The Lakes, Princess Anne Plaza, and Windsor Woods Combined Drainage Project

BRIEFING

Clarence Warnstaff
Michael Baker International

May 28, 2019
Agenda

- Project Background
- Level of Service (LOS)
- Major Program Elements
- Recommended Improvements & Phasing
- FEMA Considerations
- Summary
Total Project Area = 2,585 Acres (8,500 Parcels)
Total Length of Roadways = 77 Miles
Total Assessed Value Approximately $2B*

*Source Emergency Management 2016
Tidal Influence

Natural Drainage Patterns

Project Area

Chesapeake Bay

Atlantic Ocean

Tidal Influence

Project Area

Chesapeake Bay

Atlantic Ocean
Background/Issues

- Elevations in the area are low
  - Most homes slab on grade (little fall to street)
- Area is tidally influenced
- Increased frequency & severity of storms
- Infrastructure is $\pm50$ years old (Built in 1960’s)
- Existing storm drains are inadequate and/or non-existent
- Lack of stormwater storage
- Flood Insurance Rates Dramatically Increasing
  - Post-Matthew some people reported paying $5,000+ per year
Existing WW-TL-PAP Flooding

With NO Infrastructure Improvements, modeling results:

- **978 structures** (~12%) flood during a 100-year design storm
- **80,000 linear feet (15 miles) of roadways** (~20%) flood during a 10-year design storm (3-inches or more over crown)*

* Street flooding is defined as areas with greater than 3-inches of water over the road crown.
Level of Service (LOS)

- **Program Standard (Modified LOS):**
  - **10-Year Design Storm** – Limit to 3-inches or less over road crown
  - **100-Year Design Storm** – No Flooding of Structures

- **Current City Standard:**
  - **10-Year Design Storm** – Shall not exceed capacity of storm drain system (pipes and structures) – No flooding in the street
  - **100-Year Design Storm** – Streets shall remain passable and no property damage

- **With Modified LOS for Program:**
  - There will be flooding in streets (curb-to-curb) during 10-year storm event. Streets are used as storage and to convey water.
  - Some structure and significant street/yard flooding for 100-year storm event.
Residential Street Cross-Section
(Showing 3-inches of Flooding Over Road Crown)

- 2” (0.15’)
- 3” (0.25’)
- 8” (0.65’)
- 6” High Curb
Major Program Elements
(Recommended Infrastructure Improvements)

- Tide Gates & Barriers (3 locations)
- Large Capacity Pump Stations (2 locations)
- Additional Storage Capacity
- Storm Drain Improvements
Overall Preliminary Concept Plan
(Recommended Infrastructure; $354M)

NEW STORM DRAINS WILL BE INSTALLED THROUGHOUT THE PROJECT AREA

POTENTIAL STORMWATER STORAGE

WINDSOR WOODS PUMP STATION, TIDE GATE & BARRIER LOCATION

POTENTIAL NORTH PUMP STATION, TIDE GATE & BARRIER LOCATION

POTENTIAL SOUTH TIDE GATE, CHANNELS & BARRIER LOCATION
BERM ➝ POND ➝ PUMP

Tide Gates & Barriers

Additional Stormwater Storage

Stormwater Pump Stations

Gates & Barriers Block Incoming Tide Creating Storage

Pumps Lower & Maintain Water Levels
## WW Major Improvements

<table>
<thead>
<tr>
<th>CIP No.</th>
<th>Project Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-078</td>
<td>Windsor Woods Tide Gate</td>
</tr>
<tr>
<td>7-077</td>
<td>Windsor Wood Pump Station</td>
</tr>
<tr>
<td>7-076</td>
<td>Windsor Woods – Thalia Creek/Lake Trashmore Improvements</td>
</tr>
<tr>
<td>7-028</td>
<td>Windsor Woods Drainage</td>
</tr>
</tbody>
</table>
## TL-PAP Major Improvements

