Briefing on:

**Federal Triangle Stormwater Drainage Study**  
**Flood Risk Mitigation Alternatives**

Briefing for:

**Federal Triangle Area Flood Workshop #2**

September 5, 2018
2011 Federal Triangle Drainage Study

- Developed as part of follow-up to a June 2006 storm that caused flooding in Federal Triangle
  - 14 inches of rain over 3 days
  - >200-year return period
- Flood Protection Steering Committee
  - Department of Energy and Environment
  - DC Office of Planning
  - DC Water
  - National Capitol Planning Commission
  - General Services Administration
  - Smithsonian Institute
  - Federal Emergency Management Agency
- Additional Partner Agencies
  - Smithsonian
  - Department of Justice
  - National Archives
  - National Park Service
  - Washington Metropolitan Area Transit Authority
- Completed by DC Water via its CSO Long Term Control Plan Consultant
Goals and Objectives:

- Identify capacity of the existing sewer system
- Identify areas at risk for flooding
- Identify and evaluate potential alternatives to mitigate flood risk (including cost estimates)
- Propose alternatives for an early warning system

Previously Discussed in April Workshop

Today’s Workshop
## Screening of Alternatives

<table>
<thead>
<tr>
<th>Strategy</th>
<th>No.</th>
<th>Description</th>
<th>Keep/Reject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning System</td>
<td>A</td>
<td>Early Warning Systems</td>
<td></td>
</tr>
<tr>
<td>Reduce floodwaters entering Fed Triangle</td>
<td>B</td>
<td>Low Impact Development (green practices)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Storage Upstream of Federal Triangle</td>
<td></td>
</tr>
<tr>
<td>Convey floodwaters out of Federal Triangle or store them</td>
<td>D</td>
<td>Use GSA Condensate Line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>Storage under National Mall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Pumping Station Serving Mall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>Tunnel to Main &amp; O Pumping Stations</td>
<td>Evaluate these alternatives</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>Maximize use of sewer system</td>
<td>Reject - existing sewer system not designed for 50 to 200 year storms</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>Gravity sewer to Tidal Basin</td>
<td>Reject – Federal Triangle too low for reliable drainage by gravity</td>
</tr>
<tr>
<td>Protect properties from flood waters</td>
<td>J</td>
<td>Flood-proof buildings</td>
<td>Not part of scope of study – should be evaluated by others</td>
</tr>
</tbody>
</table>

**Focus of Today’s Presentation**
Alternative B
Low Impact Development (Green Practices)

- Implement green infrastructure (GI) in the upstream watershed to reduce stormwater runoff
- Typical DC GI facilities are designed to manage 1.2” of rainfall
- If GI implemented for 50% of the Federal Triangle watershed, <10% of the 100-year storm rainfall would be captured
  - Implementation on this scale would be difficult in the highly urbanized Federal Triangle watershed
- **Findings: Not viable as a standalone solution**
  - Could be used to supplement other flood control measures

![Rainfall Depths and Low Impact Development](chart.png)
Alternative C
Storage Upstream of Federal Triangle

- Construct storage facilities upstream of Federal Triangle to capture and store stormwater runoff
- Underground tanks and inlets/ sewers to collect flow
- Pumps required to empty the tanks after a storm
- Constructed in parking lots, vacant land, or beneath roadways

**Findings: Not a viable solution**
- Multiple facilities required to collect runoff from different portions of the watershed
- Expensive and extremely disruptive to construct
- Does not collect runoff in the immediate Federal Triangle area
Alternative D
Use GSA Condensate Line

- Repurpose abandoned GSA condensate line as a storm sewer to convey flow from Federal Triangle to the Tidal Basin
- 48” gravity pipeline that originally conveyed water from the Tidal Basin to the Federal Triangle buildings

**Findings: Not a viable solution**
- Conveyance capacity is insufficient
  - Undersized for this application
  - Low grade of Federal Triangle can’t “push” water out against the tide
  - Sloped in the wrong direction
- Prone to siltation
Alternative E
Storage Beneath National Mall

- Construct storage facility on the National Mall to store stormwater runoff
- New storm sewer and inlets would be constructed to convey flow to the storage facility
- Pumping station to empty the facility after storms
- **Findings: Viable solution**
  - Can be located entirely underground
  - Disadvantages:
    - Large reservoirs required (20 million gallons for 100-year storm)
    - Significant disruption to National Mall activities during construction
    - Limited effectiveness for back-to-back storms
Alternative F
Pumping Station Serving National Mall

