



Review & Evaluation of FEMA's Coastal Flood Risk Study

Final Summary Technical Memorandum (Deliverable 6.1) Task Order
#1778-01

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
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Rev B	12/17/20	Draft	County Comments	GT	OK	GT
Rev 0	12/21/20	Final		GT		GT

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Executive Summary

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance to property owners within participating communities. Palm Beach County and a number of its communities participate in the program. The Federal Emergency Management Agency (FEMA) is responsible for administering the NFIP and, as such, periodically updates information on the flood hazards. The updated information is incorporated into FEMA's Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for a given study area. FEMA is in the process of updating the FIS and FIRMs for the South Florida study area with the Coastal Flood Risk Study (SFL study), which reevaluated the coastal flood hazard originating from the Atlantic Ocean for Palm Beach, Broward, Miami-Dade, and Monroe Counties.

Baird was tasked by Palm Beach County with performing a technical review and evaluation of FEMA's model setups, inputs, outputs, and other provided data to identify specific elements to improve the accuracy, consistency, reliability, and repeatability of the SFL study used to develop the FIRMs within eastern Palm Beach County. Several issues were identified during the review and evaluation that result in the 100-year (aka 1-percent annual chance) flood elevations being over estimated (i.e., higher) in locations. This over estimation of the simulated flood elevations will result in County residents paying higher insurance rates than they otherwise would if a more accurate 100-year flood elevation had been determined. Baird has prepared several reports that discuss the technical findings and documents coordination with FEMA and other stakeholders during the review and evaluation of FEMA's Coastal Flood Risk Study.

A summary of some of the key findings is presented here followed by a recommendation for next steps.

1. Key Findings

1.1 Unrealistic Waterfall at Boynton Inlet

FEMA's model showed unrealistic conditions at many inlets between the Atlantic Ocean and Lake Worth Lagoon. For example, there was a drop in water level of 10 feet from just west of the Boynton Inlet to the Atlantic Ocean. Furthermore, FEMA's model suggested that the water level was at an elevation of -12 feet NAVD88 within the inlet itself. In this scenario, the bottom of the inlet would almost be dry. This issue has been termed the waterfall at Boynton Beach Inlet because there is a modeled water elevation change of 19 feet within a horizontal distance of 150 feet (see **Figure 3.7 in Deliverable 5.1 – Storm Surge, Wave Model & Flood Map Evaluation**). This clearly shows that FEMA's model was not accurately representing flow out of the Boynton Inlet, which results in higher water levels within the Lake Worth Lagoon and thus higher flood elevations.

While most notable at Boynton Inlet, this effect was also observed at Boca Raton, Lake Worth (or Palm Beach), and Jupiter Inlets. Constriction of flows was also observed within interior waterways. This may have resulted in both the overestimation and underestimation of 100-year water levels throughout the coastal areas of Palm Beach County.

To correct this issue and more accurately model the flow of water through the inlets, it is recommended that FEMA modifies the model to have a finer model grid, increase the number of grid nodes within the inlets, and rerun the model.

1.2 Palm Beach County Treated Differently

To make the modeling effort manageable, FEMA separated Florida into different study areas, which is normal and acceptable. Palm Beach County was modeled as part of the South Florida study area, which included Palm Beach, Broward, Miami-Dade, and Monroe Counties. However, the northern 32 miles of Palm Beach County were modeled differently than the other three Counties in the South Florida Study area.

The model has a large grid encompassing a wide swath beyond the boundaries of the counties to simulate wind and pressure fields that generate storm surge. There is then a finer grid within the areas affected along the coast to provide greater resolution of storm surge. However, this finer grid stops just inside Palm Beach County, and the northern 32 miles of Palm Beach County only have the coarse grid. Therefore, this area is not represented to the same level of precision as the other three counties, which can lead to greater inaccuracies in the model.

To correct this technical deficiency, it is recommended that FEMA corrects this issue by implementing a finer model grid for the northern 32 miles of Palm Beach County (similar to the other three counties) and rerun the model.

1.3 Wrong Storms were Modeled

FEMA's model was validated using five storms. None of the modeled storms exceeded the 1-percent annual chance (aka 100-year) storm surge, so storm surge was extrapolated. While this can be justified under some conditions, it suggests other storms should have been used.

Only one of the storms used by FEMA for calibration (Hurricane Wilma) passed through Palm Beach County. However, Hurricane Wilma was excluded from FEMA's East Coast Central Florida (EECF) study model due to, "uncertainty in the wind and pressure fields." Furthermore, this was an exiting storm (storms that made

landfall on the west coast of Florida), which does not provide the best example of storm surge. The method by which FEMA added the storm surge for exiting storms is questionable, and including exiting storms increased the storm surge estimate by 0.4 feet.

