St. Clair Conservation

Baird.

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Dynamic Beach Assessment
Sarnia, Reach 5

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Monday November 14, 2016

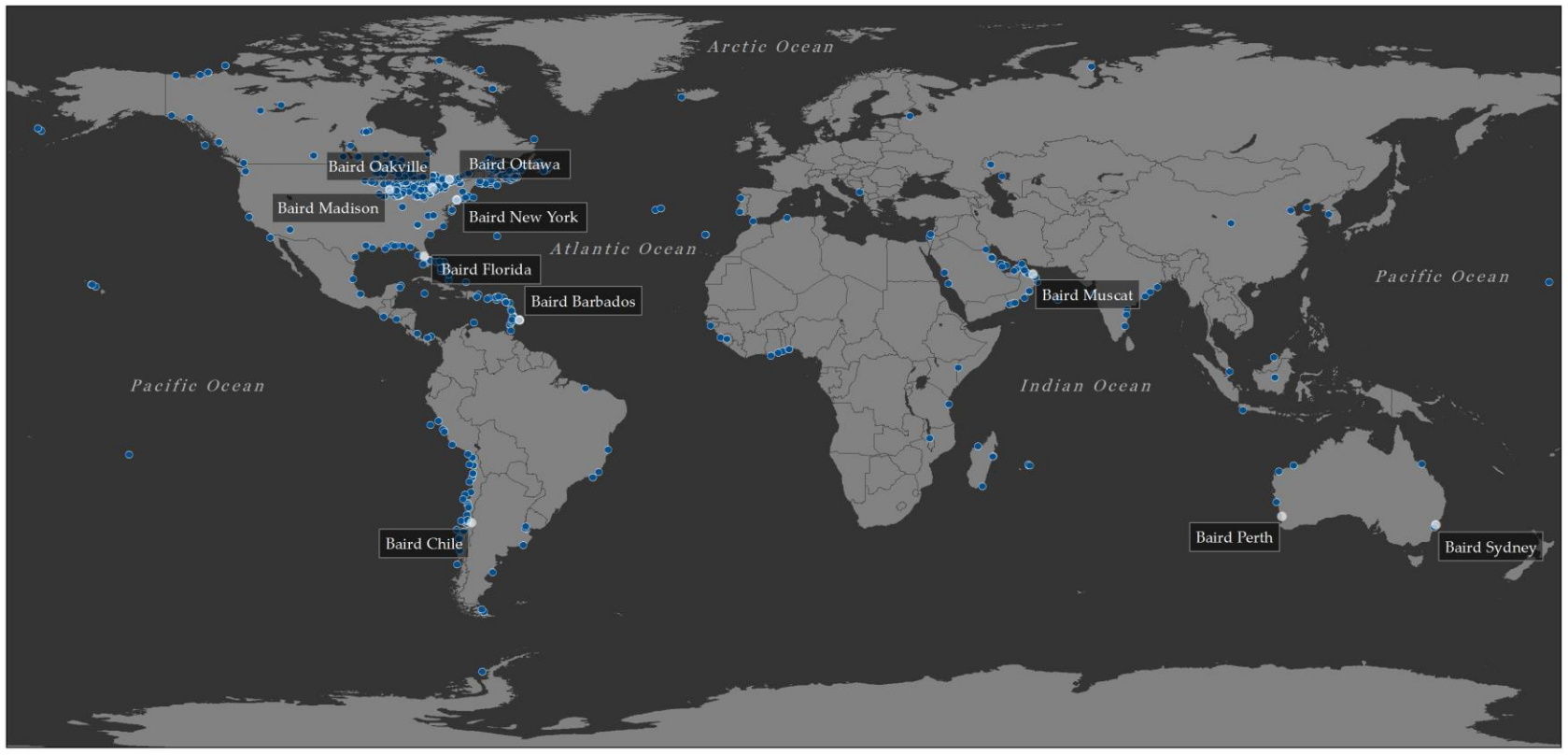
Baird.
Innovation Engineered.

