Rapid Inundation Mapping – An Alternative City Lead Approach

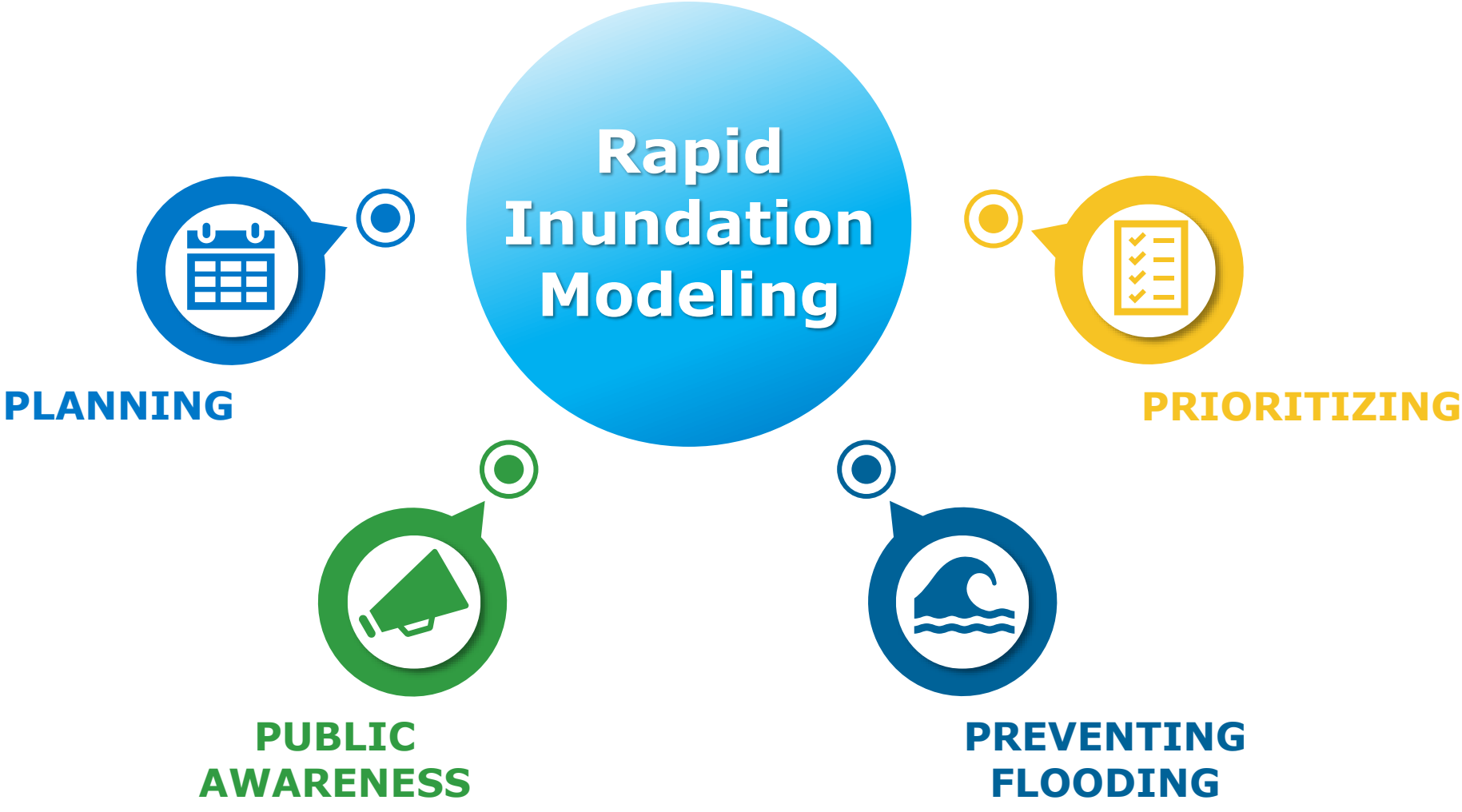
FSA Winter Conference

December 3, 2020

CITY OF TALLAHASSEE

JonesEdmunds

Rapid Inundation Modeling



Flood Impacts

- 154 dead
- 4,000 displaced from their homes

- Damages > $40 Million

Recent Storms

May 1, 2014

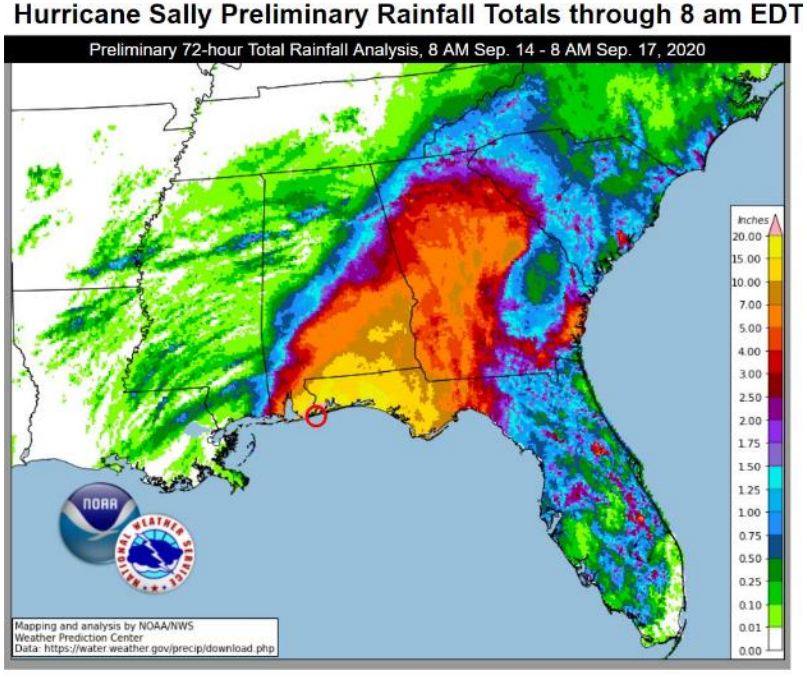
- Lilian Alabama - 28.8 inches (3-day total)
- Pensacola – 20 inches (3-day total)

August 30, 2017 (Harvey)

- Cedar Bayou Texas - 51.9 inches (5-day total)
- Baytown Texas - 41 inches (3-day total)

September 16, 2020 (Sally)

- NAS Pensacola – 24.8 inches (2-day total)
- Pensacola – 22.1 inches (2-day total)



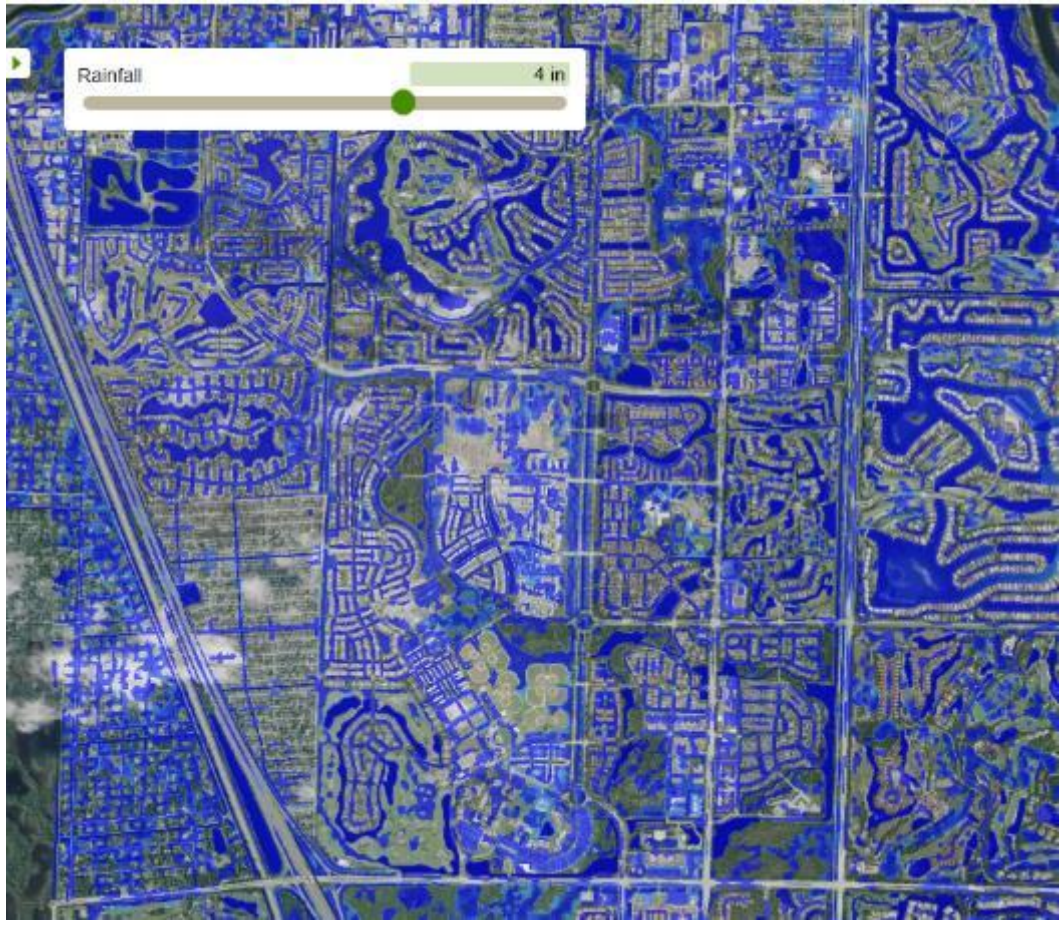
2D Flood Screening

What it's not

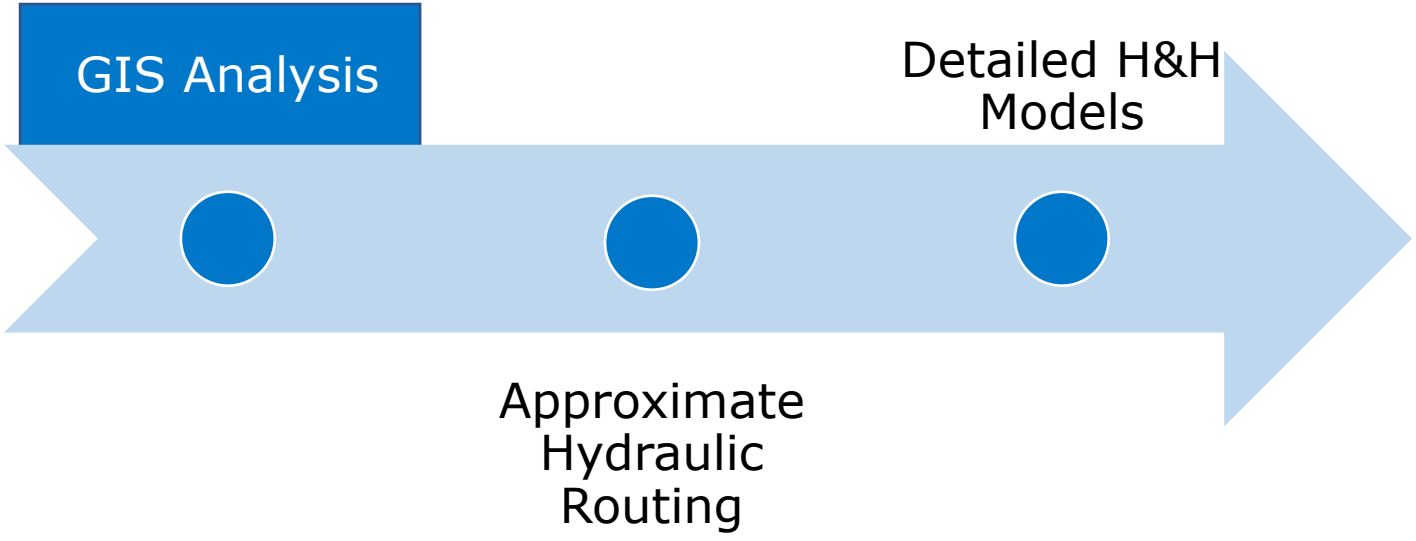
- Detailed Hydraulic Model
- Regulatory Product

What it is

- Tool to Rapidly Assess Approximate Flooding
- Source of Approximate Flooding Extents
- Tool that Addresses Current Local Needs



2D-Flood Screening



GIS Flood Screening Analysis

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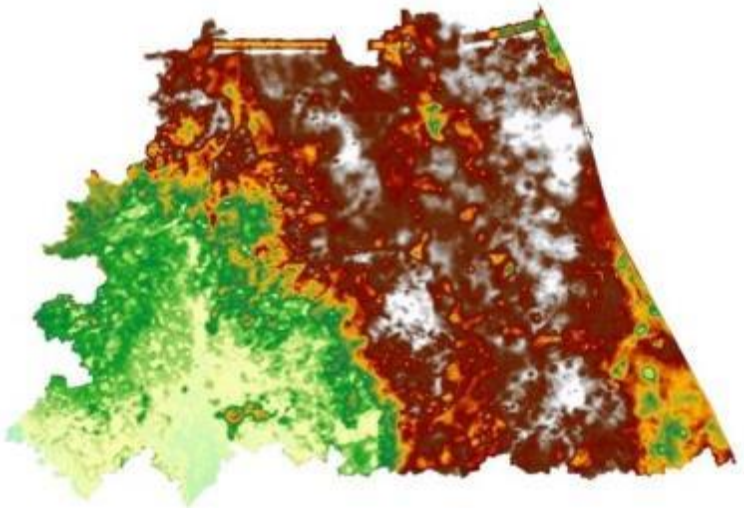
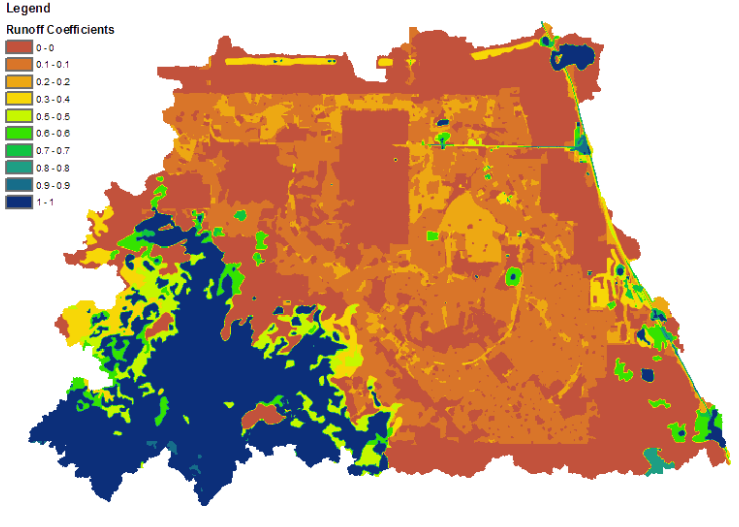
Model Inputs

