Columbus, Ohio Regional Bioretention Pilot Project Inspection & Maintenance Assessment

Ohio Stormwater Conference
May 8, 2019
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Agenda

- Project Design/Objectives
- Post Construction Inspection Monitoring
- Performance Metrics
- Common Issues
- Columbus SWSP2

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Pilot Objectives

- GI Performance Objectives
  - Reduce surface water flooding and sanitary sewer influence
  - Provide stormwater quality treatment
- Neighborhood Objectives
  - Utilize vacant parcels with recently demolished homes
  - Provide green space and amenities for neighborhood
- Learning Objectives
  - Develop coordination practices for other departments
  - Identify ways to improve future design and construction projects

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Site Design and Construction

- South Side Settlement Heritage Park
  - Bioretention Cell Design/Construction
  - Pervious Asphalt Basketball Court
  - Pervious Paver Shelter Area
  - Playground/Site Furnishings
  - Plantings
- 4 Additional Bioretention Sites
  - Located on vacant properties
  - Homes were abandoned and demolished by Land Bank

South Side Settlement Heritage Park – Pre-construction

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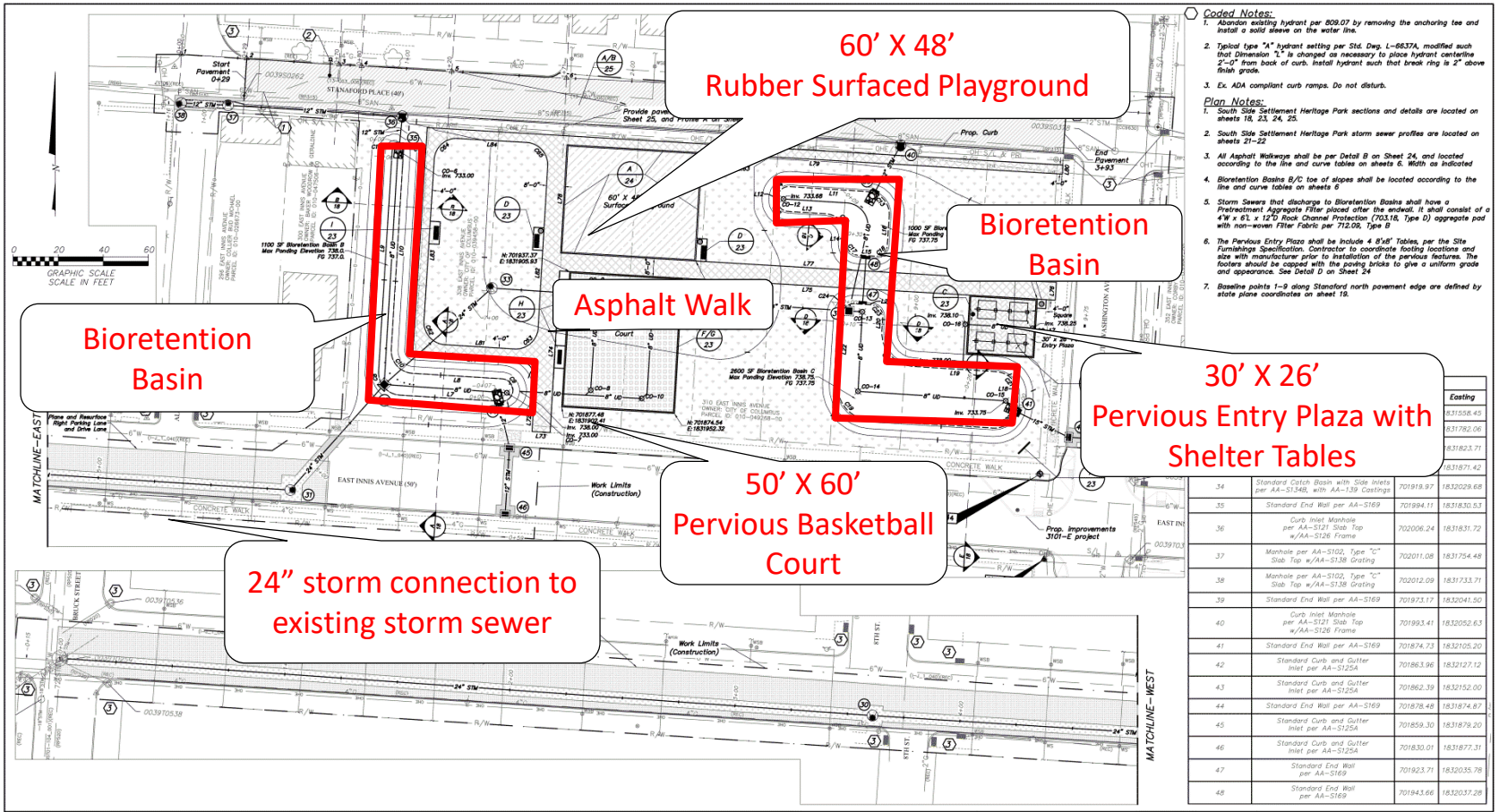
Proposed Site Plan



