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Flood of Problems: Modern Urban Watersheds

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Indianapolis Characteristics

- Impervious Clay Soils
- Flat Topography
- Early Neighborhoods
 - Curb and Gutter
 - Combined Sewer Area
- Mid-Century Neighborhoods
 - Ditches
 - No Curb and Sidewalk



How Big is the Problem?

- >200 Defined Problem Areas
 - Does not include capital maintenance of levees and dams
- > \$300 Million over 20 Years
- O&M \$15M Annually



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Urban Watershed Common Problems: Agenda

- Development Prior to Modern Standards
- Minimal Grade Changes
- Channelized Streams
- Buildings in Floodplain
- Combined Sewers
- Aging Infrastructure



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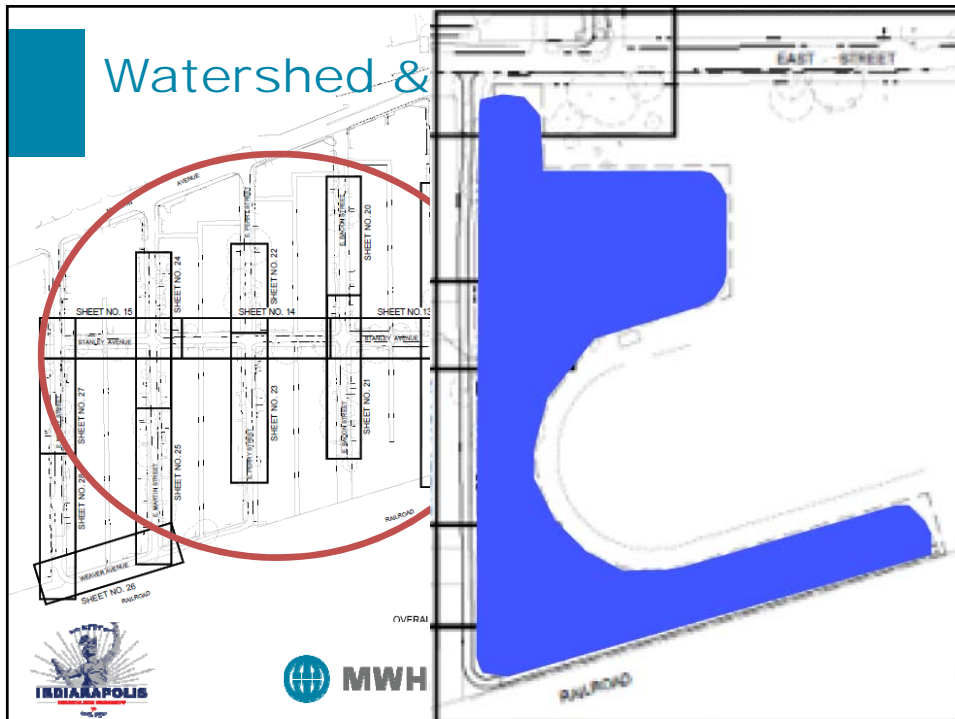


Urban Watershed Common Problems

- **Development Prior to Modern Standards**
 - Watershed Not Always Considered
 - Little/No Detention
 - Impervious Surface Added Over Time
 - Hodgepodge of Pipe Installations (Material, Sizes, Structures)
 - Difficult to Retrofit to Modern Standards



Watershed &



Impervious Surface Added over Time

1962

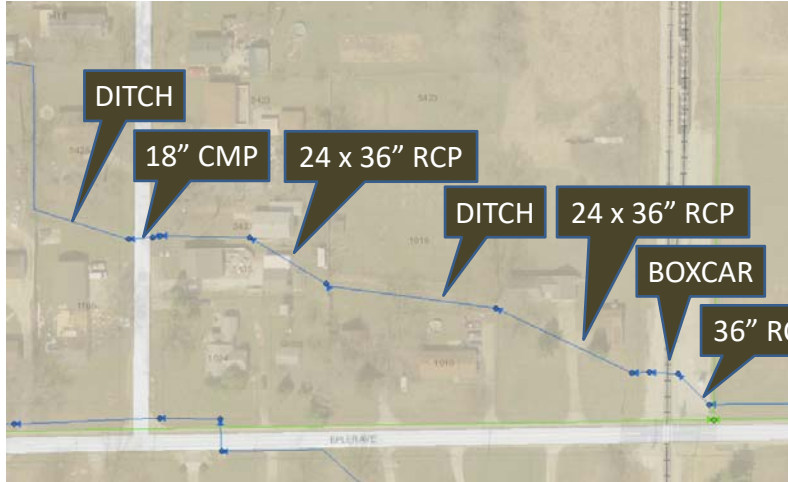


Impervious Surface Added over Time

2015



Hodgepodge Infrastructure



Retrofit to Modern Standards

Replacement Cost of System > \$1 Billion

Existing Conditions Constraints

- Downstream Capacity
- Space Constraints



Urban Watershed Common Problems: Solutions

- **Increase Detention**
 - Hybrid Ditches
 - Regional Detention where possible
- **Decreased Impervious Area**
 - Ditches Replace Off-Pavement Parking
 - Minor Green Space Additions

