Tools to Assess Flood Risk of Commercial Property Investment

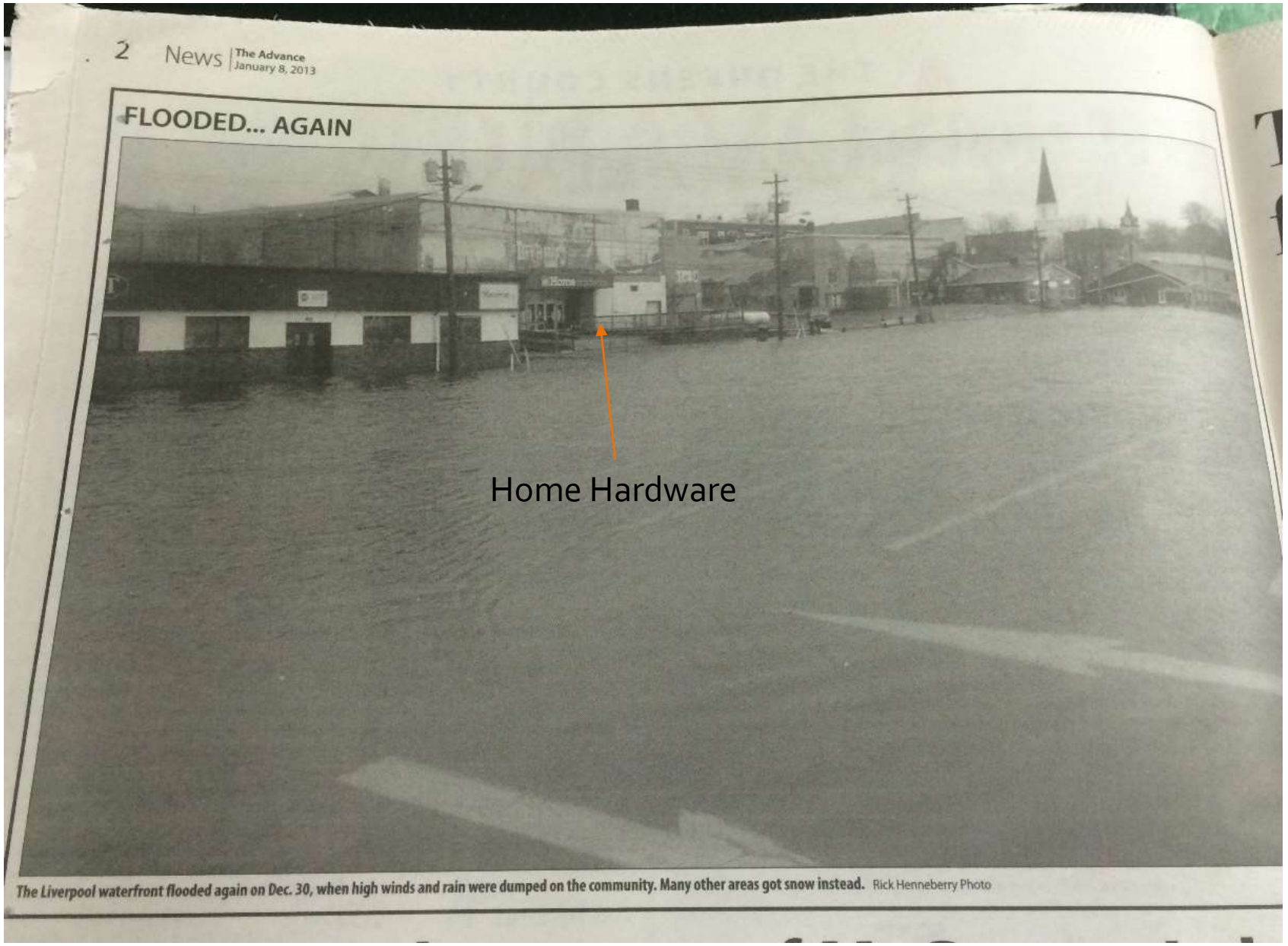
NSERC Workshop

March 1, 2016

Kate Collins, Tim Webster, Nathan Crowell
AGRG, NSCC, Middleton, NS

Liverpool, NS
Mersey River

"FLOODED… AGAIN
The Liverpool waterfront flooded again on Dec 30…" 2013
- The Advance



February 9, 2013 "Storm surge floods coastal Nova Scotia"

- Chronicle Herald

February 9, 2013
"…wharves underwater,… roads impassable…"
- Chronicle Herald

Parsons Investments

Small NS company with commercial and residential real estate properties across the province and in Liverpool

The company is looking to develop tools to investigate flood mitigation options, and provide a greater understanding of flooding potential for future property development and coastal investments.

AGRG awarded an NSERC Engage Project to assist Parsons Investments in determining the susceptibility of its assets in Liverpool to flooding as well as Liverpool's downtown area, and propose adaptation strategies

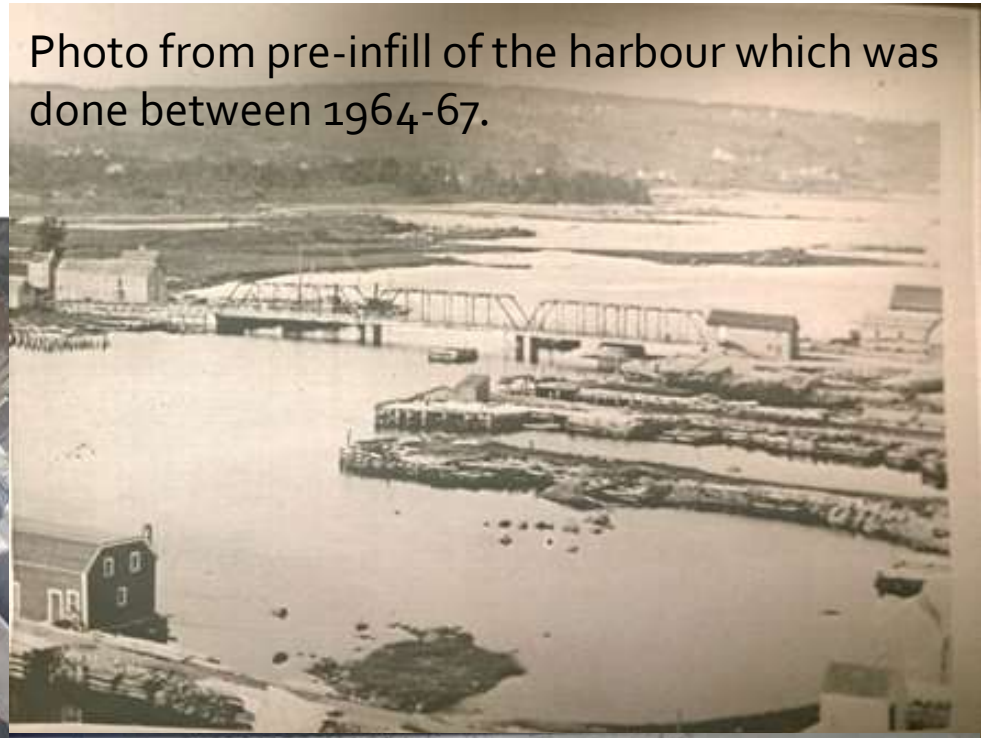
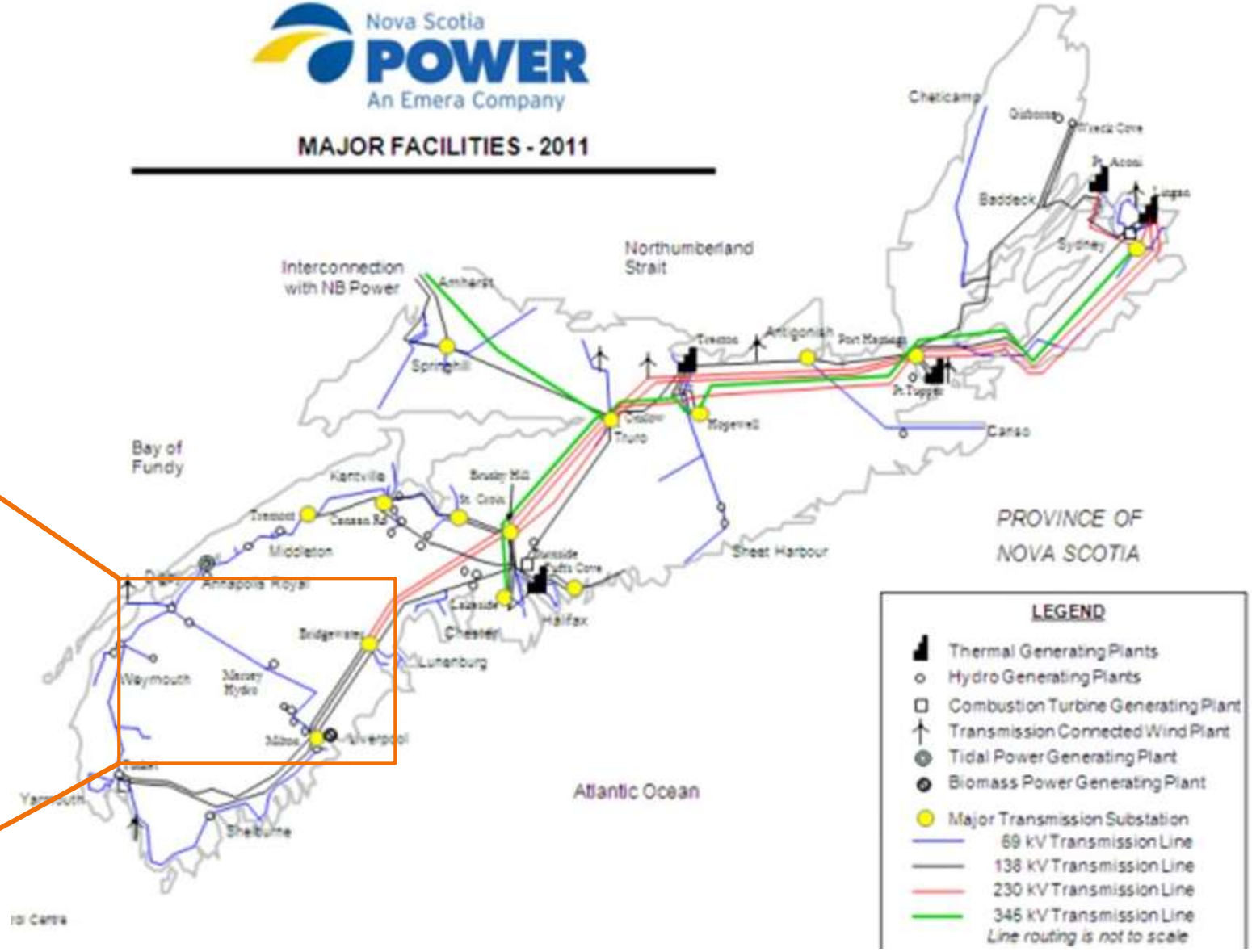


Photo from pre-infill of the harbour which was done between 1964-67.

