A look back over ten years of tidal wetland restoration in NS

CB Wetlands & Environmental Specialists

tony.bowron@cbwes.com
www.cbwes.com

& Environmental Specialists

Halifax, Nova Scotia (2005)

Tony M. Bowron, B.Sc., MES
Coastal Wetland Ecologist
Director, CBWES Inc.

Nancy C. Neatt, B.Sc., MMM
Coastal Marine Ecologist
Director, CBWES Inc.

Jennie Graham, B.Sc., Adv.Dip.RS, M.Sc.
Geomatics Specialist
CBWES Inc.

Danika van Proosdij, Ph.D.
Professor
Saint Mary's University
Department of Geography

Jeremy Lundholm, Ph.D.
Associate Professor
Saint Mary's University
Department of Biology & Environmental Science

Full service coastal wetland restoration provider

Also…
Ecological monitoring & research
GIS mapping & hydrological modeling
Shoreline Management & Climate Change Adaptation
Low-altitude aerial photography

Strong research partnership with Saint Mary's University

NOVA SCOTIA
Transportation and Infrastructure Renewal

SAINT MARY'S UNIVERSITY SINCE 1802
One University. One World. Yours.

Tidal Wetland Restoration Projects

Culvert replacement:

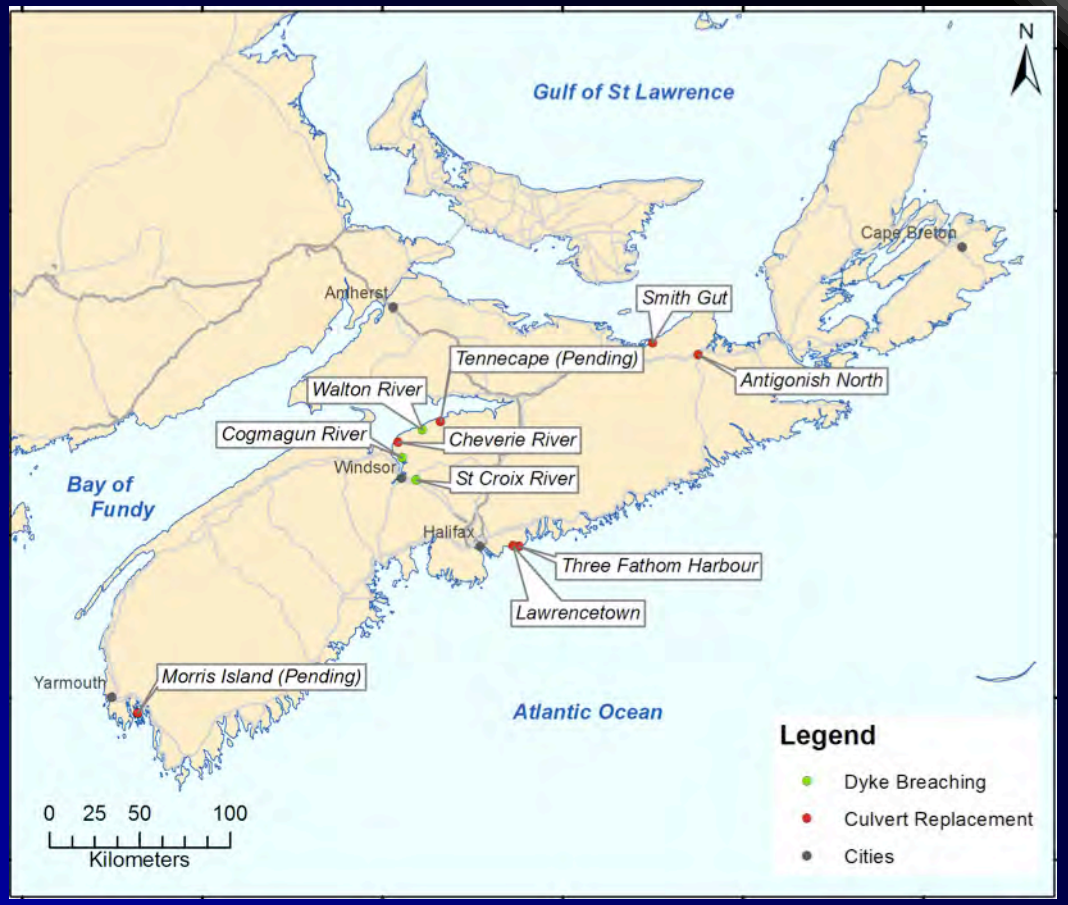
- Cheverie Creek (2005)
- Smith Gut (2006)
- Lawrencetown (2006)
- Antigonish Landing (2014)
- Three Fathom Harbour (2015)

Dyke Breach:

- Walton River (2005)
- St. Croix River (2007)
- Cogmagun River (2009)

Restored – 90 ha; 222 acres

Pending – 150 ha; 370 acres



Federal & Provincial NSTIR compensation projects

Partners:

NSTIR; DFO; DOA; SMU; DUC; CBCL Ltd.; EAC; local communities

Cheverie Creek Tidal River & Salt Marsh

2005

Eliminated tidal restriction

Increase amount of salt marsh (5 – 43 ha)

