Developing a Stormwater Retrofit Plan to Reduce Directly Connected Impervious Area (DCIA)

Eastern Connecticut Stormwater Collaborative

Spring Meeting - April 22, 2020
Presentation Outline

- What is DCIA and why does it matter?
- DCIA reduction – how much is enough?
- How can I achieve DCIA reduction goals?
- What is a retrofit plan and why do I need one?
- How do I develop a retrofit plan?
- Examples
- Questions
MS4 Permit Requirements

- MCM 6 – Pollution Prevention/Good Housekeeping “Retrofit Program” (p. 32)
- Goal: “disconnect” existing Directly Connected Impervious Areas (DCIA)
- Develop Stormwater Retrofit Plan by end of Year 3
- Implement retrofit projects by end of Years 4 and 5
Why Impervious Cover?

- Reliable indicator of water quality in a watershed

Source: CT Watershed Response Plan for Impervious Cover, CTDEEP

>12% IC Threshold

Streams with <50 sq miles drainage upstream

Meet WQC

Fail WQC

% of Reference Community

% IC Upstream

n=125
What is DCIA?

**Directly Connected Impervious Area (DCIA)**

- Impervious area from which stormwater runoff discharges **DIRECTLY** to the MS4 or directly to waters of the state
- NOT impervious areas discharging through a system designed to retain the appropriate Water Quality Volume

All impervious area is not created equal!

IC ≠ DCIA
Examples of DCIA

- Runoff from parking lots, roads, driveways, roofs, etc. entering the drainage system directly.

- Parking Lots

- Driveways

- Roads & Sidewalks
Examples of DCIA

- Runoff discharging directly to waters of the state – rivers, ponds, wetlands, coastal waters
Examples – Not DCIA

- Driveways, roofs, etc. that discharge to pervious areas and infiltrate into the ground

Pavement Disconnection

Disconnected Downspouts

Disconnected Driveway
Examples – Not DCIA

- Impervious areas discharging through stormwater controls (structural BMPs)
When is DCIA Considered “Disconnected”?

- Retain appropriate portion of the Water Quality Volume on-site (infiltration or storage BMPs)
  - \( \frac{1}{2} \text{WQV} \geq 40\% \text{DCIA} \)
  - Full \text{WQV} <40\% \text{DCIA} 
- Where not feasible, retain runoff volume to maximum extent achievable and treat rest of the volume up to the \text{WQV} (treatment BMPs) 
- Treatment for sediment, floatables, and nutrients
Types of Stormwater Retrofits

- **Municipal Sites**
  - Municipal parking lots
  - Schools, libraries, police, fire stations
  - Parking at parks and recreation areas
  - Public works facilities

- **Municipal Right-of-Way**
  - Roads and sidewalks
  - Local roads can account for 20% or more of town-wide IC

Retrofit existing municipal sites and right-of-way using LID and GI stormwater controls
Infiltration BMPs – Site Retrofits

Surface and Subsurface Infiltration Systems
Infiltration BMPs – Site Retrofits

Permeable/Porous Pavement
Infiltration BMPs – ROW Retrofits

Roadside Bioswales

Bioretention Curb Extensions

Pretreatment Area (Sediment Forebay Shown with Hardened Bottom); Refer to Pretreatment Section

Outlet Structure (Riser Structure Shown); Refer to Inlet/Outlet Section

Vegetative Cover (Native Plantings & Grasses Shown); Refer to Vegetation Section

Level Bottom (0.5% max.). For Infiltration Planters; Bottom Slopes > 0.5% Allowed For Flow-Through Planters if Designed With Check Dams

Inlet (Curb Opening Shown); Refer to Inlet/Outlet Section

24-48 in. Engineered Soil Media

4 in. (min.) Pea Gravel (Optional For Infiltration Planters; Required For Flow-Through Planters)

Vertical Planter Sidewall

Filter Fabric (Only Necessary Along Sidewalls below Vertical Planter Walls and Top of Underdrain, if Present)

12 in. Crushed Gravel Sump (Optional For Infiltration Planters; Required for Flow-Through Planters)

Bottom of Engineered Soil Media at or Above SHGT; Top of Engineered Soil Media At Least 36 in. above SHGT

Perforated Underdrain Pipe (Optional for Infiltration Bioretention Basins; Required for Flow-Through Bioretention Basins)
Infiltration BMPs – ROW Retrofits

