# INDEPENDENT TECHNICAL REVIEW OF WINTHROP SHORES RESERVATION RESTORATION PROJECT

## EXECUTIVE SUMMARY

Over the last three years, the DCR has implemented long-delayed improvements to Winthrop Beach that were first proposed in the 1993 "Back to the Beaches Plan." The highly eroded beach required rebuilding to protect the seawall and reduce flooding and damage to the adjacent neighborhood of five thousand people.

Work completed from 2013-2014 included placement of approximately 500,000 cubic yards of material on the beach, repairs to existing groins and construction of a new terminal groin at the northerly end of the beach.

While the completed project has, thus far, fulfilled its role as shore protection, wave and tidal action has washed away fine sediments from the seaward edge of the northerly portion of the beach, leaving steep ridges of loose rounded stone and cobbles which are very difficult to traverse on foot, impairing public access.

DCR contracted with Tetra Tech, Inc. to review and evaluate the design and construction of the project in terms of best coastal engineering practices.

Tetra Tech's findings are as follows:

1. The studies and design reports leading to the final design were competently performed, using standard coastal engineering design principles as well as competent, adequately performed numerical modeling simulations of anticipated Project performance. Further, the inputs to those models were all in the range of acceptable scientific and engineering judgement.
2. The contract documents for the southern sections, DCR Project P11-2686-C3A and northern section, DCR Project P11-2686-C4A are competently prepared, meet the applicable engineering standards for such coastal work and reflect the results of the design studies.
3. The Project reflects the beach nourishment effectiveness for Shore Protection and Flood Damage Reduction conclusions reached by the U.S. Army Corps of Engineers in their August 1994 Reconnaissance Report for Winthrop Beach.
4. The Project as built and in today's post-construction condition provides a significant improvement to shore protection from pre-construction conditions.

5. The use of the soils from the Saugus roadway embankment mixed with gravel and cobble, from quarries in Lancaster and Carver, MA provided suitable and appropriately sized materials for beach nourishment on Winthrop Beach.

6. Given Winthrop Beach's open-ocean exposure to the most damaging NE-ENE winds, the depth of the Broad Sound near shore and the high-energy waves which result from that setting, it is not reasonably possible to maintain the nourishment as a sandy beach over the entire Project length.

7. In large measure, the eroded nourishment materials are not "lost" - nor has the fill been wasted; rather:

    - the sediments have been resorted and redistributed by nature, with the shingle, cobble components redistributed by waves and tidal forces into tall, steep shingle berms in the exposed areas;

    - the sand components have been washed into the broad sandy high-tide salient (curved beach) in the wave shadow of Five Sisters; and,

    - a gravelly, coarse sand low-tide beach is present between the salient and the breakwaters.

## TECHNICAL REVIEW

The following is Tetra Tech's report on its review of the Winthrop Beach Nourishment Project (also referred to, variously, as the Winthrop Shores Reservation Restoration Project and the Winthrop Shore Protection Design Project; for simplicity, hereafter the "Project"). Responses to questions posed to the Massachusetts Department of Conservation and Recreation (DCR), observations during a site visit conducted by two members of the Tetra Tech Team on 05 May 2016, relevant clarifications provided in a teleconference call held between representatives of DCR, the Parsons Brinckerhoff Team and Tetra Tech on 05 May, and an on-site meeting with DCR staff on 06 May all serve to contribute to the findings of this report.

### 1. BACKGROUND

In response to Winthrop residents' displeasure with the stony composition of the seaward face of the completed Project, the Massachusetts Department of Conservation and Recreation (DCR) retained Tetra Tech Inc. to provide an independent technical review to determine if this shore protection project was designed and constructed in accordance with best engineering practices. The effort includes a review of relevant Project documents, discussions with DCR staff and site visit observations conducted on 05 and 06 May 2016. The overall Project location (within which the approximate limits of restoration – constructed in two segments and referenced as 'southern nourishment' of 960 feet [ft] and a 'northern nourishment' segment of 2,200 ft) is shown in Figure 1. The Project documents that were provided to Tetra Tech for review are

listed in routing slips from DCR dated 22 March 2016 and 28 April 2016 and included as Appendix A. In addition, DCR provided responses to questions posed by Tetra Tech; these responses are provided as Appendix B.

## 2. PREVIOUS STUDIES

In the early 1970s, the Metropolitan District Commission (now DCR) retained Dr. Miles Hayes of the University of South Carolina to review the coastal geologic conditions of the Boston coastal segments within Broad Sound and to provide recommendations for their restoration as beach areas. Dr. Hayes' final report[1] includes descriptions of the three beach areas, causes of beach erosion, and recommendations for the restoration of the beaches of Revere, Winthrop and Nantasket. The listed causes of erosion are:

1. Natural depletion of the sources of sediment;
2. Removal of sediment by man;
3. Reflection of waves off of vertical seawalls;
4. Abolition of dune areas; and,
5. Focusing of waves by refraction off of offshore bottom features.


Figure 1. Winthrop Shores Reservation Restoration Program – Shore Protection Project Limits (image courtesy of Google Earth)

[1] Hayes, M., O., E. K. Hubbard and D. M. FitzGerald (1973). Investigation of Beach Erosion Problems at Revere, Winthrop and Nantasket Beaches, Massachusetts, Department of Geology, University of South Carolina, Columbia, SC.

The second and third listed causes are currently (May 2016) under effective control in the Project boundaries, as a result of the constructed Project. However, the remaining three causes are still active in influencing erosion. The Hayes report emphasizes the importance of wave energy focusing by refraction on erosion at Winthrop Beach. The effect is so strong that the Hayes report goes on to recommend that:

> "Emplacement of sand fill at Winthrop Beach would be a waste of resources inasmuch as it will not stay on that beach because of the steep offshore slope, the exposure to large waves, and the difficulty in providing enough sand to avoid wave reflection from the seawall."[2]

The report went on to recommend the placement of riprap or coarse gravel on the beach as a means to protect the seawall. It is noted that, as a component of the constructed Project, a significant portion of the northern nourishment (72,392 cubic yards of the 367,718 cubic yards of material placed) was quarry-sourced/delivered gravel and cobble-sized sediments.

The Hayes report did provide recommendations for beach nourishment at Revere and Nantasket Beaches. Anecdotal mentions of the (at the time of preparation of the report) 'recent' Revere beach nourishment project suggested that it was performing up to public expectations.

The Hayes report further recommends the discontinuation of certain beach manicuring practices that have been used over the years at all three of the beaches studied. These include:

- Removal of stone and gravel from the beach;
- Bulldozing the natural beach profile into a plane surface;
- Pushing of gravel off of the berm (horizontal plateau formed by the deposition of beach material by wave action) and into the intertidal zone; and,
- Pushing sand from the intertidal zone onto the berm.[3]

It is noted that, while the above recommendations have merit from a coastal processes standpoint, there does not appear to be consideration given toward public safety or the ability of the public to gain reasonable access to the intertidal beach/shoreline.

In the lee (shadow) of the Winthrop Beach breakwaters, there appears to be sand remaining in the system, as evidenced during low tide. In this shadow region, there is no need for regrading activities. It is possible that this shoreline segment could realize sand transport back onto the upper portions of the berm under less energetic wave conditions typically associated with late spring/summer.

At the specific request of the Massachusetts Metropolitan District Commission (MDC-predecessor agency to the DCR), the U.S. Army Corps of Engineers completed a study[4] of the

[2] Ibid, page 6.
[3] Ibid, page 5.

Project area. The MDC sought federal participation and funding for the protection of the seawall and adjacent roadway and utilities following the no-name storm of October 1991 and the December 1992 blizzard.

The 1994 Reconnaissance Report considered a variety of shore protection options including modifications to the existing seawall and groins; revetment placement; construction of additional breakwaters; and beach restoration and nourishment. The report states "the most supportable alternative would appear to be placement of beachfill material."5

In the late 1990's, the DCR retained the design team led by Parsons Brinckerhoff with coastal engineering support from Aubrey Consulting/Woods Hole Group, Inc. and Applied Coastal Research & Engineering, Inc. The proposed restoration project designed by the Parsons Brinckerhoff team was consistent with the earlier reconnaissance study recommendations of the U.S. Army Corps of Engineers.

## 3. RESTORATION PROJECT FIELD STUDIES

Field investigation programs are outlined in some of the reviewed reports[6 and 7]. The reports cover: waves; water levels; winds; shoreline changes; sediment characteristics; condition of beach and beach amenities; inventory and description of sand trapping structures; and environmental, wetland and water quality issues. The studies appear to be comprehensive in nature and with a scope appropriate to the design of the restoration project. We do, however, have some concerns over some elements of the study that we discuss in the following sections.

### a. Tide Levels

The National Oceanic and Atmospheric Administration (NOAA) uses a specific 19-year period known as the National Tidal Datum Epoch as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g. mean lower low water, etc.). It is necessary for standardization because of periodic and apparent secular trends in sea level. The baseline studies were completed in 1999 and used tidal datum levels based upon the (then current) 1960-1978 tidal epoch**.** NOAA has revised tidal datum levels for all of its stations based upon the current tidal epoch of January 1983-December 2001. Values from the preceding tidal epoch are superseded by the current values. Table 1 presents the changes in sea level and the principal tidal datum levels for the two tidal epochs. It is noted that, although the more current epoch values were not utilized in the later design documents prepared by the Parsons Brinckerhoff team, the Mean High Water elevation value increased by 0.10 ft and the Mean Low Water elevation by 0.16 ft. The changed values, even had they been utilized, would not

[4] USACE, 1994. Winthrop Shore Drive/Winthrop Beach, Winthrop Massachusetts: Reconnaissance Report, New England Division.
[5] Ibid, Appendix B, page 7.
[6] Woods Hole Group, 1999. Marine Baseline Report, Winthrop Shores Reservation Restoration Program
[7] Parsons Brinkerhoff, 1999, Final Existing Conditions Report, Winthrop Shores Reservation Restoration Program.

likely have resulted in notable changes to the design elevations or widths of the placed sediments comprising the north and south nourishment project sites.

**Table 1. Tidal Datum Level Changes for NOS Tide Station Boston, Station ID 8443970**

| Tidal Datum | 1960-1978 Epoch Value[4] | | 1983-2001 Epoch Value[8] | |
|---|---|---|---|---|
| | ft, MLLW | ft, NGVD 88 | ft, MLLW | ft, NGVD 88 |
| Mean Higher High Water (MHHW) | 10.33 | 5.48 | 10.27 | 5.58 |
| Mean High Water (MHW) | 9.89 | 5.04 | 9.83 | 5.14 |
| National Vertical Datum (NAVD 88) | 5.12 | -- | 5.51 | -- |
| Mean Sea Level (MSL) | -- | -- | 5.20 | 0.51 |
| Mean Tide Level (MTL) | 5.12 | 0.27 | 5.09 | 0.40 |
| National Geodetic Vertical Datum (NGVD29) | 4.85 | 0.00 | 4.69 | 0.00 |
| Mean Low Water (MLW) | 0.34 | -4.51 | 0.34 | -4.35 |
| Mean Lower Low Water (MLLW) | 0.0 | -4.85 | 0.00 | -4.69 |
| Mean sea level rise increment | -- | -- | 2.8 mm/yr[9] | -- |

While the elevation of tides have changed approximately 0.1 ft in the 1983-2001 epoch from the prior epoch data then available for design it would not affect the overall wave energy and sediment transport analyses.

### b. Storm Water Levels

A U.S. Army Corps of Engineers reconnaissance report from 1994 as well as Federal Emergency Management Agency (FEMA) flood studies (undated) provided the baseline for extreme storm water levels that include tide and surge components. FEMA revised its flood studies and flood mapping for Suffolk County in 2009 and 2016[10]. Table 2 compares the still water storm levels from the baseline studies and the 2016 revision.

[8] NOAA, Tides and Currents website, URL: http://tidesandcurrents.noaa.gov/benchmarks.html?id=8443970 , Accessed 6 April 2016.
[9] Ibid, URL: http://tidesandcurrents.noaa.gov/sltrends/sltrends.html, accessed 11 April 2016.
[10] FEMA, 2016. Flood Information Study, Suffolk County, Massachusetts (All Jurisdictions), Community Number 25025C, effective date March 16, 2016.

