

DRAFT

**Memorandum – Coastal Engineering Review
Review of USACE Proposed Mitigation for Impacts Rockaway
Peninsula Storm Risk Reduction on Sediment Transport to GATE JBU
Atlantic Beaches
TAR 19876**

13 October 2021

REVIEW REQUEST SUMMARY

GATE - Coastal Engineering Review of Rockaway Peninsula storm damage reduction

Introduction and Background

The US Army Corps of Engineers (USACE) New York District (NYD) is constructing a storm risk reduction project for the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay area in the boroughs of Queens and Brooklyn in New York City. The project area was severely impacted by Hurricane Sandy in October 2012. The project includes construction of a reinforced dune along the Atlantic, construction of additional groins, modification of existing groins, and cyclical beach nourishment along the Atlantic shoreline east (updrift) of Fort Tilden and Riis Park.

GATE enabling legislation (16 U.S. Code Subchapter LXXXVII) requires a plan that is “mutually acceptable to the Secretary of the Interior and the Secretary of the Army” and consistent with the purpose of the park. To mitigate for the impacts of the project to sediment transport processes to GATE Jamaica Bay Unit Atlantic Ocean beaches, USACE will provide initial beach nourishment at Riis Beach and a cyclical nourishment throughout the 50-year project lifecycle. USACE has provided GATE with proposed plans for the initial nourishment. GATE must determine if that plan is appropriate mitigation for the initial project construction. Additionally, GATE must negotiate with USACE to identify the following: the criteria for triggering future beach nourishment cycles over the 50-year project lifecycle, the design template for future nourishment cycles, and adaptive management over the project lifecycle to account for changes in sediment transport impacts of the project as sea-levels rise and climate changes.

For this TAR, GATE is requesting assistance to identify what is appropriate mitigation for the impacts of the USACE storm risk reduction project on sediment transport processes to ensure that GATE beaches are not negatively impacted. GATE is also requesting review of the following: the USACE modeling reports that quantify impacts of the project on sediment transport, the USACE proposal for initial beach nourishment, and development of project mitigation over the 50 year lifecycle (including development of criteria for when future beach nourishment would be required, development of the nourishment template for future nourishment cycles, and adaptive management over the project lifecycle to account for changes in sediment transport impacts of the project as sea-levels rise and climate changes).

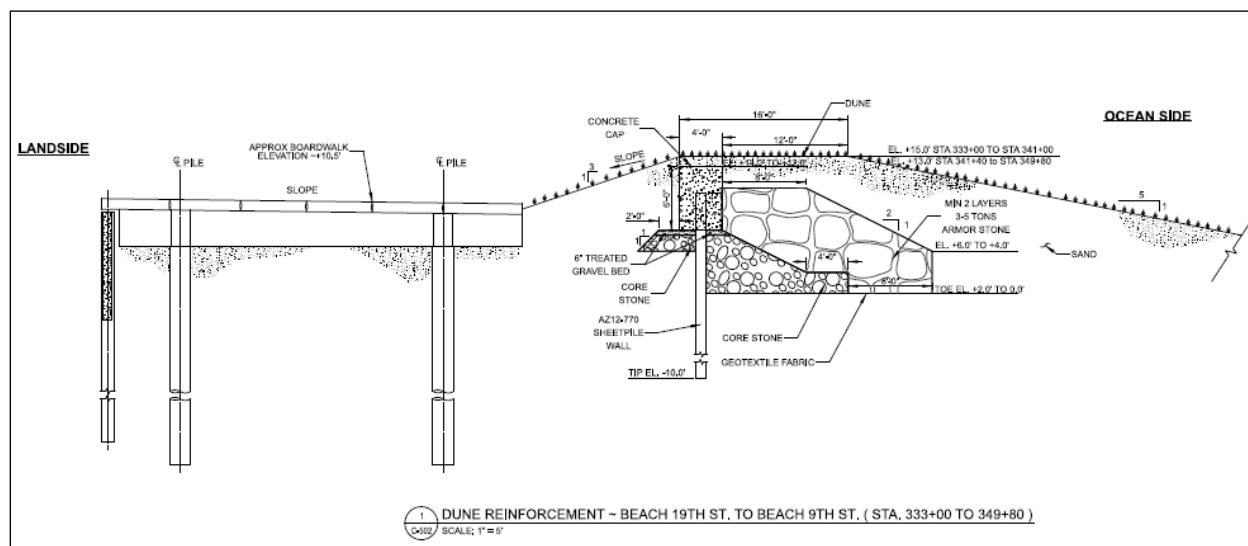
EA’s review is based on *CMS Modeling for Rockaway Beach Groin Field Layout* dated March 7, 2019 (numerical modeling memo) and the associated plans and specifications (dated April 2021). This review does not address the alternatives analyses that led to this final design, nor does it include detailed engineering analysis of calculations associated with the design.

