Monitoring Performance and Effectiveness of Urban Stormwater Best Management Practices

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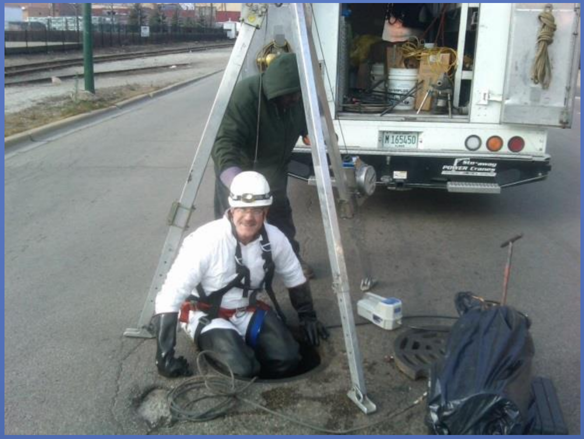

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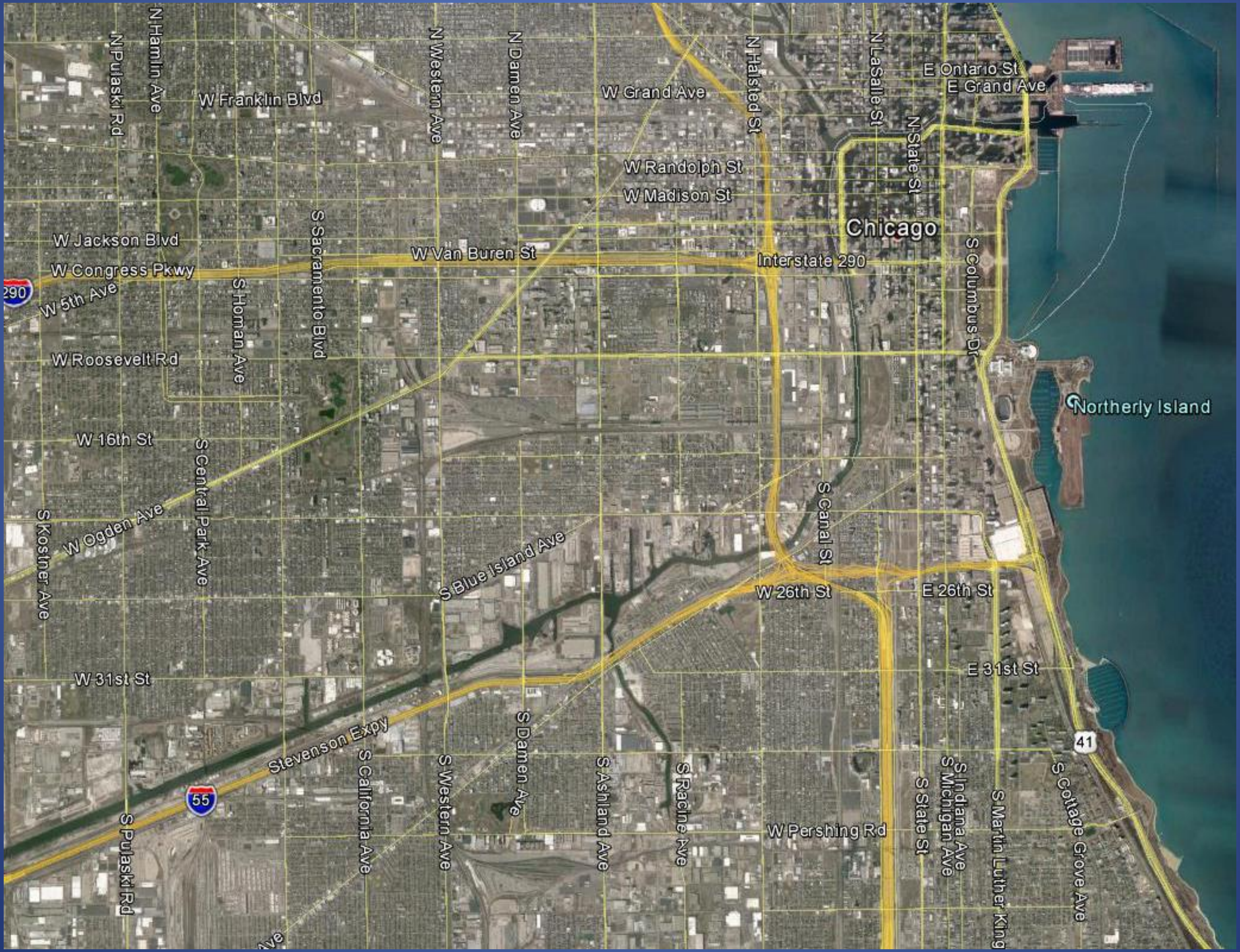
CDOT
CHICAGO DEPARTMENT OF TRANSPORTATION

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

Project Sustainable Goals

Stormwater Management	Divert 80% of the typical average annual rainfall and at least 2/3 of rainwater falling within catchment area into stormwater best management practices.
Water Efficiency	Eliminate use of potable water for irrigation, specify native or climate adapted, drought tolerant plants for all landscape material.
Transportation	Improve bus stops with signage, shelters and lighting where possible, promote cycling with new bike lanes, improve pedestrian mobility with accessible sidewalks.
Energy Efficiency	Reduce energy use by min. 40% below a typical streetscape baseline, use reflective surfaces on roads/sidewalks, use dark sky-friendly fixtures. Min. 40% of total materials will be extracted, harvested, recovered, and/or manufactured within 500 miles of the project site.
Recycling	Recycle at least 90% of construction waste based on LEED NC criteria, Post/Pre-Consumer recycled content must be min. 10% of total materials value.
Urban Heat Island, Air Quality	Reduce ambient summer temperatures on streets and sidewalks through use of high albedo pavements, roadway coatings, landscaping, and permeable pavements. Require ultra low sulfur diesel and anti-idling.
Education, Beauty & Community	Provide public outreach materials/self-guided tour brochure to highlight innovative, sustainable design features of streetscape. Create places that celebrate community, provide gathering space, allow for interaction and observation of people and the natural world.
Commissioning	Model Stormwater BMP's in Infoworks to analyze and refine design. Monitor stormwater BMP's to ensure predicted performance and determine maintenance practices.

