Using Rapid Flood Inundation Modeling to Make Informed Decisions and Optimize Investments

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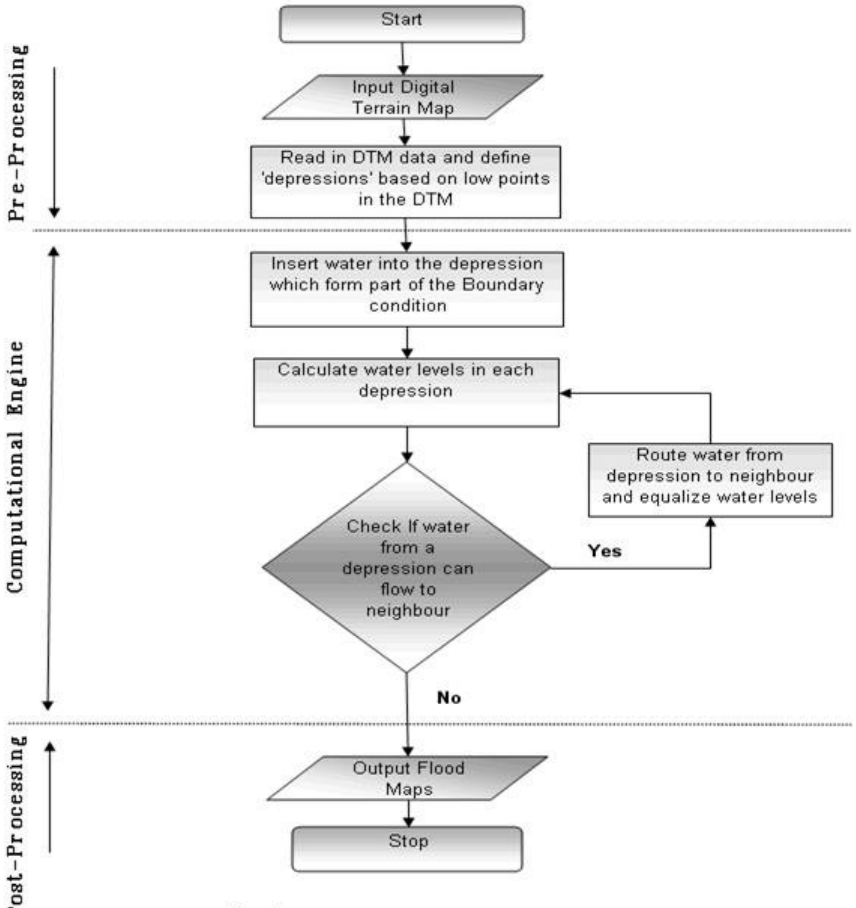
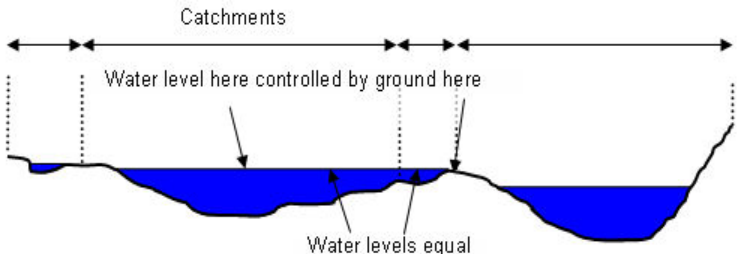
ch2m SM

So what is Rapid Inundation?

- Being able to answer the "*what if*" quickly and assess what is at risk
  - Optimize investment….risk-based planning
- Recent tools in the armoury (RFIM and Flood Modeller FAST in use)
- Flood Modeller FAST – uses simplified hydraulics, can be 1000x quicker than traditional detailed models; no infrastructure
- Benefits include:
  - Very quick to set up and run (just need DEM and inflows/rainfall)
  - May be sufficient for some areas or a screening tool to ID areas for more detail
  - Surface water flood modelling/mapping for large areas





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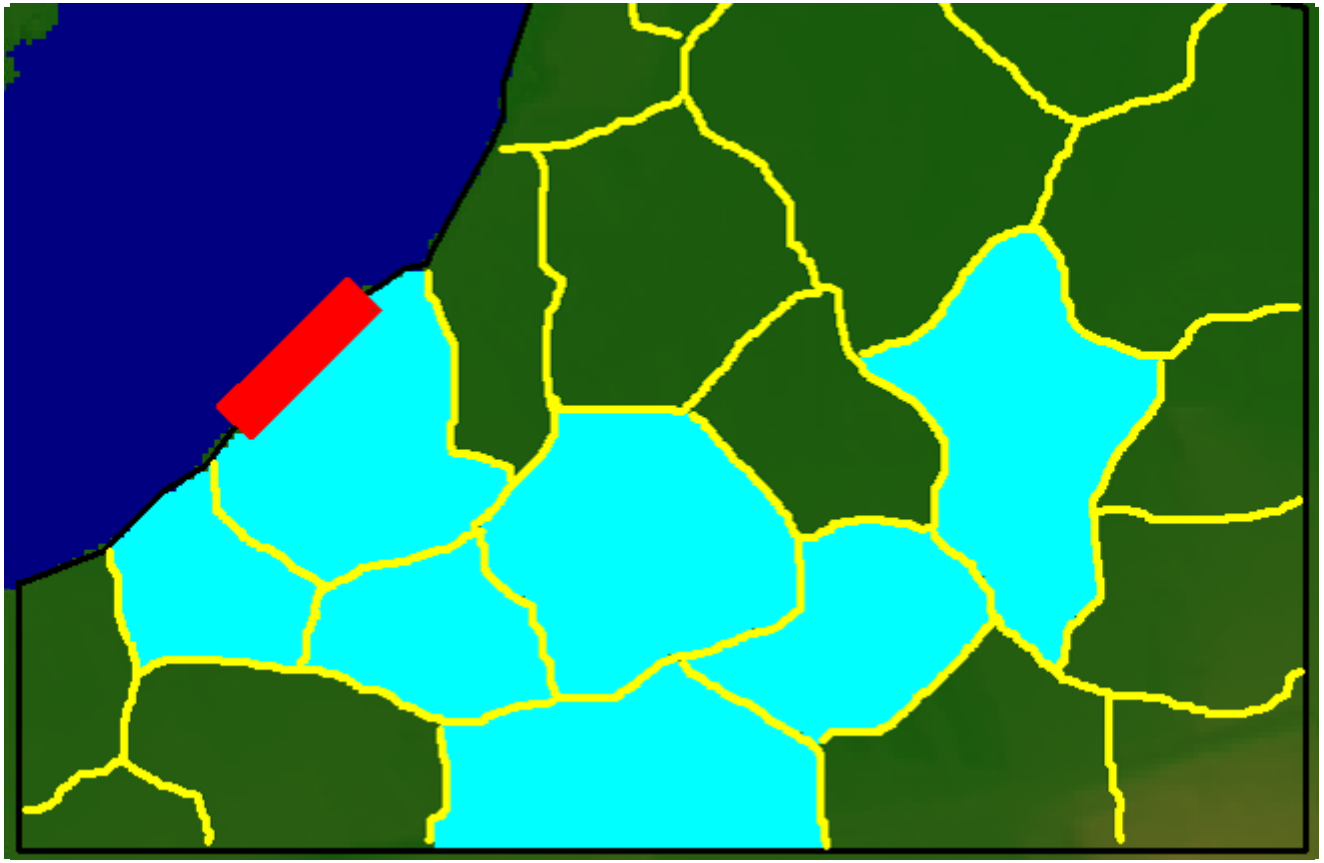
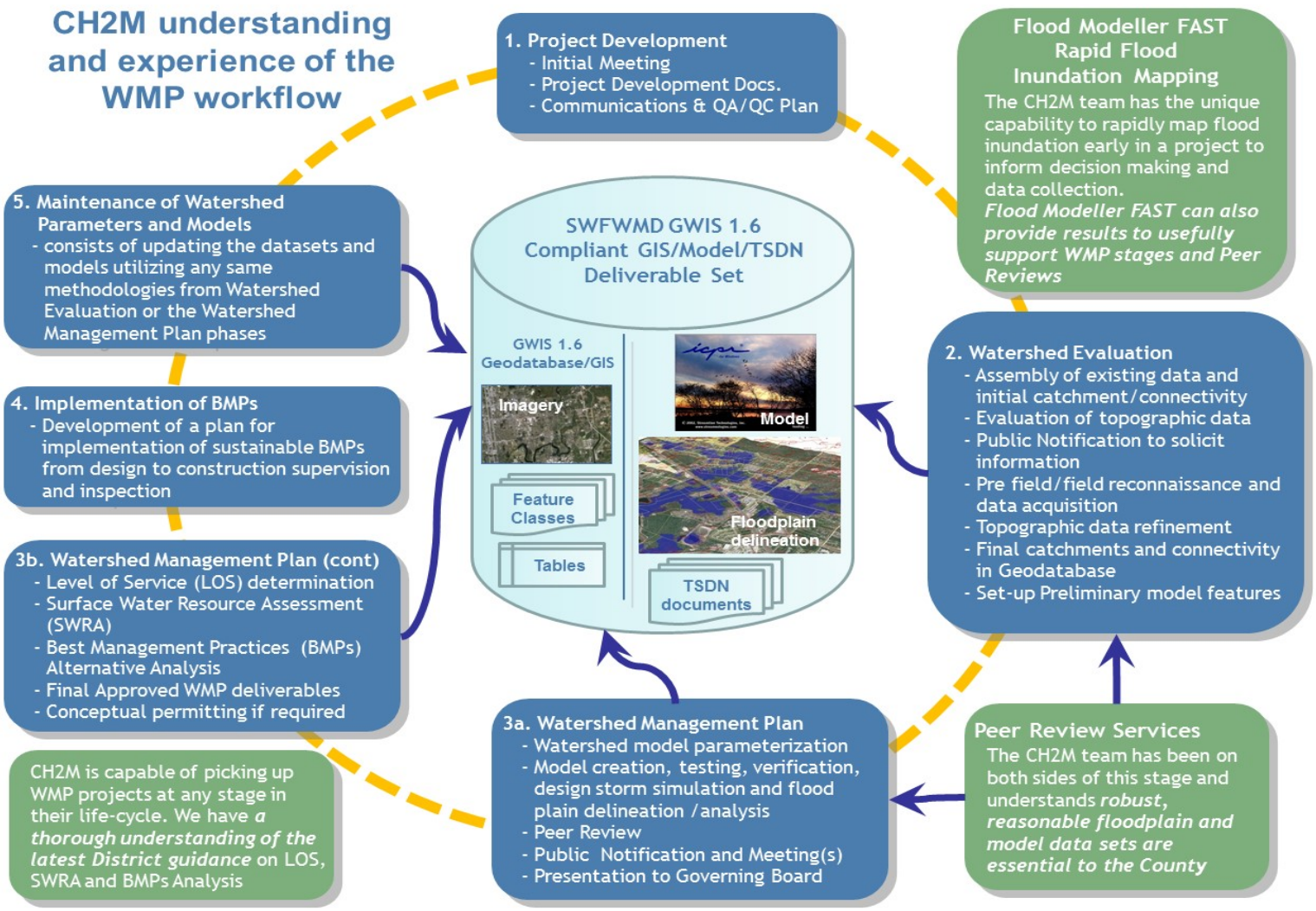
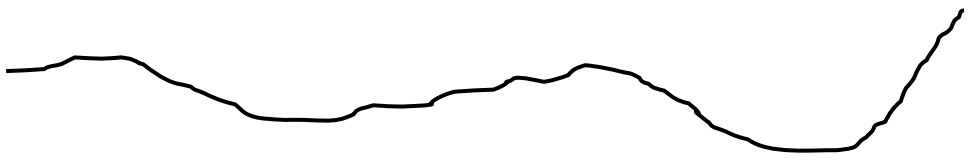


