Marsh Futures: Development of a Methodology to assess needs and tactics for marsh resiliency

Natural Lands Trust
1031 Palmers Mill Road, Media, PA 19063
610-353-5587 ~ www.natlands.org

PARTNERSHIP FOR THE DELAWARE ESTUARY, INC

The Nature Conservancy
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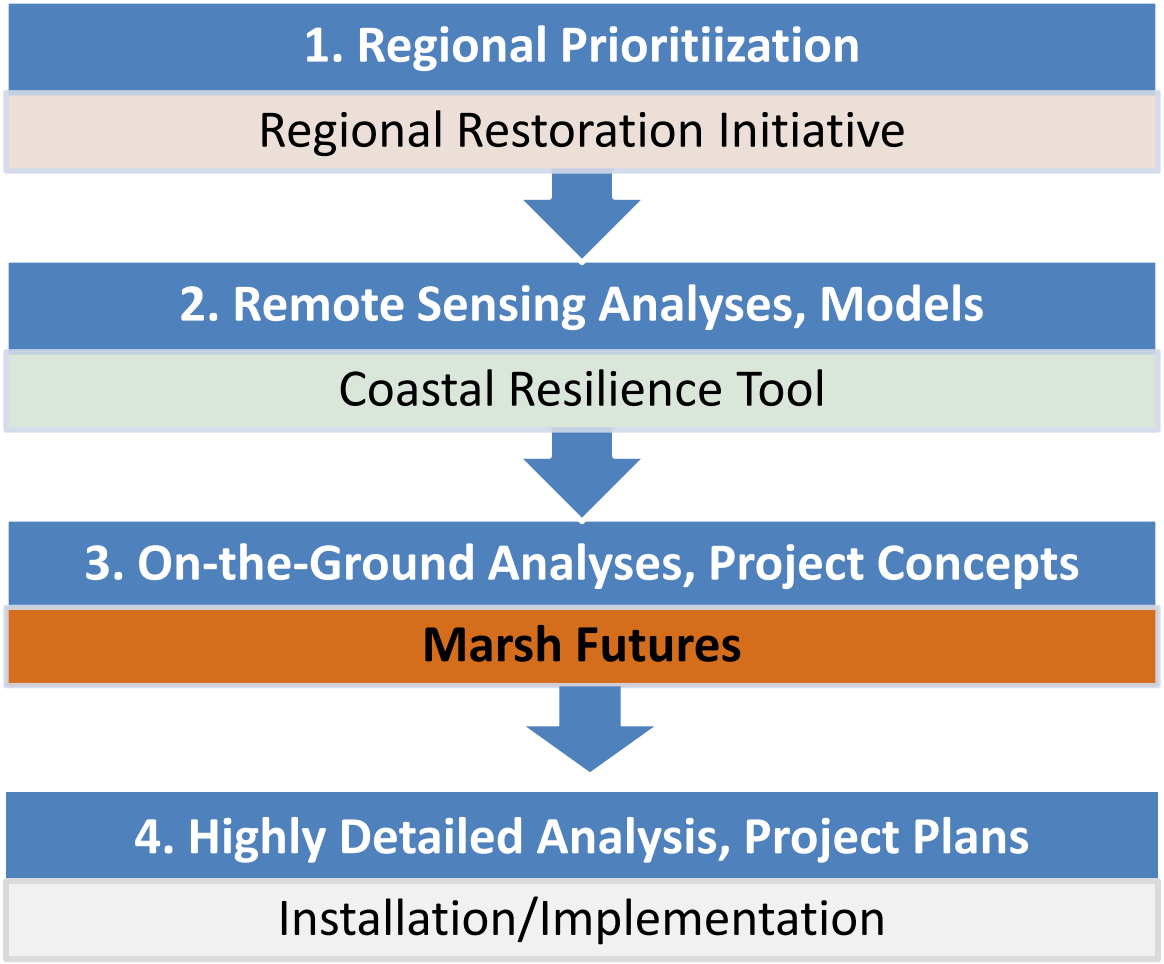
Partnership for the Delaware Estuary 2015 Science Summit
Balancing Progress & Protection – 10 Years of Science in Action
January 25-28, 2015
Cape May, NJ

