Session Agenda

City of Lancaster

Problem and Solutions

Green Infrastructure Plan

Demonstration Projects

www.saveitlancaster.org
About the City of Lancaster

- Incorporated in 1742
- Temporary National Capital during the Revolution
- Historic building stock (median home 100 years old)
- Surrounded by some of the most productive non-irrigated farmland in the U.S.
- ~60,000 residents in the 2010 census
- 7.34 square miles
- ~8,000 persons/square mile
Existing Conditions

Lancaster City covers a land area of 7.34 square miles and includes 241 acres of publicly-owned park land and playgrounds, 135 miles of streets of which 27 miles are classified as alleys within the Conestoga River watershed with a small portion within the Little Conestoga Creek watershed and a minor portion draining to the Mill Creek watershed. The City is the urban center of one of the nation’s most productive agricultural farming areas.

A Geographic Information System (GIS) was used to document and analyze the existing conditions for the planning area. Data was organized into a geospatial database to support the mapping of existing resources and other land and environmental features which are critical inputs for green infrastructure planning. The existing resource inventory includes maps of land use, impervious surfaces and open space opportunities which support specific locational strategies to implement green infrastructure technologies.
Problem

• Lancaster is one of about 770 cities nationwide with a combined sewer system (EPA).
• During intense rainstorms the system becomes overwhelmed causing combined sewer overflows (CSOs), which releases about 1 billion gallons of untreated wastewater into the Conestoga River.

• Impervious Coverage. 44% of the land area of the entire City is covered by impervious surfaces.
• 56% of CSS is impervious.
45% of the City is Served by Combined Sewers
Combined Sewer Overflow (CSO)

Under normal circumstances, wastewater and stormwater pipes are joined and flow to a treatment plant.

In heavy rains, the combined sewer and stormwater pipes overflow, and discharge directly to the river.
Impervious Area

- Building: 41%
- Roadway: 25%
- Parking Lot: 32%
- Railroad: 2%
Solutions

Employ “green infrastructure” methods of stormwater management -

• technologies that replicate and restore the natural hydrologic cycle and reduce the volume of stormwater entering the sewer system by:
  o infiltrate (porous pavements, sidewalks, and gutters; linear infiltration systems)
  o evaporate, transpire and reduce energy consumption (vegetated roofs, trees, planter boxes)
  o infiltrate and transpire (rain gardens and bioretention)
  o capture and reuse rainfall (rain barrels, cisterns, irrigation supply systems, and gray water systems)

AND

Increase the efficiency and capacity of the City’s existing “gray infrastructure“-

• Increase the capacity of wastewater conveyance and treatment infrastructure;
• Add storage or holding tanks to detain wastewater flows until treatment capacity returns;
• Treat the overflow discharges.
• More than $18 million already invested including first wastewater treatment system in PA to meet nutrient removal requirements. expensive to construct and maintain
• One storage tank to manage 1/10 annual CSO volume = $70 million
1 billion gallons of polluted stormwater discharge  
= 1515 Olympic-sized swimming pools

"Lancaster is in violation of the AO, and needs to address these deficiencies as soon as possible. Violation of the terms of the AO may result in further EPA enforcement action for violation of the order and for the underlying violations including, but not limited to, imposition of administrative penalties, 33 U.S.C § 1319(g), and/or initiation of judicial proceedings that allow for civil penalties of up to $37,500 per day, 33 U.S.C § 1319 (b) and (d), for each day of violation."
EPA stormwater regulations require us to protect our waterways by -

- Reducing the **quantity** of runoff
- Improving the **quality** of runoff
To meet these requirements, Lancaster has to:

- Operate and maintain our existing facilities
  - Drainage System
  - Water Quality Treatment Systems

- Build new stormwater control facilities
  - Green Infrastructure Plan
  - Rehabilitation/Repair Projects
MISSION: To provide more livable, sustainable neighborhoods for City residents and reduce combined sewer overflows and nutrient loads.
Goals

1. Strengthen the City’s economy and improve health and quality of life for its residents by linking clean water solutions to community improvements.

2. Create a green infrastructure program to respond comprehensively to the multiple water quality drivers to maximize the value of the City’s investments meeting the numerous overlapping environmental regulations and programs.

3. Use green infrastructure to reduce nutrients and erosive flows from urban storm water runoff and combined sewer overflows to support the attainment of Pennsylvania’s Watershed Implementation Plan for the Chesapeake Bay.