St. Clair Conservation

Baird & Associates

- Largest specialized coastal engineering firm in North America
- Founded in 1981
- Employee owned
- ~80 employees

Worldwide Engineering



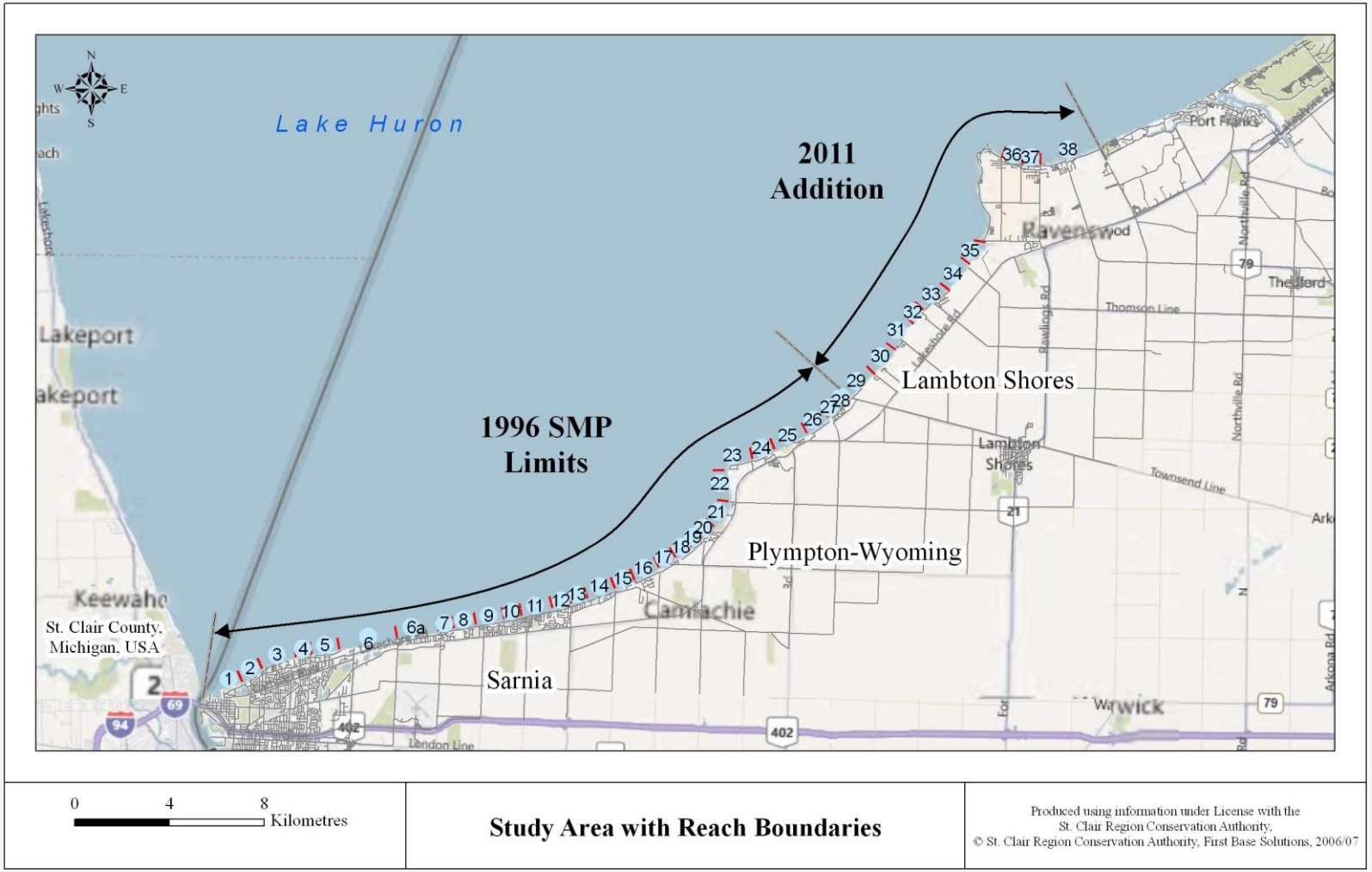
- 10 offices worldwide (white dots)
- Head office in Ottawa
- Blue dots represent location of Baird projects

Dynamic Beach Assessment
Sarnia, Reach 5

Background Information

- 1996
  - St. Clair Region Conservation Authority (SCRCA) developed the Lake Huron Shoreline Management Plan (SMP).
- 2011
  - Baird updated the SMP to the current technical standards as per MNR Technical Guide for the Great Lakes – St. Lawrence River Systems and Large Inland Lakes (MNR, 2001) and to include Lambton Shores.
  - Reach 5 was identified as a dynamic beach.
  - The dynamic beach hazard limit was delineated in accordance with the Technical Guide (MNR 2001)
    - Flooding allowance of 15 m plus a dynamic beach allowance of 30 m, measured horizontally from the 100-year flood level.

