Green It!
Lancaster’s Integrated Green Infrastructure Plan
Reviewing a Decade of Implementation and Planning for the Next
Leah Rominger, RLA
Overview

- City of Lancaster - one of 770 cities nationwide with combined sewer system
- CSOs discharge to Conestoga River (Chesapeake Bay Watershed)
- Lancaster’s 300 year-old CSS system covers 45% of the City
- City has worked proactively for many years to reduce CSOs
- Dual/integrated strategy of Grey and Green infrastructure methods
City’s 1st Green Infrastructure Plan

- Adopted in 2011
- Strategic planning initiative
- Envisioned a GI Program that incorporates GI in a cost-effective, adaptive, systematic matter into public improvement projects/select private projects
- Laid out a 25-year implementation strategy
- Award winning program!
Green It!
Lancaster

- Lancaster entered into a Consent Decree with EPA and PADEP in 2018 to comply with Clean Water Act and Clean Streams Law
- 2018 Consent Decree required updated GI Plan
- Builds upon 2011 GI Plan
- Submitted to EPA in Feb 2019
Green It! GI Program Update

- 2010 - 2018 GI Program accomplishments:
  - 57 projects implemented
  - 44 acres impervious area managed
  - 36 million gal/yr total estimated annual runoff capture volume
- Other significant metrics to demonstrate the impact that the GI Program has had since 1st GI Plan was published in 2011
GI Program
2010 - 2018

- Green Streets comprise largest % of annual runoff volume capture
- Green Streets and Green Parks provided highest capture efficiency
Green It! Future Program Goals

Vision

• A livable, sustainable, and safe community with clean rivers and streams.

Goals

• Improve water quality in the Conestoga River by integrating stormwater and pollution reduction into City public works and community improvement programs.
• Reduce pollution and excessive flows from urban stormwater and combined sewer overflows.
• Prioritize green infrastructure (GI) projects to maximize economic, clean water, health and quality of life benefits for residents.
• Achieve cost-effective Clean Water Act compliance by integrating multiple water quality drivers (e.g., consent decree, stormwater regulations, and the Chesapeake Bay Plan).
• Reinforce Lancaster City as a national, international, and statewide model in GI implementation.
Green It! Existing Conditions Update

- Hydrologic Systems - watersheds, stream assessment, historic hydrology
- Sewer Systems (CSS vs MS4)
- Geology
- Brownfields
- Land Use
- Impervious Area Analysis
- Socioeconomic Trends
Combined Sewer System (CSS)

- Future GI Program focus is on Engleside and North basins
- Other two basins are small with high levels of existing wet weather controls and planned pump station improvements/sewer separation work
- Other areas of City are covered by MS4 permit
Impervious Area Analysis

Table 5.5 - Total Area (AC) and Total Impervious Area (AC) for the Engleside and North Basins

<table>
<thead>
<tr>
<th>CSO Sewershed</th>
<th>Total Area, Acres</th>
<th>Total Impervious Area, Acres</th>
<th>% Impervious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engleside</td>
<td>1,006</td>
<td>706</td>
<td>70%</td>
</tr>
<tr>
<td>North</td>
<td>1,222</td>
<td>590</td>
<td>48%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,228</td>
<td>1,296</td>
<td>58%</td>
</tr>
</tbody>
</table>

Figure 5.10 - Impervious Area Categories (acres) in the City

Figure 5.11 - Impervious Area in the City of Lancaster (Source: City of Lancaster and Jacobs)
**Green It! Strategies for Future Implementation of GI**

**Public Strategies**

- “Green” Parks
- “Green” Schools
- “Green” Streets/Alleys (Right-of-Way)

**Private Strategies:**

- Privately-Owned Parcels (i.e. Parking Lots)
- Private Alleys
Green Parks

- Implemented significant GI at 4 parks to date
- Potential to implement at additional parks
- Localized scale and neighborhood scale (manage 3x impervious area)
Long’s Park
Green Streets

- Coordinate GI with repaving/repair schedule
- Coordinate with one-way to two-way conversions
- Coordinate with bike/ped planning efforts
Private Strategies

- Parking Lot Standards
- Incentives for Private Property Owners
- Approximately 10% of parcels with parking lots over 20,000 SF (0.46 acre) account for over 50% of the private parking lot impervious acreage
Green It! Recommendations for Ongoing GI Implementation

- Analysis of Benefits of potential GI implementation over 20 years
- Discussion of “co-benefits”
- Prioritization strategies related to GI implementation
- List of potential GI projects to consider for future implementation

<table>
<thead>
<tr>
<th>GI Potential Project Type</th>
<th>Number of Potential Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green School</td>
<td>20</td>
</tr>
<tr>
<td>Green Park</td>
<td>33</td>
</tr>
<tr>
<td>Private Property</td>
<td>125</td>
</tr>
<tr>
<td>Green Alley</td>
<td>93</td>
</tr>
<tr>
<td>Green Street</td>
<td>51</td>
</tr>
<tr>
<td>Green Roof</td>
<td>3</td>
</tr>
<tr>
<td>Other Public Property</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>327</strong></td>
</tr>
</tbody>
</table>
Cost Analysis of Built Projects

- Green Parks and Green Streets have lowest unit costs on average
- Economy of scale (larger projects on average)
- Integration with other enhancements (e.g., park renovations and traffic improvements)