Leaching Catch Basins

Underground Infiltration Systems

- Inlet (Catch Basin): Refer to Inlet/Outlet Section
- Pretreatment (Proprietary Pretreatment Device Shown); Refer to Pretreatment Section
- Filter Fabric along Sides & Top of Crushed Stone Reservoir
- Subsurface Infiltration Chambers
- 36 in. Separation to SHGT/Bedrock (min.)
- Crushed Stone Reservoir
- Level Bottom
- 36 in. Separation to SHGT/Bedrock (min.)
- Frame and Cover (Locate Completely within the Sidewalk or Roadway)
- Leaching Basin (Open Bottom Perforated Precast Concrete Vault Shown)
- Filter Fabric along Sides & Top of Crushed Stone
- Crushed Stone
- 36 in. Separation to SHGT/Bedrock (min.)
Treatment/Infiltration BMPs – Site Retrofits

Bioretention/Rain Gardens
Bioretention Swale

Bioretention Curb Inlet Planter

Treatment/Infiltration BMPs – ROW
Treatment/Infiltration BMPs – ROW

Wet Vegetated Treatment System

Tree Filter with Storage
DCIA Reduction Goals in MS4 Permit

- 2% reduction by end of 5-year permit
  - 1% in Year 4 (2021)
  - 1% in Year 5 (2022)
- 1% reduction per year after Year 5
- Can take credit for:
  - Disconnections implemented since 2012
  - Disconnections by private redevelopment
- Maximum Extent Practicable (MEP)
- Track DCIA/disconnections annually
Estimating Baseline DCIA

- Reductions measured against 2012 baseline
- Estimate DCIA town-wide (excluding state roads and other MS4s)
- 1-foot resolution statewide IC data (2012 imagery)

Source: UConn CLEAR
DCIA Estimation Method

- Range of Approaches (UConn CLEAR/NEMO)

Getting from IC to DCIA

- Three Approaches
  - Just use IC
  - Estimate DCIA based on existing land use
  - Aerial imagery and field checks

- Fiesta
- Tesla
- Prius
### Sutherland Equations

<table>
<thead>
<tr>
<th>Connectivity Level</th>
<th>Description of Contributing Area</th>
<th>Land Use Type</th>
<th>Equation</th>
<th>Example for a Watershed with 20% Impervious Cover (IC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fully Connected (default)</td>
<td>100% storm sewered with all IC</td>
<td>High density mixed use, commercial</td>
<td>None. DCIA% = IC%</td>
<td>DCIA = 20%</td>
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<tr>
<td>2. Wicked Connected</td>
<td>Mostly storm sewered with curb and gutter, residential rooftops connected to MS4</td>
<td>High density residential, commercial, industrial, institutional</td>
<td>DCIA%=0.4(%IC)^1.2</td>
<td>DCIA = 14.6%</td>
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<tr>
<td>3. Moderately Connected</td>
<td>Mostly storm sewered with curb and gutter, residential rooftops NOT connected to MS4</td>
<td>Medium density residential, commercial, industrial, institutional, open land</td>
<td>DCIA%=0.1(%IC)^1.5</td>
<td>DCIA = 8.9%</td>
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<tr>
<td>4. Sorta Connected</td>
<td>50% storm sewered with some infiltration and residential rooftops not connected to MS4</td>
<td>Low density residential, open land</td>
<td>DCIA%=0.04(%IC)^1.7</td>
<td>DCIA = 6.5%</td>
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<tr>
<td>5. Slightly Connected</td>
<td>Small % of urban area storm sewered or mostly infiltration</td>
<td>Agricultural, forested, natural areas</td>
<td>DCIA%=0.01(%IC)^2</td>
<td>DCIA = 4%</td>
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</table>
## Baseline DCIA and DCIA Reduction Goals

<table>
<thead>
<tr>
<th>Municipality</th>
<th>DCIA (%)</th>
<th>DCIA (acres)</th>
<th>2% DCIA Reduction Goal (acres)</th>
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</thead>
<tbody>
<tr>
<td>Danbury</td>
<td>9.2</td>
<td>2,599</td>
<td>52.0</td>
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<td>Stonington</td>
<td>3.5</td>
<td>871</td>
<td>17.4</td>
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<td>New Fairfield</td>
<td>1.2</td>
<td>185</td>
<td>3.7</td>
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<tr>
<td>Somers</td>
<td>1.5</td>
<td>268</td>
<td>5.4</td>
</tr>
<tr>
<td>Woodbury</td>
<td>0.8</td>
<td>192</td>
<td>3.8</td>
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Developing a Stormwater Retrofit Plan

