

HDR

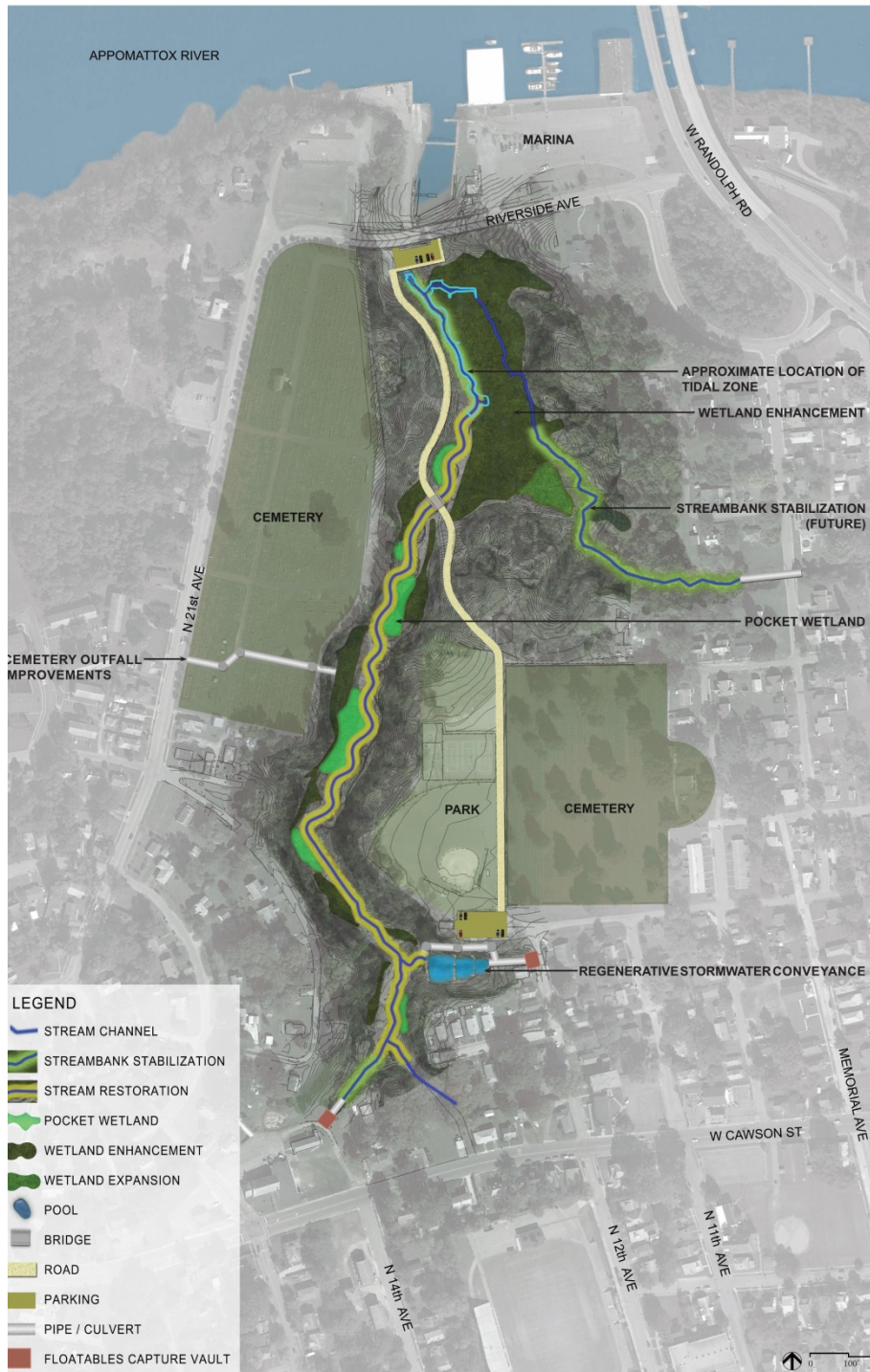


# Unique Strategies to Integrate Community Needs and Bay TMDL Solutions

CWEA Stormwater Committee  
2016 Fall Seminar







01 Hopewell's Program

02 Marina BMP Project Vision

03 Beyond the Traditional TMDL Strategy

04 Making the Math Work



LEARN WELL, LIVE WELL, WORK WELL, PLAY WELL, IN HOPEWELL

a historic riverfront community.

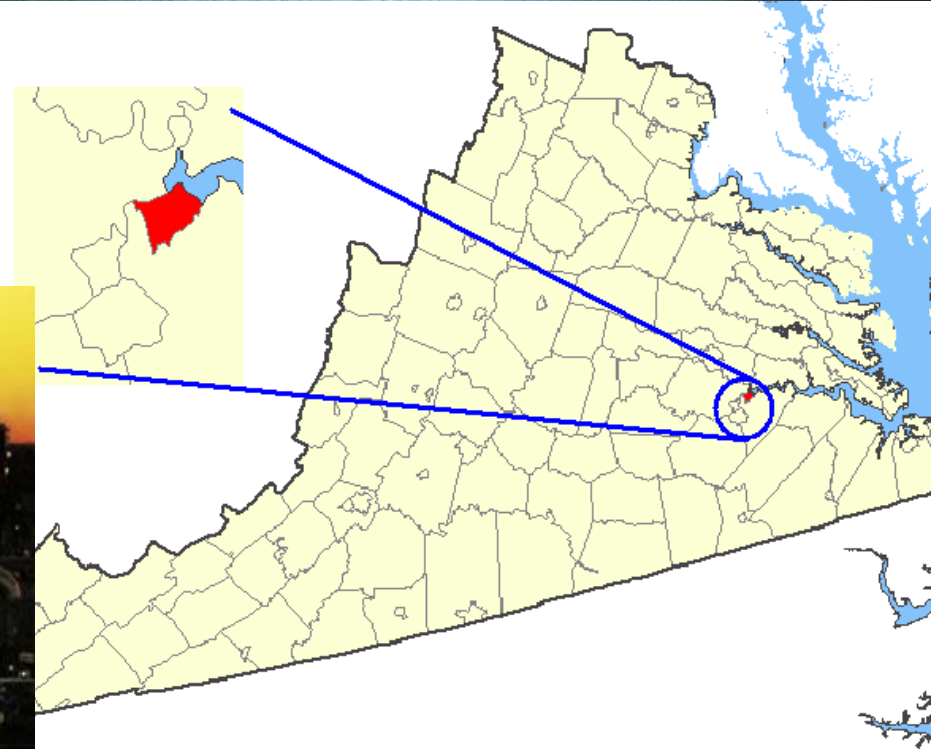
01

# Hopewell's Stormwater Program



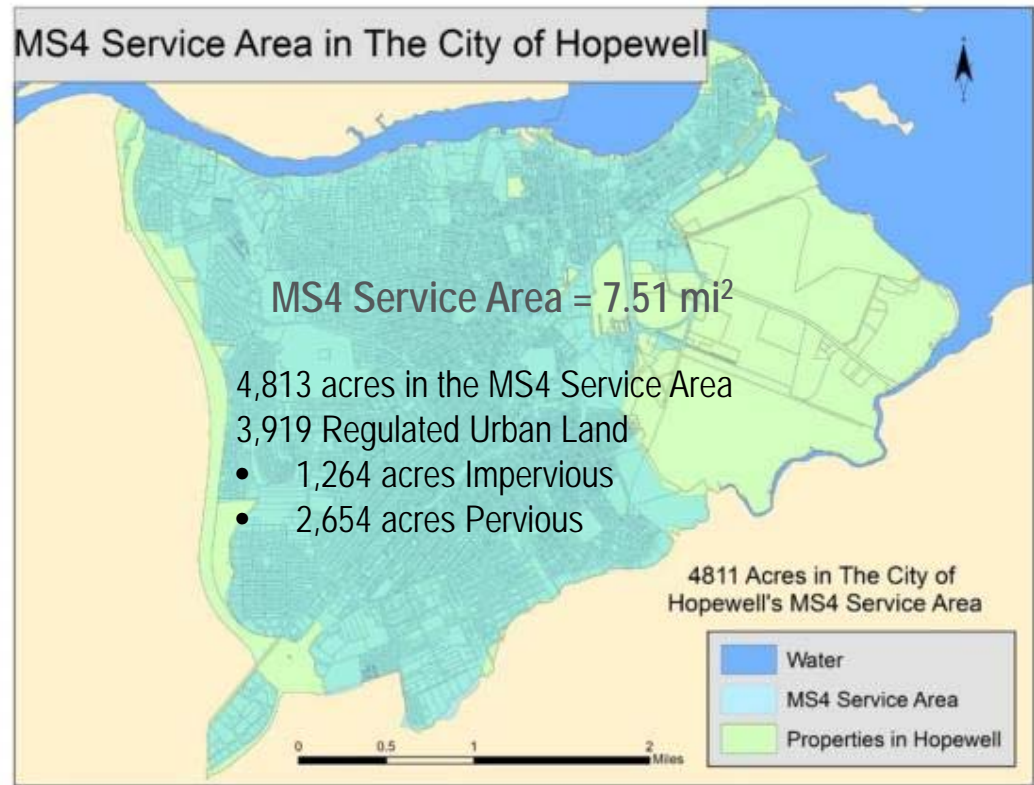
## Get to know Hopewell, VA

- 10.8 sq.miles; 22,196 people (2014)
- Median Income: \$ 37,196 (2013)
- ~ 60% rental property
- City Point: at the confluence of the James and Appomattox Rivers
  - 1613: founded by Sir Thomas Dale
  - Mid 1800s: City Point Railroad established
  - 1864-65: General U.S. Grant's command post
  - 1914: The DuPont Company develops a City
  - 1916: Hopewell incorporated



# Virginia's Strategy for Bay TMDL Compliance

- Phase II MS4
- Stormwater Utility: \$4/ERU (2,100 ft<sup>2</sup>)
- 2013 MS4 Permit includes
  - EOS Loading Rate
  - Required Load Reductions per 5-yr permit cycle