- LiDAR-based DEM
- Runoff Coefficients
- Stormwater Infrastructure
- Range Rainfall Depths





GIS Flood Screening Analysis

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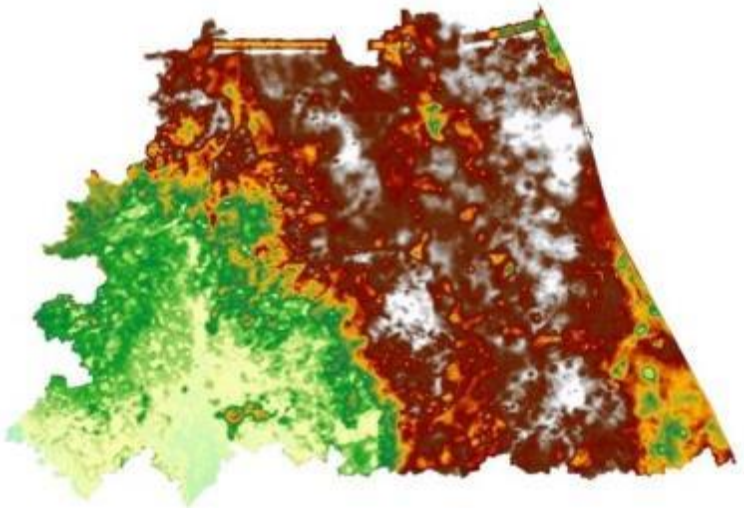
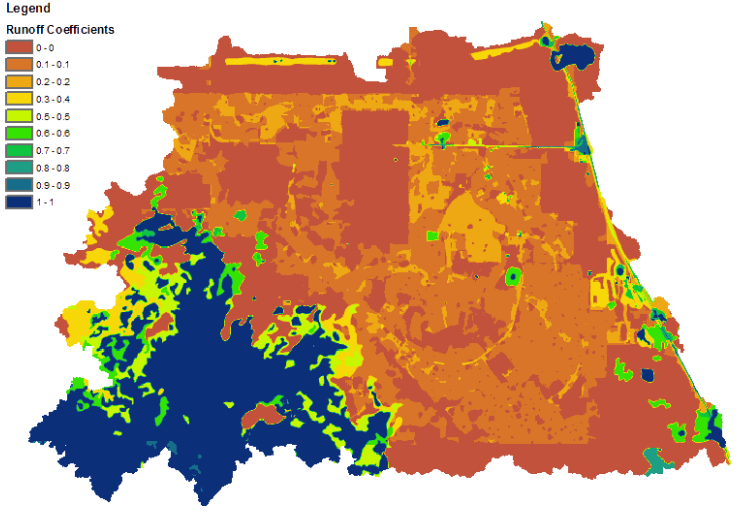
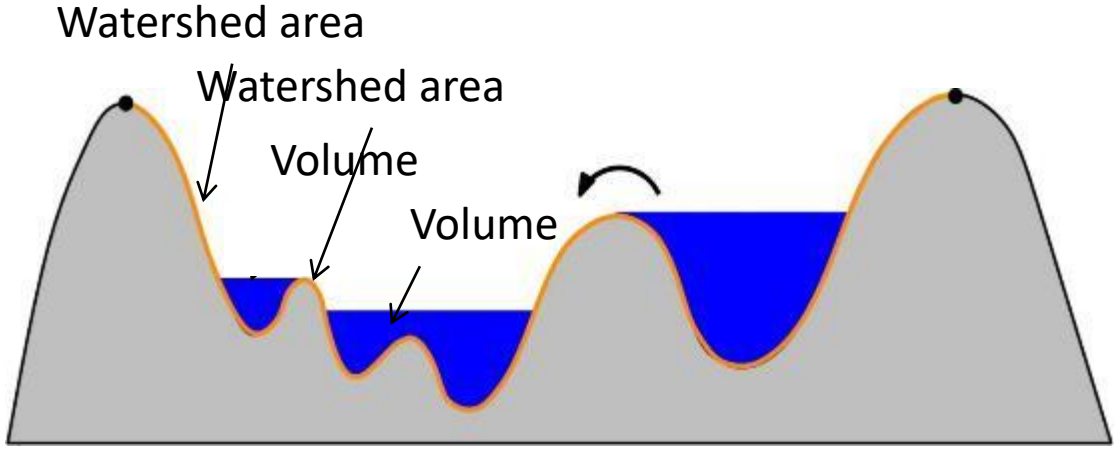
Model Capacity

- Process billions cells quickly
- Analyzed St Johns County
  - 5-foot grid cells
  - ~900 million cells
  - ~1 day





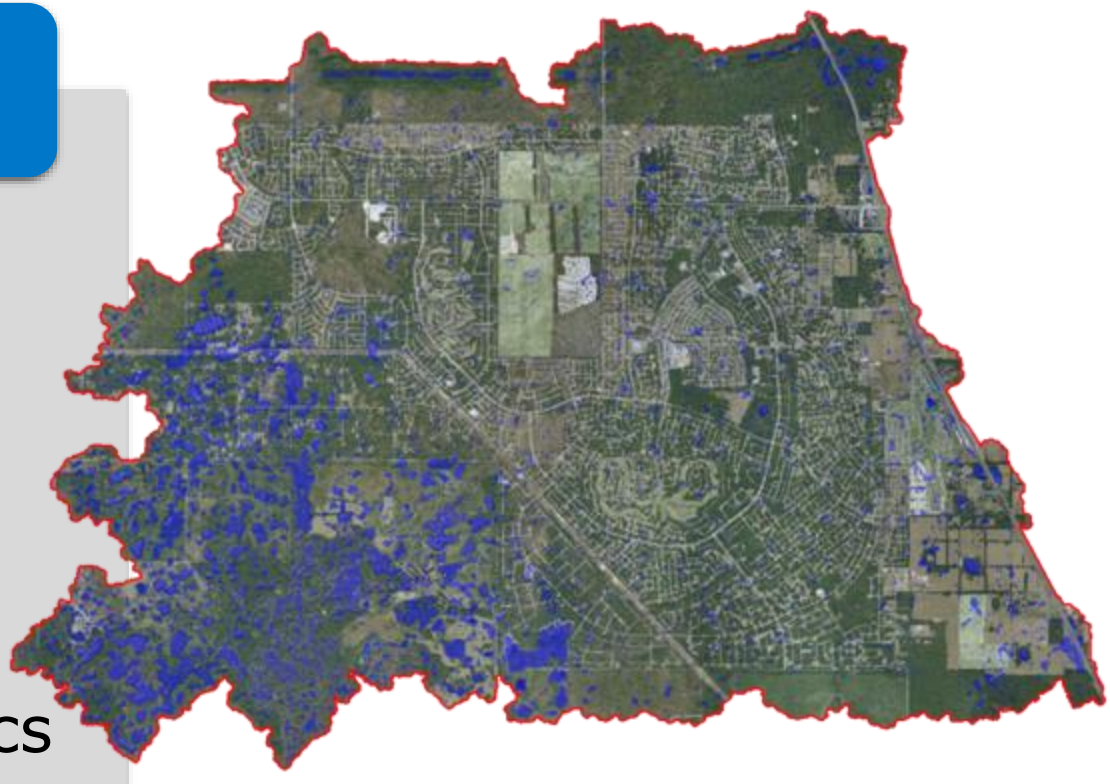
Modeling runoff accumalation in depressions



GIS Flood Screening Analysis

Model Results

- Flood extent for all rainfall depths
- Same resolution as LiDAR DEM
- Detailed understanding of drainage characteristics



GIS Flood Screening Analysis

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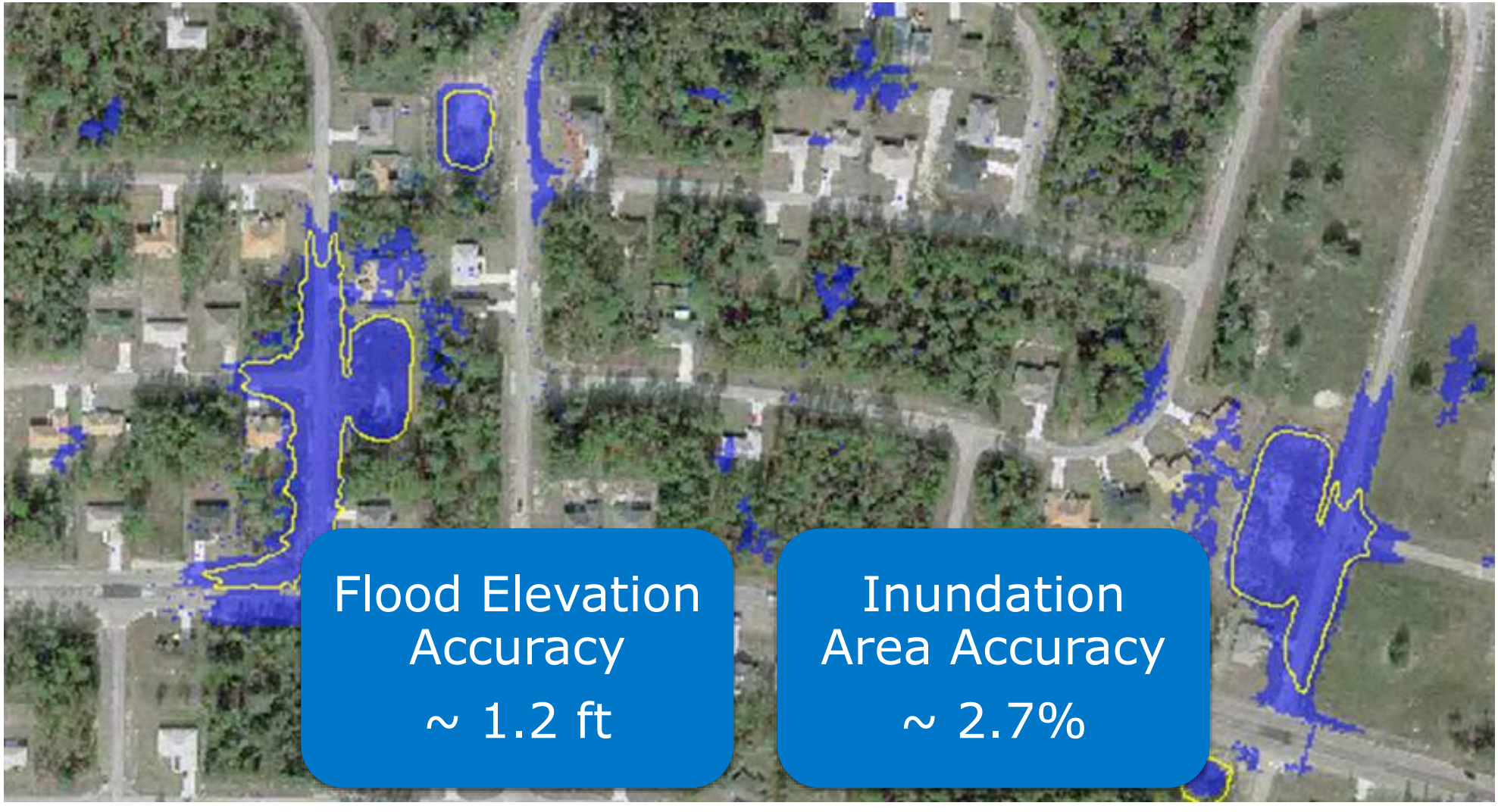
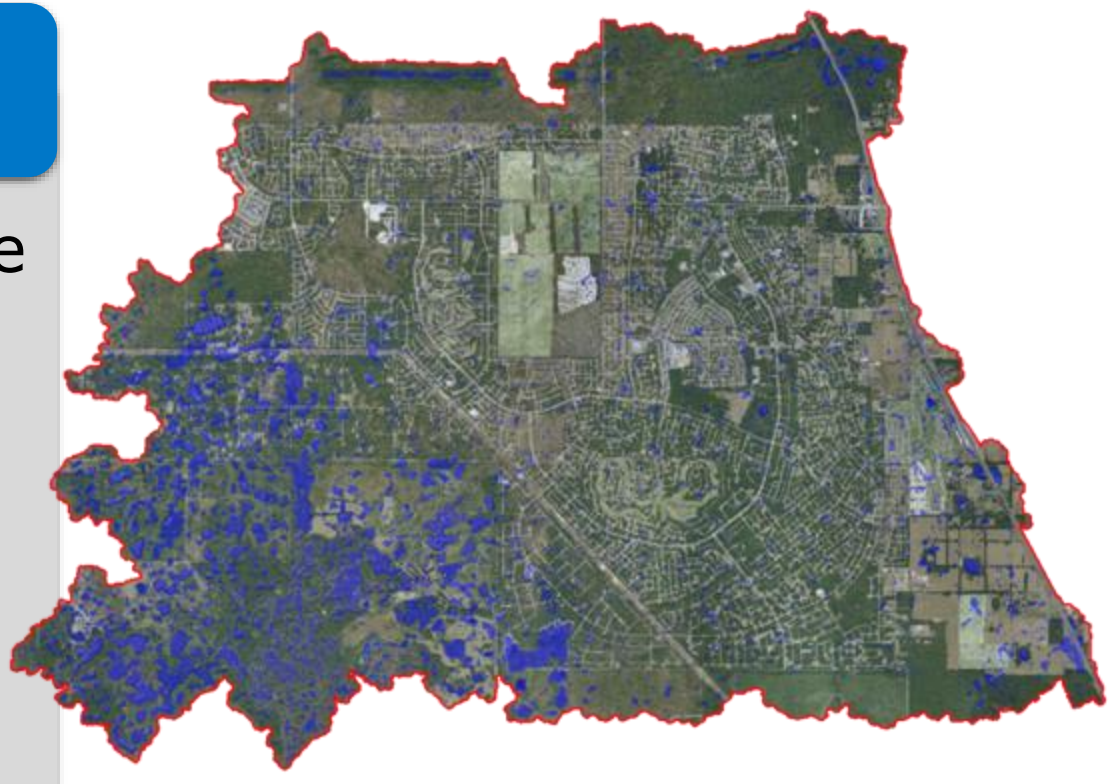