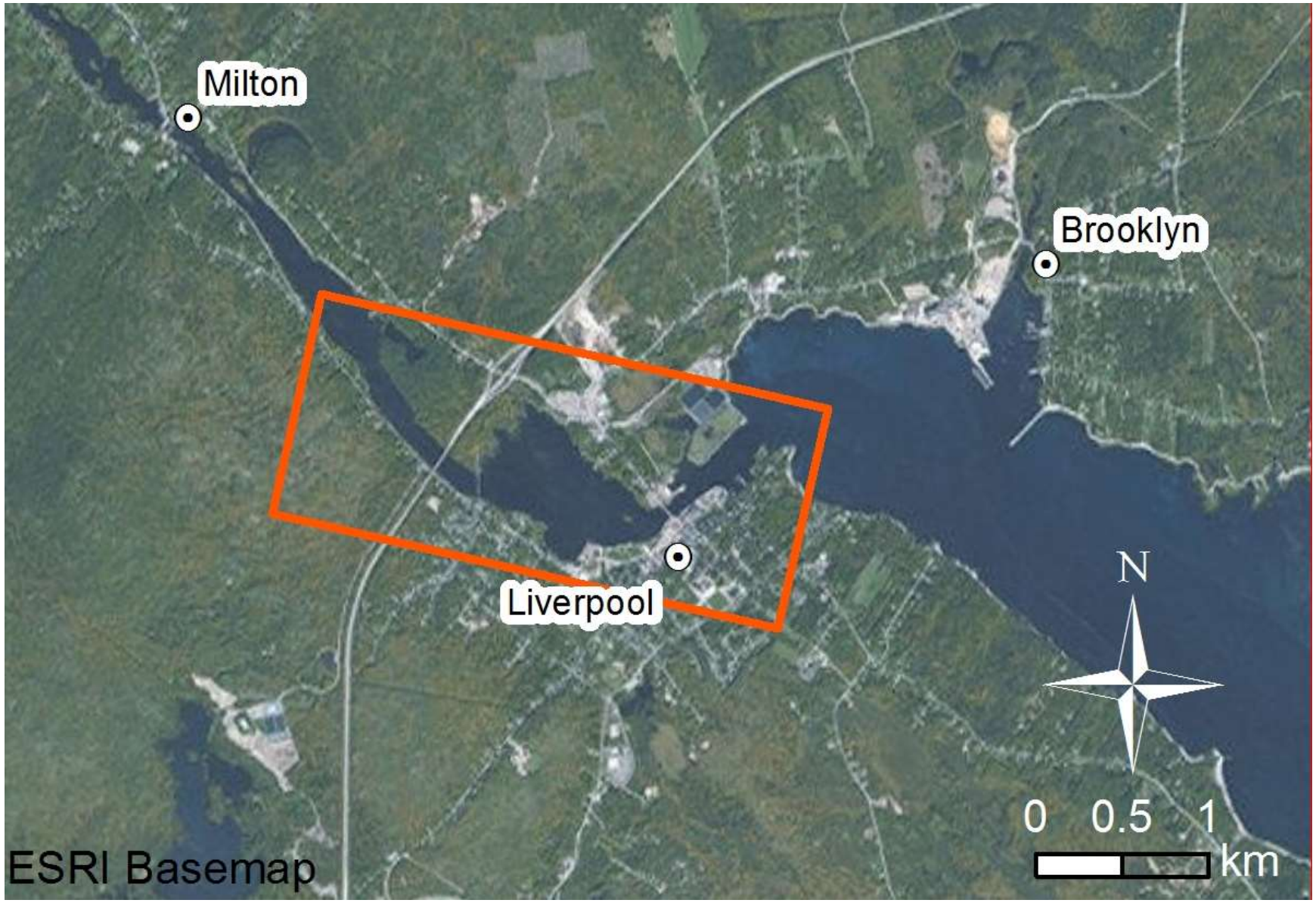
Map of Liverpool prior to harbour infilling.