Improve fish passage & habitat conditions

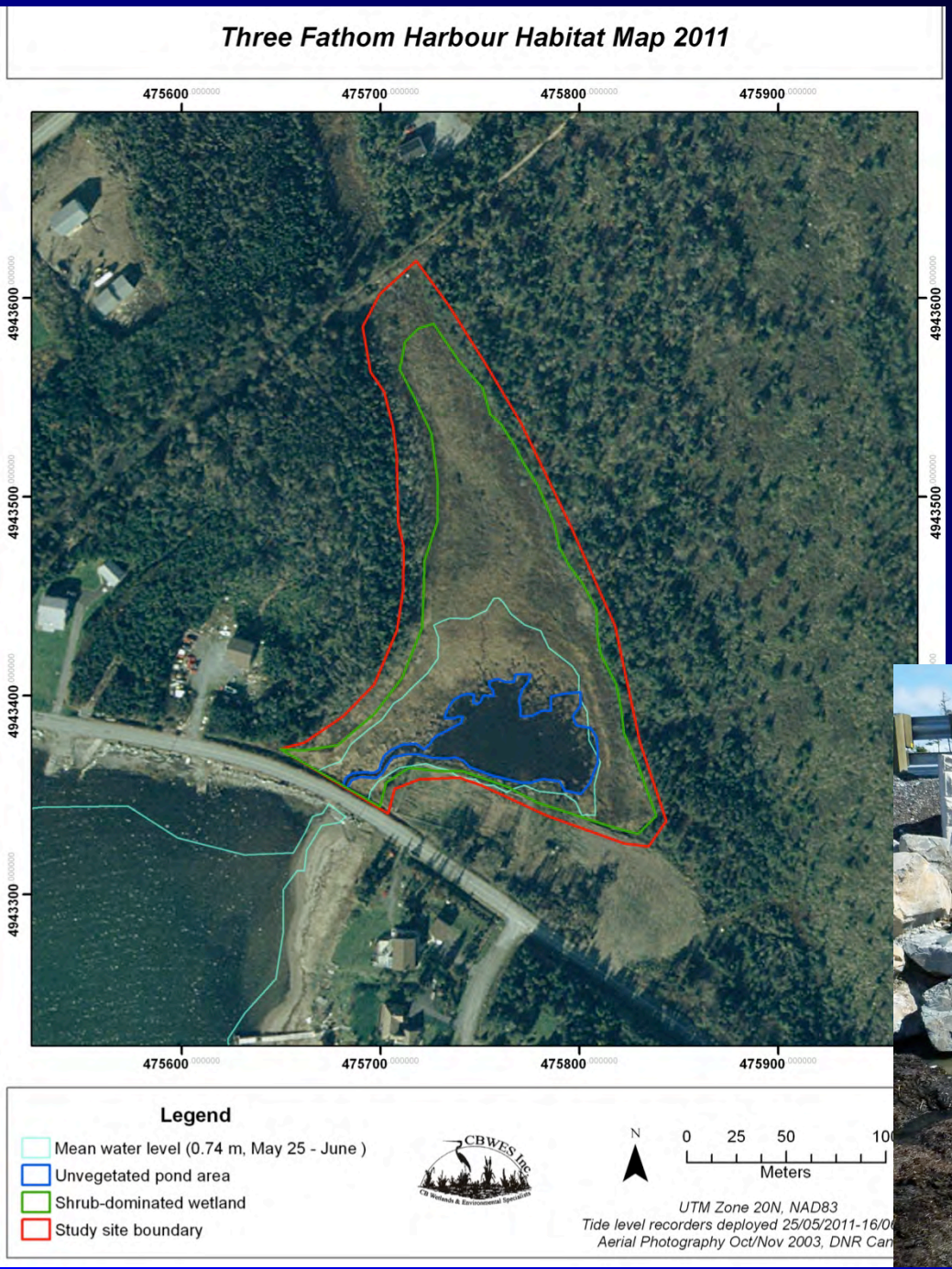
Lawrencetown Lake

Culvert installed in 2007

Near complete restriction

1.43 ha

Three Fathom Harbour



1.43 ha

Near complete restriction

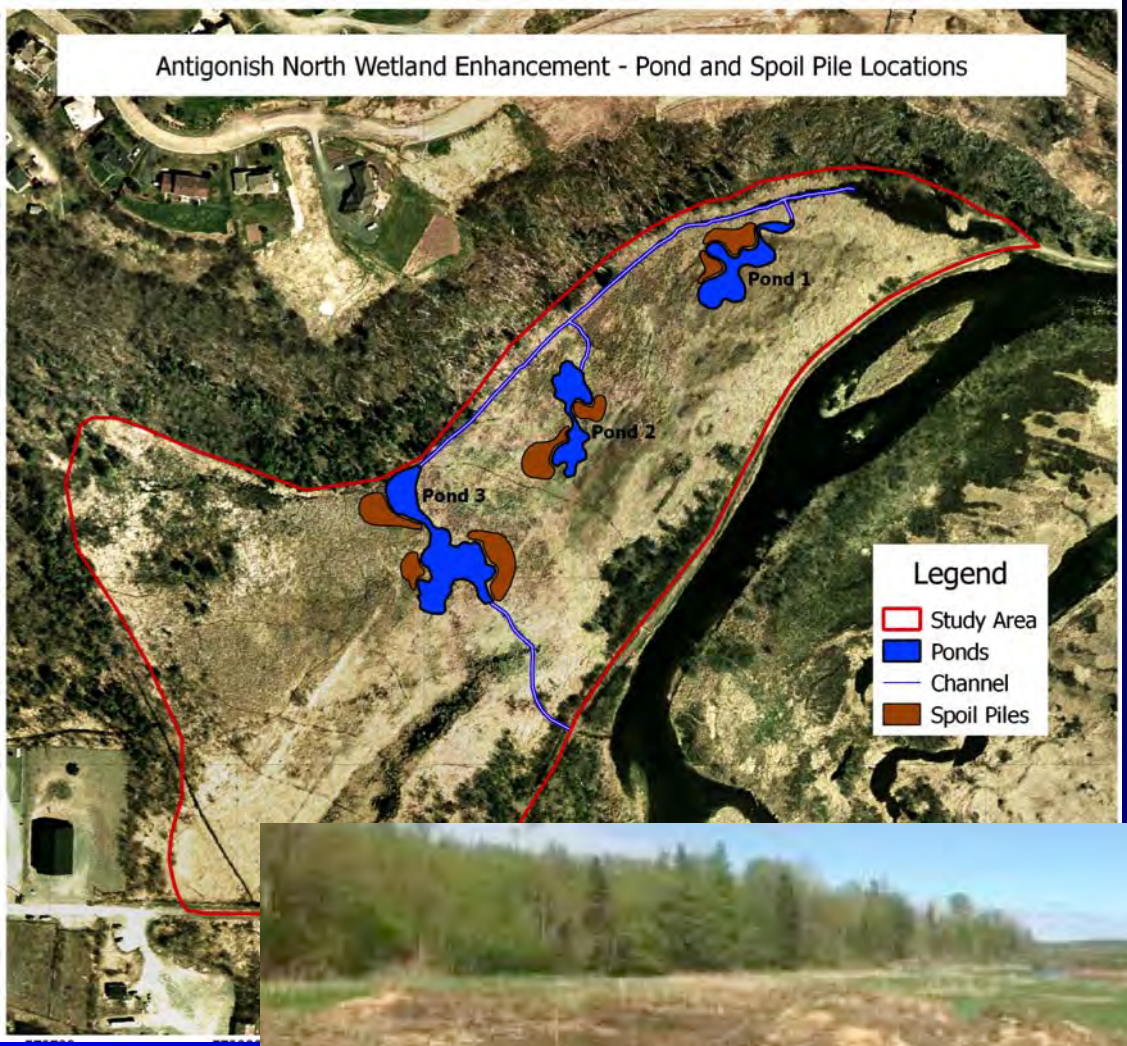
New crossing installed 2015

Antigonish Landing

1.5 ha

Multiple culvert replacement; channel enhancement & pond creation

2014 - 2015



Walton River

1990

Dyke constructed

Salt marsh to freshwater impoundment

2005

Dyke breached in 5 locations & 1 shallow channel excavated

Impoundment to salt marsh