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Post Construction SSSHP Site

Post Construction SSSHP Site

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Pre-construction Additional Bioretention Sites

Additional Bioretention Sites

Post Construction Monitoring Approach

- Provides a quantitative ability to track basin performance
- Allows for evaluation over time and comparison of basin performance
- Can lead to work order generation
- Will help to set inspection schedules for different basins as additional data is gathered

Post Construction Monitoring – Rating System

– Approach

- Visit sites 1/month in growing season. Evaluate performance of basins on quantitative rating scale
  - System Overview
  - Inflow and Outflow
  - Perimeter and Basin Bottom

	Assessment Metric		Rating Scale				
			5	4	3	2	1
System Overview	1	**Aesthetics**	Excellent	Good	Neglected	Deteriorating	Poor
	2	**Debris/Trash & Oil/Chemical Accumulation**	None		Slight		Excessive
	3	**Plant Cover**	80-100%	60-80%	40-60%	20-40%	0-20%
	4	**Vegetation Health**	Well established/Mature	Mostly healthy	Sparse/ Stressed	Many/ Dying	Dead/Absent
	5	**Weeds/ Invasives**	None		Slight		Overgrown
	6	**Mosquito proliferation**	None/ Minimal		Average		Excessive

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Post Construction Monitoring – Rating System

Inflow and Outflow

Assessment Metric			Rating Scale				
			5	4	3	2	1
Inflow Points	**7**	**Inlet Functionality**	Unobstructed		Obstructed		Blocked
	8	**Erosion Protection**	Sufficient/Effective		Moderately Effective		Absent/Ineffective
Outlet/ Overflow Structures	**9**	**Outlet Functionality**	Clear	Sediment buildup	Slight obstruction	Severe Obstruction	Blocked
Pre-Treatment Area	**10**	**Sediment Buildup**	Empty/ Minimal		Moderate/ Half full		Full/ Nearly full

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Post Construction Monitoring – Rating System

Perimeter and Basin Bottom

	Assessment Metric		Rating Scale				
			5	4	3	2	1
Perimeter/ Embankment	**11**	**Erosion/ Undercutting**	None	Ground cover missing	Slight channelization	Heavily channelized	Substantial scouring
	12	**Edge/Edging**	Well defined		Moderately defined		Poorly defined
Bottom of System	**13**	**Mulch**	Good	Slightly eroded	Uneven, loose edges	Heavily eroded	Missing
	14	**Soil Moisture**	Soil moisture is good		Dry and cracked		Cracked soil - extremely hard
	15	**Drainage**	Under 24 hours	Ponding > 24 hours	Ponding > 48 hours	Ponding >72 hours	No drainage - extensive ponding
	16	**Soil Compaction**	None		Slight		Extreme
	17	**Sediment Buildup**	None	<2”	2”-4”	4”-6”	>6”

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Results of the Post Construction Monitoring

		Total Score by Location (Max: 100)						
Date	Rating Scale	Forest St./ Gilbert St.	S. Ohio Ave./ E. Sycamore Ave.	E. Columbus St.	SSSHP East Cell	SSSHP West Cell	Parsons North	Parsons South
7/22/2016	Original	92	91	91	88	88	95	93
8/5/2016		94	94	95	**93**	92	93	93
8/18/2016		93	**93**	92	**93**	93	93	96
9/9/2016		93	**92**	93	**92.5**	91	94	95
10/5/2016		93	**92**	93	**92.5**	91	94	95
5/9/2017		91	**91**	92	**88**	**87**	90	**90**
6/13/2017	Revised	**89**	**90**	92	**86**	**86**	**89**	**89**
8/1/2017		**83**	87	**85**	88	**85**	**87**	**87**
10/19/2017		**81**	**84**	**85**	86	**84**	88	88