4. Achieve lower cost and higher benefit from the City’s infrastructure investments.

5. Establish Lancaster City as a national and statewide model in green infrastructure implementation.
Over the next 25 years

<table>
<thead>
<tr>
<th>Area / Impervious Source</th>
<th>Green Infrastructure Project / Program Type</th>
<th>Assumed Percent of Impervious Area Managed</th>
<th>Impervious Area Managed (acres)</th>
<th>Total SW Runoff (MG/yr)</th>
<th>Assumed WQv or BMP Capture Volume (in.)</th>
<th>Average Annual Runoff Reduction</th>
<th>Runoff Reduction (MG/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads / Alleys</td>
<td>Green Streets</td>
<td>30%</td>
<td>158.7</td>
<td>513</td>
<td>1.0</td>
<td>86%</td>
<td>132.4</td>
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<tr>
<td>Parks</td>
<td>Park Improvements / Greening</td>
<td>85%</td>
<td>17.0</td>
<td>19</td>
<td>1.0</td>
<td>86%</td>
<td>14.2</td>
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<tr>
<td>Sidewalks</td>
<td>Disconnection, Porous Pavement</td>
<td>35%</td>
<td>43.3</td>
<td>120</td>
<td>1.0</td>
<td>86%</td>
<td>36.1</td>
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<tr>
<td>Parking Lots</td>
<td>Porous Pavement, Bioretention</td>
<td>20%</td>
<td>129.5</td>
<td>628</td>
<td>2.0</td>
<td>97%</td>
<td>121.3</td>
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<tr>
<td>Flat Roofs</td>
<td>Vegetated Roofs</td>
<td>15%</td>
<td>32.7</td>
<td>212</td>
<td>1.0</td>
<td>86%</td>
<td>27.3</td>
</tr>
<tr>
<td>Sloping Roofs</td>
<td>Disconnection/Rain Gardens</td>
<td>25%</td>
<td>163.5</td>
<td>635</td>
<td>1.0</td>
<td>86%</td>
<td>136.5</td>
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<tr>
<td>Street Trees</td>
<td>Enhanced Tree Planting</td>
<td>N/A</td>
<td>45.1</td>
<td>44</td>
<td>0.3</td>
<td>49%</td>
<td>21.5</td>
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<tr>
<td>Public Schools</td>
<td>Green Schools</td>
<td>75%</td>
<td>38.4</td>
<td>50</td>
<td>1.0</td>
<td>86%</td>
<td>32.0</td>
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<tr>
<td>Various (Ordinance)</td>
<td>First-Flush Ordinance</td>
<td>50%</td>
<td>637.0</td>
<td>1236</td>
<td>1.0</td>
<td>86%</td>
<td>531.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>1,265</strong></td>
<td><strong>3,752</strong></td>
<td><strong>1,053</strong></td>
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</tr>
</tbody>
</table>

55%
Green Infrastructure Benefits

The Triple Bottom Line

• *Environmental* – recharges ground water, provides natural storm water management, reduced energy usage, improved water quality.

• *Social* – beautifies and increases recreational opportunities, improves health through cleaner air and water, improves psychological well-being.

• *Economic* – reduces future costs of stormwater management and increases property values.
Funding the stormwater management program

• Potential funding sources:
  – Increase property taxes
  – Raise sewer bills
  – Implement a fee based on stormwater runoff

Stormwater runoff is measured by impervious area = roofs and pavement where rain runs off, rather than soaking into the ground
A fee based on impervious area is the most equitable measure of stormwater runoff.
Impervious Area Analysis

- Stormwater impacts are directly linked to the amount and type of impervious land cover.

<table>
<thead>
<tr>
<th>Impervious Cover</th>
<th>Area (Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>865</td>
</tr>
<tr>
<td>Parking Lot</td>
<td>649</td>
</tr>
<tr>
<td>Railroad</td>
<td>46</td>
</tr>
<tr>
<td>Roadway/Driveway</td>
<td>518</td>
</tr>
<tr>
<td>Total Impervious Area</td>
<td>2,079</td>
</tr>
</tbody>
</table>

![Pie chart showing distribution of impervious area]

- Building: 42%
- Parking Lot: 31%
- Roadway: 25%
- Railroad: 2%
Implementing a rate structure with four “tiers” based on impervious area.

Percentages refer to percent of all properties

Rates are estimated first year fees per quarter, for Medium Level of Service

For example – average fee per quarter:
Residential: $10
Commercial: $139

Tier 1 (0-999 sq. ft.)
Tier 2 (1,000-1,999 sq. ft.)
Tier 3 (2,000-2,999 sq. ft.)
Tier 4 (≥3,000 sq. ft.)
Green Infrastructure Demonstration Projects

• 20 initial projects
• eight GI program “types”
  1. green streets/green alleyways
  2. green sidewalks
  3. green parking lots
  4. green roofs
  5. private disconnection / rain gardens & rain barrels
  6. enhanced street tree plantings
  7. green parks, and
  8. green schools and city-owned sites.
Cost and Benefit

- “green infrastructure benefit calculator”
- to evaluate the potential stormwater benefits and costs associated with the implementation of green infrastructure

