

# Using GIS to Access Risks of Stormwater Assets

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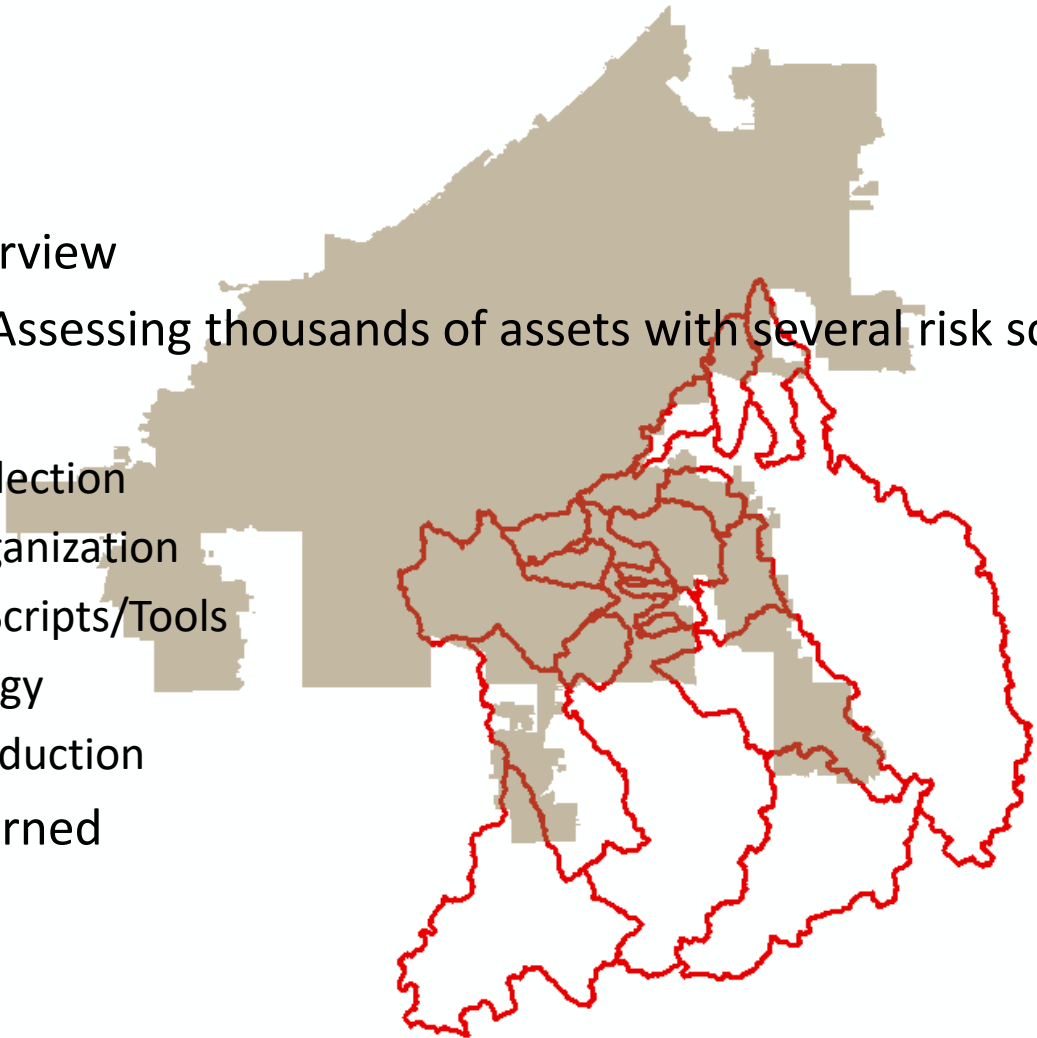


**CDM  
Smith**



# Outline

- Project Overview
- Challenge: Assessing thousands of assets with several risk scores
- Solution
  - Data Collection
  - Data Organization
  - Python Scripts/Tools
  - Symbology
  - Map Production
- Lessons Learned