Major Observed Issues:

Overflow and Outlet Issues
Plant Die-Off (Cone Flowers)
Debris Accumulation
Weeds/Invasives
Erosion/Channeling
Vandalism

Overflow and Outlet Issues

- Debris can build up significantly over the winter
- Items placed in outlet structures
- Trash and floatables

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Plant Die Off

- Cone Flowers did not survive
- Worthwhile to “overplant”, some will die off
- Plant Losses
  - Total of approximately 4700 plants were included in all 5 sites
  - Approximately 268 plants did not survive (6%)

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Debris/Sediment Accumulation

- Floatables
- Trash
- Litter
- Sediment

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Weeds/Invasives

- Weeds come up fast in the spring and City needs to be prepared to address during peak growth months
- Plant spacing during construction (overcrowding/sparse)

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Erosion/Channeling

- Erosion and minor landscaping issues, including bare spots
- Engineered media settling
- Channelization near structures due to settling

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Vandalism

- Stolen plants
- Broken trees
- Rocks in outlets
- Rocks in inlets
- Concrete markings
- Outlet structure covers removed
- Large objects in outlet structures
- Trampling of plants

Plant Successes

- Asters (ground cover/barriers)
- Black-Eyed Susans (flowering)
- Grasses (fill/height)

Columbus SWSP2 - I&M Guidance

BIORETENTION FACT SHEET

Inspections and Maintenance

As a general standard, monthly inspections are required during the establishment period and for the service life of all bioretention facilities. During each visit and inspection, the following tasks should be performed in accordance with the schedule included in this fact sheet:

Inspection Form

- Complete an inspection form during facility inspection that details the condition of the facility, work performed during the inspection, and any recommendations for as-needed maintenance.
- During each inspection, all stormwater BMP design components including area protection, stormwater entrances, pervious surfaces, energy dissipation devices, piping and appurtenances, and outlets, should be inspected for physical damage, repair needs, or disruptions to stormwater flow through the system.

Watering

- Watering should be conducted on a routine basis during the establishment period. Watering may also be required on an as-needed basis during the service life of the facility during times of drought, but consult with the City of Columbus to determine if water conservation efforts are in effect during drought.

Weeding

- All plants that are not specified on the permitted planting plan should be removed entirely including all roots and root fragments, before plants set seed, such that no more than 5% weed coverage is present at any time.
- Proactive weeding is especially critical during the establishment period.

Trimming

- Seeded lawn areas surrounding the bioretention facility should be routinely trimmed during the growing season.
- A brush trimmer should be used to cut down brush and shrubs once annually between March and April.

Plant Pruning

- All shrubs, perennials, and trees within and adjacent to the bioretention facility should be pruned routinely.
- Woody species require pruning and branches should be inspected to remove crossed or dead branches. Shrubs and perennials require pruning/dead-heading to encourage new growth and promote the health of the plants.

Plant Replacement

- Any plants that do not survive must be replaced with the identical number of plants lost and species specified on the permitted planting plan. If derivations must be made at City-owned stormwater BMPs, a formal request detailing why must be submitted to the City for approval.
- If a plant survivability study has been conducted to identify recommended species substitutions, plant replacements should be in accordance with the approved modified planting plan.

