



Rapid Inundation Mapping – An Alternative City Lead Approach

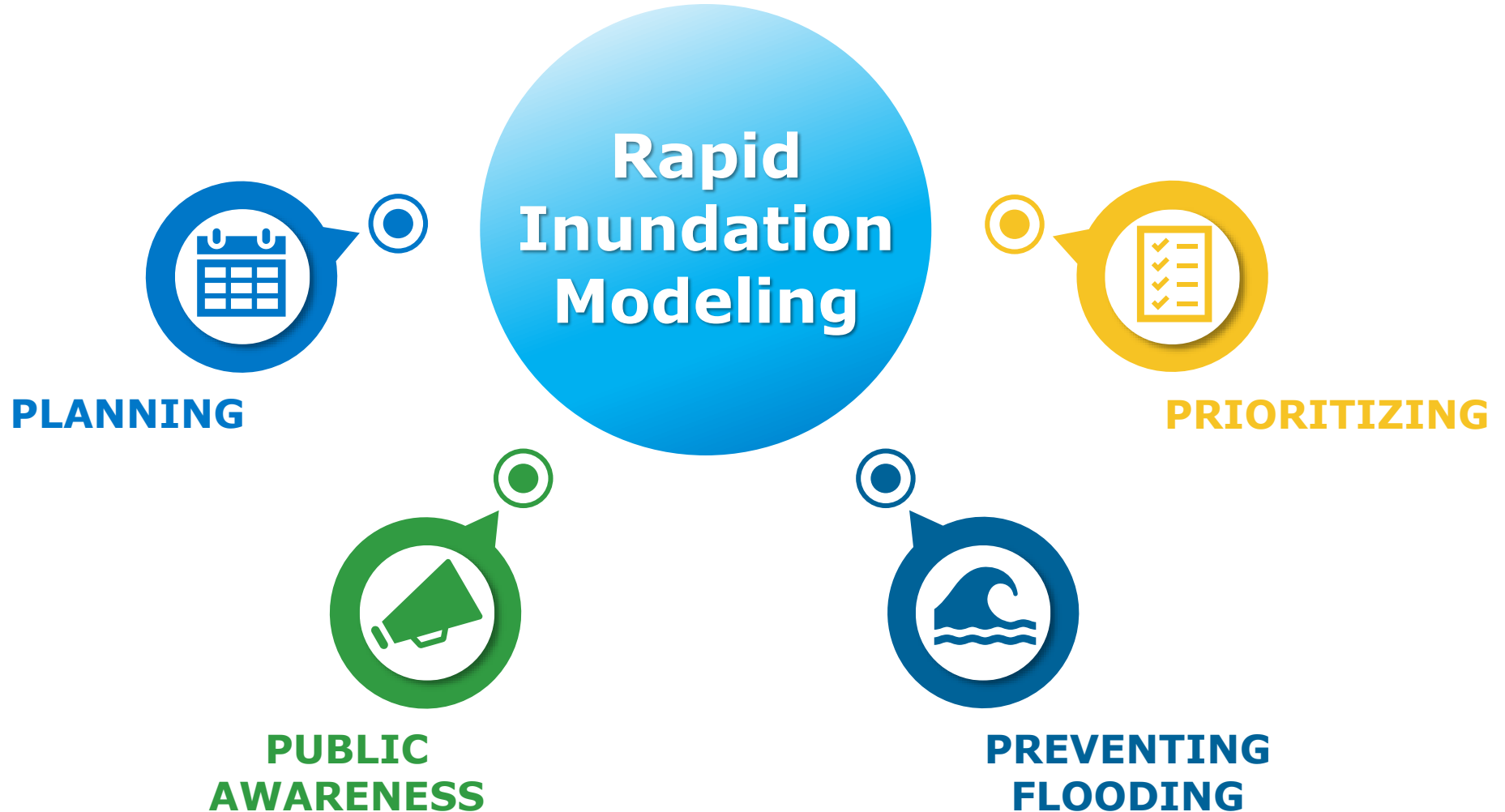
FSA Winter Conference

December 3, 2020



**CITY OF
TALLAHASSEE**

JonesEdmunds



Flood Impacts



- 154 dead
- 4,000 displaced from their homes

- Damages > \$40 Million



May 1, 2014

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

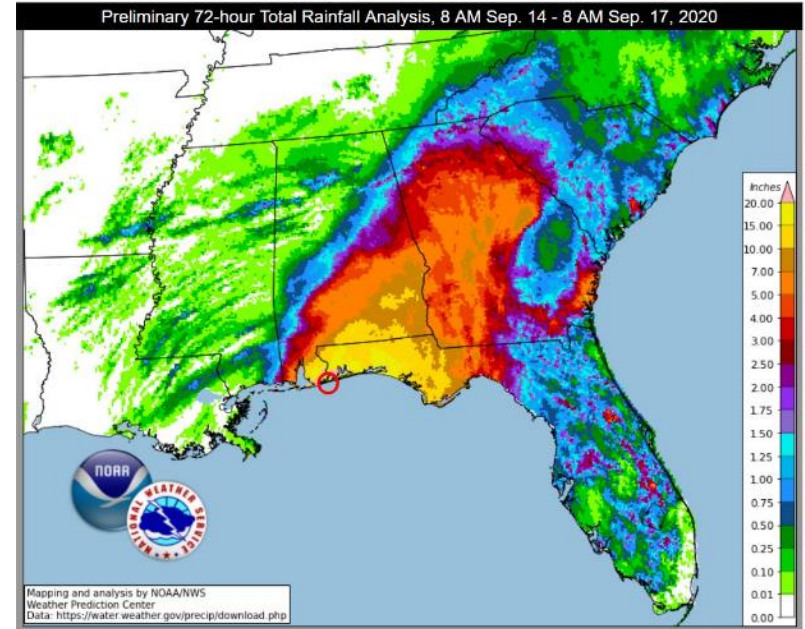
August 30, 2017 (Harvey)

- 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)