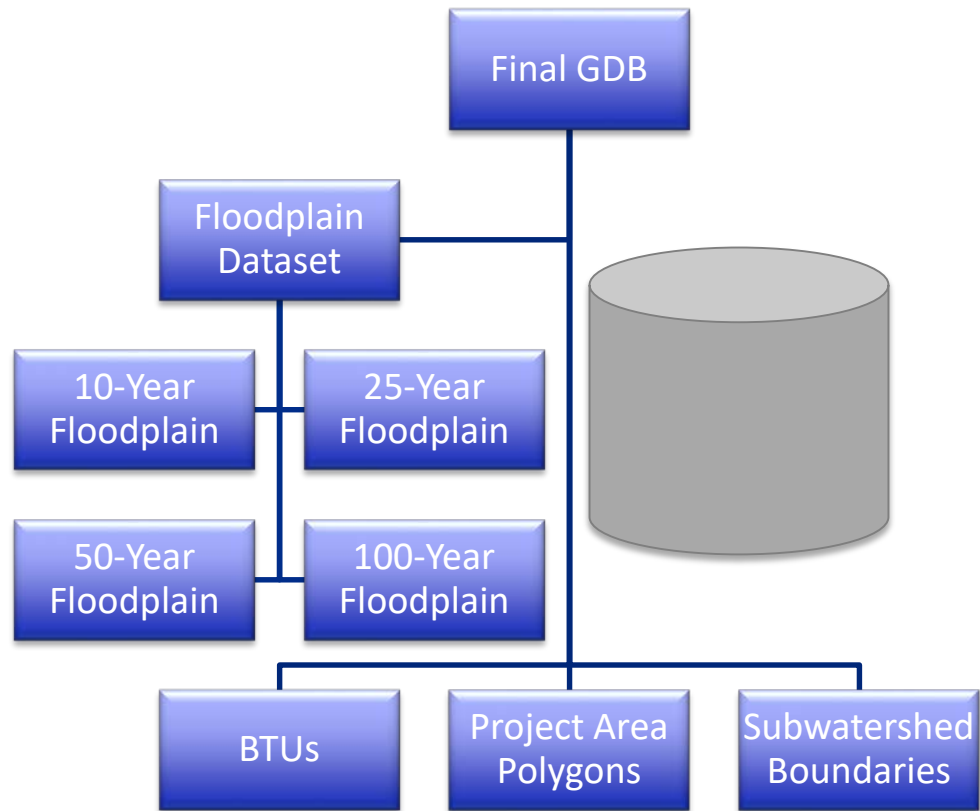
# Cuyahoga River South Stormwater Master Plan

Northeast Ohio Regional Sewer District (NEORSD)

Operational Performance Evaluation	Identify areas of erosion and flooding through modeling, field assessments, and monitoring
Alternatives Development & Evaluation	Comprehensive set of solutions, incorporating stream health, function, habitat, and water quality improvements
Development of Master Plans	Recommended policies, construction projects, maintenance activities, and areas for preservation

# Data Organization

- File Geodatabase
  - Utilization of datasets
  - No storage limit
  - Works with many data formats
  - Can upload to an enterprise ArcGIS Online account/system
- Shared Server Space
  - All access
  - Create scratch workspace
  - Export figures to same location

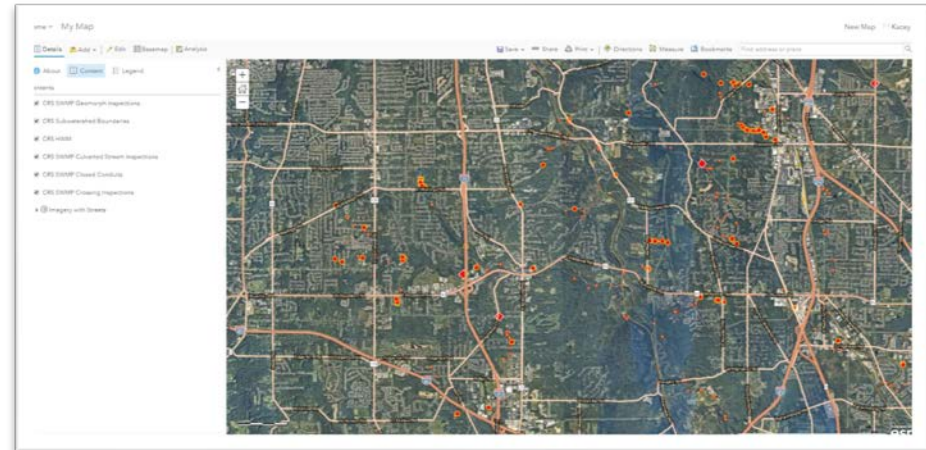


# Data Collection

- Survey 123
  - Flexibility
  - Easy to Use
  - Syncs with ArcGIS Online (AGOL)