- Identify prioritized list of stormwater retrofit projects to meet 2% DCIA reduction goal and provide water quality and quantity benefits.
- Retrofits are more cost-effective when implemented in conjunction with planned infrastructure projects.
- Integration with municipal capital planning process.
Retrofit Plan Development Process

1. Objectives and criteria
2. Background data/information gathering
3. Desktop screening
4. Site assessment
5. Prioritization
6. Conceptual designs
7. DCIA reduction estimates and costs
Retrofit Objectives and Criteria

- Permit compliance and other local objectives
  - Planned municipal stormwater/drainage infrastructure upgrades, road projects, site projects (CIP)
  - Water Quality
  - Flooding
  - Preferred BMPs
  - O&M issues
Background Data and Information Needs

- Priority Area
- Drainage system mapping
- Impaired Waters/TMDLs
- Hydrologic Soil Group
- Depth to Groundwater
- Parcel Data (Ownership)
Desktop Screening

- Parcel-based opportunities
- Right-of-way opportunities
Screening Factors

Municipal Facilities & Sites
- Priority Area
- Water Quality Impairments/TMDLs
- Impervious area
- Slope
- Soils
- Depth to groundwater

Municipal Right-of-Way
- Priority Area
- Water Quality Impairments/TMDLs
- Impervious area
- Slope
- Soils
- Depth to groundwater
- Road classification
- Road Width
Site Assessment – Pawcatuck River

• Field reconnaissance/site visits

• Site constraints
  – Site drainage patterns
  – Storm drainage system configuration
  – Available space
  – Utility conflicts
  – Site operations
Site Assessment – New Haven Bioswales

- Visually inspected all streets in project area (West River)
- Sufficient space
- Streets with sidewalk & tree belt
- Minimum separation distances
- Avoid infrastructure conflicts
  - Trees
  - Parking meters
  - Sign posts
  - Telephone/light poles
  - Fire hydrants
  - Edge of driveway/curb cut
Potential Bioswale Locations

- 154 potential bioswale locations identified

- 70 bioswales constructed (2019)
Site Assessment – New Haven Bioswales
Retrofit Project Prioritization

- Built-in to site screening
  - Priority Area (required by MS4 Permit)
  - Other site and BMP factors
- Other Considerations
  - O&M issues
  - Public acceptance
  - Public visibility
  - Educational/demonstration value
  - Costs and benefits
Retrofit Project Prioritization

- Quantitative Approach (scoring and ranking)
  - Watershed and BMP characteristics
  - Community considerations
  - Cost effectiveness

Subwatershed | Identifier | Total Raw Score | Total Normalized Score | Ranking
--- | --- | --- | --- | ---
Maidford River | MR_BR_1 | 27 | 10.0 | 10.00
Maidford River | MR_FB_1 | 25 | 9.2 | 9.22
Maidford River | MR_FB_2 | 25 | 9.2 | 9.22
Other | Almy | 24 | 8.6 | 8.60
St. Mary’s Pond | SM_W_2 | 23 | 8.1 | 8.14
Other | Newport | 21 | 7.4 | 7.42
St. Mary’s Pond | SM_W_1 | 21 | 7.3 | 7.30
Maidford River | MR_BR_3 | 20 | 6.8 | 6.89
Maidford River | MR_BR_9 | 20 | 6.8 | 6.80
Maidford River | MR_O_3 | 20 | 6.8 | 6.79
Maidford River | MR_RS_7 | 20 | 6.8 | 6.79
Maidford River | MR_FR_2 | 20 | 6.7 | 6.74
Maidford River | MR_BU_11 | 20 | 6.6 | 6.60
Sisson Pond | SP_W_1 | 19 | 6.5 | 6.52
Retrofit Costs