Hurricane Sally Preliminary Rainfall Totals through 8 am EDT





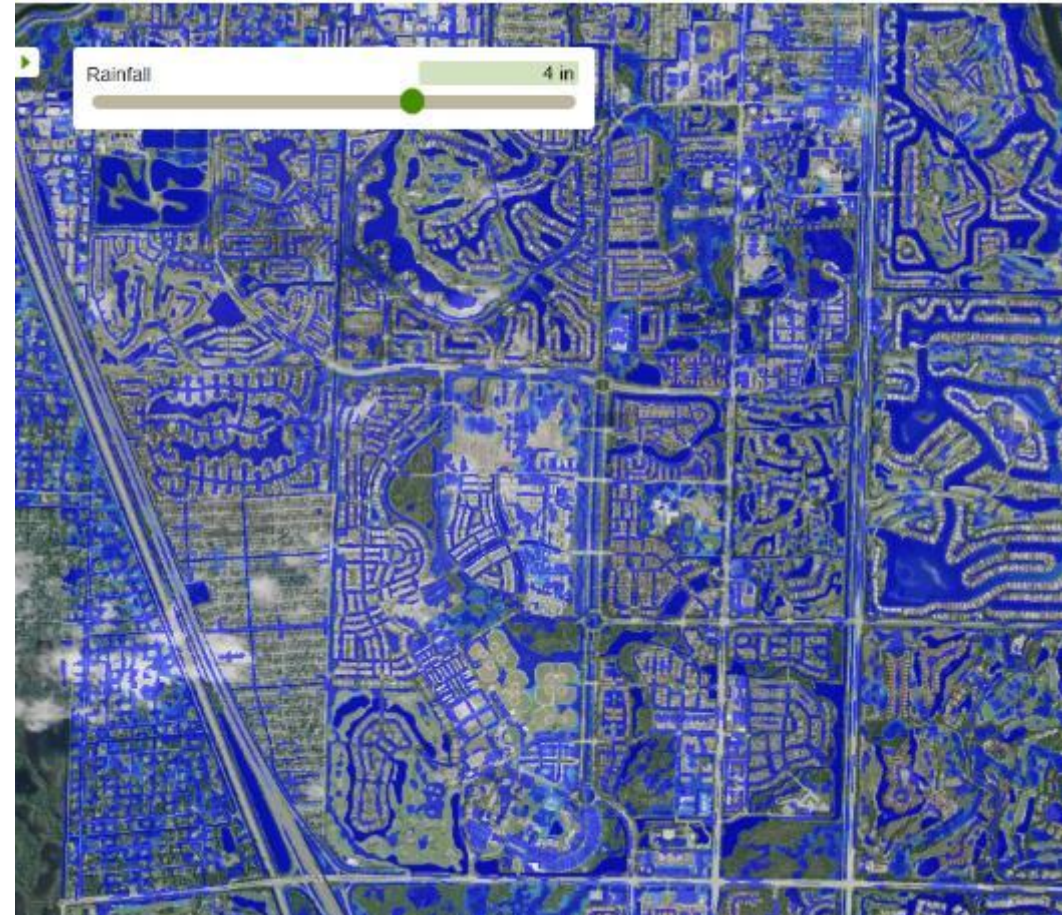
What it's not

- Detailed Hydraulic Model
- Regulatory Product

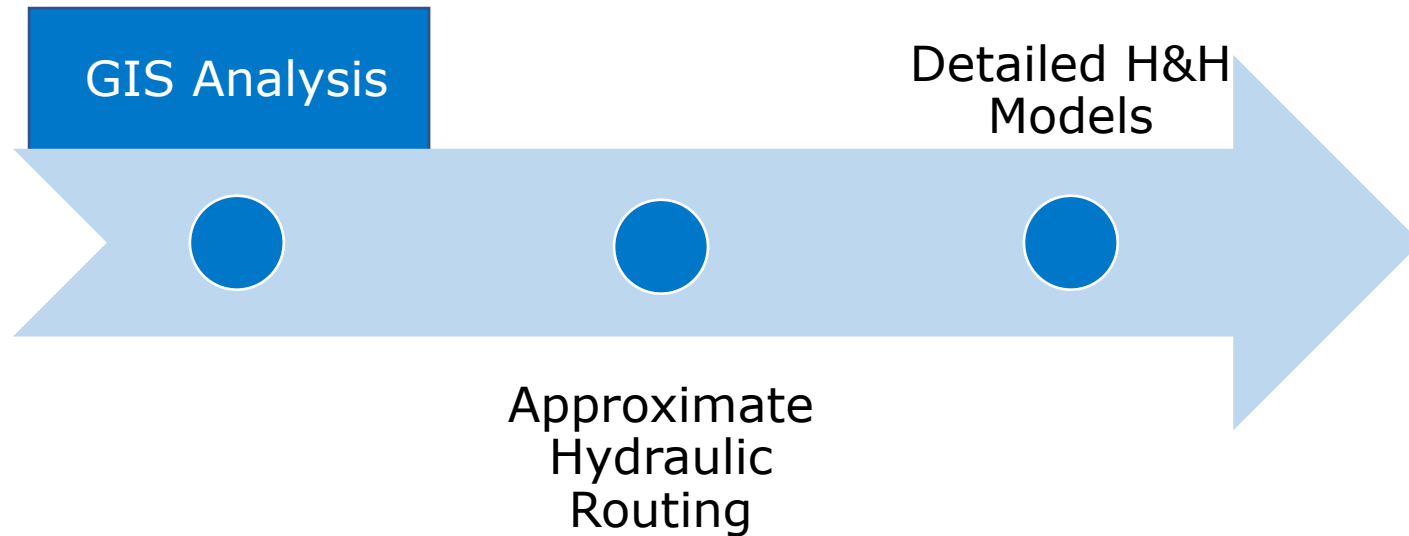


What it is

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

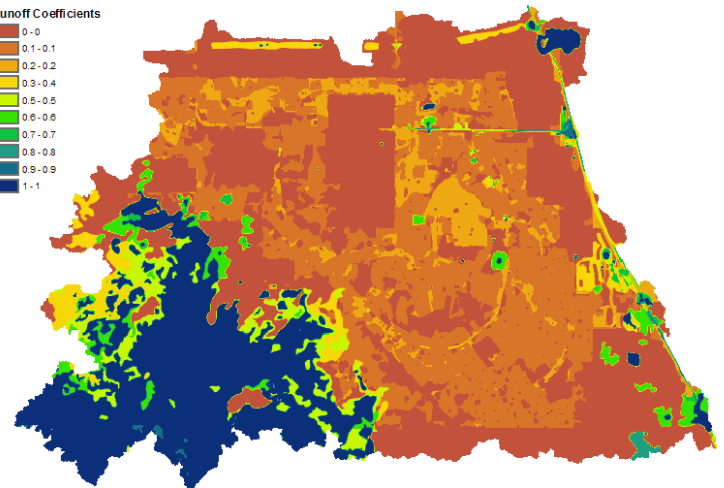
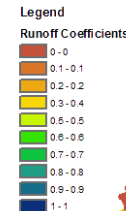
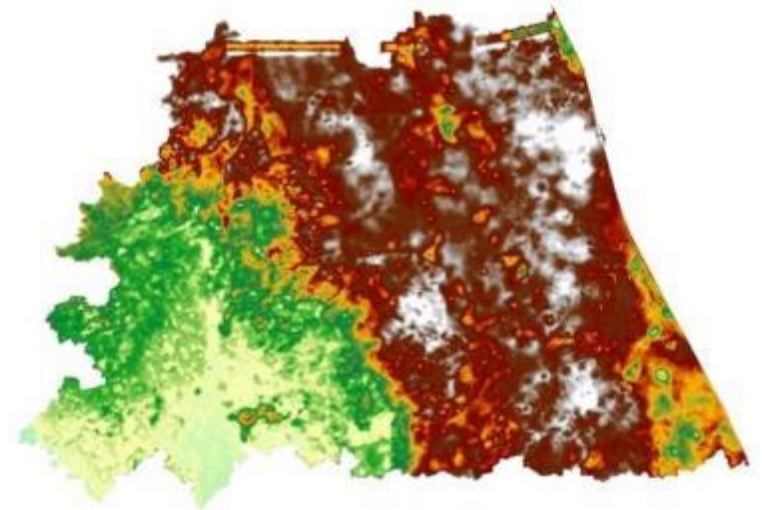


2D-Flood Screening



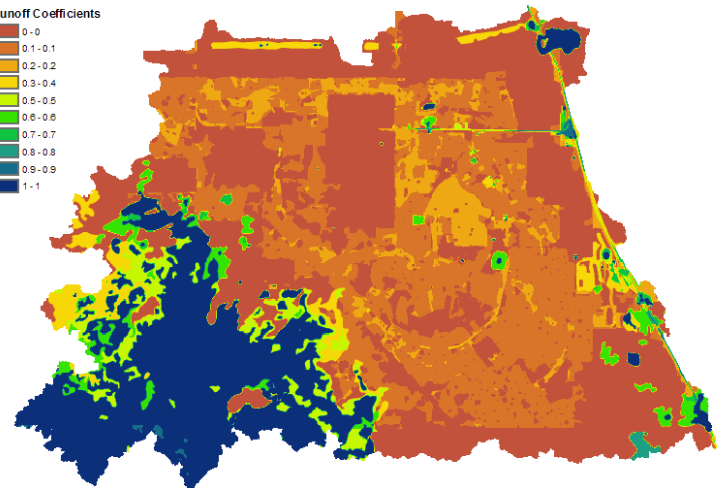
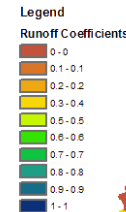
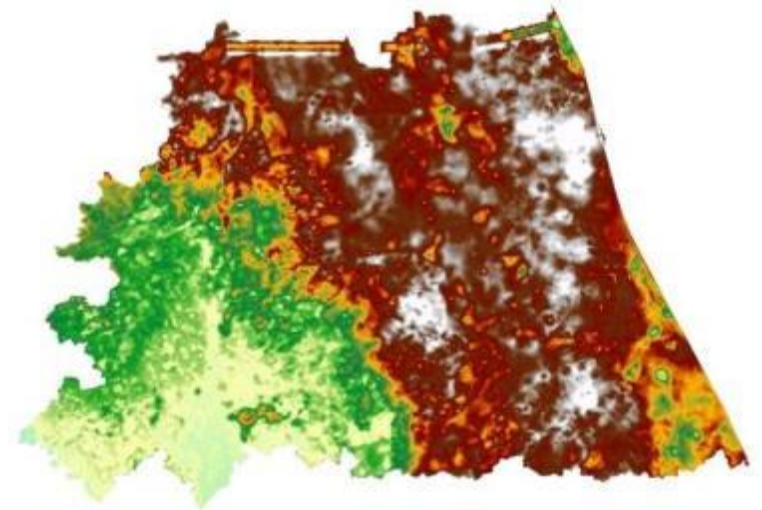
Model Inputs