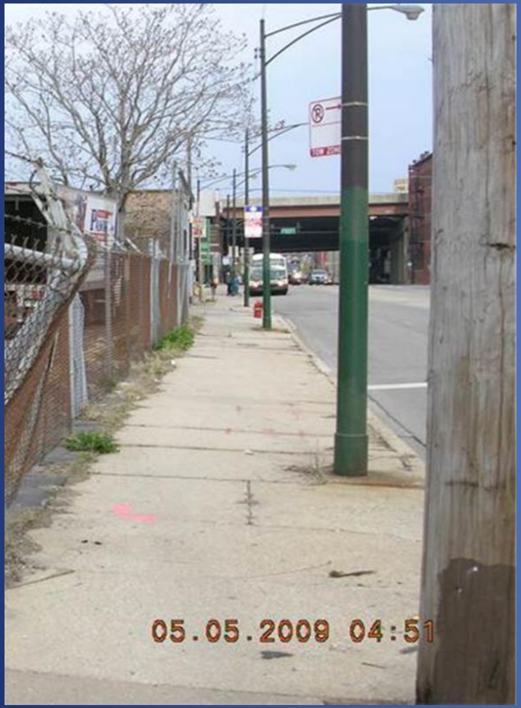
CDOT Cermak/Blue Island Sustainable Streetscapes Corridor



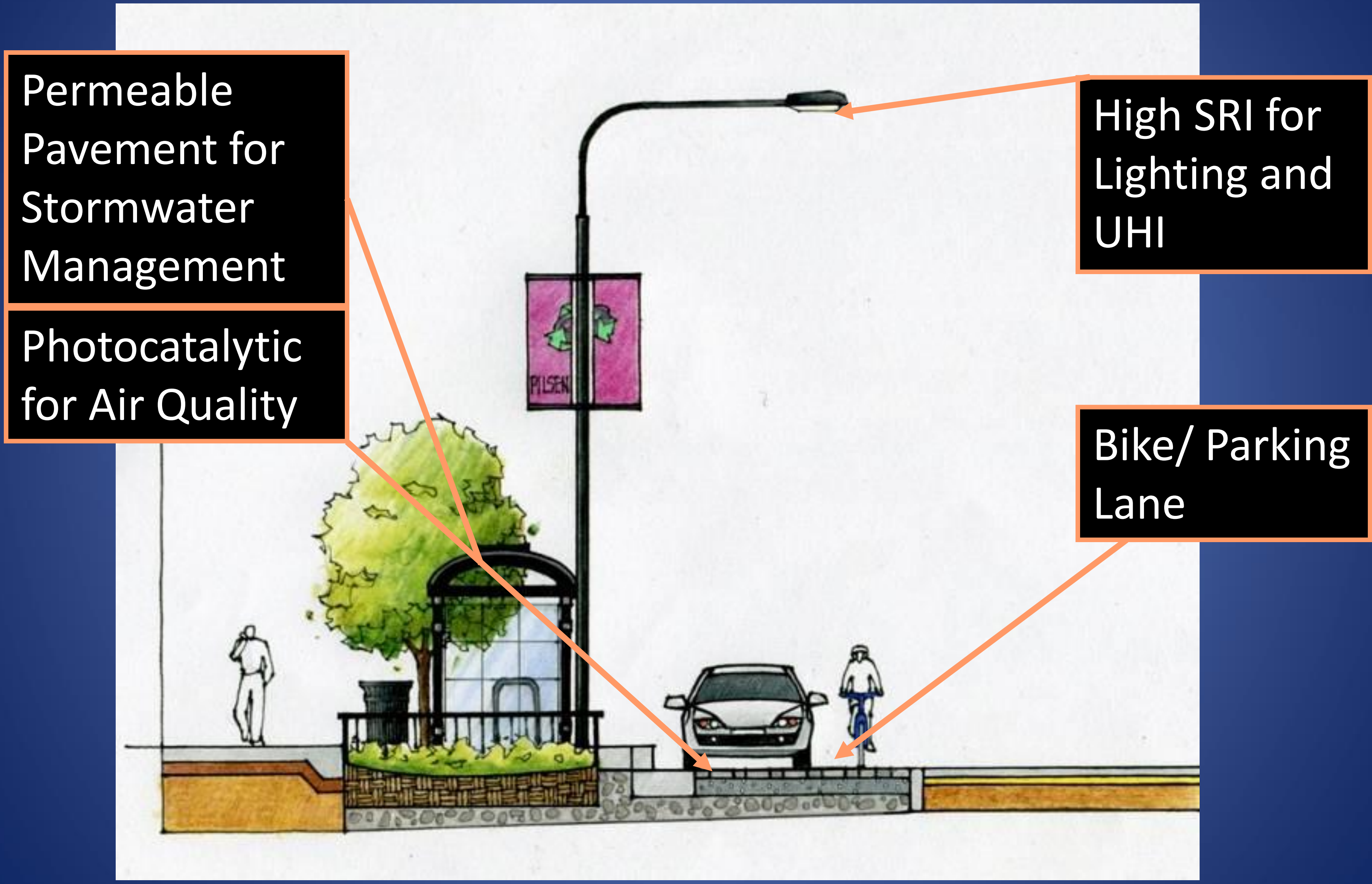
CDOT Cermak/Blue Island Corridor-Sustainable Streetscapes Study Reach