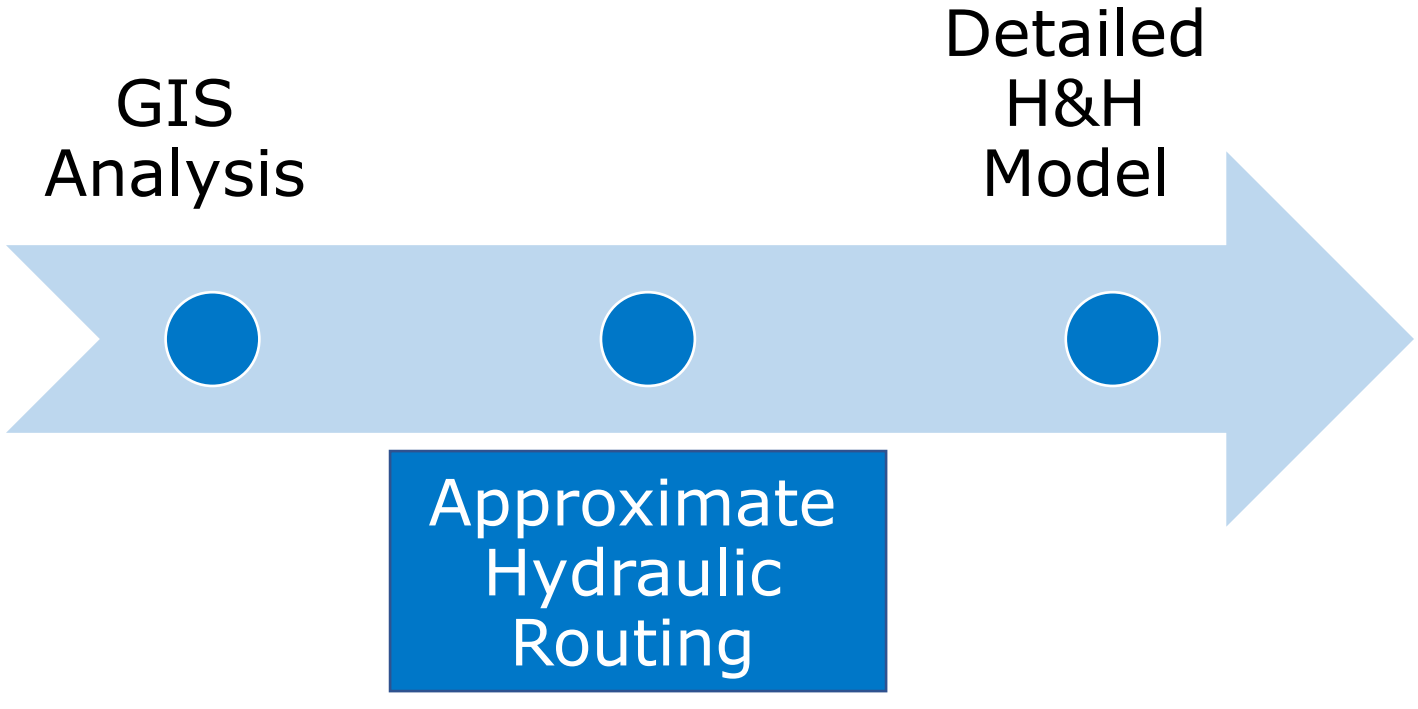
GIS Flood Screening Analysis

Uses

- Rapidly Map Approximate Flood Risk
- Identify Priority Areas
- Choose Appropriate Flood Model and Scale
- Map Inundation in Real Time

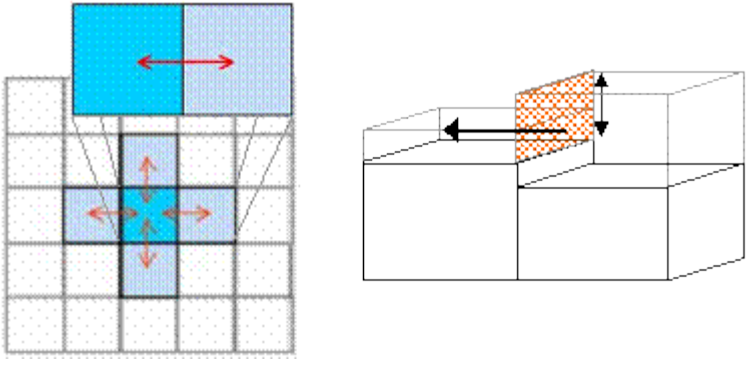


2D Flood Screening



Approximate Hydraulic Routing Models

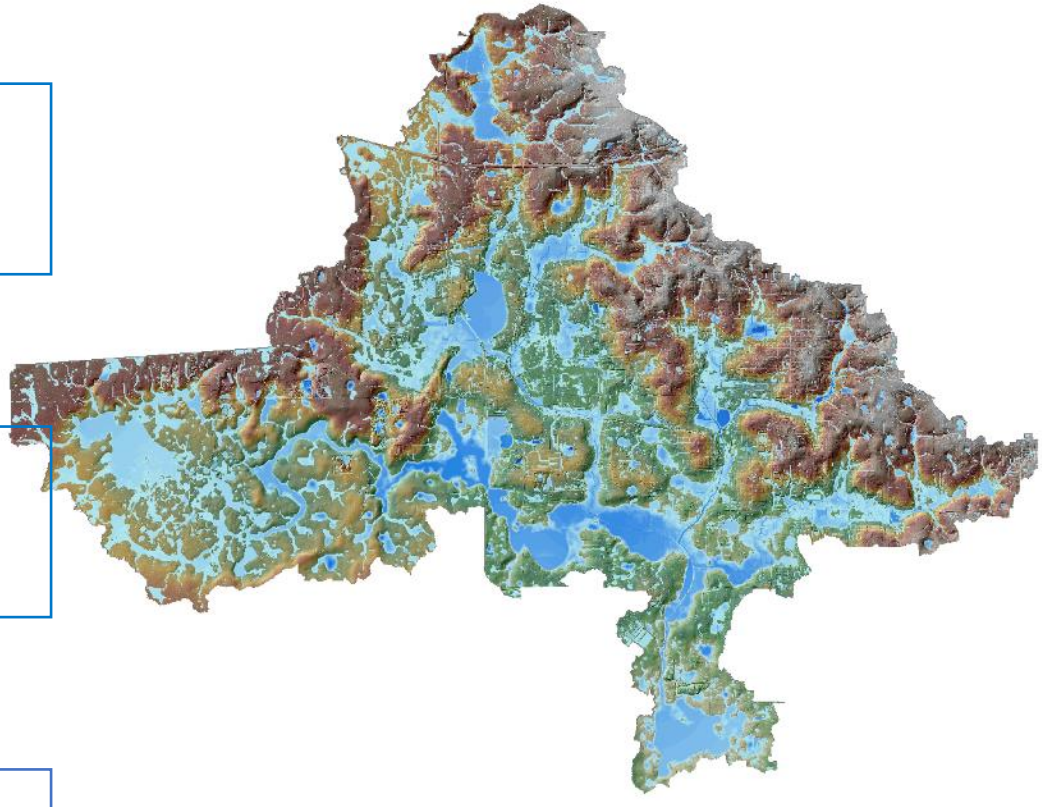
- Approximate runoff and routing calculations
- Use computationally efficient solutions
- Take advantage of modern computer hardware



Source: LISFLOOD-FP

Approximate Hydraulic Routing Models

- High Resolution DEM
- Fast model runs times
- ~100 million model cells



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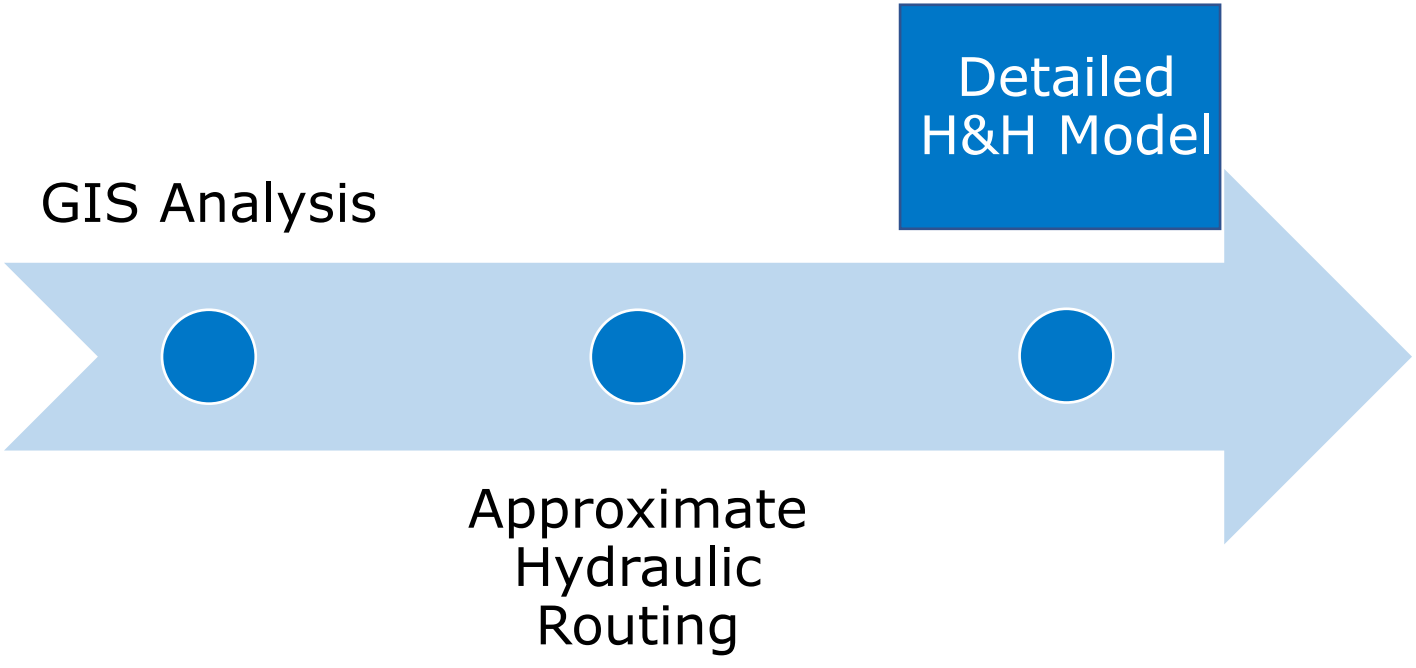
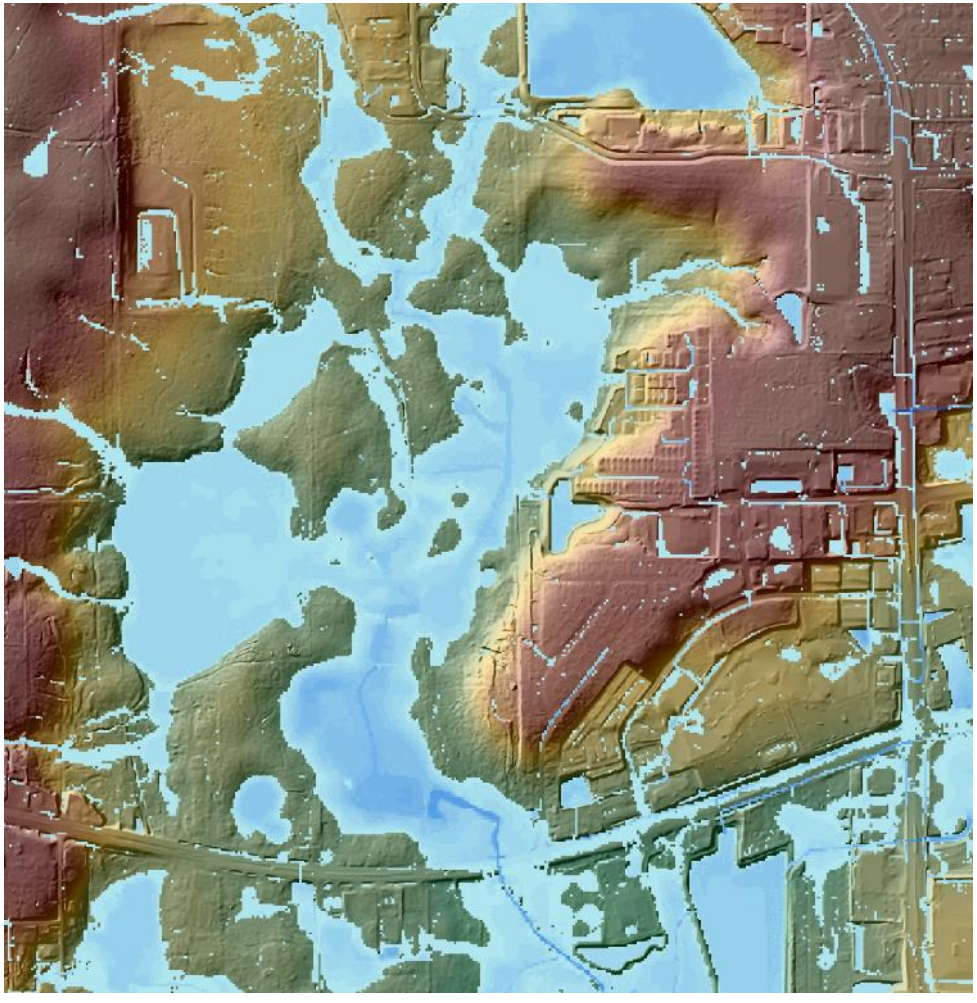