Bayshore Sustainable Infrastructure Planning Project (BAYSIPP)

Marsh Futures

Hierarchical Analysis

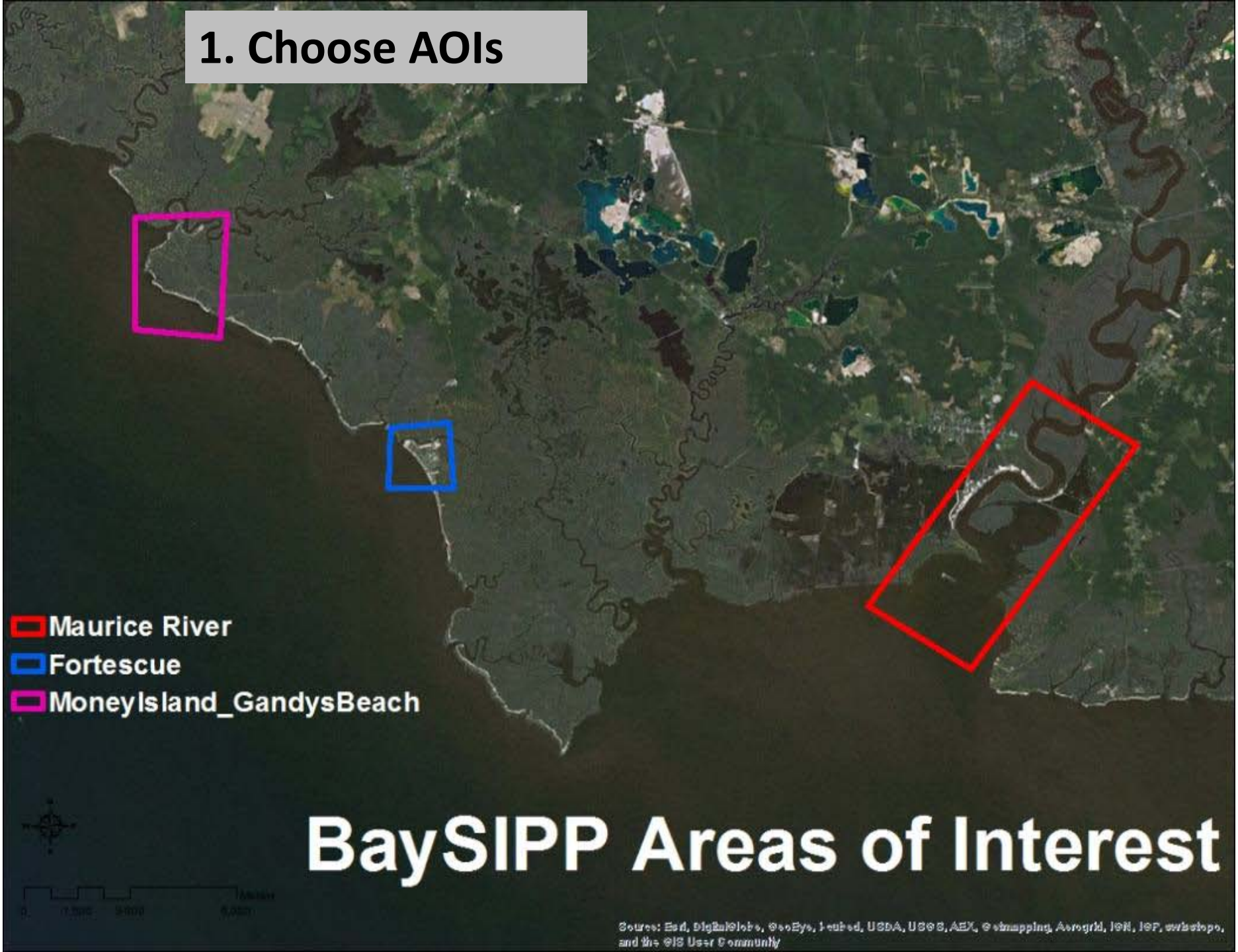
Resolution of Tech Group Analysis



Tech Group Steps

Development of Methodology to assess needs and tactics

1. **Choose Ares of Interest** (AOIs)based on public needs and interest
2. **Survey area of interest** (AOI)
   - Determine topography
   - Placement in tidal regime
3. **Assess Vegetation**
   - Stressed?
   - Where?
4. **Assess erosion** over time at each AOI
5. **BMPs:** Use Shoreline Change, Vegetation and Elevation to assess vulnerability type and appropriate tactic


