand bags will endanger the overall installation less. Nonetheless, they also did settle and shift in both examples, leaving gaps when wave impacts were concentrated.

One of the larger uses of tubes made of coir was on the south coast of Chappaquiddick Island. Continuous coir bags were placed to the top of the coastal bank to protect a home long enough to move it landward. The tubes extended to the top of the bank, which was 15-20 ft ht. (est.). The project ended up comparable to painting the Golden Gate Bridge; the construction crew replaced bags continuously as sections failed.

Similar tubes made of coir have been used at numerous sites on Cape Cod. As well, smaller diameter coir tubes have been pinned in place using soil anchors or spikes going up sandy coastal banks in an attempt to create biodegradable terraces. If vegetation could take hold, the bank could be stabilized. These projects have greatest potential for success on lower slope, wave-protected shorelines.

All of these geotextile approaches have value as a short-term measure and have greatest likelihood of success in lower energy settings.

Of greatest relevance to evaluation of approaches to stabilizing the Harborview Road shoreline is the setting. At Harborview Road, there is a gravel/boulder beach. There is no (significant) sand, no longshore transport issues, and apparently no exchange of sediment with the nearshore. The backbeach is a vertical stone wall extending up the base of the coastal bank. With the exception of isolated areas where stones in the wall were raveled or shifted, the bank is largely protected from coastal processes. This is confirmed by the generally thick, mostly upland, vegetation along most of the shoreline. Therefore, the wave energy, runup, and storm frequency characteristics are not important in this project design. The project site consists mostly of semi-cohesive glacial till and underwent a classic slump, or landslide. Although there are few details of the event itself, the failure event was driven by processes at the top of the slope, and consisted of development of a plane-of-failure, or crack in the material. The material seaward of the plane slid by gravity downward forming the slump block at the base. Typically, the moving material starts as a solid block (like a rockslide), then tumbles and mixes once moving until it stops at the base. It should be noted that this slump block overlies the existing vertical stone wall, which likely is in place, as the moving material is derived from the top, not the base of the slope. The lack of maintenance of this Town seawall is certainly one of the causative factors of the subsequent failure of the slope. Based on historic air photos and reports, the project site had the largest active erosion at the slope base (above the seawall), corresponding to the (reportedly) most degraded section of Town seawall. This evidence forms compelling evidence that the degraded seawall at this site contributed to or caused

the slope failure due to loss of vegetation and storm erosion removing the preexisting support from the base.

The most challenging aspect of the project site is that the plane-of-failure is now the face of the upper bank and is near-vertical. As this area is not impacted by marine processes, it is best addressed by a geotechnical engineer whose expertise is slope stability, not marine processes. Of course, it will be reviewed by marine scientists and marine regulatory agencies.

Regrading the Slope: There has been some comment about the feasibility of removing the existing engineering structure at the top of the bank, which has the patio above it, and to then regrade the bank. The Order of Conditions, when issued in 2019, was issued with a Woods Hole peer report that acknowledged that the then-proposed engineering structure was necessary to protect not just the deck, but the house itself, and that the house predates 1978. I would not second guess that peer review opinion and the Order of Conditions that is still in effect. The existing engineering structure is keeping the upper area of the bank in place – it is functioning as designed and the house remains stable at this time. If the patio and the existing engineering structure were removed, and if the bank could be graded to meet the 3:1 slope as Mr. Humphries specifically advocated at the last meeting, that work would involve extensive use of large excavation equipment and trucks on the bank and the beach, and even such work would pose a significant risk of causing further damage to the stability of the slope and trigger further failure, endangering not just the locus at 51 Harborview, but the adjacent properties as well. Removal of the existing engineering structure and completely regrading the slope should be avoided at all cost.

In my view, and having considered all other given the geotechnical engineer's recommendation that the soil nail technology will be effective and should be used for all of the steeper areas of this slope, that recommendation should be followed on all the steep parts of this slope. Use of geotextile or jute or coir fabrics will not significantly improve the stability of the upper steep parts of this slope. Opposition to and delay of the work only increases the risk of additional failure of that slope.

The lower parts of the bank have a flatter, less steep slope and, as noted elsewhere, can effectively be stabilized with vegetation and fill as needed. The slump block that extends onto the beach will gradually erode back to the position of the vertical stone wall. Since that material is now actually contributing sediment to the beach and down drift coastal resources, I would caution against removal of that material.

Sealevel Rise: The structural aspects of the proposed project are above the 100-year flood elevation. The 100-year flood elevation is the maximum runup elevation in a 1% probability storm, the accepted standard. This a reasonable standard, as lower probability storms elevate water levels increasingly smaller amounts. The lowest part of the proposed soil nail system is 22 ft and which is 2 feet higher than the FEMA elevation (20 ft).

As the project is 2 feet higher than the FEMA elevation, rising sealevel should not directly impact this project for at least a century. At that time, if issues arrive, the most reasonable approach that can be foreseen from the present is to raise the elevation and upgrade the form of the seawall at the base of the slope to more effectively dissipate wave runup. Therefore, potential SLR is not expected to impact the proposed project.

Shoreline Erosion: Based on CZM shoreline change data, the position of the 1938 shoreline is the identical to the 2013 shoreline position at the project site. The Town seawall and the rocky characteristics of the beach appear to be effectively holding the position of the shoreline stable along this beach. Therefore, shoreline erosion is not a variable impacting this project.

The engineers have pulled back the soil nail system 10 feet from the northern boundary. A temporary construction fence will be set 1 foot onto the property and a fabric-backed riprap slope can be constructed without extending onto the abutter's property or diverting runoff toward it. Of course, we believe that extending the stabilization project across the property line to tie in with the established vegetated slope is the best alternative for all parties.

I look forward to discussing this information further, or other issues that you may have.

Yours truly,

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