SMP Reach Boundaries



Purpose of Study

- 2013
  - This study provides a site specific assessment of the dynamic beach hazard in Reach 5.
  - The methodologies used in this study are based on accepted engineering and scientific principles and are consistent with the requirements of the Provincial Policy Statement (2005) and the Technical Guideline (MNR, 2001).
- 2016
  - Holding final consultation on two dynamic beaches for incorporation into SMP.

Study Area


CANADA
Sarnia
CHRIS HADFIELD AIRPORT
402
Western Limit of Reach 5
Western Limit of Reach 6
N
W
E
S
Lake Huron PKY
Hillcrest DR
Haight LANE
Green Acres RD
Pamela CRT
Chudleigh RD
Rutherglen DR
Lakeshore RD
Braemar LANE
Murphy RD
Sylvan

Provincial Policy

- 3 Natural Hazards:
  - Erosion
  - Flooding
  - Dynamic Beach
- Development is restricted within the hazard limits

Erosion Hazard

Dynamic Beach Hazard

Flood Hazard

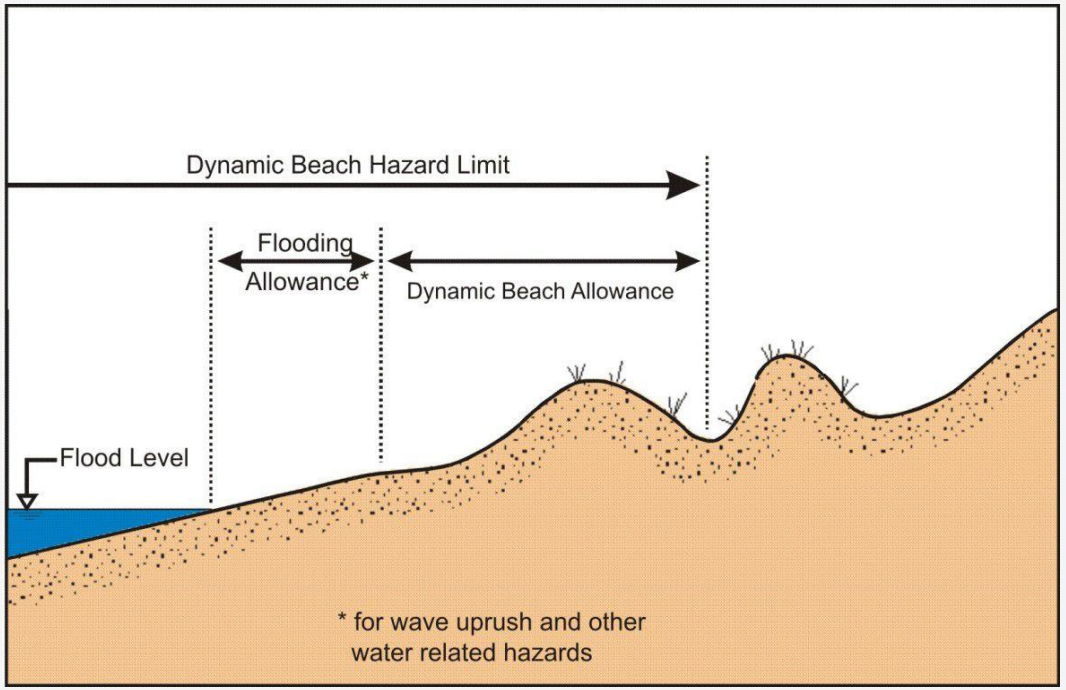
Dynamic Beach

- Dynamic beach is defined by MNR as:
  - Shoreline with a beach or dune landward of the water line;
  - Beach is greater than 0.3 m deep, 10 m wide, and 100 m long;
  - Beach is exposed to wave action that can alter the beach profile.

Dynamic Beach Hazard

Landward limit of:

- 100 Yr Flood + Flood Allowance + 30 m Dynamic Beach Allowance; or
- 100 Yr Flood + Flood Allowance + Dynamic Beach Allowance based on Scientific Principles



Hillcrest Nisbet Drive
Lot 50, Concession 9

1378 Lakeshore Road
Lot 49, Concession 9

Project Scope

- Assemble and Review Existing Data
  - including the 1:2000 topographic mapping, Canadian Hydrographic Services Field Sheet (offshore bottom elevations), historical water levels and Ministry of Natural Resources (MNR) wave climate database;
- Site reconnaissance
  - Undertake a site reconnaissance to assess the nature of the existing beach and complete beach profile surveys;
- Sediment sampling
  - Collect beach sediment samples and test for grain size.