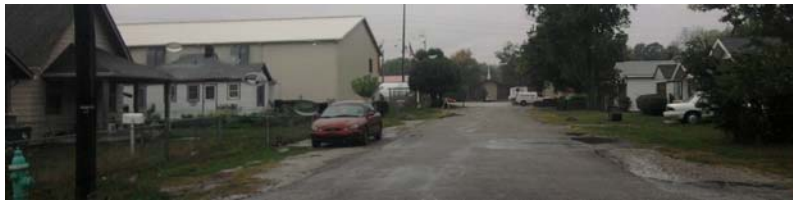


Urban Watershed Common Problems: Solutions

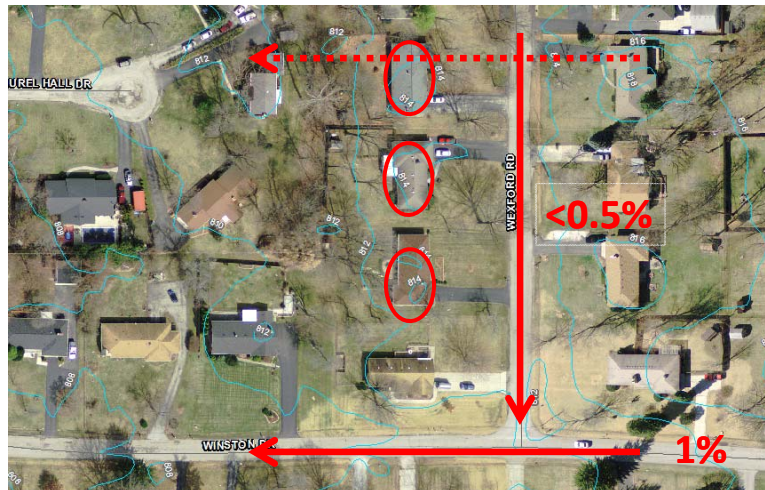


Urban Watershed Common Problems

- Minimal Grade Change
 - Silted Ditches
 - Parking on (Former) Ditches
 - Inadequate Outfall
 - Ponding on Pavement and In Yards
 - Pavement Deterioration



Silted Ditches



Silted Ditches



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Parking on Former Ditches



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Inadequate Outfall



Ponding on Pavement & In Yards



Ponding on Pavement & In Yards



Pavement Deterioration

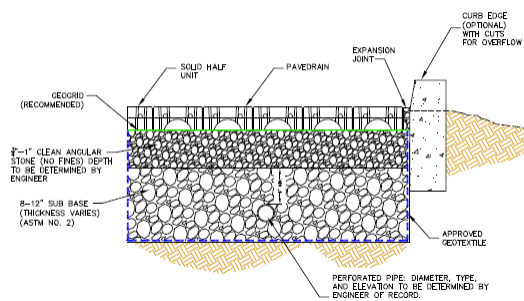


Pavement Deterioration



Minimal Grade Changes: Solutions

- Pervious Pavements



Reduced Stream Capacity



Reduced Stream Capacity



Access and Maintenance



Channelized Streams: Solutions



Access and Maintenance

- Private Property Constraints



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Urban Watershed Common Problems

- Buildings In Floodplains
 - Safety Concerns
 - Displacement of Families / Businesses



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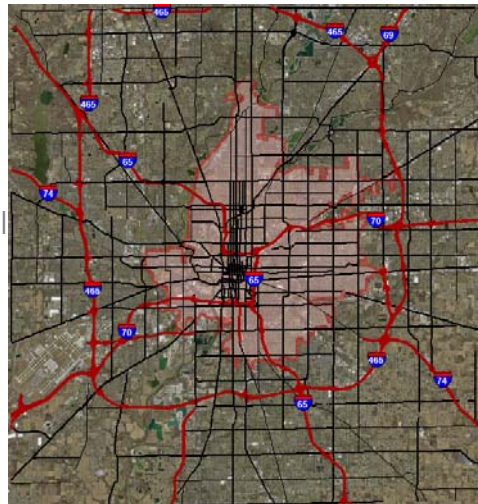
Buildings In Floodplains: Solutions