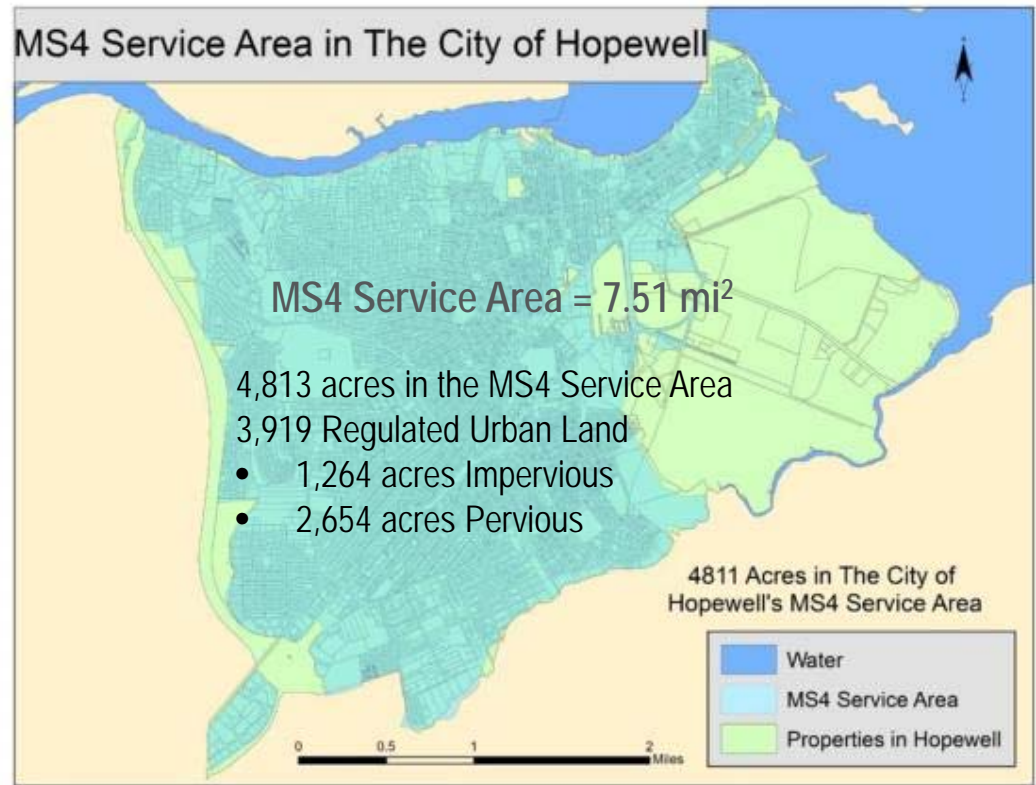


| Pollutant  | Regulated Urban Land Cover | Total MS4 Service Area (06/30/09) | 2009 EOS Loading Rate (lbs/acre) | Est. Total Load: 2009 Progress Run (lbs) | Total Load (lbs) | Required Reduction | Total reduction (lbs) | 5% (lbs) | 35% (lbs) | 60% (lbs) | Total 100% (lbs) |
|------------|----------------------------|-----------------------------------|----------------------------------|--|------------------|--------------------|-----------------------|----------|-----------|-----------|------------------|
| Nitrogen   | Impervious                 | 1,264.3                           | 9.39                             | 11,872                                   | 30,425           | 9%                 | 2,182                 | 109      | 764       | 1,309     | 2,182            |
|            | Pervious                   | 2,654.2                           | 6.99                             | 18,553                                   |                  | 6%                 |                       |          |           |           |                  |
| Phosphorus | Impervious                 | 1,264.3                           | 1.76                             | 2,225                                    | 3,552            | 16%                | 452                   | 23       | 158       | 271       | 452              |
|            | Pervious                   | 2,654.2                           | 0.50                             | 1,327                                    |                  | 7.25%              |                       |          |           |           |                  |
| TSS        | Impervious                 | 1,264.3                           | 676.94                           | 855,855                                  | 1,124,142        | 20%                | 194,646               | 9,732    | 68,126    | 116,788   | 194,646          |
|            | Pervious                   | 2,654.2                           | 101.08                           | 268,287                                  |                  | 8.75%              |                       |          |           |           |                  |



# Virginia's Strategy for Bay TMDL Compliance

- Phase II MS4
- Stormwater Utility: \$4/ERU (2,100 ft<sup>2</sup>)
- 2013 MS4 Permit includes
  - EOS Loading Rate
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|            | Pervious                   | 2,654.2                           | 6.99                             | 18,553                                   |                  | 6%                 |                       |          |           |           |                  |
| Phosphorus | Impervious                 | 1,264.3                           | 1.76                             | 2,225                                    | 3,552            | 16%                | 452                   | 23       | 158       | 271       | 452              |
|            | Pervious                   | 2,654.2                           | 0.50                             | 1,327                                    |                  | 7.25%              |                       |          |           |           |                  |
| TSS        | Impervious                 | 1,264.3                           | 676.94                           | 855,855                                  | 1,124,142        | 20%                | 194,646               | 9,732    | 68,126    | 116,788   | 194,646          |
|            | Pervious                   | 2,654.2                           | 101.08                           | 268,287                                  |                  | 8.75%              |                       |          |           |           |                  |



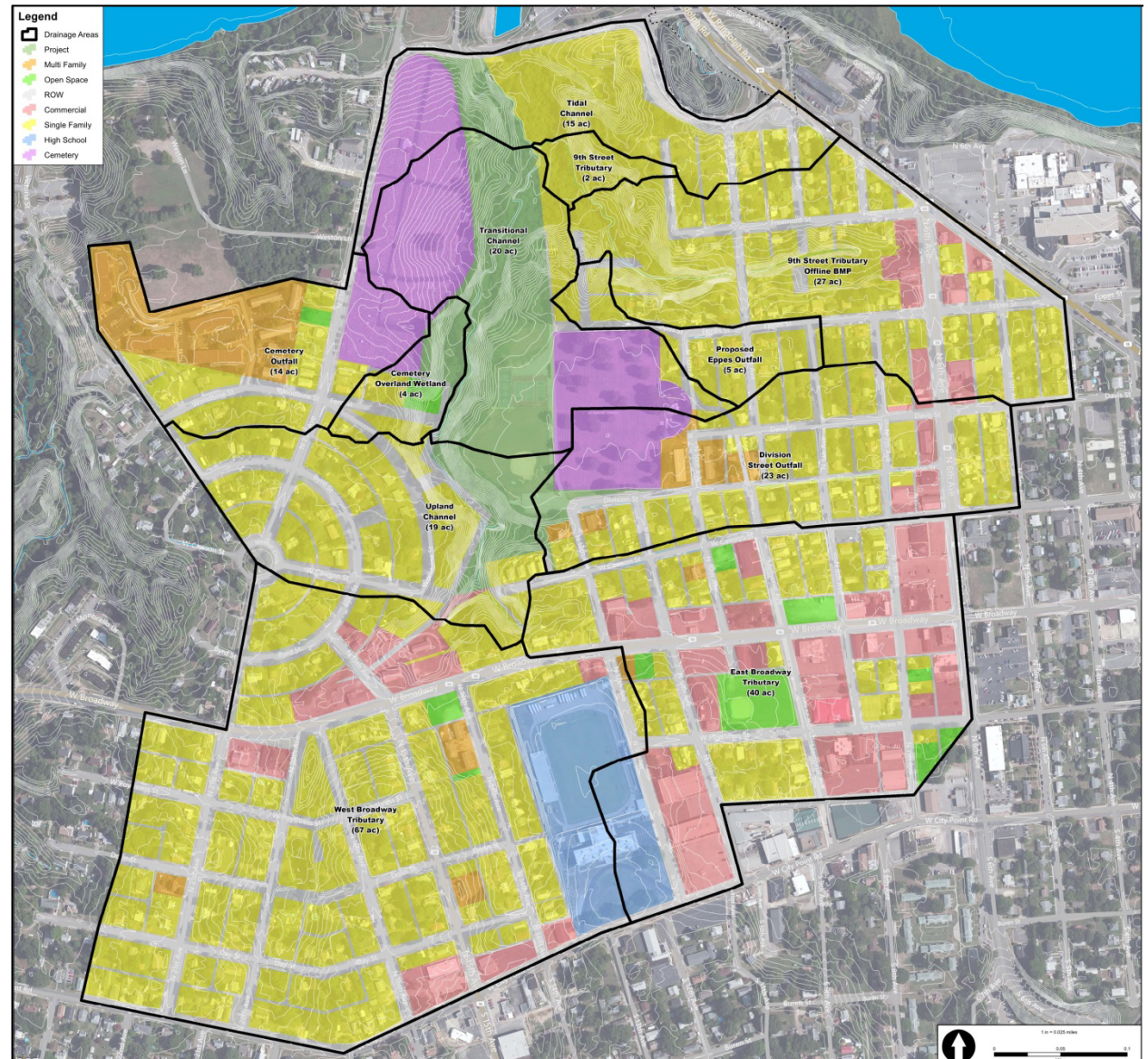


# 02 The Birth of the Marina BMP Project



# A Multi-Beneficial Vision

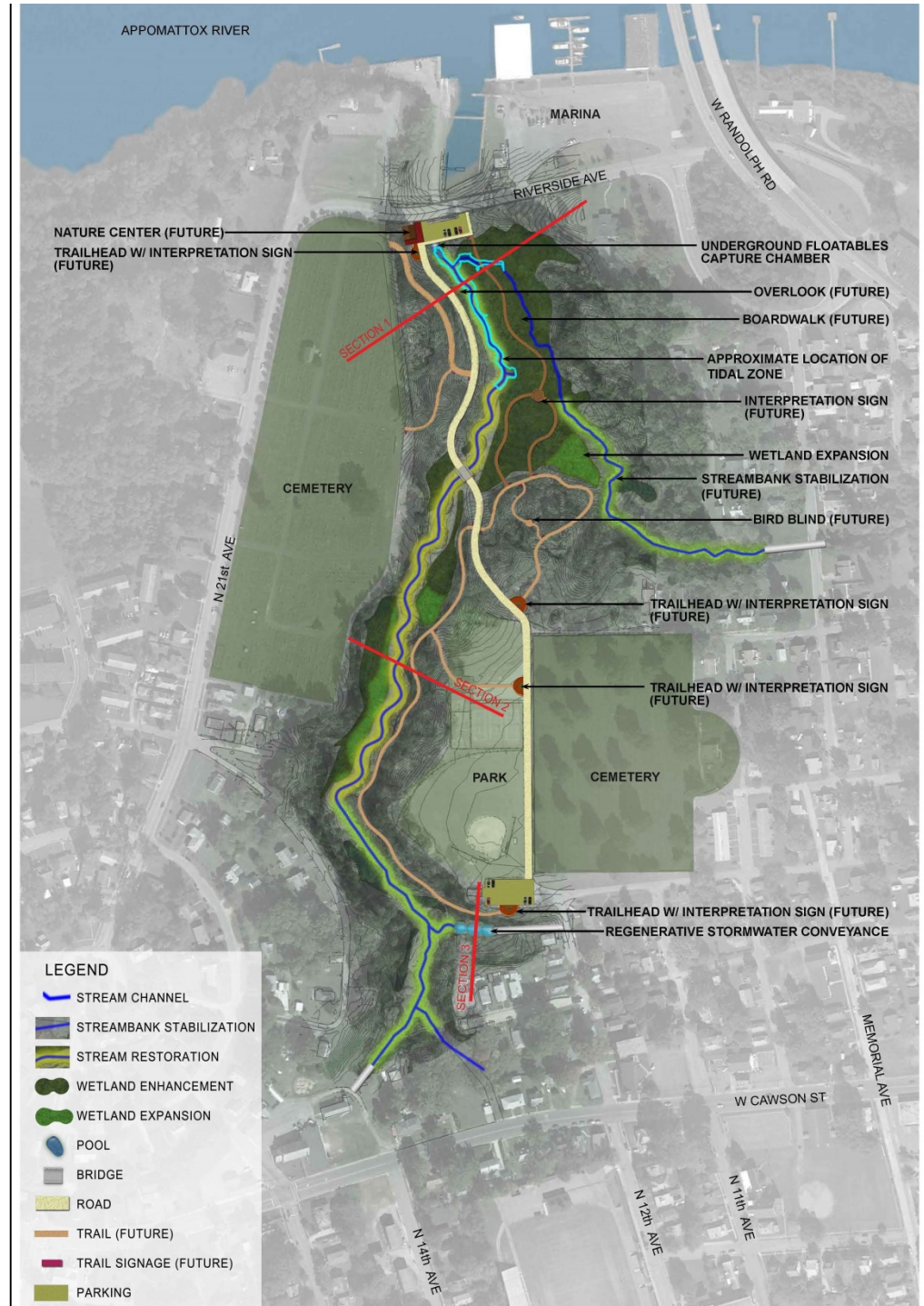
- Marina Development Initiatives underway
- Redevelopment opportunities
- Use of under-utilized City Property
- Connectivity to Community
- 296 Acres of highly urban watershed – nearly built-out