- Construct pumping station to convey stormwater runoff from Federal Triangle to the Tidal Basin
- Influent pipeline(s) from Federal Triangle to the station, discharge pipeline from the station to the Tidal Basin
- **Findings: Viable solution**
  - **Advantages**
    - Effective at any river level
    - Independent of any other systems
  - **Disadvantages:**
    - Disruption to National Mall activities during construction
    - Long-term operation, maintenance, and upgrades/replacements

Strategy: Convey floodwaters out of Federal Triangle of store them
Alternative G-1
New Tunnel to Existing O St Pumping Station

- Construct new ~14-foot diameter tunnel to convey stormwater flow from Federal Triangle to existing O St Pumping Station
- New inlets and collection sewer to collect flow and convey to tunnel
- Tunnel dewatering
  - During storm (if filled): Pumped to river by existing or expanded storm pumps (depending on design storm)
  - After storm: By gravity to the CSO tunnel system, after CSO tunnel emptied (drains to Blue Plains).
    - No longer viable – separate dewatering pumps required
- **Findings: Viable solution**
  - Takes advantage of underutilized pumping capacity
  - No pumping station near National Mall
- Major changes since report issued:
  - Blue Plains Tunnel completed (connection of Federal Triangle tunnel no longer constructible). Separate dewatering pumping station required for new tunnel.
  - Connection to existing PS complicated by:
    - New DC Water headquarters building constructed over pumping station
    - Significant development completed and more under construction in the area
Alternative G-2
New Tunnel to Existing O St Pumping Station Integrated with Potomac CSO Tunnel

- Report also evaluated integration of a tunnel for Federal Triangle into the CSO tunnel system to be constructed for the Potomac River
- Since the report, DC Water’s consent decree has been formally modified
  - Potomac River Tunnel connected to existing Blue Plains Tunnel by gravity
- Integration of the Federal Triangle Tunnel with the Potomac River Tunnel is no longer viable
  - Potomac River Tunnel NEPA documentation and Facility Plan to be completed this year

Strategy: Convey floodwaters out of Federal Triangle of store them

2011: CSO Long Term Control Plan at Time of Federal Triangle Drainage Study

2018: Current CSO Long Term Control Plan

Potomac River Tunnel
Federal Triangle Tunnel
Federal Triangle Tunnel Considered in Report
Blue Plains Tunnel (in service)

Potomac River Tunnel (gravity extension to Blue Plains Tunnel)
Blue Plains Tunnel (in service)
## Summary of Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Description</th>
<th>Viable?</th>
<th>Estimated Capital Cost ($M)(^1,2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Low Impact Development</td>
<td>No(^3)</td>
<td>$135(^3)</td>
</tr>
<tr>
<td>C</td>
<td>Upstream Storage</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>D</td>
<td>GSA Condensate Line</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>E</td>
<td>Storage Beneath National Mall</td>
<td>Yes</td>
<td>$400</td>
</tr>
<tr>
<td>F</td>
<td>Pumping Station on National Mall</td>
<td>Yes</td>
<td>$360</td>
</tr>
<tr>
<td>G-1</td>
<td>New Tunnel to O St Pumping Station</td>
<td>Yes(^4)</td>
<td>$405(^4)</td>
</tr>
<tr>
<td>G-2</td>
<td>New Tunnel to O St Pumping Station (integrate with Potomac CSO Tunnel)</td>
<td>No(^5)</td>
<td>N/A(^5)</td>
</tr>
</tbody>
</table>

1. Costs are AACE Conceptual Level Estimates (+50%-30%) utilizing Year 2010 dollars (ENR CCI = 8805).
2. Costs are based on the 100-year design storm.
3. Not viable as a standalone solution, but may be used to supplement to other solutions.
4. Major changes since report could effect evaluation and cost estimate, including completion of Blue Plains Tunnel, construction of DC Water Headquarters Building over O St Pumping Station, and significant development in Navy Yard neighborhood.
5. Found viable in original report. No longer viable due to DC Water consent decree modification and completion of Blue Plains Tunnel.
Questions

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Extra Slides
District of Columbia Water and Sewer Authority

Briefing on:

Federal Triangle Flood Risk

Briefing for:

Federal Triangle Area Flood Workshop #1

June 6, 2018
2011 Federal Triangle Drainage Study

- Developed as part of follow-up to June 2006 storm that caused flooding in Federal Triangle
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Today’s Workshop
September Workshop
Watershed
Federal Triangle is the Low Point for a Large Area