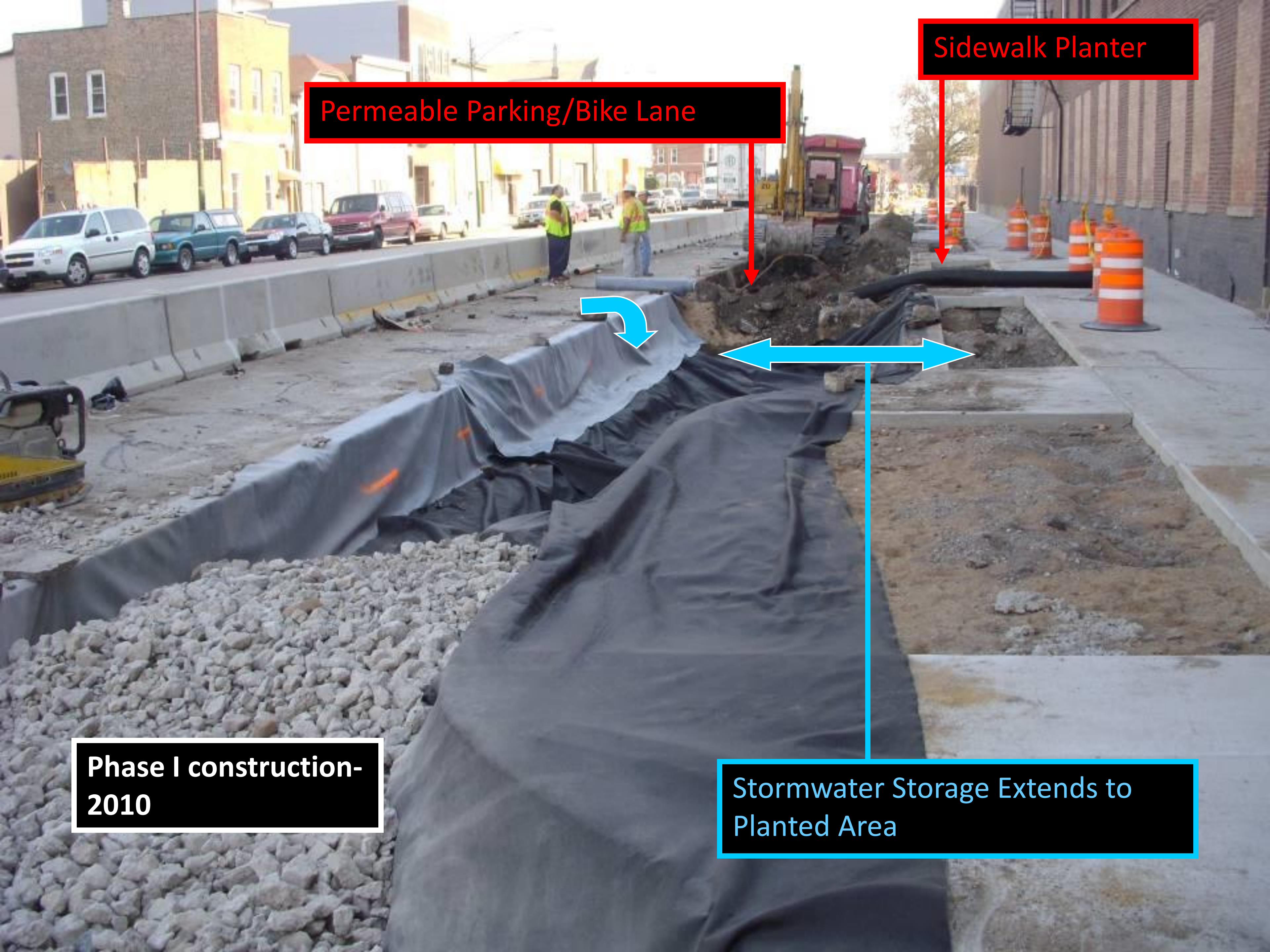
Two mile reach of Cermak-Blue Island utilizing urban stormwater BMP's to reduce stormwater loads to local sewers.

Cermak-Blue Island Corridor
Pre-construction



CDOT Integrated Design: Blue Island Cross Section




Permeable Parking/Bike Lane
Sidewalk Planter
Phase I construction-
2010
Stormwater Storage Extends to
Planted Area


RIGHT
LANE
ONLY
2012.10.04

Before/After Cermak Rd.

Functional stormwater BMP's

USGS/MWRDGC tasked with Monitoring

- Document pre-construction conditions.
- Identify all aspects of hydrologic impacts (precipitation, infiltration, soil moisture, shallow groundwater, combined sewer flows).
- Evaluate performance of best management practice features (bioswale, catch basins, etc).
- Document post-construction conditions.
- Identify lessons learned from monitoring.