**Table 2. Storm Elevations for Suffolk County, Massachusetts**

| Mean Recurrence Interval (years) | Baseline Studies | | FEMA FIS[8] |
|---|---|---|---|
| | NGVD 29, ft | NAVD 88, ft | NAVD 88, ft |
| 10 | 8.5 | 7.7 | 7.9 |
| 50 | 10.5 | 9.7 | 8.8 |
| 100 | 11.2 | 10.4 | 9.1 |
| 500 | 13.1 | 12.3 | 9.9 |

The baseline studies indicated that FEMA V-zone elevations at Winthrop Beach reached +22 ft above mean sea level (approximately +21 ft NAVD 88). The 2016 FEMA flood maps[11] now indicate V-zone elevations between +17 ft NAVD 88 and +19 ft NAVD 88.

FEMA reviewed still water flood elevations during an appeal period for Suffolk County. The analysis resulted in a reduction of the flood levels from its earlier estimates. The result is that the latest FEMA flood levels are generally less than the 1994 levels used in the baseline. Therefore, although the baseline studies used old flood level data, they still provided conservative estimates of flood levels for the Project area.

### c. Winds

The baseline marine studies used three sources of wind data that included NOAA wave buoy measurements, USACE hindcast data and wind measurements from the nearby Logan Airport. These sources provide a comprehensive wind database that is appropriate for use in the design of the beach restoration program.

### d. Waves

The baseline marine studies used two sources of wave data that included NOAA wave buoy measurements and USACE wave hindcast data. Additional studies of wave conditions by Aubrey Consulting, Inc. (ACI) and USACE supplemented the wave data program. The original plan of the baseline studies was to use the 40-year wave dataset produced by the USACE hindcast efforts[12]. After additional NOAA data became available, the plan changed to the use of 4 years (late 1993 to late 1997) of NOAA spectral data.

We agree with the conclusion that actual spectral wave measurements (NOAA data) are superior to hindcast data modeled from historical wind field records. However, the estimation of the beachfill performance using the **GENE**ralized Model for **SI**mulating **S**horeline Change (GENESIS) involves simulating the beach response over a long period of time (10 years in this case). Using only 4 years of wave data in the simulations could lead to erroneous performance predictions if the 4 year period of the wave data is not representative of the long-term wave

[11] FEMA, 2016. Flood Information Rate Maps, Suffolk County, Massachusetts (All Jurisdictions), Community Number 25025C, Map Numbers 25025C0038J and 25025C0102J, effective date March 16, 2016.

[12] Hubertz, J.M., R. M. Brooks, W. A. Brandon, and B. A. Tracy, 1993. Hindcast Wave Information for the US Atlantic Coast, WIS Report 30, March 1993, Wave Information Studies of the US Coastlines, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

climate at the site. We believe that there should have been some effort to evaluate if the 4 years of data are reasonably representative of the long-term wave climate at the site. Although the 40 years of USACE hindcast data result from modeling and not actual measurements, some analysis to those hindcast data and comparison to the NOAA results would have been able to determine if a representative set of wave data were being used.

**e. Shoreline Change**

The conceptual design studies used shoreline positions from the MassGIS 1994 aerial photograph, the MCZM shoreline change maps, and information generated from the 1954 beach fill plans. The Conceptual Design studies acknowledge that the GENESIS model application was limited to a single ten-year time period due to the limited amount of regional shoreline data. The study used all of the best data available and applied it in the modeling studies in an appropriate fashion.

**f. Sediment Characteristics**

The pre-Project, or 'native' beach at Winthrop was comprised of sand and gravel/cobble. The beach characteristics were well studied by the 1973 Hayes Report "Investigations of Beach Erosion Problems at Revere, Winthrop and Nantasket Beaches, Massachusetts". Eighty-five (85) samples were collected on the beach and the nearshore. . Hayes et al. summarized the sediment characteristics on Winthrop Beach as follows "…the beach can be divided into 6 facies…these are: naturally occurring sand, artificial sand, pebbles and gravel, pebbles and cobbles, boulders and mussels. Natural sand occurs in the area sheltered by the breakwaters. The rest of the beach is composed primarily of gravel…"[13]

The condition of the beach prior to the Project and its characteristics were also well studied by the design team beginning with their November, 1999 Existing Conditions Report that cited and documented with photographs the conditions: "Much of the intertidal region between the beach and the breakwaters is 'armored' by a layer of cobbles /gravel" (page 1-16).

The June 1999 Marine Baseline Report similarly reported no high tide beaches other than in the shadow of the Five Sisters breakwater and in exposed areas found: "beaches to the south are now armored by a layer of cobbles and gravel," and "[t]he beaches in the shoreline stretch protected by breakwater A [the most southerly breakwater], as well as groins 4 and 5 [south of the breakwaters], are primarily composed of gravel /cobble sized material", and "at the ramp providing beach access adjacent to Tewksbury Street…a low-elevation cobble-strewn beach fronts the seawall.".

The design engineer intended to replicate these sediment characteristics as closely as possible with the identification and proposed use of the New England Offshore Mining Environmental Study (NOMES) site (Site I) as the source of material for the Northern Nourishment. The

[13] Hayes, M., O., E. K. Hubbard and D. M. FitzGerald (1973). Investigation of Beach Erosion Problems at Revere, Winthrop and Nantasket Beaches, Massachusetts, Department of Geology, Univ. of South Carolina, Columbia, SC

rejection of the NOMES Site led to the evaluation, testing, and approval of alternative sources of sediment, which were derived from the Saugus embankment (approximately 80% of the total volume placed) as well as the Lancaster and Carver quarries (the remaining 20% of the placed volume, which was comprised of gravel and cobble). The design team utilized a 'blend' of these source materials with the intent of trying to match the pre-Project sediment characteristics (~1/3 sand and 2/3 gravel and cobbles) with those of the imported material.[14]

## 4. RESTORATION PROJECT CONCEPTUAL DESIGN

The conceptual design report[15] appears to provide the preponderance of the design analysis for the development of the recommended shore protection design elements in the overall Project restoration program. It is supplemented by the Notice of Project Change[16] that principally addresses the change in the proposed borrow site from the offshore NOMES Site I to the upland abandoned I-95 embankment site. The analysis uses recognized coastal engineering modeling and analysis tools in an extensive and detailed manner that is appropriate to the design of the proposed restoration program. The following sections present our specific comments with respect to the analyses.

### a. Storm Water Levels, Wave Runup and Overtopping

The summary of previous studies and reports relative to storm water levels and the subsequent selection of the more conservative 100-year water level elevation of 11.2 ft National Geodetic Vertical Datum (NGVD) from nearby Deer Island extremal analysis – as compared to a USACE determined 10.3 ft NGVD – would seem to be appropriate for the purposes of good design practice. Similarly, the procedures and assumptions used for the wave runup and overtopping analysis appears to have followed appropriate and recognized (at the time of the study) procedures and protocols used by the profession.

### b. Wave Modeling

The Conceptual Design Studies used the widely recognized REF-DIF S wave transformation model to propagate the wave conditions at the offshore NOAA buoy station to the nearshore Project location. REF-DIF S is a spectral wave model that when applied takes advantage of the spectral wave data collected at the NOAA buoy station. The model grid systems were set up to accurately reflect the influences of offshore bathymetric features and the Five Sisters on the incoming waves. The model appears to have been applied with care and consideration of all of the features of the Project area in an overall effort that was appropriate for the design of the beach restoration project. The general findings are also fully consistent with the results of earlier investigations of the site. These include:

---

[14] Department of Conservation and Resources, 2015. Winthrop Beach Nourishment Project Status Update: Conservation Commission Meeting, October 14, 2015 (PowerPoint Presentation).

[15] Woods Hole Group, 2000. Winthrop Shores Reservation Restoration Program, Conceptual Shore Protection Design, Task2 Report.

[16] Parsons Brinkerhoff. 2011. Winthrop Shores reservation Restoration Program, Winthrop, Massachusetts, Notice of Project Change, DDA # 10113, August 1, 2011.

- The islands offshore of Deer Island provide sheltering to landward areas, including the Winthrop Beach Project area particularly during southeasterly wave events;
- Winthrop Beach, north of the Five Sisters, is subject to significantly higher waves than adjacent beaches, particularly under northeast and east wave conditions;
- Winthrop Head and Winthrop Highlands are subject to higher waves under most wave conditions due to wave focusing caused by offshore shoals; and,
- The Five Sisters provide significant protection to the beach, seawall and upland development and infrastructure in the lee of the structures under all wave conditions.

As noted earlier, the wave data input to the modeling was limited to the four year period from late 1993 to late 1997. The only question that we have regarding the wave modeling effort is how well this limited dataset represents the long term wave climate at the Project site.

### c. Sediment Sampling and Analysis

The sampling of the pre-Project beach/shoreline as described in Section 4.0 of the Conceptual Design Report consisted of a series of discrete samples taken at various cross-shore positions at or near the shoreline at the time of the data collection. The distribution of samples both along the Project shoreline limits north-south and on both the dry beach and intertidal zone appear to have provided a reasonable and representative characterization of the sand present along Winthrop Beach. Only samples consisting of sand-sized fractions were collected (for the purposes of the Shoreline Change Modeling, evaluated below), with acknowledgement as to the presence and general location of significant occurrence of gravel and cobble sized sediments in the Project area. The collected sand samples were then subjected to a laboratory characterization (sieve analysis) conducted in accordance with American Society for Testing and Materials (ASTM) Standard D422. This standard of testing and analysis provides the appropriate level of detail necessary to determine the grain size distribution of the beach sediments.

### d. Shoreline Change Modeling

The baseline studies used the USACE GENESIS model to estimate the long term performance of the proposed beachfill. GENESIS was and is a recognized shoreline change model used by the coastal engineering profession. It tracks beach performance in terms of the horizontal changes of one beach elevation contour line. The baseline studies used model calibration and shoreline change predictions in a comprehensive effort that is consistent with the model developer's recommendations for the use of GENESIS.

There are specific elements of the application of GENESIS at Winthrop Beach where we have some issues and concerns. These are discussed in the following paragraphs.

*Calibration*

The Winthrop Beach Project area shoreline consisted of the seawall and limited or non-existent high tide beach area except in the tombolo region landward of the breakwaters. The usual shoreline feature used in aerial photo analysis of historical shoreline change is the high tide line. Therefore, there may not be much to record in the shoreline change area. This is critical,

since GENESIS model calibration is based on matching historical shoreline changes. The conceptual design studies used shoreline positions from the MassGIS 1994 aerial photograph, the MCZM shoreline change maps, and information generated from the 1954 beach fill plans. The Conceptual Design studies acknowledge that the GENESIS model application was limited to a single ten-year time period due to the limited amount of regional shoreline data.

*Model Limitations*

The baseline studies correctly point out that there can be significant errors associated with the prediction for shoreline change distances associated with limitations of the GENESIS model and the availability of site-specific data. These include:

- GENESIS assumes that nearshore bathymetric contours are straight and parallel – clearly, this is not the case at Winthrop Beach. GENESIS uses a simple, idealized cross-shore profile that does not match the site conditions. For example, the significant tidal flats found along portions of the site shoreline are not represented in the model;
- The GENESIS application was limited to a single ten-year time period due to the limited amount of regional shoreline data;
- GENESIS requires the application of a single median sand grain diameter for the entire modeled shoreline. Winthrop Beach sediments, however, vary considerably over the modeled extent of the beach.

*Cross Shore Transport*

GENESIS treats the volume of beach sand within the model domain conservatively. If there is erosion in one sector, there is a balancing of the local losses with accretion in other sectors of the Project area. Therefore, the cross-shore transport of sand associated with storm events or seasonal fluctuations in wave climate is not considered in GENESIS.