Hurricane David passed offshore of Palm Beach County but did not meet FEMA's stated threshold for water level records. The three other storms (Hurricanes Andrew, Betsy, and Georges) all passed well south of Palm Beach County. Hurricane Georges did not even make landfall in Florida. A storm surge was barely registered in Palm Beach County during the passage of any of these three storms.

Numerous measured water levels were used to validate the model without consideration of the proximity of the measured water levels (gages) to the paths of the storms. For instance, Hurricane Georges passed south of Key West, and a gage located as far north as St. Lucie County was included. St. Lucie County is outside the study area and approximately 200 miles north of the path of Hurricane Georges. Limited (if any) storm surge was experienced at the gage during the storm; thus, the model validation was skewed by the effects of astronomical tides as opposed to isolating the processes that contribute to storm surge.

Poor validation means that it is not known whether the model is accurate or not. The model could be overestimating storm surge and thus increasing the FEMA flood zone elevation.

To more accurately simulate storm surge in Palm Beach County, it is recommended that FEMA consider using Hurricanes Frances and Jeanne to validate the storm surge and ensure that the model was correctly representing storm surge.

1.4 Palm Beach County Storm Surge Increases 1.7 feet at Martin County Line

Martin County was modeled within the East Coast Central Florida (ECCFL) model. There was a 1.7-foot difference in the 1-percent annual chance water elevations at the Palm Beach/Martin County line as simulated by the SFL and ECCFL models, with Palm Beach County having a higher storm surge. So, FEMA adjusted the simulated water elevations down 0.85 feet for Palm Beach County and up 0.85 feet for Martin County over an arbitrary 10-mile distance. However, this adjustment may still have resulted in the 1-percent annual chance water elevation being simulated higher than is truly the case at the north end of Palm Beach County.

This could be a result of the storms that were used to validate the model (see 1.3 above) and the coarse model grid that was used for the northern 32 miles of Palm Beach County (see 1.2 above). It is recommended that FEMA reperform the SFL study modeling given the discrepancy between the ECCFL and SFL models.

1.5 Questionable Dune Breaches

Dune crests on two transect lines were determined to be below the 1-percent annual chance water elevation and subject to breaching. However, the dune crest on one transect was incorrectly identified. Further, if the exiting storms were excluded, the lower 1-percent annual chance water elevation would mean that the second dune transect would not breach either.

It is recommended that FEMA correct these issues as it would likely result in neighborhoods located near the northern Lake Worth Lagoon to no longer be in a VE zone. VE zones have higher insurance rates, because they are exposed to waves as well as wind.

1.6 Sea Level Rise Direction from Congress Ignored by FEMA

FEMA did not consider Federal legislation (Public Law 112-141) that directs FEMA to consider sea level rise in their mapping studies. Including this may provide a better estimate of risk for property owners and local governments when making decisions about how to best prepare and plan for future storm events.

1.7 Resolving Concerns with FEMA Outside of Appeal Process Appears Unlikely

Based on the discussion and feedback provided by FEMA during the coordination meeting held on November 17, 2020 between Palm Beach County, Baird, FEMA, and FEMA's contractors (the Compass/AECOM team), it does not appear likely that there is a mutually agreeable forward path to FEMA resolving the technical issues and concerns raised by the County prior to and/or outside of the formal 90-day appeal period, which is scheduled to start as early as March 2021. FEMA indicated that they have not determined how to proceed regarding the key findings discussed during the meeting and that the County would be responsible for developing sufficient documentation to support an appeal.

2. Recommendations

Baird identified several issues related to the accuracy of FEMA's South Florida Coastal Study during the technical review and evaluation of the modeling effort. These issues may have resulted in FEMA's model potentially over-estimating the base flood elevation or locating properties in a higher hazard flood zone than should be the case.

FEMA allows for a 90-day appeal period for all new or modified flood hazard information shown on a Flood Insurance Rate Maps (FIRM), including additions or modifications of any Base (1-percent annual chance) Flood Elevation (BFE), base flood depth, Special Flood Hazard Area (SFHA) boundary or zone designation, or regulatory floodway. FEMA has indicated that the appeal period will start as early as March 2021.

The onus is on the appellant (in this case the County) to show that there are errors in the FIRMs. The County will need to show how, and potentially the extent, to which the issues within the model have resulted in corrections to the FIRM being required. We recommend that the County undertake a limited modeling effort to address some of the issues identified above to determine the impact on the FEMA flood elevations. It is a significant undertaking to repeat all of the storm runs performed by FEMA in their original analysis. However, it may be possible to model a limited number of storm events and show how an improved and corrected model setup more accurately represents flooding during storm events.

The proposed modeling effort would need to start prior to the beginning of the appeal period so that the results could be submitted to FEMA during the appeal period. This would also allow time for additional discussions with FEMA during the appeal period. Given the inherent uncertainty in implementing improvements and corrections to FEMA's model, future Baird modeling efforts, if approved by the County, should include flexibility and robust and frequent coordination with the County.