Southwest Florida Water Management District - WMP

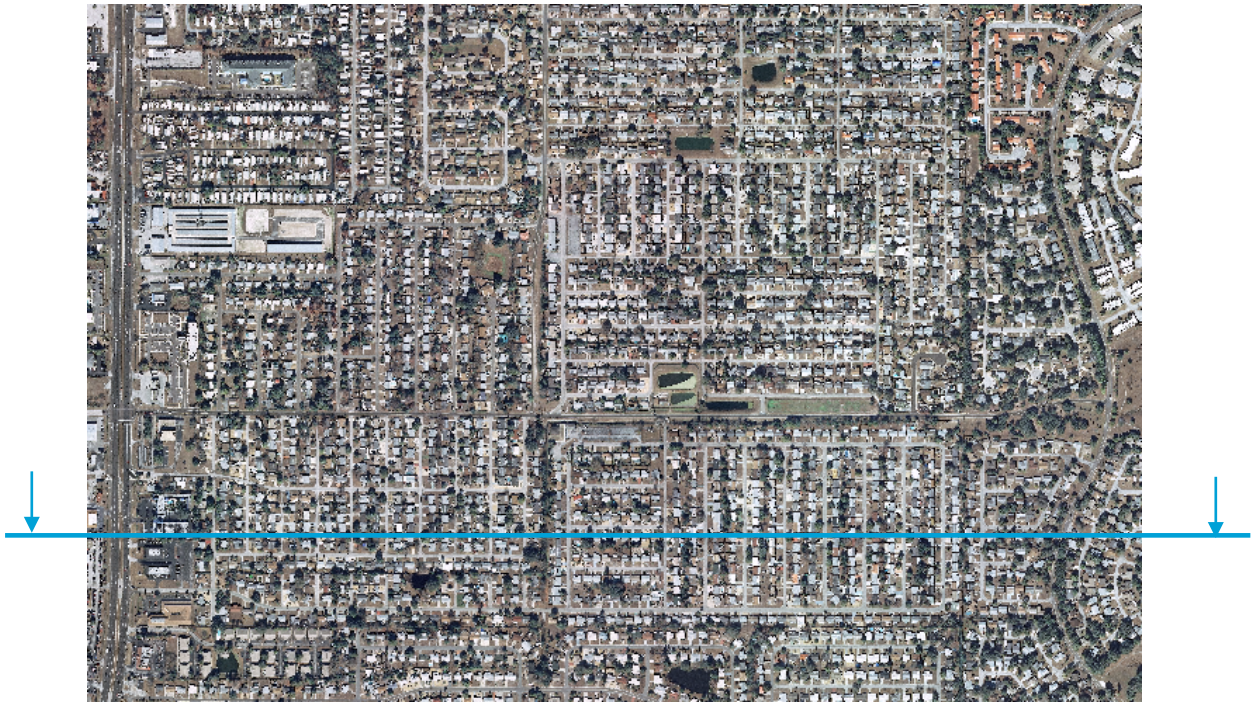


Leverage Testimonials

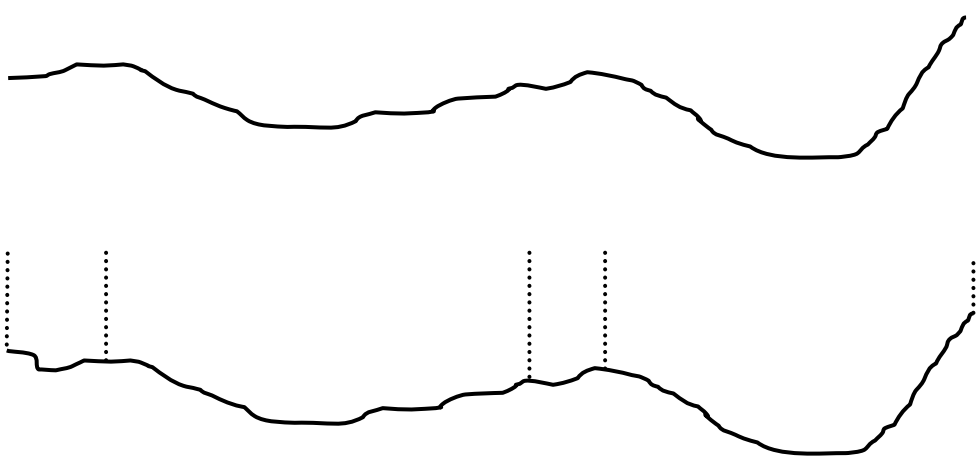
FAST Methodology



- Start with topography



FAST Methodology

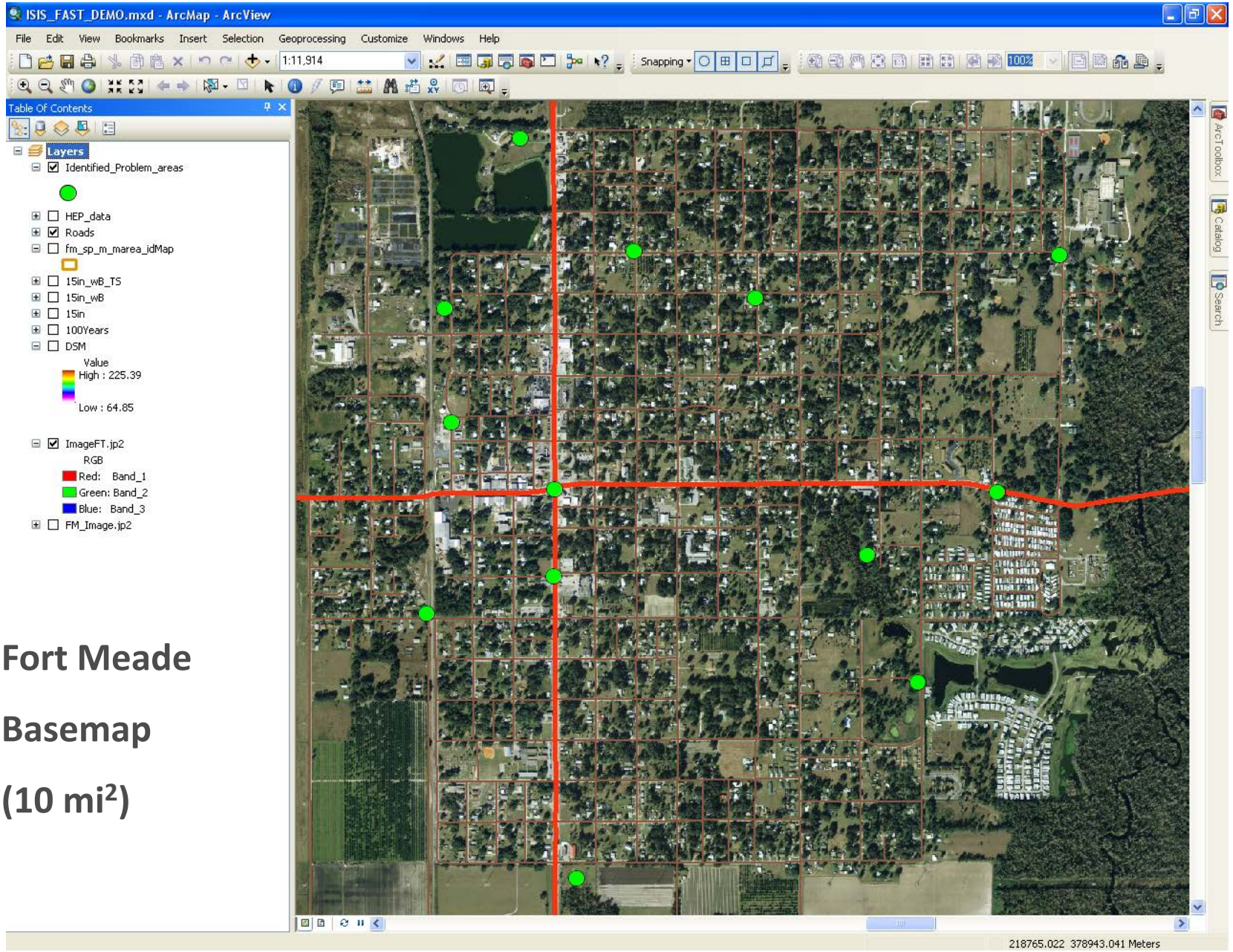


- Start with topography
- Split into catchments/depressions

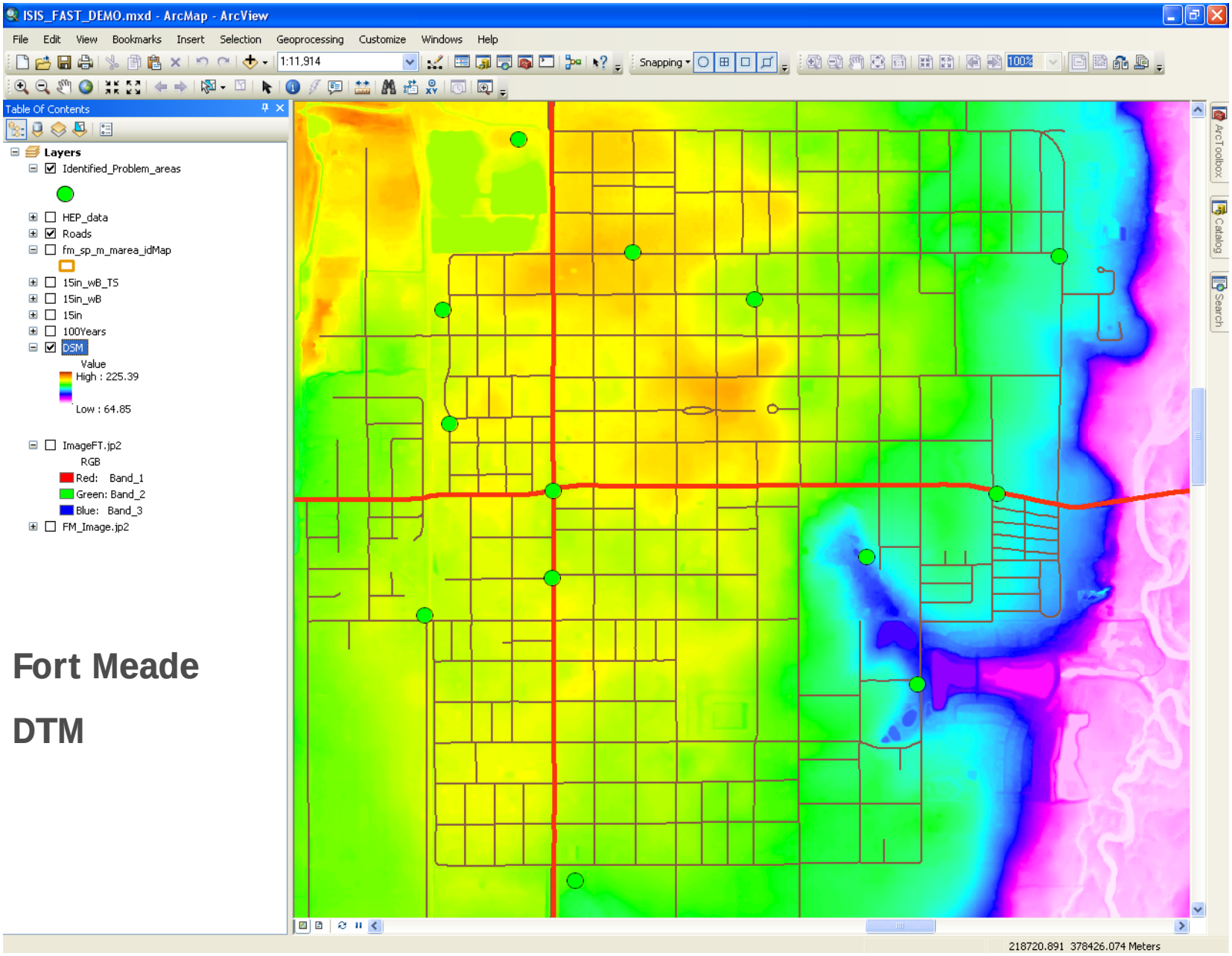
Fort Meade Example – Polk County Southwest Florida

- Using data that are already provided/generated for watershed evaluation
  - DTM
  - Rainfall
  - Aerial imagery

- Model set up and run for:
  - 100yr – 11in rainfall
  - Also 15in rainfall – representing longer duration or higher magnitude event

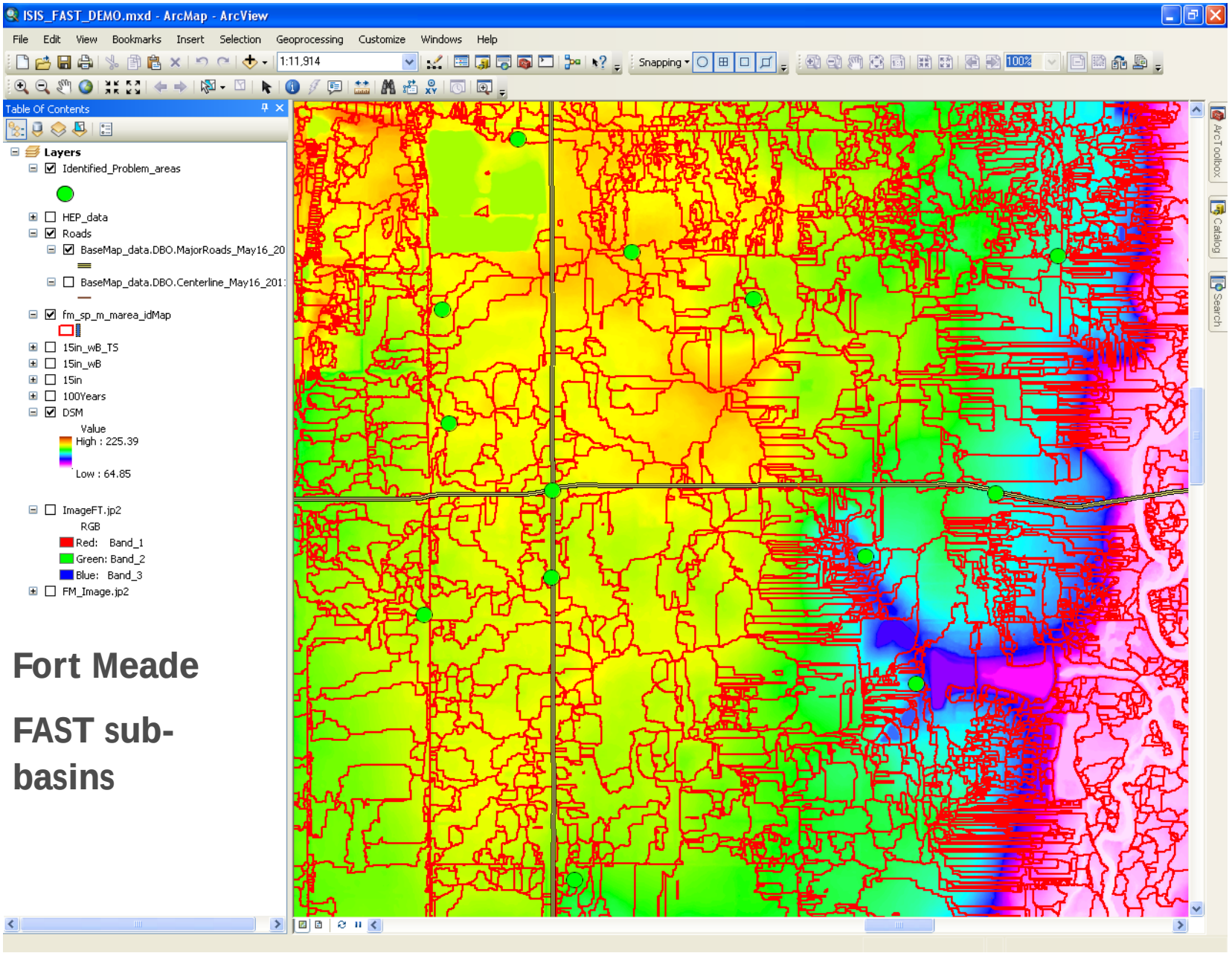


Fort Meade Basemap ($10\ mi^2$)