The early study by Hayes[1] noted that the steep offshore slopes and larger wave conditions resulting from refraction effects of offshore features places the Winthrop Beach area at considerable risk to the loss of sand by cross-shore transport. The inability of the GENESIS model to account for potentially significant sand losses drastically diminishes the value of its predictions of beachfill performance.

We believe that there should have been some recognition of the importance of cross-shore transport at Winthrop Beach. Analysis of the magnitude of potential cross-shore transport losses should have been completed to help evaluate the GENESIS model performance predictions. We understand that the design team considered the possible use of the Storm-induced BEAch CHange Model (SBEACH). SBEACH is a USACE Coastal & Hydraulics Laboratory-developed profile change model that may have had some application in this regard. However, as indicated during the 05 May teleconference call with Parsons Brinckerhoff and Applied Coastal Research and Engineering, Inc. representatives, SBEACH requires a significant amount of beach profile and storm data (as well as designation of a median grain size, typically in the sand-sized fraction) for accurate calibration. A simplified application using default calibration coefficients would provide at least a qualitative indication of the importance of cross-shore

losses. Additional evaluation (beyond the scope of this review) would be required to determine if downgrading of the GENESIS predicted beachfill project life would be warranted.

### e. Conceptual Shore Protection Design

The conceptual design process appears to have provided a comprehensive, appropriately 'multi-optioned' approach to address the beach erosion problems plaguing Winthrop Beach. As previously addressed, the consultant team used sound design principles and numerical model simulations as tools to develop a reasonable design solution. Several design challenges owing to site-specific conditions (e.g., previously constructed coastal armoring and shore protection structures; highly variable sediment characteristics and distribution across and along the Project shoreline), as well as limitations and caveats associated both with the site and with the numerical modeling, were clearly and succinctly stated.

## 5. RESTORATION PROJECT ENVIRONMENTAL IMPACT STUDIES

Owing to the extensive topical areas covered by the Winthrop Shores Reservation Restoration Program Final Environmental Impact Report (FEIR), we have necessarily limited our comments to ***only*** those aspects pertaining to the shore protection aspects of the study. Further, given the change in the sediment source from the NOMES Site I to the embankment materials, evaluation of this section of the report is moot. Similarly, the studies of finfish, shellfish and macroinvertebrates at the beach, while necessary components of the overall Project evaluation, are not the subject nor charge of this review.

The following statement is noted on page ES-15 of the Executive Summary:

> *"The DCR is committed to maintaining the nourishment for the primary purpose of shore protection to Winthrop Shore Drive. Results of the monitoring will be examined versus specific trigger conditions, which have been established, to determine if activities to initiate renourishment are required."*

The beach fill project in 1959 with 245,000 cubic yards of sand, in conjunction with other improvements to provide storm protection, is a curiosity insofar as there does not appear to be much reporting of the performance of the beach fill component of the work; that is, how did the material behave once placed? However, from the U.S. Army Corps of Engineers August 1994 Reconnaissance Report, which was undertaken as a follow-up assessment of the 1959 authorized project, we know what the conditions were at that time, approximately 20 years prior to the project under peer review. That report found, in spite of the paucity of monitoring and shoreline condition data along Winthrop shore, that following the No-Name Storm in October, 1991 and the December, 1992 Blizzard in particular, the normal high water line north of the shadow zone in the lee of the Five Sisters was washing at the base of the seawall and storm waves were directly attacking it. The 1992 storm led to collapse of a section of the wall and the street behind it.

Section 6 of the FEIR (Groin Construction) provides indication of the design intent for the terminal groin north of Locust Street to be subjected to an "overbuild" of nourishment sediments at an elevation some three feet higher than the proposed crest elevation of the groin stem. The report goes on to state "…therefore, the existing groins will be completely buried by the proposed beach fill project. Initial equilibration of the fill material will sort the sediments and flatten the offshore profile. It is anticipated that the groins will remain buried after the initial beach equilibration." Further, the stated design intent of the terminal structure was to enhance the design life (performance) of the beach fill by inhibiting and/or prohibiting longshore transport to the north, and to prevent migration of fill and coverage of the rocky intertidal substrate to its north. The consultants gave clear indication and expectation that there would likely be 'mobilization' of the sediments into this area, owing to the dynamic wave environment and exposure at Winthrop Beach.

The physical (profile/transect) monitoring proposed in Section 7 of the report appears to have followed appropriate industry standards and reflects a reasonable spatial and temporal distribution of data to ascertain the fill performance. The proposed wading profiles to elevation -5 ft NGVD between annual events, which were proposed to extend either to -15 ft NGVD or the landward toe of the Five Sisters breakwaters, offers a cost-effective means of assessing the cross-shore adjustment of the placed sediments.

## 6. RESTORATION PROJECT DESIGN

The Notice of Project Change increased the estimated required volume of fill from the 500,000 cubic yards (cy) value listed in the Final Environmental Impact Report to a range of 500,000 to 650,000 cy of beach nourishment material, and changed the source of the fill material from the offshore NOMES Site I to the abandoned highway embankment in Saugus and Revere (Rumney Marsh) [17]. The Notice of Project Change provides an analysis of the initial losses of the beach nourishment material that result from the differences in the grain size distributions of the existing Project beach and the embankment borrow area. The analysis shows that the expected initial losses would amount to 15%, or about 75,000 cy of the planned beach nourishment volume. An additional 75,000 cy of fill volume was added to the proposed plan to take into account other factors. First, the beach survey used in the planning was then 12 years old, and the current beach profile would have eroded during that time interval. Second, the now larger fill volume would extend the construction time, furthering the risk of incurring additional losses of placed fill.

During the final design, it became apparent that avoiding unsuitable materials within the embankment site would result in an insufficient volume of beach fill material for the northern nourishment segment, and further, that the embankment sediments were approximately 95-98% sand (John Ramsey, telecom 05 May 2016). Of the total 367,718 cy placed in the northern nourishment shoreline segment, the suitable sand borrow from the Saugus embankment yielded 295,326 cy of fill. The final Project design called for providing about 20% of the material

[17] Ibid, page 1.

from two quarry sites (Lancaster and Carver). Material requirements for the 72,392 cy of 6" minus gravel are outlined in the Technical Specifications for the Northern Section, Item Number 148 500 (Furnish Beach Nourishment Material) of the construction documents.

The design team relied on their professional experience and performance reports on cobble beach systems in Europe to develop the size requirements of the additional quarry-sourced material. In addition, the use of the quarried gravel and cobble was to replicate to the extent practicable the 'native' (pre-Project) sediment characteristics. Review of sediment analyses conducted by the design team to accomplish this objective suggests that a comprehensive, logical and thorough treatment of the issue/concern was undertaken. The broad distribution of sand-sized to gravel sediments found on the pre-Project ("native") beach shoreline presented a particular design challenge to replicate. The use of the sand-sized fraction from the Saugus embankment, coupled with the coarser-grained (gravel to cobble) components from the Lancaster and Carver sites, appears to represent the most reasonable and effective means of 'matching' the nourished to the existing, pre-Project sediments, to the extent practicable.

## 7. ISSUED REGULATORY AUTHORIZATIONS

The design team clearly adhered to application for, and processing/approval of, all requisite federal and state regulatory reviews and authorizations needed to construct the Project. These included:

- Order of Conditions under the Massachusetts Wetlands Protection Act (DEP File #NE 082-0379, and Superseding Order of Conditions (DEP File #067-1001). These authorizations included the water quality certification for the Project;
- Chapter 91 authorization for the terminal groin construction, also issued by MA DEP (License #11732);
- Coastal Zone Management Consistency Review, issued by the MA Office of Coastal Zone Management (File #6855);
- Section 10 of the Rivers and Harbors Act of 1899/Section 404 of the Clean Water Act authorization by the USACE New England District (Department of the Army Permit Number NAE-2012-497); and,
- Section 106 review in accordance with the National Historic Preservation Act.

While the issued permits were provided to Tetra Tech by the DCR, these authorizations do not *specifically* relate to the charge of the peer review. Therefore, no additional statements or observations regarding this aspect of the Project implementation are offered.

## 8. POST-CONSTRUCTION MONITORING

On 26 April 2016, DCR provided Tetra Tech with AutoCAD files of the first three quarterly monitoring surveys, conducted in August and November 2015, and March 2016. The files provided plan view contour plots of the Project shoreline and nearshore zones from the seawall (~+20 ft) to -10 (elevations referenced to Boston base). Representative cross sections comparing the three surveys at the locations are shown in Figure 2 (Plan view). At Coral Avenue

and Dolphin Avenue the approximate shoreline location midway between Ocean Avenue and Irwin Street, and midway between Charles and Moore Streets, are shown comparatively in Appendix C. The vertical scale is exaggerated at 5:1 to better show the relevant changes in the beach profile elevations and slopes.

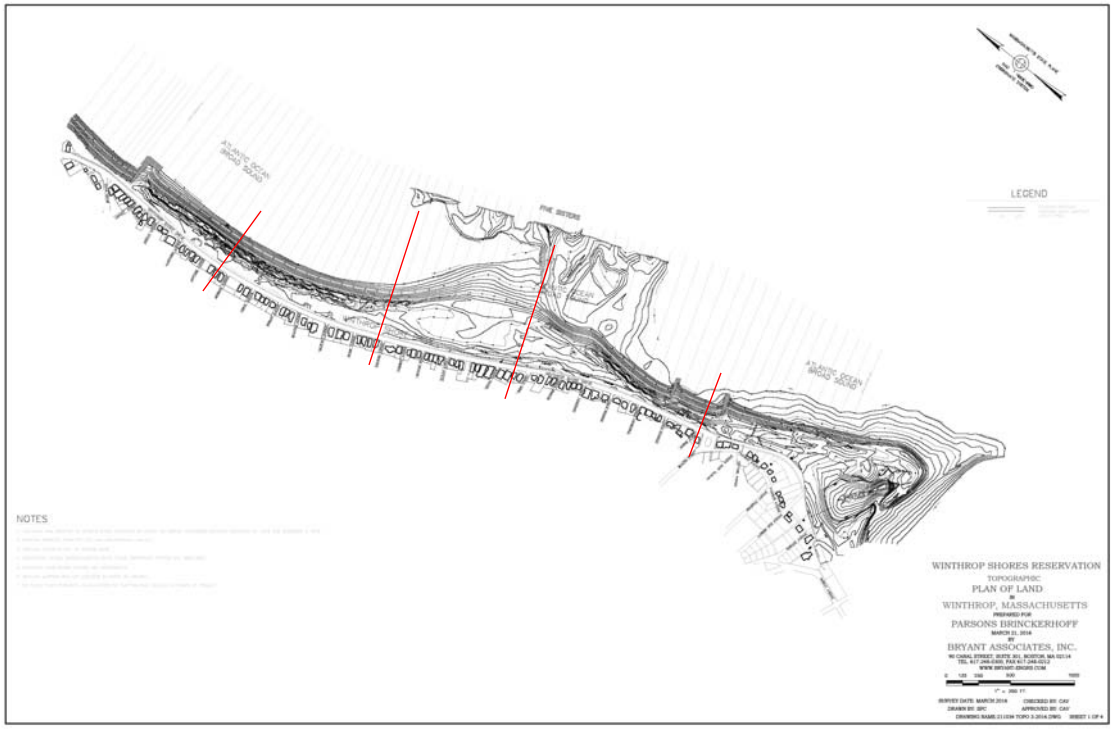



Figure 2. Plan view of Project Shoreline Contour Plot with Locations of Selected Cross-Sections for Comparison (see Appendix C for representative cross sections comparing the three surveys).

Overall, the survey data shows adjustments that would be expected following a restoration or nourishment project to the upper beach berm position over the time period August 2015 to March 2016, and only modest shoreline position changes at elevation +5. This provides a partial indication of the overall stability of the placed materials.