Project Scope (Continued)

- Numerical Modelling
  - Using the CHS hydrographic data and the MNR wave database as input, along with the surveyed profiles and beach sediment data, numerically model the beach profile response.
- Estimate beach response
  - The response of the beach profiles to storm events including the 20-year return waves at the MNR 100-year flood level.
- Estimate dynamic beach hazard
  - The results from the beach profile modeling are then assessed to estimate the dynamic beach hazard limit.

Site Reconnaissance
Beach Profiles

0 100 200 m

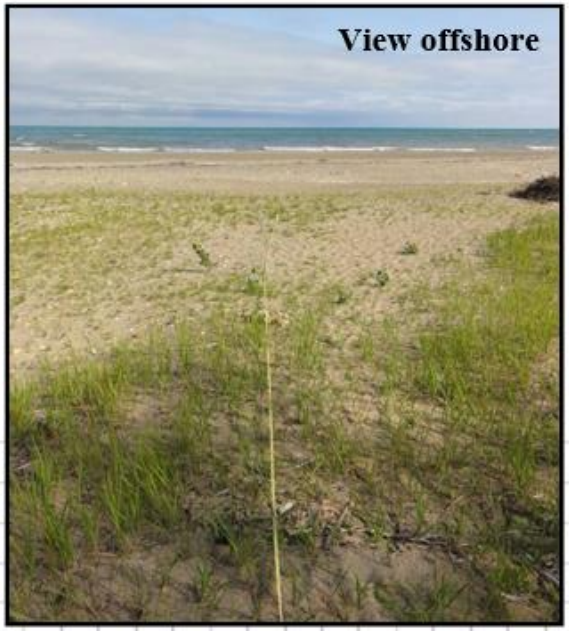
August 8, 2013 Beach Profiles

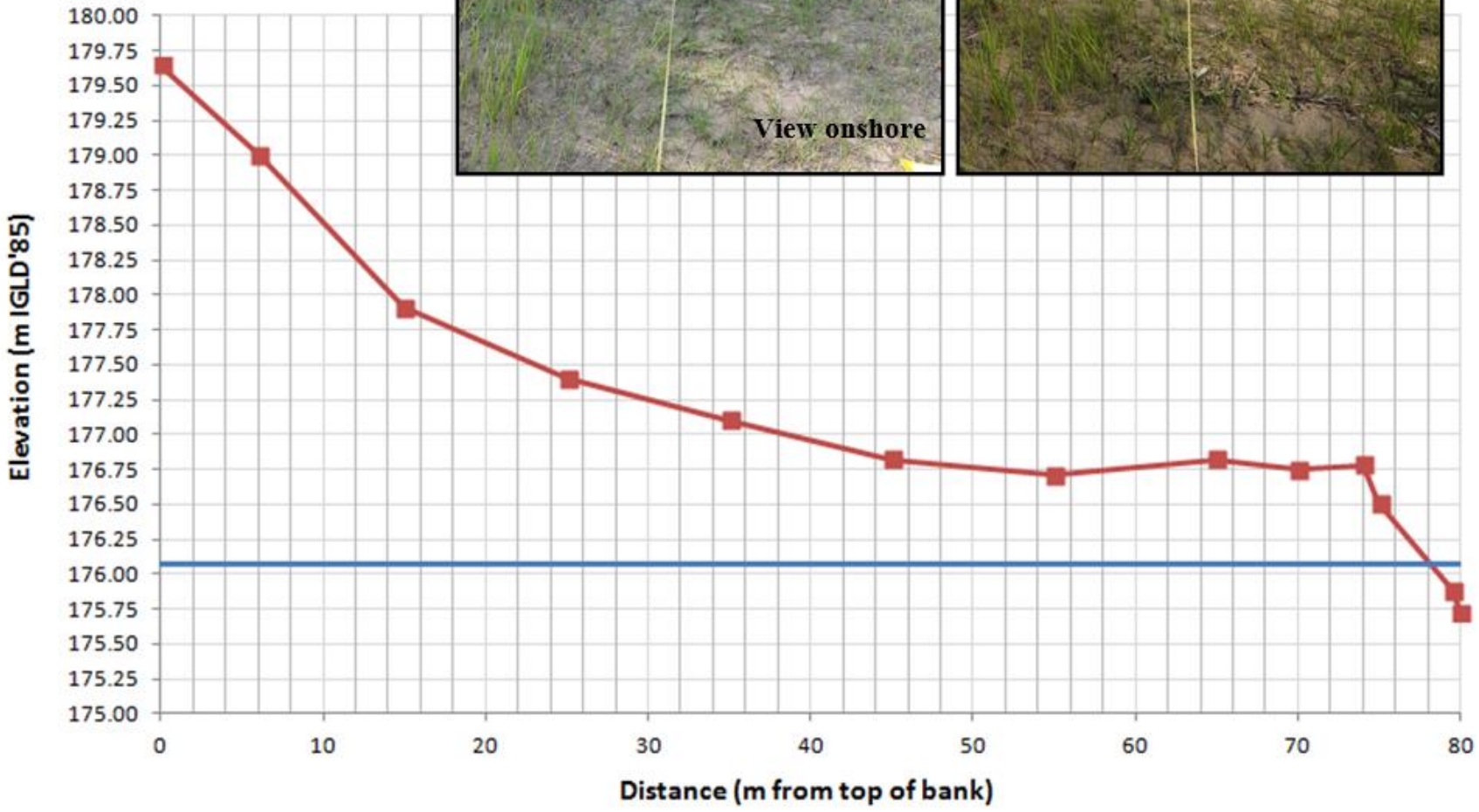
Imagery: 2006 Aerial Photos provided by S.C.R.C.A.