<table>
<thead>
<tr>
<th>Area/Impervious Source</th>
<th>Green Infrastructure Project/Program Type</th>
<th>Assumed average loading ratio</th>
<th>Area/Number of GI (acre or number)</th>
<th>Unit</th>
<th>Assumed Unit Implementation Cost ($/Unit)</th>
<th>Assumed Marginal Unit Implementation Cost ($/Unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streets/Alleys</td>
<td>Green Streets</td>
<td>5.0</td>
<td>2.64</td>
<td>SF</td>
<td>$20.00</td>
<td>$15.00</td>
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<tr>
<td>Parks</td>
<td>Park Improvement/Greening</td>
<td>3.0</td>
<td>1.33</td>
<td>SF</td>
<td>$15.00</td>
<td>$7.50</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>Porous Pavement, Bioretention</td>
<td>2.0</td>
<td>1.55</td>
<td>SF</td>
<td>$15.00</td>
<td>$7.50</td>
</tr>
<tr>
<td>Parking Lots</td>
<td>Disconnection, Porous Pavement</td>
<td>3.0</td>
<td>2.16</td>
<td>SF</td>
<td>$13.00</td>
<td>$6.50</td>
</tr>
<tr>
<td>Flat Roofs</td>
<td>Vegetated Roofs</td>
<td>1.1</td>
<td>2.08</td>
<td>SF</td>
<td>$18.00</td>
<td>$5.00</td>
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<tr>
<td>Sloping Roofs</td>
<td>Disconnection/Rain Gardens</td>
<td>5.0</td>
<td>3.27</td>
<td>SF</td>
<td>$16.00</td>
<td>$12.00</td>
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<tr>
<td>Street Trees</td>
<td>Enhanced Tree Planting</td>
<td>N/A</td>
<td>1250</td>
<td>Each</td>
<td>$2,000.00</td>
<td>$500.00</td>
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<tr>
<td>Public Schools</td>
<td>Green Schools</td>
<td>3.0</td>
<td>1.70</td>
<td>SF</td>
<td>$12.00</td>
<td>$6.00</td>
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<tr>
<td>Various (Ordinance)</td>
<td>First Flush Ordinance</td>
<td>3.0</td>
<td>53.83</td>
<td>SF</td>
<td>$0.55</td>
<td>$0.55</td>
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Green Infrastructure
Project Implementation

Plum and Walnut Streets Intersection
Alley 42 (Brewery Alley)
Brandon Park
Green Roofs
PLUM AND WALNUT: “A GREEN INTERSECTION”

This keystone project is part of the City’s ongoing commitment to reduce urban stormwater runoff and associated pollutants from combined sewer overflows and separate storm sewers. The drainage area contributing to this intersection currently has 86,000 square feet of impervious area. Adding porous pavement and bioretention areas (rain gardens) will help capture approximately 86% of annual stormwater run-off, which equates to over 1,400,000 gallons per year.

Plum and Walnut Street Intersection Improvements Featuring Green Infrastructure

The green stormwater infrastructure installed at Plum and Walnut includes the following:
- Vegetated curb extensions with subsurface infiltration facilities at 3 corners
- New porous paver patio and parking spaces with subsurface infiltration facilities
- New porous paver angled back-in parking spaces
-砾滤 filter inserts for pretreatment

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Quantity Captured/Removed Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stormwater Runoff Capture</td>
<td>1.4 million gallons/year</td>
</tr>
<tr>
<td>Total Suspended Solids (TSS)</td>
<td>2400 lbs/year</td>
</tr>
<tr>
<td>Total Phosphorus (TP)</td>
<td>50 lbs/year</td>
</tr>
<tr>
<td>Total Nitrogen (TN)</td>
<td>120 lbs/year</td>
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</tbody>
</table>

Porous Pavers - Patio and Parking Lanes

Porous pavement consists of a pervious surface course underlain by an aggregate trench placed on uncompacted subgrade to facilitate stormwater storage and/or infiltration. Porous pavement can be asphalt, concrete, or paver blocks and generally looks similar to regular pavement.

Curb Extensions and Rain Gardens

Rain gardens and vegetated curb extensions are designed to capture stormwater runoff from adjacent impervious areas through a process called “bioretention.” Water is collected before infiltrating into the groundwater below. Plants help to prevent soil erosion while also increasing evapotranspiration of stormwater.
# Stormwater Chart

<table>
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<tr>
<td>Total Phosphorus (TP)</td>
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</tr>
<tr>
<td>Total Nitrogen (TN)</td>
<td>120 lbs/year</td>
</tr>
</tbody>
</table>
GREEN INFRASTRUCTURE AT BRANDON PARK

This project is part of the City’s ongoing commitment to reduce urban stormwater runoff and associated pollutants from combined sewer overflows and separate storm sewers. The drainage area contributing to Brandon Park currently has 180,000 square feet of impervious area. Adding porous pavement and bioretention areas (rain gardens) will help capture approximately 86% of annual stormwater run-off, which equates to over 3,900,000 gallons in a typical year.