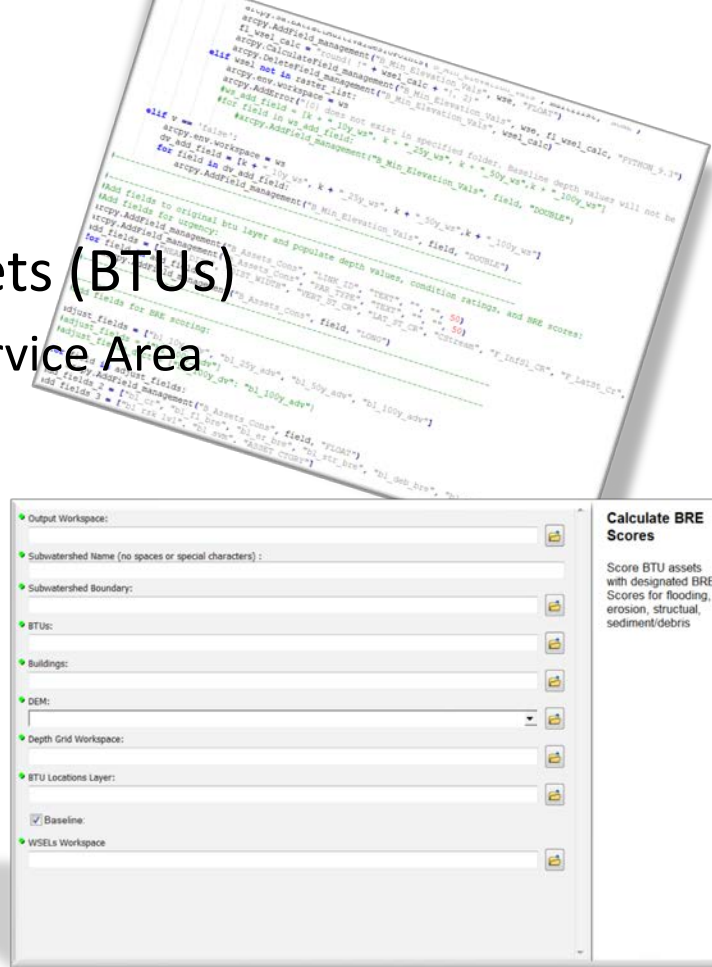


start	type	name	label	relevant
hidden	start	status	Status	
begin group				
	first_group	General Inspection Information:		
text	file_num	File Number		
text	asset_num	Asset Number		
decimal	bank_hght	Bank Height (ft)		
integer	bank_lnght	Bank Length (ft)		
integer	dis_to_bt	Distance to BTU Asset (ft)		
select_one_bt	btu_type	BTU Type:		
text	inspectors	Inspectors:		
text	weather	Weather:		
text	gen_notes1	General Notes:		
image	img_us	Upstream:		
image	img_ds	Downstream:		
image	img_rb	Right Bank (look to your right when facing upstream):		
image	img_lb	Left Bank (look to your left when facing upstream):		
end group				
begin group				
	second_group	Pre-Screening:		
select_one_yes_no	prescrn_q1	Does the bank exhibit less than or equal to 50% protection at the toe?		
select_one_yes_no	prescrn_q2	Does 50% or more of the bank exhibit an undercut of 6 inches or more?		
select_one_yes_no	prescrn_q3	Does 50% or more of the bank exhibit stratification where at least one layer is		