<table>
<thead>
<tr>
<th>CIP No.</th>
<th>Project Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-073</td>
<td>Princess Anne Plaza Golf Course (Bow Creek) Conversion</td>
</tr>
<tr>
<td>7-089</td>
<td>Princess Anne Plaza North London Bridge Creek Pump Station</td>
</tr>
<tr>
<td>7-094</td>
<td>The Lakes – South London Bridge Creek Channels and Gate</td>
</tr>
<tr>
<td>7-050</td>
<td>Princess Anne Plaza Drainage</td>
</tr>
<tr>
<td>7-051</td>
<td>The Lakes Drainage Improvements</td>
</tr>
</tbody>
</table>
Windsor Woods Tide Gate & Pump Station Rendering

Control Building
(Generator, Fuel Tanks, etc.)
CIP 7-077

Pump Station
(750 cfs)
CIP 7-077

Tide Gate
(4 Gates; Total 60’ wide)
CIP 7-078
North London Bridge Creek Pump Station & Gate Rendering

Pump Station (1,400 cfs)

Control Building (Generator, Fuel Tanks, etc.)

Tide Gate
South London Bridge Creek Tide Gate & Channel CIP 7-094

Insert rendering of S. Tide Gate and Channels once complete. In process…almost done!
Princess Anne Plaza Golf Course (Bow Creek) Conversion Concept CIP 7-073

Concept 4 (Revised) Narrative
Storage Volume (Excavated+Elevated): 319 Ac/Ft
Shared Use Path / Greenway Length: 3.1 miles (SK)
Mountain Bike Single Track: 2.9 Miles
Existing Canopy: 34.4 Ac (25% of site)

Legend
- Upland Storage
- Floodplain Storage
- Channel Storage
- Proposed Lawn
- Existing Trees to be Preserved
- Proposed Trees
- Property Line
- Shared Use Path / Greenway
- Mountain Bike Trail
- Natural Surface Trail
- Public Access / Trailhead
- Water Inflow

Park Amenities - Active Uses
- Pickleball Courts
- Skatepark Features
- Sand Volleyball Courts
- Multi-Purpose Field
- Mountain Bike Trail
- Nature/Interpretive Trail

Park Amenities - Passive Uses
- Walking Paths
- Interpretive Stormwater
- Foot Bridges
- Overlooks / Wildlife Viewing Blinds
- Piers and Blueway Access
- Shelter
- Parking
- Pro Shop Re-use
Princess Anne Plaza Golf Course (Bow Creek) Conversion Concept CIP 7-073
Preliminary Concept Plan
(Phase I – $225M)

WINDSOR WOODS PUMP STATION, TIDE GATE & BARRIER LOCATION

POTENTIAL SOUTH TIDE GATE, CHANNELS & BARRIER LOCATION

POTENTIAL NORTH PUMP STATION, TIDE GATE & BARRIER LOCATION

POTENTIAL STORMWATER STORAGE

EARLY STORM DRAIN PROJECTS
(Club House Road and FEMA Reimbursement Projects – FRP1 and FRP2-3)

Lynn Haven Pkwy
Lake Windsor
Lake Trashmore
Windsor Woods Canal
Holland Rd
London Bridge Creek
Bow Creek Golf Course
Holland Road Gate
The Lakes
# Windsor Woods Incremental Improvements

| Phase | Description (Each item builds on previous item) | Linear Feet of Street Flooding | Simulated Flooded Structures | CIP Cumulative Cost ($M)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Improvements (Existing, Base Condition)</td>
<td>38,060</td>
<td>357</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>I-a</td>
<td>Thalia Creek Gate with Temp Pump (50 cfs) &amp; Connection of Lake Windsor &amp; Lake Trashmore</td>
<td>36,460</td>
<td>287</td>
<td>$12</td>
</tr>
<tr>
<td>I-b</td>
<td>Early Projects (Club House Road and FEMA Reimbursement Projects - FRP1 &amp; FRP2-3)</td>
<td>21,120</td>
<td>287</td>
<td>$27</td>
</tr>
<tr>
<td>I-c</td>
<td>Perm. Pump Station (750 cfs) &amp; Phase 1 Barriers</td>
<td>21,080</td>
<td>46</td>
<td>$60</td>
</tr>
<tr>
<td>I-d</td>
<td>Phase 2 Barriers</td>
<td>21,080</td>
<td>46</td>
<td>$74</td>
</tr>
<tr>
<td>II</td>
<td>Remaining Infrastructure Improvements (Storm Drains)</td>
<td>170</td>
<td>19</td>
<td>$154</td>
</tr>
</tbody>
</table>

