Low Impact Development/Stormwater Management

in an Ultra Urban Environment

Practices for Design, Engineering, Construction/Installation and Maintenance

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Vanasse Hangen Brustlin, Inc.
City of Boston
State Hospital Redevelopment

- Joint Venture with Lena Park Community Development Corporation and New Boston Development Partners
- Joined to purchase, develop, re-develop, operate, lease and sell mixed use properties
- Affordable housing – teen center – training – elders
- High community involvement and benefits
- Urban Farm
- Low Impact Development Design
- Healthy Homes

Rojas Landscape Architecture
Olmsted Green
Significance and Scale

- Largest number of units and land area of any project in Boston over 20 years
- Exemplifies Commonwealth’s Smart Growth Principals
- Opportunity to re-knit 6 communities and return blighted state property to productive use
- Unique vision for economic development, affordable and workforce housing and sustainable development
The Site
Boston's Emerald Necklace - Olmsted Design
Impacted Waterways to Harbor

- Flooding
- Sediment
- Bacteria
- Trash
- Oil/grease
Typical Site Design/Stormwater LID – How Do We Minimize Impacts?

- Minimize impervious area
- Maintain vegetation, slopes, depressions
- Infiltrate/store
- Materials selection

ALL OF THESE ARE DIFFICULT TO ACHIEVE IN A DENSE URBAN ENVIRONMENT
LID in Ultra Urban Setting

- Underground, aboveground and overhead space limitations/constraints
- Site layouts more complicated
- Site design & modeling more complicated
- Technologies – more structures/overflow required
- Specifications – details critical
- Installations – construction management critical
- High public and vehicle traffic use
Low Impact (Re-)Development Choices:
City of Boston State Hospital

- Shared drives, rain gardens, different permeable surfaces, urban farm, native vegetation, minimal lawn surfaces, vegetated embankments, soil amendment, mature tree preservation….do what you can, where you can.
Tree Canopy – Vegetation

- Preserve significant existing trees and vegetation to reduce runoff
- Canopy maintenance
- Very Dense – “non-lawn” ground covers
- Mostly residential use – not well suited for green roofs
- Tree consultant hired to flag, inspect and provide contractor guidance
Soil Amendment

- Joint 319 Grant to test compost amendments for vegetative growth, infiltration improvement and erosion control

Test Plot Layout for 319 Grant BMP Treatments on East and West Campus

Source: Bruce Fulford, City Soil and Greenhouse Company
Compost Socks for Sedimentation and Erosion Control

- 319 Grant also used to investigate success of compost filled sock for sedimentation and erosion control
Rain Gardens

- Take roof top runoff
- Treat the small flows from paved areas for quality with pre-treatment for frequent storms
- Site soils with limited infiltration and contamination so under drains needed
- Overflow to subsurface detention
- Still need storage and conveyance for large events
Rain Garden Design – Very Detailed and Tightly Designed

Secondary outfall from roof drain to infiltration / detention basin

Overflow from rain garden to infiltration / detention basin

Roof drain header to rain garden
More Geotech Information Early On…

- Preliminary design/location of infiltration systems earlier
- Develop specific Geotechnical Investigation Plans
- Final designs being requested earlier

The attached plan contains locations for 8 test pits that are requested for the investigation of subsurface conditions at proposed infiltration basins. The following information is requested at each location:
- Depths to groundwater
- Soil gradation analysis at Proposed Infiltration Elevation
- Permeability of soil at Proposed Infiltration Elevation, based on soil gradation analysis/Knowles Equation
- Excavate 2-3 feet beyond depth of proposed infiltration if groundwater was not encountered. The purpose is to verify that infiltration systems designed will have MA DEP 2-foot required separation from bottoms of system to groundwater.

<table>
<thead>
<tr>
<th>Proposed Test Pit #</th>
<th>Proposed Basin #</th>
<th>Existing Ground Surface Elevation</th>
<th>Depth to Proposed Infiltration Elevation</th>
<th>Proposed Infiltration Elevation</th>
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<tr>
<td>TP-1</td>
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</table>

Based on the results of the test pits, it is requested that GZA provide recommended quantities and locations for bores to determine the groundwater elevation determination on the proposed site, and complete borehole permeability tests, if necessary.
Rain Gardens – LID Measures Different Design Parameters

- Analyze/Design two separate models
- LID Measures (Model #1)
  - Rain gardens, swales, pavers, etc.
    - Treat small storm events (1” over 12-hrs)
    - Treat for water quality and small volume
- Typical Stormwater Mgt. (Model #2)
  - Infiltration/detention chambers
    - Provide additional treatment and Storage
    - Manage higher volume storm events (10, 25, 50 & 100-yr)
Grass Swales - Surface Infiltration – Delay Runoff - Conveyance

- Water kept on site longer
- Minimal surface area in urban setting
- Do the best you can in poor soils
- Small grass depressions -- provide an overflow and under drain
- Designs more advanced depending on site
Stone Channels/Swales

- New designs – no longer dumped rip rap
- Specific flow regimes – pools and riffles
- Boulders place for natural look and bank stabilization
- More design – very specific construction requirements
- Daylighting in redevelopments

Source: University of Vermont
Sub-Surface Infiltration not always the urban panacea

- Poor soils
- Recharge not critical
- High groundwater
- Contamination
- Utilities (corridors)
- Public Roadways
- Maintenance

• May choose to have solid systems for just storage
Porous Pavement

- Main roadways – high sanding concerns (not used on City of Boston Roadways)
- Contaminated soils
- Poor underlying soils
- High groundwater – reservoir depth not effective for storage
- High urban use – fear of clogging even with good maintenance
Snow Management –

- Need to include in plans early on
- Difficult to accommodate in Urban Environment if not trucking off-site
- Evaluate options for dual uses (snow storage winter, open space, damage from debris etc.)
# Long-Term Maintenance Requirements

<table>
<thead>
<tr>
<th>Project Name – City, State</th>
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<tbody>
<tr>
<td><strong>Best Management Practice</strong></td>
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<tr>
<td>---------------------------</td>
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<tr>
<td>Street Sweeping</td>
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<td>Permeable Pavers</td>
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<td>Outfall Structures</td>
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<td>Deep Sump and Hooded Catch Basins</td>
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<tr>
<td>Subsurface Infiltration Basins</td>
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<tr>
<td>Rain Gardens</td>
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</tbody>
</table>

* Recommend sweeping oct/nov, feb/mar, apr/may/jul/aug with late winter most important

Stormwater Control Manager ________________________________
Permitting - Engineering - Design - Construction
Making sure it all works…
Assess Existing Conditions Early on to See What You Can Do

- **Assess hydrology & discharge points**: minimal infiltration, wetlands are “surface” fed, existing flooding downstream, water quality concerns to receiving water body
- **Assess soils & geotech info EARLY**: urban fill, poorly drained, shallow bedrock, high groundwater, contamination
- **Assess key factors and opportunities for LID with preliminary information**
- **Important factors for THIS site**: timed storage, water quality