Hydro Generating Plants on Mersey River

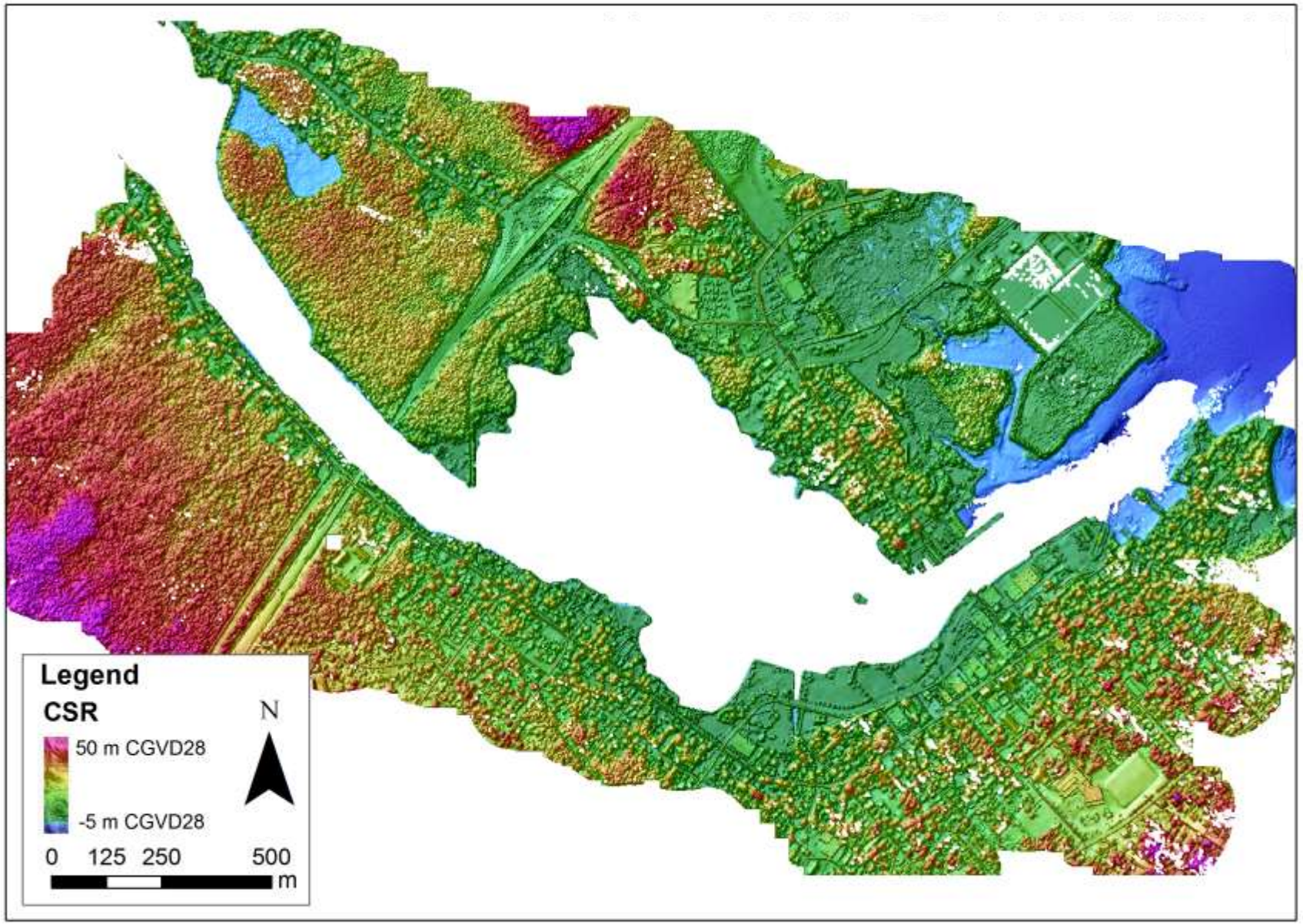


GIS Model Using Topographic Lidar

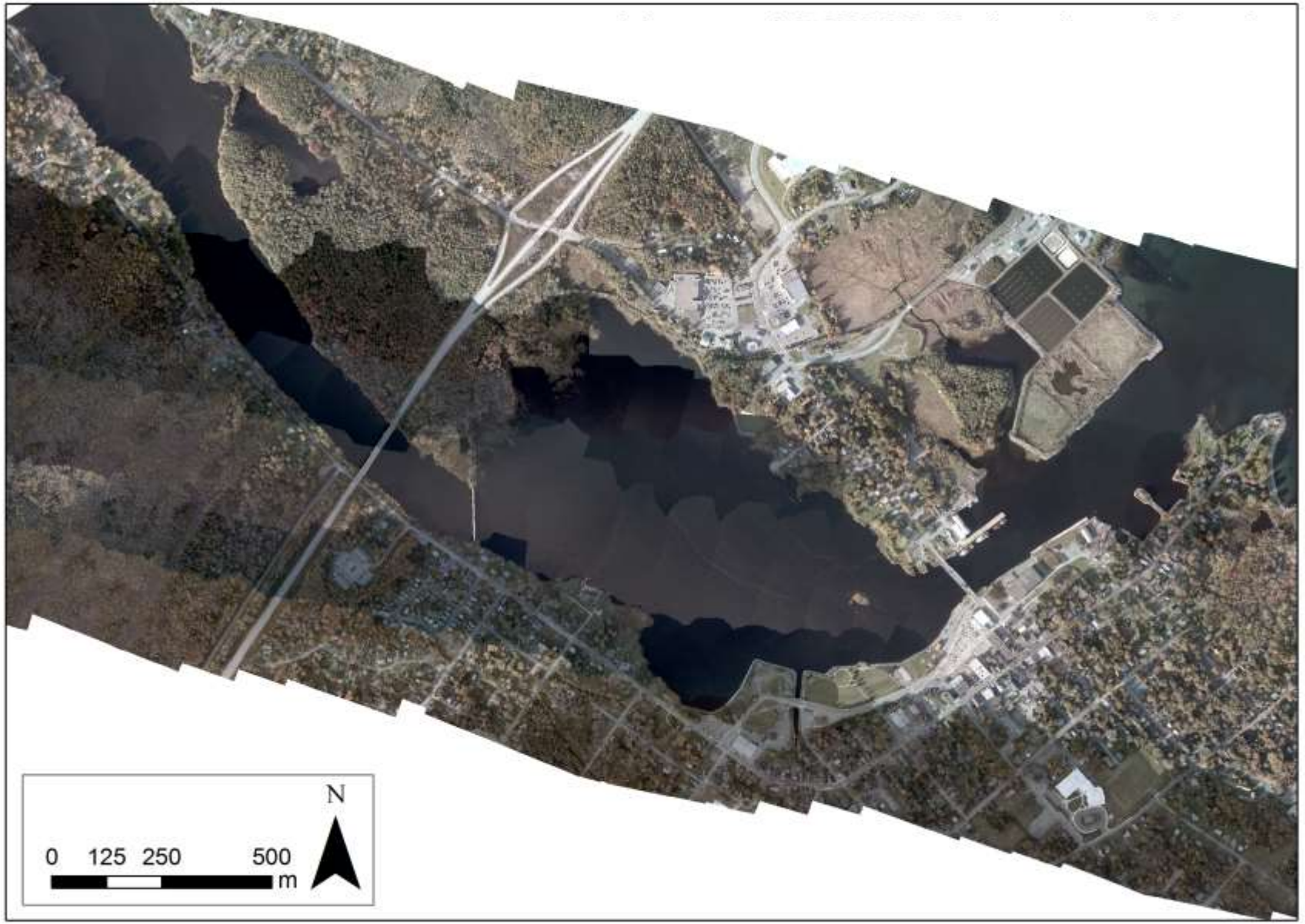
- Study area focused on downtown to capture Parsons Buildings, model known high water levels
- Lidar Survey: October 23, 2015