1. Choose AOIs
Maurice River
Fortescue
MoneyIsland_GandysBeach
BaySIPP Areas of Interest
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Fortescue BaySIPP AOI
n=807 points
N
0 95 190 380 570 760
Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

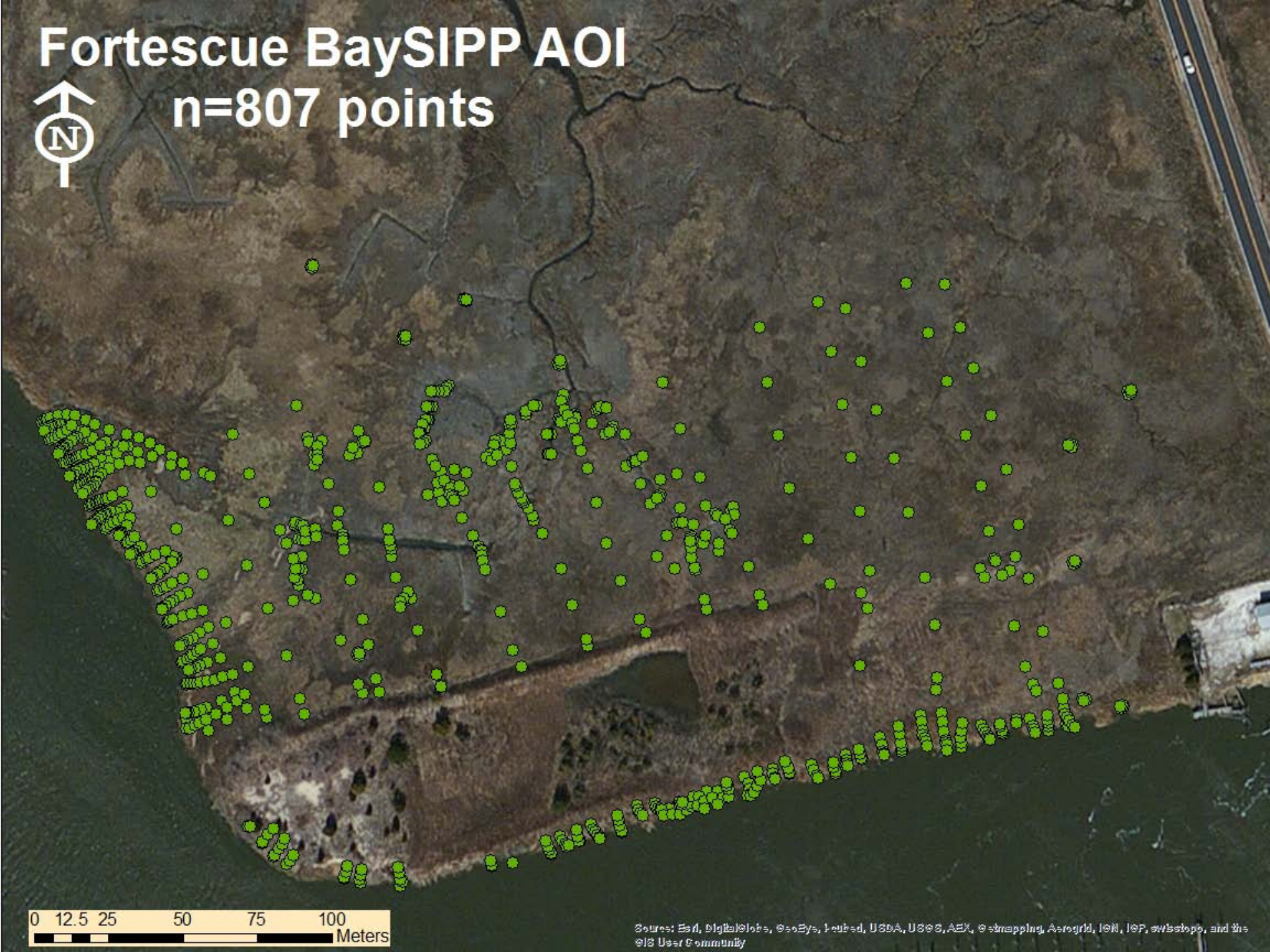
Step2 : Elevation
Real-Time Kinematic GPS