## 9. SITE VISIT BY TETRA TECH 05 MAY 2016

Tetra Tech conducted a site visit of the Winthrop Beach shoreline on Thursday 5 May 2016. The timing of the 05 May inspection enabled coastal engineers to observe the condition of the shoreline over the range of tide, with the timing of arrival largely coincident with the high tide event at approximately 1045 hours. The weather at the time of the inspection was intermittent light to moderate rain showers, winds NE at 15-20 mph, temperature 45 degrees Fahrenheit. Two inspectors walked the entire ~5,000 ft Project shoreline commencing from a point roughly due east of Crystal Cove Avenue (approximately 200 ft south of the southern groin S-1), and ending roughly coincident with a point due east of the intersection of Beach Road and Winthrop Shore Drive (approximately 200 ft north of the terminal groin).

The back beach berm that ties into the seawall from approximately Tewksbury Street north to approximately Pearl Avenue could be generally characterized at the time of the site inspection, near or shortly following high tide, to contain a relatively broad and moderately-sloped (1:15) face, with the width noted as highly variable along this entire reach of shoreline. Representative views of this shoreline segment are provided as Photographs 1, 2 and 3. The remaining emergent shoreline noted during high tide in this reach transitions from a largely sand and medium gravel to cobble interspersed sediment matrix to one more dominated by cobble sized units. It is noted that this area is roughly coincident with the 'shadow' of the Five Sisters.


Photograph 1. Upper beach berm near Underhill Street looking South-southeast toward Groin #5/south terminus of Project.


Photograph 2. Lower beach berm in the 'shadow' of the middle breakwater (Sister) looking north. Photo taken east of mid-point between Ocean Avenue and Cutler Street.


Photograph 3. Project shoreline in lee of northernmost breakwater ("Sister") looking north; photo taken east of Forrest Street.

North of Pearl Avenue, and continuing north to the terminus of the Project, the shoreline configuration was noted to transition rapidly to not only a narrower beach width, but a much steeper (1:3) berm face comprised of gravel, cobble and small boulders. The back beach berm was noted to gradually diminish to approximately 30 ft in width from the face of the seawall to the exposed crest of the terminal groin (Photographs 4 and 5).

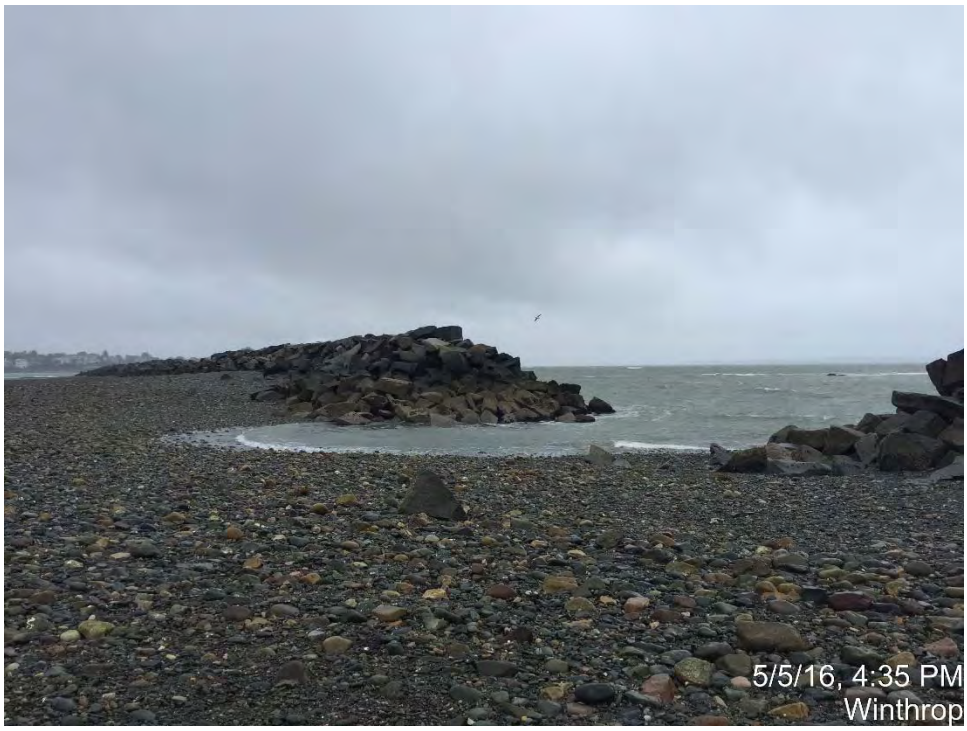
Photograph 4. Project shoreline in vicinity of Trident Avenue.

Photograph 5. Project shoreline in the vicinity of the terminal groin, located approximately 180 ft north of the Locust Street/Winthrop Shore Drive intersection.

South of Tewksbury Street to the south Project limit, the shoreface was noted to be similarly comprised of gravel and cobble, but the berm slopes were not as steep nor as high in crest elevation as those noted between Seafoam and Myrtle Avenues in particular (Photograph 6).


Photograph 6. Project shoreline in the vicinity of Charles Street.

Returning to the beach at low tide (~1545 hours), winds were noted to be generally NE at 20 mph with occasional gusts estimated at 25 mph, moderate to heavy rain, temperature 42 degrees Fahrenheit. With water levels at approximately 1 ft below normal, much of the lower portion of the beach could be readily observed. Again commencing at the south end, Tetra Tech engineers traversed much of the southern shoreline from Groin #5, noting that the seaward terminus of the southernmost two groins were completely emergent. It was possible to walk to the landward edge of the southernmost three breakwaters at this time. A sand and gravel matrix was observed on a low, flat tombolo platform extending to each of these breakwater units. The crescentic gap between the middle and fourth breakwater was estimated to extend landward approximately 50 ft to the water's edge at the time the tombolos were traversed on foot (Photograph 7).




Photograph 7. Tombolo formation in the lee of the middle Sister
and the adjacent breakwater to the south just beyond the time of low tide.

The beach platform during the time of the site inspection exhibits the characteristics of a reasonably continuous - albeit variable - emergent shoreline. There was no location along the entire Project shoreline where the beach width, even at high tide, was noted to be less than approximately 60 ft seaward of the seawall protecting Winthrop Shore Drive and the infrastructure and properties landward of it. The most narrow berm locations observed at high tide were noted at and immediately north of the terminal groin, and between Groins 4 and 5 (approximately 100 ft north of Moore Street). Along the remainder of the Project shoreline, beach widths were noted to be significantly wider than the above-noted locations.

## 10. SUMMARY OF FINDINGS

The Project beach, as observed on 05 May 2016, is comprised of a mix of sand, gravel, and cobbles, with the shoreline position displaying variable widths over the approximately 4,900 ft of shoreline between the groins that serve to 'anchor' the Project fill. Following review of the relevant files furnished by DCR, discussions with DCR staff and representatives of the design team, and the site visit, it is evident that the Project, as designed and constructed, has provided storm protection seaward of the seawall (and hence to Winthrop Shore Drive and the existing development and infrastructure) in the form of a beach berm of variable width and height. At no location along the shoreline, as evidenced by both the March 2015 post-nourishment condition survey and the 05 May 2016 site inspection by Tetra Tech, is the seawall or Winthrop Shore Drive imminently threatened by direct wave attack under non-storm conditions.

Rocky beaches including Winthrop Beach make up a significant portion of the world's shorelines. They are variously called cobble, shingle, and rubble beaches. Significant portions of the east facing Massachusetts coast line consists of shingle beaches or coarse sandy gravel beaches in small coves between rocky headlands ("pocket" beaches). The NW-SE trending coastline on the South Shore between Nantasket, Hull and Brant Rock, Marshfield consists primarily of such beaches. In several cases, such as Mann Hill Beach and Humarock Beach in Scituate (see Photographs 8 and 9), homes are built directly on the shingle berm with steep cobble winter berms on the seaward face.

Photograph 8. Mann Hill Beach, Scituate, MA

Photograph 9. Humarock Beach, Scituate, MA

During the 1980's, the Delft Hydraulics Institute in the Netherlands conducted an extensive research program on the static and dynamic stability of rubble mound revetments, breakwaters and gravel beaches. Large breakwaters resist wave attack with little or no movement of the individual breakwater units. These are referred to as statically stable systems. Cobble and sand beaches respond to wave attack by shifting of the beach material so that there is a change in the beach profile but without significant movement of the material off of the nearshore beach. These are referred to as dynamically stable systems. Van der Meer[18] presented the research results for dynamically stable structures and profile development. Cobble beaches are one of the most efficient forms of coastal protection. They exhibit a remarkable degree of stability in the face of sustained wave attack. They have been considered as a form of shore protection because of this stable performance and the availability of Van der Meer's analysis techniques.

Examples of the application of cobble beaches for shore protection exist worldwide. Oregon developed design recommendations[19] for dynamic revetments on its coast; a cobble beach forms part of the shore protection system for the latest expansion of the Port of Rotterdam[20] out into the North Sea. The most significant feature of the Rotterdam project is its design storm

[18] Van der Meer, J. W. and K. W. Pilarczyk, 1986. Dynamic Stability of Rock Sloped and Gravel Beaches, Proceedings of the 20th International Conference on Coastal Engineering, Taipei, 9-14 November 1986.

[19] Allan, J. C., R. Geltgey, and R. Hart, 2005. Dynamic Revetments for Coastal Erosion Stabilization: A Feasibility Analysis for the Application on the Oregon Coast, Special Paper SP-37, State of Oregon, Department of Geology and Mineral industries.

[20] Loman, G. J. A., 2009. "Massvlakte 2" Project: The winning DCM Bid with an EMSAGG Focus on the Innovative Cobble Sea Defense, European Marine Sand and Gravel Group – A Wave of Opportunities for the Marine Aggregate Industry, EMSAGG Conference, 7-8 May, 2009 Rome.

conditions. In its project specifications, the Port of Rotterdam required that the harbor area landward of the sea defense system could not be flooded or eroded during the operational phase of the project during or after an extreme North Sea storm surge which has a recurrence interval of 10,000 years. This translates to a design wave height of 7.9 meters and a storm surge level of 5.1 meters above chart datum. The paper claims that the cobble beach design provided the lowest total cost of ownership with a sustainable “green shore solution”.

Cobble beaches are common along the northeast-facing shorelines of Massachusetts Bay. Hundreds of families live directly on such beaches and have enjoyed the recreation afforded by such beaches for many generations. The photographs 8 and 9 are just an example of such cobble beach homes in Massachusetts.

## 11. CONCLUSIONS AND RECOMMENDATIONS

The native cobble shoreline of Winthrop Beach has the capability to provide significant shore protection for the community. This capability can be enhanced with a designed cobble beach nourishment program such as has been successfully demonstrated in Oregon and the Netherlands. The existing cobble beach north and south of the Five Sisters’ wave shadow presents recreational access challenges, and part of the nourishment design should be an evaluation of the means to improve recreational access while providing the storm protection benefits.

Figures 3, 4 and 5 show the high and low water marks before the Project, as the Project was designed and the Project in March, 2016. These figures are based upon actual field surveys and construction drawings. As is evident from an inspection of the beach today, the wave energy, primarily in the winter and spring of 2015 and 2016, has resorted and redistributed the fill materials which were placed by December, 2014.

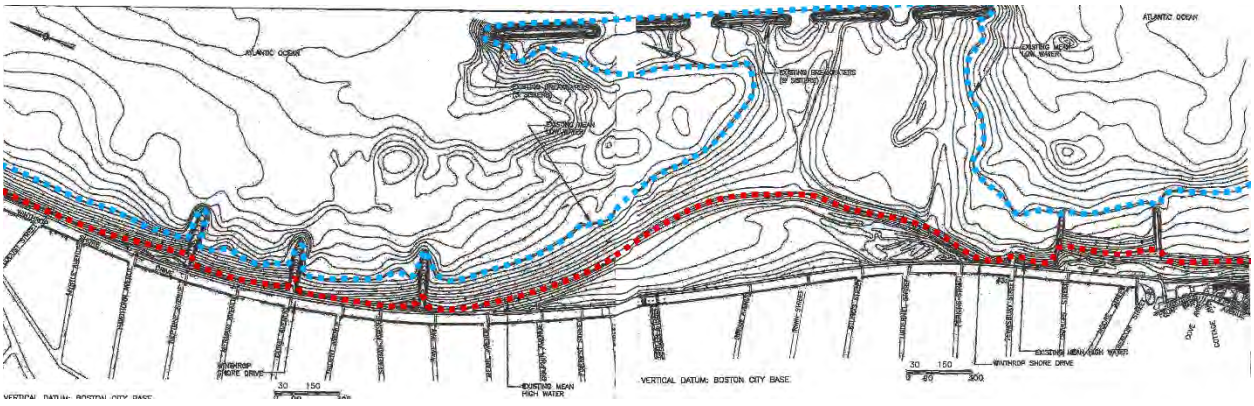



Figure 3. Pre-construction shorelines.