Detailed 2D H&H Model

- Solve "full" SWE
- Include rainfall excess model
- Include 1-D features



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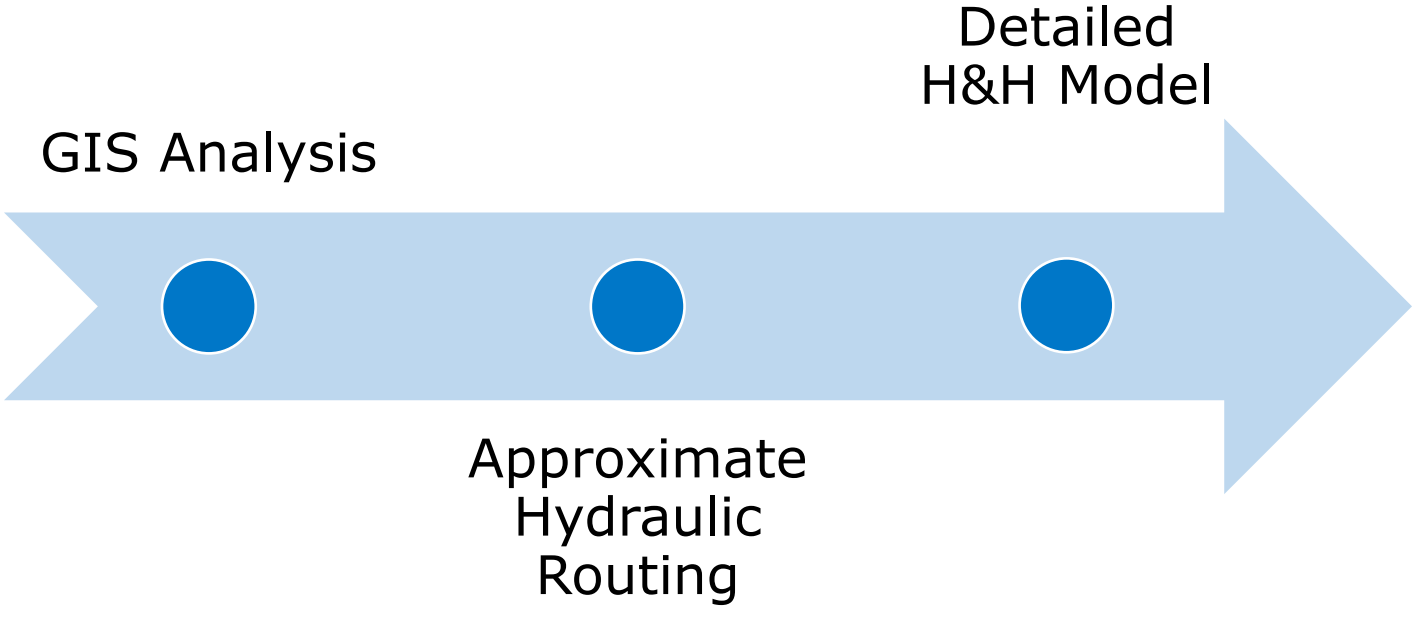

Tallahassee City-Wide Inundation Modeling

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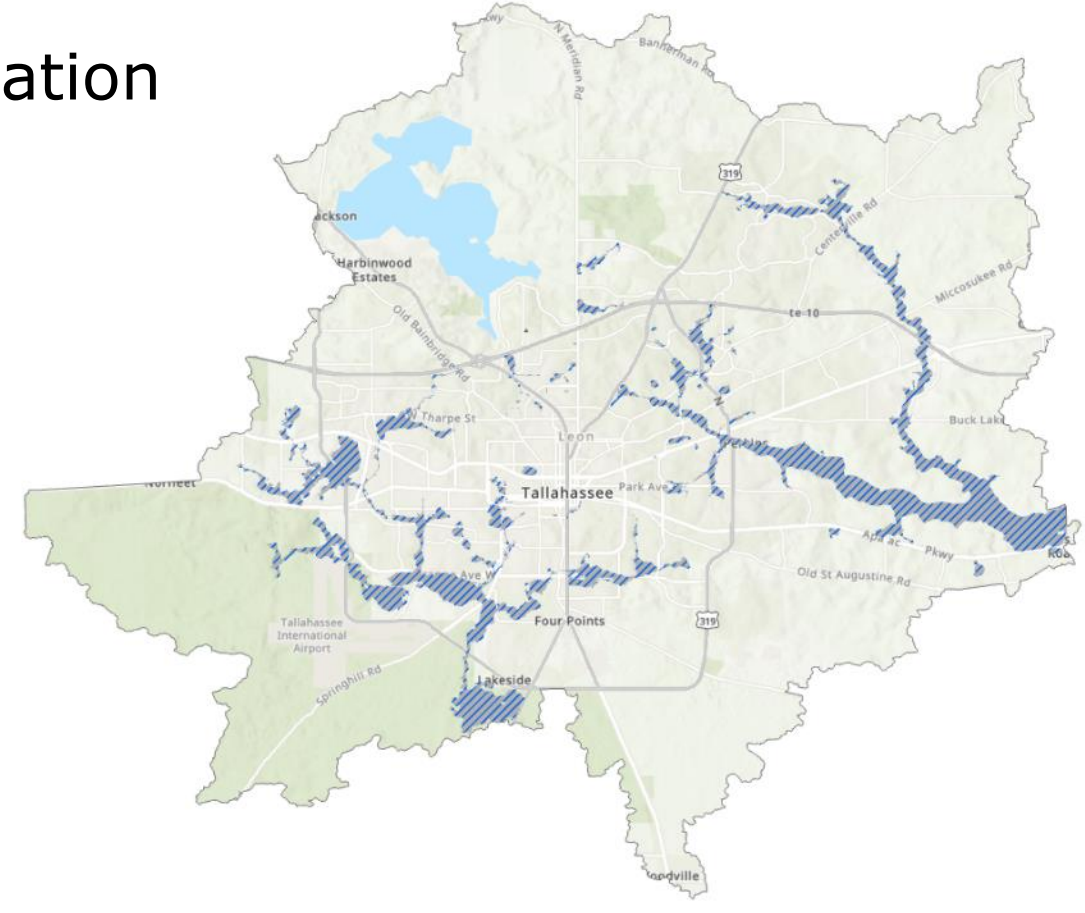
- Generate City-wide Inundation mapping
- Support City Stormwater Planning
- Use Simplified Modeling Approaches
- Publish Results



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Tallahassee City-Wide Inundation Modeling

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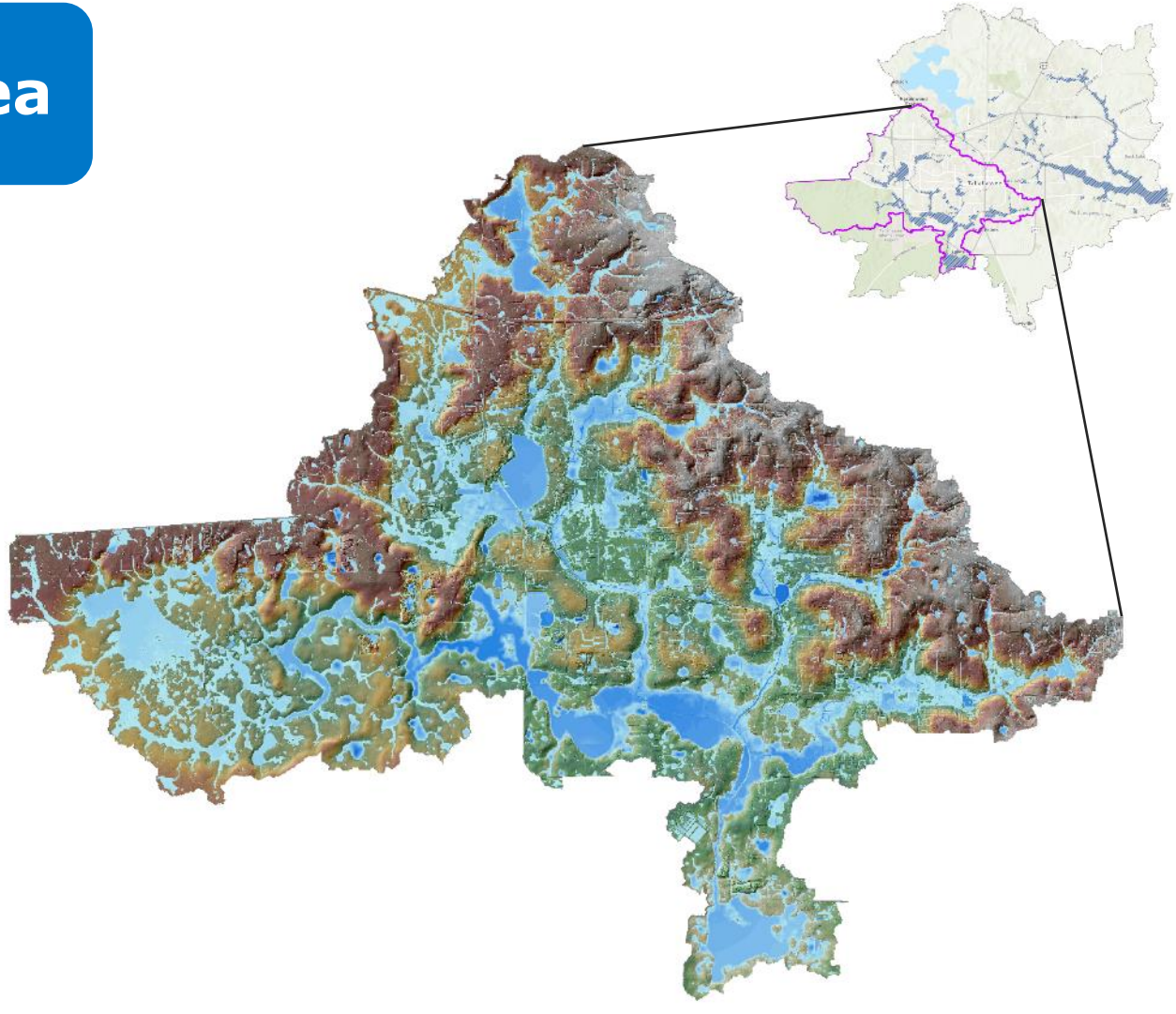
Rapid Inundation Mapping – An Alternative City Lead Approach

Demonstration Area

- Lake Munson Planning Region
- Simplified Routing
- ~60 square miles
- 5-foot resolution
- 67 million model cells



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Tallahassee City-Wide Inundation Modeling