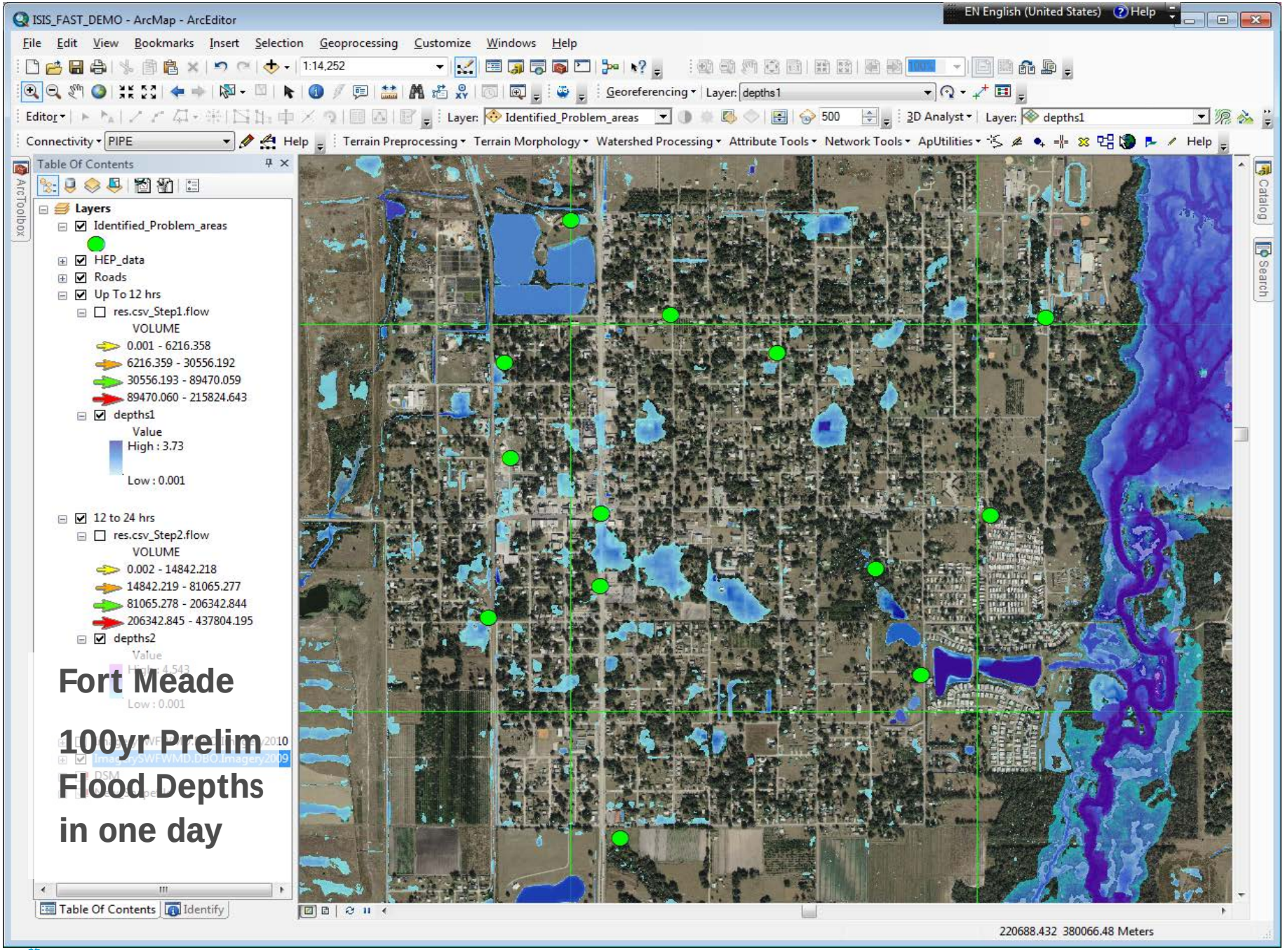
Fort Meade

DTM



Fort Meade

FAST sub-basins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EN English (United States)
Help
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
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Georeferencing
Layer: depths1
Editor
Layer: Identified_Problem_areas
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3D Analyst
Layer: depths1
Connectivity
PIPE
Help
Terrain Preprocessing
Terrain Morphology
Watershed Processing
Attribute Tools
Network Tools
ApUtilities
Help
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Roads
Up To 12 hrs
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12 to 24 hrs
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Fort Meade
100yr Prelim
Flood Depths
in one day
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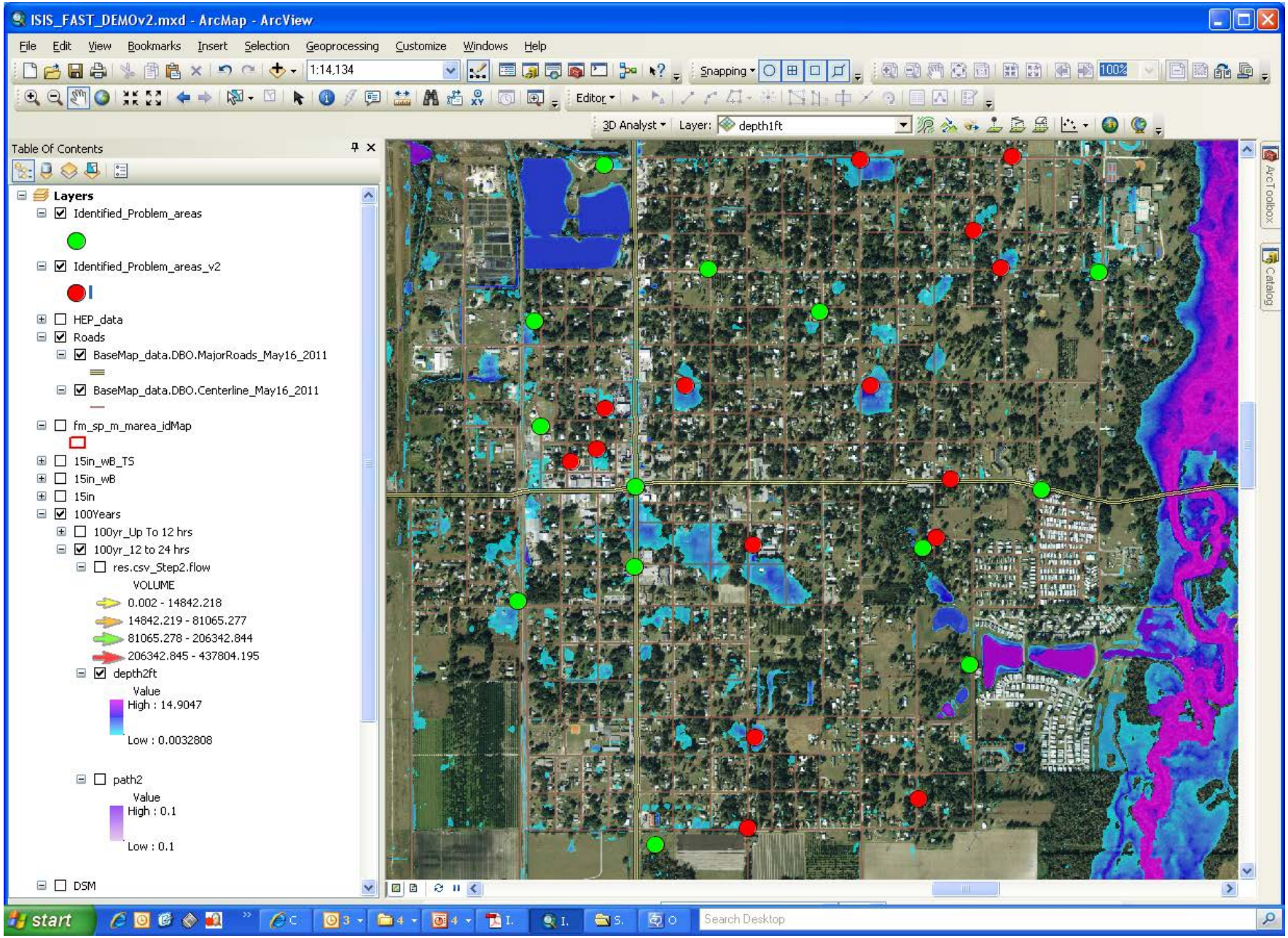
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3D Analyst
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15in_wB
15in
100Years
100yr_Up To 12 hrs
100yr_12 to 24 hrs
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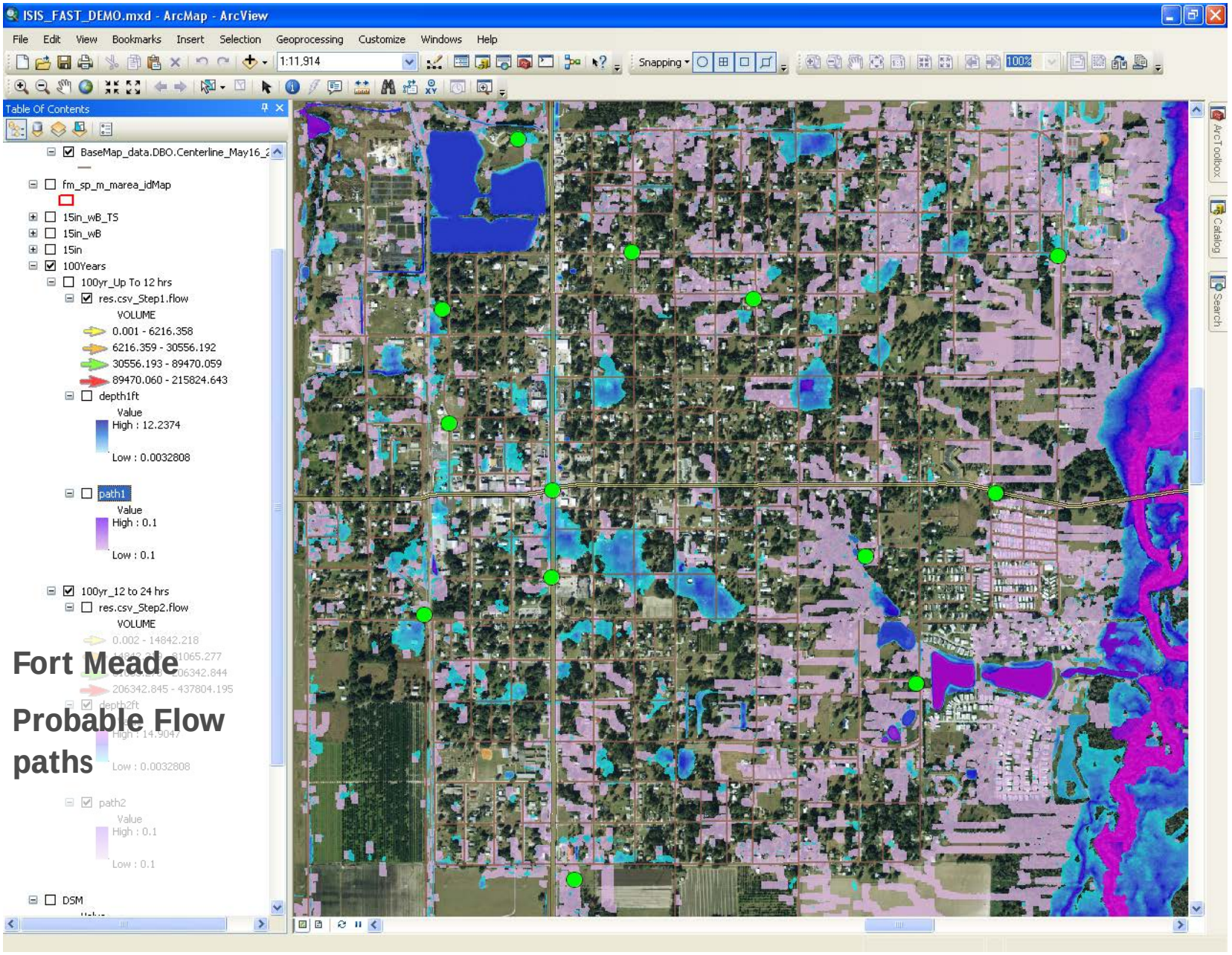
Low : 0.1
DSM
ArcToolbox
Catalog
start
Search Desktop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15in_wB
15in
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100yr_Up To 12 hrs
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100yr_12 to 24 hrs
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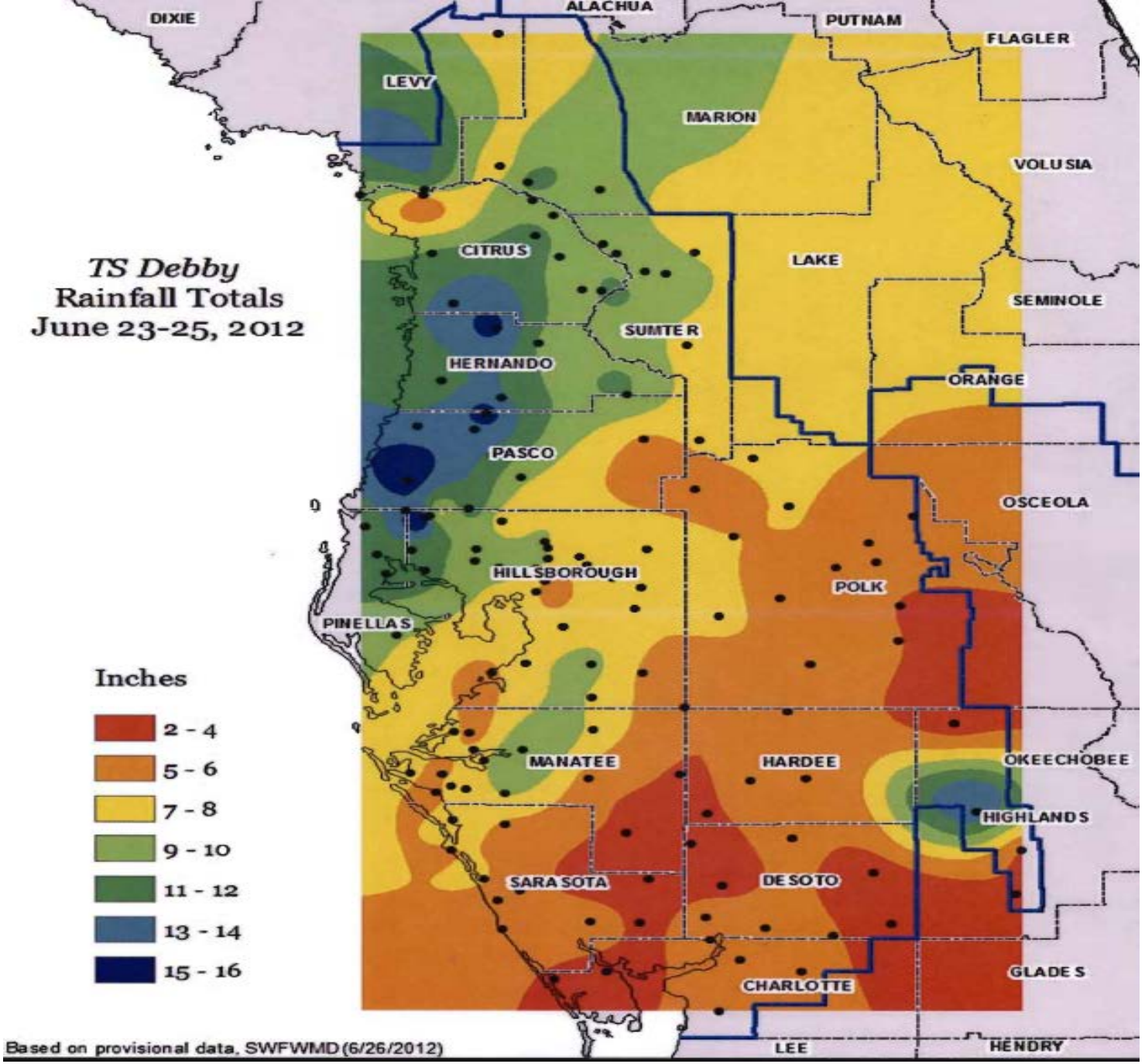
depth2ft
Low : 0.0032808
path2
Value
High : 0.1
Low : 0.1
DSM
ArcToolbox
Catalog
Search
Fort Meade
Probable Flow paths