Figure 4. Design shorelines.

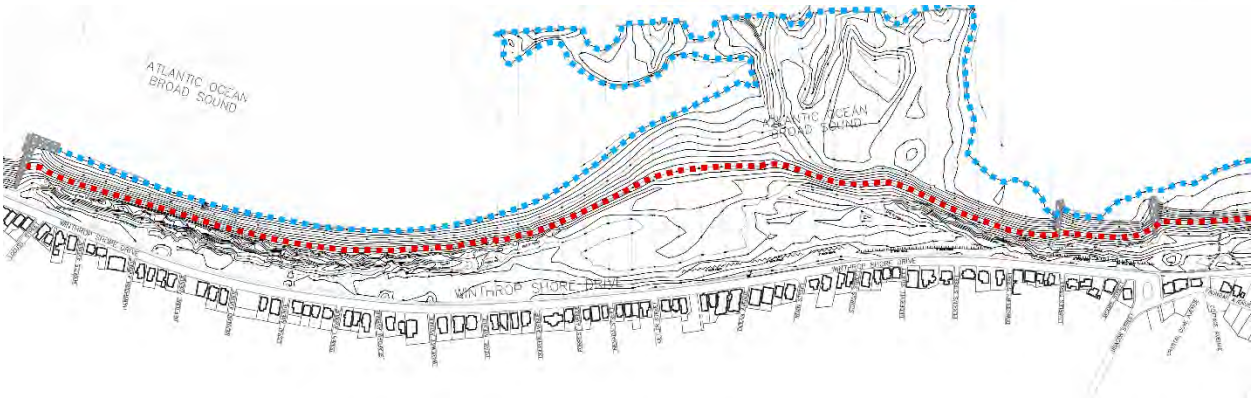



Figure 5. Post-construction shorelines.

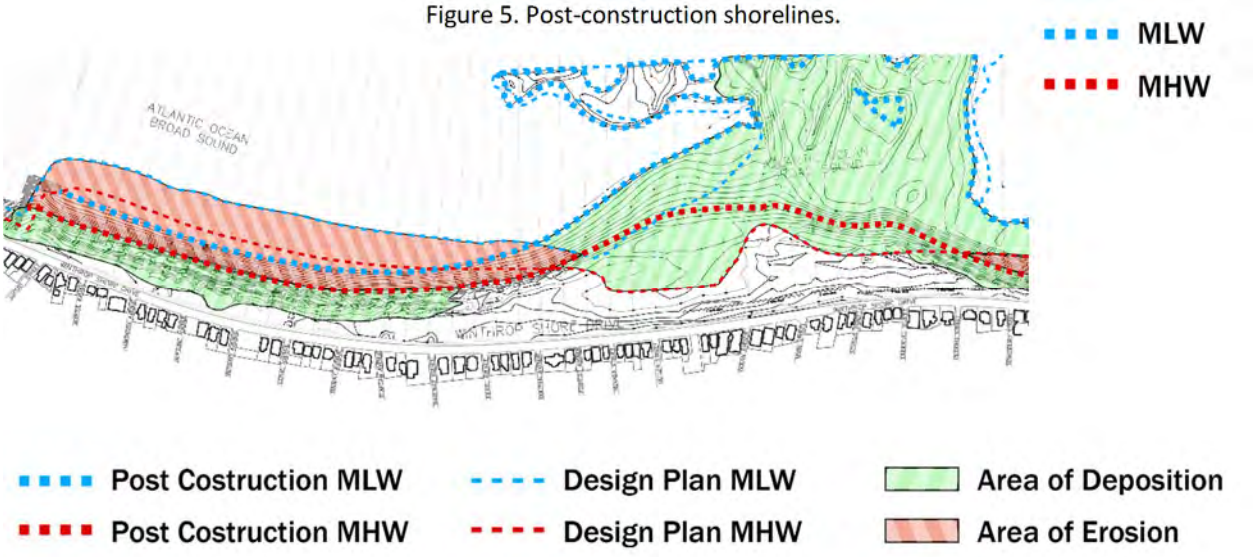



Figure 6. Erosion and deposition of the fill materials.

In the areas north and south of the Five Sisters the winter beach form has a narrow 60-100 foot sandy-gravel beach above the tide with a steep shingle berm raised along the intertidal zone. In

the wave-shadow of the Five Sisters there is a broad, above -the-tide sandy curved salient. The intertidal beach profile here displays much more modest (flatter) slopes and allows for accessibility to a broad low tide sandy gravel tombolo beach extending to the breakwaters. The low tide beach has some mixed shingle cover in undulations, but contains numerous small coarse sand pools and rivulets depending upon the state of the tide.

In the exposed areas, it may be possible to provide a sandy beach segment adjacent to the seawall that is maintained by a sustainable cobble beach system seaward of the sandy beach. It may also be possible in these exposed areas to flatten the shingle berm profiles by grading the berm crest into the intertidal zone to improve access along all of the beach without destabilizing the protective value of the beach. From a shore protection perspective, a desirable outcome would be to have the shingle berm reside in the intertidal zone during the summer's gentler southwesterly off-shore winds and be available in the winter to be reformed into a tall protective shingle berm for the winter nor'easters. While this activity was not recommended in the earlier Hayes report, it is necessary to provide convenient access to the water and does not threaten the stability of the beach.

The U.S. Army Corps of Engineers 1994 Reconnaissance Report concluded that the costs of additional offshore breakwaters could not be justified by an equivalent or greater reduction in storm damage risk. Federal and State coastal regulations do not favor offshore fixed structures because of the impacts to natural resources. The breakwaters built in 1933 and 1935 are an anomaly along Massachusetts shores and would face very lengthy (5 years plus) environmental and permitting processes with no sure outcome. They would have to overcome the 1994 Corps of Engineers conclusions and show significant increase in storm damage protection. Their costs and the potential impacts to marine fisheries habitat could not be justified by creating a bigger sandy recreation beach in their wave shadow.

## PEER REVIEW SUMMARY

In summary, from our independent peer review of the Project we concluded the following:

1. The studies and design reports leading to the final design were competently performed, using standard coastal engineering design principles as well as competent, adequately performed numerical modeling simulations of anticipated Project performance. Further, the inputs to those models were all in the range of acceptable scientific and engineering judgement. *No flaws in the design that would have affected the outcome of the project were found.*

2. The contract documents for the southern sections, DCR Project P11-2686-C3A and northern section, DCR Project P11-2686-C4A are competently prepared, meet the applicable engineering standards for such coastal work and reflect the results of the design studies. *The plans and specifications were complete and sufficient to provide the construction contractor with all of the information needed to complete the project.*

3. Over the past two winters, the beach nourishment project has proved to be an effective way to protect the shore and reduce flood damage, as predicted by the U.S. Army Corps of Engineers in their August 1994 Reconnaissance Report for Winthrop. *The project achieved the projected results from this earlier comprehensive study.*

4. The Project as built and in today's post-construction condition provides a significant improvement to shore protection from pre-construction conditions. *Waves overtopping the seawall and debris being deposited on Winthrop Shore Drive have been controlled.*

5. The use of the soils from the Saugus roadway embankment mixed with gravel and cobble, from quarries in Lancaster and Carver, MA provided suitable and appropriately sized materials for beach nourishment on Winthrop Beach. *Use of different sand size would not have changed the sand loss from the beach*.

6. Given Winthrop Beach's open-ocean exposure to the most damaging NE-ENE winds, the depth of the Broad Sound near shore and the high-energy waves which result from that setting, it is not reasonably possible to maintain the nourishment as a sandy beach over the entire Project length. *The orientation of Winthrop Beach exposes it to tremendously focused storm wave conditions that will continue to remove any beach nourishment sand from the beach over a short period of time.*

7. In large measure, the eroded nourishment materials are not "lost" - nor has the fill been wasted; rather:

    - the sediments have been resorted and redistributed by nature, with the shingle, cobble components redistributed by waves and tidal forces into tall, steep shingle berms in the exposed areas;

    - the sand components have been washed into the broad sandy high-tide salient (curved beach) in the wave shadow of Five Sisters; and,

    - a gravelly, coarse sand low-tide beach is present between the salient and the breakwaters.

**12. ABOUT THE REVIEW TEAM**

Ocean sciences and coastal engineering have been one of Tetra Tech's core competency areas since its founding 50 years ago. Now with 16,000 employees and a $2.5 billion a year business, those skills have only been expanded. For this peer review we have reached into those skills combining the local knowledge of our senior Boston staff with the special expertise of our water resources group.

These are the principal reviewers:

**Michael (Mike) Barnett, PE, Senior Coastal Engineering Project Manager.** *(M.E., Coastal & Oceanographic Engineering, University of Florida, 1987; B.S., Ocean Engineering, Florida*

*Institute of Technology, 1981, and Diplomate, Coastal Engineering, Academy of Coastal, Port & Navigation Engineers, October 2011).* Mr. Barnett has 31 years of experience in coastal engineering and has led technical teams in the feasibility, planning, design, engineering, permitting, and construction document preparation for beach restoration and nourishment projects for critically-eroding beaches fronting the Atlantic Ocean and Gulf of Mexico.

**Richard (Dick) Czlapinski, PE, D.CE, Senior Coastal Engineer, Project Manager.** *(O.E., Ocean Engineering professional degree, Massachusetts Institute of Technology, 1975; M.S., Ocean Engineering, Massachusetts Institute of Technology, 1975; B.CE., Civil Engineering, University of Detroit, 1969, and Diplomate, Coastal Engineering, Academy of Coastal Ocean Port and Navigation Engineers, December 2009)*. Mr. Czlapinski has 44 years of professional experience in civil and coastal engineering and the design of beach nourishment and coastal protection. He has extensive experience in project feasibility and design studies, hydrodynamic, hydrothermal and contaminant transport modeling, dredging and coastal sediment transport investigations.

**Robert (Bob) Daylor, PE, PLS, Senior Vice President.** *(MS, Civil Engineering, Northeastern University, 1968; BS, Civil Engineering, Northeastern University, 1961, and Postgraduate Loeb Fellow in Advanced Environmental Studies, Harvard University, 1977)*. Mr. Daylor has over 50 years of experience in the planning and design of works in and near sensitive landscapes such as coastal and inland wetlands and flood hazard areas.

**Edward (Ed) Ionata, Senior Vice President.** *(MS, Forestry and Environmental Science, Yale University, 1982, and BS, Natural Resources, University of Rhode Island, 1980.)* Mr. Ionata has 33 years of experience in the implementation of multi-disciplinary projects. He managed environmental review, permitting and construction compliance for two of the largest public infrastructure projects in the United States – the $15B Central Artery/Tunnel and the $3.5B Deer Island Wastewater Treatment Plant and Outfall.