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

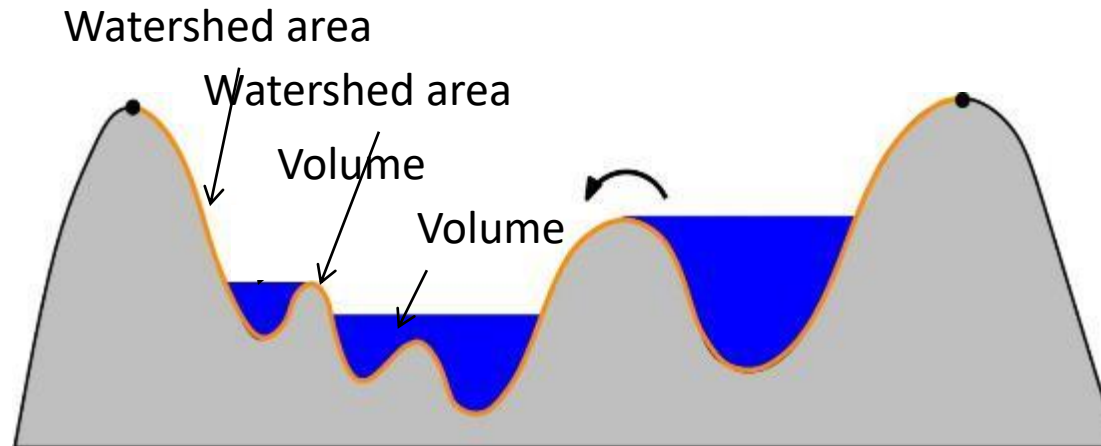


Model Capacity

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

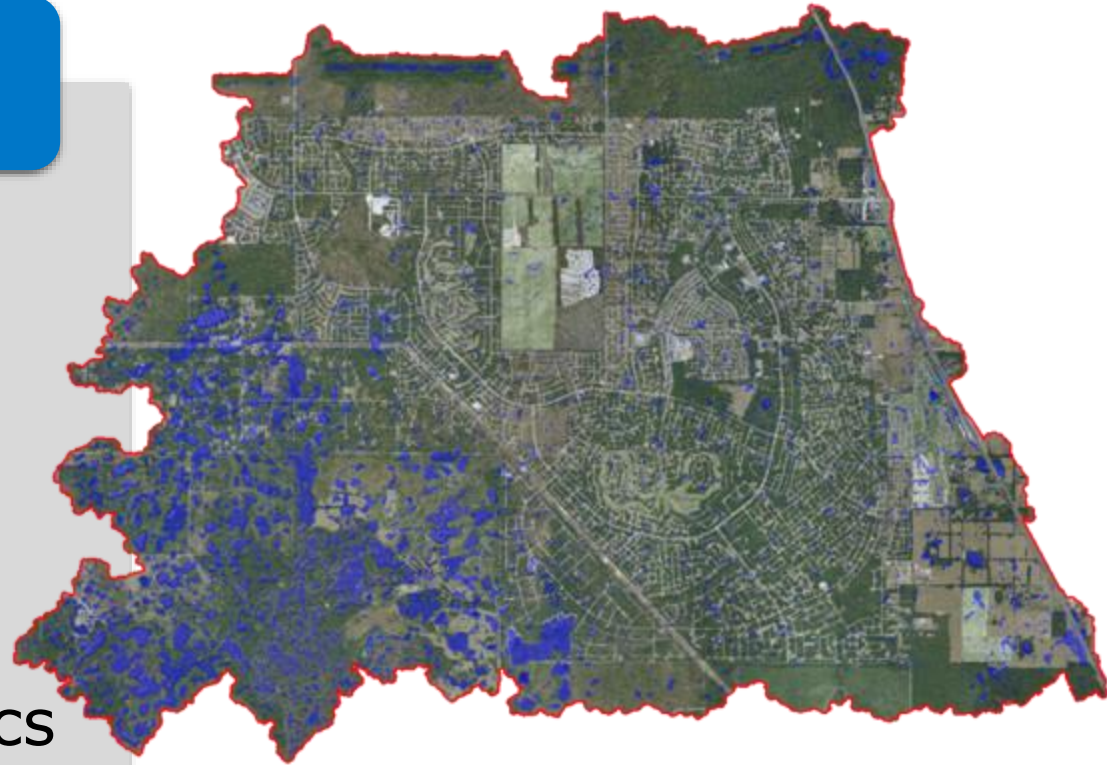


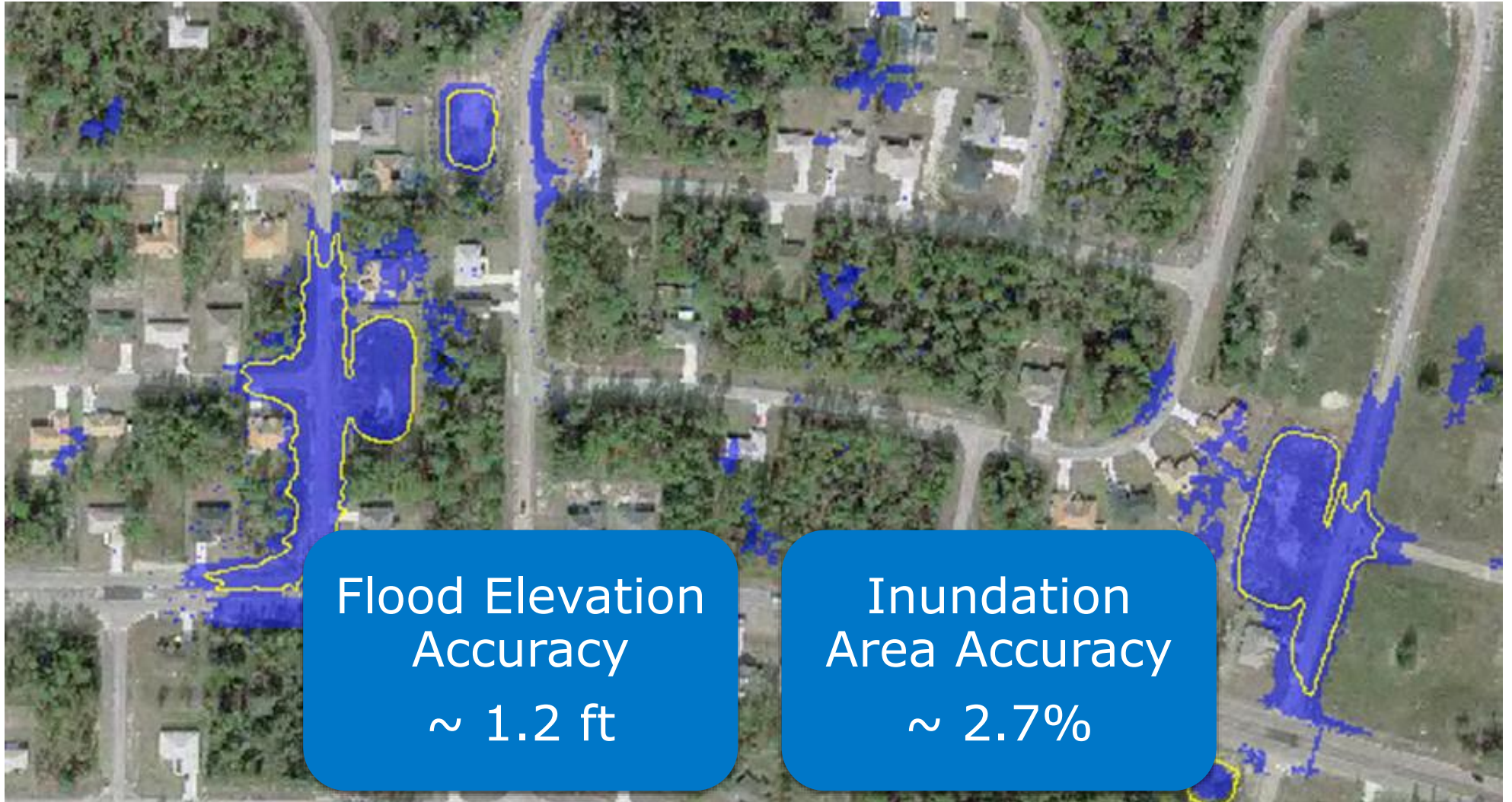
Modeling runoff accumulation in depressions



