



Beyond Sediment and Nutrients Using Green Infrastructure to Meet Your Local TMDL Goals

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AECOM

Today's Discussion

- What is Green Infrastructure?
- Benefits of using GI in TMDL Planning
- Examples where GI is used to address local TMDLs
- Putting it all together



What is Green Infrastructure?

- Natural and managed green areas in both urban and rural settings
- Strategic connection of open green areas
- Treating rainwater as a resource
- Transforming “grey” infrastructure to green through restoration of watersheds to slow and store water



Potential Benefits

- Reduced runoff
- Improved water quality
- Improved air quality
- Reduced water usage during droughts
- Improved aesthetics
- Improved habitat
- Reduced costs
- Increased property values
- Permit credits



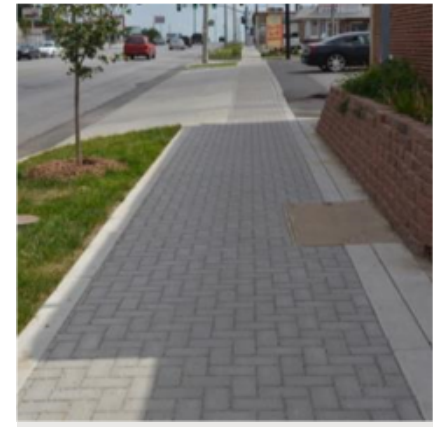
Examples of Green Infrastructure



Bioretention



Rain Garden



Permeable Pavements



Green Roof



Tree Canopy



Rain Barrels

Tree Box Application



Tree box filters with monitoring



Curb Extensions with Below-Grade Storage



- Stormwater collection focal points
- Traffic calming

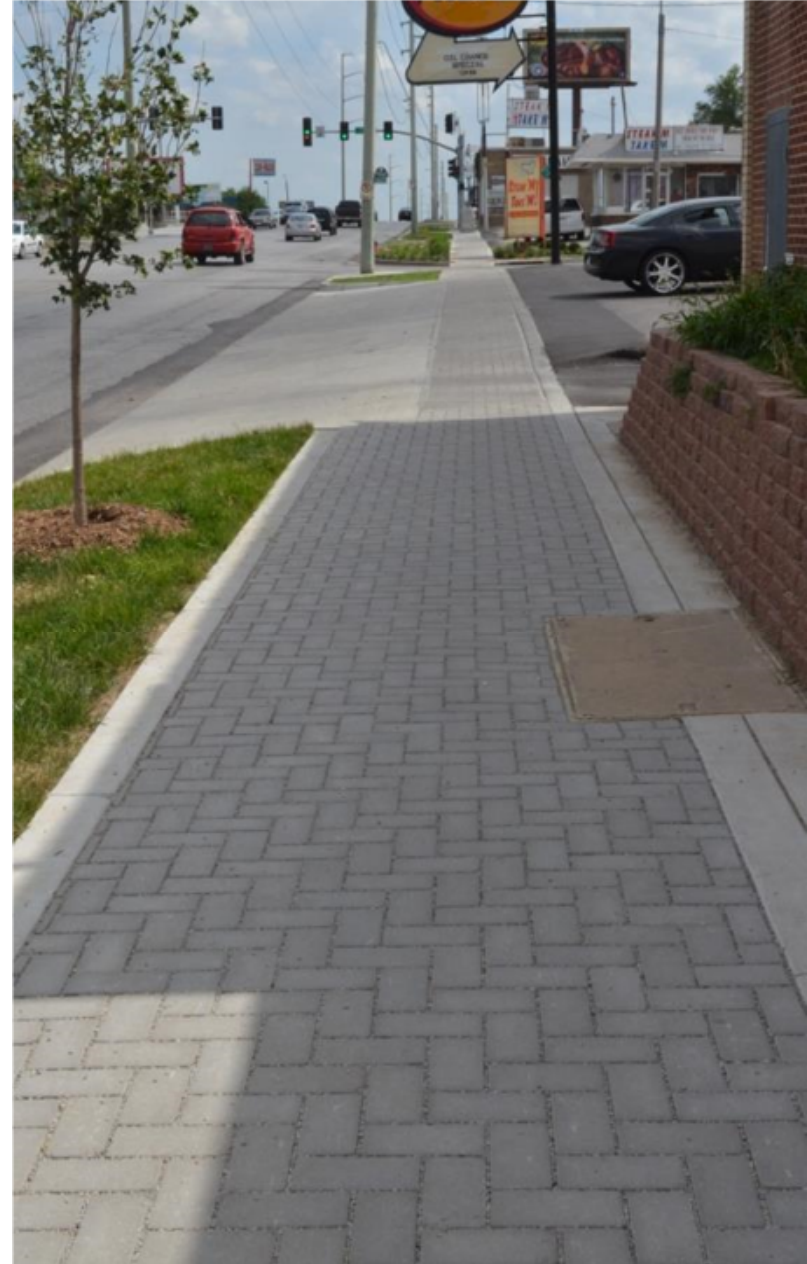


Pervious Sidewalk with Storage

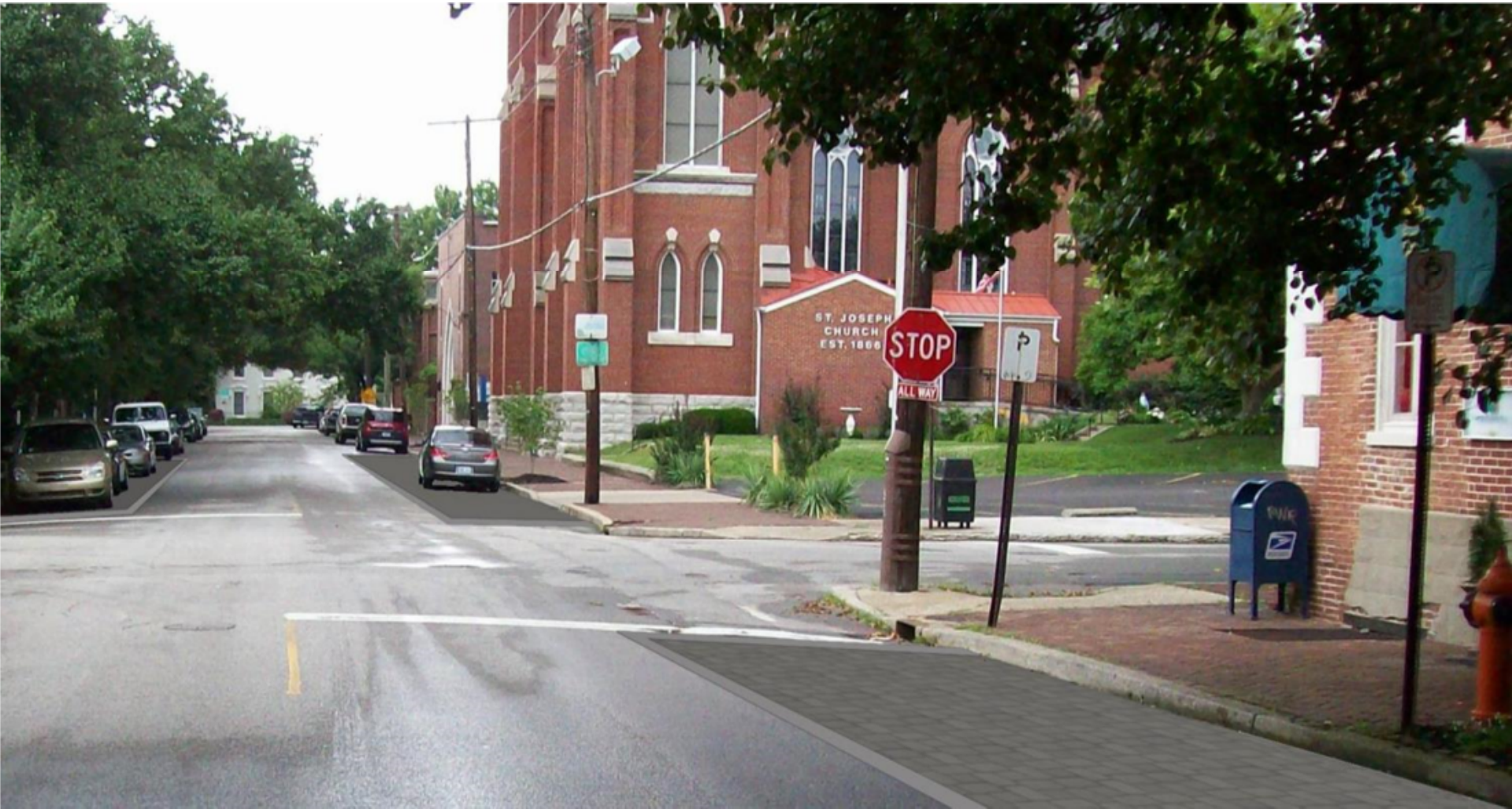


Below-grade storage

Pervious sidewalk



Using Rights-of-Way



Cascades



Photo: URS

Neighborhood Improvements



Neighborhood Improvements





Most Popular Green Infrastructure Techniques

Municipalities

- Bioretention
- Permeable Pavements

Private Property

- Rain Gardens
- Conservation Landscaping
- Tree Canopy
- Rain Barrels

Beyond Sediment and Nutrients?