2005 Before Restoration – freshwater impoundment

Post breach -June 2006

August 2006

August 2007

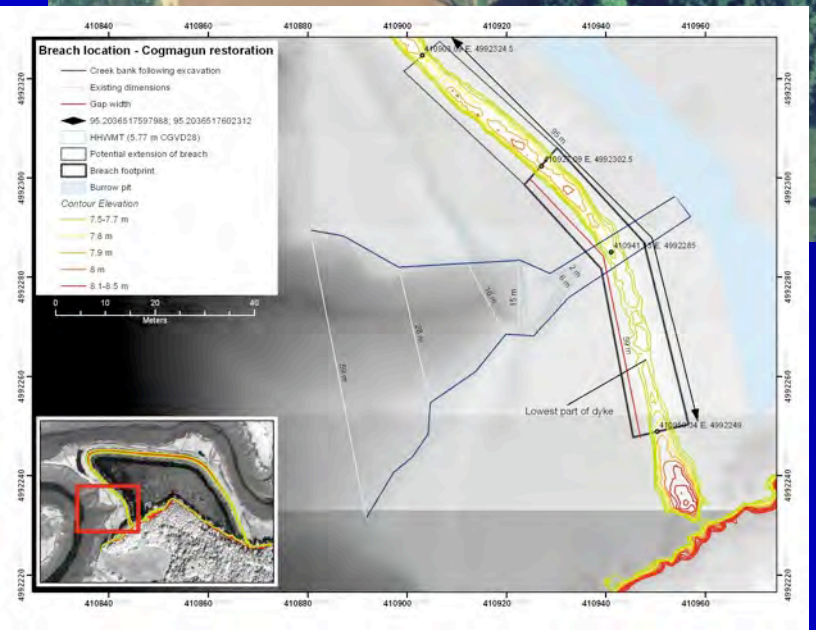
Fall 2011

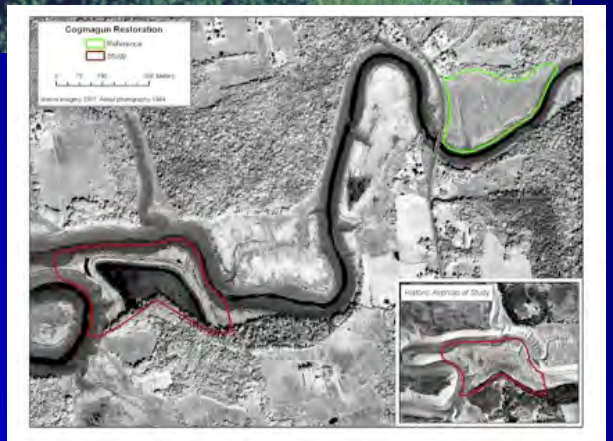
Restoration site (WAL) 9.72 ha

Reference site (WAL-R) 4.95 ha

Main channel development at the second breach of WAL in a) fall 2005, b) spring 2006, c) fall 2009, and d) fall 2010 (ebb tide).

Cogmagun River Salt Marsh Restoration Project



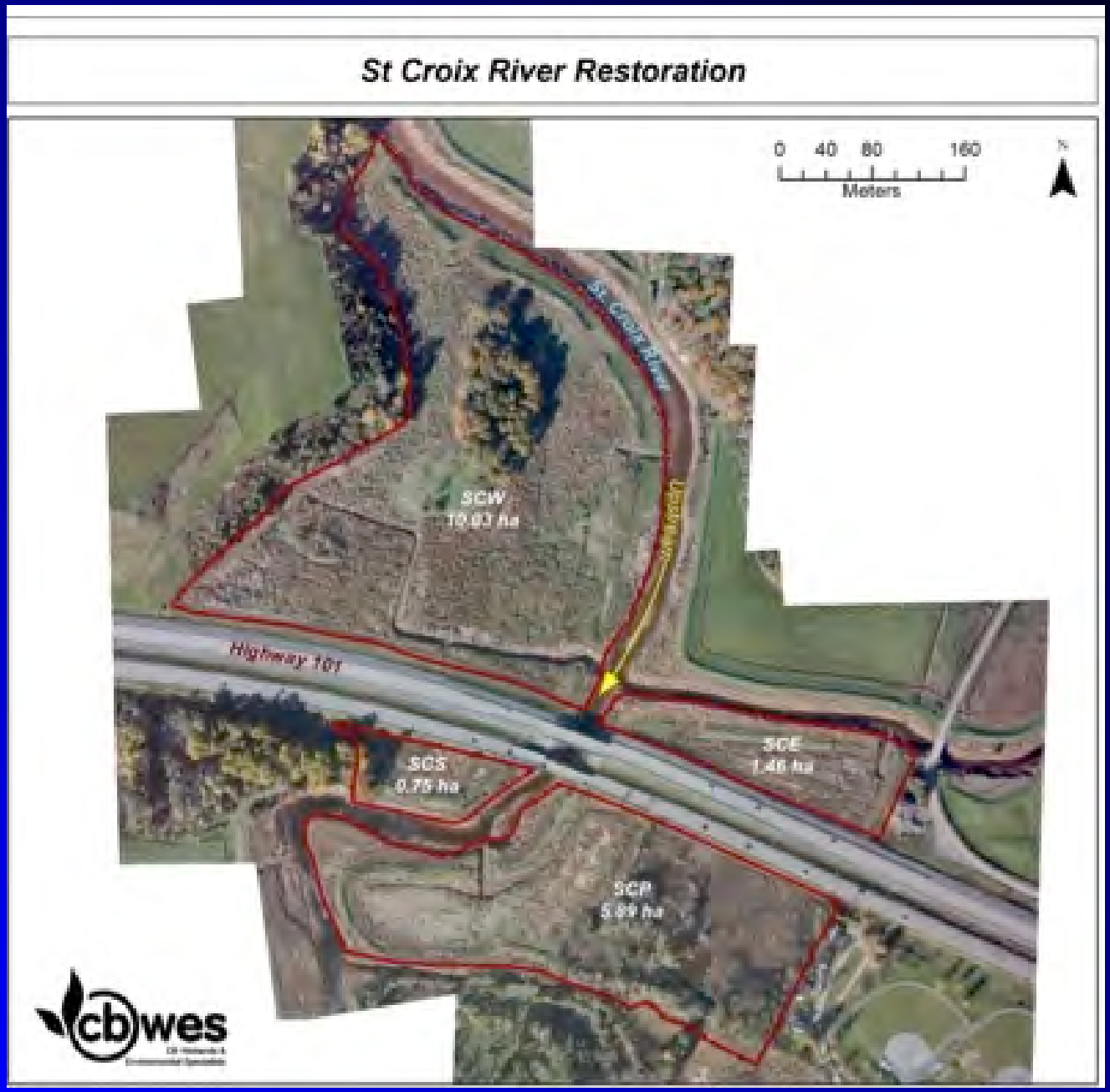


- Freshwater Impoundment
- 4.89 ha
- Restoration Design – breach #, location, size
- Single breach
- excavated channel
- 2009