Model Results

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



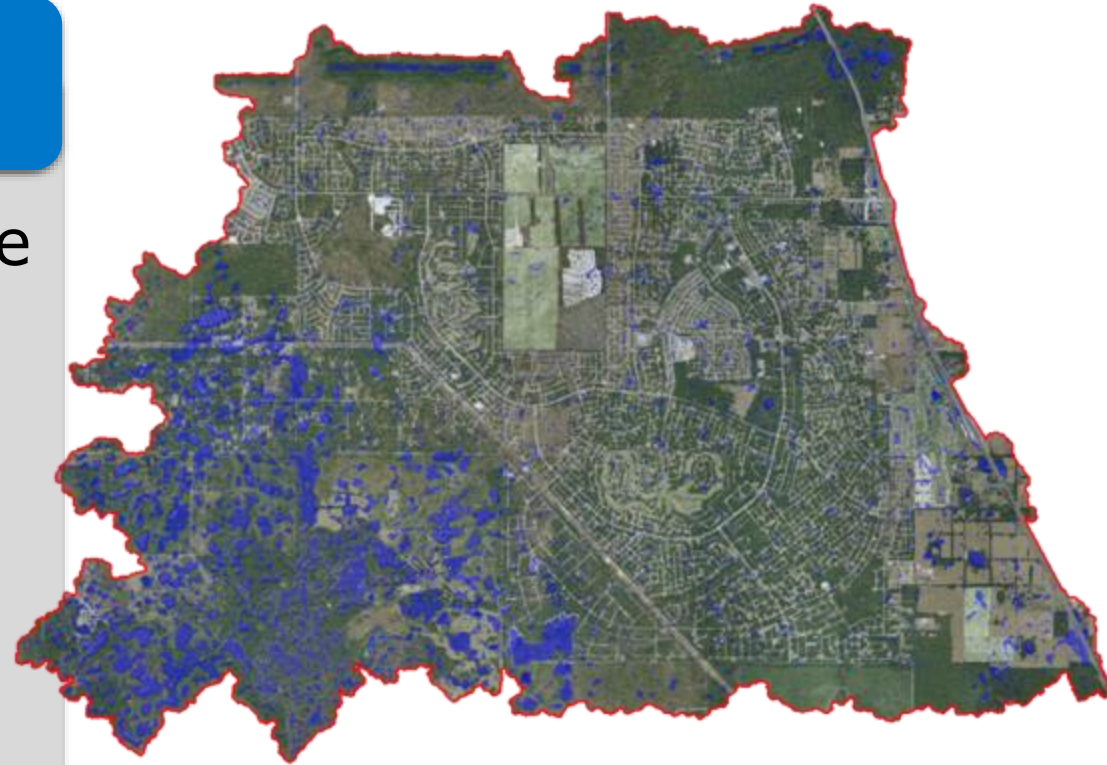


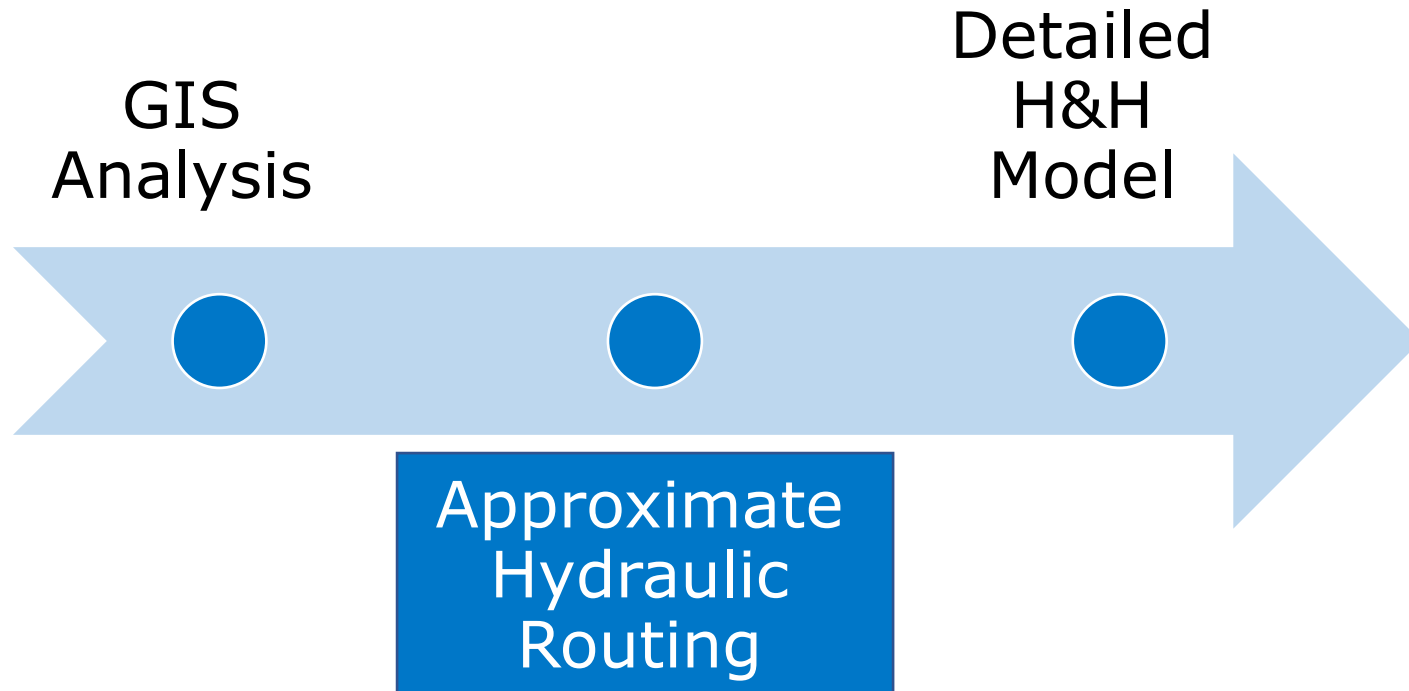
Flood Elevation
Accuracy
~ 1.2 ft

Inundation
Area Accuracy
~ 2.7%

Uses

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



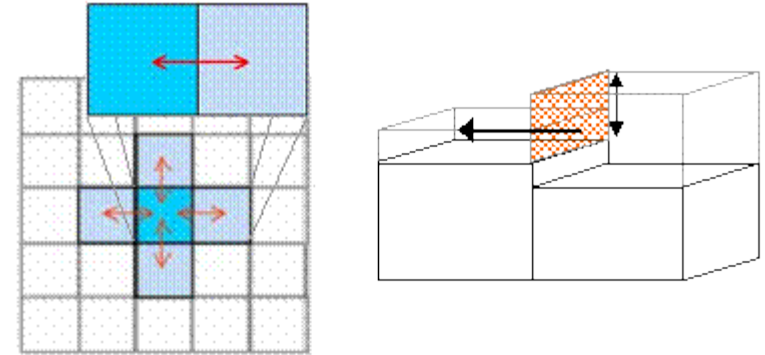


Approximate Hydraulic Routing Models

Approximate runoff and routing calculations

Use computationally efficient solutions

Take advantage of modern computer hardware



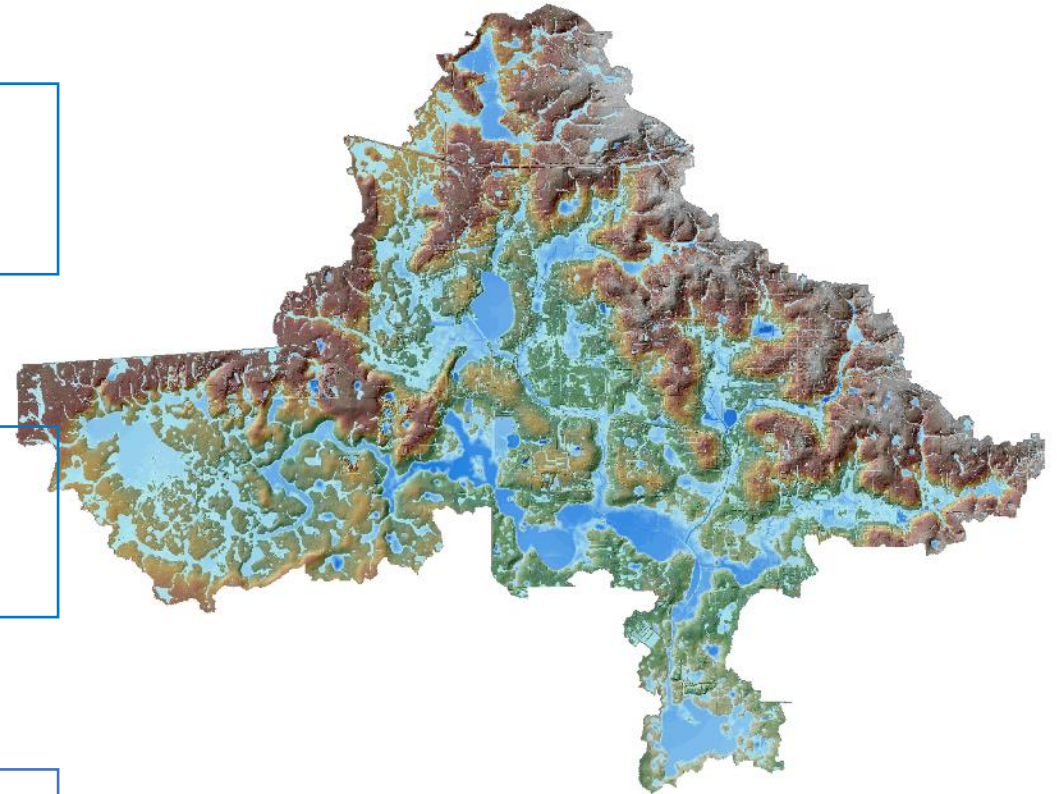
Source: LISFLOOD-FP

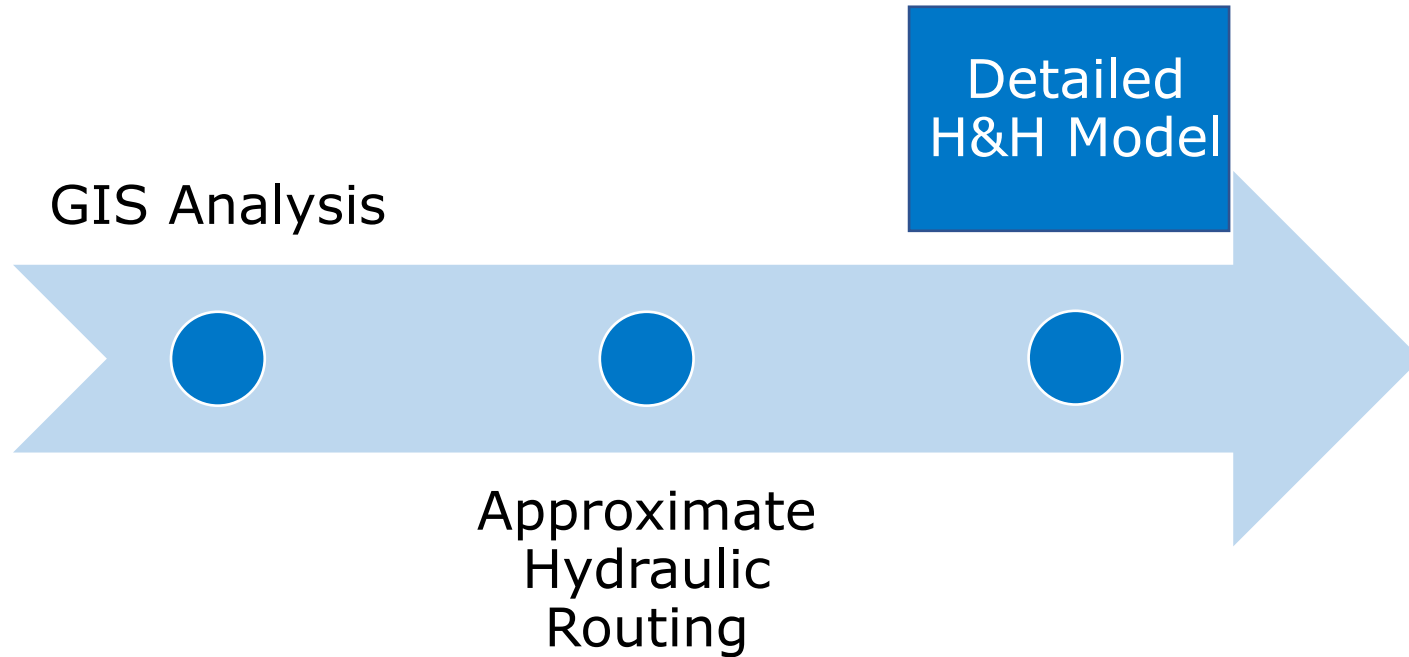
Approximate Hydraulic Routing Models

High Resolution DEM

Fast model runs times

~100 million model cells