# Greenway Connectivity/Marina BMP

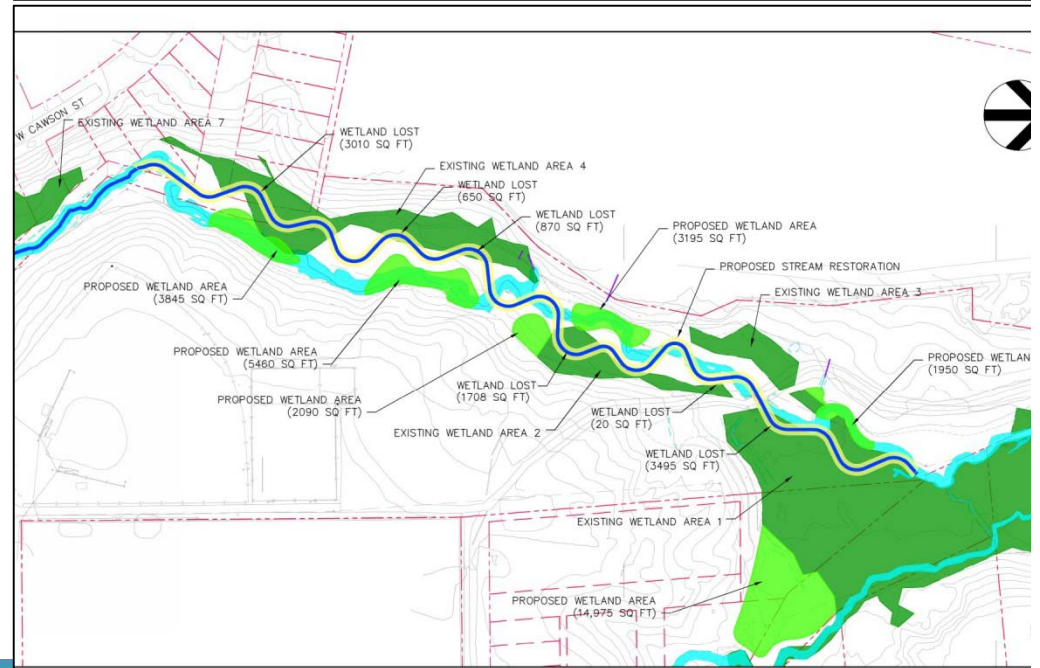
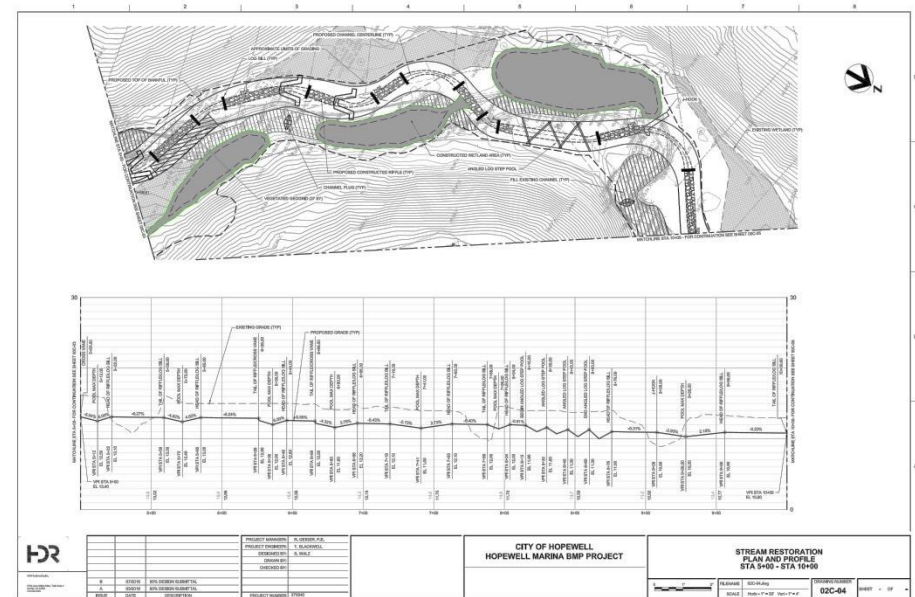
- Park and Recreation Component
  - Greenway Trails
  - Nature Center
  - Interpretive Areas
  - Destination Linkages
- Stormwater Component
  - Stormwater Park
    - Stream Restoration
    - Regenerative Stormwater Conveyance
    - Wetland Enhancements
    - Wetland Expansion
    - Bio-retention
    - Permeable Pavement
  - Other Factors
    - Maintenance access
    - Stormwater Education
    - Grey Infrastructure Rehab
    - Trash/Debris Management





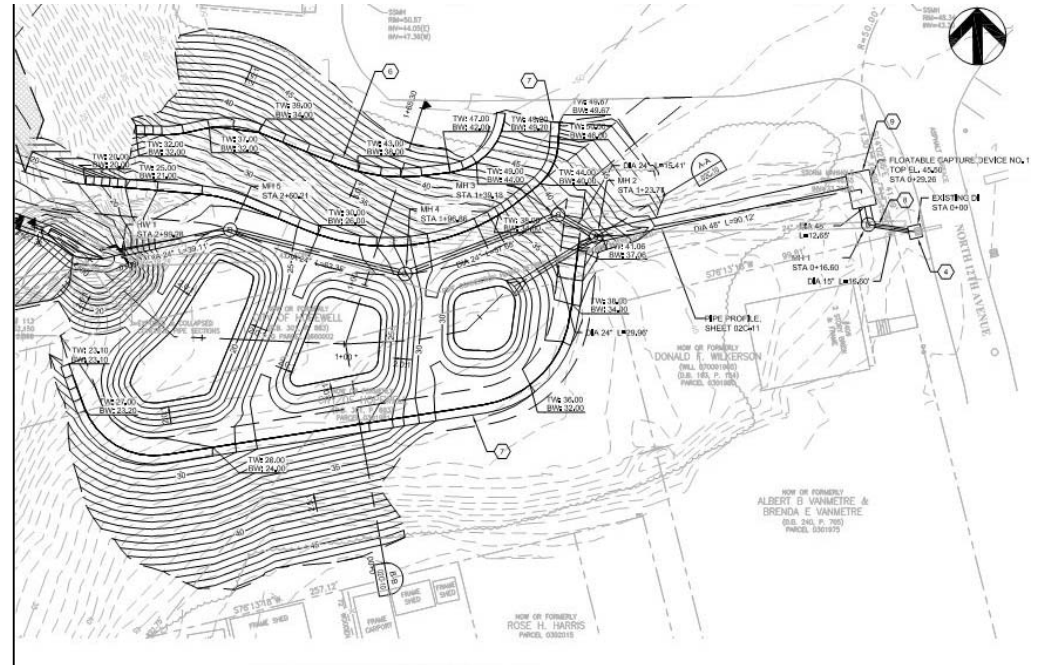
# Stream Restoration

- 2400 lf of full restoration (Priority 1)
  - Reconnection to floodplain
  - Floatable/debris collection upstream
  - Complimentary with park elements
  - Grade control to protect steep channel slope
  - Diversity in type of in-stream structures
  - Tidally influenced portion contains limited improvements – somewhat stable section
  
- 150 lf of stream bank stabilization
  - Limited floodplain
  - Creation of low-flow channel
  - Grade control to protect steep channel slope



# Regenerative Stormwater Conveyance

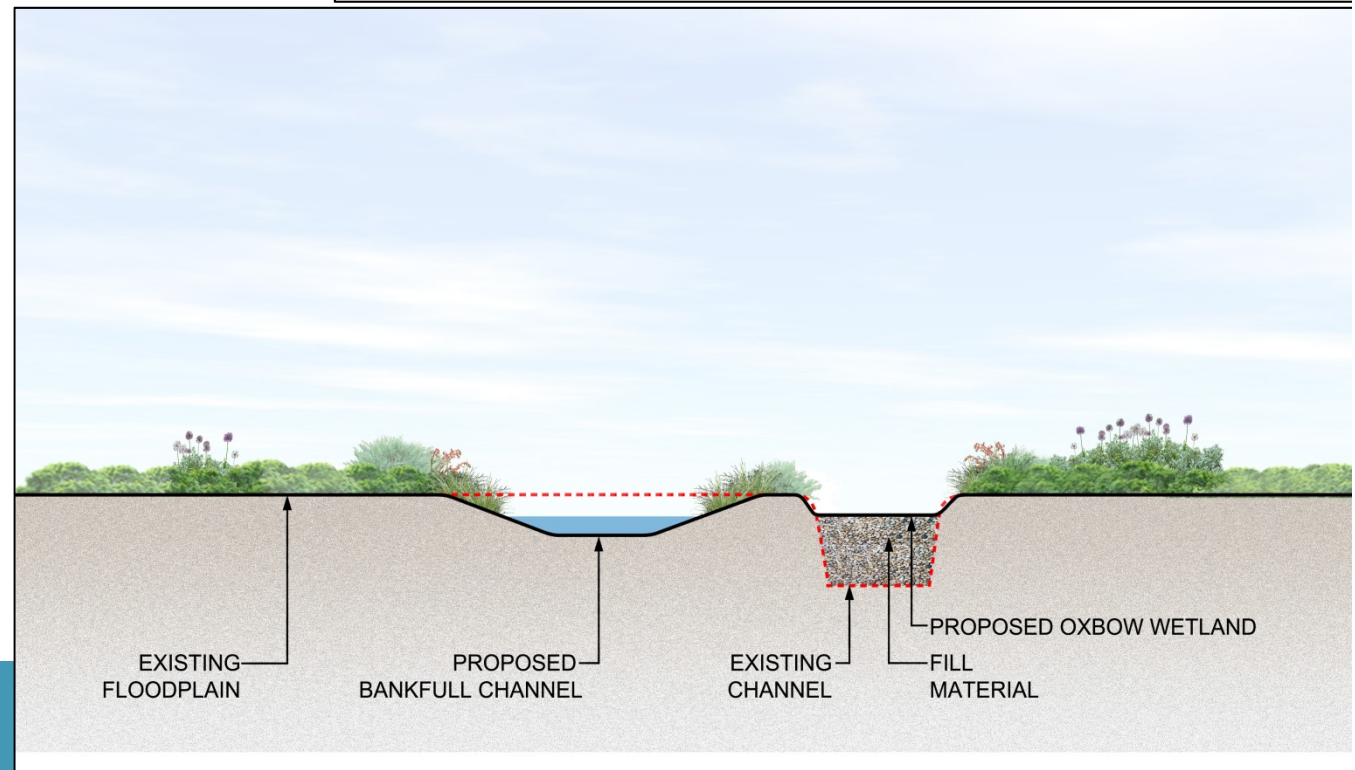
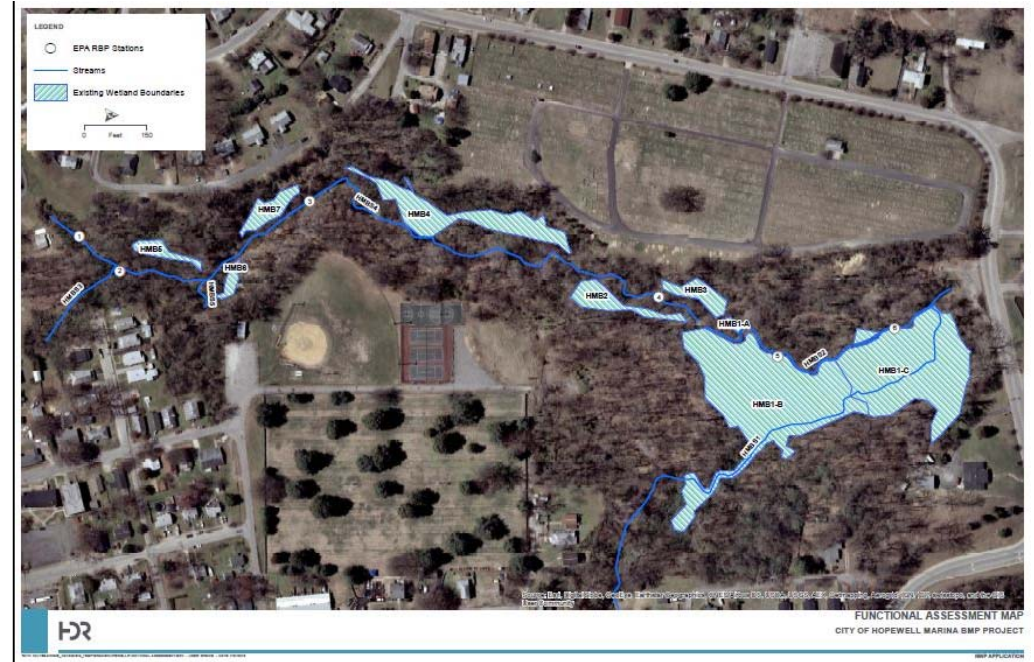
- Upstream of tributary to main stream
  - 40+ acres of highly urban watershed
  - Unknown culvert system
    - Stream head cutting
    - Culvert sections eroded at discharge to stream
  - Opportunity for significant storage given City-owned property
  - Opportunity to control energy to downstream channel
  - Opportunity to address failing pipe system