1 Level of Service: Limit peak stages to three (3) inches or less above the road crown for the 10-year design storm and prevent flooding of structures for the 100-year design storm.

2 The costs presented above includes the construction cost, 30% contingency and a 25% non-construction cost which includes design and easement acquisition costs. Escalation is NOT included.

3 The 750 cfs permanent pump station will provide a much greater benefit than the 50 cfs interim (temporary) pump station during pre-storm drawdown, storm events and post-storm return to normal water levels.
Windsor Woods – Cost vs. Protection

Permanent Pump Station (750 cfs) & Phase 1 Barriers 87% - Structures 45% - Roadways

Full FEMA Benefit

Remaining Infrastructure Improvements (Storm Drains) 95% - Structures 99% - Roadways

Infrastructure Cost Curve

Early Projects (FRP I, II & III and Club House Road) 20% - Structures 44% - Roadways

Tide Gate, Temp Pump (50 cfs), Lake Windsor to Lake Trashmore Connection 20% - Structures 4% Roadways

Existing Conditions 100-year Design Storm Simulated Flooded Structures = 357

10-year Storm = Roadway Flooding 100-year Storm = Structure Flooding
# The Lakes & Princess Anne Plaza Incremental Improvements

## Cumulative Improvements

<table>
<thead>
<tr>
<th>Phase No.</th>
<th>Description (Each item builds on previous item)</th>
<th>Linear Feet of Street Flooding</th>
<th>Simulated Flooded Structures</th>
<th>CIP Cumulative Cost ($M)²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10-year</td>
<td>100-year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Improvements (Existing, Base Condition)</td>
<td>41,690</td>
<td>621</td>
<td>$0</td>
</tr>
<tr>
<td>I-a</td>
<td>Tide Gates (London Bridge Creek North &amp; South)</td>
<td>30,020</td>
<td>538</td>
<td>$19</td>
</tr>
<tr>
<td>I-b</td>
<td>Princess Anne Plaza Golf Course (Bow Creek) Storage Conversion Phase I</td>
<td>24,270</td>
<td>389</td>
<td>$57</td>
</tr>
<tr>
<td>I-c</td>
<td>Pump Station (1,400 cfs)</td>
<td>23,700</td>
<td>243</td>
<td>$108</td>
</tr>
<tr>
<td>I-d</td>
<td>Princess Anne Plaza Golf Course (Bow Creek) Storage Conversion Phase II</td>
<td>21,430</td>
<td>97</td>
<td>$128</td>
</tr>
<tr>
<td>I-e</td>
<td>Barriers</td>
<td>21,430</td>
<td>97</td>
<td>$134</td>
</tr>
<tr>
<td>I-f</td>
<td>Additional Storage, Holland Gate, Ditch Maintenance</td>
<td>20,170</td>
<td>79</td>
<td>$151</td>
</tr>
<tr>
<td>II-a</td>
<td>Storm Drain Improvements (Faraday, Coach House, Burnt Mill &amp; Lakecrest)</td>
<td>16,620</td>
<td>40</td>
<td>$164</td>
</tr>
<tr>
<td>II-b</td>
<td>Remaining Infrastructure Improvements (Storm Drains)</td>
<td>5,230</td>
<td>13</td>
<td>$200</td>
</tr>
</tbody>
</table>

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1 Level of Service: Limit peak stages to three (3) inches or less above the road crown for the 10-year design storm and prevent flooding of structures for the 100-year design storm.