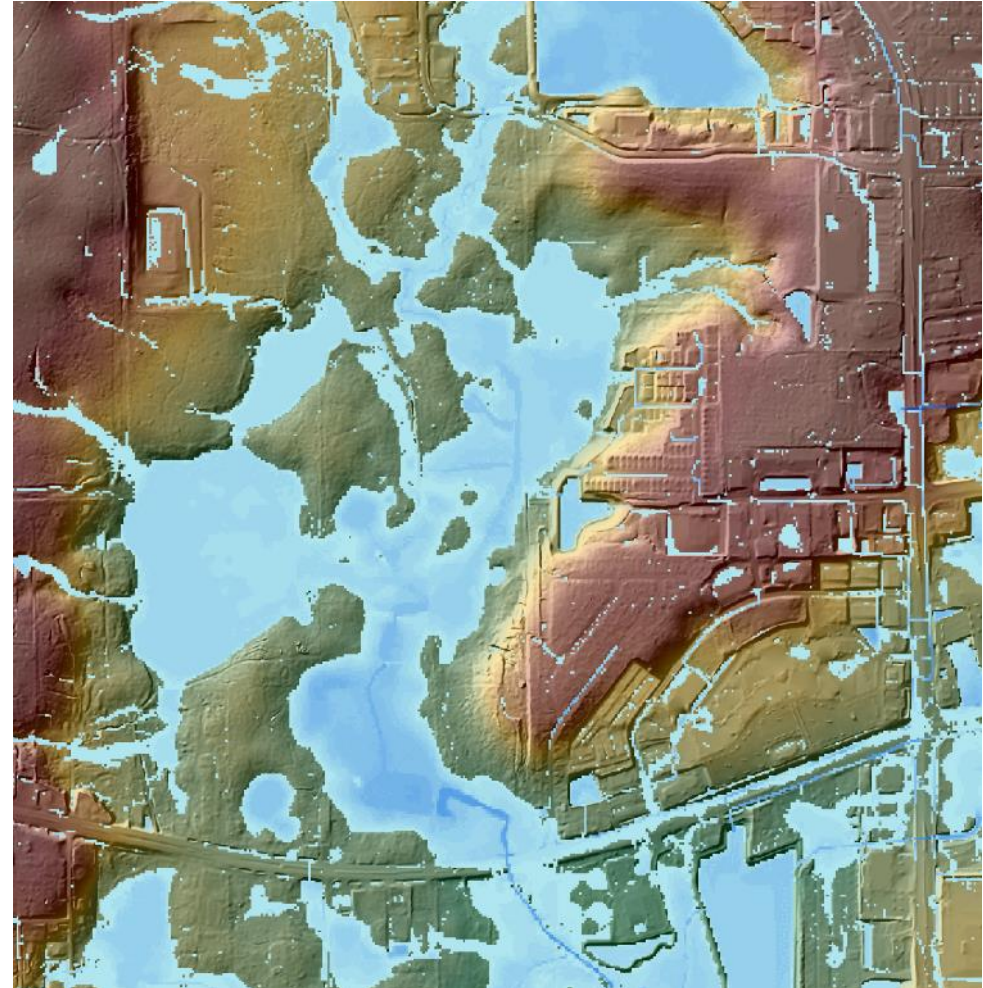


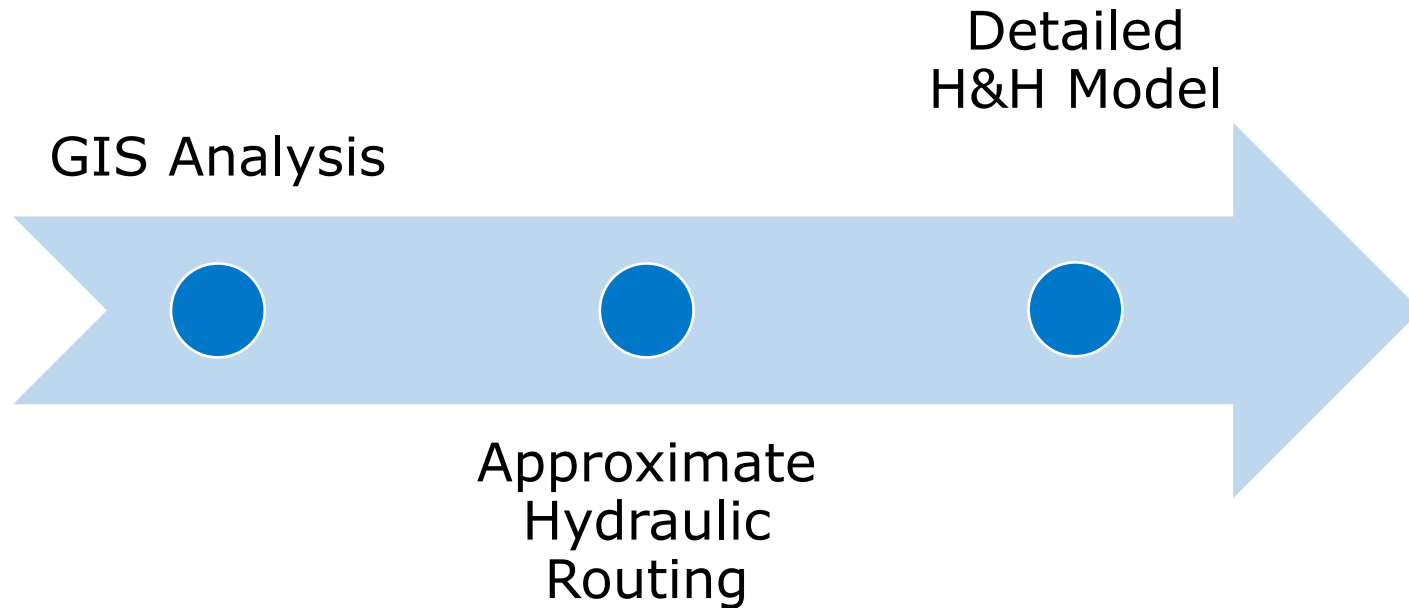
Detailed 2D H&H Model

Solve “full” SWE

Include rainfall
excess model

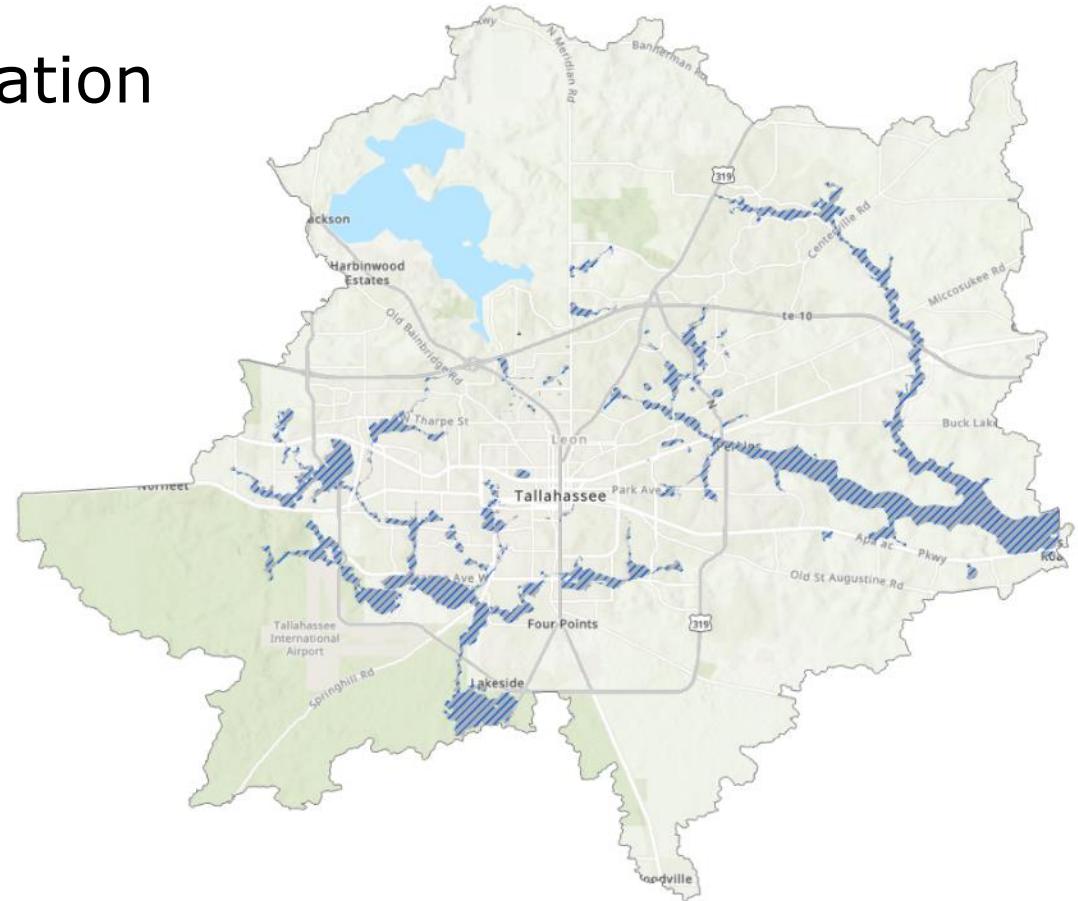
Include 1-D
features





Tallahassee City-Wide Inundation Modeling

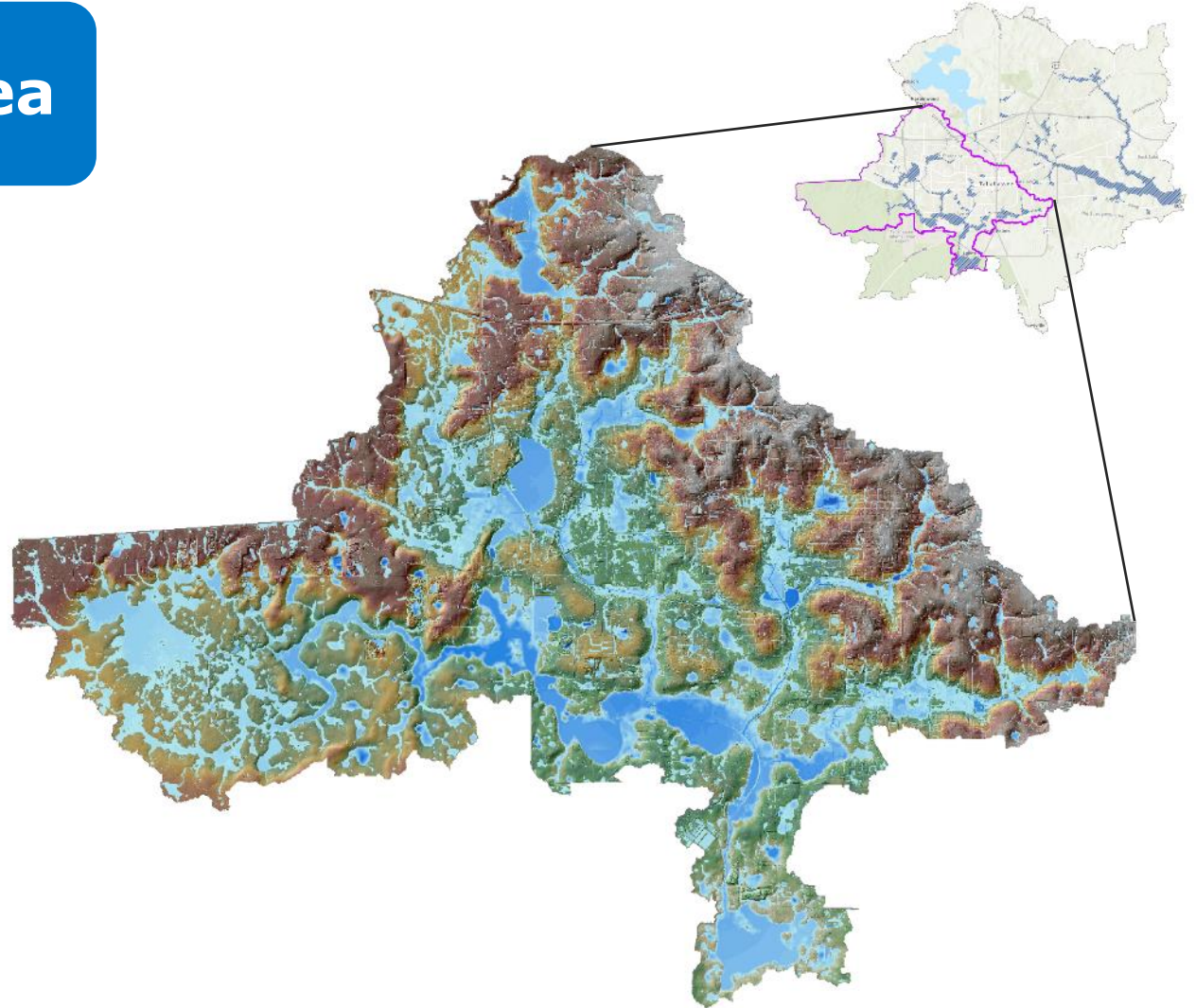
- Generate City-wide Inundation mapping
- Support City Stormwater Planning
- Use Simplified Modeling Approaches
- Publish Results



Tallahassee City-Wide Inundation Modeling

Demonstration Area

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



Demonstration Area

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

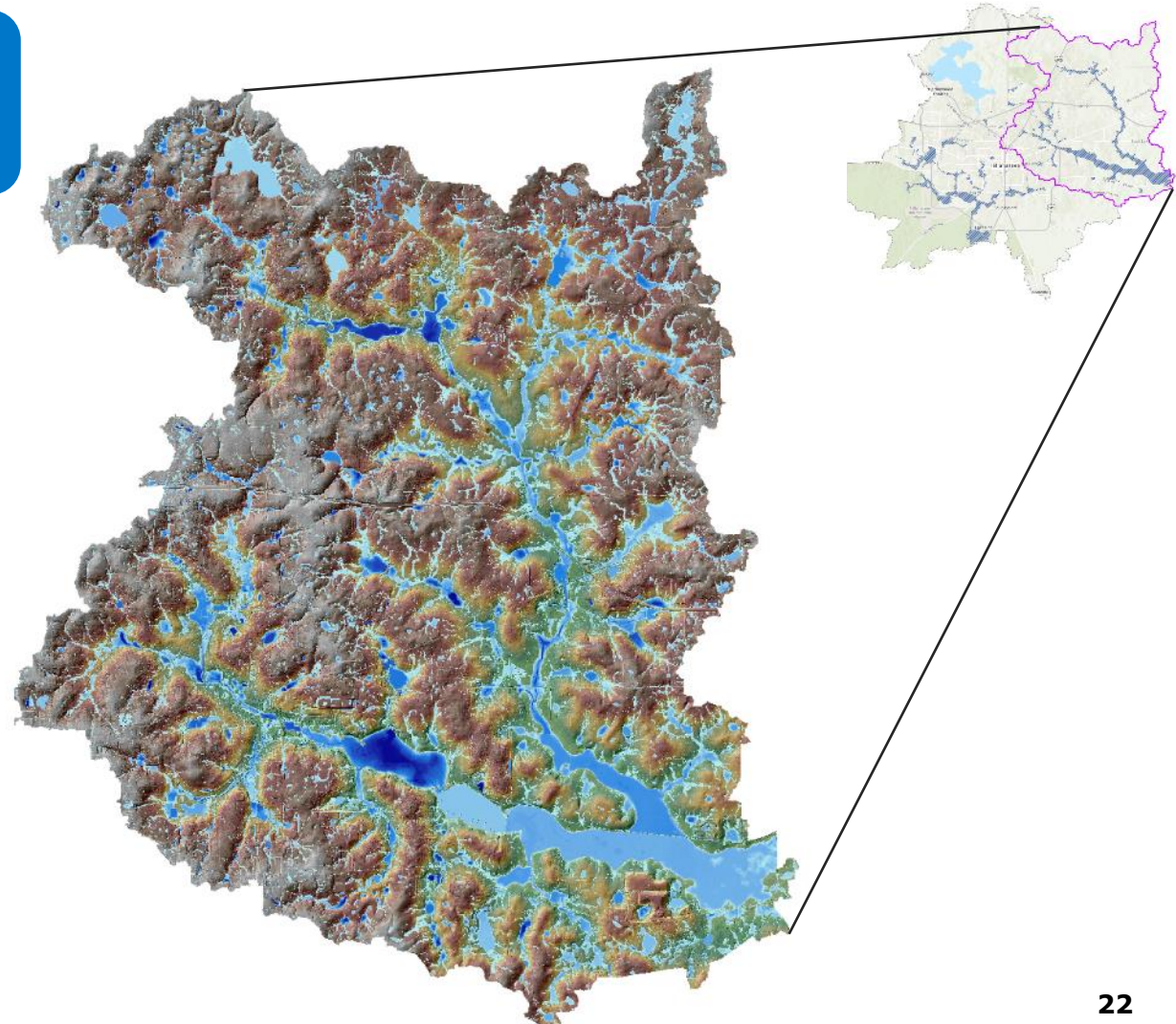
Tallahassee Inundation Extents: 13-Inches/1-Day