# Appendix A

dcr
Massachusetts

# Routing Slip

TO: Ed Ionata, Tetra Tech

FROM: Dave Ouellette

DATE: 03/22/16

SUBJECT: Winthrop Beach Peer Review

| | |
|---|---|
| ☒ For Your Information | ○ Make Recommendations |
| ○ Please Advise | ○ Note and Return |
| ○ Approval Needed | ○ File |
| ○ See Below | ○ Take Necessary Action |

## *Comments:*

Attached are copies of the following:

Reports and Studies:

- Investigation of Beach Erosion Problems at Revere, Winthrop and Nantasket Beaches, Massachusetts, by Miles O. Hays, 1973;
- Plan for the Future of Boston Harbor Beaches by Lane, Frenchman and Associates, Inc., June 1993;
- ✓ Metropolitan District Commission Winthrop Shores Reservation Restoration Program Marine Baseline Report by Woods Hole Group et al, June 1999;
- Metropolitan District Commission Winthrop Shores Reservation Restoration Program Final Existing Conditions Report by Parsons Brinckerhoff, November 1999;
- Winthrop Shores Reservation Restoration Program Conceptual Shore Protection Design Task 2 Report by Woods Hole Group & Applied Coastal Research and Engineering, Inc., March 2000;
- Winthrop Shores Reservation Restoration Program Alternatives Analysis developed for the DEIR by Parsons Brinckerhoff Quade & Douglas, Inc. et al, May 2002;
- Winthrop Shores Reservation Restoration Program, Final Environmental Impact Report by Parsons Brinckerhoff Quade & Douglas, Inc. et al, October 2005; and
- Winthrop Shores Reservation Restoration Program, Winthrop Massachusetts, Notice of Project Change by Parsons Brinckerhoff et al, August 2011.

Permits and Associated Permit Applications:

- Winthrop Beach Nourishment Order of Conditions;
- USACE permit (2012-497);
- MESA permit (DCR7044);
- DEP Ch. 91 permit for dredging (13331); and
- DEP Ch. 91 license for Groin #6 (11732).

dcr
Massachusetts

# Routing Slip

Construction Documents:

- Construction plans for Winthrop Beach Nourishment, Southern Section, Project No. P11-2686-C3A by Parsons Brinckerhoff, Inc. et al, April 2013;
- Construction specifications book for Winthrop Beach Nourishment, Southern Section, Project No. P11-2686-C3A;
- Construction plans for Winthrop Beach Nourishment, Northern Section, Project No. P11-2686-C4A by Parsons Brinckerhoff, Inc. et al, April 2013; and
- Construction specifications book for Winthrop Beach Nourishment, Northern Section, Project No. P11-2686-C4A.

dcr
Massachusetts

# Routing Slip

TO: Mike Barnett, P.E., D.CE

FROM: Dave Ouellette

DATE: 4/28/16

SUBJECT: Winthrop Beach

| | |
|---|---|
| X For Your Information | ○ Make Recommendations |
| ○ Please Advise | ○ Note and Return |
| ○ Approval Needed | ○ File |
| ○ See Below | ○ Take Necessary Action |

## *Comments:*

Mike,

Enclosed are the two volumes of the Draft Environmental Impact Report (DEIR) from December 2002. Within the DEIR is some additional discussion of the Alternatives Analyses performed for Winthrop Beach. This may be useful for the peer review.

Best regards,
Dave

# Appendix B

| | |
|---|---|
| **From:** | Ionata, Edward |
| **To:** | Ouellette, David (DCR) |
| **Cc:** | Czlapinski, Richard; Barnett, Michael; Daylor, Robert |
| **Subject:** | Winthrop Beach Peer Review - Clarifying Questions |
| **Date:** | Monday, April 11, 2016 3:01:56 PM |
| **Attachments:** | WINTHROP BEACH PROJECT REVIEW questions to DCR.docx |

Dave – here are the questions we discussed. Responses to some or all would be helpful. If you want to respond in writing that is great, but a conference call will work just as well,

Thanks,

Ed

**Edward Ionata** | Senior Vice President

Direct **+1 508-786-2276** | Business **+1 (508) 786-2200** | Mobile **+1 401-474-7463** | ed.ionata@tetratech.com

**Tetra Tech** | Complex World, Clear Solutions™

**WEI Water Environment Infrastructure** | 100 Nickerson Road., Marlborough, MA 01752 | tetratech.com Please consider the environment before printing. Read More.

**WINTHROP BEACH PROJECT REVIEW – QUESTIONS**

1. An early (1973) study and recommendations for the Metropolitan District Commission of the Commonwealth of Massachusetts of Revere, Winthrop and Nantasket Beaches was conducted by Dr. Miles Hayes, Dr. Dennis Hubbard and Dr. Duncan Fitzgerald (Hayes, et al.). The recommendations offered by Hayes et al. for Winthrop Beach do not appear to have been considered in the design of the nourishment project. Is there some other study (not included in our package) that might offer an explanation as to why?

2. Is there a Scope of Work that outlines the Parsons Brinckerhoff Team's overall tasks under the contract with the DCR and its predecessor agency? When was nourishment project that is the subject of the current peer review initially envisioned/contracted?

3. The Winthrop Shores Reservation Restoration Program, Notice of Project Change (EEA #10113) dated August 1, 2011, suggests higher anticipated losses by utilization of the abandoned I-95 embankment material in Saugus in lieu of the preferred NOMES Site 1. The (denied/rejected by the USACE) NOMES offshore borrow source contains coarser grain size material than the embankment sediments, and the PB Teams' assertion that higher embankment sourced beach fill losses would be anticipated owing to the finer grain size and the increased construction time are valid, logical and defensible statements. This, coupled with outdated survey data available for the project shoreline and hence an ability to accurately assess the attendant nourishment volume needed to fill the design template, the design volume was thereby increased from 500,000 to 650,000 cubic yards. We are trying to determine if there is a document, report or other file element that might provide additional rationale behind equally allocating a 15% contingency factor for the design volume, essentially twice.

4. Attachment D of the Notice of Project Change document (a Memorandum prepared by Applied Coastal Research and Engineering, Inc. dated July 15, 2011) contains an appropriately-prepared compatibility analysis of the Saugus embankment material versus the 'native' (existing) beach. An overfill factor of 1.15 was assigned, with a recommendation that, for planning purposes, 600,000 cubic yard nourishment volume "…would be appropriate for the Winthrop Beach project, assuming losses during the 18 month placement can be minimized." What was the overall duration of the actual truck haul construction? And, were there documented storms that may have adversely impacted the sediment transport during construction?

5. We understand that there may be some ongoing work involving the regrading of the cobble beach berms. We are unable to locate any documents in our package provided on 22 March 2016 that provides the design basis for this work. Is there such a document detailing the regrading work?

| | |
|---|---|
| **From:** | Barnett, Michael |
| **To:** | Barnett, Michael |
| **Subject:** | FW: Winthrop Beach Peer Review - Clarifying Questions |
| **Date:** | Wednesday, May 18, 2016 2:54:01 PM |
| **Attachments:** | 160407 Cover letter.pdf<br>Cobble Rework Plan.pdf |

---

**From:** Ouellette, David (DCR) [mailto:David.Ouellette@MassMail.State.MA.US]
**Sent:** Wednesday, April 13, 2016 8:59 AM
**To:** Ionata, Edward
**Cc:** Galvin, Mike (DCR)
**Subject:** RE: Winthrop Beach Peer Review - Clarifying Questions

Hello Ed,

Attached is the letter and plan filed with the Winthrop Conservation Commission for the regrading of the cobble proposed for this May.

I have distributed your other questions to various project team members for responses. I will touch base late today or tomorrow with some additional information.

Thanks,

*David Ouellette, PE*
*Department of Conservation and Recreation (DCR)*
*251 Causeway Street, Suite 700*
*Boston, MA 02114*
*(617)626-1347*
*david.ouellette@state.ma.us*

---

**From:** Ionata, Edward [mailto:ed.ionata@tetratech.com]
**Sent:** Monday, April 11, 2016 4:02 PM
**To:** Ouellette, David (DCR)
**Cc:** Czlapinski, Richard; Barnett, Michael; Daylor, Robert
**Subject:** Winthrop Beach Peer Review - Clarifying Questions

Dave – here are the questions we discussed. Responses to some or all would be helpful. If you want to respond in writing that is great, but a conference call will work just as well,

Thanks,

Ed

**Edward Ionata** | Senior Vice President
Direct **+1 508-786-2276** | Business **+1 (508) 786-2200** | Mobile **+1 401-474-7463** | ed.ionata@tetratech.com

**Tetra Tech** | Complex World, Clear Solutions™
**WEI Water Environment Infrastructure** | 100 Nickerson Road., Marlborough, MA 01752 | tetratech.com Please

consider the environment before printing. Read More.

April 7, 2016

Winthrop Conservation Commission
Winthrop Town Hall
One Metcalf Square
Winthrop, MA 02152

**RE: Additional Work at Winthrop Beach**
**DEP File #082-0391**

Dear Commissioners:

This letter is to inform you of work that the Department of Conservation and Recreation (DCR) wishes to add and amend to the existing Order of Conditions for the above referenced file numbers at Winthrop Beach.

In addition to the previously submitted additional work package, we'd like to submit for your review and consideration the enclosed proposal for rework of the cobble material on Winthrop Beach.

The attached plan shows the area of cobble and a typical section for proposed conditions. The latest monitoring survey performed shows a cobble ridge of approximately 100 feet in width running from the new terminal groin structure to the newly constructed Pearl Avenue entrance.

The proposed plan would involve using some earth moving equipment on the beach to flatten the existing ridge to a more manageable height by moving the cobbles within the ridge. No work would be done to the sandy berm between the ridge and the seawall, nor would any work infringe on the sandy intertidal area that is developing between MLW and MHW.

Contractor access will be from the existing Cutler Street entrance. A straw wattle perimeter will be set up parallel to the seawall to allow the Contractor a path to reach the cobble ridge, but also keep any of the threatened bird species from wandering into the worksite. This perimeter will be removed as soon as construction is completed.

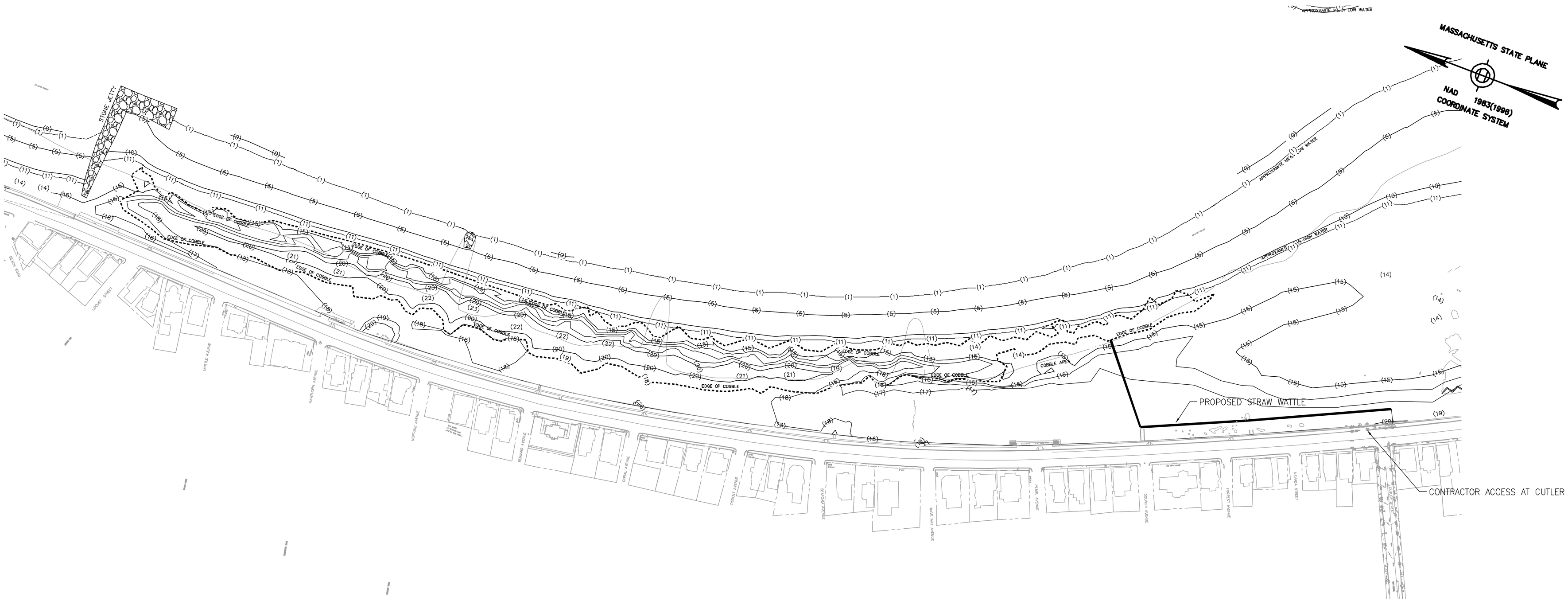
Additionally, an equipment pad will be set up in accordance with the existing Order of Conditions with plastic sheeting, crushed stone, and fencing to stage the machinery overnight.