Streetscapes Project Monitoring
Blue Island Ave- Cermak Rd Corridor

- 3-Precipitation gages.
- 5-Shallow groundwater wells.
- 3-Sewer flow gages
- 2-catch basin water level

Infiltration data

Average Percolation Rate of Pavers (inches/hr)

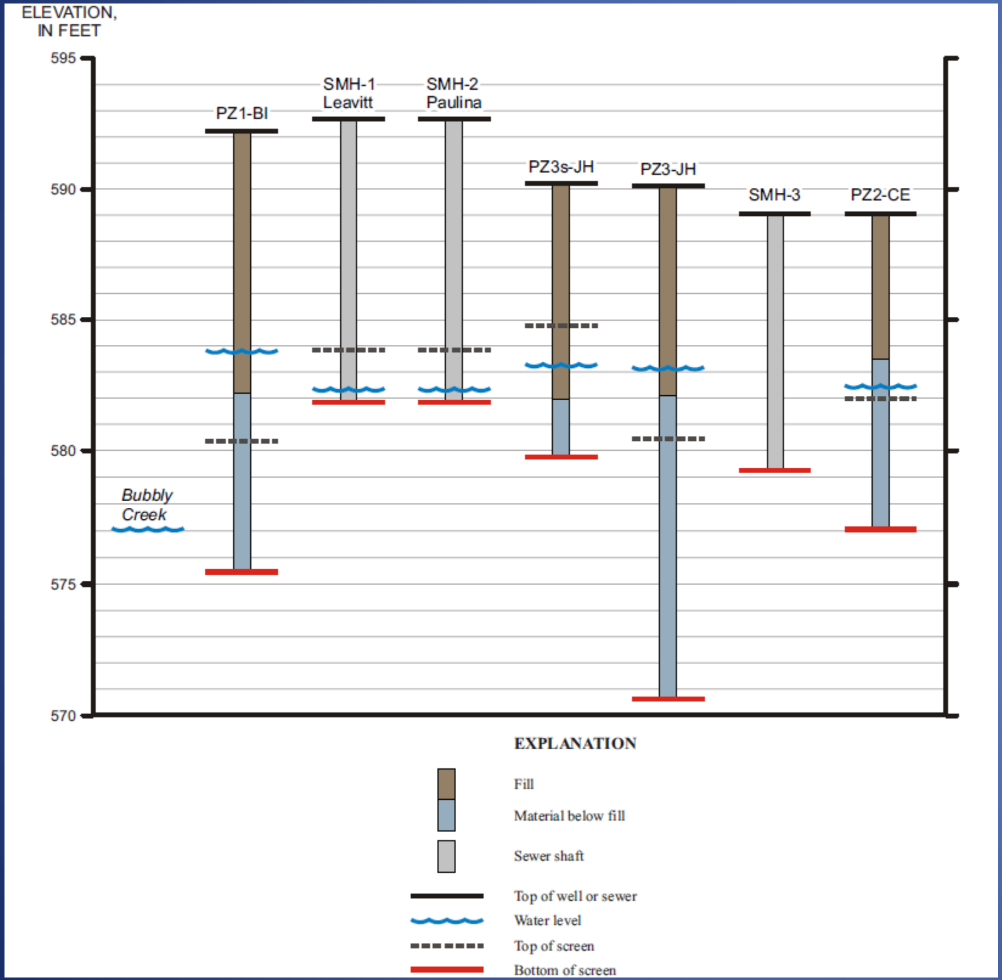
Date	Juarez Academy	Blue Island - North	Blue Island - South
10/31/12	9.0 ± 1.2	18.2 ± 3.4	20.1 ± 2.2
6/11/13	3.9 ± 0.9	4.1 ± 1.8	8.3 ± 1.9
Pavers Cleaned on Blue Island on July 26th wk			
8/5/13	2.7 ± 0.6	44.7 ± 6.9	169.5 ± 22.4

Groundwater Monitoring

- Four monitoring locations (5 monitoring wells)
  - Leavitt
  - Juarez High school (2)
  - Canalport
  - Bioswale
- Groundwater level relative to sewers and BMP's