Accuracy

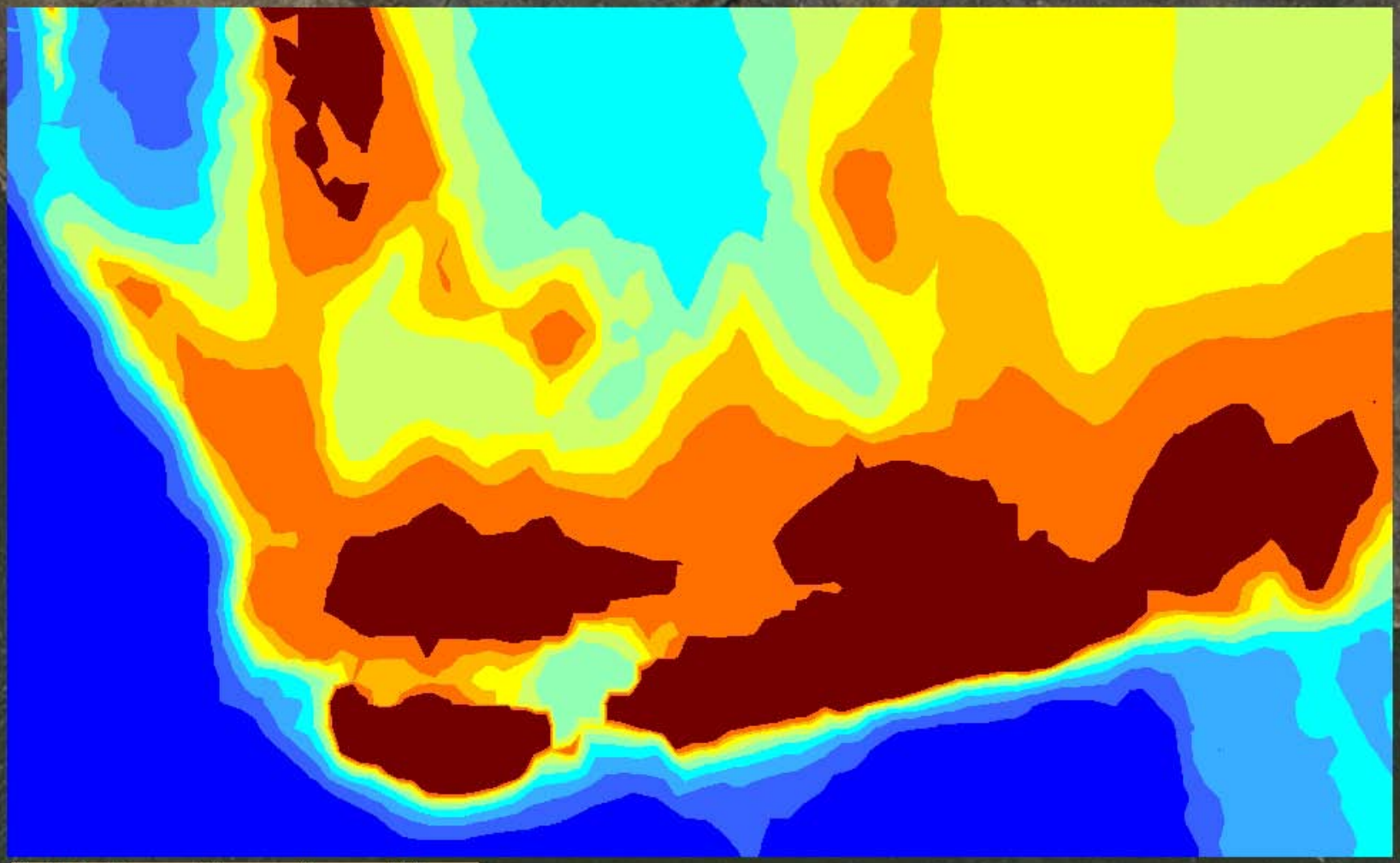
- Horizontal: 8mm+1ppm RMS*
- Vertical: 15mm+1ppm RMS*

