

Coastal Protection Design

Elevation of the area along the toe of the dikes where the erosion is located is at 0 feet below Mean Lower Low Water (MLLW). The project area is gently sloping eastward at about 1:100. Normal water levels at the site are dictated by astronomical tides which have a mean range of 1.4 feet and a spring range of 1.7 feet. Extreme water levels are dictated by storm surge, which is the temporary rise in water level generated either by large-scale extra-tropical storms known as northeasters, or by hurricanes. The rise in water level results from wind action, the low pressure of the storm disturbance and the Coriolis force. Wave setup is a term used to describe the rise in water level due to wave breaking. Specifically, change in momentum which attends the breaking of waves propagating towards shore results in a surf zone force that raises water levels at the shoreline.

A comprehensive evaluation of storm-induced water levels for several Chesapeake Bay locations was conducted by the Virginia Institute of Marine Science (1978) as part of the Federal Flood Insurance Program. Results of this study are summarized in the following Table 1 for selected locations, which is for the closest station location to Cox Creek at Baltimore (Fort McHenry).

Table 1.

Water Level Elevation per Return Period for the Patapsco River (ft, MLLW)

Return Period (Years)	Baltimore, Fort McHenry
10	4.1
50	6.8
100	8.1
500	10.7

Design winds for the site were developed on the basis of data collected at Baltimore-Washington International (BWI) airport (Table 2). These winds, which can exceed 90 miles per hour during a 100-year storm, were used to develop design wave conditions. Predominant wind direction is from the northwest.

**Table 2. Design Wind Speed per Direction and Return Period
for Baltimore-Washington International (BWI) Airport
Wind Speed and Direction (MPH)**

Return Period (Years)	N	NE	E	SE	S	SW	W	NW
5	40	37	32	37	36	47	50	54
10	48	44	38	45	43	56	54	59
25	59	55	47	58	54	70	60	67
50	69	65	55	69	63	82	64	73
100	81	76	65	82	74	97	69	81

Cox Creek is primarily exposed to wind-generated waves approaching from the eastern direction. The longest fetch distances to which the site is exposed correspond to the southeast direction, thus the highest waves approach from this direction. Hindcast waves were computed and the results indicate that 5-year return period waves from the southeast direction have a significant height (H_s) of 3.8 feet and a peak spectral wave period (T_p) of 4.1 seconds. The 100-year return period significant wave height from the southeast direction was hindcast to be 7.8 feet with a peak spectral wave period of 5.6 seconds. These wave heights represent deep water conditions some distance offshore of the dikes. Given the relatively shallow depths fronting the dike, the structure will be exposed to some breaking waves, and wave heights would be reduced. Nearshore significant wave heights at the project area from the southeast were computed to range from about 1.9 feet for a 5-year storm to about 3.8 feet for a 100-year storm.