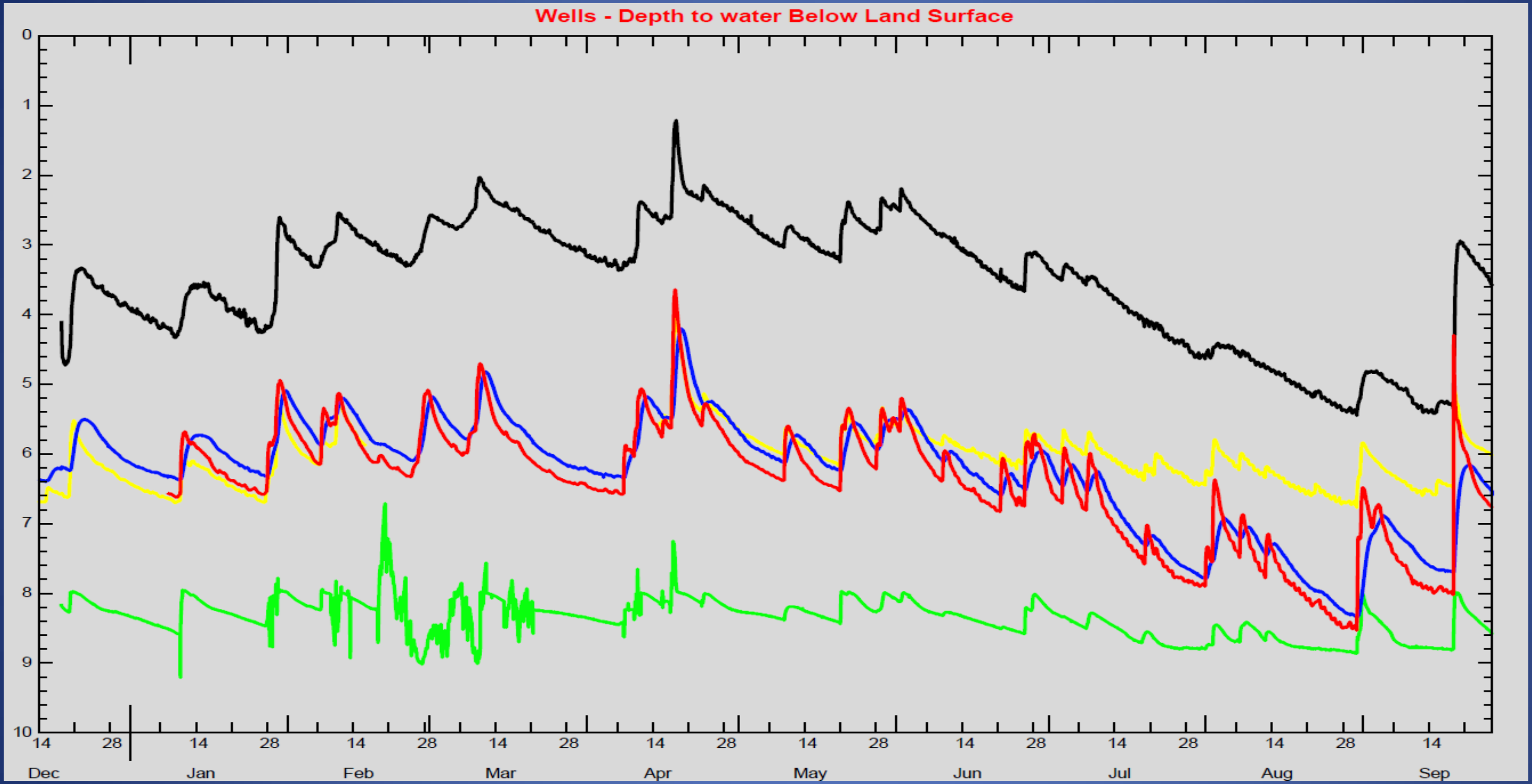
- What are characteristics of groundwater infiltration after storm event. Drainage rates??

Groundwater-relative water elevations



- Groundwater levels are higher than sewer elevations, however no evidence in sewer monitoring for inflow.
- Fill material has the greatest hydraulic conductivity .