Plans and Specification Review

After reviewing the numerical modeling memo (March 7, 2019) and the associated plans and specifications (dated April 2021), it is clear that the proposed groin field (discussed in the numerical modeling memo) design is not included in the designs for beach nourishment, sheet pile wall, and dune restoration/improvement designs detailed in the plans and specifications. The plans and specifications, as provided for review, encompass a reinforced dune flood protection system as designed through New York's Rebuild By Design (RBD) program (<http://rebuildbydesign.org/>) as one of the Long Island, NY projects. The projects (beach nourishment, sheet pile wall, and dune restoration/improvement) however will act in conjunction with the groin field elements as the increased sediment from the proposed beach nourishment will be lost without some form of erosion protection.

The design of the reinforced dune system is based on the installation of a sheet pile floodwall with concrete cap, which is covered by a natural dune. The dune is designed to resist flood forces from the revised FEMA and ASCE standards New York City adopted post-Sandy, while the buried sheet pile floodwall will prevent any transmission of floodwaters through the dune during prolonged storm surge events, typically associated with hurricanes or large nor'easters (refer to Figure 1). This design has been vetted through the RBD review process, including numerous public meetings and comment, and is focused on preventing flood damage rather than modifying sediment transport at the site. While the continued nourishment of the dune system will provide significant source material for sediment transport, the reinforced dune project is not likely to significantly impact sediment transport rates laterally along the shoreline as there are no structures that will allow for an increase or decrease in sediment movement.

Figure 1 - Proposed Section of Reinforced Dune from Rockaway C2 Revised Post Review 2021-04-15.pdf



CMS-Flow Model of Proposed Groin Field Expansion Review

CMS-Flow is the typical numerical model suite used by USACE for sediment transport analysis. This model relies on rectilinear grids to depict the model domain, with squares ranging from 4 to 256 meters used for the local level model of the project area (Figure 2). This resolution is considered coarse to analyze near-field impacts, as the smallest feature that would typically be captured is 2 grid cells, or 8 meters across. It should also be noted that the grid sizing chosen makes it problematic to model the

existing groins located along Jacob Riis Park as they vary in size from 1-3 meters wide as measured from existing aerial photography by the EA review team. The project area is the southern shore of the Rockaways on Long Island, appearing as solid blue due to the scale of Figure 2. The western and southern boundaries are within the Atlantic Ocean, along with most of the eastern boundary.

A small portion of the eastern boundary is located within Jamaica Bay, where the model has been simplified by assuming a large portion of the bay to be dry land (brown squares in Figure 2). The simplification of Jamaica Bay may be accomplished by defining an input at the small connection with Jamaica Bay and extracting the information from the larger regional model and using that for an input at this location. It is unclear if this approach was followed as the input locations are not identified in the report. The report states that all “open boundary” locations were forced using the larger regional model.

The inlet to Jamaica Bay is the closest area where velocity gage data was available for the months of January and June in 2018, which were used as the validation periods. As Figure 3 shows, the model consistently underpredicts observed flood tidal currents during this event, with better agreement to ebb currents, compared to the flood currents. No discussion is made on why these two months from 2018 were chosen, or of any significant storm events that may have occurred during these months. An internet search indicates a significant “bomb cyclone” that occurred in January of 2018 causing higher than average waves and winds to hit the Rockaways (https://www.wpc.ncep.noaa.gov/storm_summaries/2018/storm1/stormsum_6.html).

