Dewberry

MEMORANDUM

DATE: February 2, 2023

TO: Bryan Lightner, Town Administrator, Town of Charlestown

FROM: Jessica Seipp, Department Manager, Dewberry

SUBJECT: Explanation of Scenario Selection for Charlestown Watershed Master Plan Modeling

Message

Multiple storm scenarios were selected for modelling to show existing and future conditions based on a variety of climate and occurrence factors.

Time Period

Three (3) time periods were selected to show how flooding currently affects the Town and how much it is expected to change in future conditions. The existing time period is for 2022. The two future time periods describe the mid-century (2050) and end of century (2080) scenarios.

Storm Frequency & Duration

The 10-year (10% annual exceedance probability) and the 100-year (1% annual exceedance probability) design storms were selected to show how low and high frequency storms affect the Town. The storm duration chosen for all scenarios was 24-hours. This value is based on the watershed size, as mentioned in the HEC-HMS Technical Reference Manual (see link), which suggests using a 24-hour storm for Maryland watersheds between 2 and 50 square miles. Additionally, much of the stormwater drainage system in the United States is designed for the 24-hour event, so this should align with the current infrastructure in the Town.

Emissions

Representative Concentration Pathway (RCP) 8.5 was used as the emissions scenario when determining rainfall increases and sea level rise. The RCP 8.5 represents the growing emissions pathway, or the "worst-case" scenario, as opposed to the stabilized RCP 4.5 scenario. According to the Guidance for Using Maryland's 2018 Sea Level Rise Predictions (2022), experts believe actual emissions will be between RCP 4.5 and RCP 8.5 and using RCP 8.5 "may be appropriate for projects with long timeframes, very low flood risk tolerance, and little or no adaptive capacity".

Rainfall

Rainfall increases for the mid-century and end-of-century scenarios were calculated from the median county change factor (50th percentile) using the MARISA IDF Curve Data Tool for the Chesapeake Bay Watershed, with the emissions scenario of RCP 8.5. The rainfall increases based on the county change factors nearest Cecil County for each storm frequency and duration are shown in Table 1. Mid-Atlantic IDF Curve Tool (rcc-acis.org)

Table 1: Rainfall increases for mid-century and end-of-century conditions.

TIME PERIOD	FREQUENCY (YR)	RAINFALL INCREASE (%)
2050	10	11
	100	9
2080	10	16
	100	18

Tidal Conditions

The mean high high water (MHHW) and 10-year storm surge were chosen as the moderate and extreme tidal scenarios, respectively. The MHHW refers to the average of the highest water height each day and was calculated using NOAA's Online Vertical Datum Transformation tool for 1994, which is close enough to 2000 to assume no difference, along with NOAA's Relative Sea Level Trend slope to determine the additional sea level rise from 2000 to 2022. The two values were added to get a current existing tidal elevation. Maryland's 2018 Sea Level Projections Guide was used to estimate the average sea level rise heights above 2000 levels using the Baltimore Tide Gauge. Low tolerance for flood risk was assumed as this project pertains to community assets and residential areas. The 2050 and 2080 values were added to the MHHW value to get future scenario sea level rise estimates. The RCP 8.5 was assumed for all conditions. The 10-year storm surge refers to the 10% annual exceedance probability and describes the more extreme tide conditions. Table 2 shows the tidal elevations for each scenario.

Table 2: Tidal values for existing, mid-century and end-of-century conditions.

TIME PERIOD	TIDE CONDITION	TIDAL ELEVATION (FT)
2022	MHHW	1.555
	10yr surge	5.57
2050	MHHW	3.625
	10yr surge	7.78
2080	MHHW	6.025
	10yr surge	10.27

Final Selection

Six (6) scenarios were ultimately selected based on the various factors described above. Scenarios 1, 3, and 5 describe moderate scenarios, with smaller storms and current sea levels. Scenarios 2, 4, and 6 show extreme scenarios, with larger storms and storm surge tides. The scenarios are outlined in Table 3.

Table 3: Scenarios for modelling.

SCENARIO	TIME PERIOD	FREQUENCY (YR)	DURATION (HR)	TIDE
1	2022	10	24	MHHW
2	2022	100	24	10yr surge
3	2050	10	24	MHHW
4	2050	100	24	10yr surge
5	2080	10	24	MHHW
6	2080	100	24	10yr surge