Schedule and Frequency of I&M Activities for Bioretention Facilities

Phase			Task	Suggested Schedule											
Establishment	Routine	As-Needed		January	February	March	April	May	June	July	August	September	October	November	December
X	X		Inspection	Once/Month											
X		X	Watering			Once/Week or As Needed									
X	X		Weeding			Once/Month									
X	X		Trimming			Once/Week									
X	X		Plant Pruning			Once							Once		
		X	Plant Replacement			As Needed						As Needed			
		X	Stake Repair/Replacement	As Needed											
X	X		Mulch Replacement		Once										
		X	Media Replacement				As Needed						As Needed		
		X	Rock Channel Replacement	As Needed											
		X	Minor Soil Compaction Repairs	As Needed											
X	X		Minor Erosion Repairs	As Needed											
X	X	X	Sediment/Leaf Removal	As Needed											
X	X	X	Trash & Debris Removal	As Needed											
		X	Inlet/Outlet Structure Cleaning	As Needed											
		X	Pest/Disease/Invasive Species Management	As Needed											

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Columbus SWSP2 - I&M Guidance

BIORETENTION INSPECTION FORM

Facility Name/Asset ID: **Time In:** am/pm **Out:** am/pm

Inspection & Maintenance Type (Check One)	Inspected By	Date	Weather	Temp (°F)	Date of Last Rainfall	Precipitation (in)
☐Establishment ☐Routine						

Site Inspection

Category	Assessment Metric	Rating 1 (Poor) – 5 (Excellent)	Comments
System Overview	Aesthetics		
	Debris/Trash & Oil/Chemical Accumulation		
	Plant Cover		
	Vegetation Health		
	Weeds/ Invasives		
	Mosquito Proliferation		
Inflow Points	Inlet Functionality		
Outlet Structures	Outlet Functionality		
Pre-Treatment Area	Sediment Buildup		
Perimeter/ Embankment	Erosion/ Undercutting		
	Slope Stability & Grading		
Bottom of System	Mulch		
	Soil Moisture		
	Drainage		
	Soil Compaction		
	Sediment Buildup		

Maintenance Log

Maintenance Performed (Check all that apply)	Establishment	Routine
Watering	☐	
Minor Erosion Repair	☐	☐
Trimming	☐	☐
Weeding	☐	☐
Trash & Debris Removal	☐	☐
Sediment/Leaf Removal	☐	☐
Mulch Replacement	☐	☐
Plant Pruning	☐	☐

As-Needed Maintenance *(Check all that apply & describe in comment box)*

Plant Replacement	Mulch Replacement	Media Replacement	Sediment /Debris Removal	Inlet or Outlet Cleaning	Structural Repair	Other

As-Needed Maintenance/ Work Order Description/ Comments

BIORETENTION INSPECTION FORM RATING SYSTEM

Category	Assessment Metric	Rating Scale 5	4	3	2	1
System Overview	Aesthetics	Excellent	Good	Neglected	Deteriorating	Poor
	Debris/Trash & Oil/Chemical Accumulation	None		Slight		Excessive
	Plant Cover	80-100%	60-80%	40-60%	20-40%	0-20%
	Vegetation Health	Well Established/ Mature	Mostly Healthy	Sparse/ Stressed	Many Dying	Dead/Absent
	Weeds/ Invasives	None		Slight		Overgrown
	Mosquito proliferation	None/ Minimal		Average		Excessive
Inflow Points	Inlet Functionality	Unobstructed		Obstructed		Blocked
Outlet/ Overflow Structures	Outlet Functionality	Clear	Sediment Buildup	Slight Obstruction	Severe Obstruction	Blocked
Pre-Treatment Area	Sediment Buildup	Empty/ Minimal Accumulation		Moderate/ Half Full		Full / Nearly Full
Perimeter/ Embankment	Erosion/ Undercutting	None	Ground Cover Missing	Slight Channelization	Heavily Channelized	Substantial Scouring
	Slope Stability/Grade	Well Defined		Moderately Defined		Poorly Defined
Bottom of System	Mulch	Good	Slightly Eroded	Uneven, Loose Edges	Heavily Eroded	Missing
	Soil Moisture	Moist		Dry and Cracked		Cracked Soil - Extremely Hard
	Drainage	Under 24 Hours	Ponding > 24 Hours	Ponding > 48 Hours	Ponding >72 Hours	No Drainage - Extensive Ponding
	Soil Compaction	None		Slight		Extreme
	Sediment Buildup	None	<2"	2"-4"	4"-6"	>6"

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Summary- Lessons Learned

- Minor O&M issues can build up – may require small fixes, but need to be identified and communicated to responsible parties
- Developed performance metrics for the City I&M guidance based on field investigations and data
- Preventative maintenance is better than reactive maintenance
- Provide detailed schedule for all O&M activities following construction completion