Figure 2 - Local Model Grid from Attachment 1-Rockaway_CMS_final (1).pdf

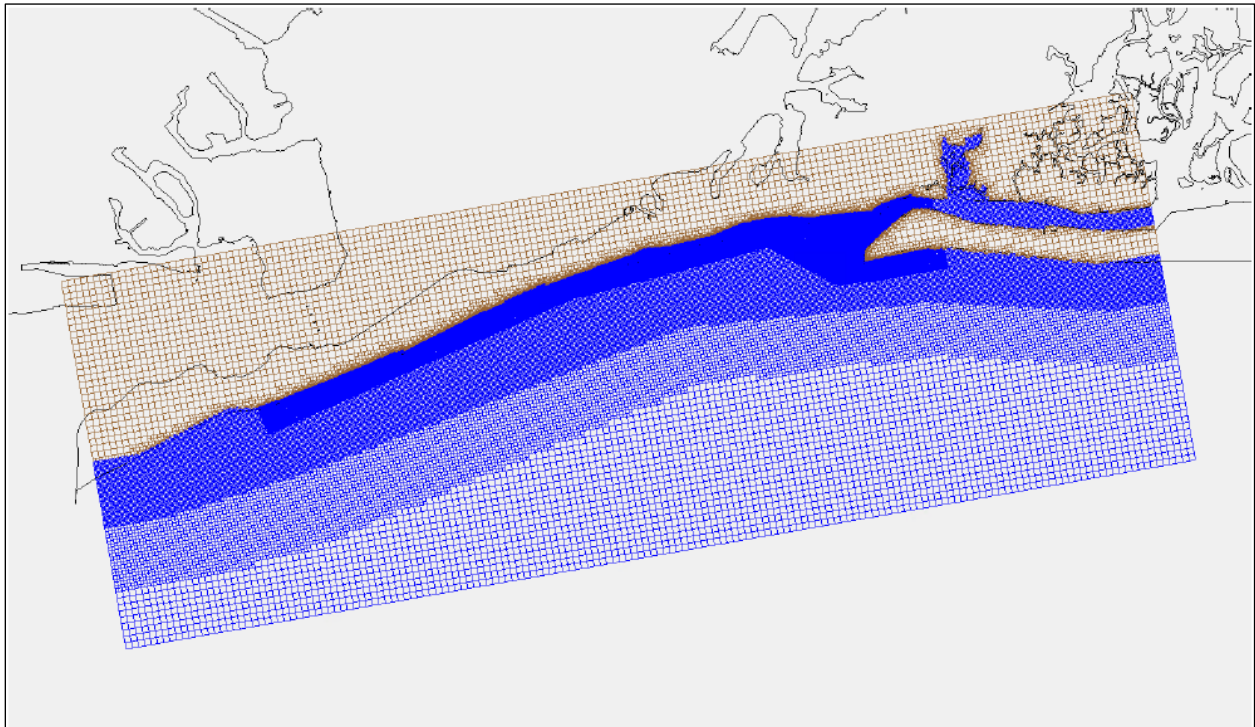
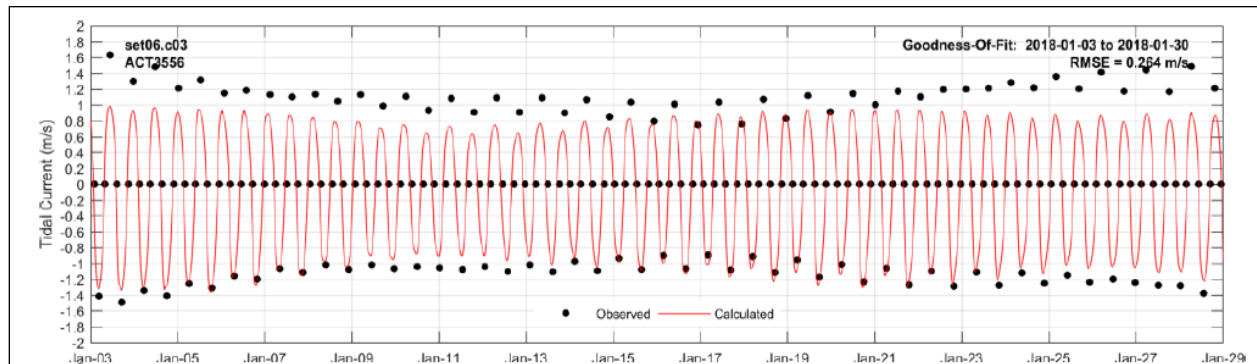
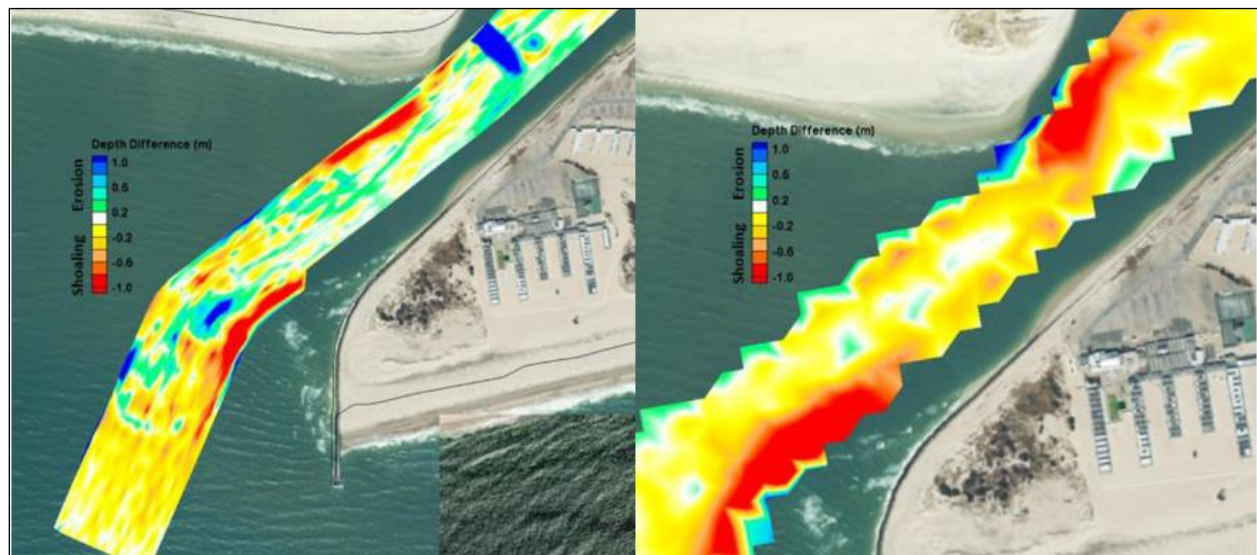