- Bacteria
 - Escherichia coli
 - Fecal Coliform
 - Enterococci
 - Total Coliform
- Heavy Metals
 - Cadmium
 - Copper
 - Lead
 - Zinc
 - Iron
- Mercury
- Polychlorinated Biphenyl (PCB)
- Trash
- Aquatic Habitat



Suttons Bay, MI – Bacteria Impairment

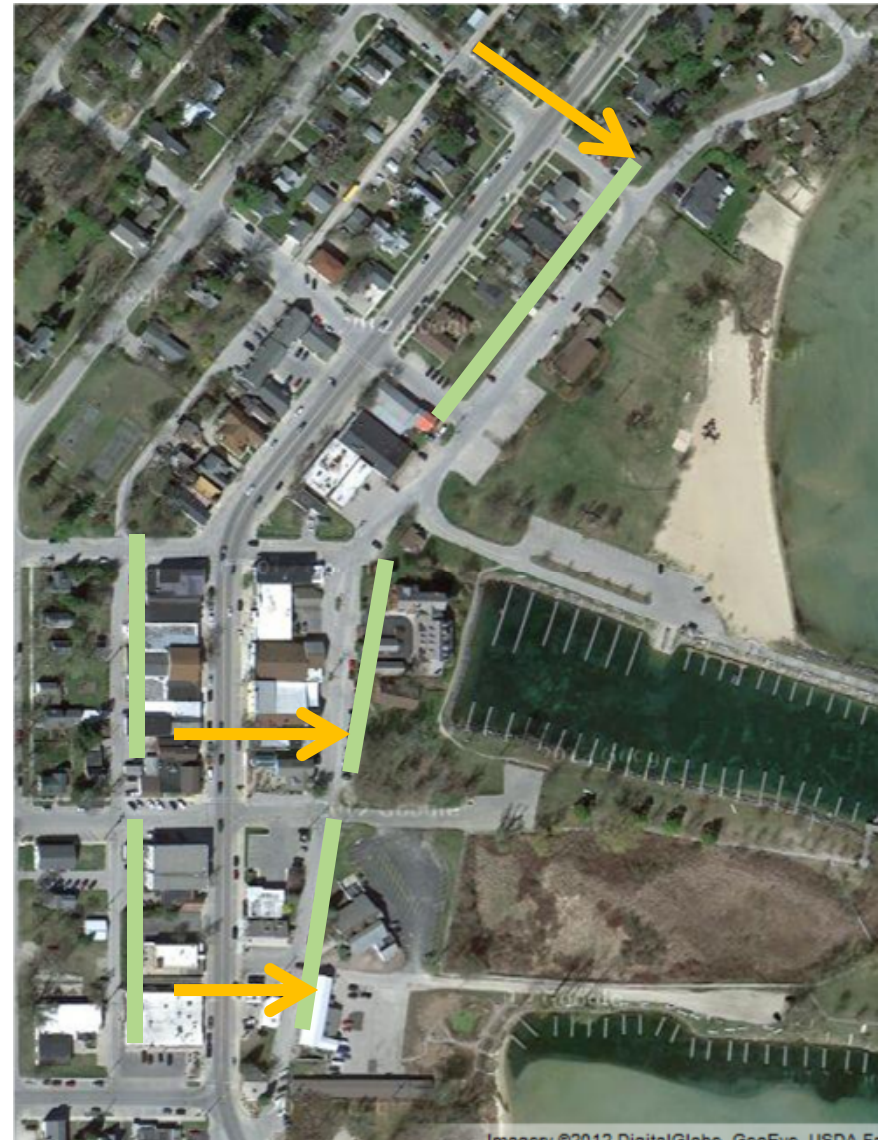
- Stormwater is major pathway for E. Coli to enter water
 - Pet waste, ducks/geese, parking lot runoff, human waste (leaking sanitary or septic systems)
 - Storm drain pipes are a good medium for cultivating bacterial growth
- Beaches frequently located near stormdrain outlets
- GI restoration techniques included
 - Raingardens
 - Hydrodynamic separators
 - Engineered wetland
 - Subsurface infiltration basins
 - Outfall relocation
 - Filtration or retention in low DO zones



Suttons Bay, MI – Infiltration Trenches

- Reduce volume of discharge through infiltration

*About 3,612 feet of infiltration trench installed
~nearly $\frac{3}{4}$ mile*



Kids Creek, MI – Aquatic Life Impairments

- 303(d) list for aquatic life impairments
- Volume reduction goals
- Sediment removal



Kids Creek, MI – GI Restoration Techniques

- Creek Restoration
- Green Roof
- Raingardens
- Pervious Pavement
- Planter Boxes



Heavy Metals

- Common Sources
 - Roadway runoff
 - Parking lot runoff
 - Rooftop runoff
- GI restoration techniques
 - Bioswales
 - Slightly different plant palette



Confidential Client – Heavy Metals Impairment

- TMDLs for
 - Copper
 - Iron
 - Lead
 - Zinc
- TMDL requirement
 - Up to 80 percent reductions in concentrations
- GI restoration techniques
 - Retrofitting inlets
 - Downspout disconnections and installation of downspout treatment



Putting It Together

Integrated planning—identify opportunities to incorporate Green Infrastructure into planned projects

Communication up front is key!



Maintenance Matters!



Maintenance Matters!





Maintenance/O&M
Strategies



Planning
and Modeling



Quantification
and Design



Construction
Oversight and
Implementation



Questions?