Tallahassee City-Wide Inundation Modeling

Pilot Area

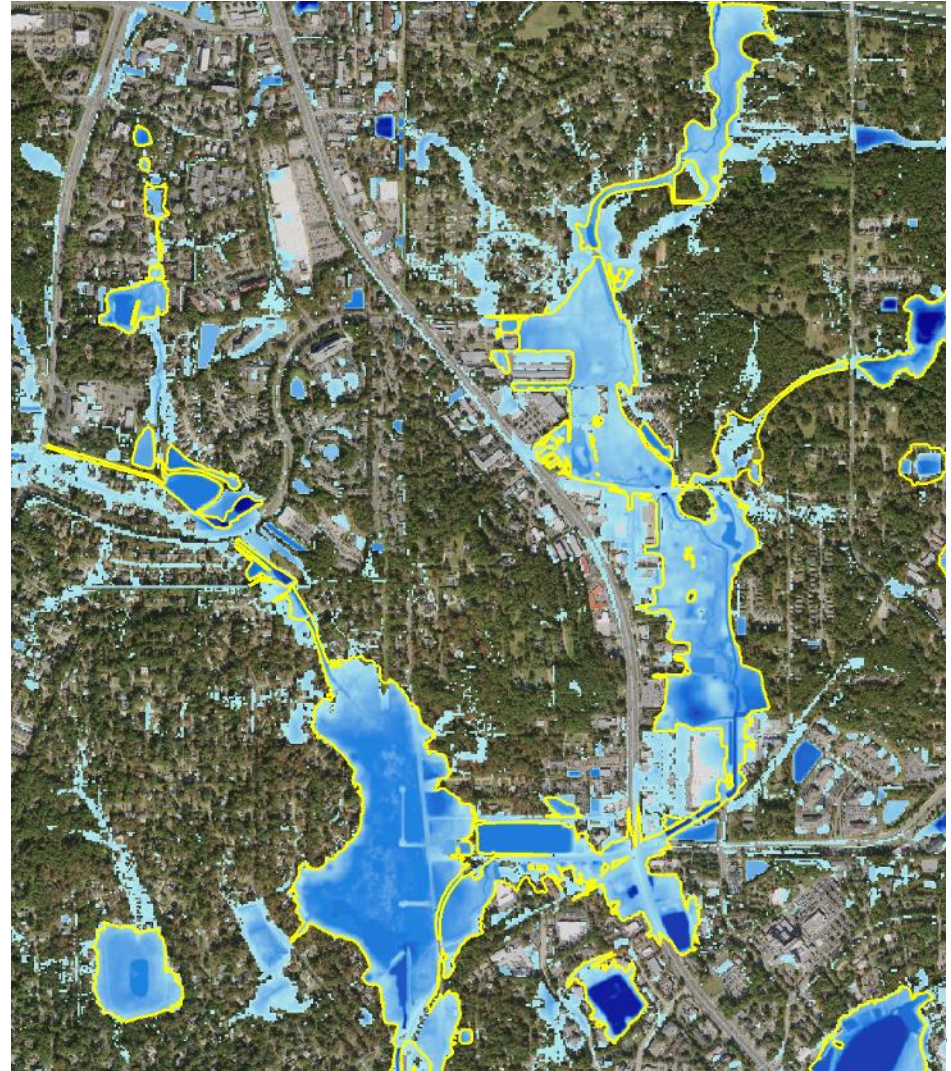
- Lake Lafayette Planning Area
- More detailed hydraulic analysis
- 85 square miles
- 15-foot resolution
- 10.5 million model cells



Tallahassee City-Wide Inundation Modeling

Pilot Area

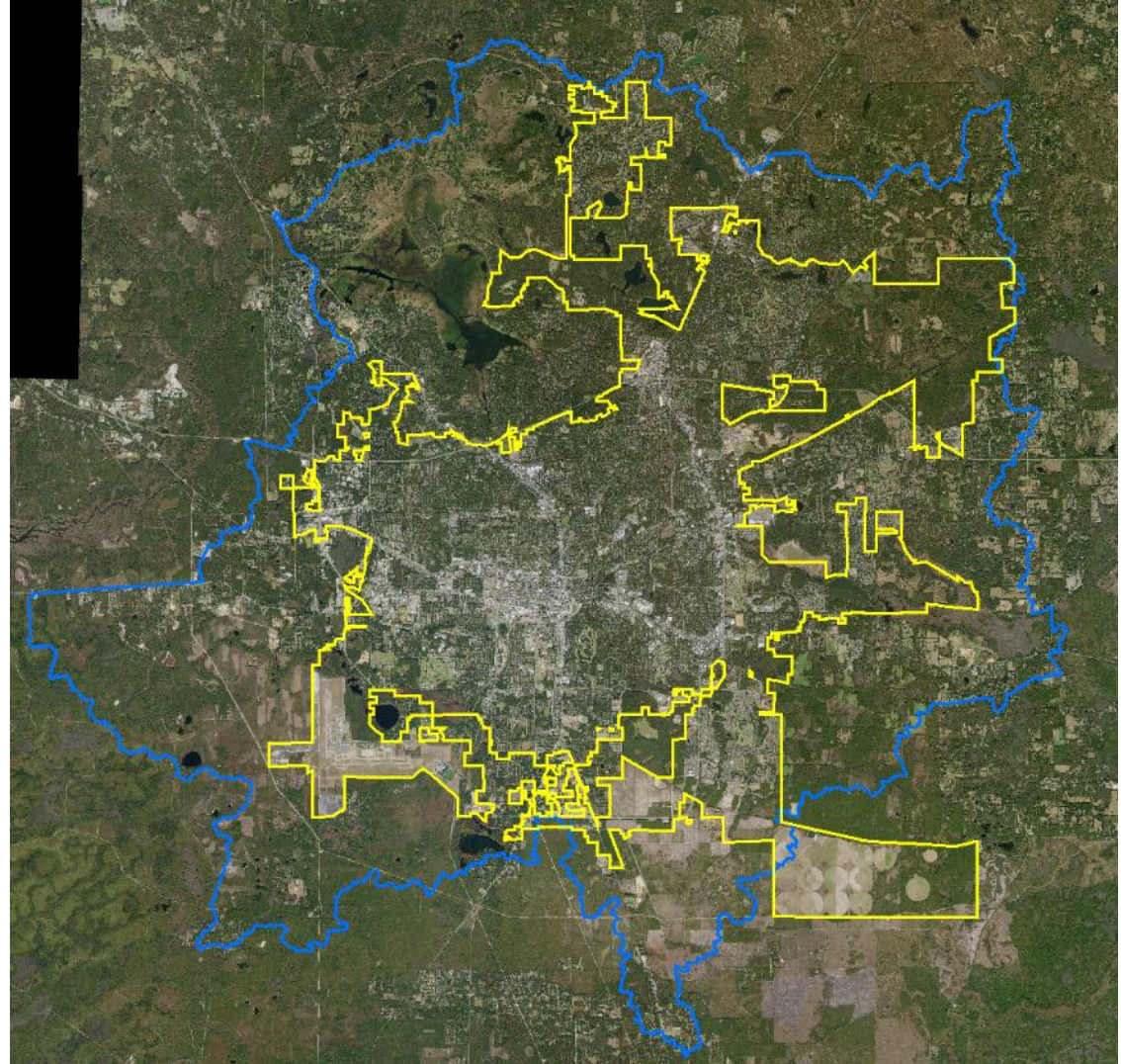
- Verified model against historic storm (RMSE = 0.95 feet)
- Compared to FEMA BFEs (RMSE ~ 1.5 feet)
- Identified glass wall in preliminary FIS



