Living on the Edge

For the City of New Castle, located on the west bank of the Delaware River in northeastern Delaware, controlling flood waters has been the way of life for centuries. Since the 1600’s, four earthen dikes have afforded the City a level of flood protection that has allowed it to sustain itself in relative comfort and safety. Additionally, these dikes not only protect the residents and businesses within the City of New Castle, they also protect state and county roads, utilities, and surrounding communities and help to prevent flooding upstream during large storm events. However, without proper attention, over time dikes can be overtopped, eroded and/or catastrophically fail which, unlike natural flooding, is often rapid, forceful, extremely damaging, and may occur with little or no warning. Proper operation and maintenance of the dikes is essential to providing long-term public safety and flood protection for the City and surrounding areas.

The “Dike Maintenance and Emergency Planning Report for the City of New Castle Flood Control Dikes”, a 2011 study conducted in collaboration with the City and the DNREC’s Delaware Coastal Programs, has identified areas of concern with each dike that if not addressed could increase the City’s risk to coastal flooding. Increased erosion, animal burrows, deep woody growth and other issues all compromise the stability of the dikes and increase the risk of full or partial failure of these barriers.

City of New Castle Dike Management Advisory Committee

A multi-agency committee was formed to evaluate the long-term flood control requirements of the City and develop a comprehensive dike management plan to restore or enhance the dikes and to implement a long-term maintenance strategy.

The Committee includes representative from:

City of New Castle
City Council
City Administration
Trustees of New Castle Commons
Residents

Department of Natural Resources and Environmental Control
Delaware Coastal Programs
Dam Safety
Mosquito Control
Site Investigation and Restoration Branch

Department of Transportation
New Castle County Emergency Management

Additional Technical Advisors
Issues and Concerns

As a result of the 2011 Dike Maintenance study, a number of important issues were identified. The following are a few issues identified as high priority actions. The complete list of dike maintenance issues is available on the website below.

Unwanted Vegetation

While trees and brush may be aesthetically pleasing and provide cooling shade, the growth of woody vegetation on and near dikes can lead to serious problems. Sudden uprooting of trees by strong winds can result in the displacement of large amounts of dike embankment material. The root systems of trees can also be a potential hazard by allowing seepage pathways to develop through a dike. Trees eventually die and their roots decay and rot, leaving a void within the dike through which water can enter and flow leading to internal erosion. Brush and woody vegetation can also hinder the visual inspection of dike surfaces by obscuring sinkholes, animal burrows, seeps, and other irregularities.

Erosion and Bank Caving

Erosion is the displacement of soils by the agents of wind, water, or ice. Erosion on dike slopes typically occurs as a result of wave action or rainfall, especially on dikes with inadequate grassy vegetation protecting the slope. Erosion may also occur when a dike is overtopped by water as a result of water moving at a high velocity down an embankment slope. Erosion may reduce the effective width of the dike, facilitate seepage, and lead to conditions that may reduce the stability of the slope.

Animal Burrows

Burrowing animals can cause serious damage to a dike. Beavers will sometimes block a tide gate thus raising the water level and diminishing tide gate capacity. Muskrats and other burrowing animals dig tunnels that could create pathways for water to seep or flow very rapidly through the dike, which could lead to sudden failure due to subsurface soil erosion.

Restoration Options:

1) Complete Repair — The current height of the dikes varies from 5-6 ft. Raising the height, or crest elevations, to the 500-yr storm level (11.0 ft), would provide additional protection to those areas situated behind the dikes. Additionally, the site preparation requirements would address all previously identified maintenance issues. The costs to raise the elevation of each dike ranges from $810,000-1.72 Million.

2) Incremental Improvements — Addressing each identified issue can be done separately and reduce the immediate burden placed on fiscal and staff resources. This would allow the City to maintain the current functionality of the structures. However, using this approach will end up costing the City between $3.5-10 Million per dike and does not provide the added protection against 100-yr or 500-yr storms events.

Additional information on the New Castle Dike Management Advisory Committee, including the full Dike Maintenance Study, can be found at: http://www.swc.dnrec.delaware.gov/coastal/Pages/CityofNewCastle.aspx
Buttonwood Creek Dike

Overview:

Buttonwood Dike is the northern-most flood protection dike in the City of New Castle. Its recently rebuilt tide gate structure is located at the confluence of Buttonwood Ditch and the Delaware River. The tide gate protects the historic Buttonwood community from coastal flooding, while also allowing for limited tidal flushing into Buttonwood Ditch. This helps to improve the health of its adjacent wetlands. The dike is in need of refurbishing and maintenance work to correct eroding areas.