Spring 2010


August 2015

St. Croix River Tidal Wetland Restoration Project



Fallow dykeland

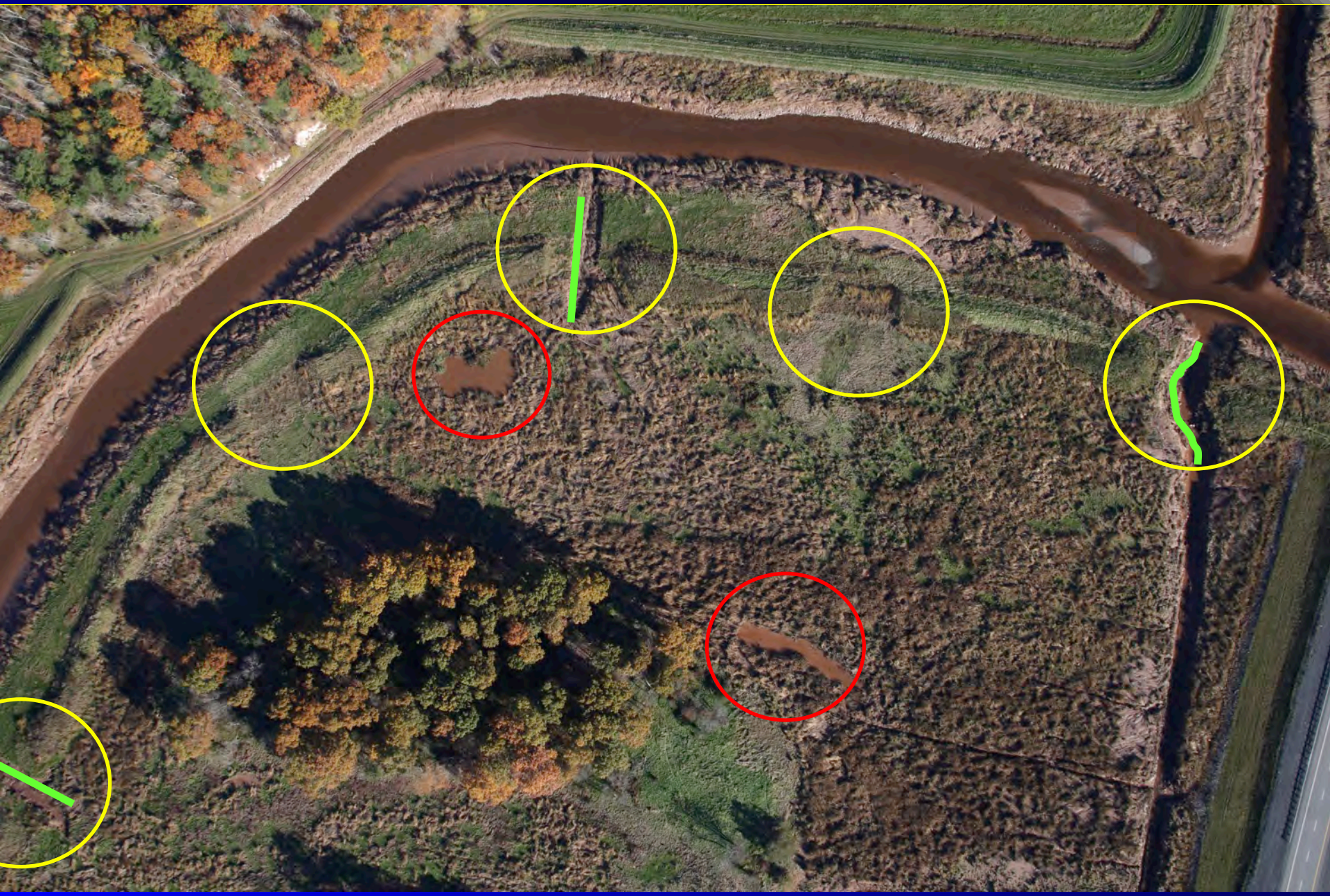
Complete restriction

~18 ha

Tidal wetland & floodplain habitat

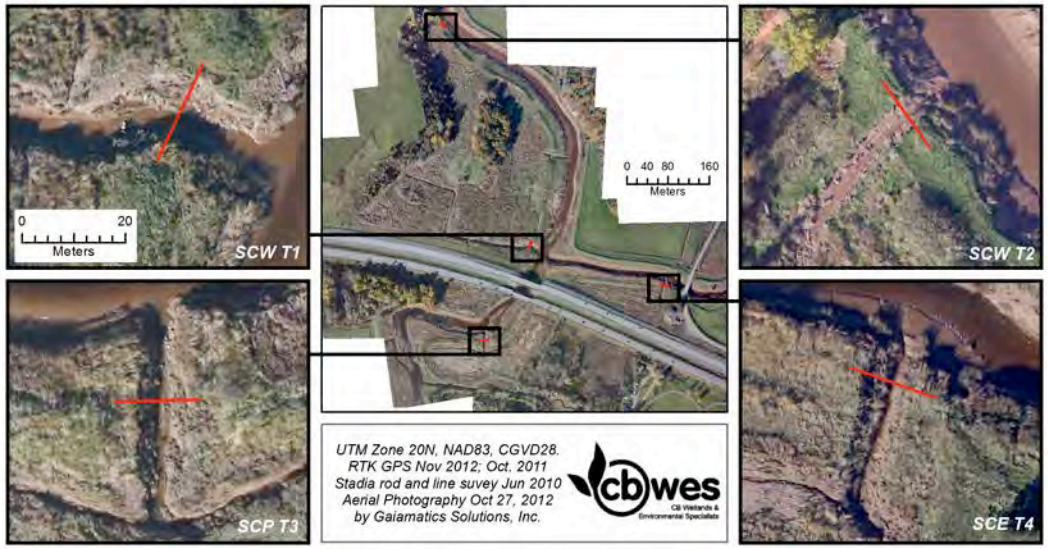
Project design:

- Breaching dykes
- Channel re-construction
- Ponds
- 2009



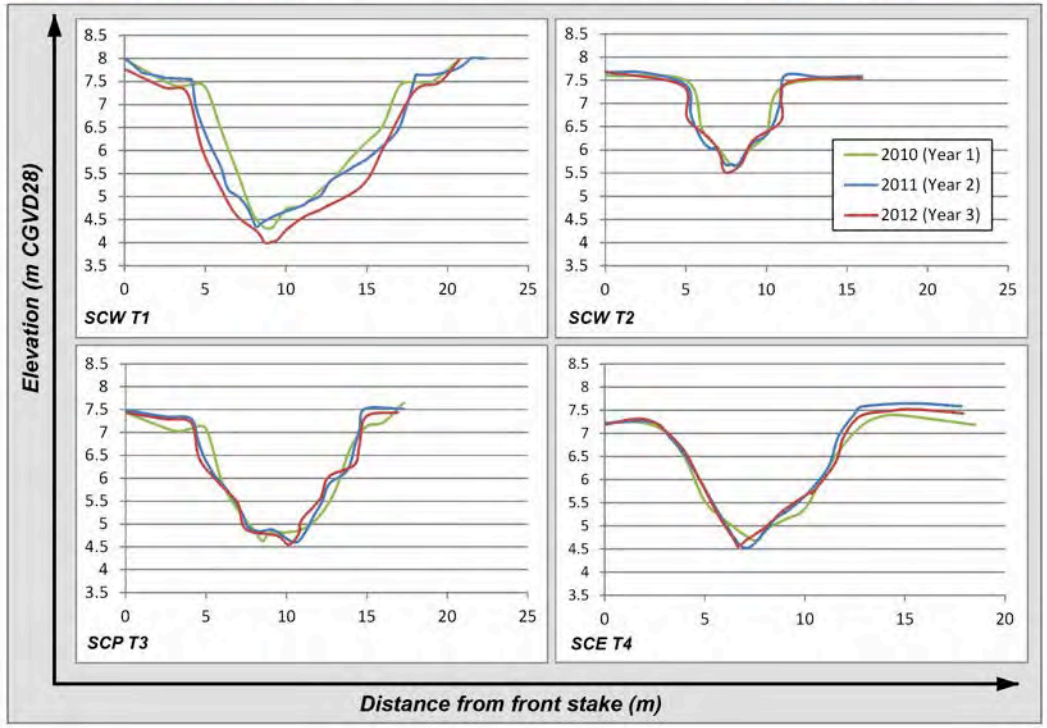
Fall 2012; 3 yrs post

St Croix Restoration - Excavated Channel Development 2012



UTM Zone 20N, NAD83, CGVD28.
RTK GPS Nov 2012; Oct. 2011
Stadia rod and line suvey Jun 2010
Aerial Photography Oct 27, 2012
by Gaiamatics Solutions, Inc.

cbwes
CB Wetlands & Environmental Specialists



Immediate post (2009)

One year (2010)

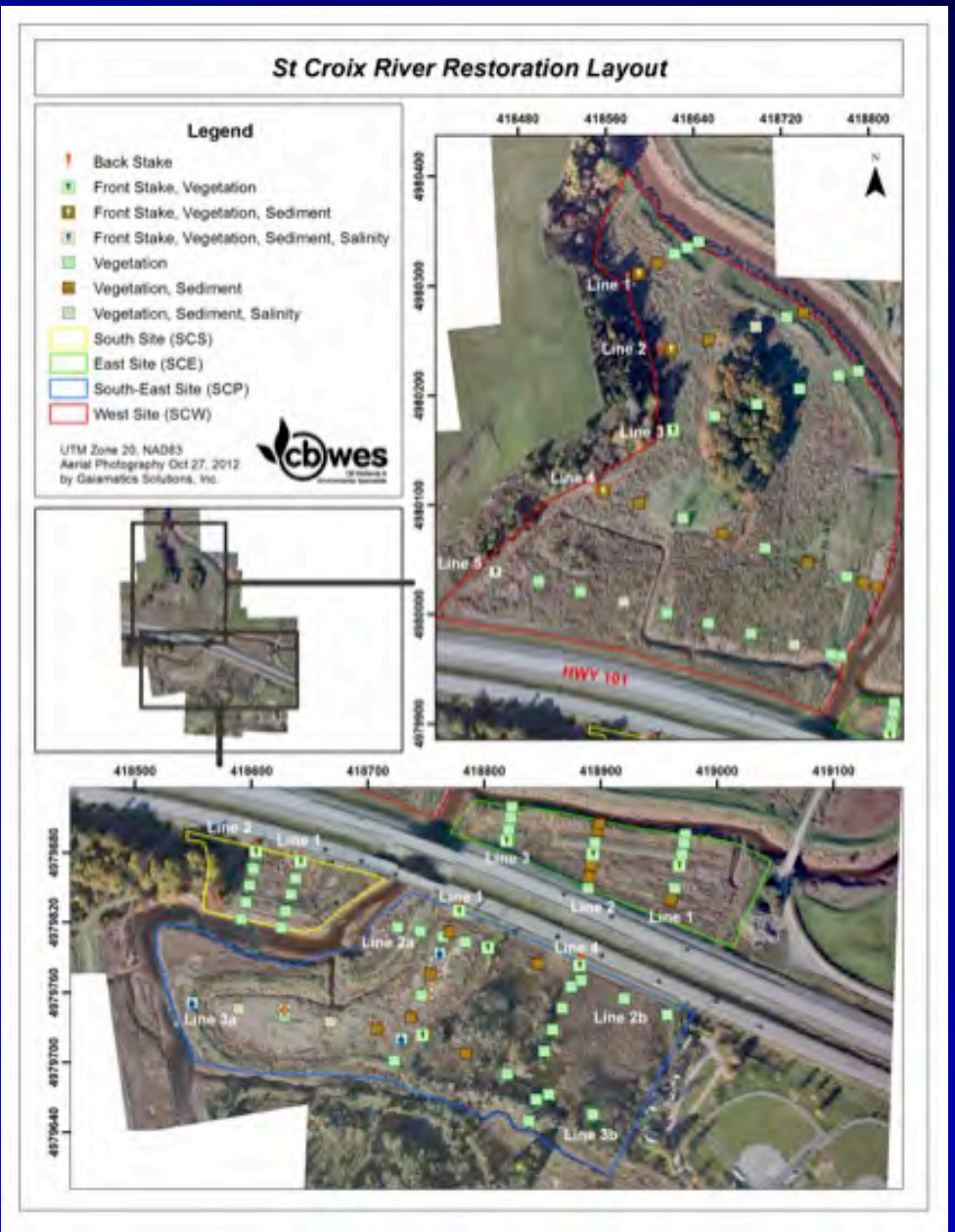
Two years (2011)

Three years (2012)

Four years (2013)

September 2015 (6 years post)