# Wetland Expansion

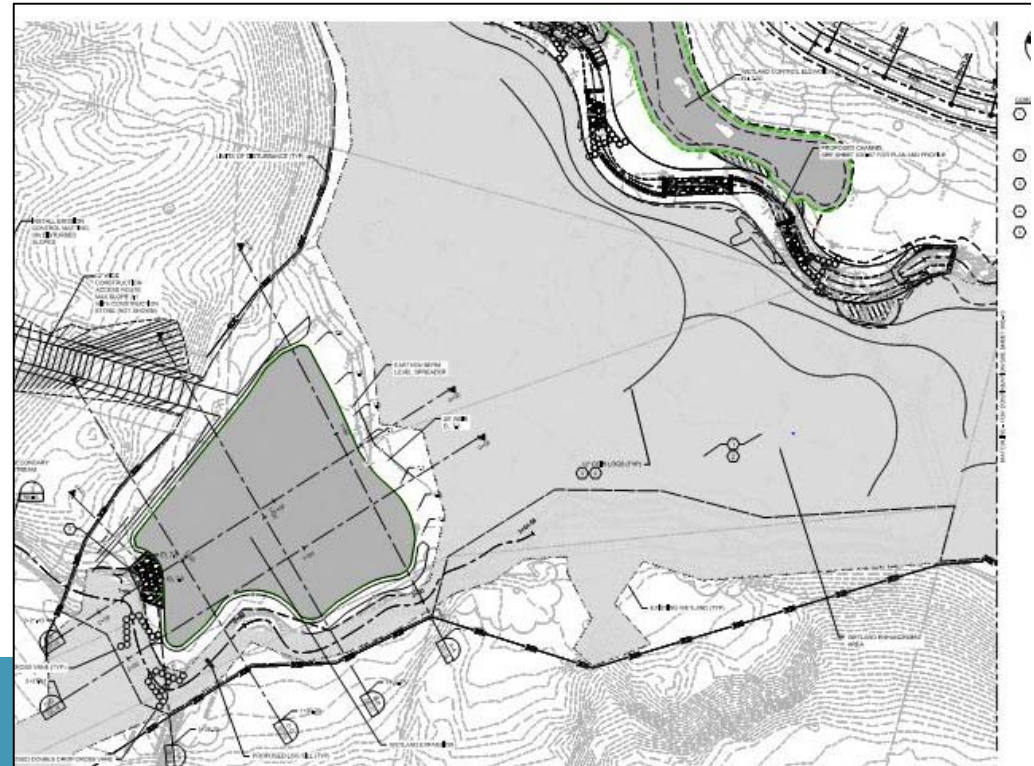
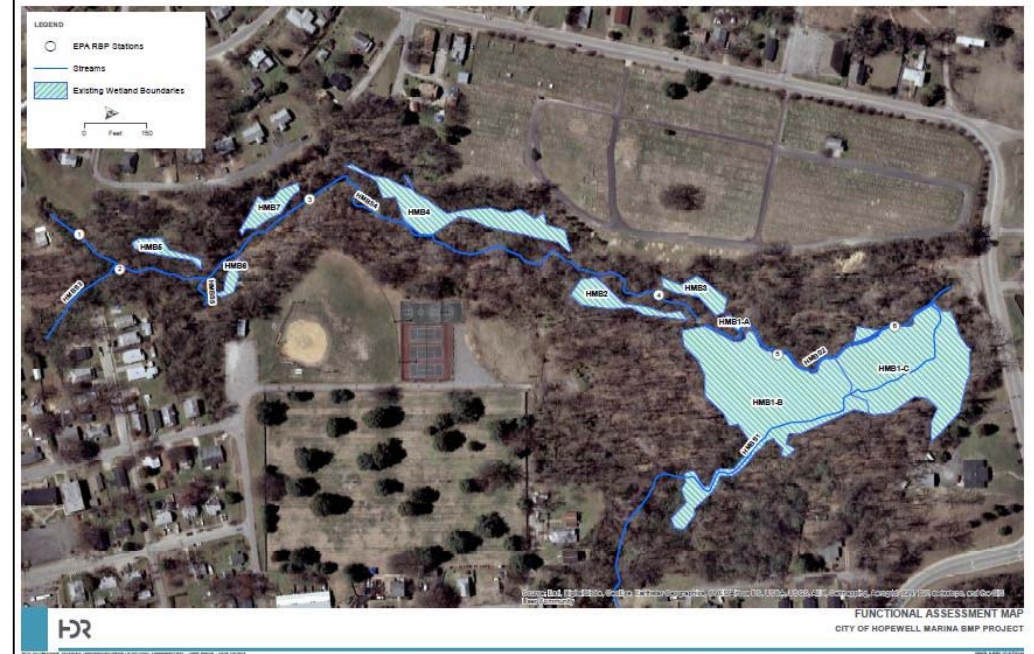
- Pocket Wetlands
  - Repurpose existing stream corridor
  - Preserve loss of jurisdictional wetlands
  - Biological/Habitat diversity
  - Re-use of stream excavation





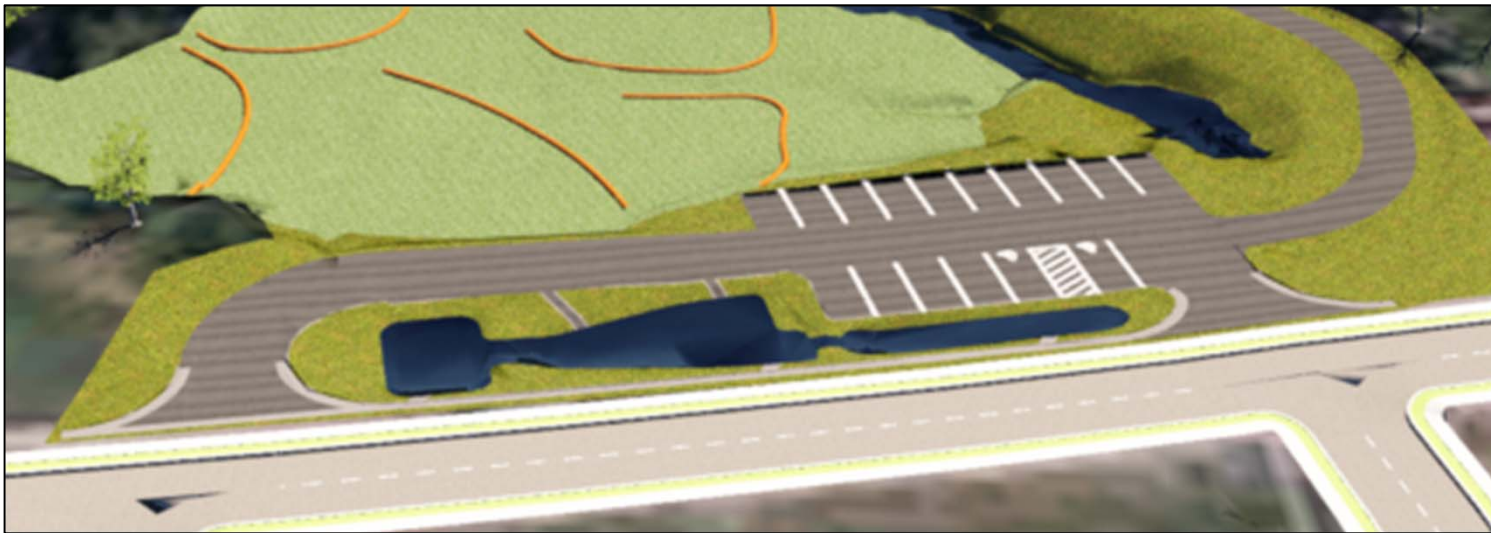
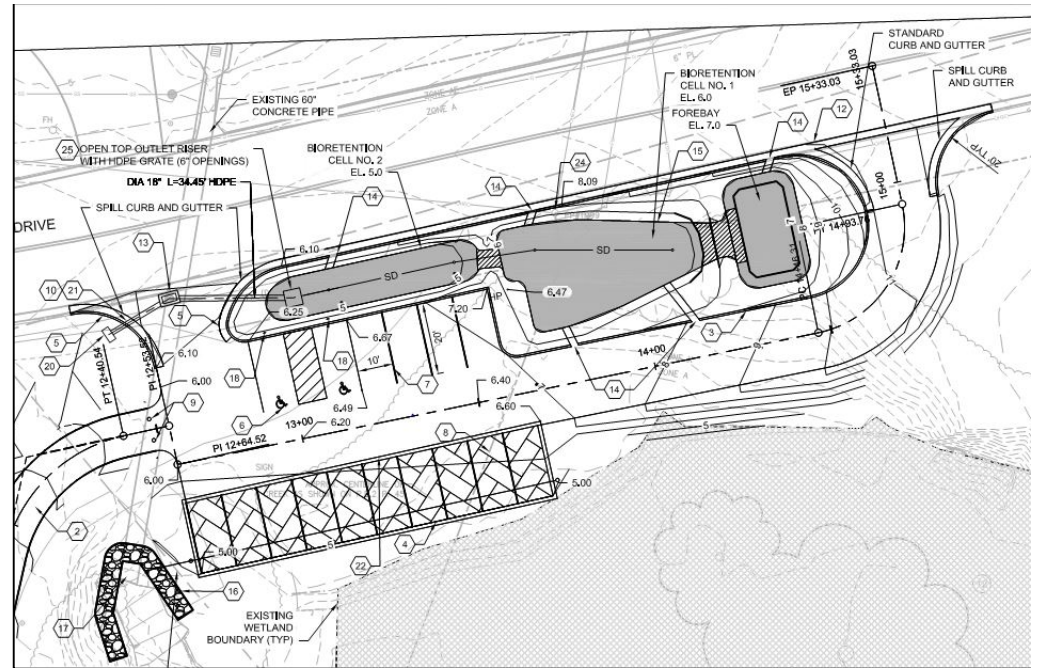
# Wetland Expansion