Baird

Profile 1


View onshore


View offshore


Elevation (m IGLD'85)
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179.25
179.00
178.75
178.50
178.25
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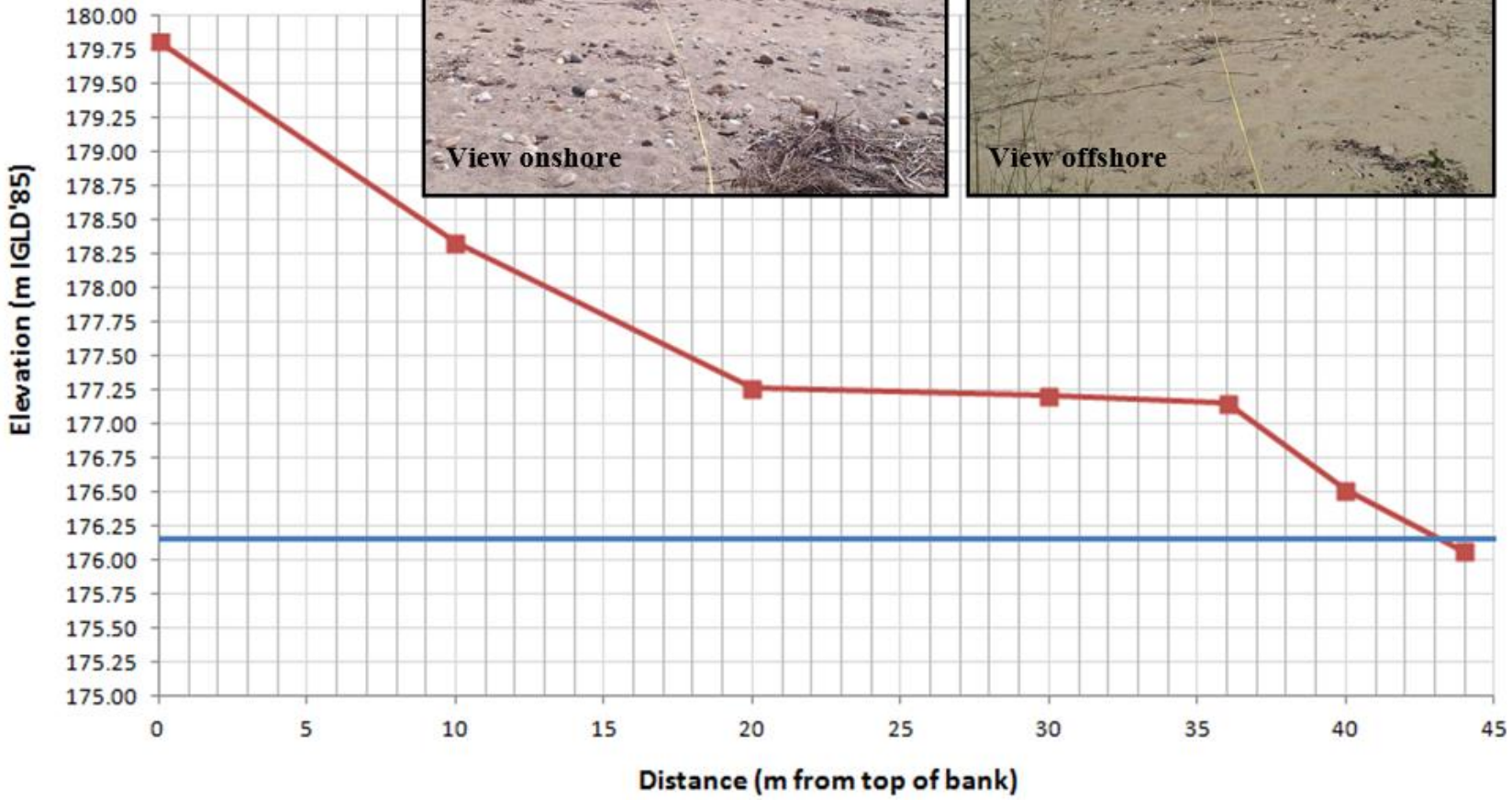
177.75
177.50
177.25
177.00
176.75
176.50
176.25
176.00
175.75
175.50
175.25
175.00
0
10
20
30
40
50
60
70
80
Distance (m from top of bank)