- Pilot Study conducted to determine point density needed to accurate capture topographic conditions (~400/Ha)

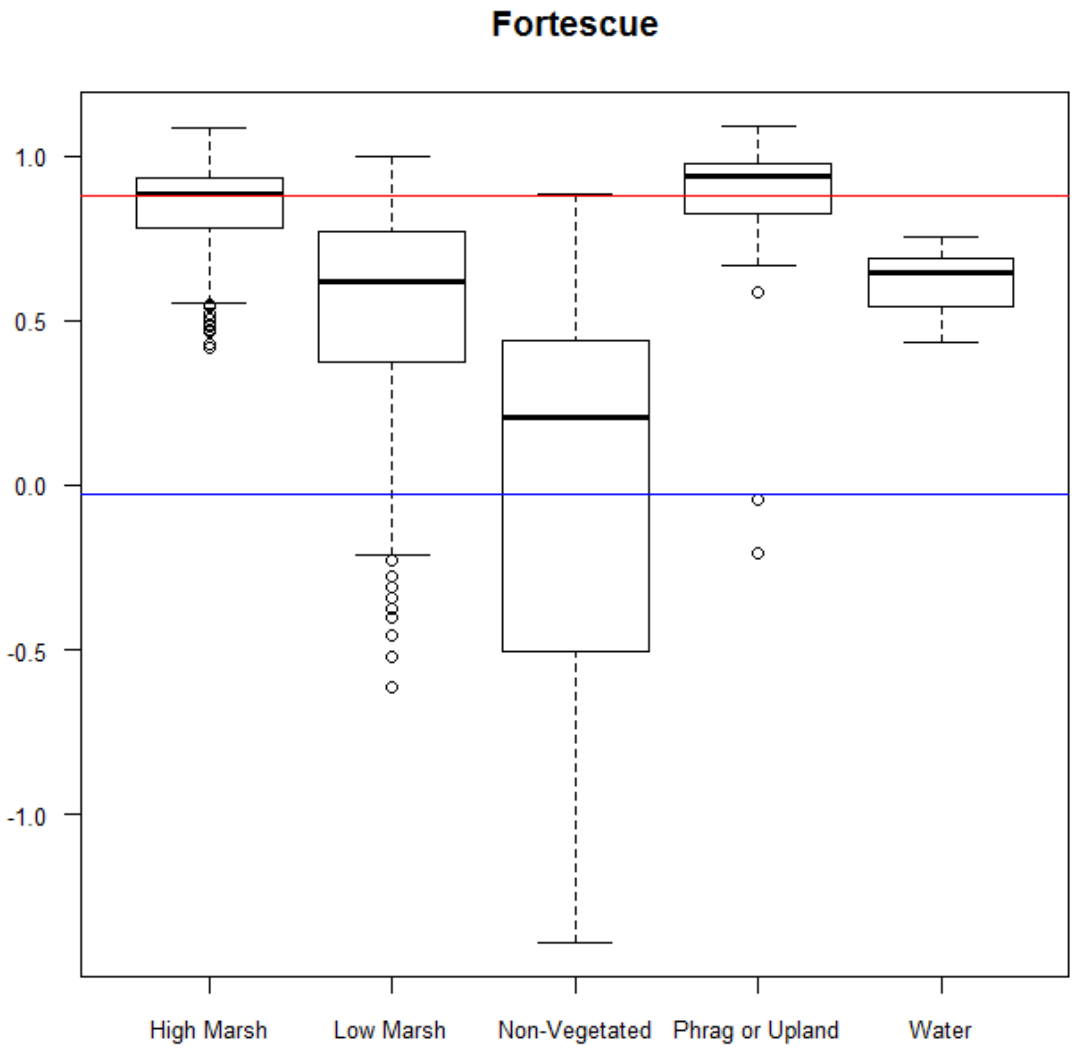
*1mm/km added for distance from base station