- Expansion of existing Wetlands
  - 60 Acre watershed to secondary stream
  - Connection via grade control structures in existing secondary stream
  - Mimic natural wetland systems
    - No engineered control structure
  - Aid in bringing runoff into existing wetlands for added storage
  - Outside of jurisdictional wetlands



# Bioretention and Permeable Pavement

- Parking Lot enhancements
  - Treat nearby street and private property runoff
  - NFWF Grant opportunity
  - Opportunity for WQ Diversity
  - Beginning of greenway trail system







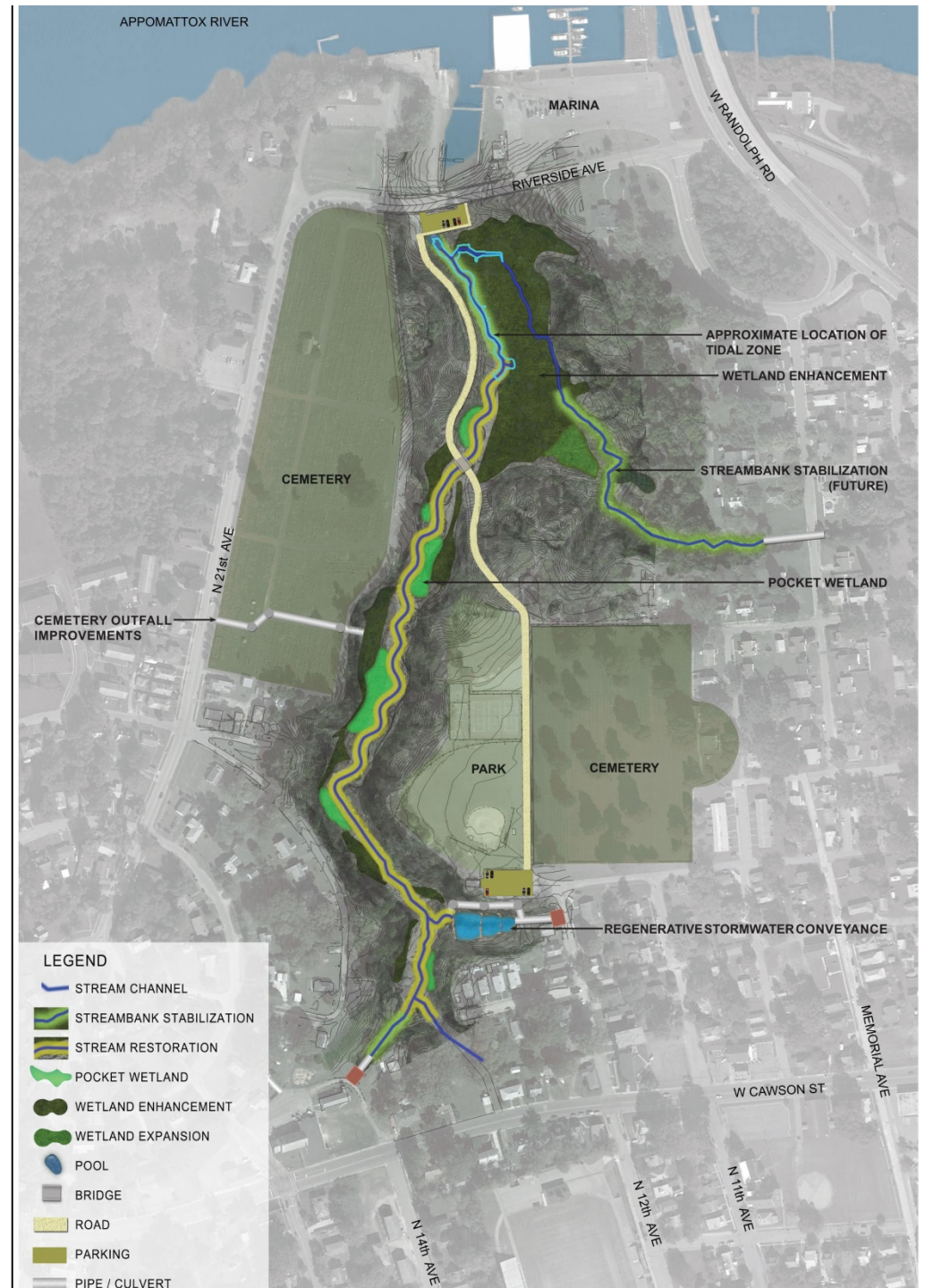
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## Beyond the Traditional TMDL Strategy



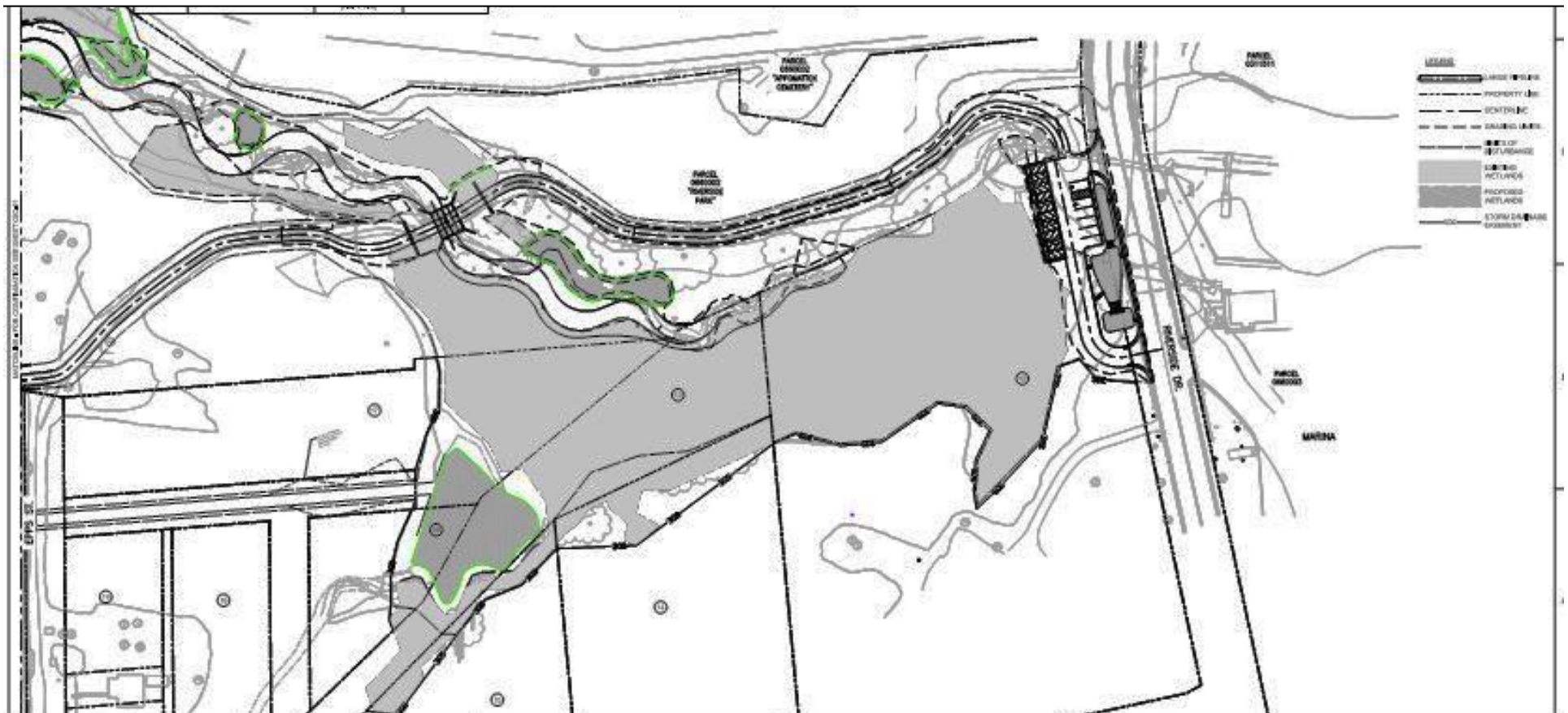
# Wetland Enhancements

- Over 3 acres of existing jurisdictional wetlands
  - City Property
  - Adjacent Private Property
- Wetland currently of poor quality
  - Invasive vegetation
  - Disconnection from stream channel
  - Siltation from degraded streams
  - Transient population (i.e. squatters)
  - Limitation in beneficial use and value
- Opportunity is Calling
  - Improved function for biological and habitat function
  - Utilize for Pollution Capture / Bay TMDL Credit