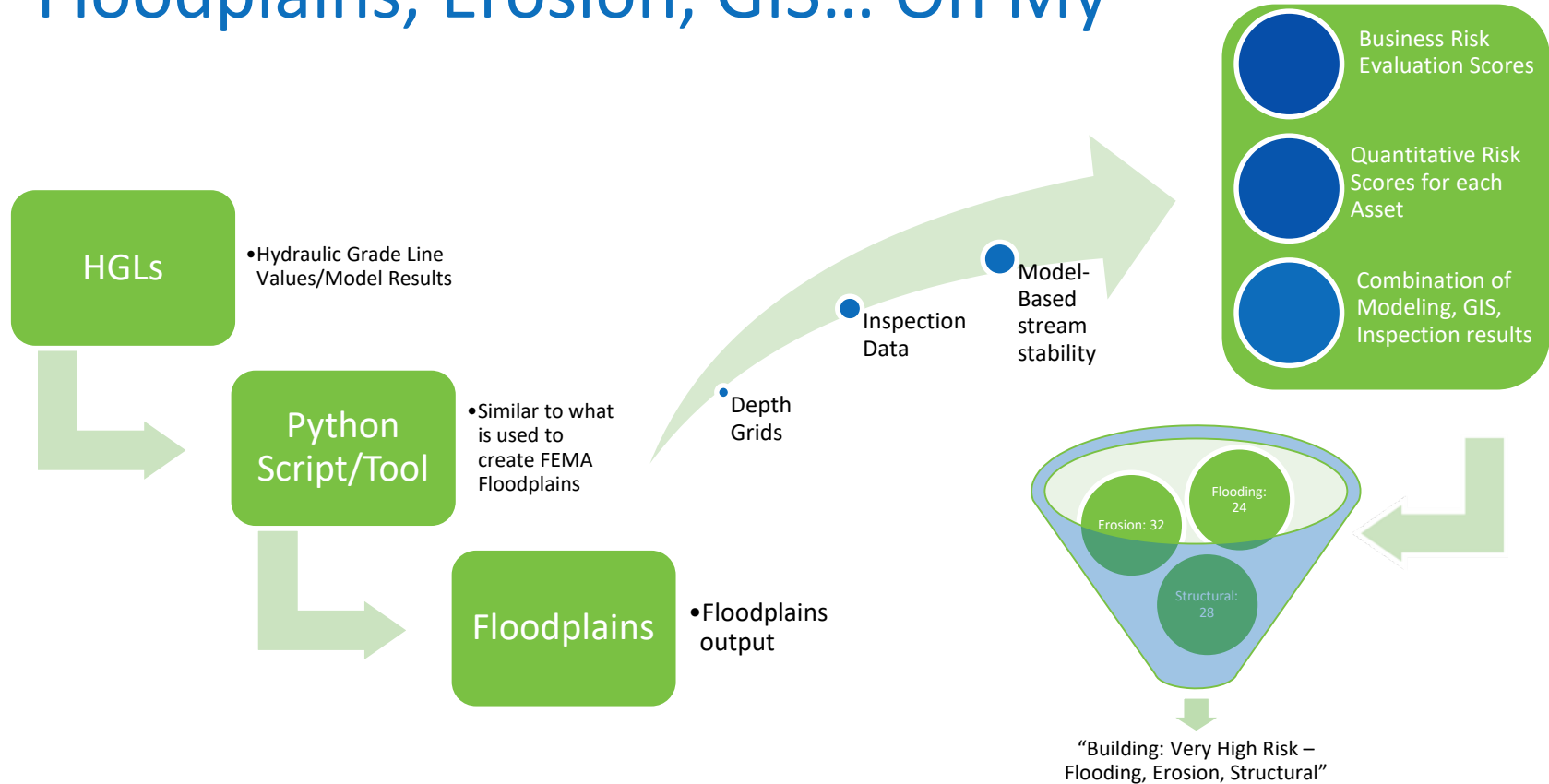


# Assessing The Assets

- Building, Transportation, Utility Assets (BTUs)
  - 2000+ Assets in District Stormwater Service Area
  - 600+ inspections
- Risk Factors
  - Flooding (GIS and Inspection Analysis)
  - Erosion (GIS and Inspection Analysis)
  - Structural (Inspection Analysis)
  - Sediment/Debris (Inspection Analysis)
    - Hydraulic and Hydrologic Modeling



# Floodplains, Erosion, GIS... Oh My



# Metrics used to define Erosion Risks



## Flooding Risks

- H&H Modeling
  - HGL results used in GIS Floodplain Tool
- GIS
  - Depth Grids and criticalities used to determine severity of flooding and priority of asset



































## Erosion Risks

















- H&H Modeling
  - Vertical and Lateral Stability values
- Inspections
  - BEHI scores
- GIS
  - Stability values, BEHI Scores, and criticality values used to determine severity of erosion and priority of asset



# Symbology Challenge

-  B (Res): Erosion - High Risk
-  B (Res): Flooding - High Risk
-  B (Res): Flooding, Erosion - High Risk
-  B (Res): Flooding - Very High Risk
-  B (Res): Erosion - Very High Risk
-  B (Res): Flooding, Erosion - Very High Risk
-  B (Non-Res): Erosion - High Risk
-  B (Non-Res): Flooding - High Risk
-  B (Non-Res): Flooding, Erosion - High Risk
-  B (Non-Res): Erosion - Very High Risk
-  B (Non-Res): Flooding - Very High Risk
-  B (Non-Res): Flooding, Erosion - Very High Risk
-  T: Erosion - High Risk
-  T: Erosion, Sediment/Debris - High Risk
-  T: Flooding - High Risk