- **Remove From Floodplain**
 - After Home Flooding
 - Abandoned Homes in Blighted Areas
 - Raise Finish Floor Elevation



Urban Watershed Common Problems

- **Combined Sewer Area**
 - Water Quality Concerns
 - Sewer Capacity
 - Often No Other Feasible Outfall
 - Coordination with CEG

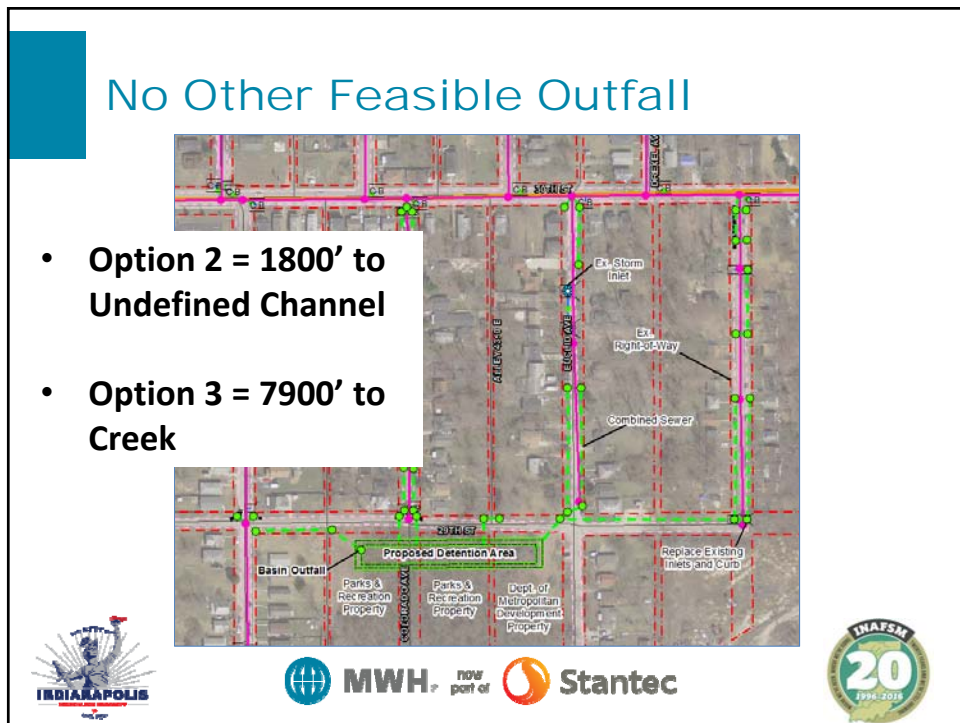
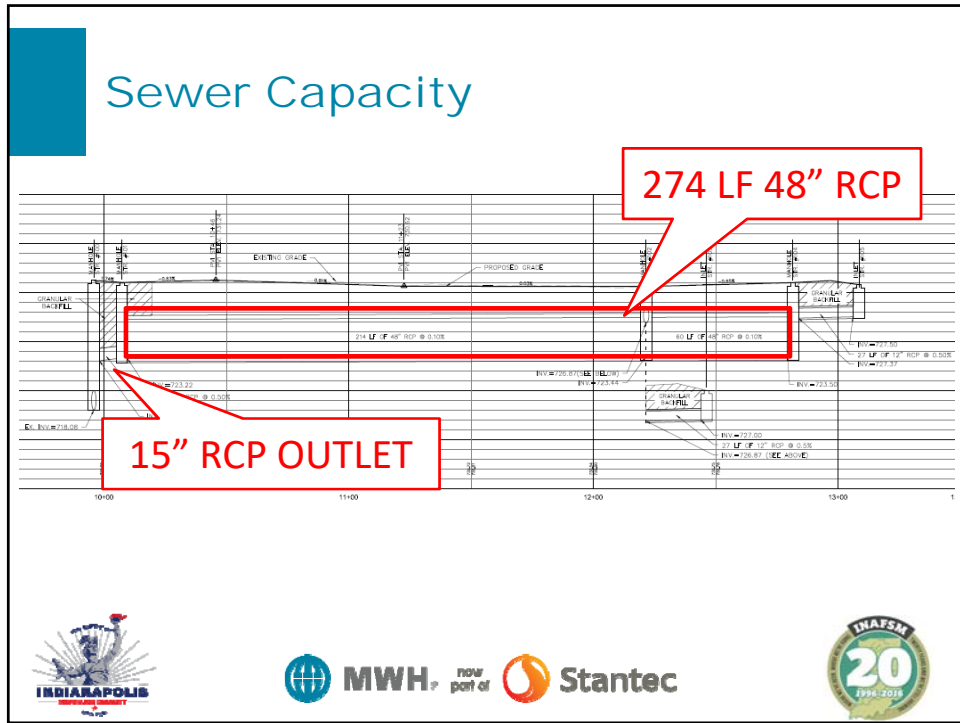