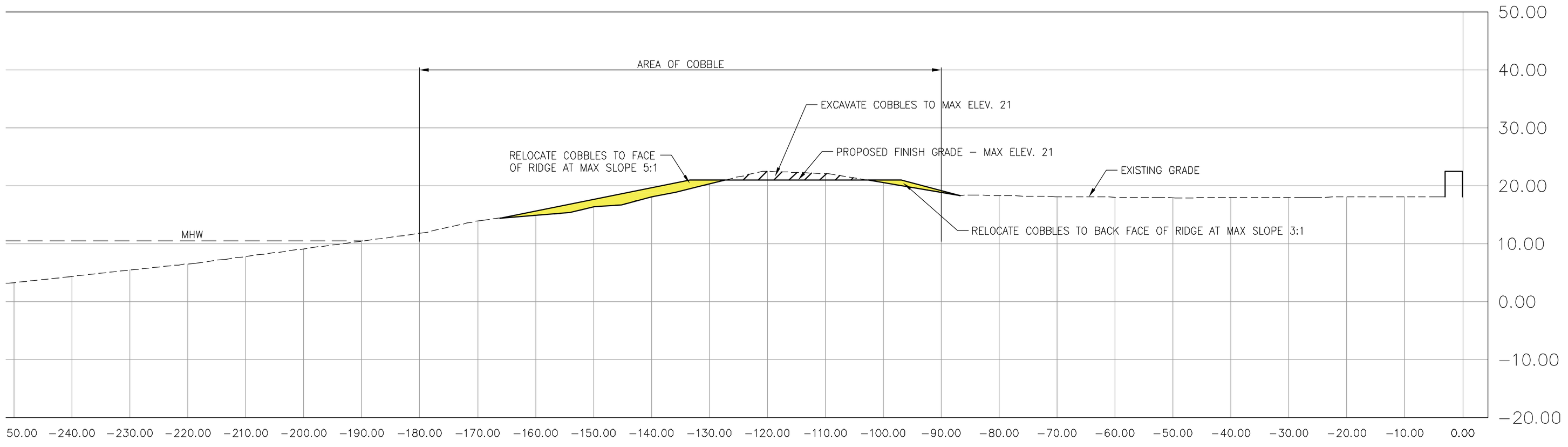
If you or any of the Commissioners have any questions or concerns, please do not hesitate to contact me or the Department's project manager, Mike Galvin.

Sincerely,

Rachel J. Burckardt, Project Manager
Parsons Brinckerhoff

c: M. Galvin, DCR Project Manager
D. Ouellette, DCR Project Engineer




WINTHROP BEACH SHORE PROTECTION

**From:** Barnett, Michael
**To:** Barnett, Michael
**Subject:** FW: Question from Tetra Tech
**Date:** Wednesday, May 18, 2016 2:53:56 PM

---

**From:** Ouellette, David (DCR) [mailto:David.Ouellette@MassMail.State.MA.US]
**Sent:** Wednesday, April 13, 2016 9:47 AM
**To:** Ionata, Edward
**Cc:** Galvin, Mike (DCR)
**Subject:** FW: Question from Tetra Tech

Ed,

Regarding question 4, placement of nourishment material on the northern section of beach occurred from May 2014 through December 2014. Basic weather logs from the resident engineer are attached. The logs lack detailed information on weather, but they do document days of precipitation and wind. For detailed info on storms, you may have to go online and check historical data for those dates noted as stormy or windy.

Best regards,

*David Ouellette, PE*
*Department of Conservation and Recreation (DCR)*
*251 Causeway Street, Suite 700*
*Boston, MA 02114*
*(617)626-1347*
*david.ouellette@state.ma.us*

---

**From:** Colometo, Steven (DCR)
**Sent:** Wednesday, April 13, 2016 9:33 AM
**To:** Ouellette, David (DCR)
**Subject:** RE: Question from Tetra Tech

Hi Dave: See attached.

---

**From:** Ouellette, David (DCR)
**Sent:** Wednesday, April 13, 2016 8:34 AM
**To:** Colometo, Steven (DCR) <scolometo@MassMail.State.MA.US>
**Cc:** Vickery, Michael (DCR) <Michael.Vickery@MassMail.State.MA.US>
**Subject:** Question from Tetra Tech

Hi Steve,

Below is the questions from Tetra Tech. Whatever records you have of storm events from May through December 2014 would be helpful.

"Were there documented storms that may have adversely impacted the sediment transport during construction?"

Thanks,
Dave

# WEATHER & TEMPERATURE LOG

| 5/1/2014 | WEATHER | TEMP. |
|---|---|---|
| 5/1/14 | RAIN | 49 |
| 5/2/14 | CLEAR | 51 |
| 5/5/14 | CLEAR | 51 |
| 5/6/14 | CLEAR | 47 |
| 5/7/14 | CLEAR | 46 |
| 5/8/14 | CLEAR | 52 |
| 5/9/14 | CLOUDY | 51 |
| 5/10/14 | CLOUDY | 56 |
| 5/12/14 | CLEAR | 61 |
| 5/13/14 | CLOUDY | 50 |
| 5/14/14 | CLEAR | 48 |
| 5/15/14 | CLOUDY | 61 |
| 5/16/14 | CLEAR | 64 |
| 5/17/14 | RAIN | 54 |
| 5/19/14 | CLEAR | 51 |
| 5/20/14 | CLEAR | 52 |
| 5/21/14 | CLEAR | 54 |
| 5/22/14 | DRIZZLE | 52 |
| 5/23/14 | CLOUDY | 54 |
| 5/24/14 | CLOUDY | 53 |
| 5/26/14 | "HOLIDAY" | |
| 5/27/14 | CLEAR | 66 |
| 5/28/14 | LT. RAIN | 50 |
| 5/29/14 | CLEAR | 47 |
| 5/30/14 | CLEAR | 51 |
| 5/31/14 | CLOUDY | 53 |

# WEATHER & TEMPERATURE LOG

| 6/1/2014 | WEATHER | TEMP. |
|---|---|---|
| 6/2/14 | CLEAR | 55 |
| 6/3/14 | CLEAR | 55 |
| 6/4/14 | RAIN | 56 |
| 6/5/14 | RAIN | 63 |
| 6/6/14 | CLOUDY | 55 |
| 6/7/14 | CLEAR | 63 |
| 6/9/14 | CLOUDY | 70 |
| 6/10/14 | CLOUDY | 62 |
| 6/11/14 | CLEAR | 59 |
| 6/12/14 | CLOUDY | 60 |
| 6/13/14 | RAIN | 58 |
| 6/16/14 | CLEAR | 61 |
| 6/17/14 | CLEAR | 64 |
| 6/18/14 | CLEAR | 73 |
| 6/19/14 | CLEAR | 72 |
| 6/20/14 | CLEAR | 63 |
| 6/23/14 | CLEAR | 62 |
| 6/24/14 | CLEAR | 63 |
| 6/25/14 | CLEAR | 66 |
| 6/26/14 | LT. RAIN | 73 |
| 6/27/14 | CLEAR | 62 |
| 6/30/14 | CLEAR | 65 |

# WEATHER & TEMPERATURE LOG

**2014**

| JULY | WEATHER | TEMP. |
|---|---|---|
| 7/1/14 | CLEAR | 73 |
| 7/2/14 | CLEAR | 75 |
| 7/3/14 | OVERCAST | 73 |
| 7/4/14 | "HOLIDAY" | |
| 7/7/14 | CLOUDY | 72 |
| 7/8/14 | CLEAR | 76 |
| 7/9/14 | CLEAR | 74 |
| 7/10/14 | CLOUDY | 64 |
| 7/11/14 | CLOUDY | 67 |
| 7/12/14 | CLEAR | 63 |
| 7/14/14 | CLOUDY | 74 |
| 7/15/14 | DRIZZLE | 74 |
| 7/16/14 | CLOUDY | 70 |
| 7/17/14 | CLOUDY | 66 |
| 7/18/14 | CLEAR | 68 |
| 7/21/14 | CLOUDY | 61 |
| 7/22/14 | CLEAR | 69 |
| 7/23/14 | CLEAR | 72 |
| 7/24/14 | CLEAR | 74 |
| 7/25/14 | CLEAR | 64 |
| 7/28/14 | RAIN | 70 |
| 7/29/14 | CLEAR | 64 |
| 7/30/14 | CLEAR | 62 |
| 7/31/14 | CLEAR | 63 |

# WEATHER & TEMPERATURE LOG

2014

| SEPTEMBER | WEATHER | TEMP. |
|---|---|---|
| 9/2/14 | CLEAR | 72 |
| 9/3/14 | CLEAR | 75 |
| 9/4/14 | CLEAR | 84 |
| 9/5/14 | | |
| 9/6/14 | CLEAR | 79 |
| 9/8/14 | CLEAR | 61 |
| 9/9/14 | CLEAR | 63 |
| 9/10/14 | CLOUDY | 60 |
| 9/11/14 | CLOUDY | 63 |
| 9/12/14 | | |
| 9/13/14 | CLOUDY | 51 |
| 9/15/14 | CLEAR | 47 |
| 9/16/14 | CLOUDY | 55 |
| 9/17/14 | CLEAR | 53 |
| 9/18/14 | CLOUDY | 51 |
| 9/19/14 | CLEAR | 48 |
| 9/22/14 | CLEAR | 65 |
| 9/23/14 | CLEAR | 48 |
| 9/24/14 | CLEAR | 59 |
| 9/25/14 | CLOUDY | 54 |
| 9/26/14 | CLOUDY | 57 |
| 9/27/14 | CLEAR | 59 |
| 9/29/14 | CLEAR | 65 |
| 9/30/14 | DRIZZLE | 66 |

# WEATHER & TEMPERATURE LOG

**2014**

| OCTOBER | WEATHER | TEMP. | |
|---|---|---|---|
| 10/1/14 | LT. RAIN | 57 | |
| 10/2/14 | RAIN | 55 | |
| 10/3/14 | CLOUDY | 48 | |
| 10/4/14 | LT. RAIN | 52 | |
| 10/6/14 | CLEAR | 45 | |
| 10/7/14 | CLEAR | 56 | |
| 10/8/14 | CLOUDY | 62 | |
| 10/9/14 | CLEAR | 53 | |
| 10/10/14 | CLEAR | 50 | |
| 10/11/14 | RAIN | 60 | |
| 10/13/14 | CLEAR | 44 | "HOLIDAY" |
| 10/14/14 | CLOUDY | 62 | |
| 10/15/14 | CLOUDY | 60 | |
| 10/16/14 | RAIN | 62 | |
| 10/17/14 | DRIZZLE | 51 | |
| 10/18/14 | CLOUDY | 57 | |
| 10/20/14 | CLEAR | 39 | |
| 10/21/14 | LT. RAIN | 53 | |
| 10/22/14 | RAIN | 51 | |
| 10/23/14 | RAIN & WIND | 51 | HIGH TIDES |
| 10/24/14 | CLOUDY | 47 | |
| 10/25/14 | CLEAR | 45 | |
| 10/27/14 | CLEAR | 47 | |
| 10/28/14 | CLOUDY | 46 | |
| 10/29/14 | CLOUDY | 60 | |
| 10/30/14 | CLOUDY | 45 | |
| 10/31/14 | CLOUDY | 46 | |