2 The costs presented above includes the construction cost, 30% contingency and a 25% non-construction cost which includes design and easement acquisition costs. Escalation is NOT included.
TL-PAP – Cost vs. Protection

- Existing Conditions 100-year Design
- Storm Simulated Flooded Structures = 621

- Bow Creek Storage Phase II 84% - Structures 49% - Roadways
- Pump Station 61% - Structures 43% - Roadways
- London Bridge Creek Tide Gates 13% - Structures 28% - Roadways
- Bow Creek Storage Phase I 37% - Structures 42% - Roadways
- FULL FEMA BENEFITS
- Remaining Infrastructure (Storm Drain) 98% - Structures 87% - Roadways
- Barriers
- Additional Storage, Holland Gate, Ditch Maintenance 87% - Structures 52% - Roadways
- Infrastructure Cost Curve

10-year Storm = Roadway Flooding
100-year Storm = Structure Flooding

Costs include $15 M for Park Amenities on Golf Course
### Cumulative Improvements

<table>
<thead>
<tr>
<th>Phase No.</th>
<th>Description (Each item builds on previous item)</th>
<th>CIP Cumulative Cost (Public) ($M)(^1)</th>
<th>Approximate Assessed Value of Property Mitigated (Private) (100-year) ($M)(^2)</th>
<th>Approximate Number of Properties Impacted by Street Flooding (10-year)(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Improvements (Existing, Base Condition)</td>
<td>$0</td>
<td>$0</td>
<td>760</td>
</tr>
<tr>
<td>I-a</td>
<td>Thalia Creek Gate with Temp Pump (50 cfs) &amp; Connection of Lake Windsor &amp; Lake Trashmore</td>
<td>$12</td>
<td>$21</td>
<td>730</td>
</tr>
<tr>
<td>I-b</td>
<td>Early Projects (Club House Road and FEMA Reimbursement Projects - FRP1 &amp; FRP2-3)</td>
<td>$27</td>
<td>$21</td>
<td>425</td>
</tr>
<tr>
<td>I-c</td>
<td>Perm. Pump Station (750 cfs) &amp; Phase 1 Barriers</td>
<td>$60</td>
<td>$93</td>
<td>425</td>
</tr>
<tr>
<td>I-d</td>
<td>Phasing 2 Barriers</td>
<td>$74</td>
<td>$93</td>
<td>425</td>
</tr>
<tr>
<td>II</td>
<td>Remaining Infrastructure Improvements (Storm Drains)</td>
<td>$154</td>
<td>$101</td>
<td>4</td>
</tr>
</tbody>
</table>

\(^1\) The costs presented above includes the construction cost, 30% contingency and a 25% non-construction cost which includes design and easement acquisition costs. Escalation is NOT included.

\(^2\) Average assessed value of property estimated at $300,000. Includes assessed value only.

\(^3\) Assumes two houses per 100 feet of street. **Street flooding is defined as more than 3-inches over road crown.**
### Cumulative Improvements

<table>
<thead>
<tr>
<th>Phase No.</th>
<th>Description (Each item builds on previous item)</th>
<th>CIP Cumulative (Public) ($M)¹</th>
<th>Approximate Assessed Value of Property Mitigated (Private) (100-year) ($M)²</th>
<th>Approximate Number of Properties Impacted by Flooded Streets (10-year)³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Improvements (Existing, Base Condition)</td>
<td>$0</td>
<td>$0</td>
<td>835</td>
</tr>
<tr>
<td>I-a</td>
<td>Tide Gates (London Bridge Creek North &amp; South)</td>
<td>$19</td>
<td>$17</td>
<td>600</td>
</tr>
<tr>
<td>I-b</td>
<td>Princess Anne Plaza Golf Course (Bow Creek) Storage Conversion Phase I</td>
<td>$57</td>
<td>$49</td>
<td>485</td>
</tr>
<tr>
<td>I-c</td>
<td>Pump Station (1,400 cfs)</td>
<td>$108</td>
<td>$79</td>
<td>475</td>
</tr>
<tr>
<td>I-d</td>
<td>Princess Anne Plaza Golf Course (Bow Creek) Storage Conversion Phase II</td>
<td>$128</td>
<td>$110</td>
<td>430</td>
</tr>
<tr>
<td>I-e</td>
<td>Barriers</td>
<td>$134</td>
<td>$110</td>
<td>430</td>
</tr>
<tr>
<td>I-f</td>
<td>Additional Storage, Holland Gate, Ditch Maintenance</td>
<td>$151</td>
<td>$114</td>
<td>405</td>
</tr>
<tr>
<td>II-a</td>
<td>Storm Drain Improvements (Faraday, Coach House, Burnt Mill &amp; Lakecrest)</td>
<td>$164</td>
<td>$122</td>
<td>335</td>
</tr>
<tr>
<td>II-b</td>
<td>Remaining Infrastructure Improvements (Storm Drains)</td>
<td>$200</td>
<td>$128</td>
<td>105</td>
</tr>
</tbody>
</table>