Fortescue BaySIPP AOI
n=807 points
N
0 12.5 25 50 75 100
Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Fortescue BaySIPP AOI
n=807 points



Marsh Type Score



1. **Elevation**
2. **Dominant Vegetation**

Fortescue BaySIPP AOI
n=807 points

0 12.5 25 50 75 100
Meters

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Step 3: Vegetation Metrics

1. Blade Height: Length of 25 stems

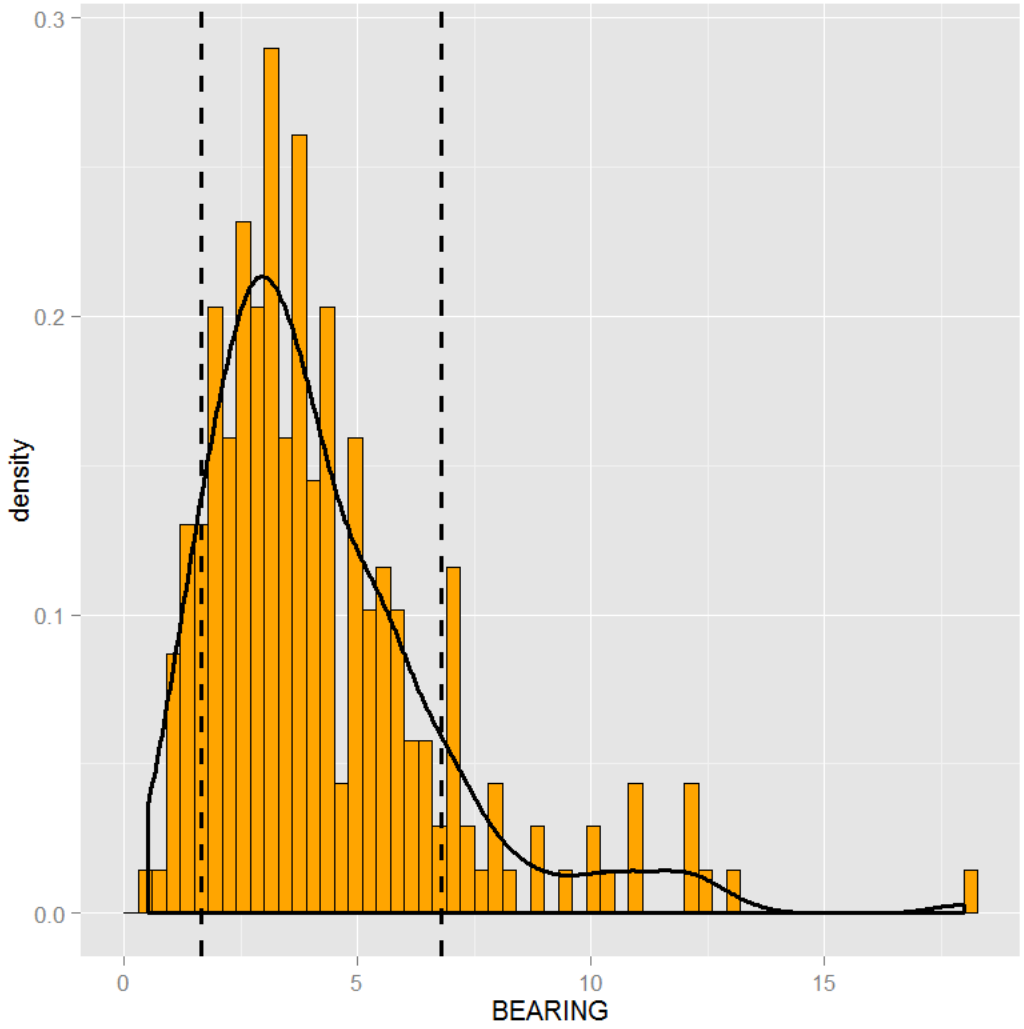
2. Canopy Cover: How Much Light Gets Through?