Attributes:

- Elevation Range: 6.0-10.0 ft
- Length: 1,800 linear feet
- Crest Width: 8-12 ft

Structures Within Inundation Areas:

- Current Elevation (5.5 ft) 25 structures
- 100-Storm (9 ft) 891 structures
- 500-yr Storm (11 ft) 175 structures

Features-at-risk ("worst-case scenario"):

- Sewer Pump Station (1) (Utility)
- Sewer Line (42,000 ft) (Utility)
- SIRB Site (40 acres) (Hazardous Waste)
- Roadway (12,000 ft) (Transportation)
**Overview:**

Broad Dike and its tide gate structure are located at the confluence of the Narrow Dike Canal and the Delaware River, next to the Bull Hill Park in the City of New Castle. Its current tide gate was installed to allow tidal exchange and flood control as part of the Broad Dike Marsh restoration project in the early 1990s. The dike system protects several communities and the Delaware Rt. 9 byway. It is in fair condition, but is in need of refurbishing and maintenance work, mostly to clear overgrown vegetation.

**Attributes:**

<table>
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<tr>
<th>Attribute</th>
<th>Value</th>
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<tbody>
<tr>
<td>Elevation Range</td>
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<tr>
<td>Length</td>
<td>1,400 linear feet</td>
</tr>
<tr>
<td>Crest Width</td>
<td>8-12 ft</td>
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</tbody>
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**Structures Within Inundation Areas:**

<table>
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<th>Event Type</th>
<th>Elevation</th>
<th>Structures</th>
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</thead>
<tbody>
<tr>
<td>Current Elevation</td>
<td>5.5 ft</td>
<td>26 structures</td>
</tr>
<tr>
<td>100-Storm (9 ft)</td>
<td></td>
<td>83 structures</td>
</tr>
<tr>
<td>500-yr Storm (11 ft)</td>
<td></td>
<td>153 structures</td>
</tr>
</tbody>
</table>

**Features-at-risk (“worst-case scenario”):**

- St. Peter’s School (Dependent Care)
- Well-head Protection Areas (Resource)
- Sewer Pump Station (2) (Utility)
- Sewer Line (108,500 ft) (Utility)
- SIRB Site (6 acres) (Hazardous Waste)
- Roadway (36,600 ft) (Transportation)
- Railway (4,250 ft) (Transportation)
Overview:

Gambacorta Dike and its tide gate structure are located in downtown New Castle at south end of 3rd Street, off of Battery Park. The dike crest has a paved walking trail extending south from the park that is frequented by many users. The dike system protects several business and homes and a section of the Delaware Rt. 9 byway. The tide gate in the dike allows tidal exchange and flood control as part of the wetland restoration project. The dike is in fair condition, but due to a low crest elevation and erosion it is in need of refurbishing and maintenance.

Attributes:

- Elevation Range: 5.8-8.0 ft
- Length: 1,600 linear feet
- Crest Width: 8-12 ft

Structures Within Inundation Areas:

- Current Elevation (5.5 ft) 17 structures
- 100-Storm (9 ft) 55 structures
- 500-yr Storm (11 ft) 83 structures

Features-at-risk (“worst-case scenario”):

- Bulkhead Bar Range Front Light (Aid to Navigation)
- Sewer Pump Station (1) (Utility)
- Sewer Line (21,400 ft) (Utility)
- ABEX / Deemer Landfills (Waste Management)
- SIRB Site (19 acres) (Hazardous Waste)
Overview:
Army Creek Dike is the southernmost flood protection dike in the City of New Castle. It is located adjacent to Delaware Rt. 9, just south of Dobbinsville. The dike protects the Delaware Rt. 9 byway, sites containing hazardous contaminants, and several structures. The dike has several areas of significant erosion and low areas along its crest. This has led to severe undercutting and washout of the dike’s slope, thereby weakening its integrity. To correct these problems, the dike needs significant refurbishment and maintenance work, or Delaware Rt. 9 may need to be elevated or relocated.

Attributes:
- Elevation Range: 5.5–9.0 ft
- Length: 3,600 linear feet
- Crest Width: 8-12 ft

Structures Within Inundation Areas:
- Current Elevation (5.5 ft)  5 structures
- 100-Storm (9 ft)          9 structures
- 500-yr Storm (11 ft)      15 structures

Features-at-risk (“worst-case scenario”):
- Well-head Protection Areas (Resource)
- Sewer Line (20,800 ft) (Utility)
- SIRB Site (126 acres) (Hazardous Waste)
- Roadway (5,500 ft) (Transportation)
Red Lion Dike is located along the Delaware riverfront just north of the Delaware City industrial complex, and south of the City of New Castle. The dike protects the Delaware Rt. 9 byway and two significant hazardous waste contaminated sites. The dike is in extremely poor condition due to extensive erosion, and it has even been partially breached in two locations. It is very likely to fail in the near future, and is in need of major refurbishment. After environmental remediation of the hazardous waste sites, consideration may be given to raising Delaware Rt. 9 and opening the dike to allow additional tidal flushing to occur.

**Attributes:**

- Exact Elevation: Unknown, Survey Planned
- Length: 1800 linear feet
- Crest Width: 4-12 ft

**Features-at-risk (“worst-case scenario”):**

- Roadway (900 LF) (Transportation)
- RCRA Site/Oxychem (300 Acres) (Hazardous Waste)
- Superfund Site/Metachem (65 Acres) (Hazardous Waste)