Figure 3 - Tidal Velocity Model Agreement to observed data from Attachment 1-Rockaway_CMS_final (1).pdf



The sediment transport model was calibrated using two surveys (February and March 2017) with no dredging operations taking place between them. A comparison of the differences between the two surveys and the modelled differences using the first survey to start the model can be seen in Figure 4. These two images from the modeling report are shown side-by-side for ease of comparison, and the different views are taken from the original report. These show some similarities within the area modelled, but the overall patterns appear to be substantially different.

Figure 4 - Measured vs Modelled Sedimentation from Attachment 1-Rockaway_CMS_final (1).pdf



CMS-Flow was reviewed by the US Army Engineer Research and Development Center (ERDC) through a series of verification and validation reports in December 2011. The fourth report Verification and Validation of the Coastal Modeling System Report 4, CMS-Flow: Sediment Transport and Morphology Change details the initial best practices for calibration and validation of CMS-Flow models based on rigorous laboratory and field data comparison to developed numerical models. These best practices have been updated with the various CMS model software updates and are posted publicly on the CMS Wiki page maintained by the Coastal Inlets Research Program (https://cirpwiki.info/wiki/Main_Page). As of

the writing of this memo, there are some inconsistencies with the CMS Model Report associated with this project and established best practice, as summarized in Table 1 below.

Table 1 - Inconsistencies between Best Practice and 2019 Model Value

Parameter	2019 Model Value	Best Practice Range
Bed Load Scaling Factor	0.2	0.5-2.0
Suspended Load Scaling Factor	0.2	0.5-2.0
Total-Load Adaptation Length	400 meters	10-100 meters

For the numerical model study to be used in design, the results must be accurate within a reasonable level of confidence. The CMS Model Report discusses accuracy of morphological modelling being acceptable within 1-meter resolution, referencing a 2012 report *St. Augustine Inlet, Florida: Application of the Coastal Modeling System Report 2* by Tanya Beck and Kelly Legault. Upon review of the 2012 report, the statement referenced is about filtering morphological changes into 1-meter bins as these bins represent an acceptable level of accuracy for morphological numerical modelling. Stated another way, the 2012 report indicates the CMS-Flow model is useful for determining morphological changes on the order of 1 meter. The groin field modification analysis report indicates the results used to identify the appropriate modification plan are on the order of 0.1 meters. The use of more significant digits than is commonly used to represent morphological changes in a CMS Flow model combined with the deviation from best practices as previously identified overstates the degree of accuracy possible within the model. Moreover, ERDC identified that morphological changes within CMS Flow have an 11% accuracy tolerance when compared to field measurements.