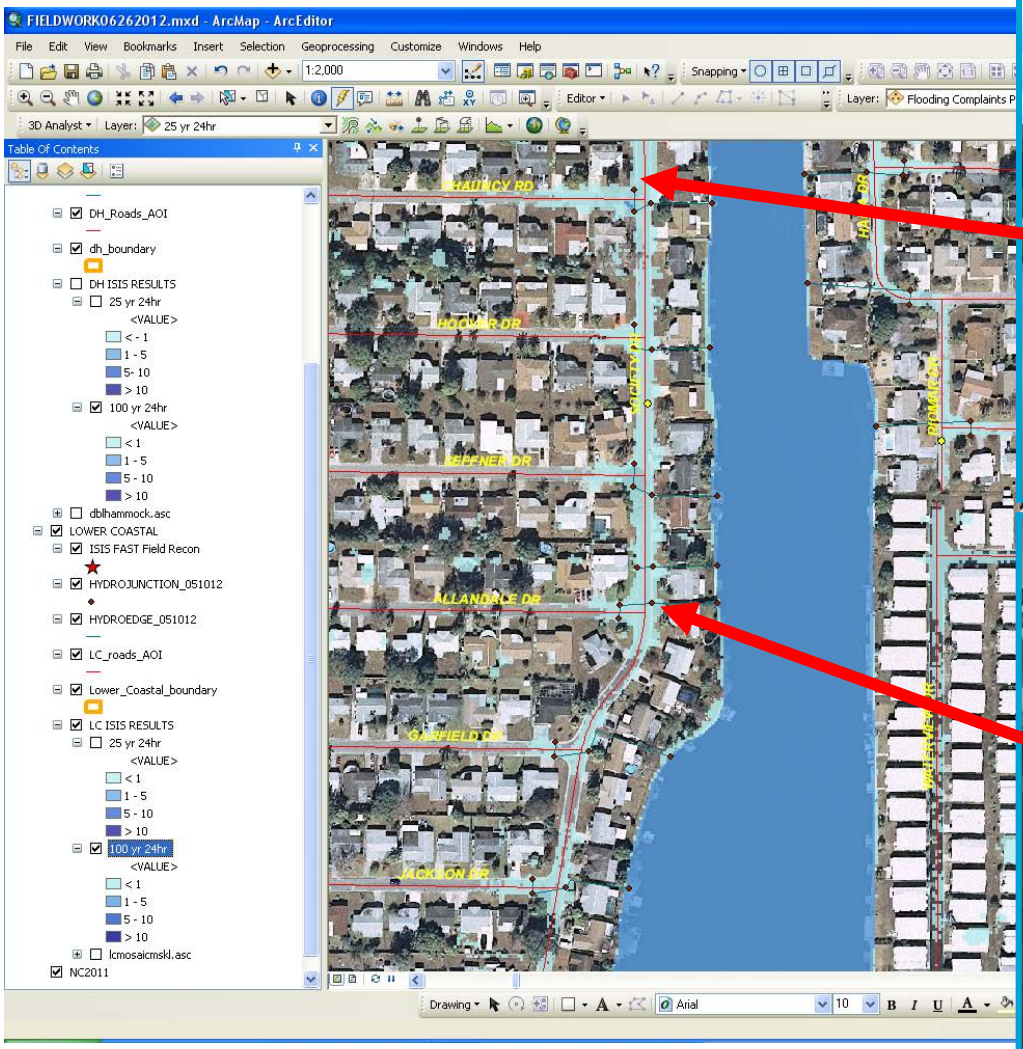
How was Rapid Flood Mapping Useful?

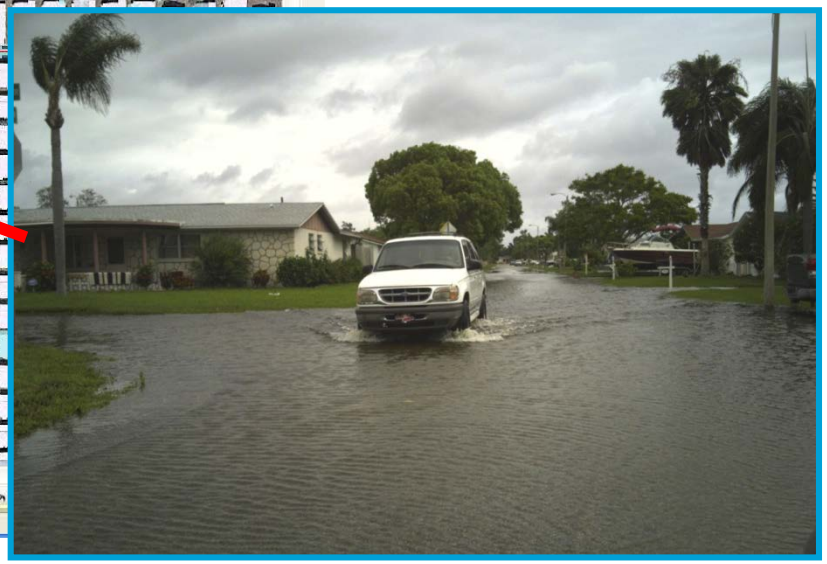
- FAST results provided the project team and stakeholders with a very early understanding of where the flood risks are.
- Facilitated the stakeholder recollections of areas with problems.
- This information guided the team on where to focus data collection and survey for detailed floodplain model work.
- Rapid flood inundation mapping tools help the users to understand flood flow mechanisms
- Aids detailed model conceptualization and construction

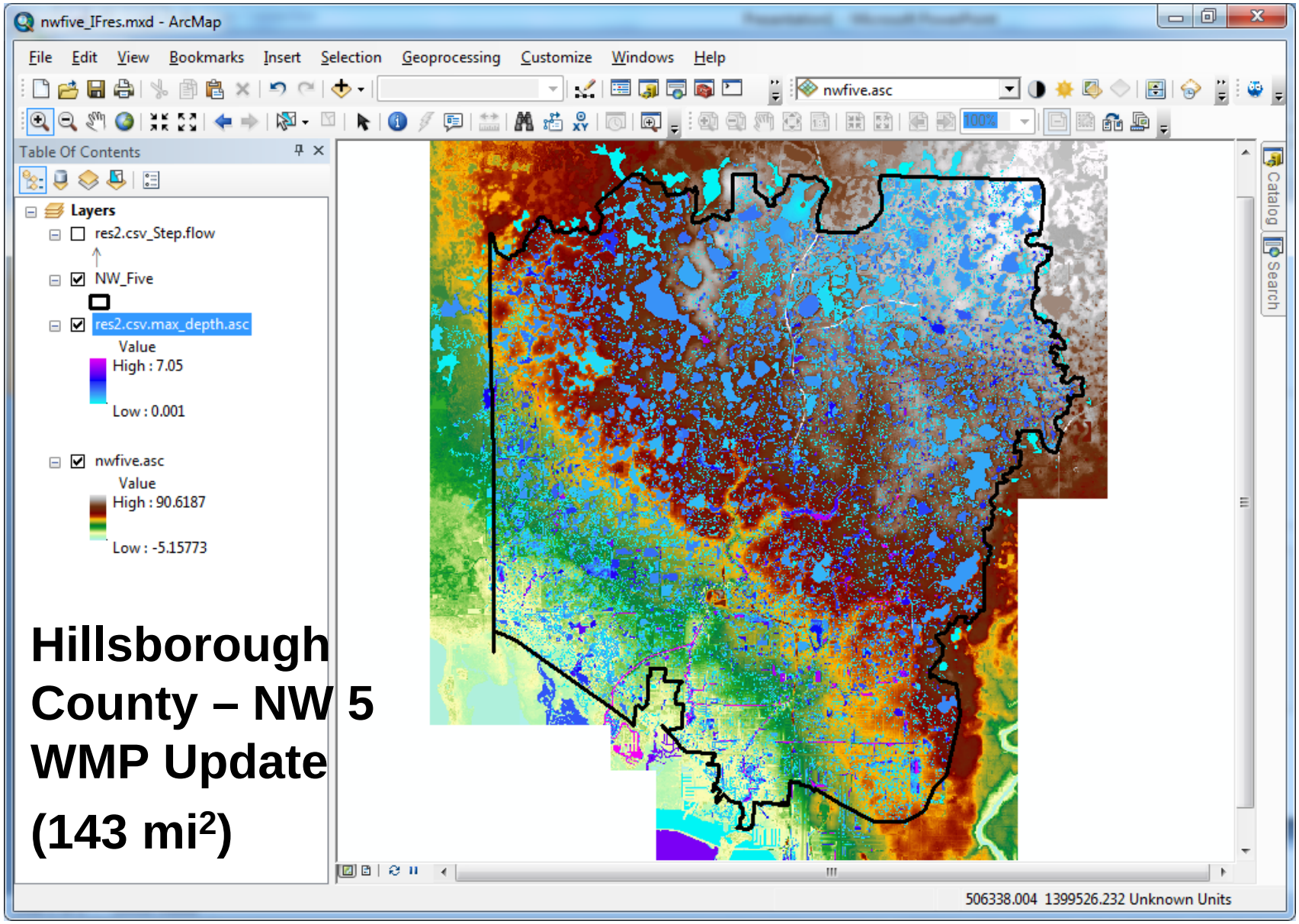
Incorporated into regional and other government units


TS Debby
Rainfall Totals
June 23-25, 2012
Inches
2 - 4
5 - 6
7 - 8
9 - 10
11 - 12
13 - 14
15 - 16
DIXIE
ALACHUA
PUTNAM
FLAGLER
LEVY
MARION
VOLUSIA
CITRUS
LAKE
SEMINOLE
SUMTER
HERNANDO
ORANGE
PASCO
OSCEOLA
HILLSBOROUGH
POLK
PINELLAS
MANATEE
HARDEE
OKEECHOBEE
HIGHLANDS
SARASOTA
DESOTO
GLADES
CHARLOTTE
LEE
HENDRY
Based on provisional data, SWFWMD (6/26/2012)