Long-term Ecological Monitoring Program



1 pre & 5 year post program

Reference site

GPAC regional monitoring protocol

- Geospatial attributes
- Hydrology
- Soils & sediment
- Vegetation
- Fish
- Invertebrates
- Aerial photography

Wetland Recovery

Ecological engineering phase

- New hydrology
- Activation of creek network
- High rates of sedimentation
- Bareground/ mudflat formation
- Die-off of non – tolerant vegetation

Year 0 - 1

Vegetation response phase

- High rate of vegetation recovery
- Reduced bareground
- High productivity in the second year
- Depending on conditions either high biodiversity or largely monoculture

Year 2 - 3

Intermittent disturbances & future of site

- Sediment rates decline
- Fully vegetated, secondary colonizers
- Secondary controls become more dominant (vegetation, competition, disturbance)
- Parity with reference conditions begin to become evident
- Productive & functioning wetland, but not mature

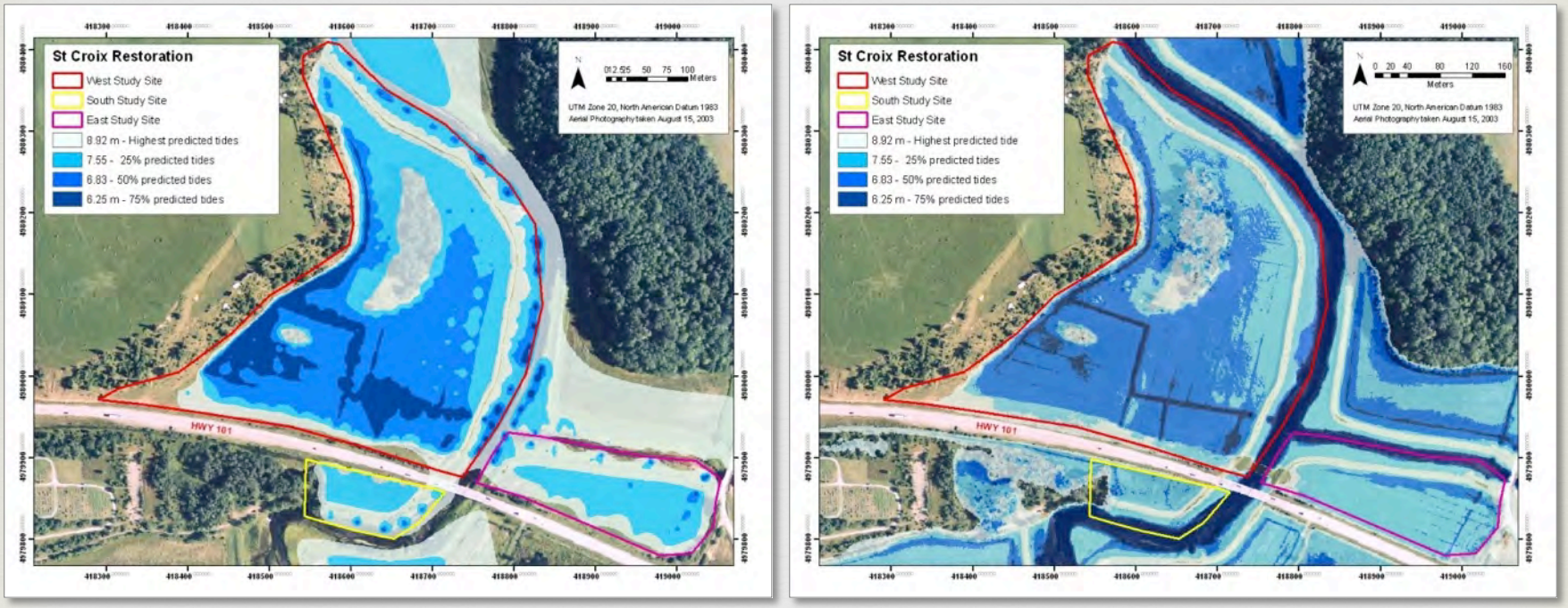
Year 3-5

Advances in Technology & Design

- Upgrade to RTK GPS
  - More efficient
  - Increased flexibility
- Lidar available for multiple projects
  - Reduced intensity of survey data collection
  - Increased DEM accuracy
- Hydrological modeling capability