Tallahassee City-Wide Inundation Modeling

City-Wide Model

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



Model Inputs

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



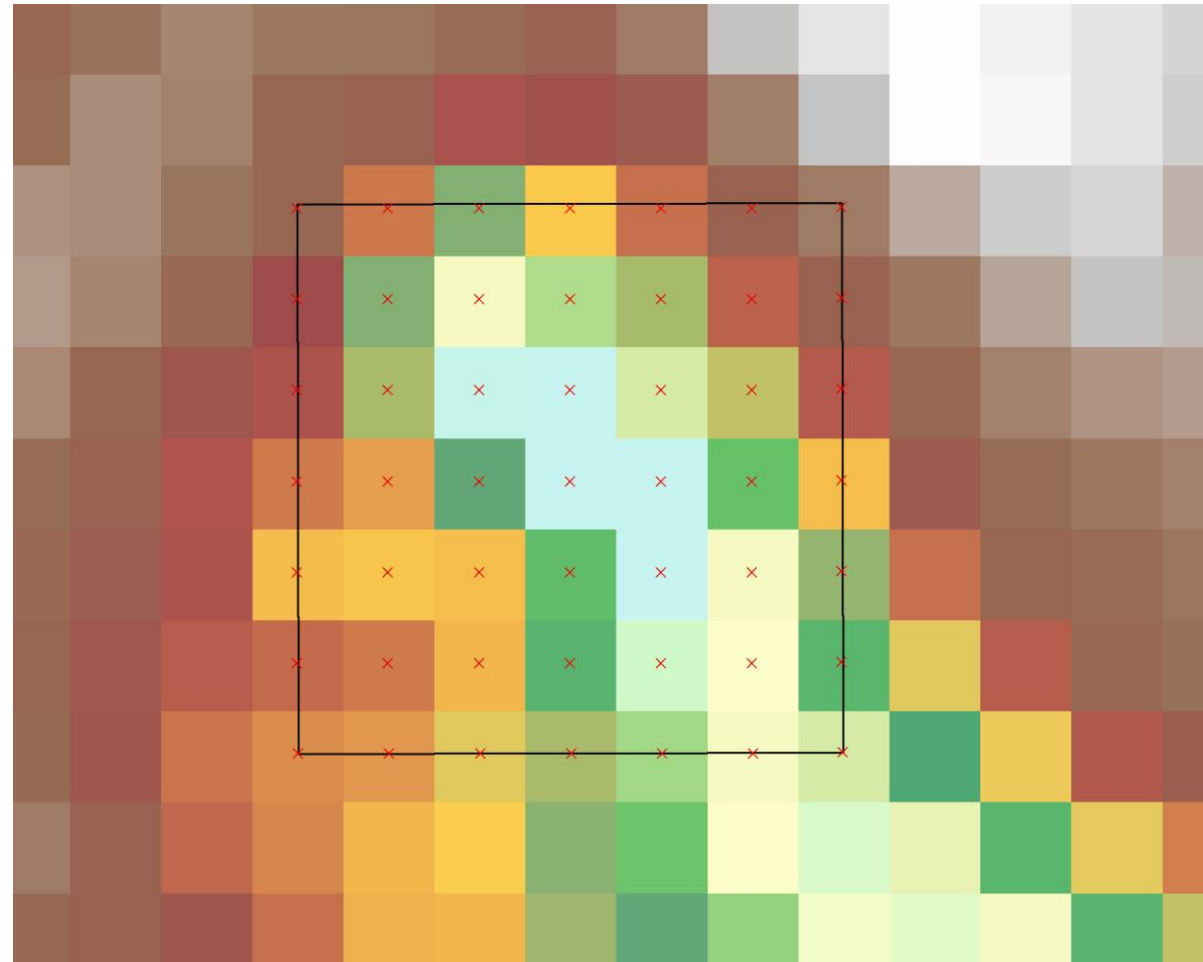
Model Inputs

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



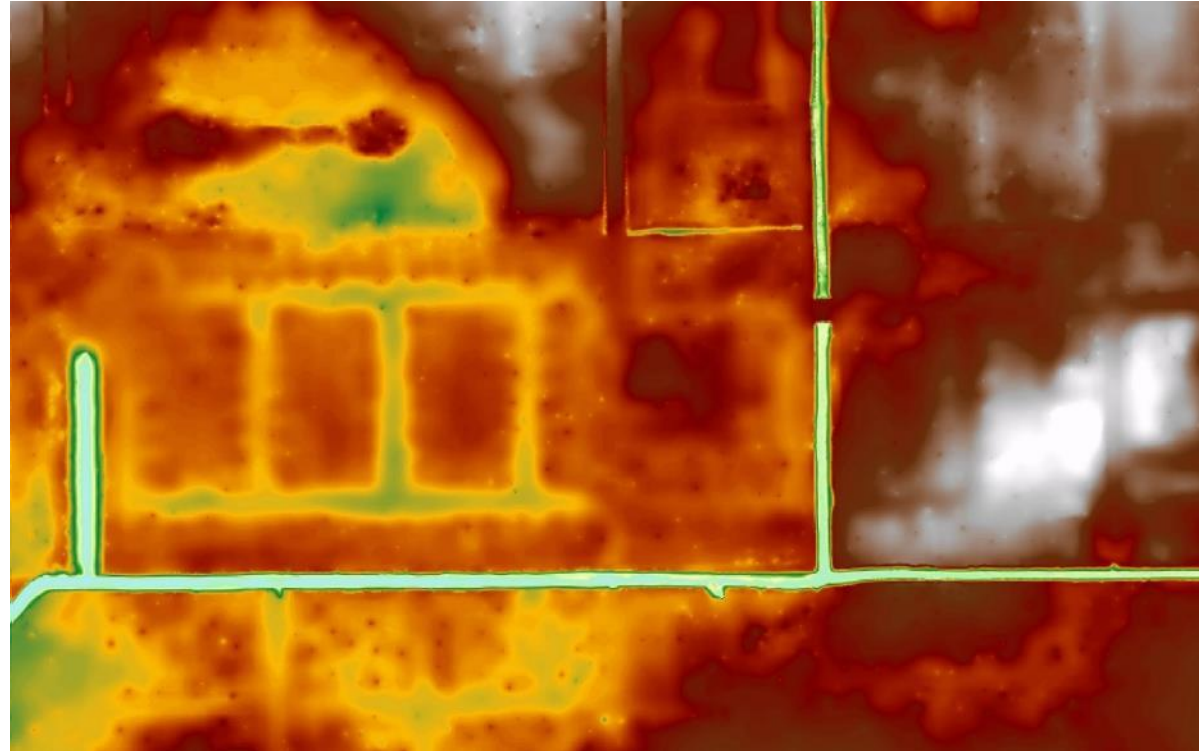
Sub-Grid Sampling

- 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



Tallahassee City-Wide Inundation Modeling



- ✓ Identifying Design Storms to Simulate City-wide inundation
- ✓ Approach for sharing results
- ✓ Model updates & Enhancements
- ✓ Model maintenance



“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

FIRST STREET FOUNDATION Mission Flood Lab API Flood Factor Team Press

First Street Foundation Mission

First Street Foundation is a non-profit research and technology group defining America’s Flood Risk.

Flooding is the most expensive natural disaster in the United States, costing over \$1 trillion in inflation adjusted dollars since 1980. While institutional real estate investors and insurers have been able to privately purchase flood risk information from for-profit companies, the majority of Americans have relied on Federal Emergency Management Agency (FEMA) maps to understand their risk. However, FEMA maps were not created to define risk for individual properties. This leaves millions of households and property owners unaware of their true risk. There has long been an urgent need for accurate, property level, publicly available flood risk information in the United States. In a mission to fill that need, First Street Foundation has built a team of leading modelers, researchers, and data scientists to develop the first comprehensive, publicly available flood risk model in the United States. By democratizing this peer-reviewed flood risk data, First Street Foundation is correcting an asymmetry of information in the United States, empowering Americans to protect their most valuable assets—their homes—from flooding.

Many areas in the U.S. are still unmapped by FEMA (white).

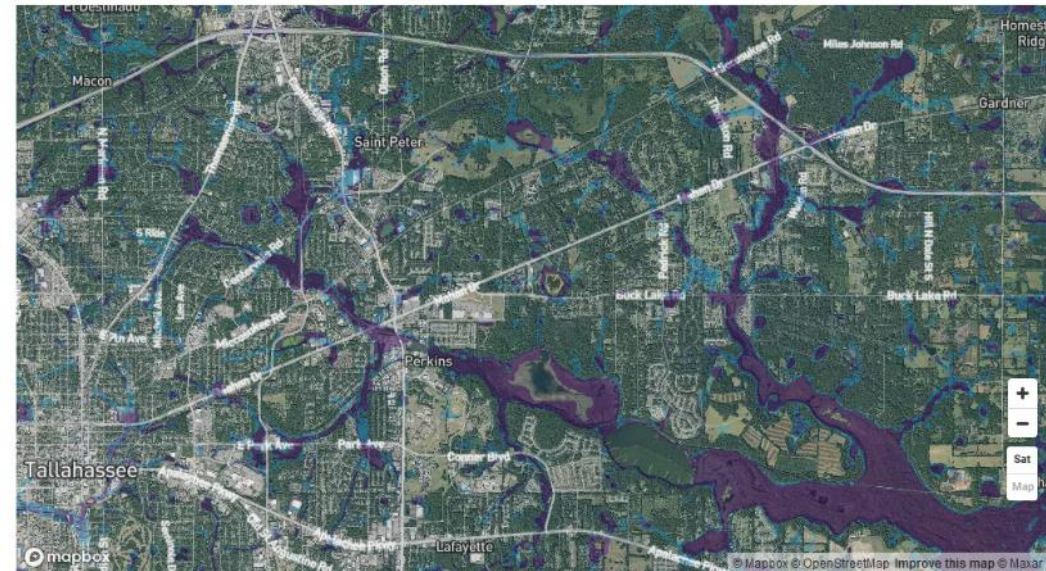
Using cutting edge modeling techniques, the Foundation’s team has calculated and made public the past, present, and future flood risk of every home and property in the contiguous United States. People can freely access the property-specific information of 142 million private and public properties at FloodFactor.com, where every property is now accompanied by a Flood Factor™, a risk score ranging from 1 to 10. This number reflects a property’s risk of flooding over the course of a 30 year mortgage.

PAST FLOOD CURRENT RISK FUTURE RISK

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



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

Provide “flood factor” scope 1 – 10 for every property in United States

Make flood risk information very accessible

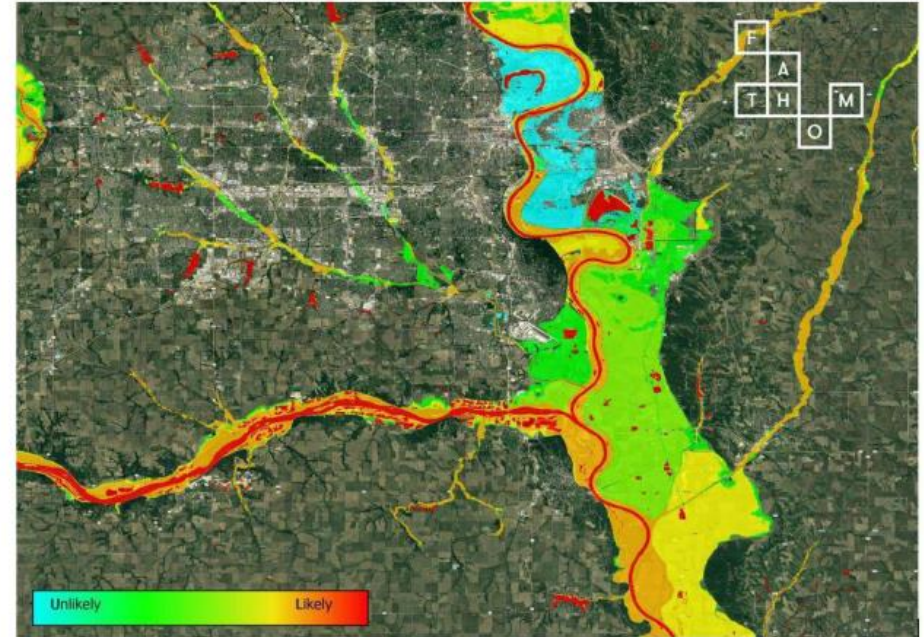
The screenshot shows a realtor.com listing for a property at 3308 N Ridge Rd, Tallahassee, FL. The listing includes a photo of the house, a price of \$149,900, and a FEMA Zone AE (est.) with a Flood Factor of 4/10. A map overlay shows the property location and flood risk information. The listing is presented by Patty Wilson with The Brokerage. The property is a single-family ranch built in 1964, with 4 bedrooms, 2.5 bathrooms, and 2,305 sqft. The status is 'For Sale'. The listing includes a 'More about this property' section with fields for Full Name, Email, and Phone, and a 'Get pre-approved by a lender' checkbox. A red 'Email Agent' button is also present. The listing includes a 'Veterans: Check Eligibility for a \$0 Down VA Loan Online | Be Ready to Buy. How Much Can I Borrow?' link. The listing includes a 'Map data ©2020 Google' overlay with a 'Commute time' and 'Noise: Medium' indicator. A 'FEMA Zone AE (est.) • Flood Factor 4/10 NEW' overlay is also present. The listing includes a 'Get Up To 4 Free Moving Quotes' link. The listing includes a 'Property Type' section with 'Single Family' and 'Ranch' options. The listing includes a 'Year Built' section with '1964'. The listing includes a 'Style' section with 'Ranch'. The listing includes a 'Status' section with 'For Sale'. The listing includes a 'Ask a question' and 'Share this home' button.