Profile 6


View onshore


View offshore


Elevation (m IGLD'85)
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175.75
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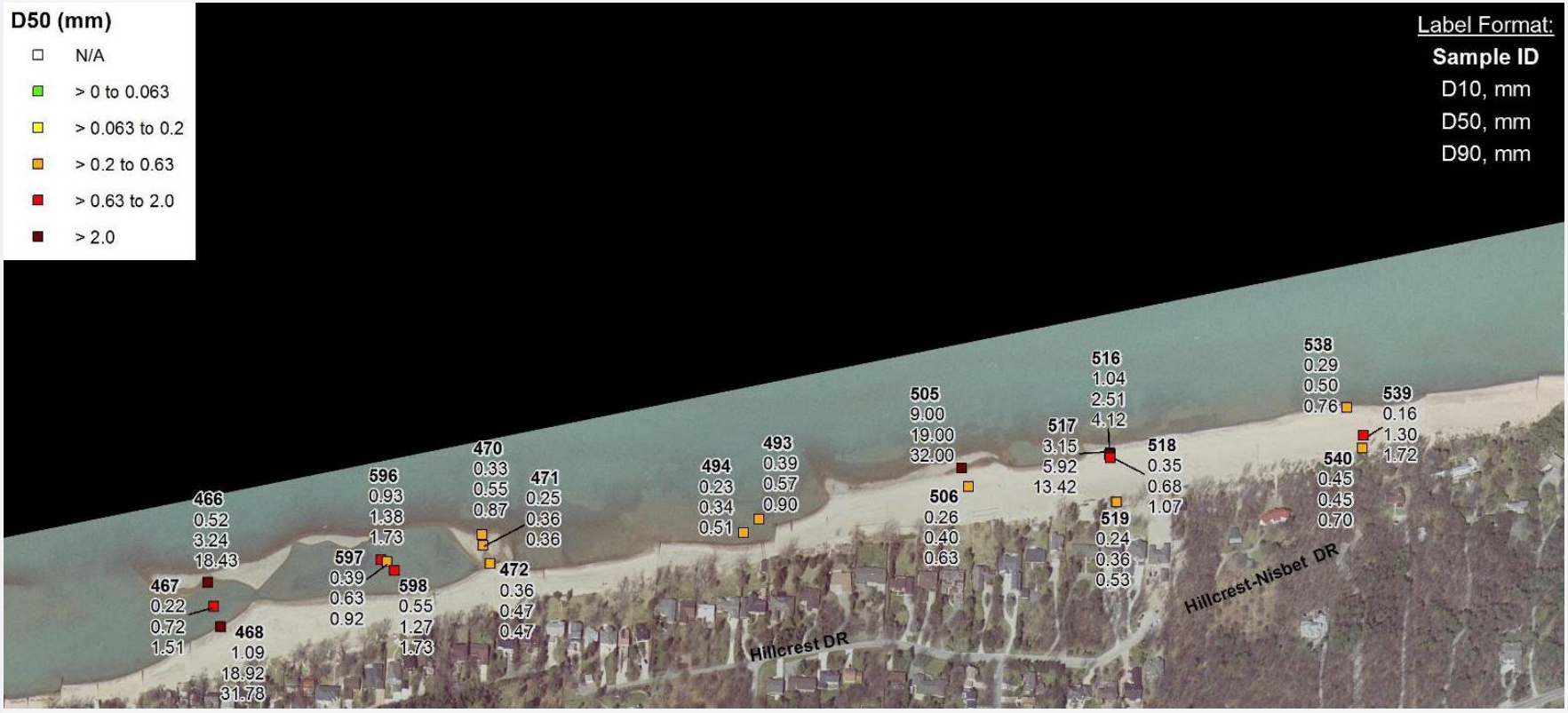
175.25
175.00
0
5
10
15
20
25
30
35
40
45
Distance (m from top of bank)