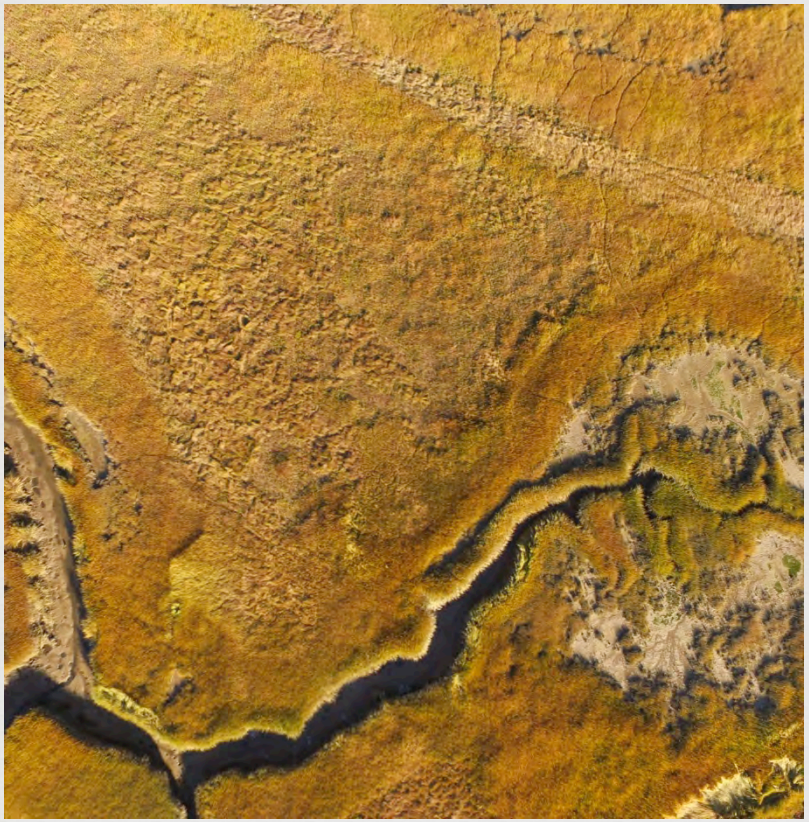
RTK channel profile on Kennetcook River

Application of Elevation Data: Flood maps



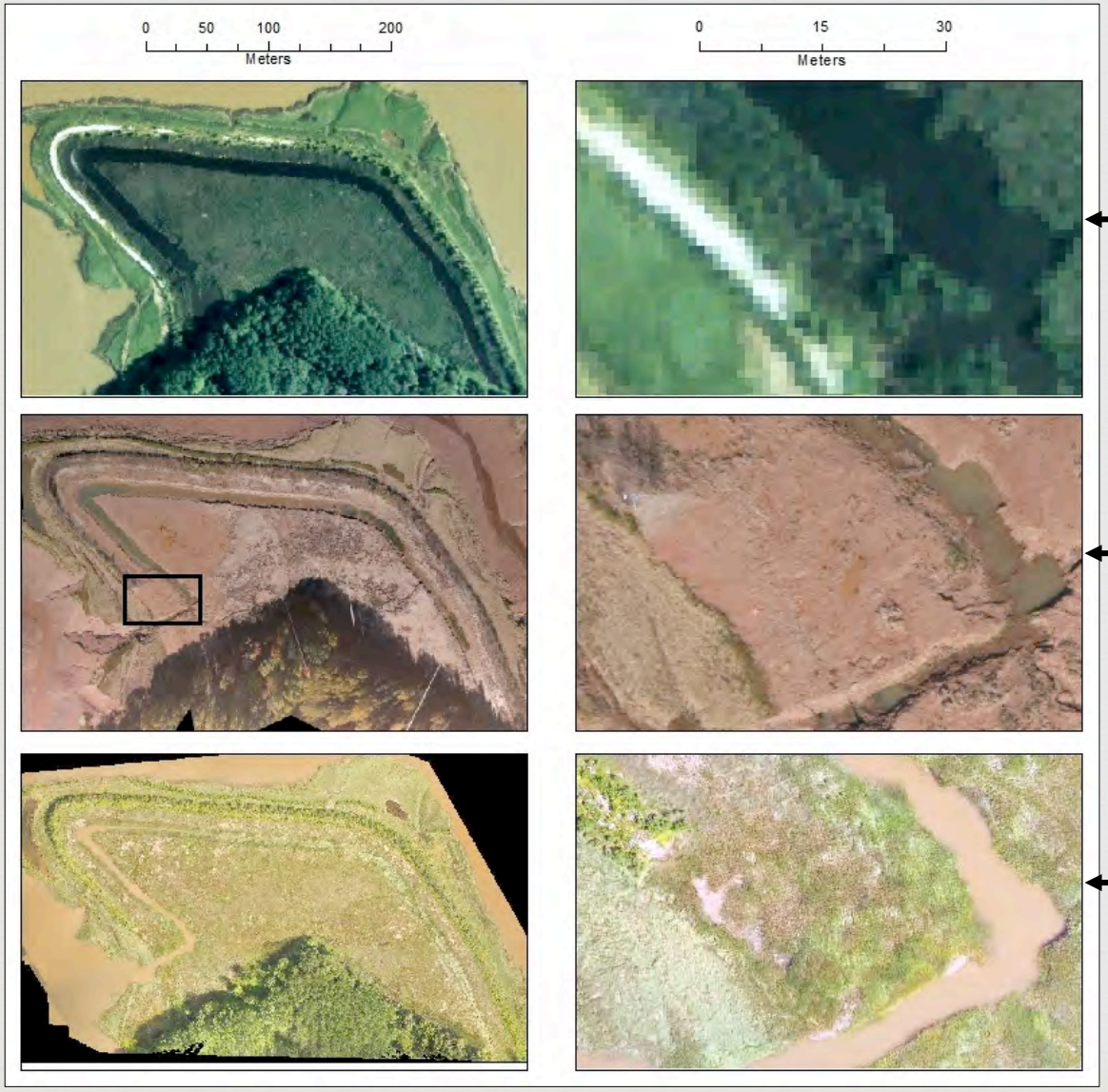
Flood map derived from Total Station DEM (left) and Lidar DEM (right)
St. Croix Restoration Project

Geo-referenced Low-altitude Aerial Photography



- "Plover 1"
  - Low-altitude blimp & camera system
  - Processing in PCI Geomatica
- "Raptor 1"
  - DJI Phantom 3 drone
  - Pix4D Mapper software
- Pros
  - High Resolution
  - Cost-effective
  - Easy deployment/ processing
  - Digital surface generation
  - Landscape scale

Comparison: Cogmagun



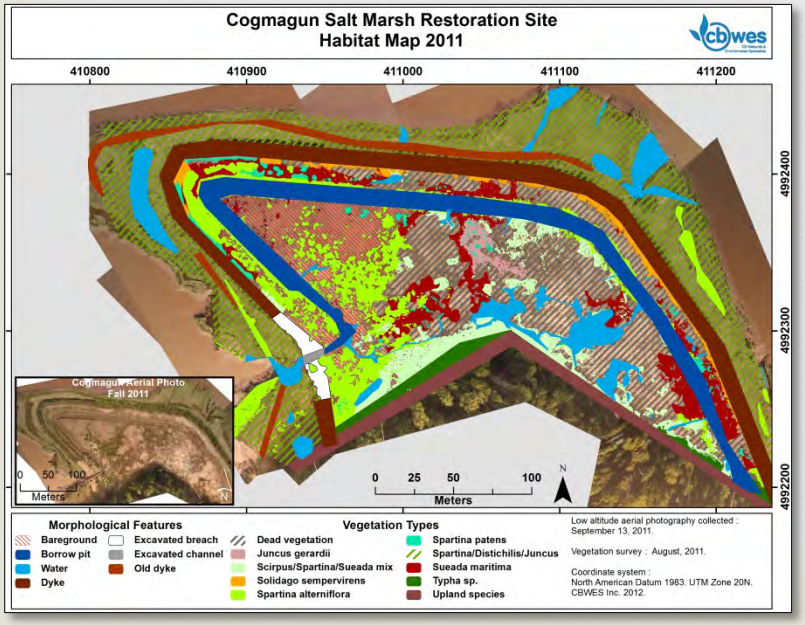
Provincial Aerial Photo (1m resolution) Pre-restoration (2009)