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



First Street Foundation

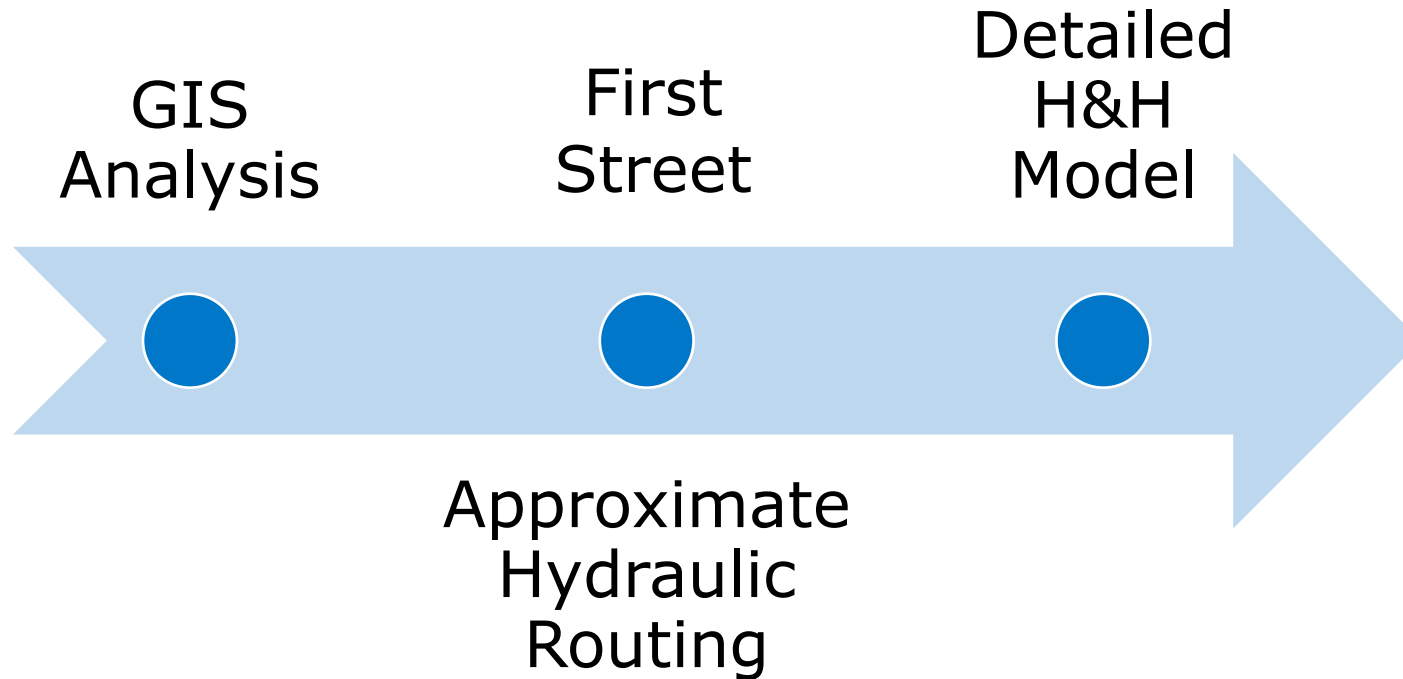
Rain-on grid – watershed < 20 square miles

LISFLOOD-FP - 100-foot grid

Flood mapping downscaled to 10-foot grid

Does not consider stormwater infrastructure





First Street Foundation



Rapid Inundation Mapping – An Alternative City Lead Approach



First Street Foundation



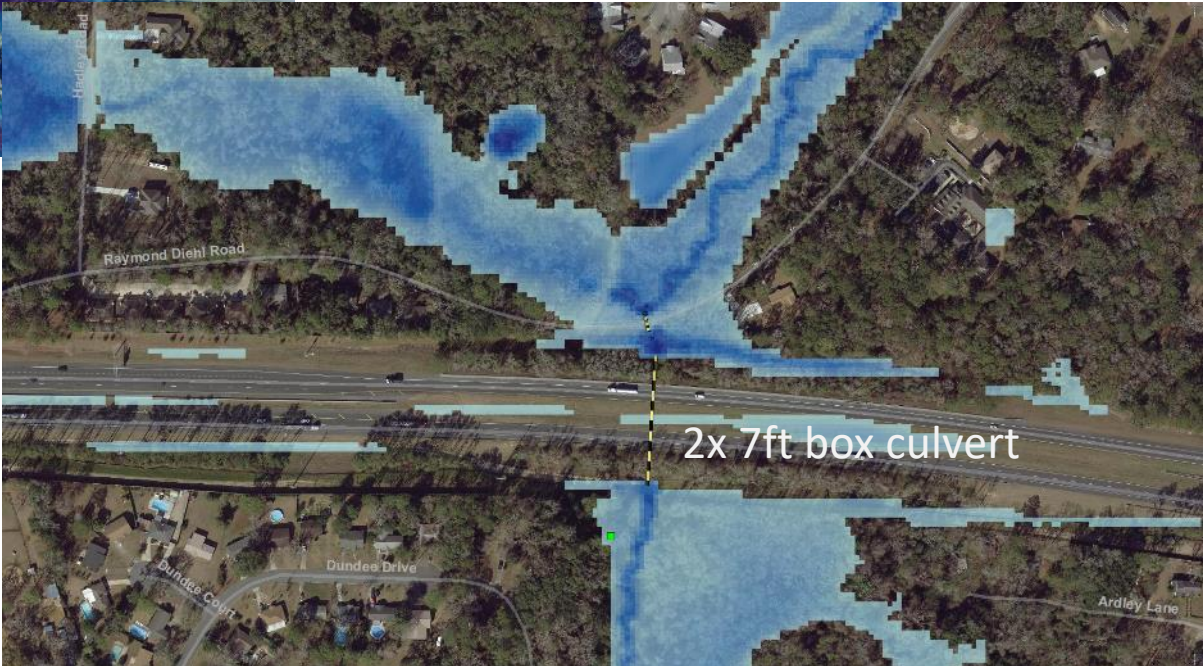
Rapid Inundation Mapping – An Alternative City Lead Approach



First Street Foundation



Rapid Inundation Mapping – An Alternative City Lead Approach

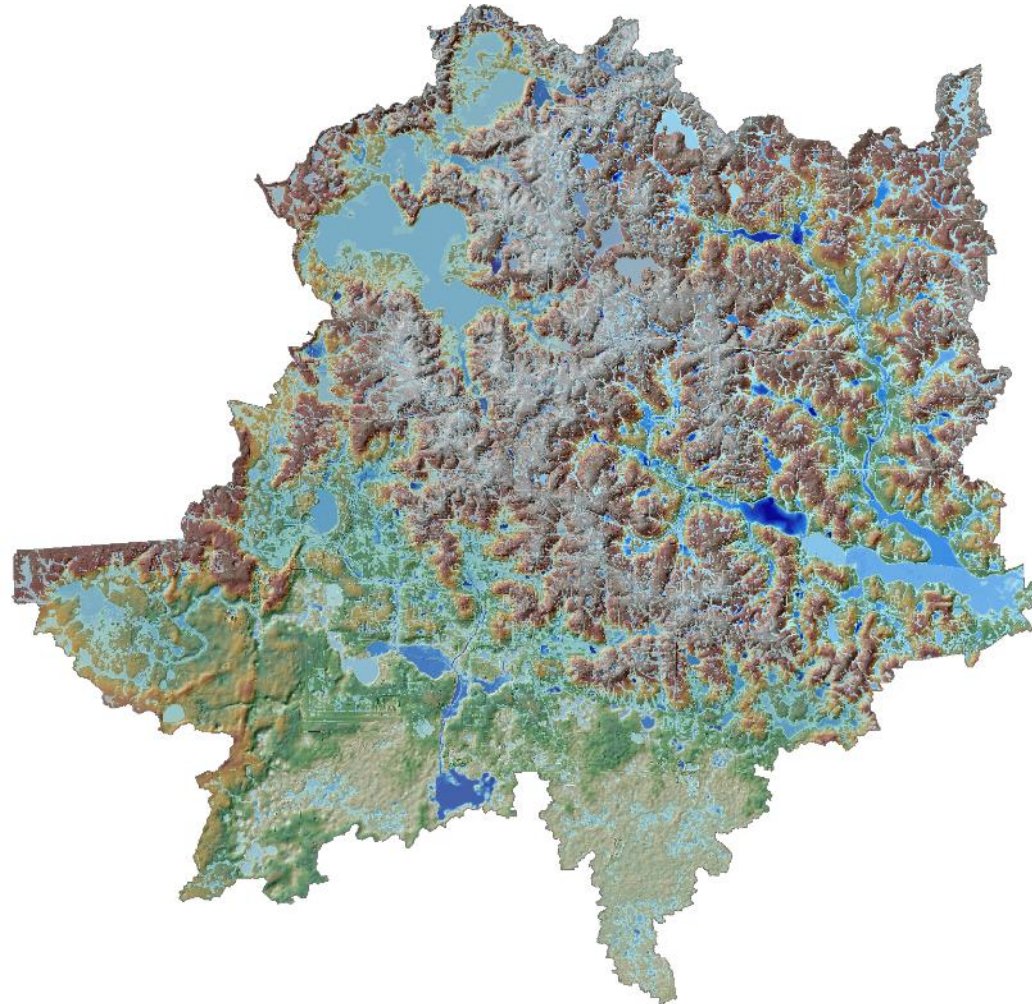


Continuum of Flood Screening Tools

Continuous improvements in data and computing

Selecting appropriate approach is important

High-Resolution City-wide inundation modeling provides a valuable tool



Rapid Inundation Mapping – An Alternative City Lead Approach

QUESTIONS?

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