<table>
<thead>
<tr>
<th>GI Project Type</th>
<th># of Projects Included in Cost Analysis</th>
<th>Total Impervious Area Managed (ac)</th>
<th>Total Construction Cost*</th>
<th>Cost / Impervious Acre ($/ac)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Park</td>
<td>4</td>
<td>7.2</td>
<td>$1,522,000</td>
<td>$211,000</td>
</tr>
<tr>
<td>Private (Penninvest Program)</td>
<td>8</td>
<td>3.6</td>
<td>$892,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>Green Alley</td>
<td>12</td>
<td>3.8</td>
<td>$1,047,000</td>
<td>$274,000</td>
</tr>
<tr>
<td>Green Street</td>
<td>24</td>
<td>30.5</td>
<td>$6,619,000</td>
<td>$217,000</td>
</tr>
<tr>
<td>Parking Lot</td>
<td>4</td>
<td>2.1</td>
<td>$785,000</td>
<td>$376,000</td>
</tr>
<tr>
<td>Green Roof</td>
<td>5</td>
<td>0.4</td>
<td>$760,000</td>
<td>$1,799,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>57</strong></td>
<td><strong>47.6</strong></td>
<td><strong>$11,625,000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td></td>
<td></td>
<td><strong>$230,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

*2018 dollars, total cost/acre calculated for ground-based projects (excluding green roofs)
## Implementing GI Over Time - Strategy Matrix

<table>
<thead>
<tr>
<th><strong>City has budgeted $1.2 M/yr for GI focused in North and Engleside basins</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional implementation via grants and partnerships</strong></td>
</tr>
<tr>
<td><strong>Using City budget, a sample mix of green alleys, streets, parks, and schools could potentially reduce CSOs by a combined total of approximately 79 million gallons (MG) per year in the North and Engleside basins</strong></td>
</tr>
<tr>
<td><strong>Planning approach can be scaled to estimate CSO reductions from GI over a range of implementation levels and capture objectives (frequency/volume)</strong></td>
</tr>
</tbody>
</table>
Potential Projects and Prioritization

- **Green Parks/Schools:**
  - Prioritize projects with significant potential drainage areas
  - Integrate GI with facility upgrades/renovations and coordination with School District

- **Green Streets/Alleys:**
  - Integrate GI with pedestrian/bike planning and one-way to two-way street conversions
  - Planned reconstruction/repaving

- **Green Parking Lots:**
  - Prioritize based on property owner interest, site redevelopment, ordinance
Green It!
Appendices

- GI Project Concept Plans
- GI Project Type Fact Sheets
- Related documents:
  - City’s Stormwater Ordinance Summaries,
  - DCNR Urban Tree Canopy Assessment,
  - GI Design Manual,
  - GI Operations & Maintenance Plan,
  - GI Monitoring Plan
GI Concept Plans

Edward Hand Middle School Schoolyard Habitat
City of Lancaster, PA
GI Fact Sheets

- Green Parks
- Green Schools
- Green Streets/Alleys
- Green Parking Lots

Green Parks

Fact Sheets

- Green Parks
- Green Schools
- Green Streets/Alleys
- Green Parking Lots

Green Parks

Parks can be strong candidates for green infrastructure implementation due to their ability to manage adjacent stormwater runoff (from nearby streets, for example) within the park itself. Parks typically have large available areas for storm green infrastructure, whether a surface feature such as a rain garden, or a subsurface storage/detention trench that can be designed underneath existing fields or play courts without negatively impacting park usage.

Green Parks can incorporate a wide variety of green infrastructure (GI) elements including透氣植床, porous pavements, swales, rain gardens (in adjacent streets). Although the design and appearance of green parks will vary, the functional goals are the same: provide scenic control of stormwater, limit its transport and pollution conveyance to the collection system, restore predevelopment hydrology to the extent possible, and provide environmentally enhanced public spaces. Additional potential benefits include improved aesthetics, increased biodiversity, and improved pedestrian safety/walkability.

Green Parks may include a combination of the following practices:
- Porous pavements such as porous asphalt, porous pavements, or porous play surfaces
- Rain gardens (rain ponds)
- Storage/detention basins/troughs
- Enhanced tree planting
- Vegetated swale plantings
- Vegetated rain gardens (permeable) on adjacent streets and other traffic calming strategies
- GI may be integrated with bicycle, ADA, and pedestrian safety improvements
Thank you!

Leah Rominger, RLA
Jacobs
Leah.Rominger@Jacobs.com

Ruth Ayn Hocker, P.E., D.WRE, CFM
Manager, Bureaus of Stormwater and Wastewater Collections
City of Lancaster Public Works - Stormwater Bureau
RHocker@cityoflancasterpa.com
Table 7.5 - Estimated Annual Co-Benefits of GI Per Acre in Lancaster

<table>
<thead>
<tr>
<th>Related Co-Benefit</th>
<th>Per Acre Benefit (2014 dollars)**</th>
<th>Per Acre Benefit (2018 dollars)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Energy Cost Savings ($/ac)</td>
<td>$1,872</td>
<td>$2,135</td>
</tr>
<tr>
<td>Total Value of Air Quality Benefits ($/ac)</td>
<td>$809</td>
<td>$922</td>
</tr>
<tr>
<td>Total Value of Reduced CO₂ ($/ac)</td>
<td>$621</td>
<td>$709</td>
</tr>
<tr>
<td>Annual Pumping/Treatment Cost Savings ($/ac)</td>
<td>$780</td>
<td>$889</td>
</tr>
<tr>
<td>Total Co-Benefits in CSS ($/acre managed)</td>
<td>$4,082</td>
<td>$4,655</td>
</tr>
</tbody>
</table>

![Diagram showing various co-benefits of GI per acre in Lancaster.](attachment:image.png)