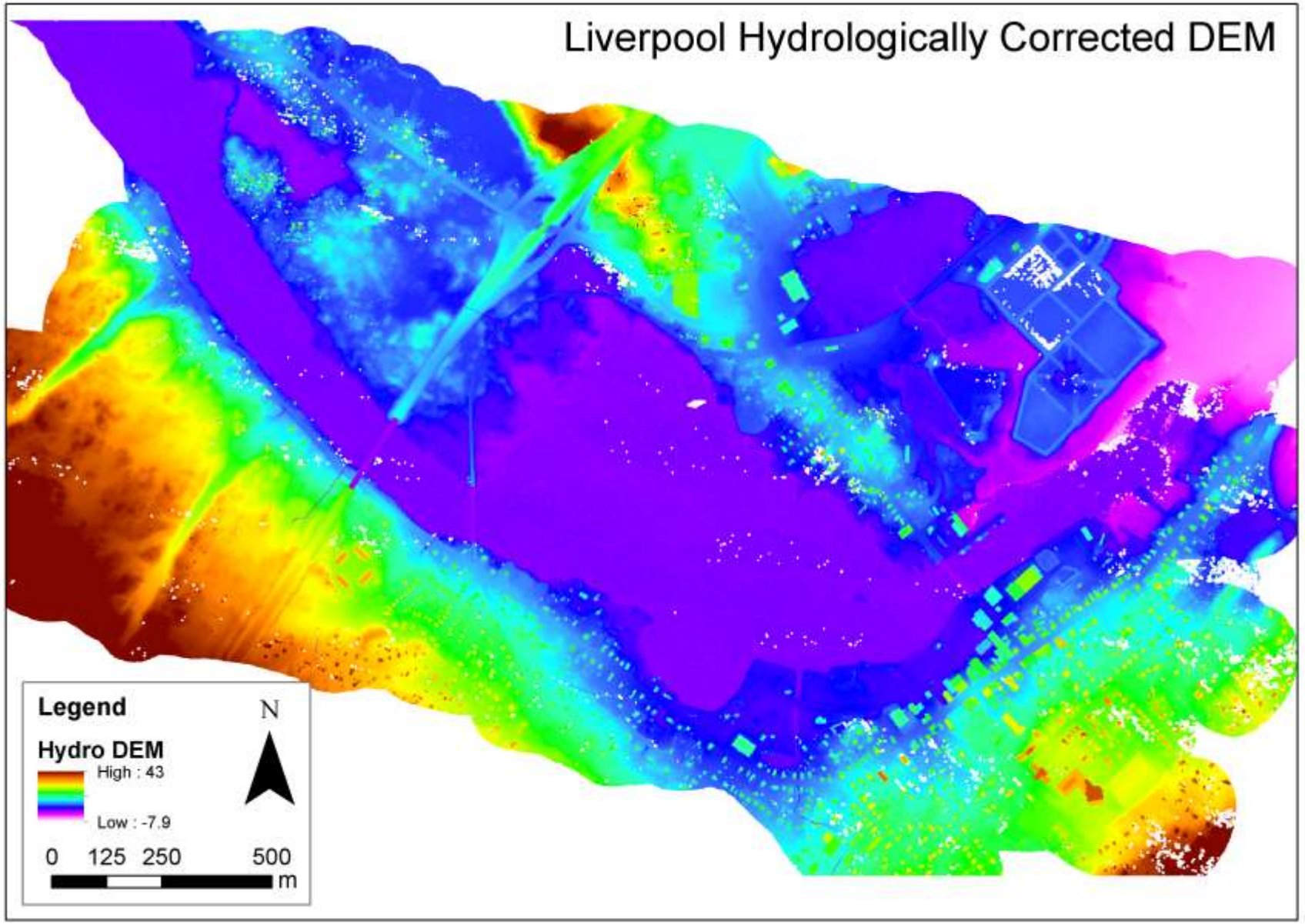
Colour Shaded Relief Model



Orthophoto Mosaic

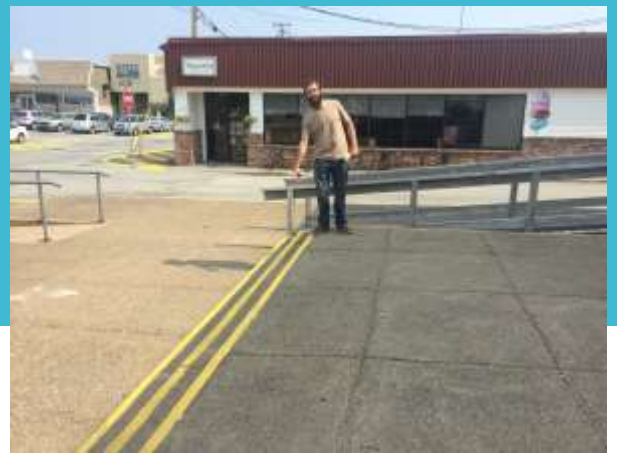


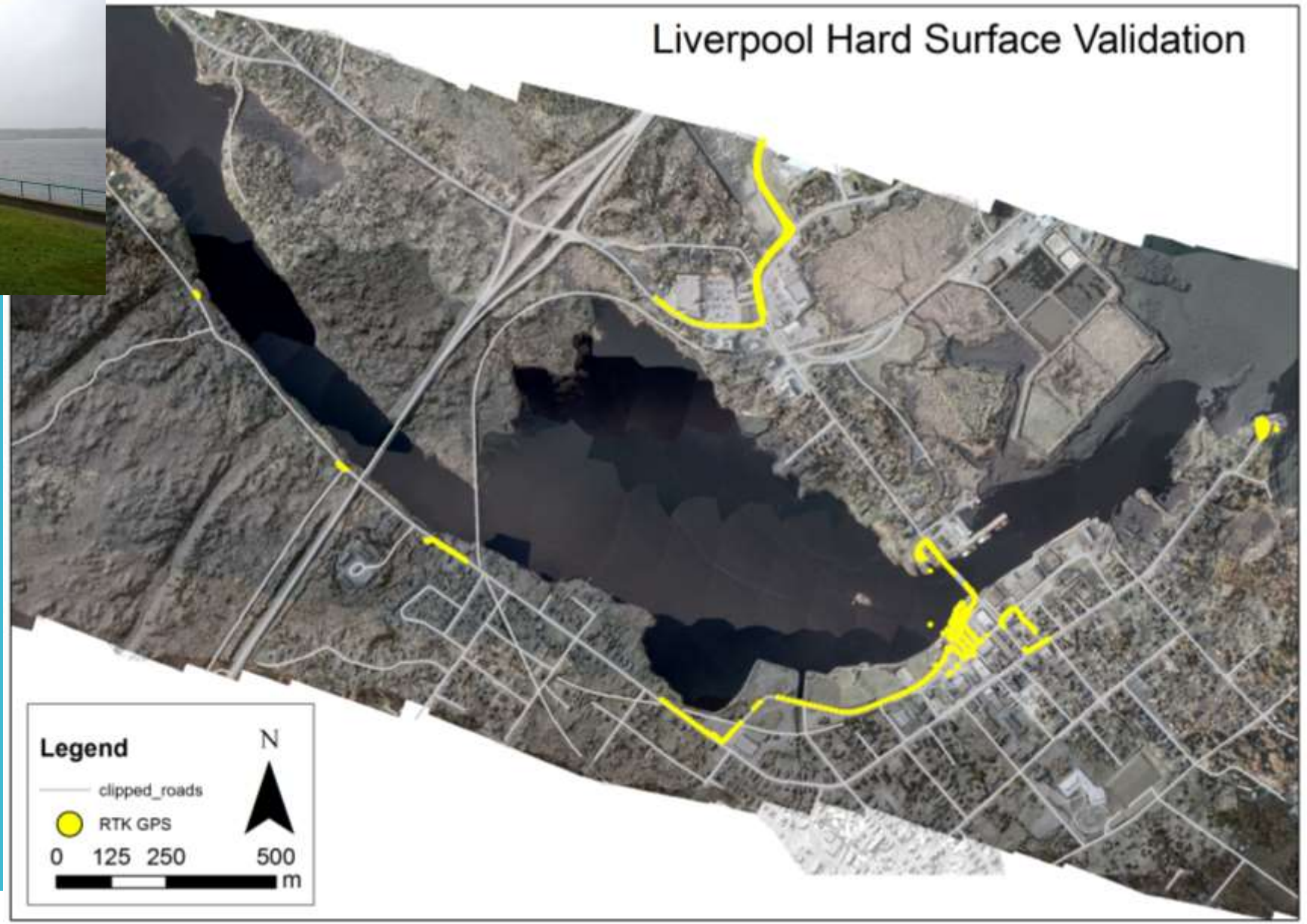
Hydrologically Corrected DEM: culverts added, bridges removed



Ground Truth

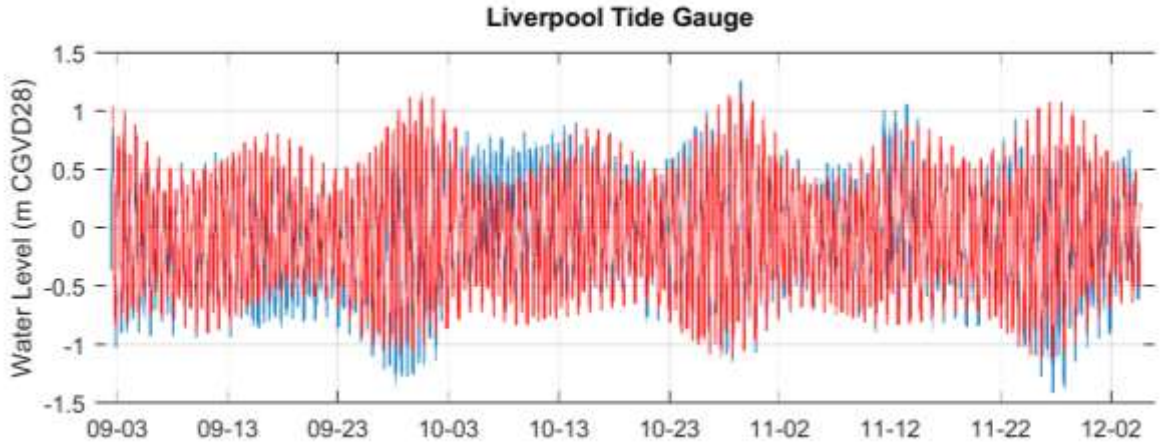
- RTK GPS of roads (for lidar validation)
- High water marks (for model validation)

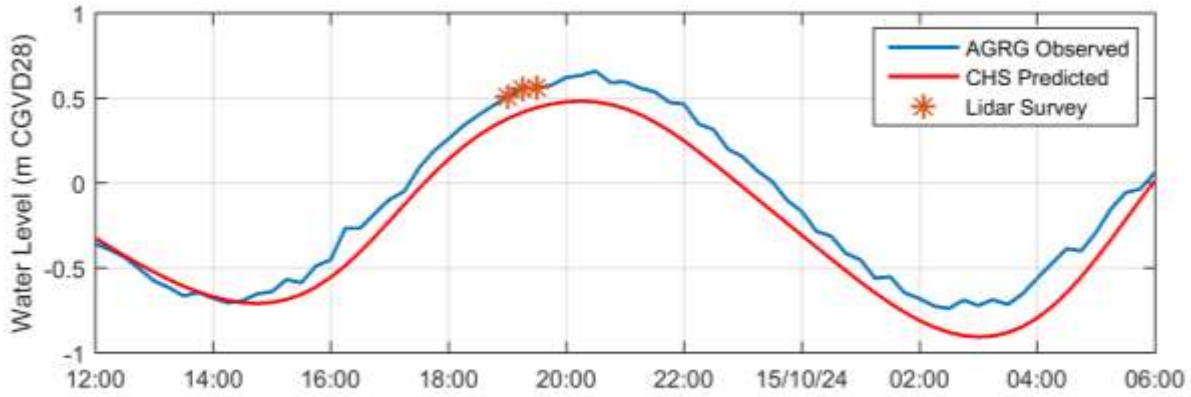




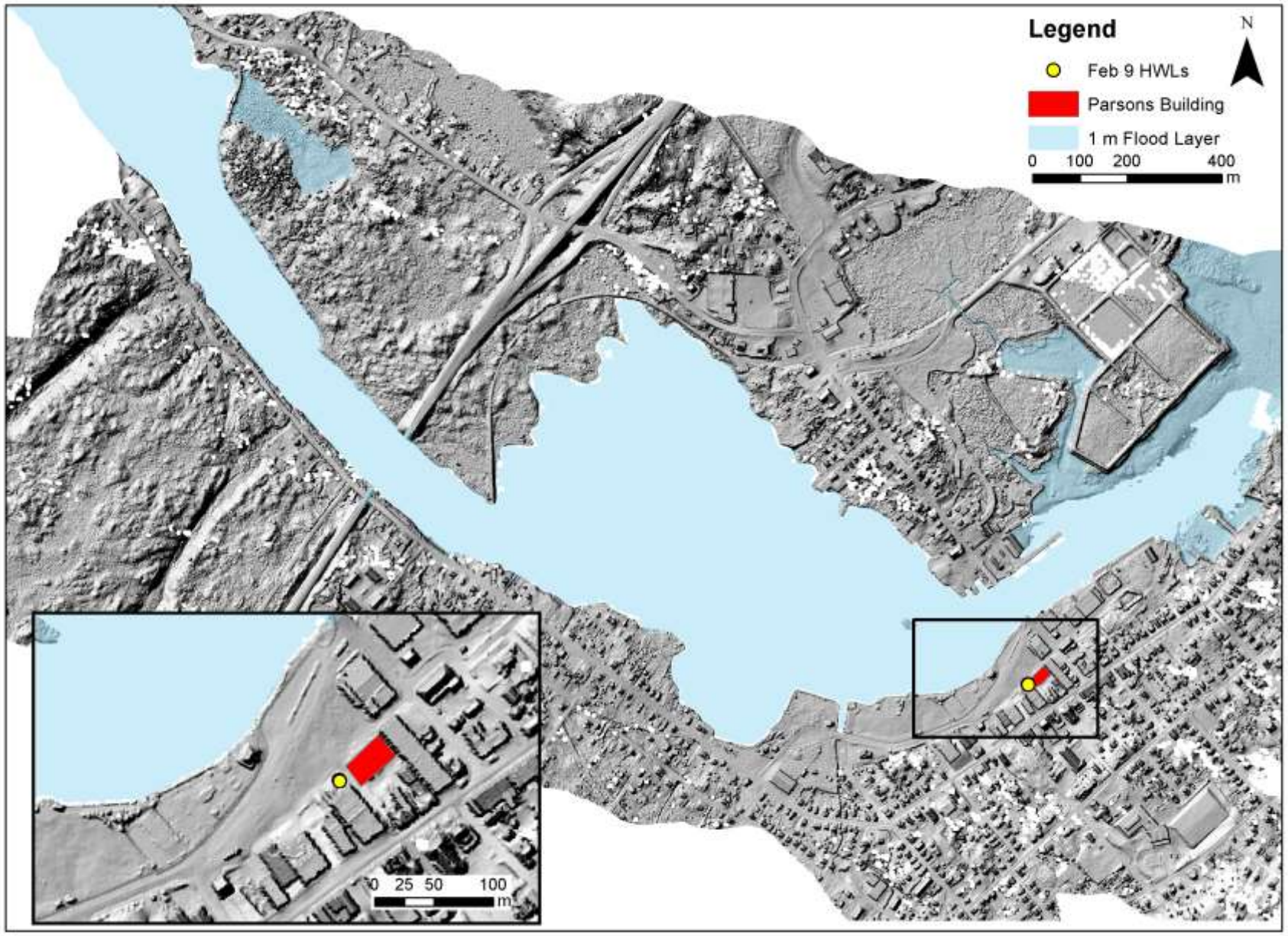
Pressure Sensor Deployment

- September to December 2015
- tidal range ~2 m
- near high tide during lidar survey