-  T: Flooding, Erosion - High Risk
-  T: Flooding, Erosion, Sediment/Debris - High Risk
-  T: Flooding, Sediment/Debris - High Risk
-  T: Sediment/Debris - High Risk
-  T: Structural - High Risk
-  T: Structural, Erosion - High Risk
-  T: Structural, Erosion, Sediment/Debris - High Risk
-  T: Structural, Flooding - High Risk
-  T: Structural, Flooding, Erosion - High Risk
-  T: Structural, Flooding, Erosion, Sediment/Debris - HR
-  T: Structural, Flooding, Sediment/Debris - High Risk
-  T: Structural, Sediment/Debris - High Risk
-  T: Erosion - Very High Risk
-  T: Erosion, Sediment/Debris - Very High Risk
-  T: Flooding - Very High Risk
-  T: Flooding, Erosion - Very High Risk
-  T: Flooding, Erosion, Sediment/Debris - Very High Risk

-  T: Flooding, Sediment/Debris - Very High Risk
-  T: Sediment/Debris - Very High Risk
-  T: Structural - Very High Risk
-  T: Structural, Erosion - Very High Risk
-  T: Structural, Erosion, Sediment/Debris - Very High Risk
-  T: Structural, Flooding - Very High Risk
-  T: Structural, Flooding, Erosion - Very High Risk
-  T: Structural, Flooding, Erosion, Sediment/Debris - Very High Risk
-  T: Structural, Flooding, Sediment/Debris - Very High Risk
-  T: Structural, Sediment/Debris - Very High Risk
-  U: Erosion - High Risk
-  U: Erosion - Very High Risk
-  B (Non-Res): Acceptable Level of Risk
-  B (Res): Acceptable Level of Risk
-  T: Acceptable Level of Risk
-  U: Acceptable Level of Risk

# Symbology Solution

- Multi-Party Symbology
  - **BASE:** Level of Risk - Red/Yellow/Green
  - **CIRCLE:** Risk Type - Orange/Green/Blue/Purple/Mixed
  - **CENTER:** Asset Type - Pictures that correspond with Asset type
- Created in PowerPoint and added to symbology “.lyr” file



# Map Production

- Challenge:

- 8.5" X 11"

- Over 600 Paper Maps

- Solution:

- Data Driven Pages

- Track map progress using

- shareable spreadsheet

- Use single folder and link to single geodatabase



# Legend

Risk Level Marker	Problem Category	Stream reaches w/ less than full function
High Risk, BRE 20 - 33	Structural	Both
Very High Risk, BRE >=34	Flooding	Lateral
Acceptable Level of Risk	Erosion	Vertical
Building (Non-Residential)	Sediment/Debris	RSS Stream
Building (Residential)	<b>Flood Extent</b>	RSS Closed Conduit
Transportation	FEMA 100-YR Flood Area	RSS Culverted Stream
Utility	10-YR Flood Area	RSS Crossing
Culverted Stream	25-YR Flood Area	RSS Basin
Basin	50-YR Flood Area	Storm Sewer
Project Area	100-YR Flood Area	Subwatershed Boundary
		Outside of DSWA
		Municipality

Risk Level Marker
High Risk, BRE 20 - 33
Very High Risk, BRE >=34
Acceptable Level of Risk
Problem Category
Structural
Flooding
Erosion
Sediment & Debris
Asset Type
Building (Non-Residential)
Building (Residential)
Transportation
Utility
Culverted Stream
Basin
Stream reaches w/ less than full function
Both
Lateral
Vertical
Flood Extent
10-YR Flood Area
25-YR Flood Area
50-YR Flood Area
100-YR Flood Area
FEMA 100 Yr Flood Area
Project Area
RSS Stream
RSS Closed Conduit
RSS Crossing
RSS Culverted Stream
RSS Basin
Subwatershed Boundary
Outside of DSWA
Storm Sewer
Municipality

- Make Legend into graphics
- Break up asset risk symbology
- Use different shapes for legend symbols
- Intuitive to reduce need to constantly check legend

*"Knowing where things are, and why, is essential to rational decision making" ~ Jack Dangermond*

# GIS Lessons Learned

- Automate everything and anything
  - Utilize python scripting and other tools to automate as much as possible to reduce human error and reduce re-work
- Create a GIS server to organize and store data for ease of accessibility for all involved
  - Geodatabases are excellent but it helps to have one central location with all of the finalized data for engineers and GIS Specialists to access conveniently
- Data-Driven Pages
  - Mass map production that keeps legends consistent and requires minimal adjustments between maps



# Questions?