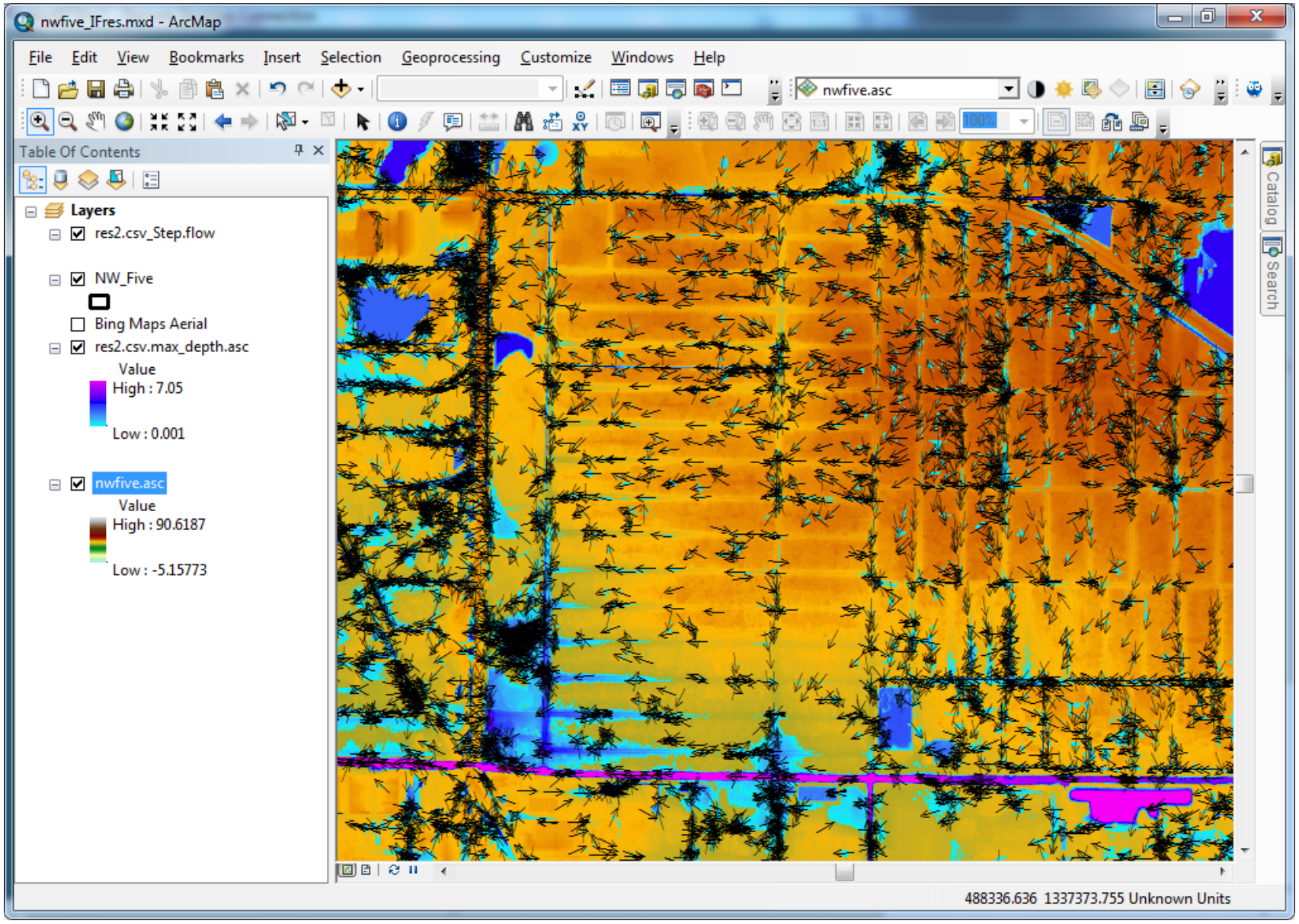
FAST vs Tropical Storm Debby







Hillsborough County – NW 5 WMP Update (143 mi²)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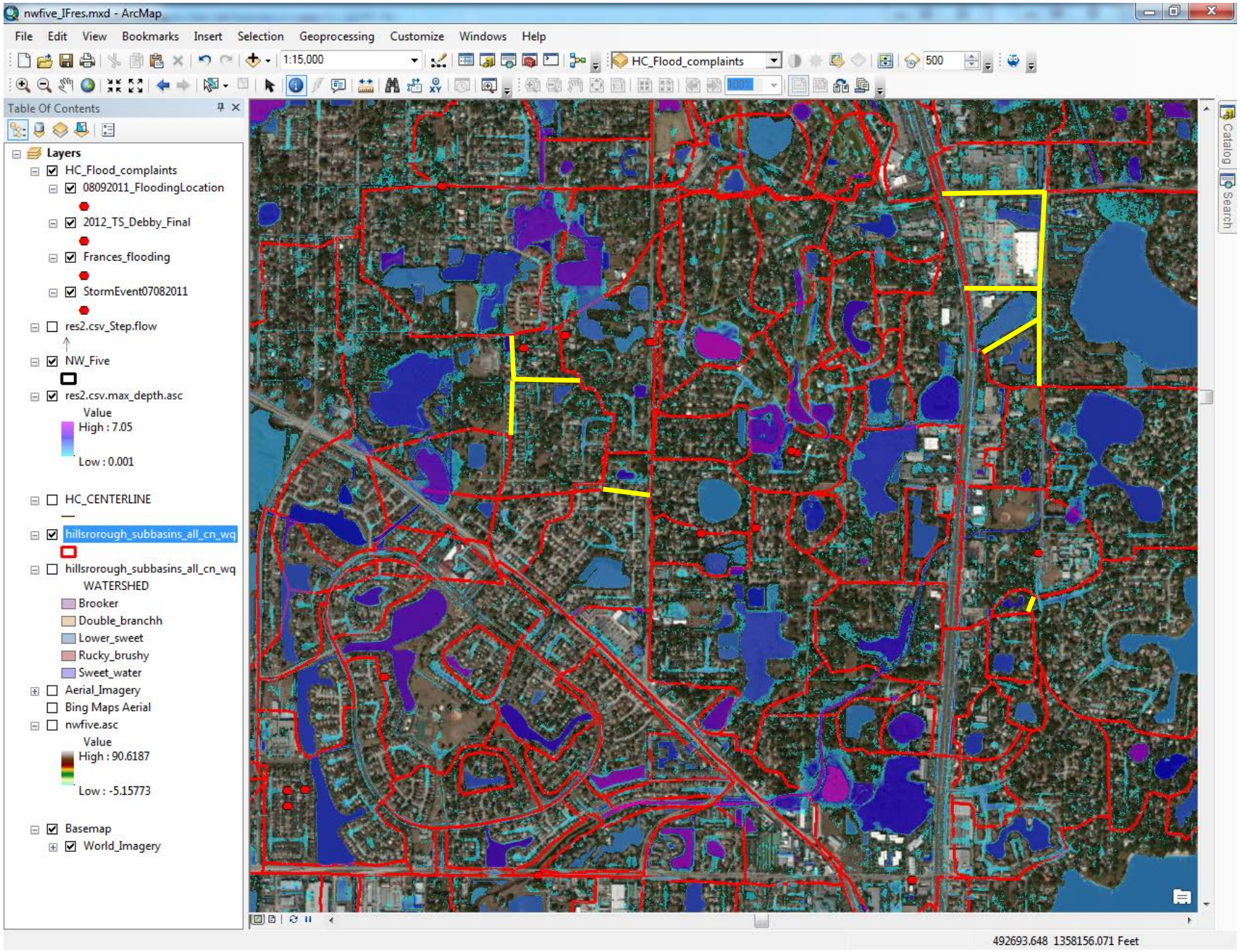
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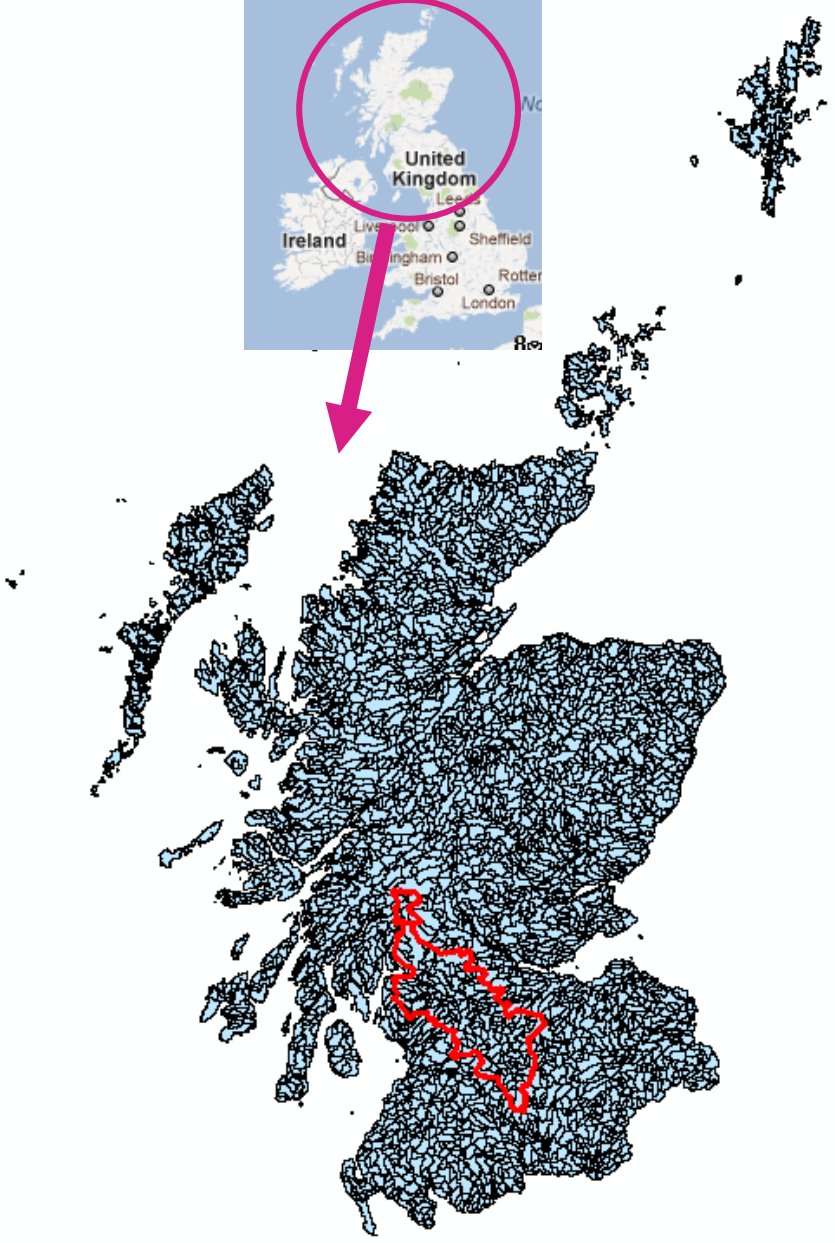
hillsrorough_subbasins_all_cn_wq
WATERSHED
Brooker
Double_branchh
Lower_sweet
Rucky_brushy
Sweet_water
Aerial_Imagery
Bing Maps Aerial
nwfive.asc
Value
High : 90.6187
Low : -5.15773
Basemap
World_Imagery
Catalog
Search
492693.648 1358156.071 Feet

National Pluvial Flood Map of Scotland

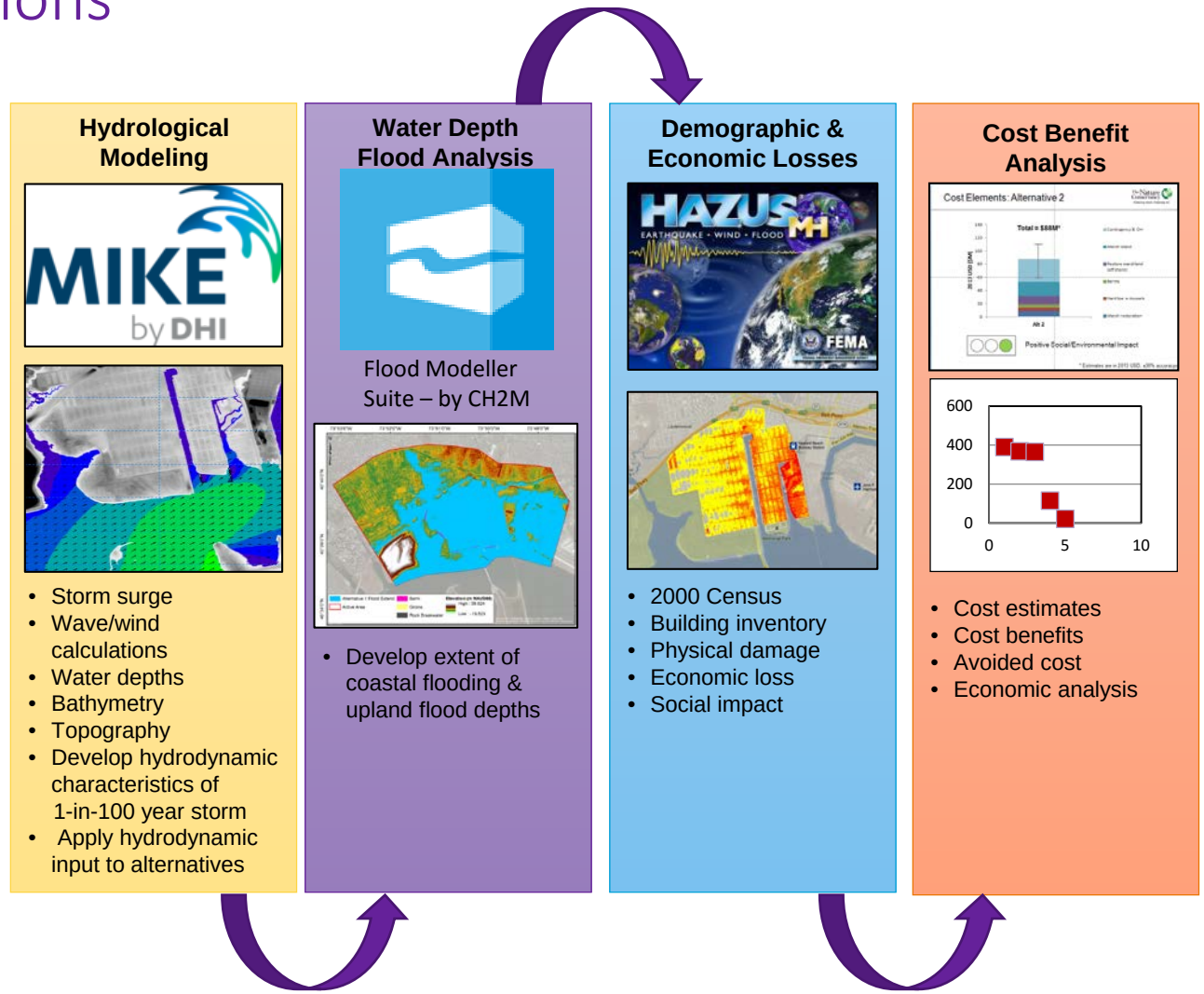
- Started Sept 2010
- All Scotland completed March 2011
- Phase 1 of project was pilot – Glasgow / Clyde / Loch Lomond (1500 sq mi)
- Total area 30,400 sq mi (=3/5 Alabama)
- Balances: Data, data processing, method, computational demands – accuracy requirements & programme constraints
- Used best available national datasets
- Applied Nationally consistent method
- About 4000 catchment models



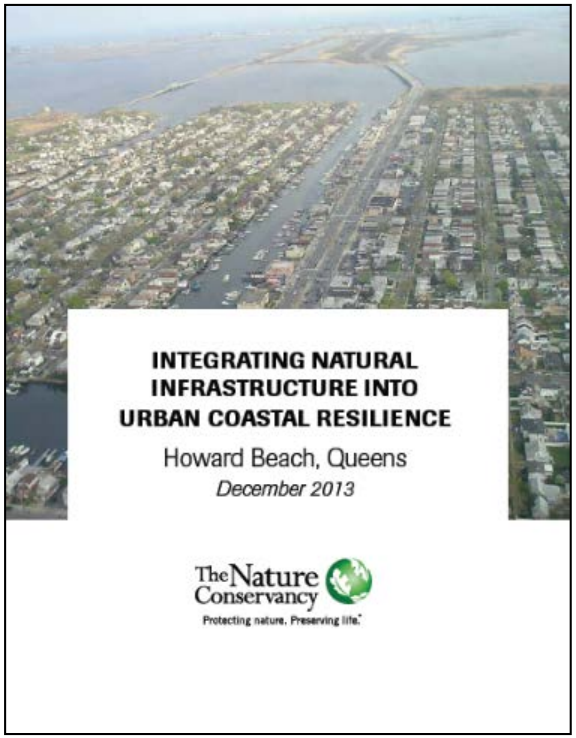
Further applications….

Assessing Different Scenarios and Alternative Solutions

- Combine:
  - Extreme Weather: rainfall runoff
  - Sea level rise
  - Alternative flood management solutions
- Rapid Inundation Modeling and Mapping allows us to narrow the range and focus detailed works