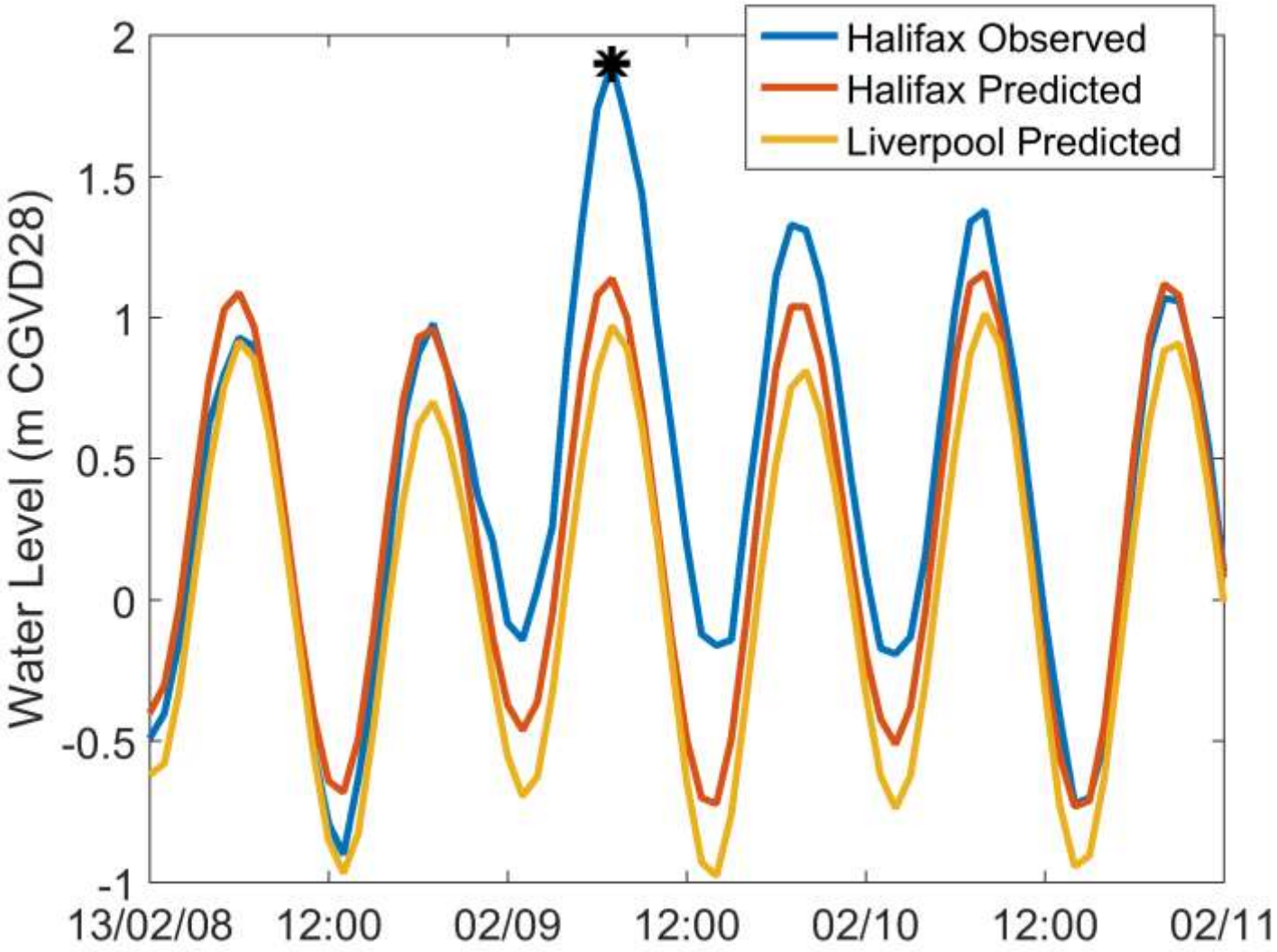




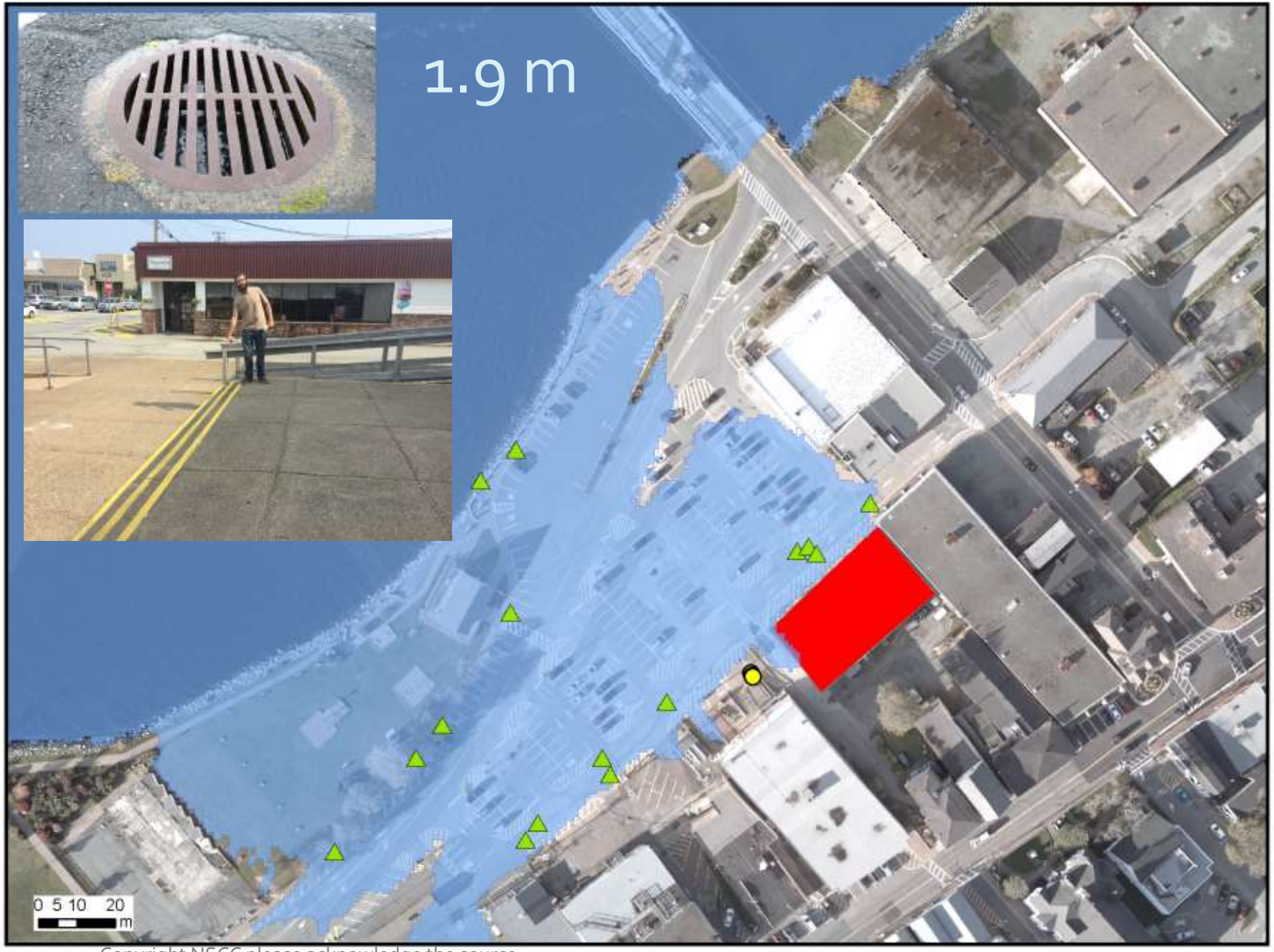
GIS Model Validation: High Tide



Feb 9 7:00 1.9 m Storm Surge recorded at Halifax Tide Gauge



Feb 9 7:00
1.9 m Storm Surge recorded at Halifax Tide Gauge;
1.98 m GPS point at Home Hardware ground