Demonstration Area

- Flood depths
- Velocity
- Developed interactive 3D Web Map

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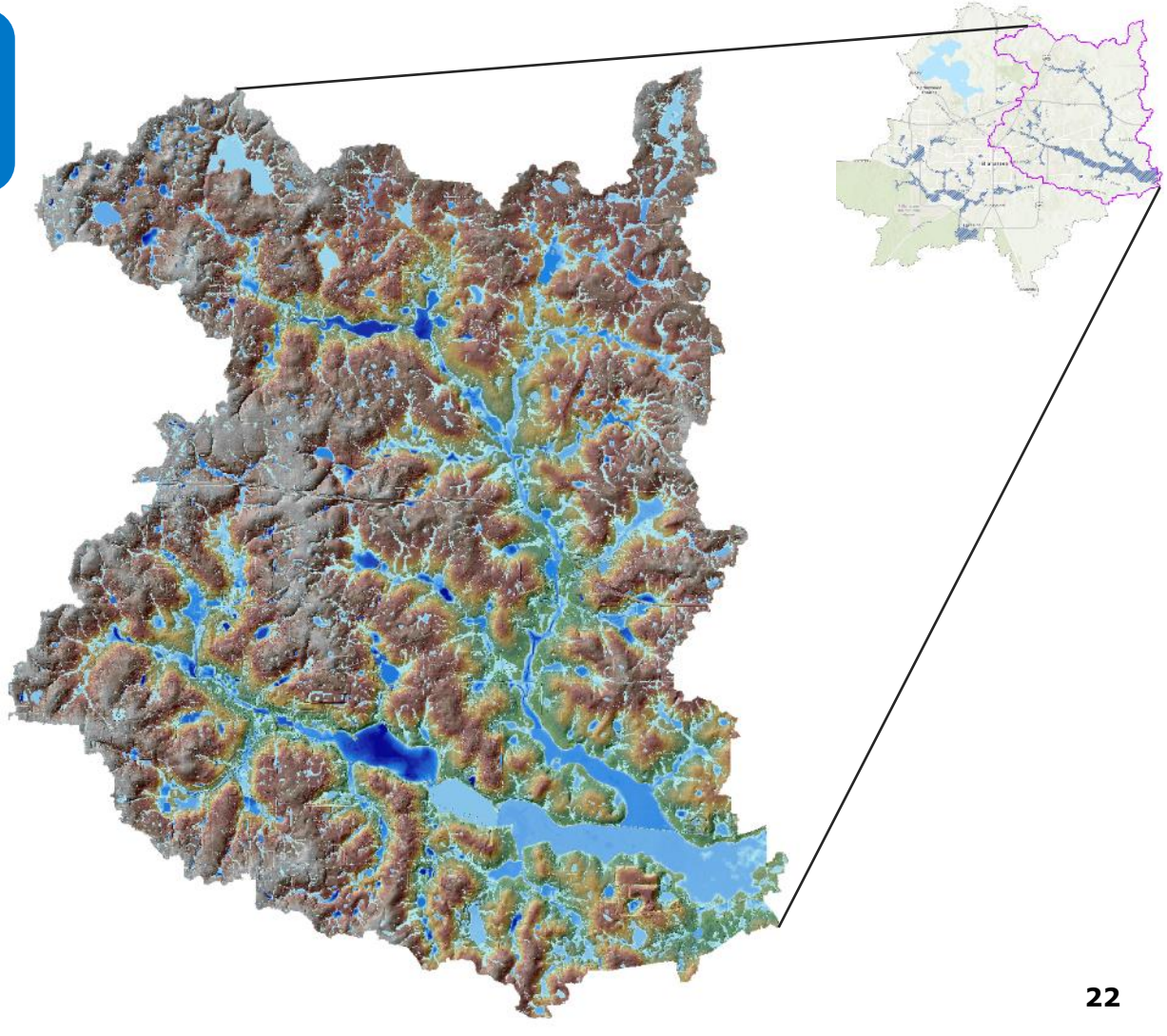
Tallahassee City-Wide Inundation Modeling

Pilot Area

- Lake Lafayette Planning Area
- More detailed hydraulic analysis
- 85 square miles
- 15-foot resolution
- 10.5 million model cells



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Tallahassee City-Wide Inundation Modeling

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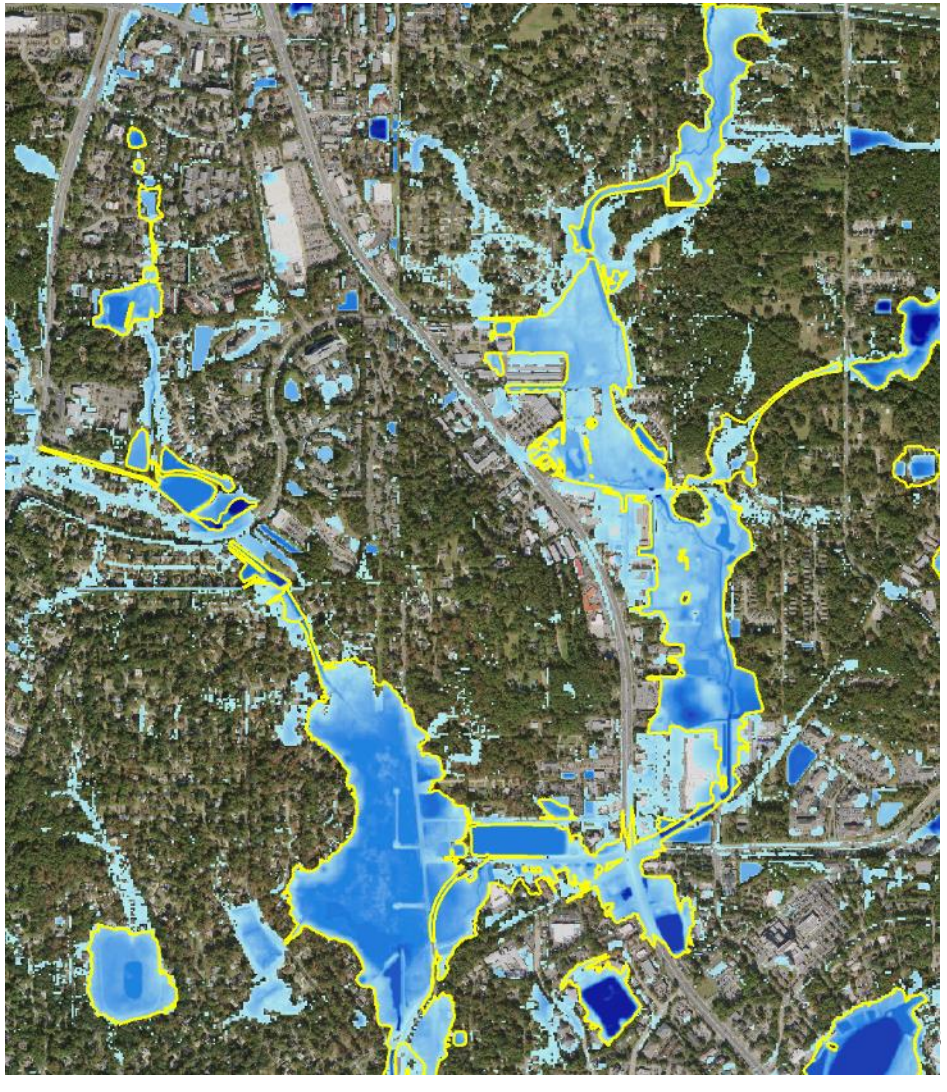
Pilot Area

- Verified model against historic storm (RMSD = 0.95 feet)
- Compared to FEMA BFEs (RMSD ~ 1.5 feet)
- Identified glass wall in preliminary FIS



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Tallahassee City-Wide Inundation Modeling

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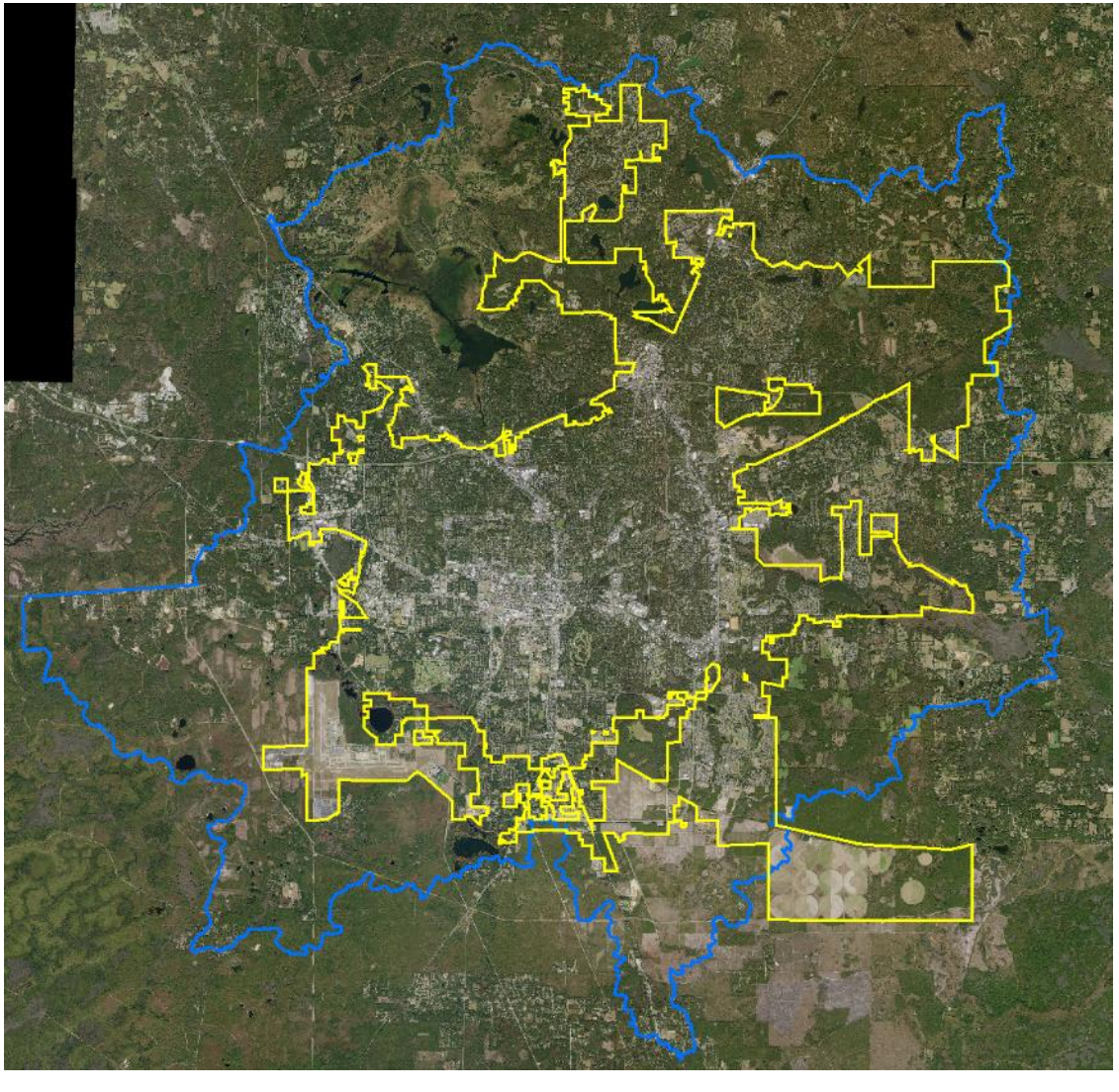
City-Wide Model

- 230 square miles
- 15-foot resolution
- 28.5 million model cells



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Tallahassee City-Wide Inundation Modeling

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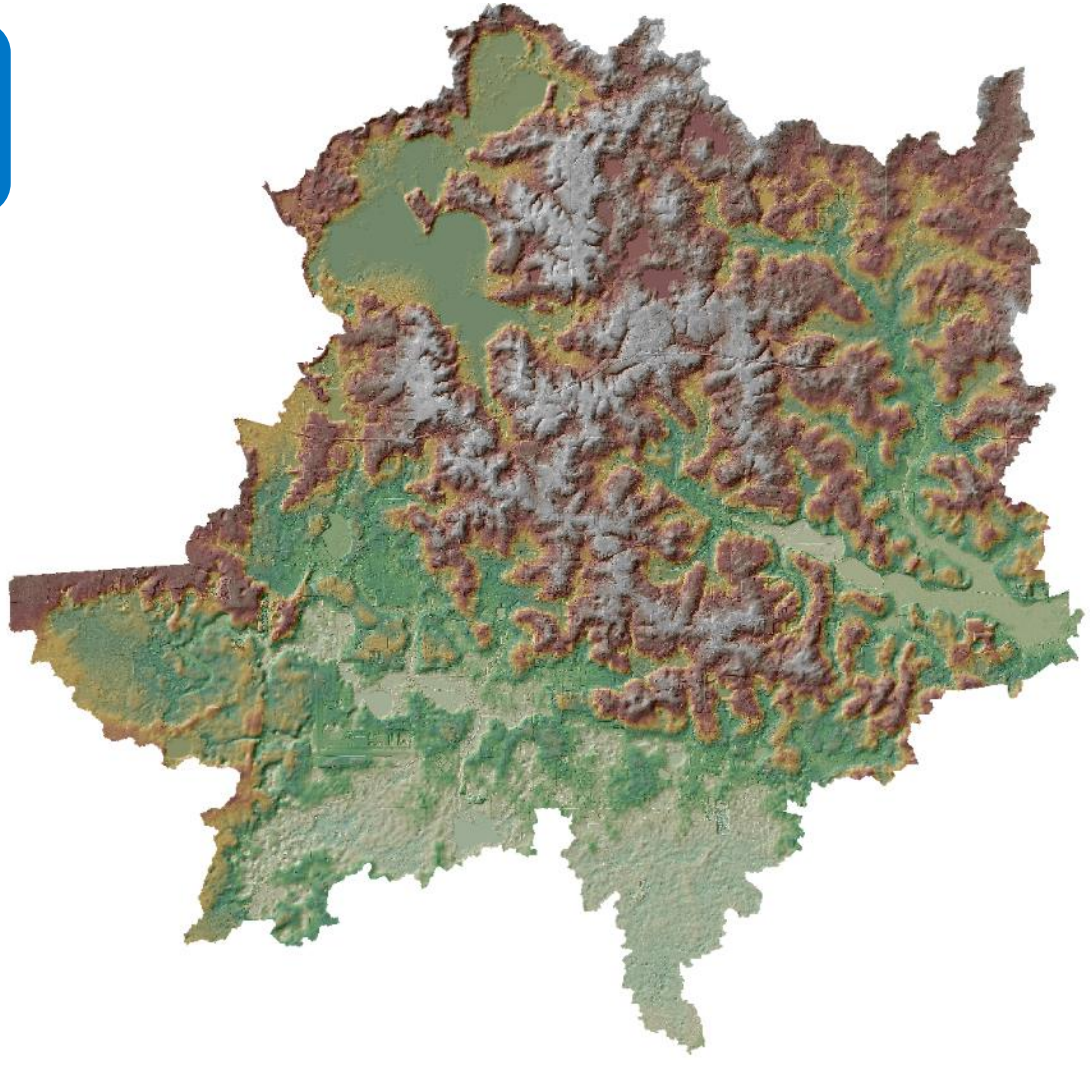
Model Inputs