Sediment

- Sediment samples were collected on August 8, 2013
- The grain size ranges from fine sand to coarse gravel.
  - The swash zone tends to be characterized by coarser material ranging from coarse sand to very fine gravel;
  - The top of beach tends to be finer material ranging from fine sand to very coarse sand.



Waves

- Offshore wave data from the MNR wave hindcast for Lake Huron were used in this study.

Station H01 (Sarnia) Deep Water Significant Wave Heights for Varying Return Period

Return Period (Years)	Significant Wave Height (m)
1	5.6
5	6.4
10	6.7
20	7.0
50	7.4
100	7.8

Water Levels

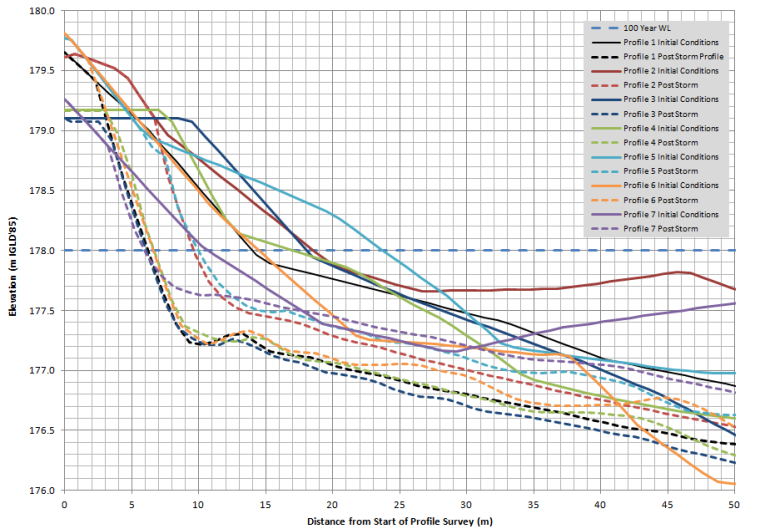
- Water levels on Lake Huron vary in the long-term and seasonally in response to climatic conditions, and in the short term due to the passage of individual storm events.
- When winds continue to blow over the lake surface in one direction for a number of hours, an increase in the water level against the downwind shoreline is produced, referred to as “wind setup” or “storm surge”. Storm surge is added to the mean lake level to determine the peak instantaneous level.

Peak Instantaneous Water Levels for Varying Return Periods

Return Period (Years)	Water Level (m IGLD’85)
2	177.2
5	177.5
10	177.7
25	177.8
50	177.9
100	178.0
200	178.1

Numerical Modelling

- The COSMOS model was used to evaluate the beach response at each of the profile locations.
- The predicted erosion measured horizontally from the pre-storm water's edge (178.0 m IGLD 1985) was a maximum of 14 m with a standard deviation of 3 m.
- It is recommended that a beach profile erosion allowance of 17 m is used. This is the maximum erosion, plus one standard deviation. This allows for variability in profile response, changes in the profile over time and variability in grain size.



Comparison of COSMOS Results for Profiles (Note: Vertical Scale Exaggerated)

Wave Uprush

- Wave uprush (aka runup) is the vertical distance that waves will runup a shoreline above the still water level.
- The runup estimates ranged from 1.2 m to 2.6 m, with an average of 1.9 m above the SWL.
- In relation to the eroded profiles, the uprush extended approximately to 14 m horizontally inland with a standard deviation of 3 m (from the position where the 100-year water level intersected the eroded profile).
- It is recommended that the wave uprush allowance is 17 m. This corresponds to the maximum wave uprush plus one standard deviation.