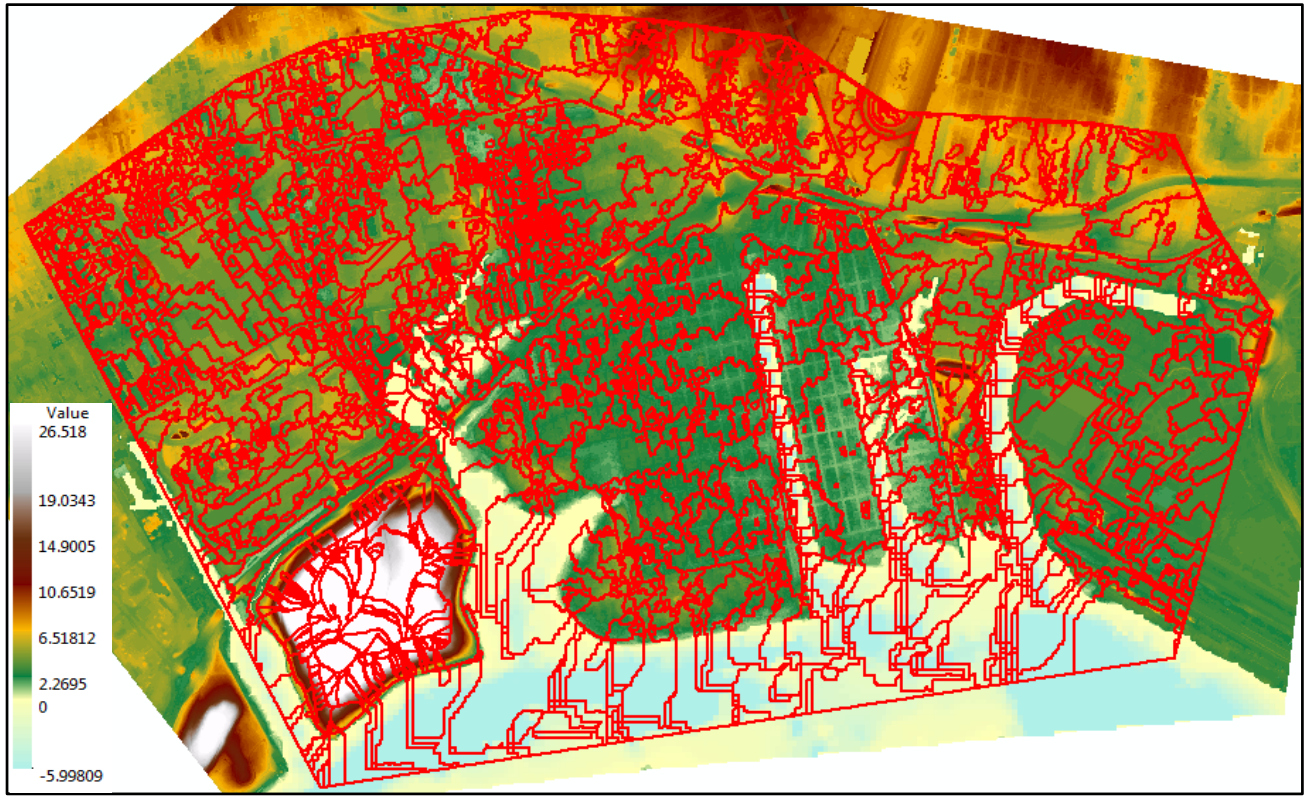


Howard Beach, Queens Natural Infrastructure for Coastal Resilience Project

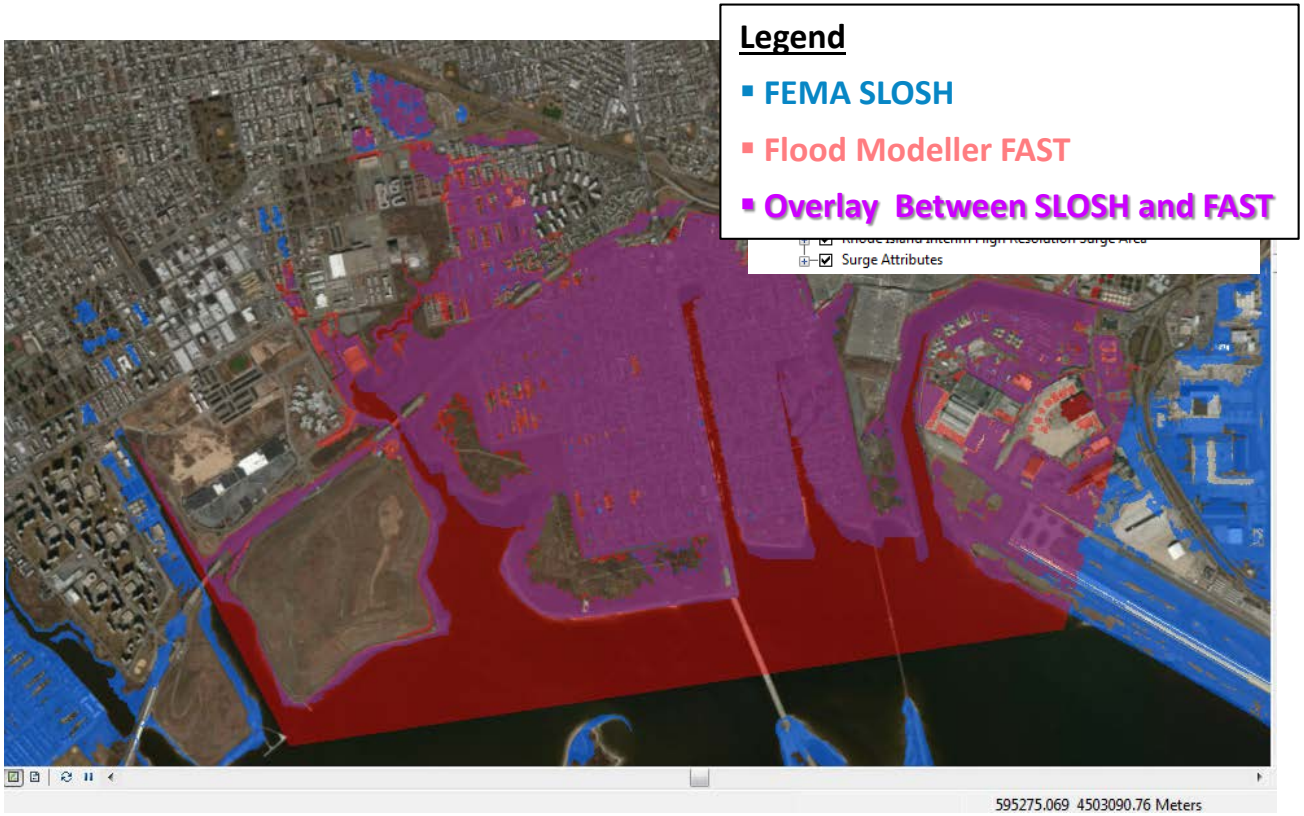


- In the first phase of a research contract with the Nature Conservancy (TNC), CH2M HILL developed a case study examining a range of natural infrastructure solutions to reduce risks in the Howard Beach Neighborhood
- Goal was to compare the financial costs and benefits of a range of Natural-Grey engineering solutions under alternative extreme weather scenarios
- Project was completed under a critical deadline to be able to provide input into the City of New York's Post Hurricane Sandy planning process
- Report was completed and released to the public in December, 2013

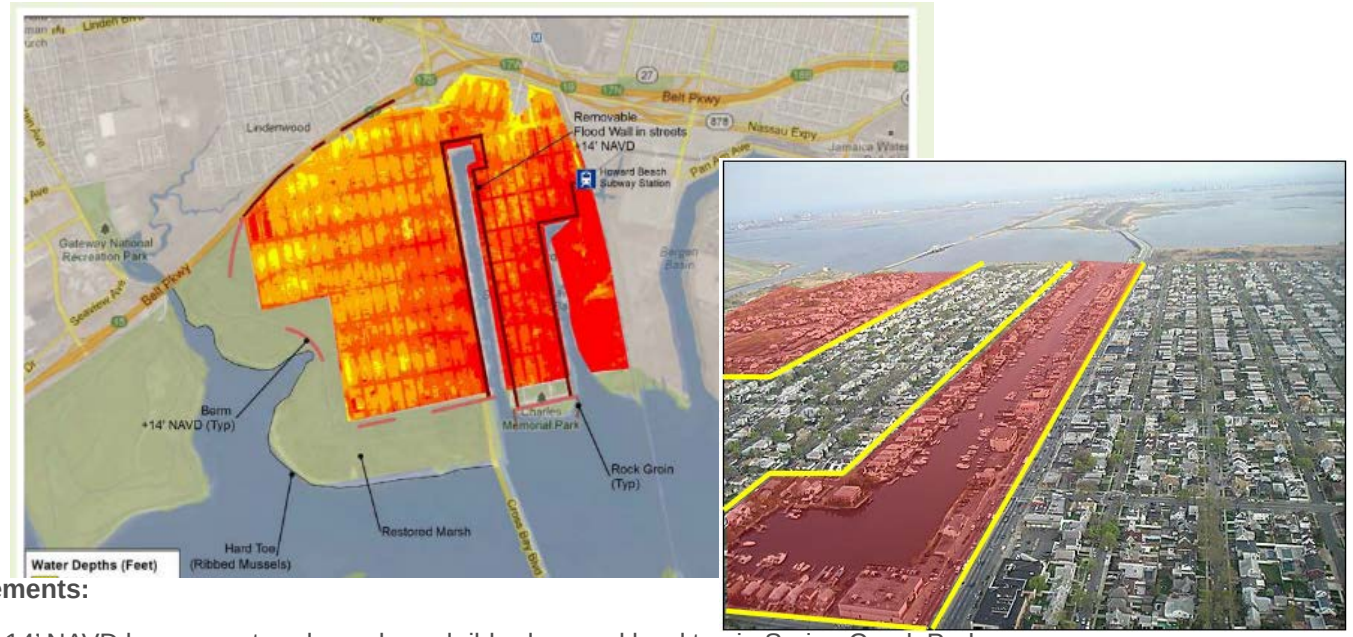
Subcatchment/Depression Identification



Strong Match Between FAST and FEMA SLOSH Results



Natural and Grey Infrastructure Needed to Meet Flood Reduction Goals (Alternative 3)



Elements:

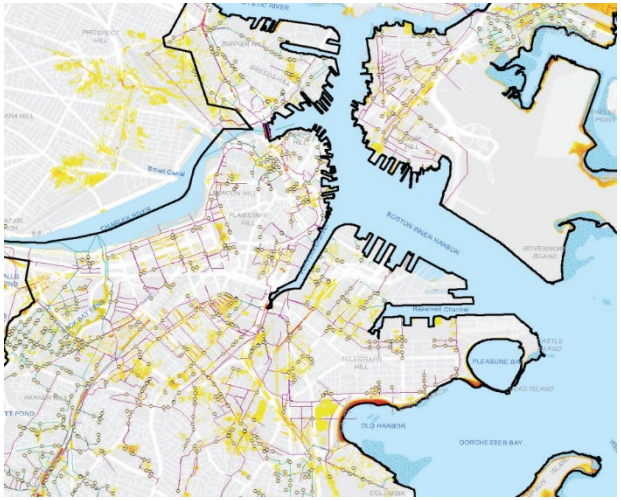
- +14’ NAVD berms, restored marsh, and ribbed mussel hard toe in Spring Creek Park;
- Berm and rock groins at Charles Memorial Park;
- Removable flood walls along Crossbay Boulevard, Shellbank Basin, west side of Hawtree Basin, and portions of the Belt Parkway.

Boston Water & Sewer Commission

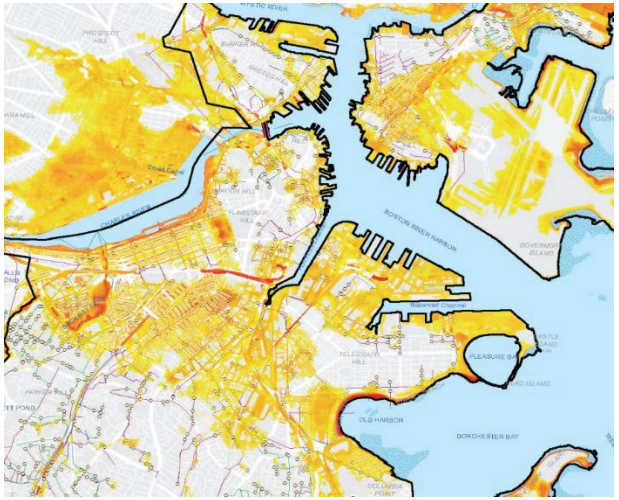
Boston Water & Sewer Commission - helped identify areas that will be prone to flooding at future year milestones due to sea level rise, storm surge, combined and storm sewer systems surcharging.

EPA SWMM 5

Flood Modeller FAST



- Year 2060 Rain
- Sea Level Rise, No Storm Surge



- Year 2060 Rain
- Sea Level Rise, With Storm Surge

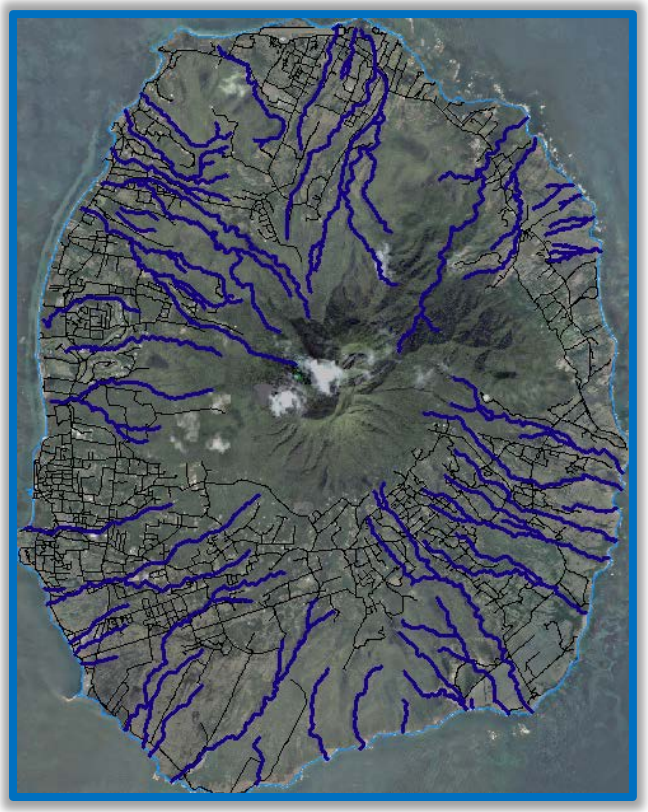
Nevis Drainage Master Plan

Objectives

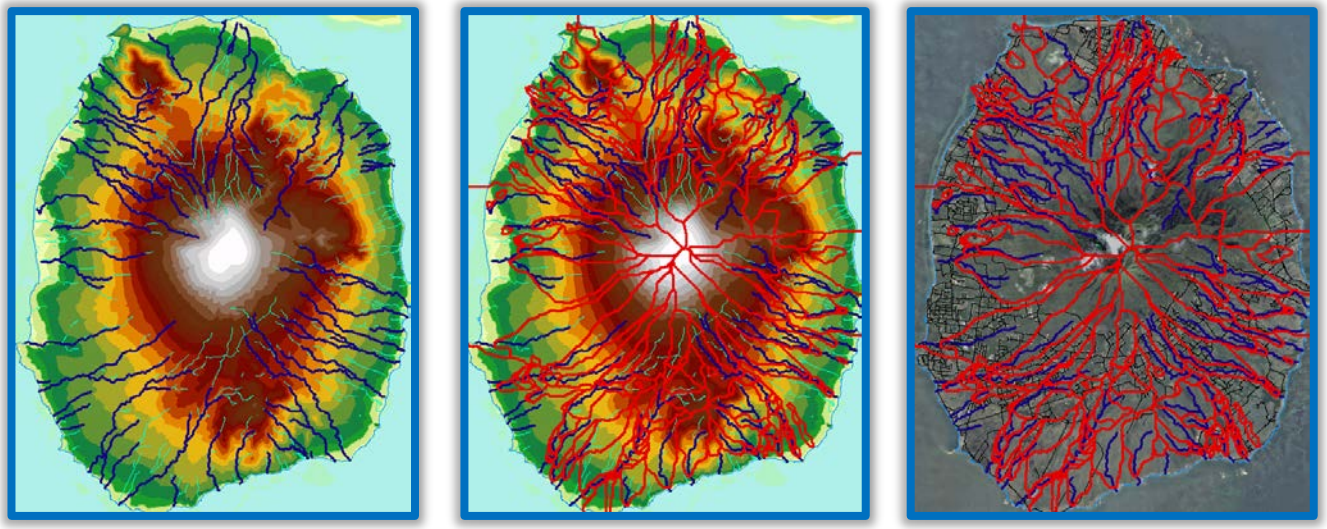
- Provide a robust drainage master plan which combines:
  - projected impacts of climate change and sea level rise;
  - assessing flood risks;
  - identifying adaptation schemes to reduce flooding and ensure long term sustainability through natural systems enhancement; and,
  - Balancing flood protection and recharge to the groundwater aquifer.
- Integrated operations and maintenance plan
- Develop a hydrometeorologic data collection and early warning system for the Charleston area
- USAID funded OECS project

Nevis – Quick Facts

- 100 sq miles
- 12,100 population
- Federation of St Kitts & Nevis
- Flood Modeller 1D (Free Version) used to model principal channel/drainage systems
- Flood Modeller 2D (FAST solver) to provide high level appraisal of whole island