Future Flooding

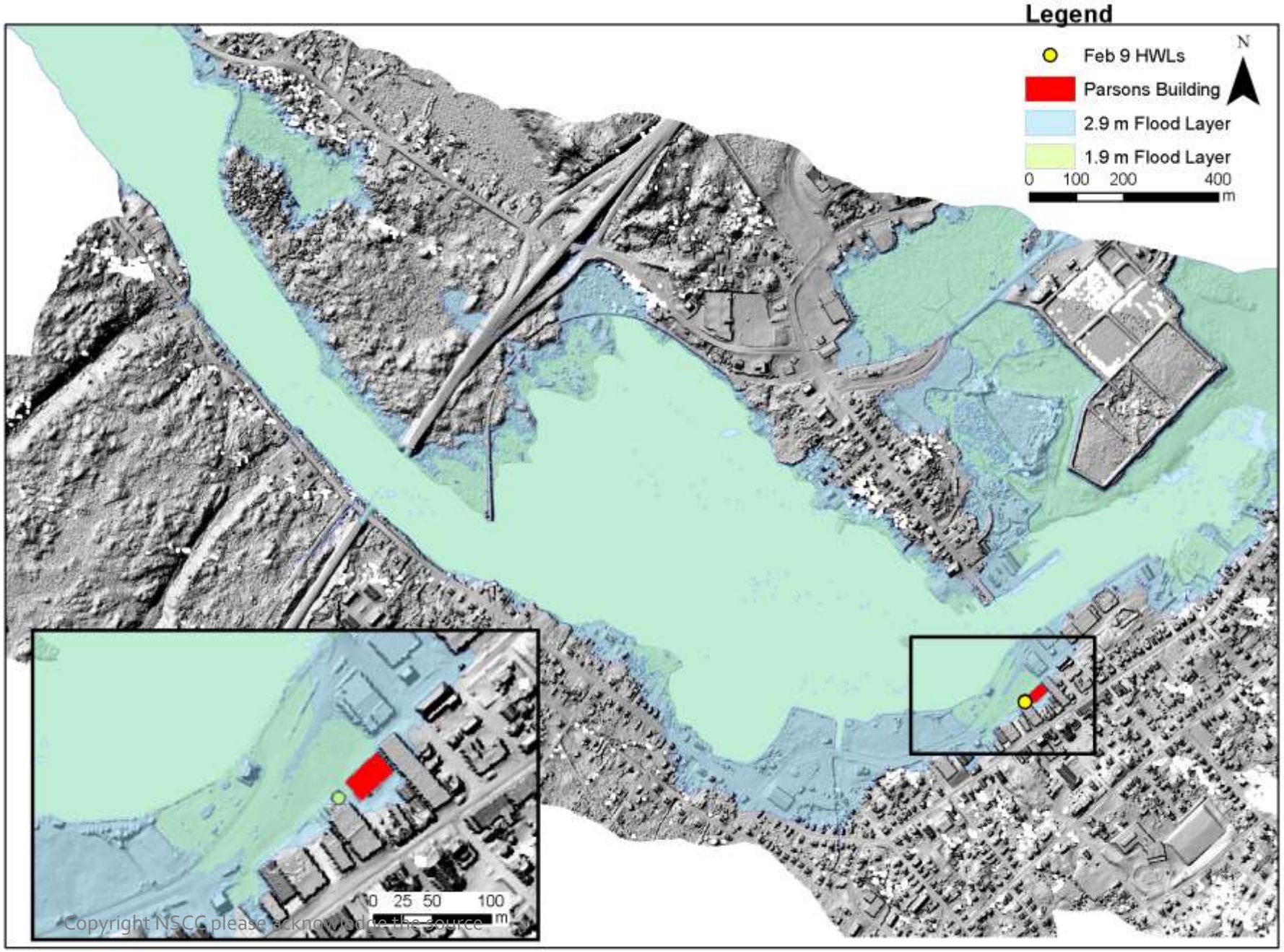
http://www.gov.pe.ca/photos/original/ccscenarios.pdf

Liverpool CD to CGVD28 = -1.04 m

CHS Representative site	HHWLT m (CD)	Sea-Level Rise (2100) + Error Bar (m)	Maximum Storm Surge to Date (m) (See Note 1)	Plausible Upper Bound Water Level (m) (CD) by Year 2100 (see Note 2)
Nova Scotia				
Burncoat Head	16.50	1.53	1.28	19.31
Joggins	13.40	1.53	1.28	16.21
Pictou	2.05	1.53	1.49	5.07
Cheticamp	1.37	1.58	1.38	4.33
Sydney	1.32	1.58	0.97	3.87
Canso Harbour	1.85	1.58	1.63	5.06
Halifax	2.16	1.54	1.63	5.33
Lunenburg	2.43	1.54	1.63	5.60
Liverpool	2.30	1.54	1.63	5.47
Yarmouth	5.16	1.54	1.49	8.19
Digby	9.13	1.53	1.49	12.15
Hantsport	15.26	1.48	1.28	18.02

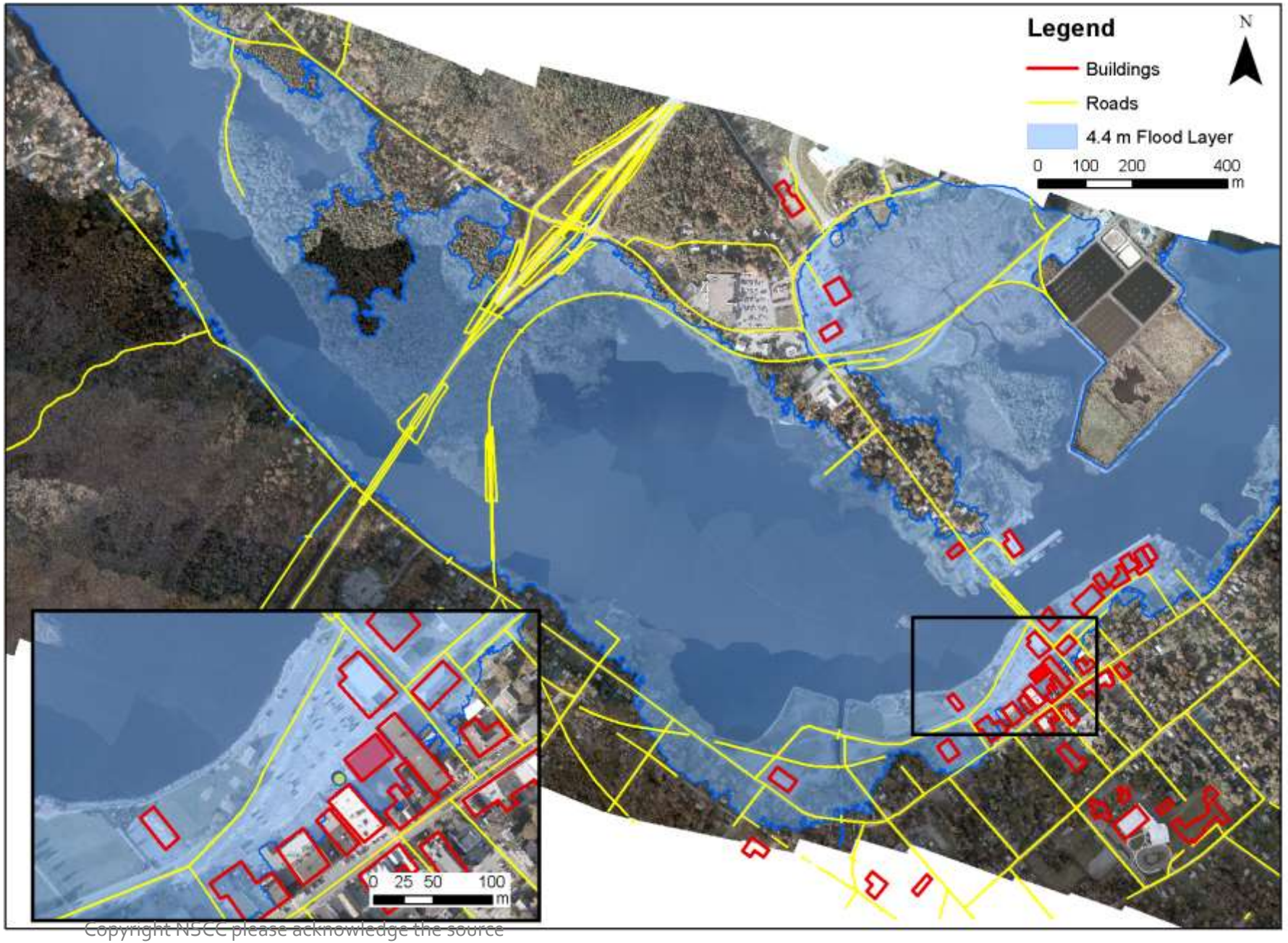
		Water Level (m CGVD28)
Scenario 1	Max Tide (HHWLT)	1.26
Scenario 2	Juan at Max High Tide, present day	1.26 + 1.63 = 2.89
Scenario 3	Juan at Max High Tide in future with SLR	1.26 + 1.63 + 1.54 = 4.43

Scenario 2: HHWLT + Juan 2.89 m CGVD28



Scenario 2: HHWLT + Juan + SLR 4.43 m CGVD28

- Model was validated by Feb 2013 storm
- Used to predict future storm surges
- Next steps: to modify Hydro DEM to include coastal protection and present how downtown is affected then