# Challenges

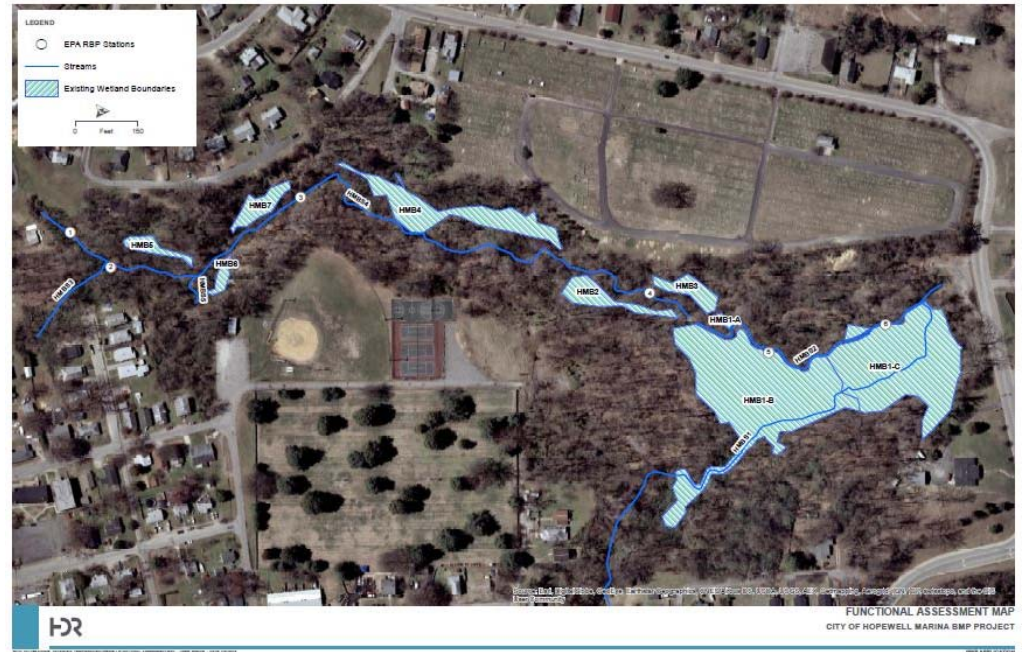
- USACE – disturbance, filling, functional loss
- DEQ – no precedent
- Private Property – several properties make up the 3 acre area targeted





# Strategy

- Functional Assessment
  - Prove poor quality and opportunity to improve
- Limited Impact to natural vegetation and topography
  - Key to USACE acceptance
- Conservative approach to Pollutant Reduction
  - Don't scare off the Regulators
- Show a Functional Lift for USACE
  - Pre-construction assessment
  - Post-construction monitoring
  - Use of NCWAM Wetland Assessment



**NC WAM WETLAND ASSESSMENT FORM**  
Accompanies User Manual Version 4.1  
Rating Calculator Version 4.1

|  |                               |                                  |                  |
|--|-------------------------------|----------------------------------|------------------|
| Wetland Site Name  | HMB - 1A                      | Date                             | 9/25/15          |
| Wetland Type   | Headwater Forest              | Assessor Name/Organization       | HDR              |
| Level III Ecoregion  | Middle Atlantic Coastal Plain | Nearest Named Water Body         | Appomattox River |
| River Basin  |                               | USGS 8-Digit Catalogue Unit      | 02080207         |
| <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Precipitation within 48 hrs? |                               | Latitude/Longitude (dec-degrees) |                  |
|  |                               | -77.289, 37.328                  |                  |

**Evidence of stressors affecting the assessment area (may not be within the assessment area)**  
Please circle and/or make note on last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, approximately within 10 years). Noteworthy stressors include, but are not limited to the following:

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), log lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed?  Yes  No

- Regulatory Considerations (select all that apply to the assessment area)**
- Anadromous fish
  - Federally protected species or State endangered or threatened species
  - NCDWQ riparian buffer rule in effect
  - Abuts a Primary Nursery Area (PNA)
  - Publicly owned property
  - N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
  - Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HDW, DRW, or Trout
  - Designated NCNHP reference community
  - Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

**What type of natural stream is associated with the wetland, if any? (check all that apply)**

- Blackwater
- Brownwater
- Tidal (If tidal, check one of the following boxes)  Lunar  Wind  Both

Is the assessment area on a coastal island?  Yes  No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver?  Yes  No

Does the assessment area experience overbank flooding during normal rainfall conditions?  Yes  No

**1. Ground Surface Condition/Vegetation Condition – assessment area condition metric**  
Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence of an effect.

|                                       |                                       |  |
|---------------------------------------|---------------------------------------|--|
| GS                                    | VS                                    |  |
| <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> A | Not severely altered   |
| <input type="checkbox"/> B            | <input type="checkbox"/> B            | Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, erosion, sedimentation, fire-pow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion (where appropriate), exotic species, grazing, less diversity (if appropriate), hydrologic alteration) |

**2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric**  
Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch  $\leq$  1 foot deep is considered to affect surface water only, while a ditch  $>$  1 foot deep is expected to affect both surface and ditch sub-surface water. Consider tidal flooding regime, if applicable.

|                                       |                                       |   |
|---------------------------------------|---------------------------------------|---|
| Surf                                  | Sub                                   |   |
| <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> A | Water storage capacity and duration are not altered.  |
| <input type="checkbox"/> B            | <input type="checkbox"/> B            | Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation)  |
| <input type="checkbox"/> C            | <input type="checkbox"/> C            | Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines) |

**3. Water Storage/Surface Relief – assessment area/wetland type condition metric (answer for non-marsh wetlands only)**  
Check a box in each column for each group below. Select the appropriate storage for the assessment area (AA) and the wet type (WT).

|                                       |                                       |   |
|---------------------------------------|---------------------------------------|---|
| AA                                    | WT                                    |   |
| <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> A | Majority of wetland with depressions able to pond water $>$ 1 foot deep         |
| <input checked="" type="checkbox"/> B | <input type="checkbox"/> B            | Majority of wetland with depressions able to pond water 8 inches to 1 foot deep |
| <input type="checkbox"/> C            | <input type="checkbox"/> C            | Majority of wetland with depressions able to pond water 3 to 6 inches deep      |
| <input type="checkbox"/> D            | <input checked="" type="checkbox"/> D | Depressions able to pond water $<$ 3 inches deep                                |

3b.  A Evidence that maximum depth of inundation is greater than 2 feet  
 B Evidence that maximum depth of inundation is between 1 and 2 feet  
 C Evidence that maximum depth of inundation is less than 1 foot

**NC WAM Wetland Rating Sheet**  
Accompanies User Manual Version 4.1  
Rating Calculator Version 4.1

|                   |                  |                            |         |
|-------------------|------------------|----------------------------|---------|
| Wetland Site Name | HMB - 1A         | Date                       | 9/25/15 |
| Wetland Type      | Headwater Forest | Assessor Name/Organization | HDR     |

|  |     |
|--|-----|
| Notes on Field Assessment Form (Y/N)   | YES |
| Presence of regulatory considerations (Y/N)  | YES |
| Wetland is intensively managed (Y/N)   | NO  |
| Assessment area is located within 50 feet of a natural tributary or other open water (Y/N) | YES |
| Assessment area is substantially altered by beaver (Y/N)                                   | NO  |
| Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)      | NO  |
| Assessment area is on a coastal island (Y/N)   | NO  |

| Sub-function Rating Summary |                               |                                   |           |
|-----------------------------|-------------------------------|-----------------------------------|-----------|
| Function                    | Sub-function                  | Metrics                           | Rating    |
| Hydrology                   | Surface Storage and Retention | Condition                         | HIGH      |
|                             |                               | Sub-Surface Storage and Retention | Condition |
| Water Quality               | Pathogen Change               | Condition                         | LOW       |
|                             |                               | Condition/Opportunity             | MEDIUM    |
|                             | Particulate Change            | Opportunity Presence? (Y/N)       | YES       |
|                             |                               | Condition                         | MEDIUM    |
| Soluble Change              | Physical Change               | Condition/Opportunity             | NA        |
|                             |                               | Opportunity Presence? (Y/N)       | NA        |
|                             | Pollution Change              | Condition                         | MEDIUM    |
|                             |                               | Condition/Opportunity             | HIGH      |
| Habitat                     | Physical Structure            | Condition                         | HIGH      |
|                             |                               | Condition/Opportunity             | HIGH      |
|                             | Landscape Patch Structure     | Opportunity Presence? (Y/N)       | YES       |
|                             |                               | Condition                         | NA        |
| Vegetation Composition      | Condition/Opportunity         | NA                                |           |
|                             | Opportunity Presence? (Y/N)   | NA                                |           |

| Function Rating Summary |                             |        |
|-------------------------|-----------------------------|--------|
| Function                | Metrics/Notes               | Rating |
| Hydrology               | Condition                   | HIGH   |
| Water Quality           | Condition                   | MEDIUM |
|                         | Condition/Opportunity       | MEDIUM |
| Habitat                 | Opportunity Presence? (Y/N) | YES    |
|                         | Condition                   | MEDIUM |

Overall Wetland Rating **MEDIUM**



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|                     |                               |                             |                  |
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| River Basin         |                               | USGS 8-Digit Catalogue Unit | 02080207         |

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| <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    Precipitation within 48 hrs? |                               | Latitude/Longitude (dec-degrees) -77.269, 37.308 |                  |

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Is the assessment area on a coastal island?  Yes  No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver?  Yes  No

Does the assessment area experience overbank flooding during normal rainfall conditions?  Yes  No

1. Ground Surface Condition/Vegetation Condition - assessment area condition metric

Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)

Assessment area is on a coastal island (Y/N)

Sub-function Rating Summary

| Function | Sub-Function | Metric | Rating |
|----------|--------------|--------|--------|
|          |              |        |        |

NC WAM Wetland Rating Sheet  
Accompanies User Manual Version 4.1  
Rating Calculator Version 4.1

Wetland Site Name HMB - 1A Date 9/25/15  
Wetland Type Headwater Forest Assessor Name/Organization HDR

|  |            |
|--|------------|
| Notes on Field Assessment Form (Y/N)   | <u>YES</u> |
| Presence of regulatory considerations (Y/N)  | <u>YES</u> |
| Wetland is intensively managed (Y/N)   | <u>NO</u>  |
| Assessment area is located within 50 feet of a natural tributary or other open water (Y/N) | <u>YES</u> |
| Assessment area is substantially altered by beaver (Y/N)                                   | <u>NO</u>  |

\* C Evidence that maximum depth of inundation is less than 1 foot

|                        |                             |               |
|------------------------|-----------------------------|---------------|
| Hydrology              | Condition                   | <u>HIGH</u>   |
| Water Quality          | Condition                   | <u>MEDIUM</u> |
|                        | Condition/Opportunity       | <u>MEDIUM</u> |
|                        | Opportunity Presence? (Y/N) | <u>YES</u>    |
| Habitat                | Condition                   | <u>MEDIUM</u> |
| Overall Wetland Rating |                             | <u>MEDIUM</u> |

| Function                      | Sub- Function*                     | HMB-1A      |             | HMB-1B      |             | HMB-1C      |             | HMB-2       |             | HMB-3       |             | HMB-4       |             | HMB-5       |             | HMB-6       |             | HMB-7       |             |
|-------------------------------|------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                               |                                    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    | Existing    | Proposed    |
| Hydrology                     | Surface Storage and Retention      | High        | High        | Low         | Med.        | Med.        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        |
|                               | Sub- Surface Storage and Retention | High        | High        | Low         | Low         | Low         | Low         | High        | High        | Med.        | Med.        | High        | High        | Med.        | Med.        | High        | High        | High        | High        |
| Water Quality                 | Pathogen Change                    | Low         | Low         | Low         | Low         | Med.        | High        | High        | High        | Low         | Low         | Low         | Low         | High        | High        | High        | High        | High        | High        |
|                               | Particulate Change                 | Med.        | High        | Med.        | High        | Med.        | High        | Med.        | High        | Med.        | High        | Med.        | High        | Med.        | High        | Low         | High        | Med.        | High        |
|                               | Soluble Change                     | Med.        | Med.        | Med.        | High        | Med.        | High        | Med.        | Med.        | High        | High        | High        | High        | High        | High        | Med.        | High        | High        | High        |
|                               | Physical Change                    | High        | High        | Med.        | High        | Med.        | High        | High        | High        | High        | High        | Med.        | Med.        | High        | High        | High        | High        | High        | High        |
|                               | Pollution Change                   | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          | NA          |
| Habitat                       | Physical Structure                 | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | Low         | Low         | High        | High        |
|                               | Landscape Patch Structure          | Med.        | Med.        | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         | Low         |
|                               | Vegetation Composition             | Low         | High        | Med.        | High        | High        | High        | Med.        | High        | High        | High        | Low         | High        | Low         | High        | Low         | Med.        | Low         | Med.        |
| Function Rating Summary       | Hydrology                          | High        | High        | Low         | Med.        | Med.        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        | High        |
|                               | Water Quality                      | Med.        | High        | Med.        | High        | Med.        | High        | High        | High        | High        | High        | Med.        | High        | High        | High        | High        | High        | High        | High        |
|                               | Habitat                            | Med.        | High        | High        | High        | High        | High        | Med.        | High        | High        | High        | Low         | High        | Low         | High        | Low         | Low         | Low         | Med.        |
| <b>Overall Wetland Rating</b> |                                    | <b>Med.</b> | <b>High</b> | <b>Med.</b> | <b>High</b> | <b>Med.</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>Med.</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>High</b> | <b>High</b> |