Using FAST To Determine Hydrologic Drainage Areas

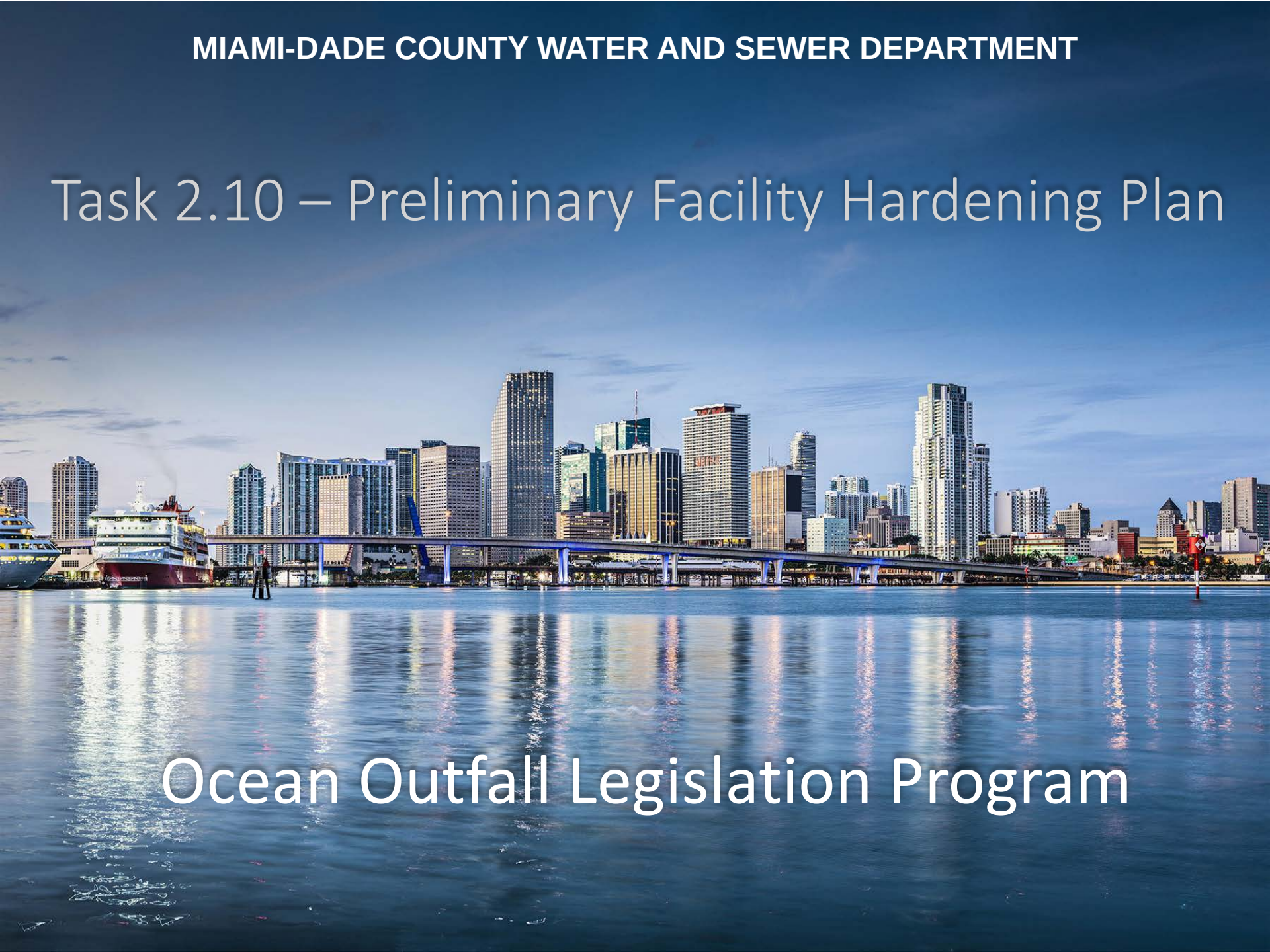


- FAST quickly enabled an understanding of hydrologic drainage basins, then used to guide more detailed 1D modeling

The view across The Narrows of St Kitts from Nevis

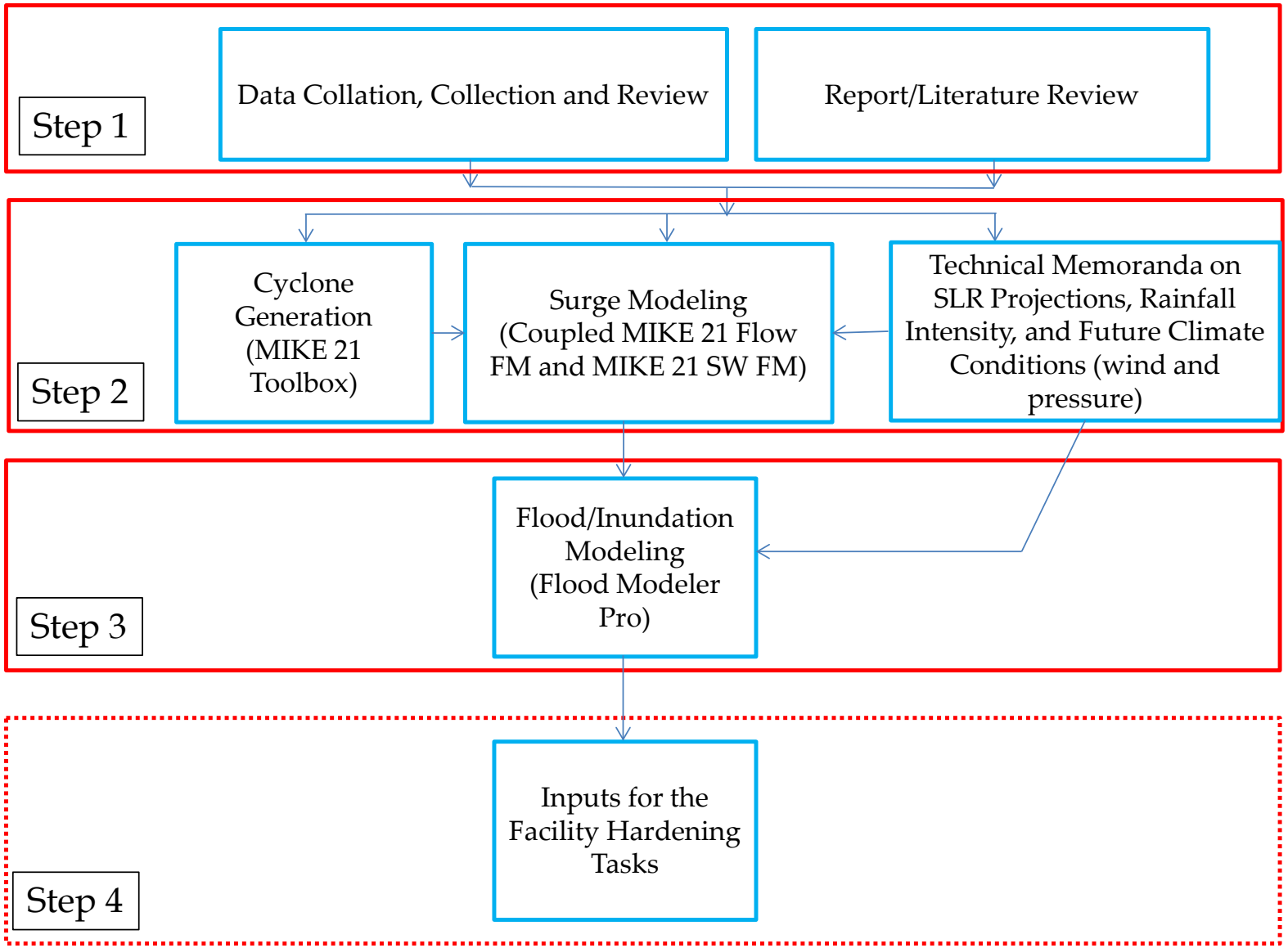
MIAMI-DADE COUNTY WATER AND SEWER DEPARTMENT

Task 2.10 – Preliminary Facility Hardening Plan

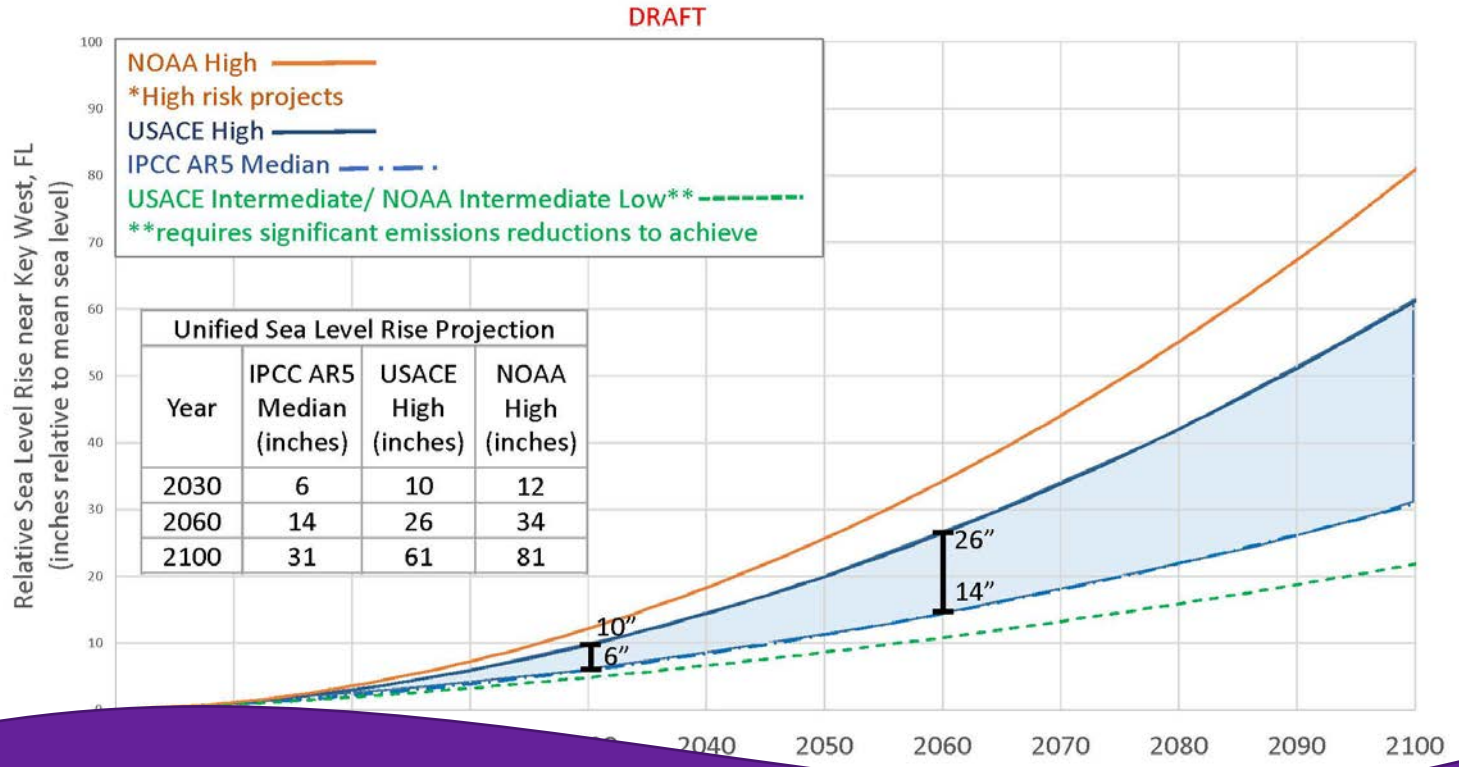


Ocean Outfall Legislation Program

Surge and Flood Modeling: Flow Chart



Stressor: Sea Level Rise
Impacts: Coastal Flooding and Increased I/I (due higher GW)



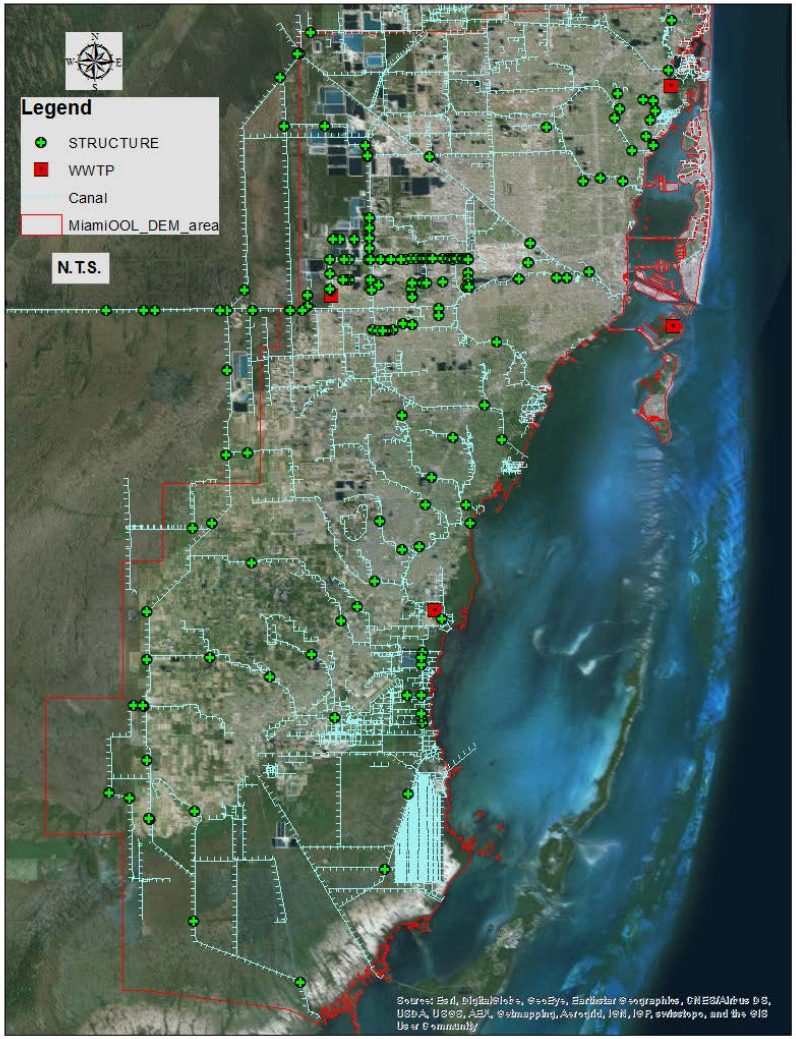
Unified Sea Level Rise Projection

Year	IPCC AR5 Median (inches)	USACE High (inches)	NOAA High (inches)
2030	6	10	12
2060	14	26	34
2100	31	61	81

- Surge and inundation modeling run with 1.23 m (48”) SLR (2075 NOAA High).
- Surge modeling also run with 0.93 m (37”) SLR (2075 USACE High), to test linearity assumption if smaller SLR design criteria are selected based on risk.