- LiDAR DEM (2.5 foot)
- Green-Ampt Soil Parameters
- Depth to Water Table
- Land Cover Roughness



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Tallahassee City-Wide Inundation Modeling

Model Inputs

- Impervious Area Mapping
- Starting Water Level
- Intermediate Scale Culverts and Control Structures
- Boundary Conditions

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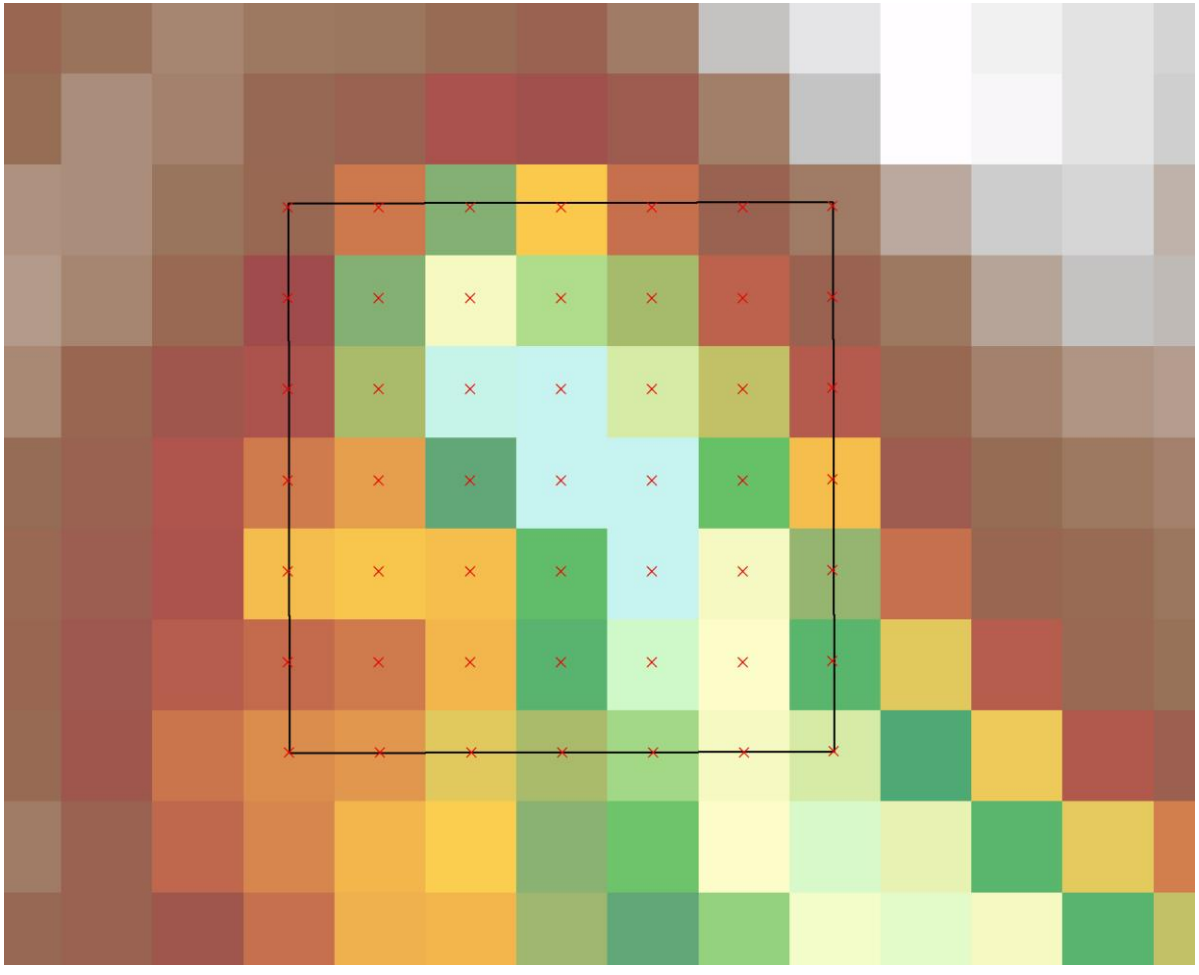
Tallahassee City-Wide Inundation Modeling

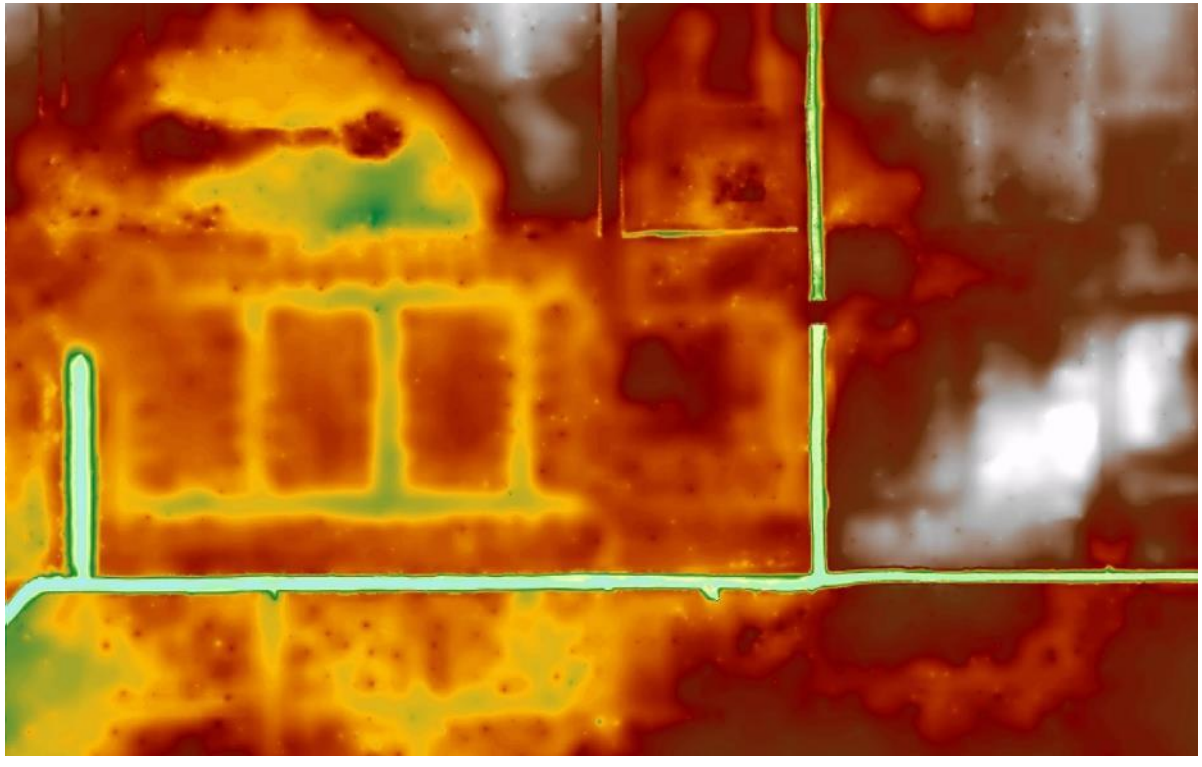
Sub-Grid Sampling

- Characterize storage within cells
- Characterize conveyance between cells



DEM Smoothing

- LiDAR Noise
- Smoothing reduce artificial storage while maintaining characterization of channels
- Fill sinks < 500 cubic feet



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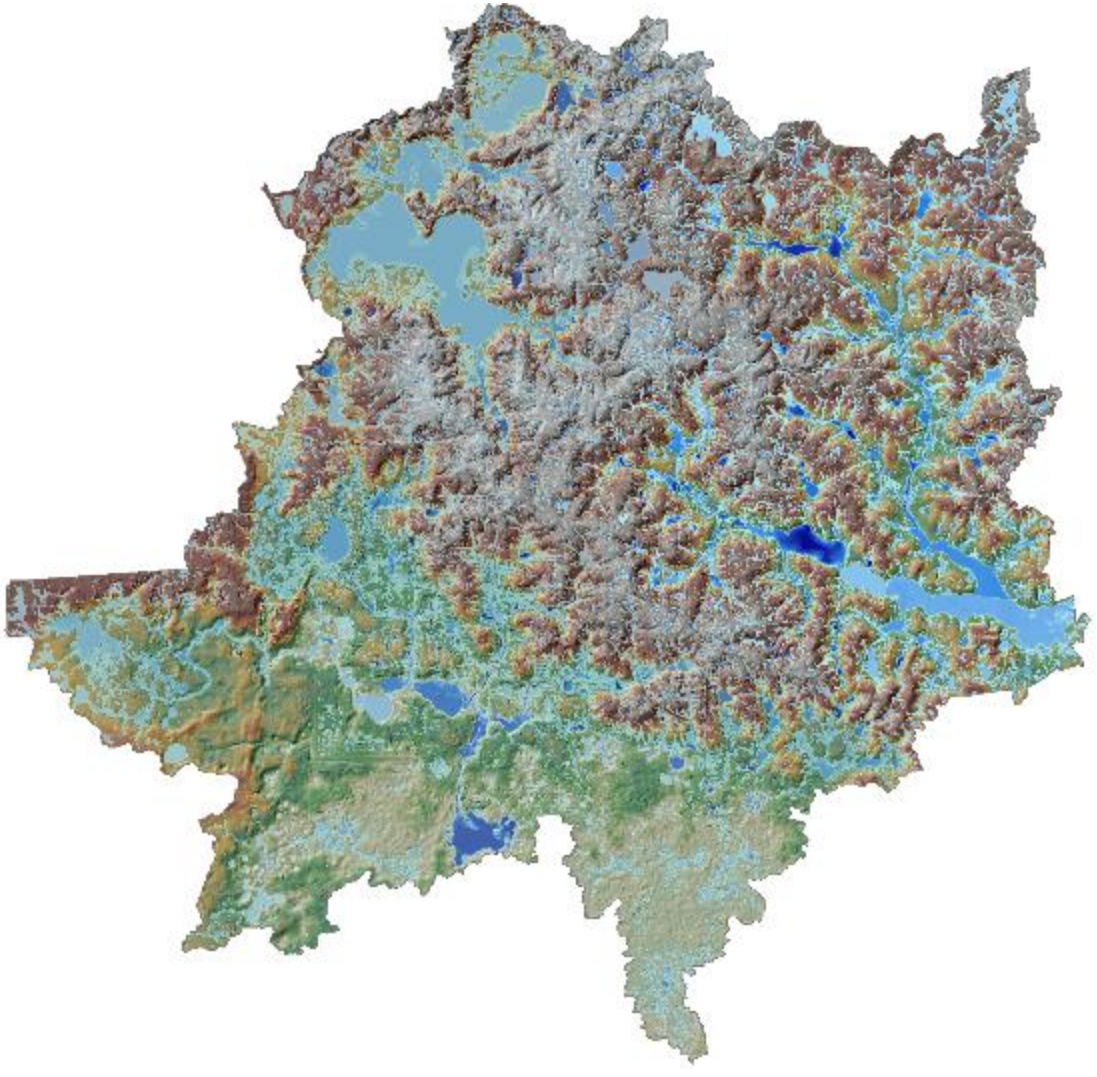