\*- only condition metrics are included in table

denotes increase in rating



**APPENDIX V.C - Chesapeake Bay Program, Established Efficiencies**

As an alternative to using the Bay Program Curves, permittees may use the Bay Program's established efficiencies for BMPs. Again, these efficiencies may be used for BMPs that do not meet the Virginia Stormwater BMP Clearinghouse design specifications.

**Table V.C.1 – Chesapeake Bay Program BMPs, Established Efficiencies**

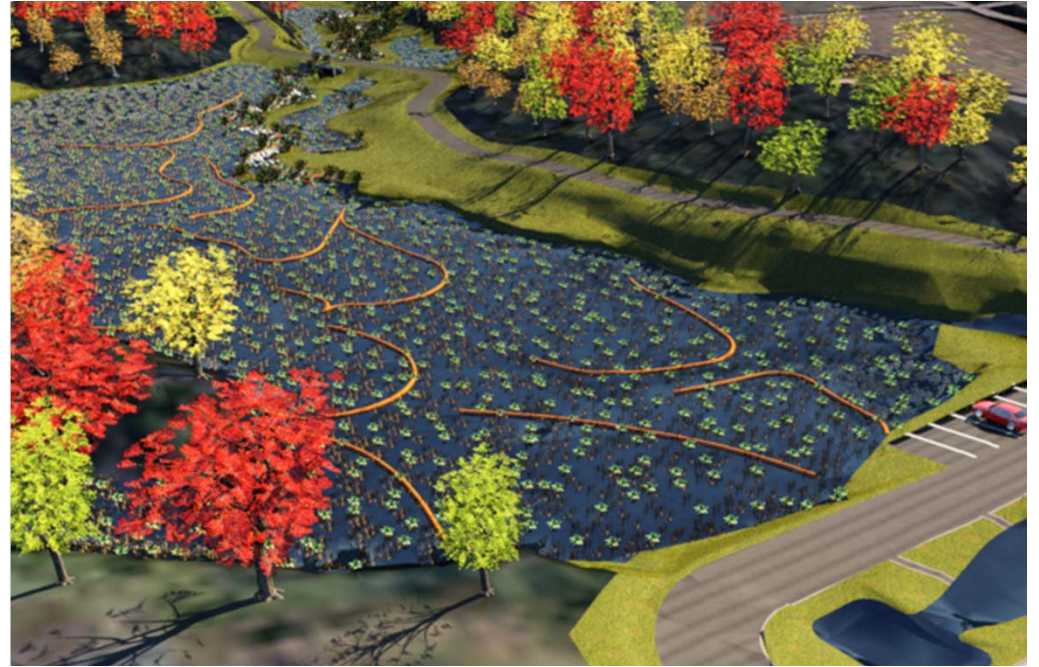
| Chesapeake Bay Program BMPs                     | TN  | TP  | TSS |
|---|-----|-----|-----|
| Wet Ponds and Wetlands                          | 20% | 45% | 60% |
| Dry Detention Ponds and Hydrodynamic Structures | 5%  | 10% | 10% |
| Dry Extended Detention Ponds                    | 20% | 20% | 60% |
| Infiltration Practices w/o Sand, Veg.           | 80% | 85% | 95% |

# 04

## Making the Math Work

# VA DEQ Methodology

- Pollutant Loading
  - Apples vs Apples (competitive grant award) req. use of VRRM Spreadsheet POC load calcs
  - TMDL compliance based on EOS loading rates
- Pollutant Removal
  - VA BMP Clearinghouse Design Specifications
  - Chesapeake Bay Program Expert Panel Reports RR & ST Performance Curves
  - Stream Restoration CBP Interim Approved Removal Rates
  - Stream Restoration CBP Recommended Protocols for Defining Pollutant Reductions
- Uplift to Wetland function and pollutant reduction
  - Preservation of hardwood tree canopy
  - Invasive Treatment followed by native planting
  - Coir Log with Live Staking (added storage)
  - Reconnection of stream to new & exist. wetlands





# Pollution Reduction

- POC Loading (RSC: 45.21 ac; 65% IC)
  - VA DEQ VRRM Spreadsheet Runoff Reduction Method for New Development Compliance:
    - TP: 72.0lb/yr; TN: 515.11 lb/yr; TSS: ?
  - TMDL/MS4 Permit TP EOS Load:
    - TP: 59.5 lb/yr; TN 386.3 lb/yr; TSS: 3,648 lb/yr
- POC Reductions
  - VA BMP Clearinghouse L1 & L2 BMP Design Specs
  - Alternate BMPs or modified design/retrofit criteria: RR & ST Performance Curves
- Hybrid Computations: Wetland Enhancements

|  |                    |   |
|--|--------------------|---|
| <b>Project Name:</b>                       | Marina BMP Project | <b>CLEAR ALL</b><br><small>(Ctrl+Shift+R)</small> |
| <b>Date:</b>                               | 2-Dec-16           |   |
| <small>2013 Draft Stds &amp; Specs</small> |                    |   |

**Site Information**

**Post-Development Project (Treatment Volume and Loads)**

Land Cover (acres)

|  | A Soils | B Soils | C Soils | D Soils | Totals |
|--|---------|---------|---------|---------|--------|
| <b>Forest/Open Space (acres)</b> -- undisturbed, protected forest/open         |         | 1.99    |         | 0.77    | 2.76   |
| <b>Managed Turf (acres)</b> -- disturbed, graded for yards or other turf to be |         | 8.62    |         | 50.46   | 59.08  |
| <b>Impervious Cover (acres)</b>  |         | 20.24   |         | 93.98   | 114.22 |
|  |         |         |         |         | 176.06 |

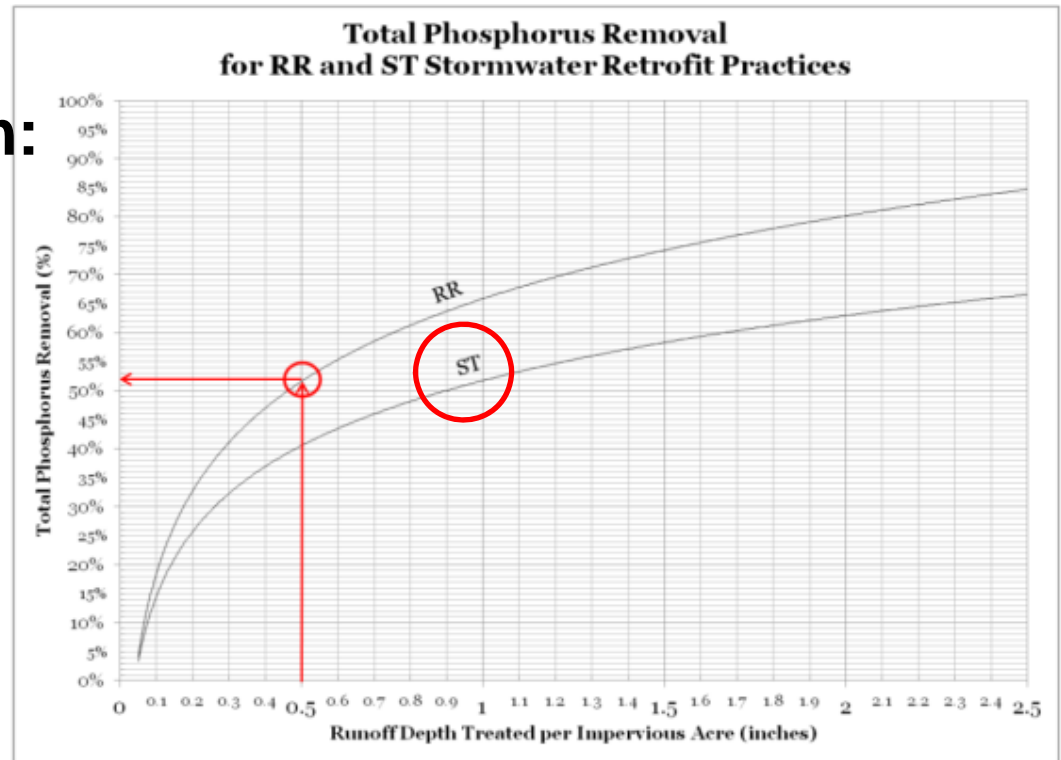
\* Forest/Open Space areas must be protected in accordance with the Virginia Runoff Feasibility Study

| Constants                        |      | Runoff Coefficients (Rv) |                |                |                |      |
|----------------------------------|------|--------------------------|----------------|----------------|----------------|------|
| Annual Rainfall (inches)         | 43   | <b>A Soils</b>           | <b>B Soils</b> | <b>C Soils</b> | <b>D Soils</b> |      |
| Target Rainfall Event (inches)   | 1.00 | Forest/Open Space        | 0.02           | 0.03           | 0.04           | 0.05 |
| Total Phosphorus (TP) EMC (mg/L) | 0.26 | Managed Turf             | 0.15           | 0.20           | 0.22           | 0.25 |
| Total Nitrogen (TN) EMC (mg/L)   | 1.86 | Impervious Cover         | 0.95           | 0.95           | 0.95           | 0.95 |
| Target TP Load (lb/acre/yr)      | 0.41 |                          |                |                |                |      |
| Pj (unitless correction factor)  | 0.90 |                          |                |                |                |      |

| LAND COVER SUMMARY -- POST DEVELOPMENT |  |
|--|--|
| <b>Land Cover Summary</b>              | <b>Treatment Volume and Nutrient Loads</b> |
| Forest/Open Space Cover (acres)        | Treatment Volume (acre-ft)                 |
| 2.76                                   | 10.2455                                    |
| Weighted Rv (forest)                   | Treatment Volume (cubic feet)              |
| 0.04                                   | 446,295                                    |
| % Forest                               | TP Load (lb/yr)                            |
| 2%                                     | 280.41                                     |
| Managed Turf Cover (acres)             | TN Load (lb/yr)                            |
| 59.08                                  | 2,005.98                                   |
| Weighted Rv (turf)                     | (Informational Purposes)                   |
| 0.24                                   |  |
| % Managed Turf                         |  |
| 34%                                    |  |
| Impervious Cover (acres)               |  |
| 114.22                                 |  |
| Rv (impervious)                        |  |
| 0.95                                   |  |
| % Impervious                           |  |
| 65%                                    |  |
| Site Area (acres)                      |  |
| <b>176.06</b>                          |  |
| Site Rv                                |  |
| <b>0.70</b>                            |  |