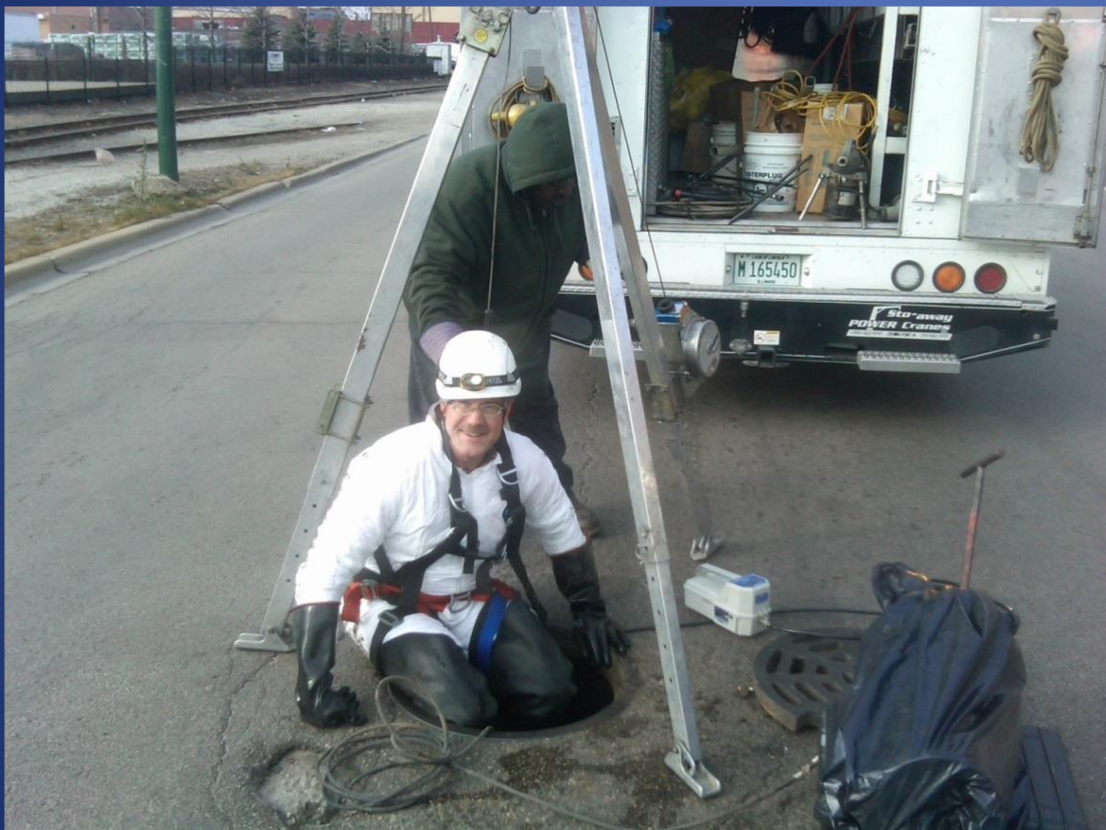
Shallow groundwater levels



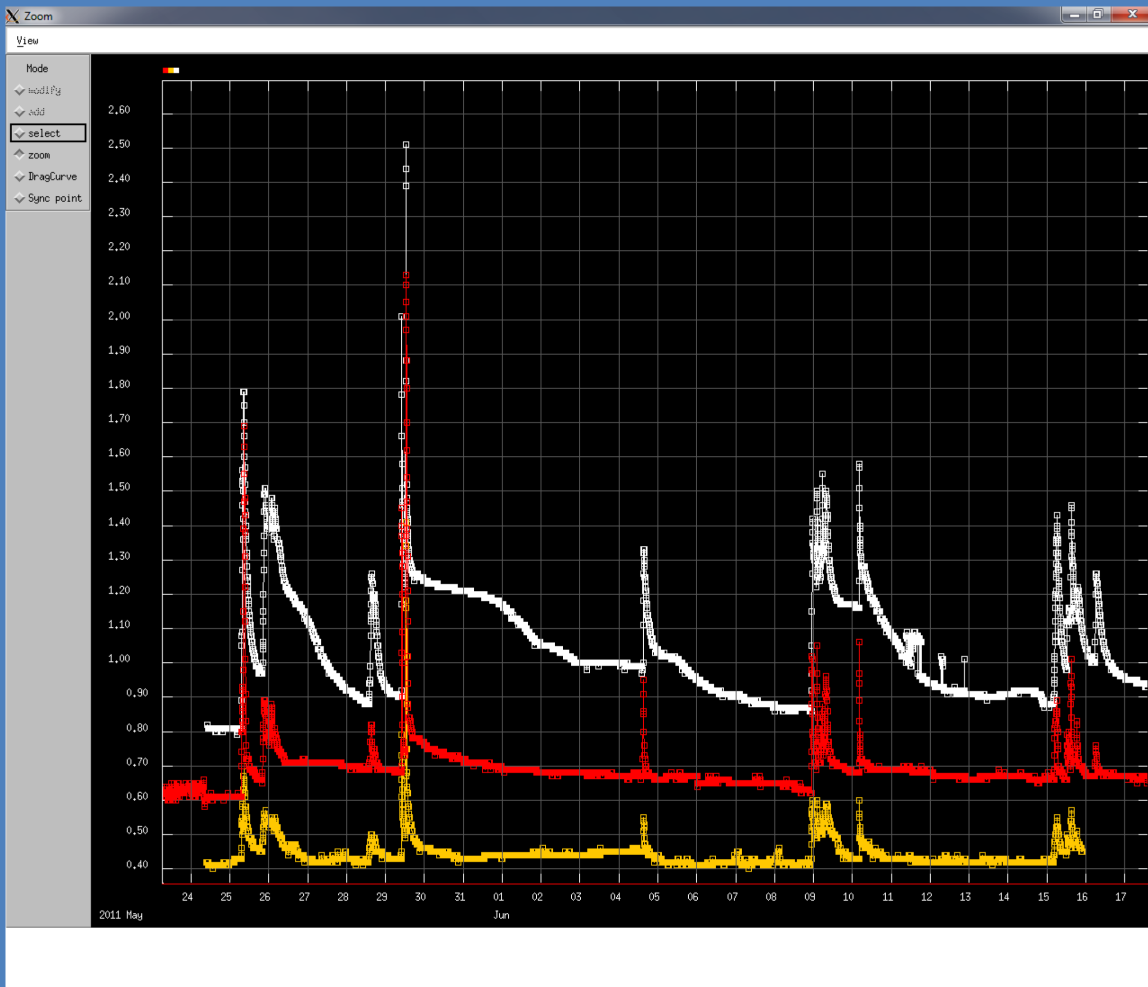
Offset reflects the depth to the water table (GW) and the water moving through the unsaturated zone at the bioswale

Black - Bioswale,
Red - Juarez HS (shallow)
Blue – Juarez HS (deep)
Yellow – Canalport (east)
Green-Leavitt (west)

Sewer flow monitoring



Analysis of sewerflow data pre- and post-construction of BMP's to evaluate effectiveness at reducing stormwater loads to local sewers.



Pre-construction Sewer flow data

white- Throop
red- Leavitt
yellow- Paulina

(Separate sewer lines)

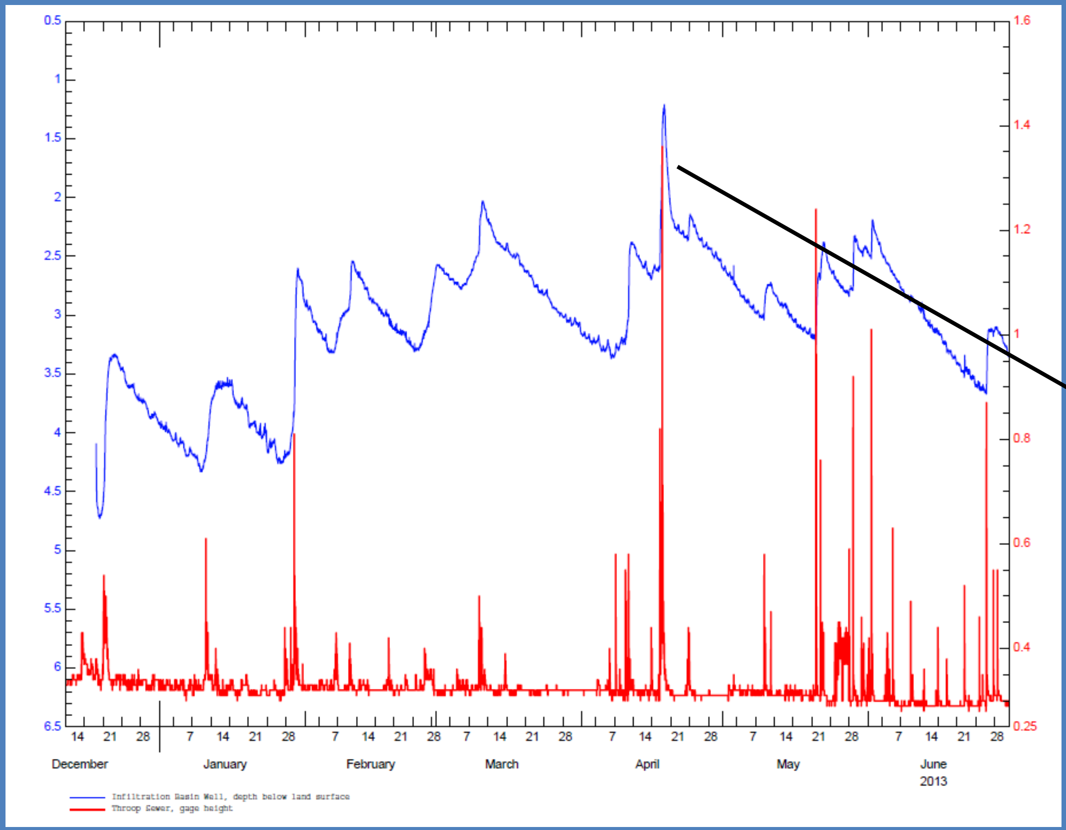
Stormwater BMP's: Using the monitoring data to evaluate the BMP's