- Design and installation
- Maintenance

<table>
<thead>
<tr>
<th>BMP</th>
<th>Design and Installation Unit Cost ($/ft³) (2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infiltration Trench</td>
<td>$12.60 – $37.80</td>
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<tr>
<td>Infiltration Basin</td>
<td>$6.30 – $18.90</td>
</tr>
<tr>
<td>Bioretention</td>
<td>$15.60 – $46.80</td>
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<tr>
<td>Gravel Wetlands/WVTS</td>
<td>$8.86 – $26.58</td>
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<tr>
<td>Porous Pavement</td>
<td>$18.24 – $54.72</td>
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<td>Sand Filter</td>
<td>$18.10 – $54.30</td>
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<tr>
<td>Wet Pond</td>
<td>$6.86 – $20.58</td>
</tr>
</tbody>
</table>

Source: Stormwater Control Measure Nomographs with pollutant removal and design cost estimates, UNH Stormwater Center, May 2019

## Potential Costs to Meet DCIA Reduction Goals

- **WQV & Typical Design and Installation Cost** ($30/ft³) and **Annual Maintenance Cost** ($1,500/acre)

<table>
<thead>
<tr>
<th>Municipality</th>
<th>2% DCIA Reduction Goal (acres)</th>
<th>Potential Design and Installation Cost ($)</th>
<th>Potential Annual Maintenance Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danbury</td>
<td>52.0</td>
<td>$5.3M</td>
<td>$78K</td>
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<tr>
<td>Stonington</td>
<td>17.4</td>
<td>$1.8M</td>
<td>$26K</td>
</tr>
<tr>
<td>New Fairfield</td>
<td>3.7</td>
<td>$380K</td>
<td>$6K</td>
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<tr>
<td>Somers</td>
<td>5.4</td>
<td>$560K</td>
<td>$8K</td>
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<tr>
<td>Woodbury</td>
<td>3.8</td>
<td>$390K</td>
<td>$6K</td>
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</tbody>
</table>
Document DCIA reduction for each retrofit and redevelopment project

### Directly Connected Impervious Area Tracking Worksheet

**City of Danbury Drainage Manual**

**Part 1: General Information**

- Project Name
- Project Location
- Project Applicant
- Date of Submittal

**Note to User:**

Directly Connected Impervious Area (DCIA) refers to all impervious area within the project site that drains directly to the City of Danbury’s storm sewer system. DCIA does not include impervious areas draining to structural or non-structural BMPs where the 1” water quality storm is fully infiltrated.

**Part 2: Project Details**

- Is this a public or private project? (choose from dropdown)
- What type of development is this? (choose from dropdown)
- What is the total area of the project site [e.g., area of parcel(s) or Right-of-Way containing development]?
- What is the total area of land disturbance for this project?

**Part 3: DCIA Tracking**

- Pre-development total impervious cover
- Pre-development DCIA
- Post-development total impervious cover
- Post-development DCIA (after considering stormwater management)
- Net change in DCIA from pre-development to post-development

**Part 4: Water Quality Target**

- Water Quality Volume (WQV)
- Required treatment/retention volume
- Proposed Low Impact Development (LID) system to be used?
- Treatment/retention volume planned for development

**Certification Statement**

I hereby certify that the information contained in this worksheet is true and correct.

- Engineer’s Signature
- Date
- Engineer’s Seal
## DCIA Reduction Tracking

- Document town-wide DCIA reduction annually

### Directly Connected Impervious Area Tracking Spreadsheet

City of Danbury

<table>
<thead>
<tr>
<th>Date Completed</th>
<th>Project Name</th>
<th>Owner Type (Dropdown)</th>
<th>Owner Type (Dropdown)</th>
<th>Project Type (Dropdown)</th>
<th>Notes (e.g. UID Practice Used)</th>
<th>Change In IC¹ Acres</th>
<th>Change In DCIA² Acres</th>
<th>Cumulative Total DCIA² Acres</th>
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<tr>
<td>2012 Watershed Baseline</td>
<td>Select One</td>
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<td>4,879.42</td>
<td>17.354%</td>
<td>2,598.70</td>
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MS4 Permit Schedule

- Determine Baseline DCIA – June 2020
- Develop Retrofit Plan – June 2020
- Implement Projects from Retrofit Plan
  - June 2021 (1% DCIA Reduction Goal)
  - June 2022 (1% DCIA Reduction Goal)
  - Annually thereafter (1% DCIA Reduction Goal)
Questions?

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