# Hybrid Pollutant Reduction: Wetland Enhancement

- Stormwater Treatment Retrofit Curves
  - Value of Reduction from existing conditions
    - 0.75 ac-ft of storage (0.044")
  - Value of Reduction from increased storage
    - 2.25 ac-ft of storage (0.132")
- Pollution Reduction Credit is the difference
  - 1.5 ac-ft of storage; or 0.088"

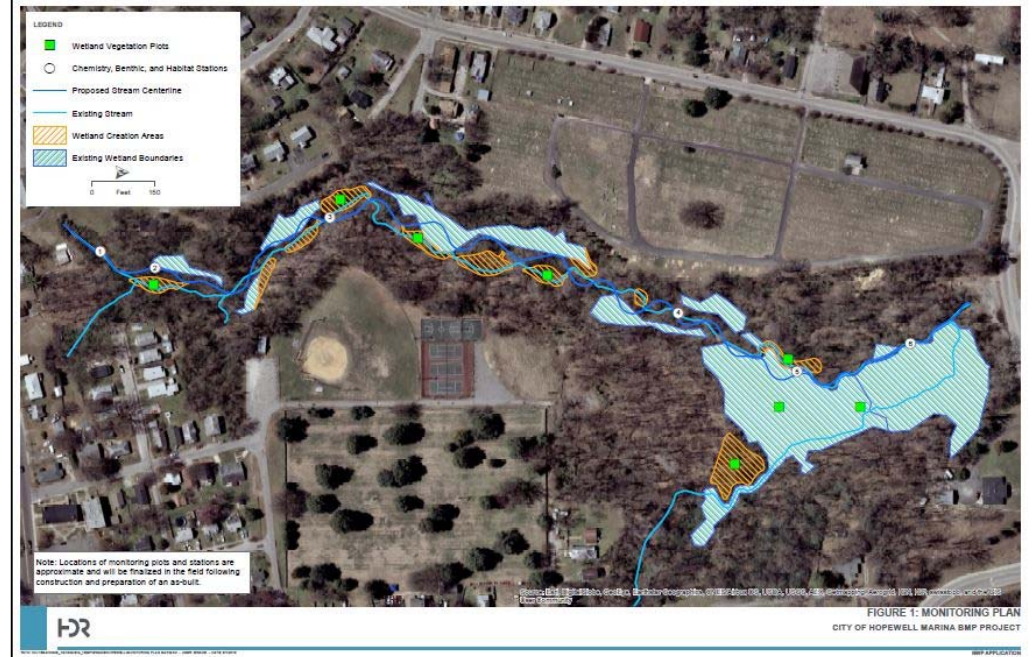


|                     | Phosphorus Reduction (%) | P Load Reduction (lbs/yr) | Nitrogen Reduction (%) | N Reduction (lbs/yr) | Sediment Reduction (%) | TSS Reduction (lbs/yr) |
|---------------------|--------------------------|---------------------------|------------------------|----------------------|------------------------|------------------------|
| Existing Conditions | 6                        | VRRM : 29<br>EOS: 24      | 4                      | VRRM:138<br>EOS: 102 | 6                      | EOS:<br>8,847          |
| Proposed Conditions | 17                       | VRRM: 82<br>EOS: 69       | 12                     | VRRM:414<br>EOS: 307 | 22                     | EOS:<br>32,440         |
| Credit              |                          | VRRM: 53<br>EOS: 45       |                        | VRRM:276<br>EOS: 205 |                        | EOS:<br>23,592         |



# Permit Agency Reaction

- USACE
  - Approval with Post-Construction Monitoring
    - Permit Application included functional assessment of existing and proposed conditions
      - » NCWAM methodology
    - Early communication through pre-application meeting with USACE and DEQ to formulate strategy to minimize impact to tree cover, and eliminate “jurisdictional filling”
  - DEQ
    - Approval concurrent with USACE
    - Pollutant Reduction Credit of uplift



restoration monitoring, the proposed monitoring activities, and reporting. The enclosed Figure 1 provides approximate monitoring locations.

Table 1. Proposed Monitoring Summary

|                                   | Wetland Enhancement Areas | Wetland Creation Areas | Stream Restoration | Frequency  |
|-----------------------------------|---------------------------|------------------------|--------------------|--|
| Visual Description (Photographs)  | X                         |                        |                    | Annually in Years 1, 2, 5, 7, and 10                                     |
| Secondary Hydrology Indicators    |                           | X                      |                    | Annually in Years 1, 2, 5, 7, and 10                                     |
| Vegetation/Stream bank Plots      | X                         | X                      | X                  | Annually in Years 1, 2, 5, 7, and 10                                     |
| Post-Storm Event Monitoring       | X                         | X                      | X                  | 1 week after storm events that meet or exceed a 1-year, 24-hour duration |
| Cross-Sections (2 Riffle, 2 Pool) |                           |                        | X                  | Annually in Years 1, 2, 5, 7, and 10                                     |
| In-Stream Structures              |                           |                        | X                  | Annually in Years 1, 2, 5, 7, and 10                                     |
| Longitudinal Profile              |                           |                        | X                  | Annually in Years 1, 5, and 7  |
| Habitat Assessment                |                           |                        | X                  | Annually in Years 1, 2, 5, 7, and 10                                     |
| Annual Monitoring Report          | X                         | X                      | X                  | Annually in Years 1, 2, 5, 7, and 10                                     |

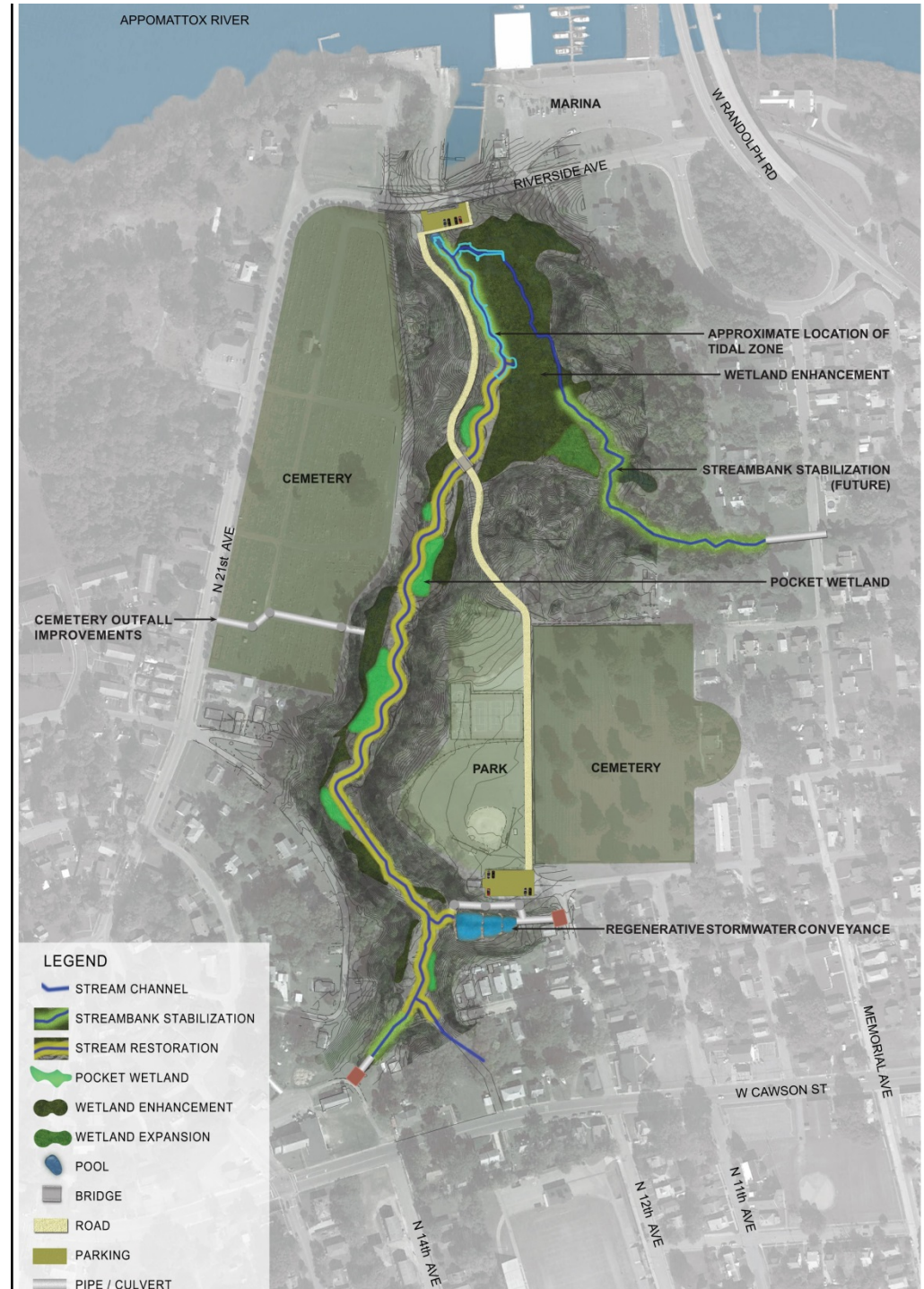
## Timing/Frequency

Monitoring activities will occur during the growing season, and at least once during the 1<sup>st</sup>, 2<sup>nd</sup>, 5<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> growing seasons following completion of grading. After Year 2, physical monitoring of stream condition (e.g. longitudinal profiles, cross-sections, channel Width and Depth) may be conducted outside of the growing season. In addition, monitoring will adhere to

# Summary

## Lessons Learned – so far

- Pre-Design
  - Have a Champion/Visionary
  - Have Stakeholder buy-in
  - Land availability is critical
- Permitting
  - Upfront meeting is critical
  - Obtain buy-in on approach when deviating from tried and true solutions
  - Be willing to be watched/monitored
- Construction
  - Stay tuned!
- Total Project Contribution to Bay TMDL
  - Nitrogen 1,730 lb. (100% goal = 2,182 lb.)
  - Phosphorus 467 lb. (100% goal = 452 lb.)
  - Sediment 78,333 lb. (100% goal = 194,646 lb.)





Questions?



# Thank you!

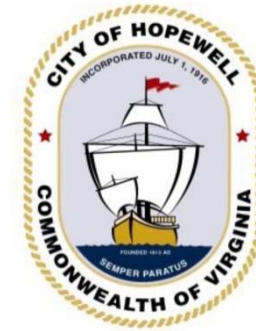
Special thanks to Ben Leach, Va DEQ (past Hopewell Stormwater Engineer)

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