¹ The costs presented above includes the construction cost, 30% contingency and a 25% non-construction cost which includes design and easement acquisition costs. Escalation is NOT included.

² Average assessed value of property estimated at $210,000. Includes assessed value only.

³ Assumes two houses per 100 feet of street. Street flooding is defined as more than 3-inches over road crown.
### Phase I Modeling Results & Cost Comparison

<table>
<thead>
<tr>
<th>Scenario</th>
<th>10-Year Design Storm Road Flooding</th>
<th>100-Year Design Storm Structure Flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(&gt;3&quot; above road crown)</td>
<td>Structure Flooding</td>
</tr>
<tr>
<td>SCENARIO</td>
<td>WW</td>
<td>TL-PAP</td>
</tr>
<tr>
<td>Existing Condition</td>
<td>38,060 LF</td>
<td>41,690 LF</td>
</tr>
<tr>
<td>Phasing Refinement</td>
<td>19,790 LF</td>
<td>20,170 LF</td>
</tr>
<tr>
<td><strong>Reduction</strong></td>
<td><strong>48%</strong></td>
<td><strong>52%</strong></td>
</tr>
</tbody>
</table>

40,000 LF (7.6 Miles) of Road Flooding (More than 3-inches over road crown)

125 Flooded Structures

<table>
<thead>
<tr>
<th>Phase I</th>
<th>$225 M</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Recommended Infrastructure Improvements (Phase I &amp; II)</td>
<td>$354 M</td>
</tr>
</tbody>
</table>
FEMA Considerations

- **Conditional Letter of Map Revision (CLOMR)** – Process to obtain FEMA’s comments on the proposed plan and anticipated floodplain modifications.
  - Submitted upfront prior to construction.

- **Letter of Map Revision (LOMR)** – FEMA’s official modification to an effective Flood Insurance Rate Map (FIRM). Project constructed & as-builts complete.
  - May be submitted after each construction project to gain benefits incrementally.

- **Potential Impacts for WW-TL-PAP:**
  - Homes removed from floodplain via LOMR require NO flood insurance.
  - Zone X areas qualify for Preferred Risk Policies, which are substantially cheaper (starting at around $350/year).
  - Shallow flooding areas may be rezoned “X-shaded” to reduce rates if average depths of flooding can be shown to be less than a foot.
  - LOMR and CLOMRs can be done in pieces or as a whole.
Summary

- Recommend Full Solution be implemented to maximize the number of structures mitigated and minimize the length of roadway flooded.
  - **Phase I** – Focuses on Structural Flooding
  - **Phase II** – Focuses on Street Flooding

- **After Phase I:**
  - 40,000 LF of roads will flood for a 10-year design storm and
  - 125 structures will not be mitigated for a 100-year design storm event.

- **After Phase II:**
  - 5,400 LF of roads will flood for a 10-year design storm and
  - 32 structures will not be mitigated for a 100-year design storm event.

- We continue to explore multi-variable options to cut costs or add protection to the areas.
- Recommend Improvements be Designed to Meet FEMA 100-Year Standards to Qualify for Reduced Insurance Rates.
Questions?