Curb Extensions at Brandon Court and Wabank Road

Park Improvements Featuring Green Infrastructure

The green stormwater infrastructure at Brandon Park includes the following:
- 1/2 bioretention areas
- 4 porous asphalt parking areas with subsurface infiltration facilities
- 4 porous asphalt basketball courts
- 4 vegetated curb extensions with subsurface infiltration facilities

Bioretention Areas Within Brandon Park

Rain gardens and vegetated curb extensions are designed to capture stormwater runoff from adjacent impervious areas through a process called “bioretention.” Water is collected before infiltrating into the groundwater below. Plants help to prevent soil erosion while also increasing evapotranspiration of stormwater.

Estimated Volume of Stormwater Capture Per Year

This project will remove the following (approximately) in a typical year:
- 4,880 pounds of Total Suspended Solids
- 158 pounds of Total Phosphorus
- 336 pounds of Total Nitrogen

Porous Asphalt Basketball Courts and Parking Areas

Porous pavement consists of a pervious surface course underlain by an aggregate trench placed on uncompacted subgrade to facilitate stormwater storage and/or infiltration. Porous pavement can be asphalt, concrete, or paver blocks and generally looks similar to regular pavement.
Green Roofs

• Nearly 1.5 SF per resident
• Most per capita in North American

<table>
<thead>
<tr>
<th>Project Name</th>
<th>GI Area (SF)</th>
</tr>
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<tbody>
<tr>
<td>Wharton Elementary</td>
<td>13,150</td>
</tr>
<tr>
<td>Lafayette Elementary</td>
<td>11,500</td>
</tr>
<tr>
<td>Ross Elementary</td>
<td>2,500</td>
</tr>
<tr>
<td>National Novelty Brush Co.</td>
<td>16,900</td>
</tr>
<tr>
<td>F&amp;M Brooks Bump out</td>
<td>1,250</td>
</tr>
<tr>
<td>Wohlson Center for Sustain. Envr.</td>
<td>1,825</td>
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<tr>
<td>Groff Family Funeral Home</td>
<td>8,910</td>
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<tr>
<td>Tellus 360</td>
<td>9,600</td>
</tr>
<tr>
<td>F&amp;M Weis Hall</td>
<td>820</td>
</tr>
<tr>
<td>F&amp;M Schnader Hall</td>
<td>9,400</td>
</tr>
<tr>
<td>City Hall</td>
<td>3,000</td>
</tr>
<tr>
<td>Oxidation/Maintenance Building at City WWTP</td>
<td>10,500</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>89,355</strong></td>
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Based on 2008 *Green Roof for Healthy Cities* Figures

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>State/Province</th>
<th>Installed (SF)</th>
<th># of Projects</th>
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<tbody>
<tr>
<td>Chicago</td>
<td>IL</td>
<td>534,507</td>
<td>84</td>
</tr>
<tr>
<td>Washington</td>
<td>DC</td>
<td>501,042</td>
<td>67</td>
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<tr>
<td>New York</td>
<td>NY</td>
<td>358,986</td>
<td>35</td>
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<tr>
<td>Philadelphia</td>
<td>PA</td>
<td>353,337</td>
<td>38</td>
</tr>
<tr>
<td>Vancouver</td>
<td>BC</td>
<td>320,000</td>
<td>1</td>
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<tr>
<td>Baltimore</td>
<td>MD</td>
<td>150,032</td>
<td>21</td>
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<tr>
<td>Montreal</td>
<td>Quebec</td>
<td>75,700</td>
<td>17</td>
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<tr>
<td>Grand Rapids</td>
<td>MI</td>
<td>74,784</td>
<td>16</td>
</tr>
<tr>
<td>Princeton</td>
<td>NJ</td>
<td>56,250</td>
<td>4</td>
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<tr>
<td>Lancaster *</td>
<td>PA</td>
<td>51,385</td>
<td>7</td>
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</table>

- Nearly 1.5 SF per resident
- Most per capita in North American
- Total 89,355

*Based on 2008 Green Roof for Healthy Cities Figures*
Challenges and Opportunities

**Challenges**
- Utility conflicts
- Karst
- Urban and/or contaminated soils
- Landowner Agreements
- Funding

**Opportunities**
- Broad public support
- Supportive leadership
- Grant funding for demonstration projects
MORE Information And Questions?

City of Lancaster Green Infrastructure Plan and Demonstration Projects

www.cityoflancasterpa.com

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