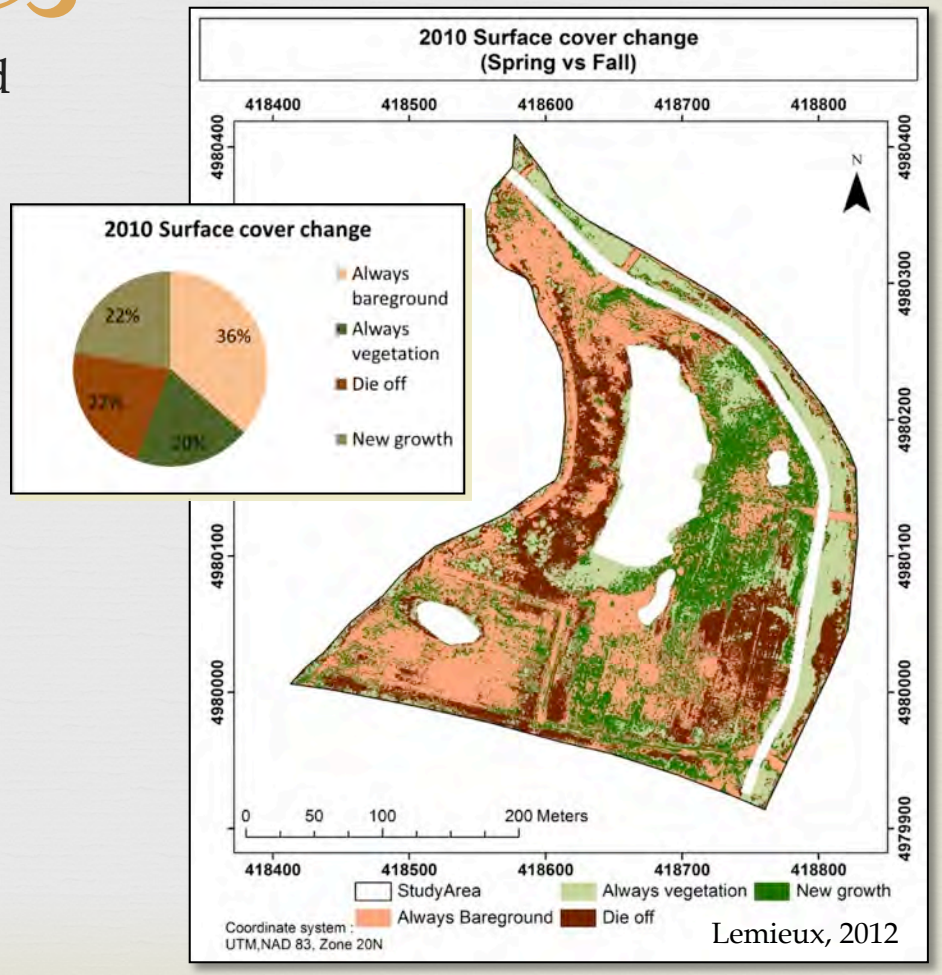
Plover 1 (10 cm resolution) Year 1 (2010)

Raptor 1 (4 cm resolution) Year 5 (2015)

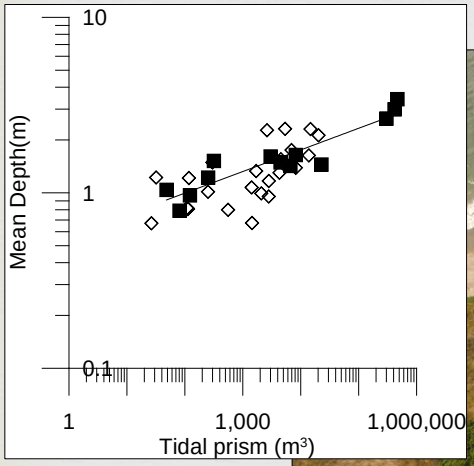
Application of Aerial Photography: Habitat Maps

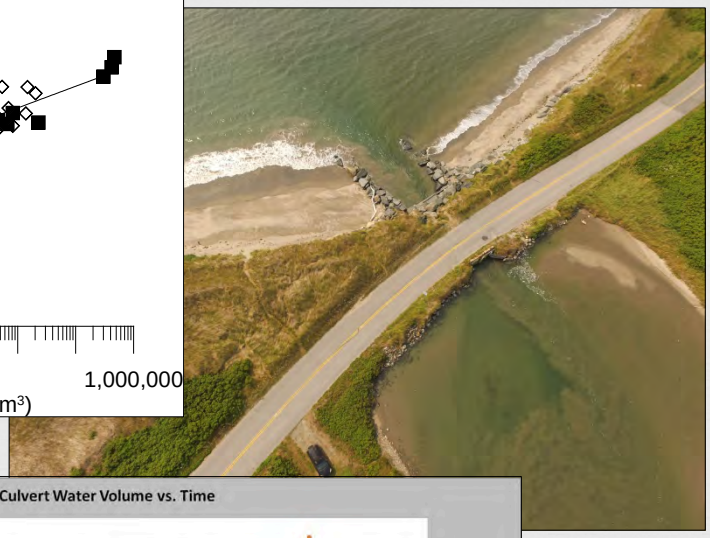
- High resolution imagery matched with vegetation surveys
- Maps updated annually
- Time change detection possible

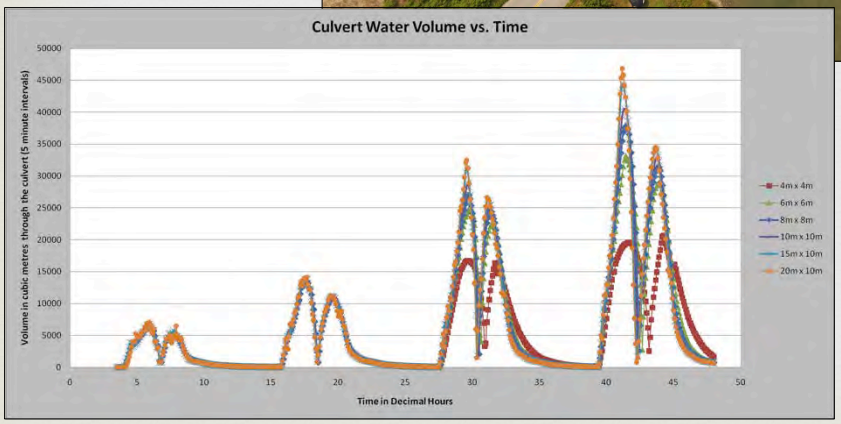




Application of Technologies to Design







- Focus on Hydrology
  - Accurate elevation critical
  - Visualization important
- Graham, 2012
  - Hydraulic geometry
  - Characterize drainage networks
- Hydrodynamic modeling
  - Complex systems
  - Scenario tests

Hydraulic geometry graph (top), Drainage analysis (middle), Tuflow output for proposed tidal crossing (bottom)

Lessons Learned

Pilot projects have been successful

Experience & science to support tidal wetland restoration:

- to mitigate unavoidable loss,
- recover some of what has been lost,
- an adaptation to CC & SLR

“Low hanging fruit”

Increased size & complexity
Driven by:

CC adaptation
coastal resilience
flood risk & safety concerns

Storm events & surges.

Questions?

Saint Mary's University Since 1802
One University. One World. Yours.

Nova Scotia
Transportation and Infrastructure Renewal

cbwes
CB Wetlands & Environmental Specialists

tony.bowron@cbwes.com

www.cbwes.com
www.facebook.com/cbwes