- Total Drainage Area Tributary to Federal Triangle = 5.83 square miles (about 3,732 acres)
- Total Federal Triangle Area = 153 acres
Federal Triangle is Low Point of a Topographic “Bowl”

- Developed using a combination of GIS and field survey data
- Constitution Avenue represents the low point for the entire watershed
Survey Results: Constitution Ave is not Much Higher than Potomac River

Based on DC Water Topographic Survey, D.C. Engineering Department Datum

PROFILE OF CONSTITUTION AVE

Potomac River Flood Stages
500-yr El. 16.3 feet
100-yr El 12.2 feet
50-Yr El 10.3 feet
25-Yr El 8.82 feet
10-yr El 6.80 feet
1 Year Flood El 4.58 feet
Mean Higher High Water Level El 1.9 feet
Two Types of Flooding Can Affect Federal Triangle: Rainfall (Interior) and River Floods

- Due to Rainfall
  - Analyzed in 2011 Study
  - Due to High River Levels

- Runoff

- Federal Triangle

- Potomac River or Tidal Basin

- 2011 Study also analyzed probability and impact of intense interior rain while river was flooding
  - Minimal impact on interior flooding
  - Low probability of simultaneous river and interior flooding

- Water levels associated with river flooding are higher than those associated with interior flooding for the same return period
Two Ways to Drain Runoff From Federal Triangle

- B ST/NJ AVENUE SEWER
- CONSTITUTION AVENUE STORM SEWER
- TO MAIN & O ST. PUMPING STATIONS
Sewer System Flow Pathways

Overland flow when capacity of upstream sewers is exceeded.

B St/NJ Ave

Fed. Triangle

Constitution Ave Siphons

Tidal Basin

O St Pumping Station

Anacostia River

Storm Sanitary

Str 14

Str 15

Str 15a

Main Pumping Station

Str 16

Tiber Creek

Storm Sanitary

B St/NJ Ave

Storm Sewer
Existing Sewer System Capacity

Constitution Avenue Storm Sewer
- Discharges by gravity
- Capacity limited by low grade of Federal Triangle relative to river
- At high flood stages, stop logs installed to block sewer (prevent backflow)
- Approximate design capacity: 2- to 5-year storm

B Street/New Jersey Avenue Trunk Sewer and Main and O Street Pumping Stations
- Discharge is pumped
- Capacity not limited by typical river stages
- Capacity is limited by the conveyance capacity of sewers, not pumps
- Approximate design capacity (sewers): 15-year storm
June 2006 Flood Event – Rainfall

Main & O Pumping Station Rain Gage vs NOAA Precipitation Frequency Data - June 25, 2006 Event

Rain Starts ~9:00 pm, 6/25/06
Approx 10:30 pm 6/25/06
Approx 11:00 pm 6/25/06
June 2006 Flood Event – Inundation

- Constitution Ave between 9th and 10th Streets
- 15th Street near Constitution Avenue

Higher water marks at planter height of approximately 2.5 feet
Higher water marks at planter height of approximately 3 feet
2011 Federal Triangle Drainage Study Modeling

- Sewers – Mike Urban
  - Same model used to develop LTCP
  - Added detail in Federal Triangle area

- Ponding on Street – Mike Flood
  - Routes flood waters on street to downstream location

- Models are connected so flow can go into and out of sewers based on capacity

- Calibrated to June 2006 storm
Baseline Ponding Predictions
15th Street and Constitution Ave

Predicted Ponding Levels at 15th & Constitution

- 500 yr Rain
- 200 yr Rain
- 100 yr Rain
- 50 yr Rain
- 15 yr Rain
- 10 yr flood
- 5 yr Rain
- Grade
- Top of Sidewalk

Avg tide EL 0.1
1 yr flood EL 4.58
River WSEL EL 6.8
100 yr flood EL 12.2
Baseline Ponding Predictions: 15-Year Storm

Approx. WSEL: 7.0

Assumes average tide conditions
Baseline Ponding Predictions: 50-Year Storm

Approx. WSEL: 7.5

Assumes average tide conditions
Baseline Ponding Predictions: 100-Year Storm

Approx. WSEL: 7.8

16” 7” 0” 16” 7” 0”

Approx. ponding depths above top of sidewalk

Assumes average tide conditions
Baseline Ponding Predictions: 200-Year Storm

Approx. ponding depths above top of sidewalk:
- 21”
- 12”
- 1”
- 20”
- 11”
- 0”

Assumes average tide conditions