Jacob Riis Park is identified as Reach 2 within the groin modification analysis. The results of the CMS-Flow analysis indicate an increase in erosion within Jacob Riis Park of approximately 2,300 cubic yards of material during the months of January and June, the same time period as the model run. This increase in erosion is proposed within the modeling report to be addressed by seasonal nourishment projects. However, the recommendation for the groin field modification does not provide details on these proposed nourishment projects beyond stating the need for 200,000 cubic yards of nourishment every 5 years.

Conclusions

The two primary designs reviewed are at different levels of completion. The drawings and specifications for the reinforced dune system and overpass walkways are at 90 percent completion, while the proposed modifications to the existing groin field are in a feasibility study phase. After reviewing the reinforced dune system and overpass walkways, it is apparent the design does not address any sediment migration and/or erosion processes as indicated from the notations on the documents that the proposed groins are under separate contract and design. This system was designed solely to resist offshore storm surge and other flooding forces. The reinforced dune system relies on the groin field to provide erosion protection in conjunction with cyclical nourishment projects.

It is EA's understanding that the proposed groin field modifications will be based on the *CMS Modeling for Rockaway Beach Groin Field Layout* numerical modeling report dated March 7, 2019. Based on our review of this document, we have several concerns with the study methodology, detailed below:

- Model Calibration and Validation – the hydrodynamic portion of the CMS model is calibrated using water level gages located behind the barrier island as the primary matching gages. This seems counter-intuitive as the project area is located on the Atlantic Ocean side of the barrier

island, with the closest gage on this side having the worst correlation. Additionally, using only the months of January and June 2018 for calibration may or may not include seasonal high sediment transport conditions for the region. No discussion of storm events or explanation of the seasonality of sediment transport events are provided.

- **Model Domain Definition** – the model includes a significant portion of Jamaica Bay, with calibration data located there, but assumes that this region is dry land. This area was modelled in the larger, regional model and is acceptable practice so long as the regional model output was used to force the boundary where the local model transitions from wet to dry cells for simplification.
- **Model Setup and Accuracy** – after reviewing industry best practices as identified by ERDC, there are several deviations identified in Table 1 that are not explained within the model report. These deviations may not be unfounded, but without documentation of the rationale for going outside the identified bounds of the CMS-Flow model best practice ranges, we are unable to ascertain the validity of these parameters or their impacts to the overall model results.
- **Resiliency** – The numerical analysis does not indicate any consideration of sea level rise impacts or the potential impacts from stronger or more frequent storm events but relies on present day sea level and storm intensity information only.

Finally, the conclusion that an increase in erosion rates of approximately 3.7 percent for Jacob Riis Park is made based on the coarse resolution results being reported at fine-scale accuracy. Without documentation for the deviation from industry best practice we are unable to comment on the validity of the conclusions presented within the numerical modelling report.

Recommendations

The proposed dune enhancement does not represent any erosive risk to NPS assets but will provide significant material to migrate onto NPS property without appropriate erosion prevention measures. EA recommends NPS seek answers to the following questions from USACE prior to providing an opinion on the proposed groin field modification:

1. Why were the months of January and June 2018 used for calibration?
2. How do these months compare to seasonal sediment transportation rates?
3. Why are the interior gage locations matched better than the exterior gage locations near the project area?
4. What were the reasons for going beyond the industry best practice ranges for the load factors and adaptation length in the CMS model for the site?
5. What accuracy and resolution do the morphological predictions provide?
6. Was any consideration given to sea level rise and increased storm frequency/severity?

References

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US Army Corps of Engineers (USACE)

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- 2011 *Verification and Validation of the Coastal Modeling System Report 4, CMS-Flow: Sediment Transport and Morphology Change*. Available online: <https://hdl.handle.net/11681/7658>.