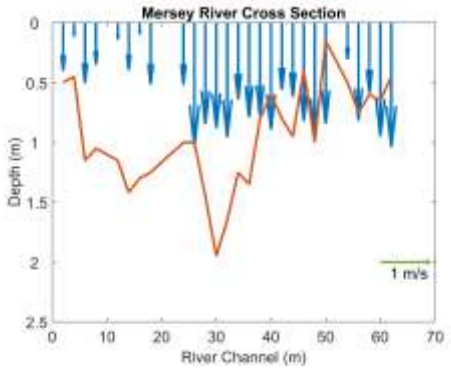


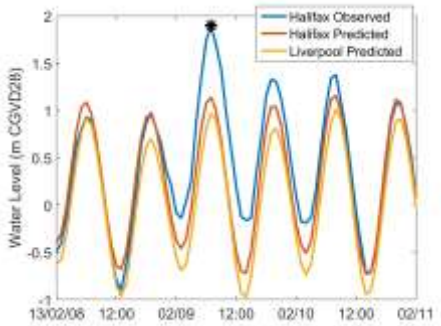
GIS Flood Animation

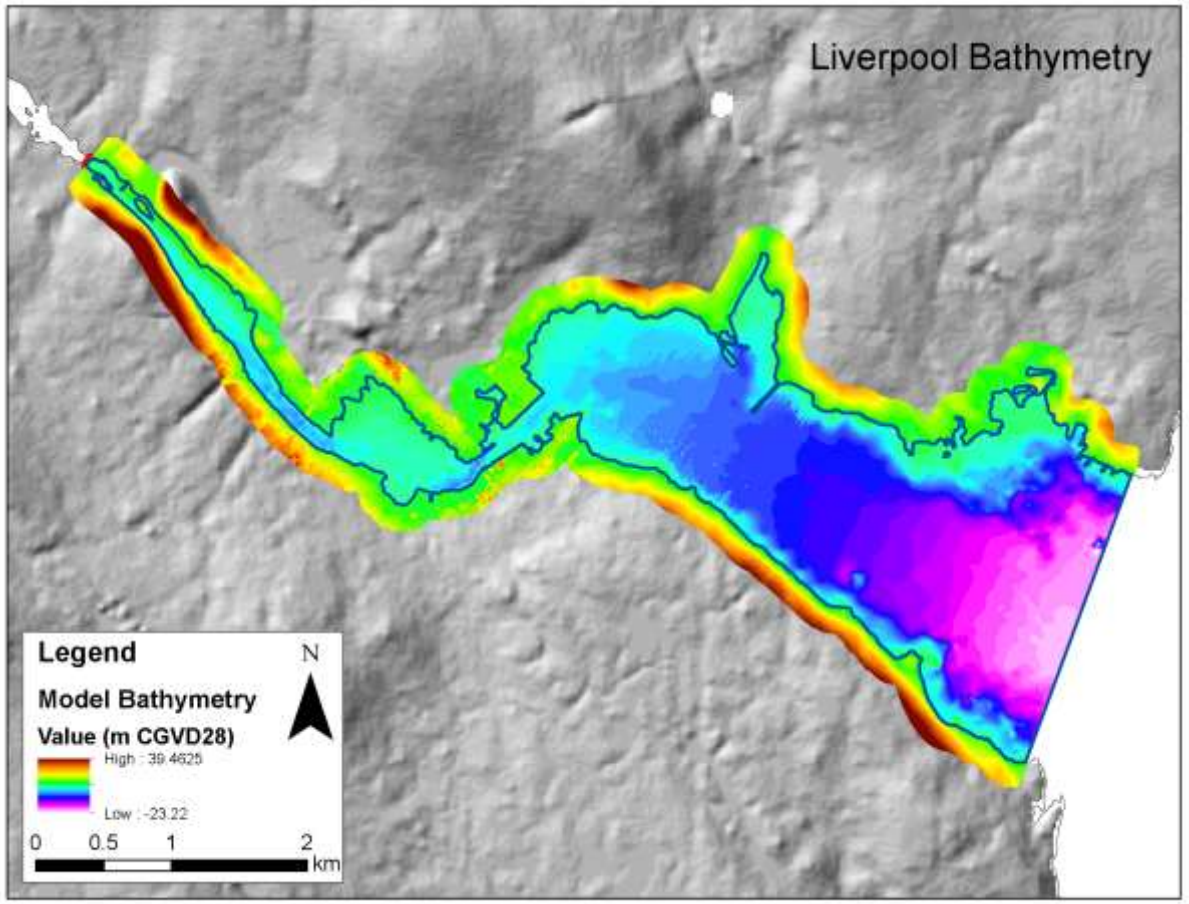
Max Flood 4.4 m

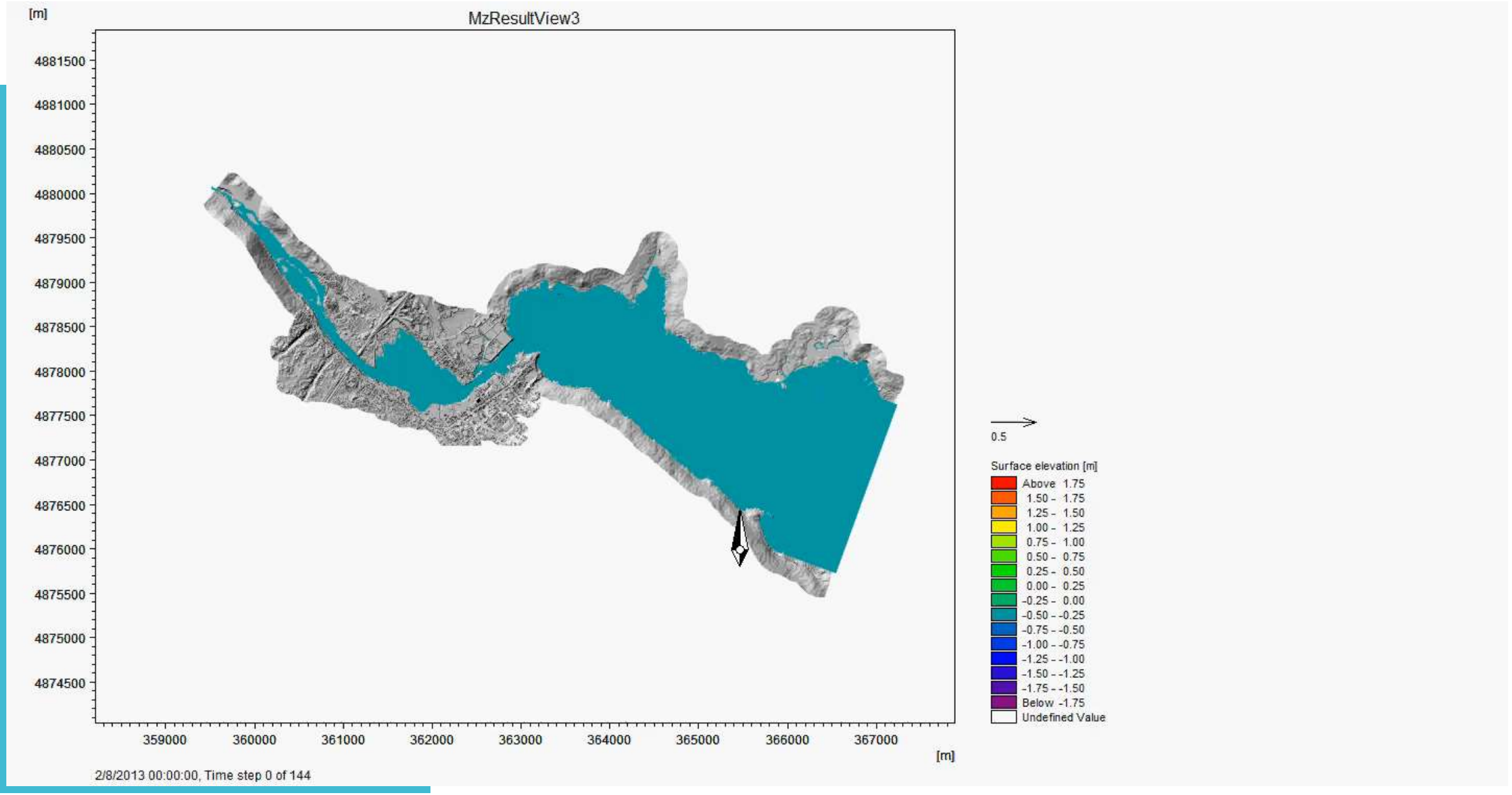
Hydrodynamic Model

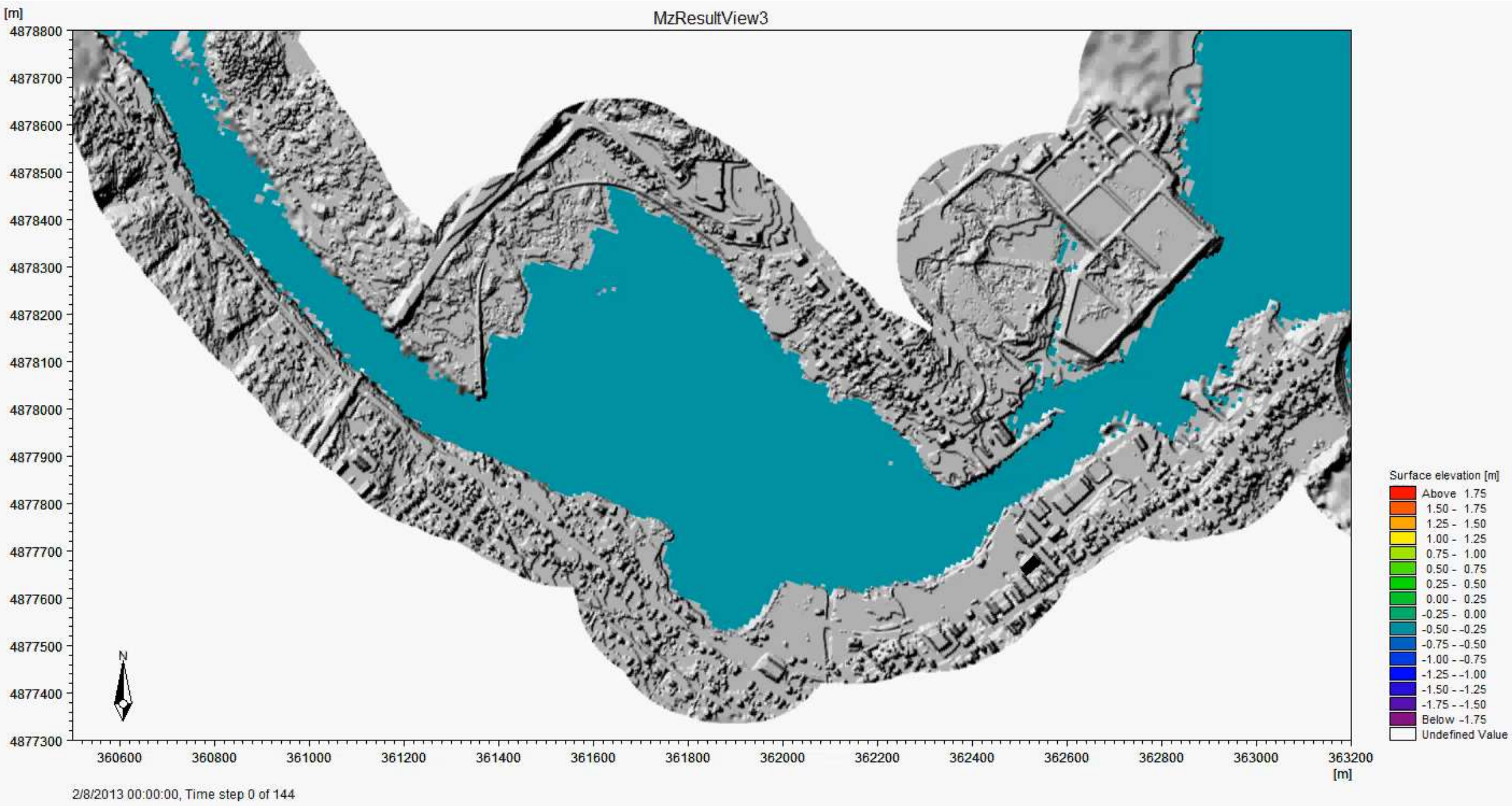
- Mike 2D by DHI
- Rectangular 9 m resolution grid interpolated from various bathymetry sources
  - CHS
  - single beam echo sounder
  - cross sections
  - lidar
- Constant flow for river boundary condition (estimated from flow measurements)
- Ocean boundary is Feb 2013 storm surge