- Bioswale

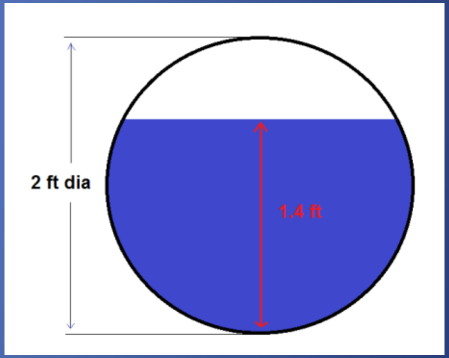
- Rain garden

- Permeable pavers

Bioswale performance



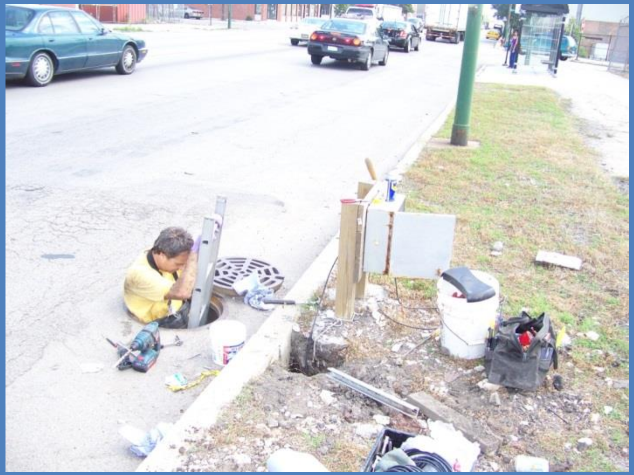
- April 17-18,2013
- 4.7 inches of rain in 24 hrs
- >10-yr recurrence interval
- did not surcharge sewer line.



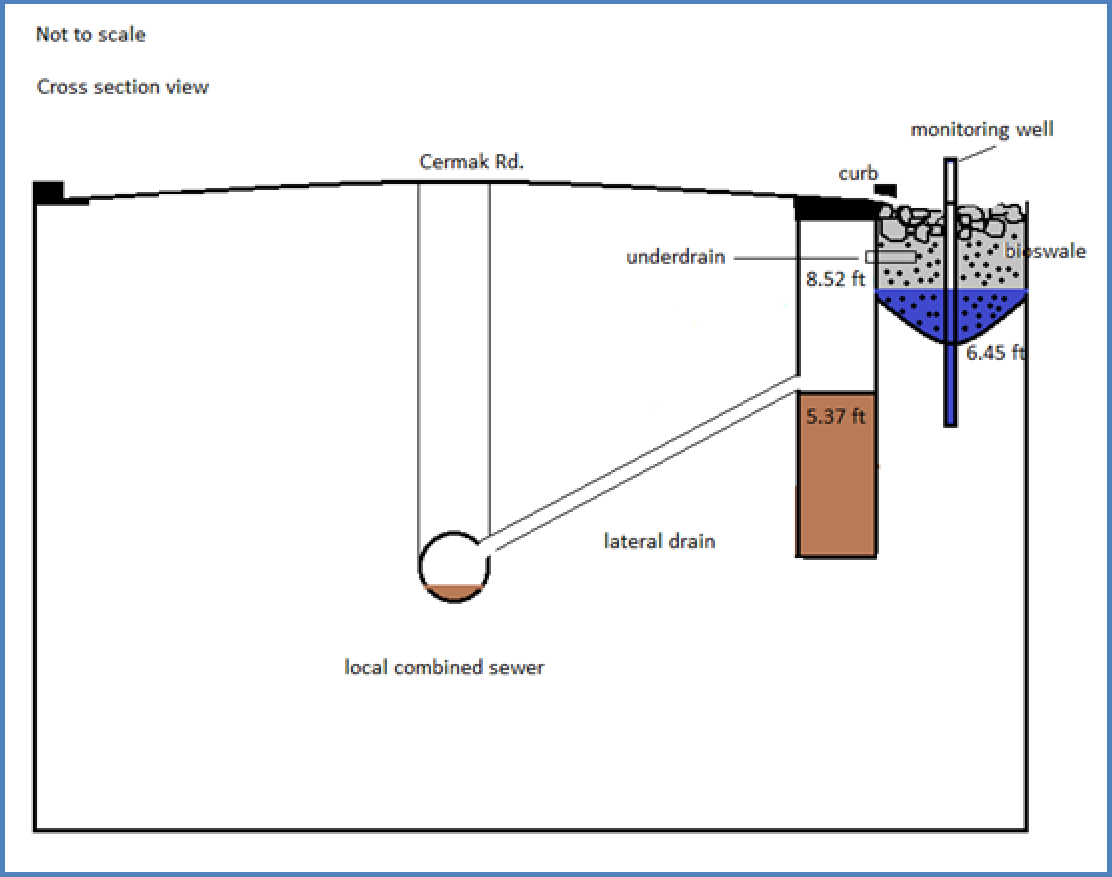
Blue - Bioswale, depth below land surface, in feet
Red –Throop Sewer flow meter, water level, in feet