Canal Initial Conditions

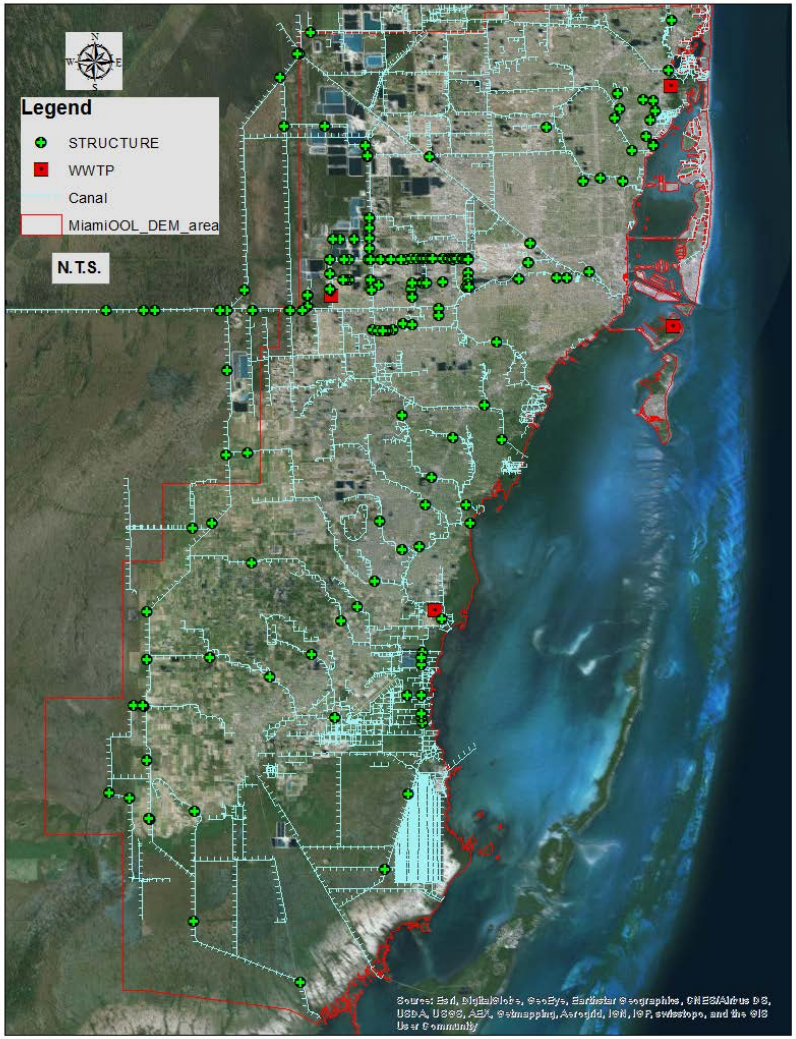
- USGS Scientific Investigation report, 2014,
  - *'Hydrologic Conditions in Urban Miami-Dade County, Florida, and the Effect of Groundwater Pumpage and Increased Sea Level on Canal Leakage and Regional Groundwater Flow'*
- Extracted average of observed maximum levels at each structure



37

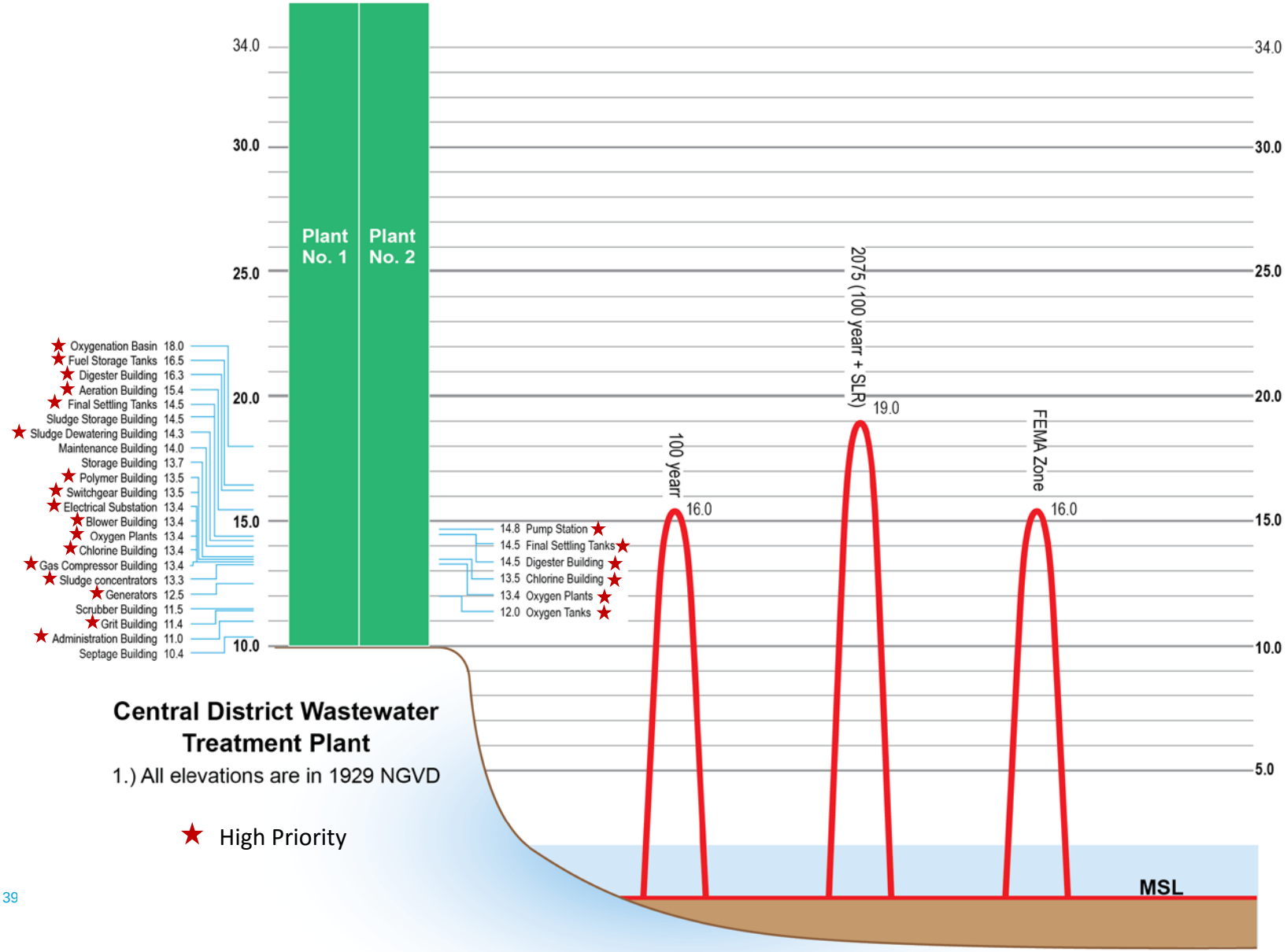
Gate Structures

- Gates are also represented as fixed breaklines as if closed (i.e. water would weir over the top of the gate breaklines if high enough)
- Data provided by WASD



38

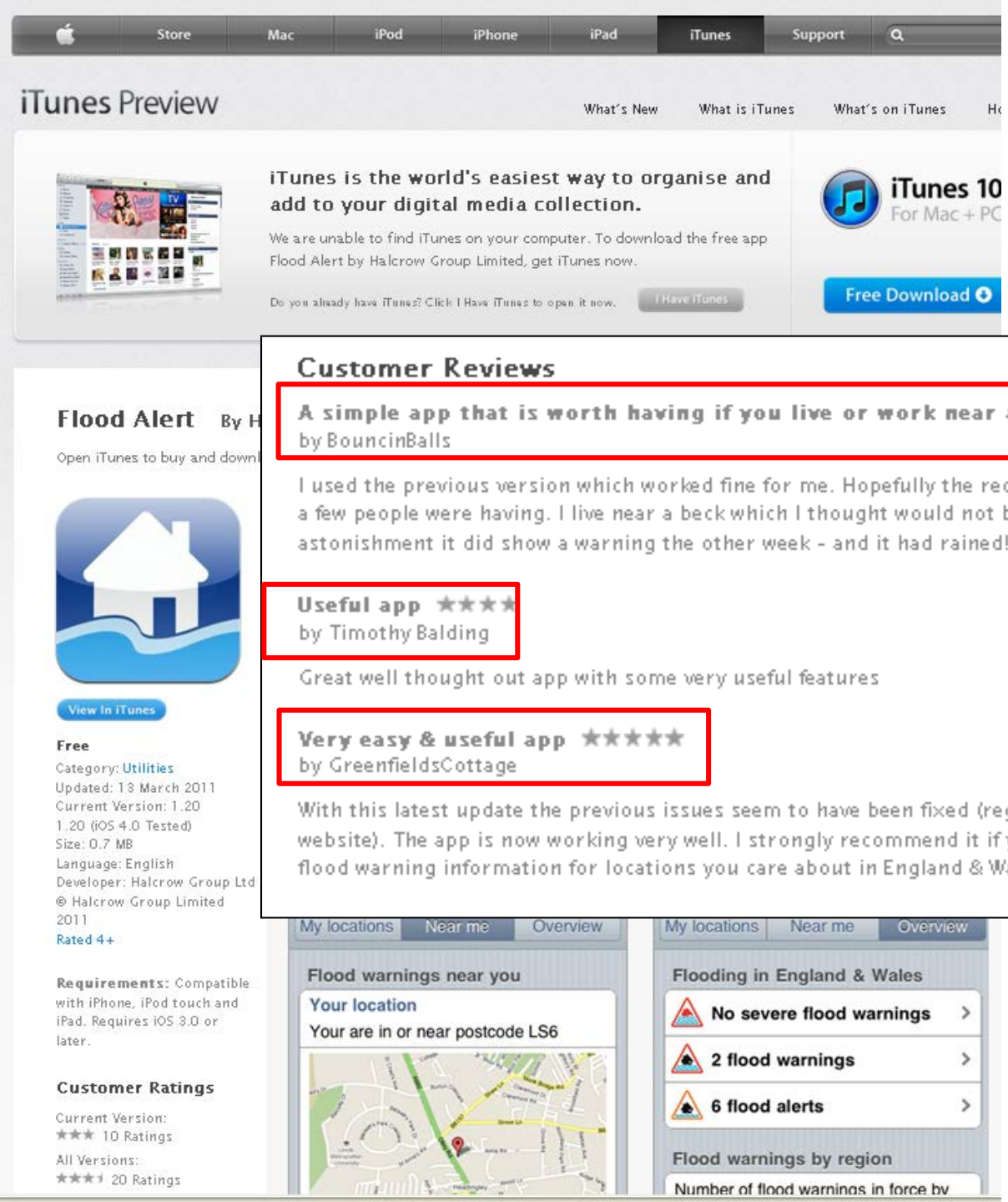
Comparison of Extents with Asset Elevations – include 2’ freeboard + 1’ safety factor, and SLR – 1.23m



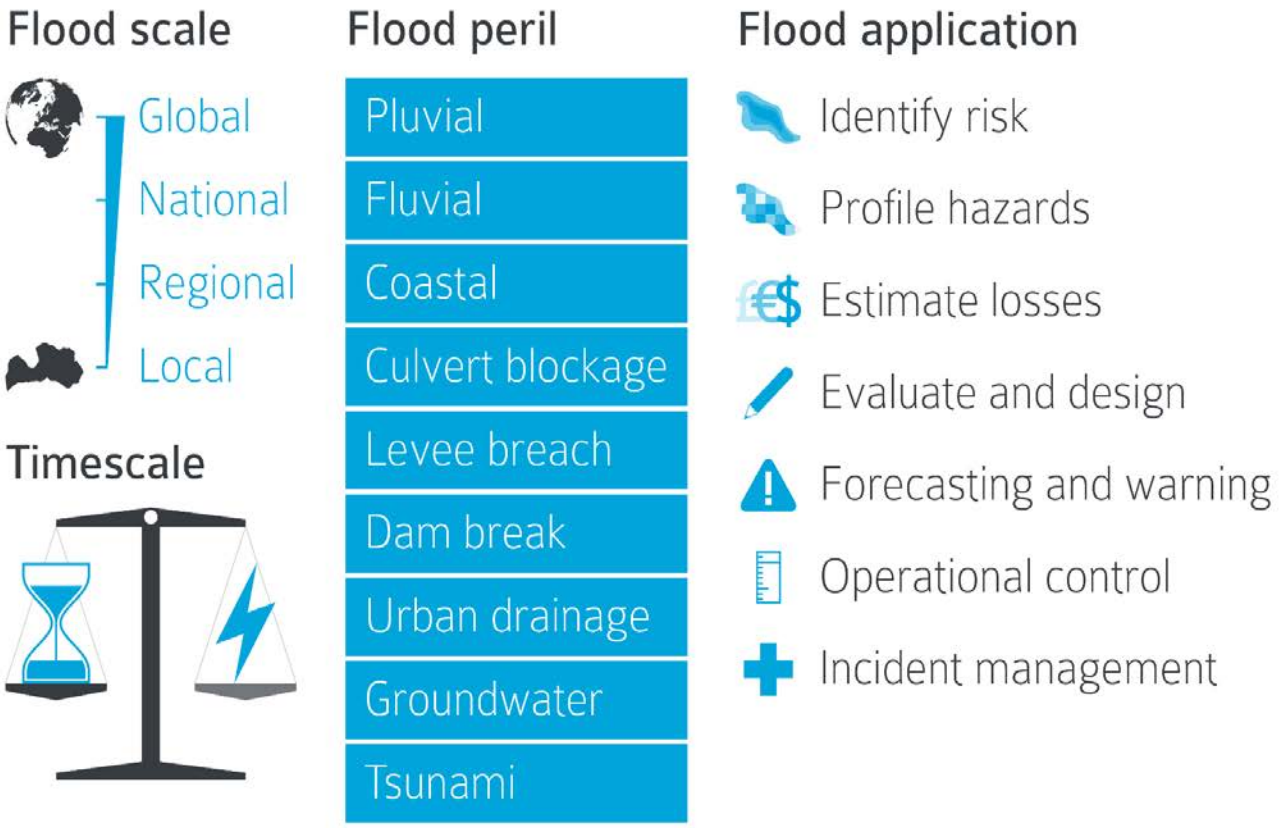
Roadmap for Future

- Probabilistic approach to assess the impacts of varying rainfall events – new precipitation frequency data from NOAA
- Assess risk for existing & future communities in support of the ~~Biggert – Waters Flood Insurance Act…~~ **Homeowner Flood Insurance Affordability Act** develop holistic floodrisk strategies… adopting sound land development policy
- Tools are being used at Country scale to support insurance industry

Flood Alert App



Flood Modeller (FAST) can be used for:



Thanks for listening!!

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