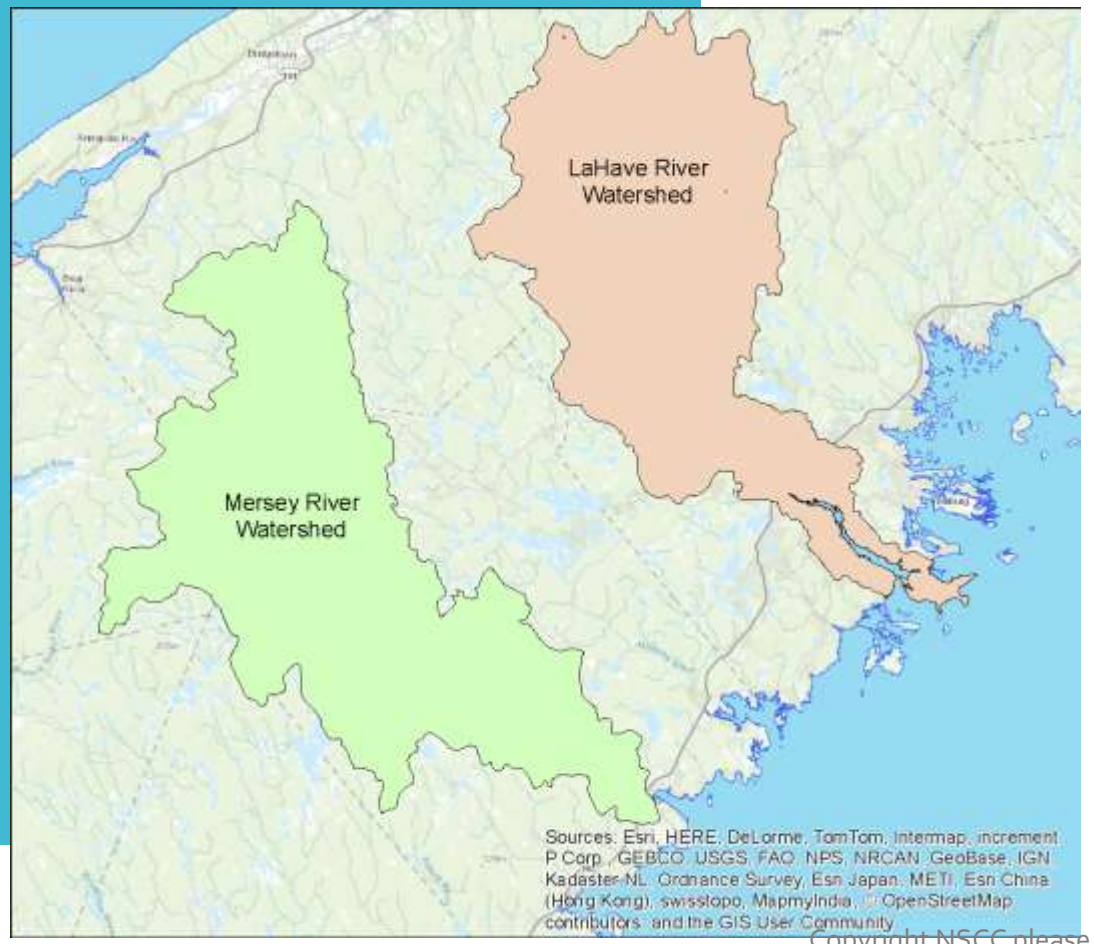






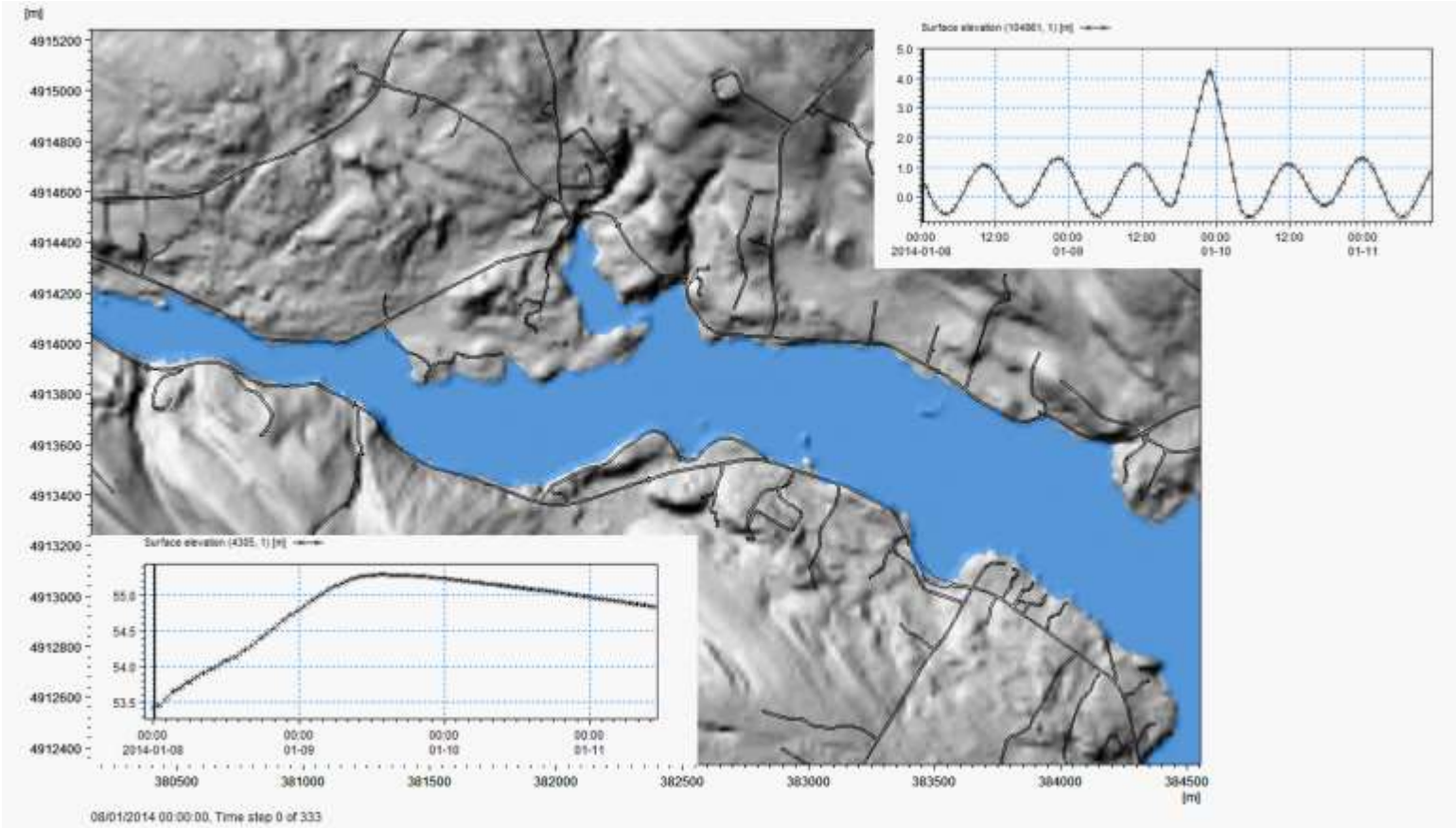


Comparison with LaHave Estuary



- Similar system to LaHave which we have studied extensively- similar watershed size, etc
- But river systems behave differently and respond differently to floods because the Mersey has several NSPI dams along it (7)
- Therefore the Mersey is regulated more, and doesn't see a lot of overland or fluvial flooding
- Also, Bridgewater is much farther inland than Liverpool, and doesn't see nearly as much storm surge

LaHave Results



Example of interaction between discharge and tide-surge

Conclusions and Future work

- HD model
  - grid modification
  - bathymetry fine-tuning
  - validation using pressure sensor
- For both sets of results
  - GIS intersection of roads, infrastructure and flood layers to quantify what's at risk
- Mitigation and Adaptation
  - Modify DEM with elevated berm or parking lot

Acknowledgements

INNOVATION.CA
CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

Springboard
Bringing Research to Life
Faire vivre la recherche

NSRIT
Nova Scotia Research and Innovation Trust