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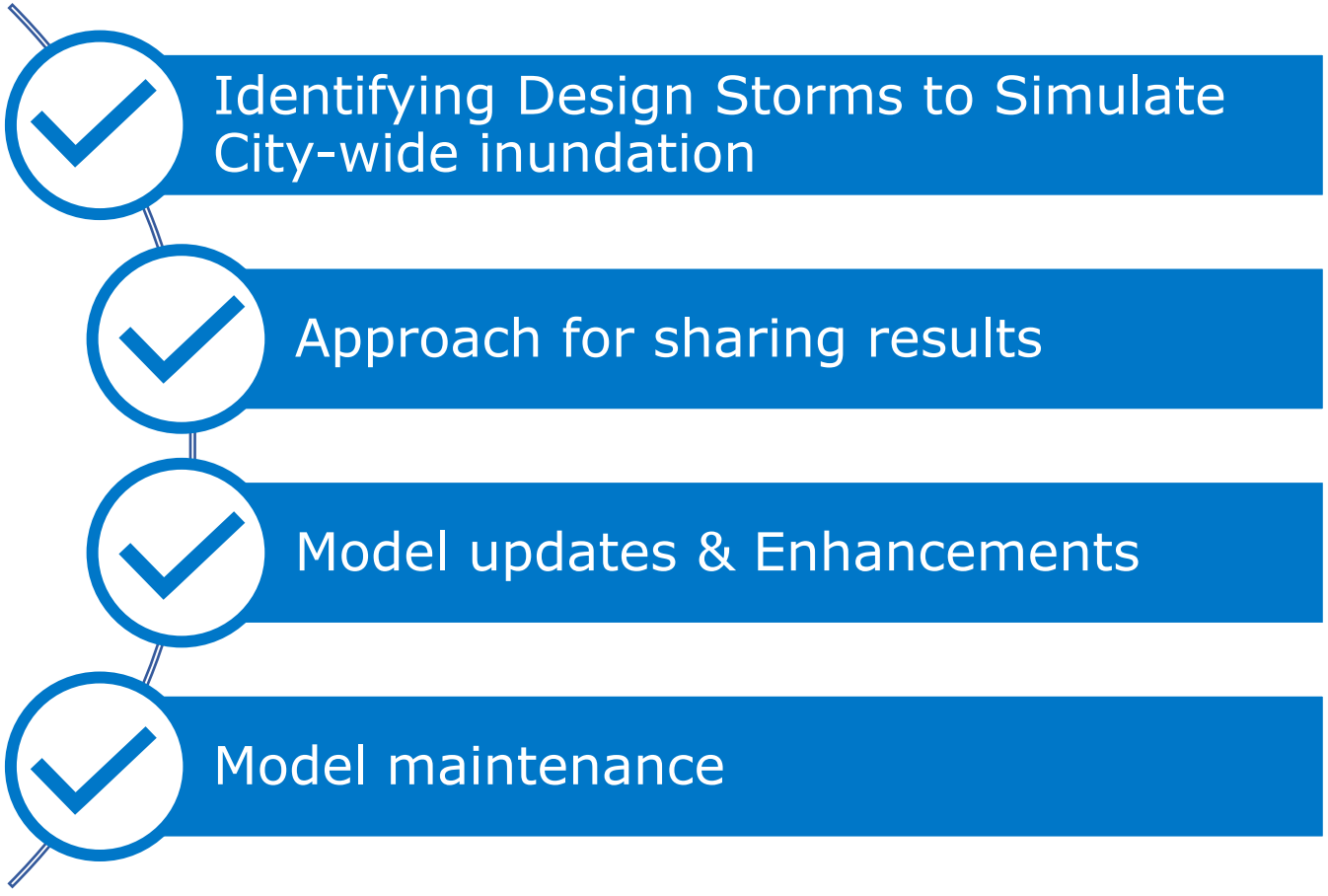
Tallahassee - Next Steps



First Street Foundation

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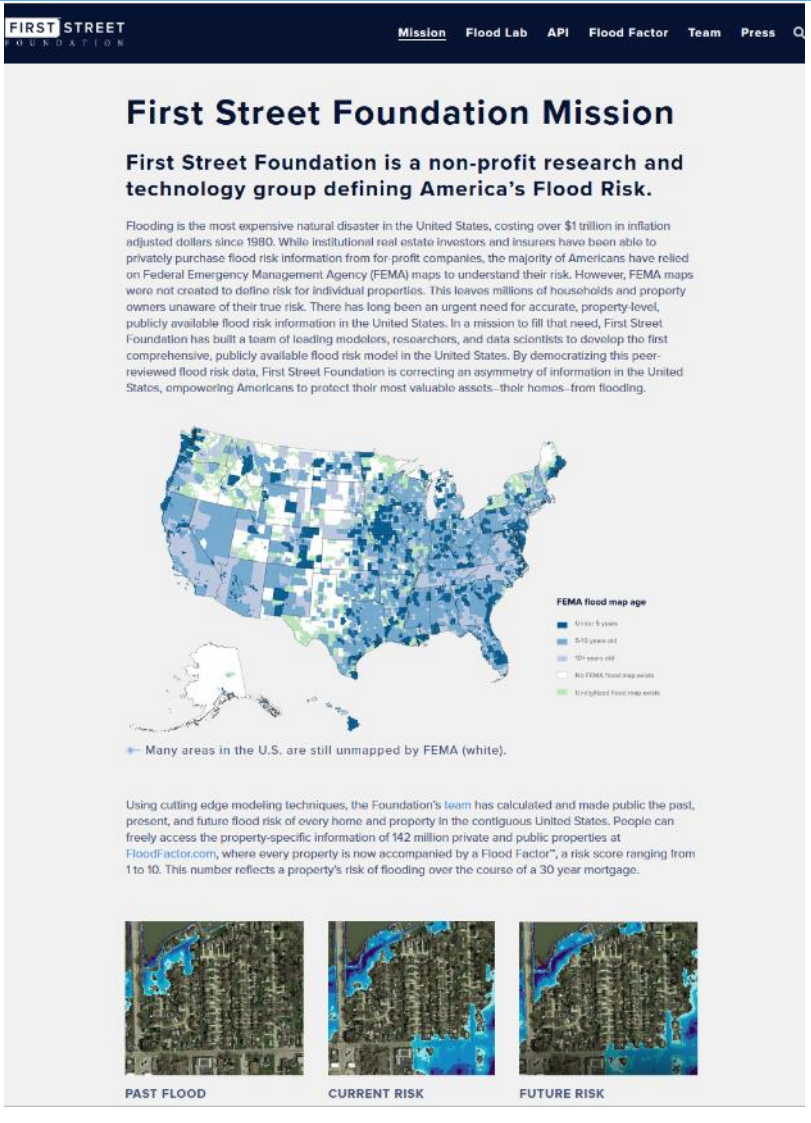
"Non-profit research and technology group defining America's Flood Risk"

"Calculated and made public past, present, and future flood risk of every home and property in the United States"

Property flood risk provided at floodfactor.com



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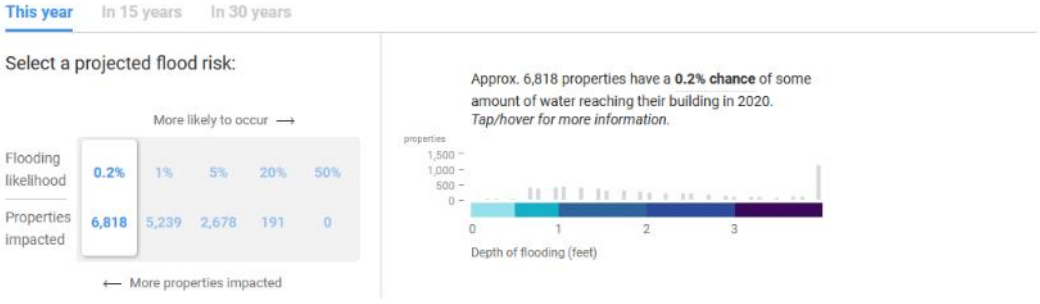
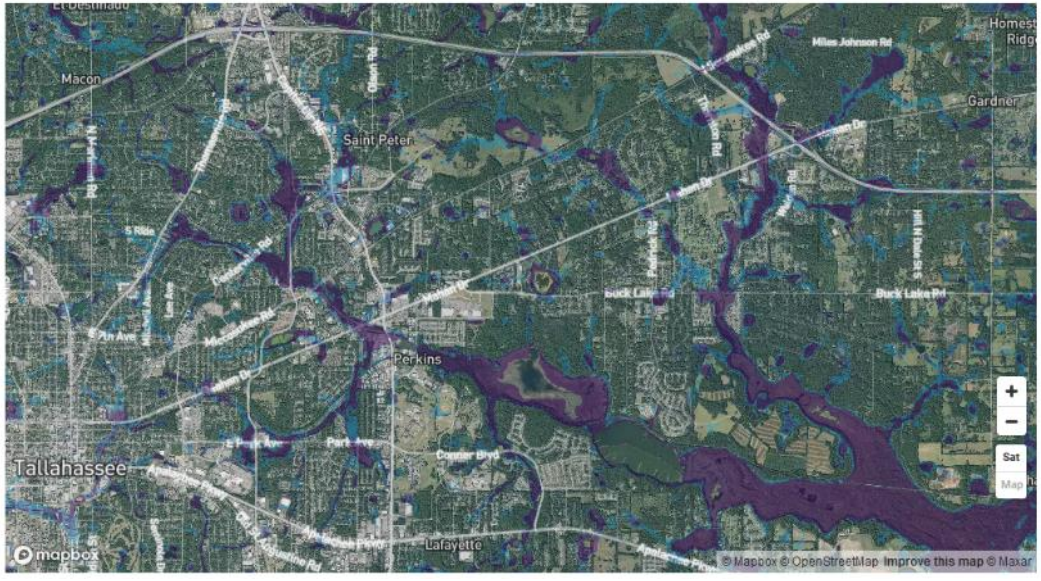
Provide flood risk maps for 0.2%, 1%, 5%, 20%, and 50% return period

Provide "flood factor" score 1 – 10 for every property in United States

Make flood risk information very accessible





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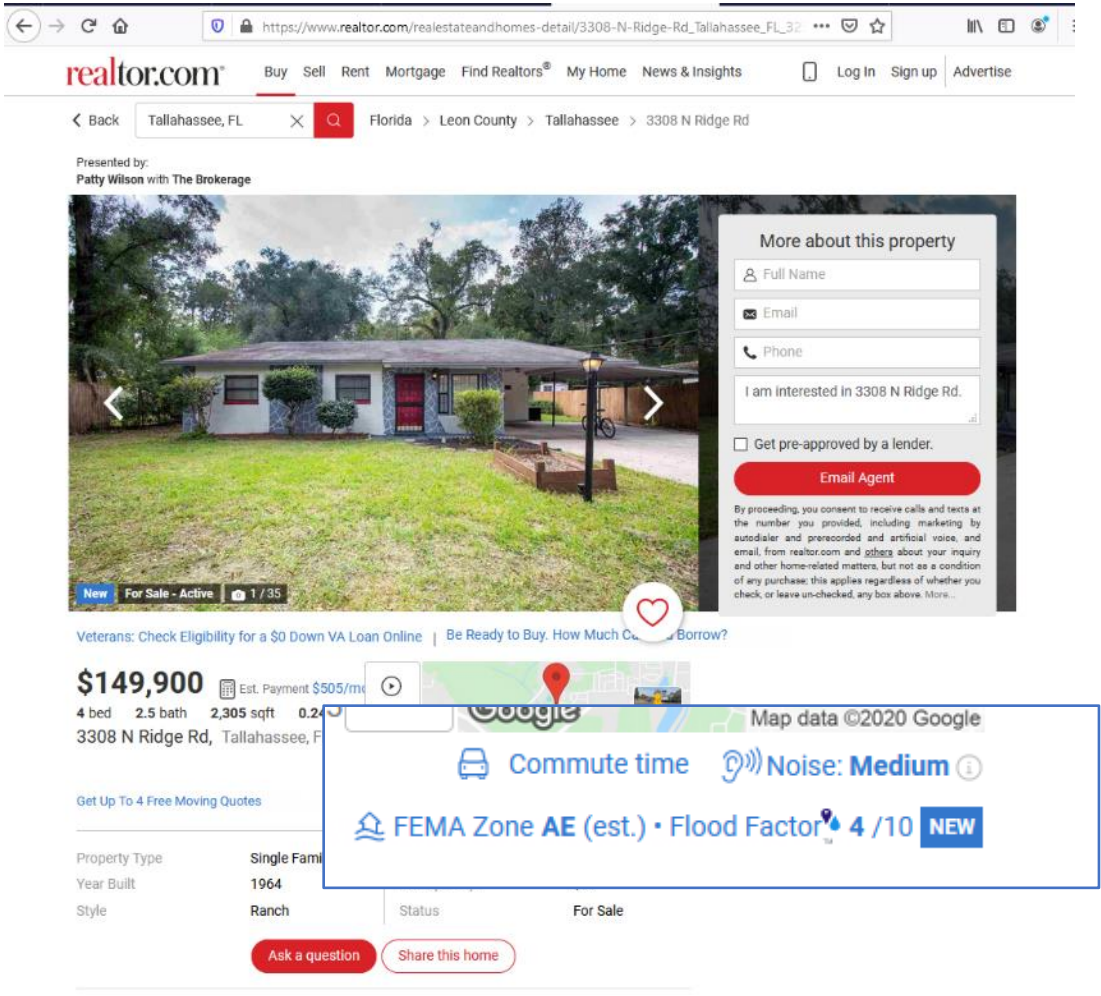
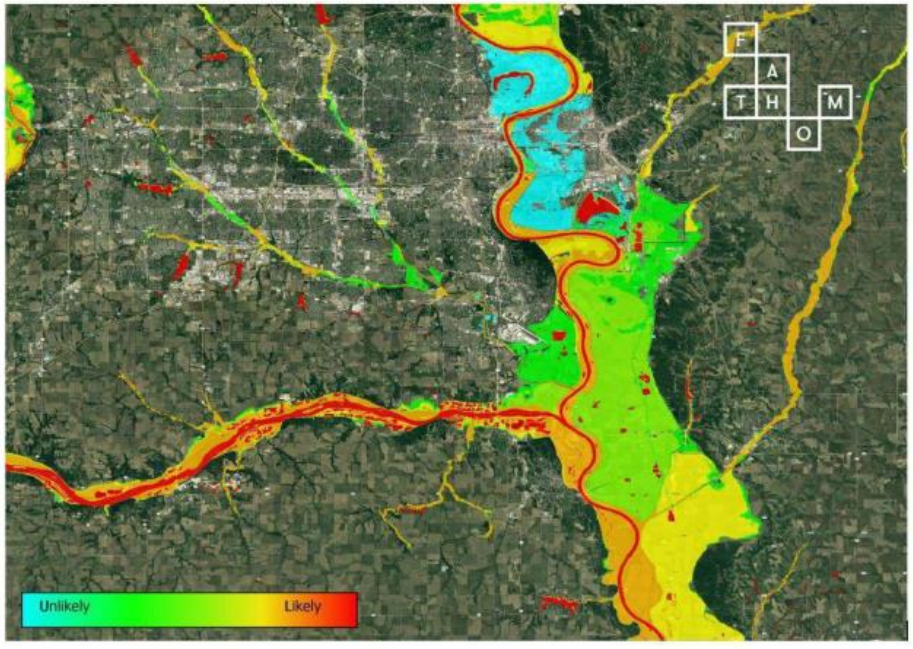


