Case Study No. 3: Waterfront Drive, East Providence

Background:
- Over a mile of new road proposed to improve traffic circulation, sited in former railroad corridor
- Immediately adjacent to Seekonk River in HSG B Soils
- Portions of road will be underwater during 100-yr storm
- Proposed roadway width varies between 32 and 40 feet: 2 12-foot travel lanes with varying shoulder widths
- Curb-and-gutter drainage to extended detention ponds and a proprietary device (Vortech)
- Designed to meet requirements of 1993 Manual
- Total drainage area to project is 44 acres, 29% impervious
Would this project meet new requirements?

- First question - Is any portion of this project redevelopment?
- Our assumption: Yes. Existing railroad bed consists of a compacted dense-grade material.
- However, the site has <40% impervious cover (assumed), so entire project would need to meet all standards anyhow.

Would this project meet new requirements?

- Standard 1?
- Utilizing existing disturbed area, minimum widths based on LOS. Other options?
- Standards 2 and 3?
- No - extended detention and proprietary devices do not provide recharge nor adequate water quality treatment.

Would this project meet new requirements? Cont’d

- Standards 4 and 5?
- Discharge to tidal waters - not needed.
- Standard 7?
- SWPPP needed.
- Standard 8?
- N/A - Not a LUHPPL.
- Standards 9, 10, 11?
- Must confirm no illicit discharges, provide adequate ESC, and O&M Plan.
Focus Drainage Area

- 2.37 acres, 59.1% Impervious
- Catchbasins collect road runoff, discharge to proposed extended detention basin with sediment forebay
- Soils are HSG B
- Discharges to Seekonk River

<table>
<thead>
<tr>
<th>Proposed Detention Pond #1</th>
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</thead>
<tbody>
<tr>
<td>Top of Pond:</td>
<td>16.00'</td>
<td>100-year storm elevation: 13.57'</td>
</tr>
<tr>
<td>Bottom of Pond:</td>
<td>11.00'</td>
<td>2-year storm elevation: 13.07'</td>
</tr>
<tr>
<td>WQCV and Sediment Storage elevation required:</td>
<td>11.41'</td>
<td>Emergency overflow elevation: 15.00'</td>
</tr>
<tr>
<td>WQCV and Sediment Storage elevation provided:</td>
<td>12.00'</td>
<td>Outlet control structure elevation: 13.00'</td>
</tr>
</tbody>
</table>

Existing Area

Area As Proposed
LID for Linear Transportation Projects:
RI SW Manual

Case Study: Waterfront Dr., East Providence

8/25/2011

Proposed Area

BMP Selection

- Which BMP could be used to meet Standards 2 and 3 for the focus drainage area?
  - WVTS?
  - Permeable Pavers?
  - Infiltration?
  - Open Channels?
  - Filtration?
No “right” answer, but some wrong ones

Required Volume Calculations

- Compute required Re, based on B Soils and Sect. 3.3.2
  \[ Re = \frac{\text{I}}{(1\text{''}) \times (F \times I)} / 12 \]
  \[ = \frac{0.35\text{''} \times 1.4\text{ ac} \times 1\text{ft}}{12\text{in}} \]
  \[ = 0.041 \text{ ac-ft} = 1,800 \text{ cf} \]

- Compute WQv based on Sect. 3.3.3
  \[ WQv = \frac{\text{I}}{12} \]
  \[ = \frac{1\text{''} \times (1.4\text{ ac})}{1\text{ft}} \]
  \[ = 0.117 \text{ ac-ft} = 5,100 \text{ cf} \]
Filter Sizing Equation

\[ A_f = \frac{(WQ_v) (d_f)}{[k (h_f + d_f) \tau_f]} \]

- \( A_f \): surface area of filter bed (ft²)
- \( d_f \): filter bed depth (ft)
- \( k \): coef. of permeability of filter media (ft/day)
- \( h_f \): average height of water above filter bed (ft)
- \( \tau_f \): design filter bed drain time (days) (2 days is recommended)

Bioretention Sizing Equation

Use sizing equation and values provided in Section 5.5.4:

\[ A_f = \frac{(WQ_v) (d_f)}{[k (h_f + d_f) \tau_f]} \]

- \( A_f \): surface area of filter bed (ft²)
- \( d_f \): filter bed depth (ft) (2–4 ft, depending on site constraints)
- \( k \): coef of permeability of filter media (1 ft/day)
- \( h_f \): ave ht of water above filter bed (ft) (half ponding depth)
- \( \tau_f \): design filter bed drain time (days) (2 days recom.)

\[ A_f = \frac{(5,100 \text{ ft}^3) (4')}{[1'/\text{day} (0.25' + 4') (2 \text{ days})]} \]

\[ A_f = \frac{2,400 \text{ sq ft}}{1'} \]

Pretreatment?

- 25% of Water Quality Volume – Sediment Forebay = 0.25*(5,100cf) = 1,275cf
- Sizing Calculation in Section 6.4.1

\[ A_s = 5,750 \times Q \]

Where:
- \( A_s \): Minimum sedimentation surface area (sf)
- \( Q \): discharge from drainage area = %WQ/86,400 sec

\[ A_s = 5,750 \times \left(0.25 \times \frac{5,100 \text{ cf}}{86,400 \text{ sec}}\right) = 85 \text{ sf} \]

*Assume 4ft depth, \( S_A = 319 \text{ sf} > 85 \text{ sf} \)
Check 75% WQv Storage

- Show that 75% WQv is provided in the filter bed, above the surface, and in forebay:
  \[0.75 \times (5,100 \text{cf}) = 3,825 \text{ cf}\]

  Total volume = \(A_f \cdot d_f \cdot n + A_f \cdot h + V_{forebay}\)

  \(A_f = \text{surface area of filter bed (ft}^2\)\)
  \(d_f = \text{filter bed depth (ft)}\)
  \(n = \text{filter media porosity (0.33)}\)
  \(h = \text{max ht of water above filter bed (ft)}\)

\[(2,400 \text{ sf}) \times (4 \text{ ft}) \times (0.33) + (2,400 \text{ sf}) \times (0.5 \text{ ft}) + 1,275 \text{ cf} = 5,643 \text{ cf} > 3,825 \text{ cf}\]

Benefits:
- Meets Recharge and WQv rqmnts
- Less clearing
- Less earthwork
- Lower safety risk

Flow Splitter

Detention Pond 1

Bioretention: ~2,700 sf

Seekonk River