# WEATHER & TEMPERATURE LOG

**2014**

| NOVEMBER | WEATHER | TEMP. | |
|---|---|---|---|
| 11/1/14 | CLOUDY/WINDY | 43 | |
| 11/3/14 | CLEAR | 37 | |
| 11/4/14 | CLEAR | 45 | |
| 11/5/14 | CLOUDY | 55 | |
| 11/6/14 | CLOUDY | 48 | |
| 11/7/14 | CLEAR | 33 | |
| 11/10/14 | CLEAR | 41 | |
| 11/11/14 | | | " HOLIDAY " |
| 11/12/14 | CLOUDY/FOGGY | 51 | |
| 11/13/14 | CLEAR | 38 | |
| 11/14/14 | CLOUDY | 36 | |
| 11/15/14 | CLEAR | 28 | |
| 11/17/14 | RAIN | 38 | |
| 11/18/14 | CLOUDY | 38 | |
| 11/19/14 | CLEAR | 24 | |
| 11/20/14 | CLEAR | 34 | |
| 11/21/14 | CLEAR | 30 | |
| 11/22/14 | CLEAR | 26 | |
| 11/24/14 | RAIN | 40 | |
| 11/25/14 | CLOUDY | 58 | |
| 11/26/14 | CLOUDY | 46 | |
| 11/27/14 | | | " HOLIDAY " |
| 11/28/14 | CLOUDY | 28 | |

# WEATHER & TEMPERATURE LOG

2014

| DECEMBETR | WEATHER | TEMP. | |
|---|---|---|---|
| 12/1/14 | CLEAR | 48 | |
| 12/2/14 | CLOUDY | 33 | |
| 12/3/14 | LT. RAIN | 39 | |
| 12/4/14 | CLEAR | 33 | |
| 12/5/14 | CLEAR | 27 | |
| 12/8/14 | CLEAR | 33 | |
| 12/9/14 | RAIN | 39 | |
| 12/10/14 | LT. RAIN | 40 | |
| 12/11/14 | LT. RAIN/ LT. SNOW | 34 | |
| 12/12/14 | CLEAR | 31 | |
| 12/15/14 | CLEAR | 33 | |
| 12/16/14 | OVERCAST | 37 | |
| 12/17/14 | RAIN | 43 | |
| 12/18/14 | LT. RAIN | 37 | |
| 12/19/14 | CLOUDY | 29 | |
| 12/22/14 | CLOUDY | 39 | |
| 12/23/14 | LT. RAIN | 44 | |
| 12/24/14 | LT. RAIN | 42 | |
| 12/25/14 | XXX | XXX | " HOLIDAY " |
| 12/26/14 | CLEAR | 35 | |
| 12/29/14 | CLEAR | 25 | |
| 12/30/14 | CLEAR | 20 | |
| 12/31/14 | CLEAR | 22 | |

Storm 1/26/15 - 1/28/15
2/7/15 - 2/10/15

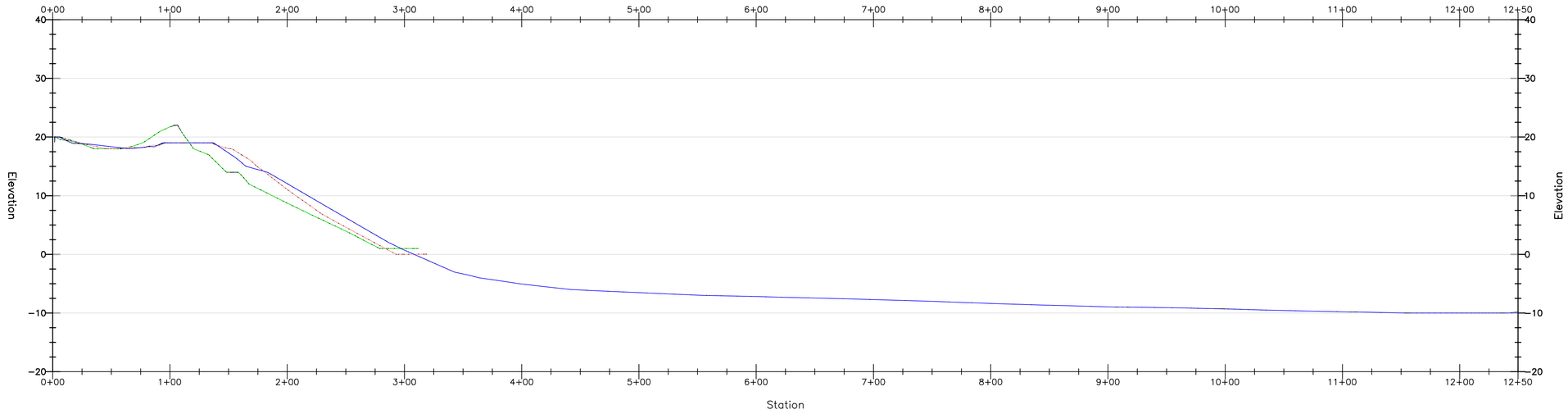
# Appendix C

GRAPHIC SCALE

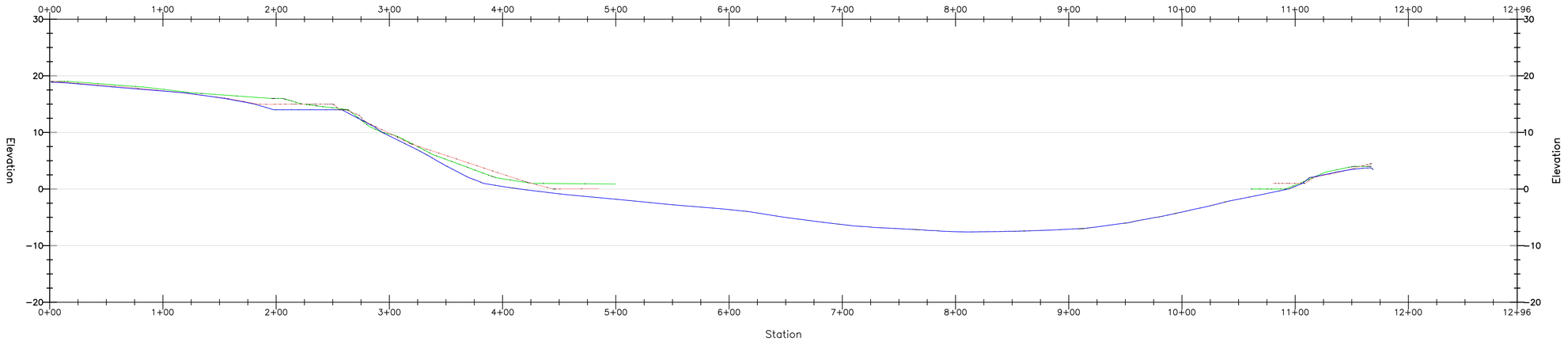
100 0 25 50 100

( IN FEET )

## Profile View of Coral Avenue Section




## Profile View of Dolphin Avenue Section




LEGEND:

AUGUST 2015 SURVEY

NOVEMBER 2015 SURVEY

MARCH 2016 SURVEY

NOTES:

1. CROSS SECTIONS SCALED 1H:5V.

| Mark | Description | Date | Appr. |
|---|---|---|---|
| | | | |
| | | | |

Designed by:

Drawn By: J. DAVIS

Checked By: M. BARNETT

Reviewed By:

Design file no:

Scale: AS SHOWN


**TETRA TECH** INC.
1901 SOUTH CONGRESS AVE.
SUITE 200
BOYNTON BEACH, FL 33426
TEL (561) 735-0482
FAX (561) 742-6813

CERTIFICATE OF AUTHORIZATION NO. 2429


**WINTHROP SURVEY COMPARISON**

Sheet Reference:

FIG-1

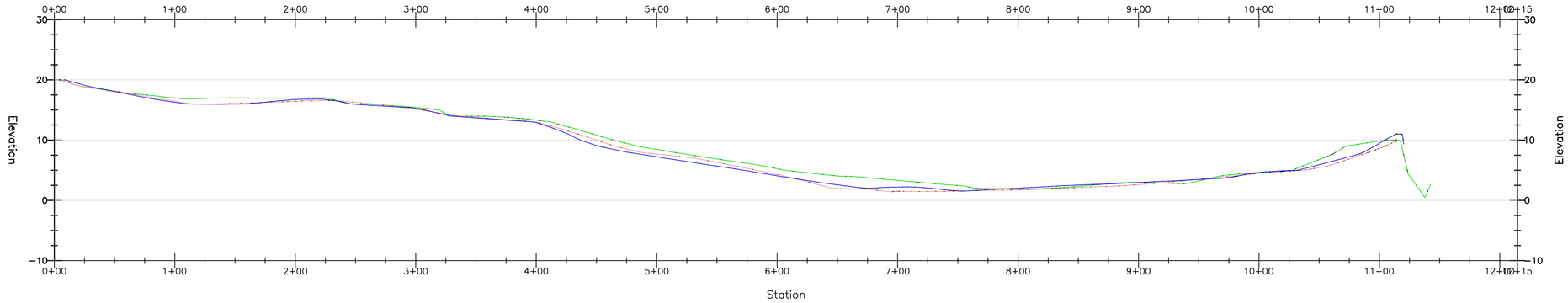
Sheet 1 of X

GRAPHIC SCALE

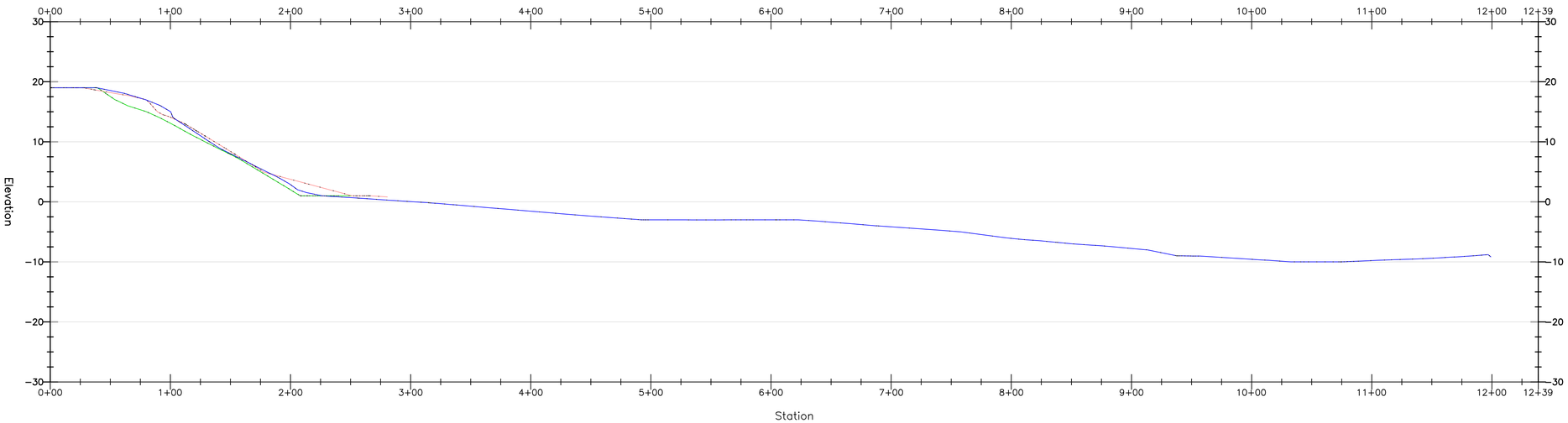
100 0 25 50 100

( IN FEET )

## Profile View of Ocean Ave – Irwin St Section




## Profile View of Charles – Moore's Street Section




LEGEND:

- AUGUST 2015 SURVEY
- NOVEMBER 2015 SURVEY
- MARCH 2016 SURVEY

NOTES:

1. CROSS SECTIONS SCALED 1H:5V.

| Mark | Description | Date | Appr. |
|---|---|---|---|
| | | | |
| | | | |

Designed by:
Drawn By: J. DAVIS
Checked By: M. BARNETT
Reviewed By:
Design file no:
Scale: AS SHOWN


**TETRA TECH** INC.
1901 SOUTH CONGRESS AVE.
SUITE 200
BOYNTON BEACH, FL 33426
TEL: (561) 735-0482
FAX: (561) 742-6813


CERTIFICATE OF AUTHORIZATION NO. 2429

**WINTHROP SURVEY COMPARISON**

Sheet Reference:
FIG-2
Sheet 1 of X