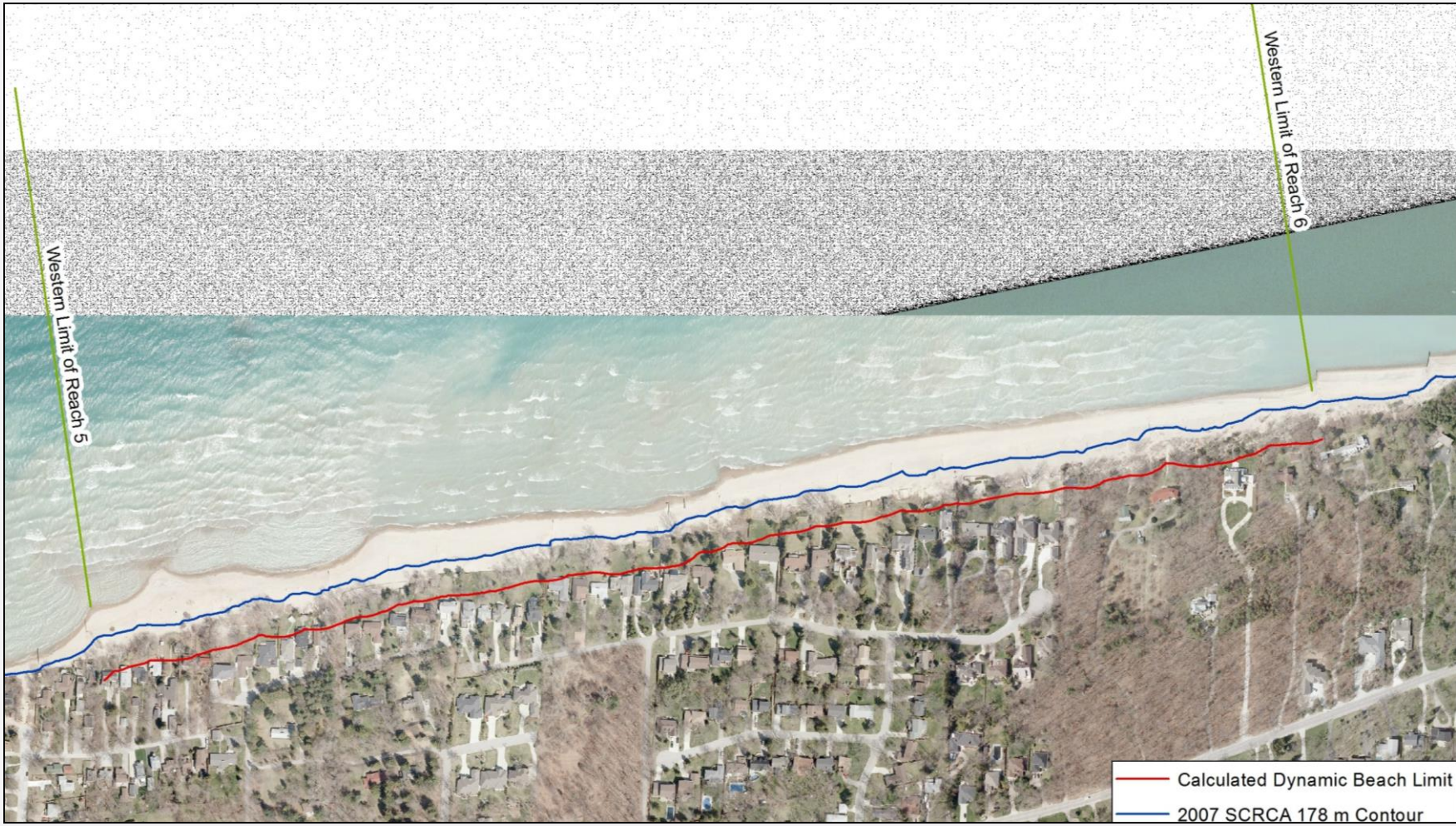
Dynamic Beach Hazard Limit

17 m Beach profile erosion allowance + 17 m Wave Uprush =

34 m Dynamic beach hazard limit

- The 34 m allowance is measured horizontally from the pre-storm position of the elevation contour equivalent to the 100-year flood level (178.0 m IGLD 1985).
- Dynamic beach hazard limit represents the combined effect of storm erosion of the beach profile and wave uprush.

Dynamic Beach Hazard Limit



General Recommendations

- The shoreline contains specialized vegetation and habitat.
- Important natural heritage elements should not be disregarded when new development is proposed.

General Recommendations

- Retain natural features (e.g. existing vegetation), regenerate additional native vegetation and encourage dune development.
- Maintain the natural dune height where it is undisturbed. Where the natural dune height has been lowered, restore the dune height with native or comparable sand.
- Where possible, it is recommended that the slope of the lakeward side of the dune should be 1:5 (vertical: horizontal) or flatter.

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