- Chicago sewers designed for 5-yr event.

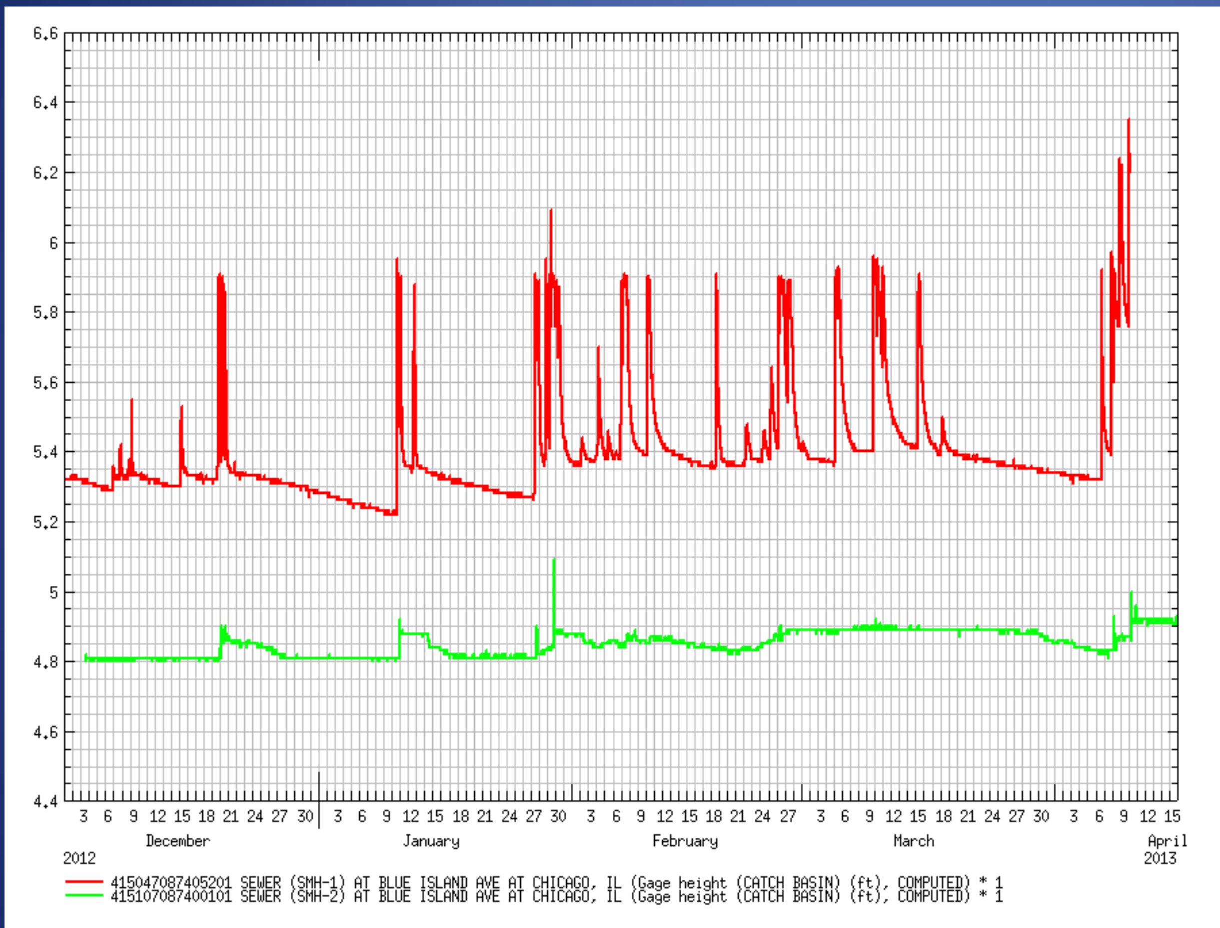
Catch basins



- Leavitt-installed 08-04 2012
- Paulina-installed 08-08-2012



Catch basin data



- Leavitt catch basin is in a reach at the western end of the study area with no stormwater BMP's.
- Paulina is in the center of the study area and has stormwater BMP's in place.
- Permeable pavers are capturing first flush.

Red-Leavitt
Green-Paulina

Maintenance of BMP's

- Changes in percolation rates of permeable pavers over time. Requires periodic cleaning.
- Changes in percolation rate of bioswale.
- Sedimentation near bioswale curb cuts.
- Litter.

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Summary

- Storm water benefits of volume reduction, reducing peak flows, and pollutant retention are clearly observed.
- Benefits go beyond storm water management
  - Improved aesthetics
- Maintenance of BMPs is important in the long-run
  - Periodic cleaning of permeable pavements
  - Periodic sediment removal from bioswales
- Community
  - Education

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Why Do We Need Stormwater Green Infrastructure Features?