First Street Foundation

- Innovative National Flood Mapping Approach
- Fluvial Mapping - Regression Analysis of USGS Gauged Flow
- Pluvial Mapping – Rain-on grid approach
- Professor Paul Bates University of Bristol & Fathom



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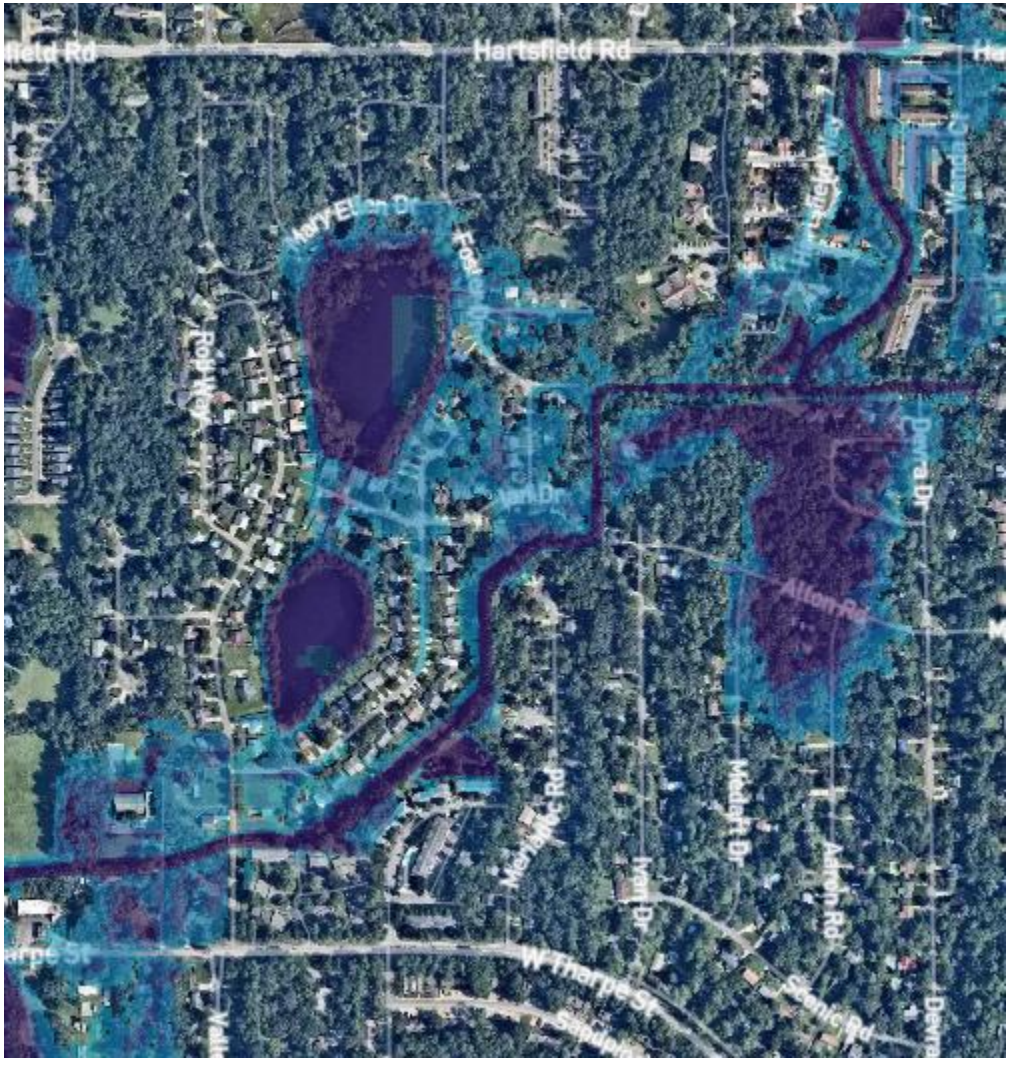
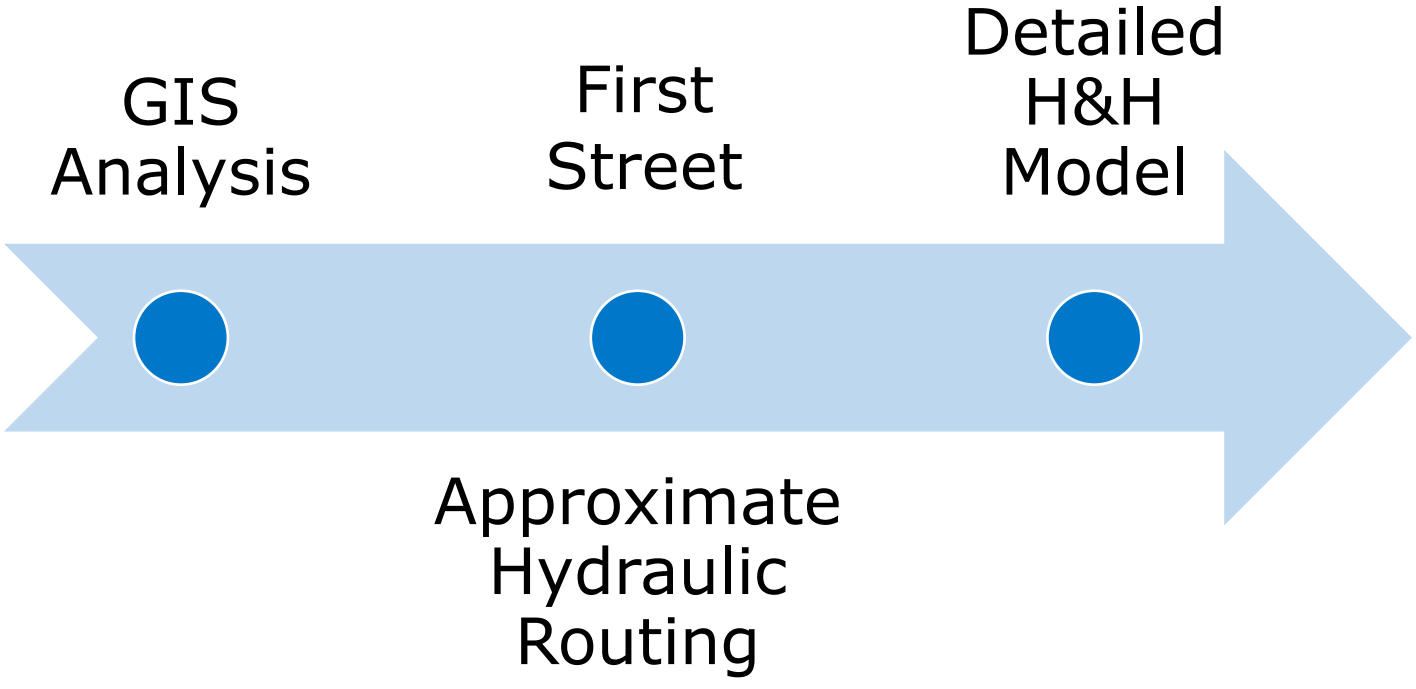
- Rain-on grid – watershed < 20 square miles
- LISFLOOD-FP - 100-foot grid
- Flood mapping downscaled to 10-foot grid
- Does not consider stormwater infrastructure



2D Flood Screening



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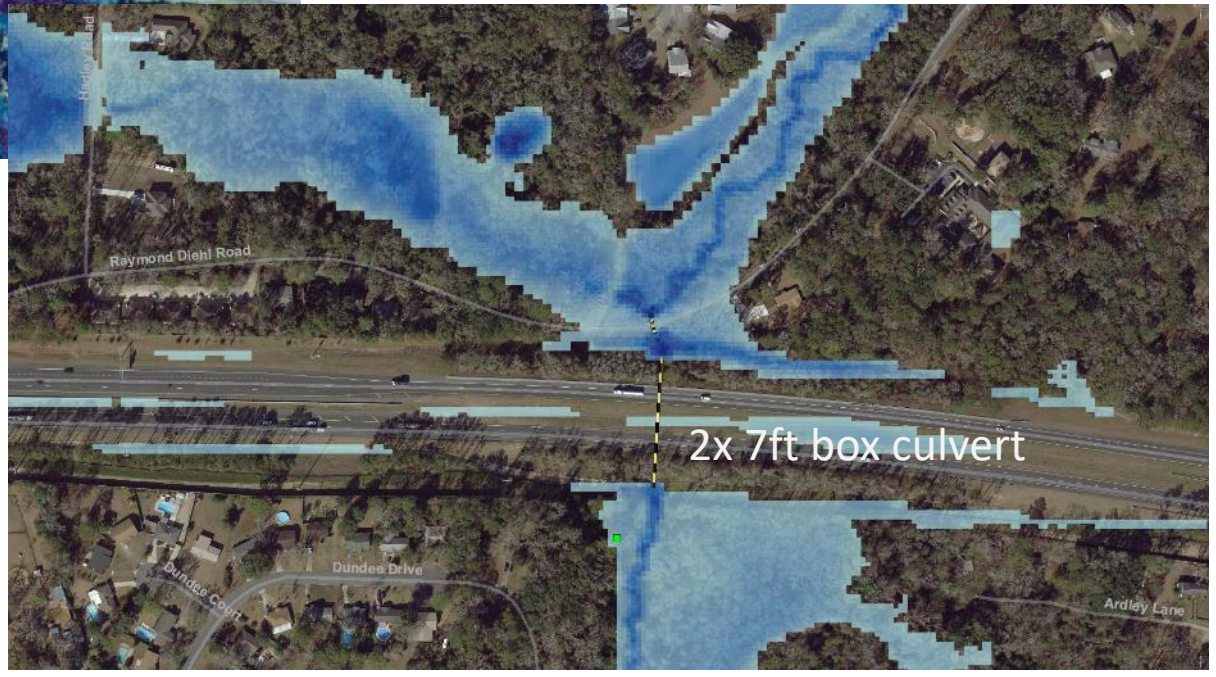
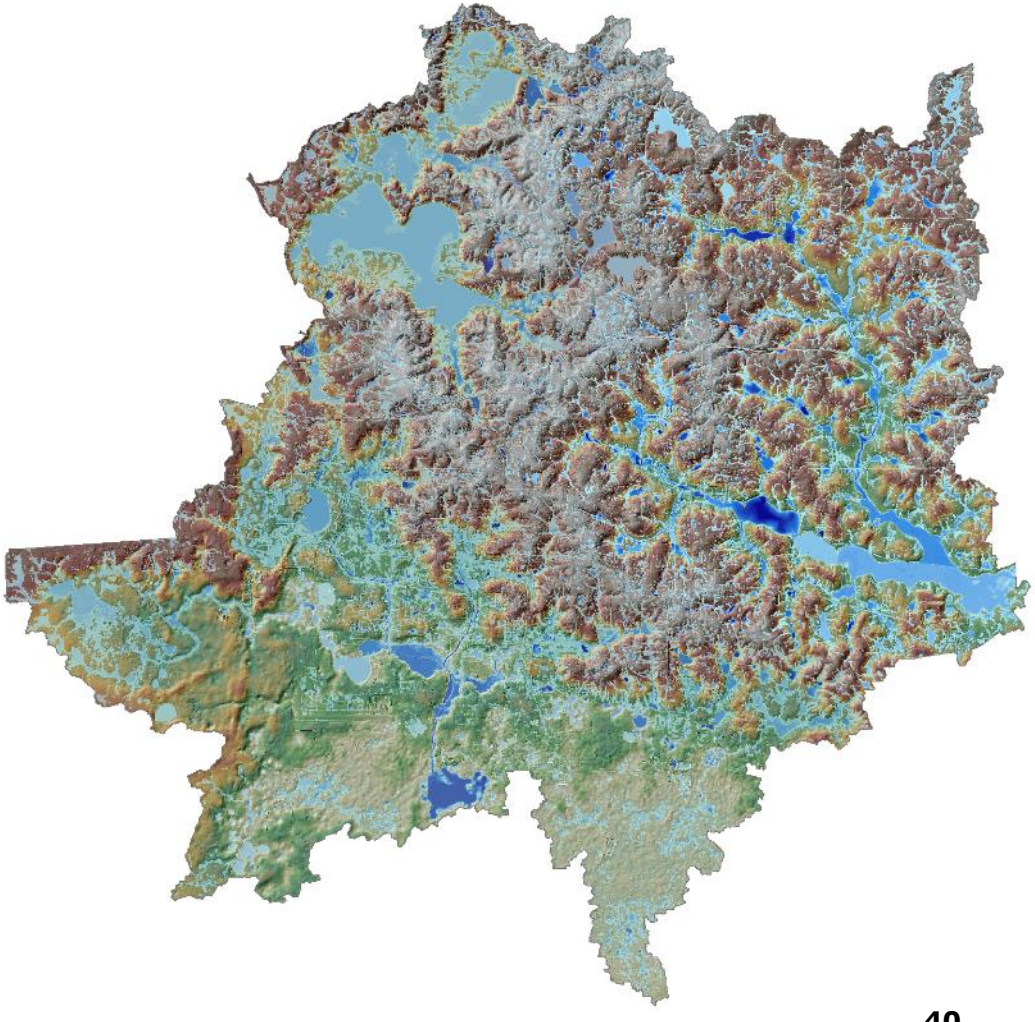


Summary

- Continuum of Flood Screening Tools
- Continuous improvements in data and computing
- Selecting appropriate approach is important
- High-Resolution City-wide inundation modeling provides a valuable tool



QUESTIONS?

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