Water Quality and Human Health



Sewer Capacity





Coordination with CEG

- Regular meetings with Citizens Energy Group
 - Utility transfer in 2011
 - Ongoing use of each other's assets
- Consent Decree



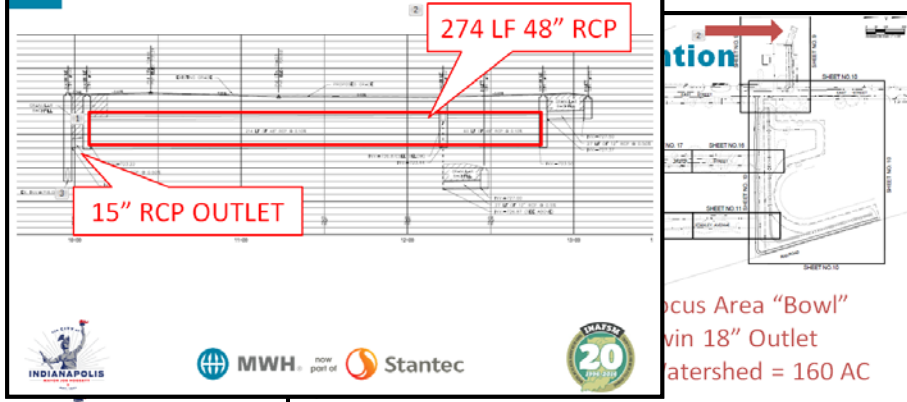
Urban Watershed Common Problems

- **Aging Infrastructure**
 - Undersized
 - End of Life Cycle
 - Various Materials
 - Traverses Public and Private Lands
 - Maintenance (Public and Private)



Undersized System

Sewer Capacity



Life Cycle and Materials

- Estimated 60% of System is over 40 Years Old
- Lifespan dependent on soils, water & installation

Table 5. Useful Life of Storm Pipes

Pipe Type	Useful Life
Vitrified Clay	100 years
Concrete	100 years
HDPE	80 years
Metal Pipe	50 years
PVC	100 years



Life Cycle and Materials



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Traverses Private and Public

- Citizens Often Unable to Maintain or Replace Large Infrastructure
 - Requires Large Equipment
 - High Cost
 - Collaboration with Neighbors
- City Cannot Spend Public Funds on Private Infrastructure (with Exceptions)



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Aging Infrastructure: Solutions

- **New Construction Standard 75-Year Life**
- **Easements on Private Land**
 - Required for Post Construction BMPs on Private Land
 - Acquired where Possible on Public Projects
- **Funding**
 - New Rate Structure July 2015
 - Approximately \$16M Annual Capital Program



The Future?

- **Both Public and Private Required**
 - Need More than Public Rights-of-Way
 - Small % of Urban Land is Public
- **Private**
 - New Development and Redevelopment (Standards)
 - Incentives on Private Land (Credit Program)
 - Public Outreach (Future)



The Future...Public Examples

- Available Space

- Within Roadway
- In Park Land
- Vacant Lots



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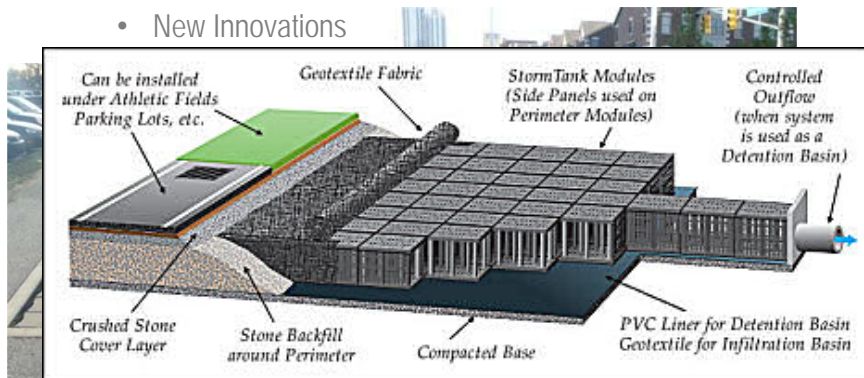
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The Future...Public Examples

- Detention and Infiltration

- Green Infrastructure
- New Innovations



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The Future...Private Examples

- Stormwater Design Manual Updates in 2017
- Green Supplemental Document
- Credits offered for residential parcels as of 7/1/2015
- Office of Sustainability Programs
 - Rain Garden Registry



Conclusion and Questions