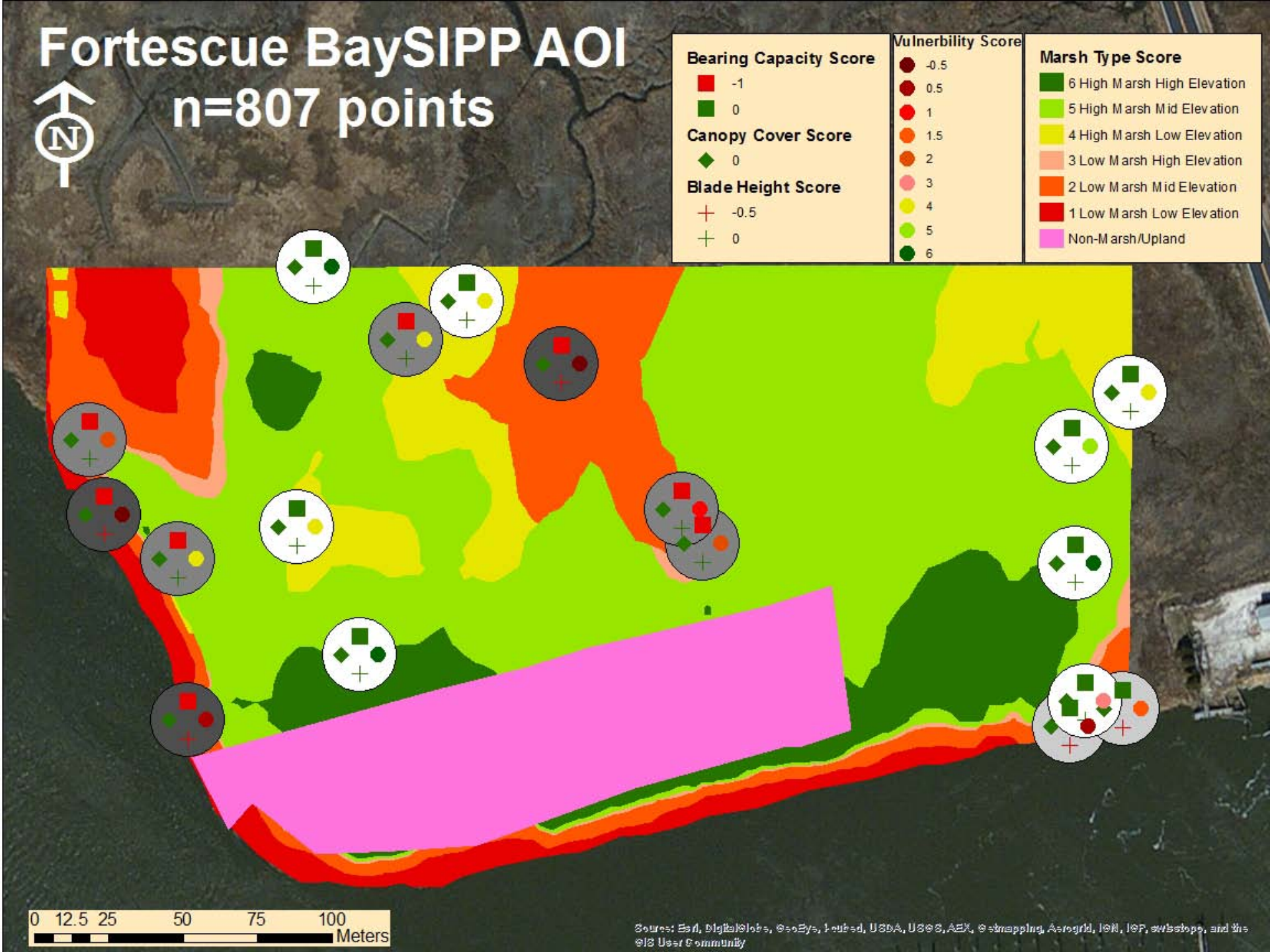
3. Bearing Capacity: How Soupy is the Mud?

•Depth rod sinks after 5 blows with slide hammer

Vegetation Scoring

- 5yr MACWA data to ID breakpoints
- Values > 1sd = unstable (negative score
- Bearing Capacity: -1
- Blade Height: -0.5
- Canopy Cover: -0.5



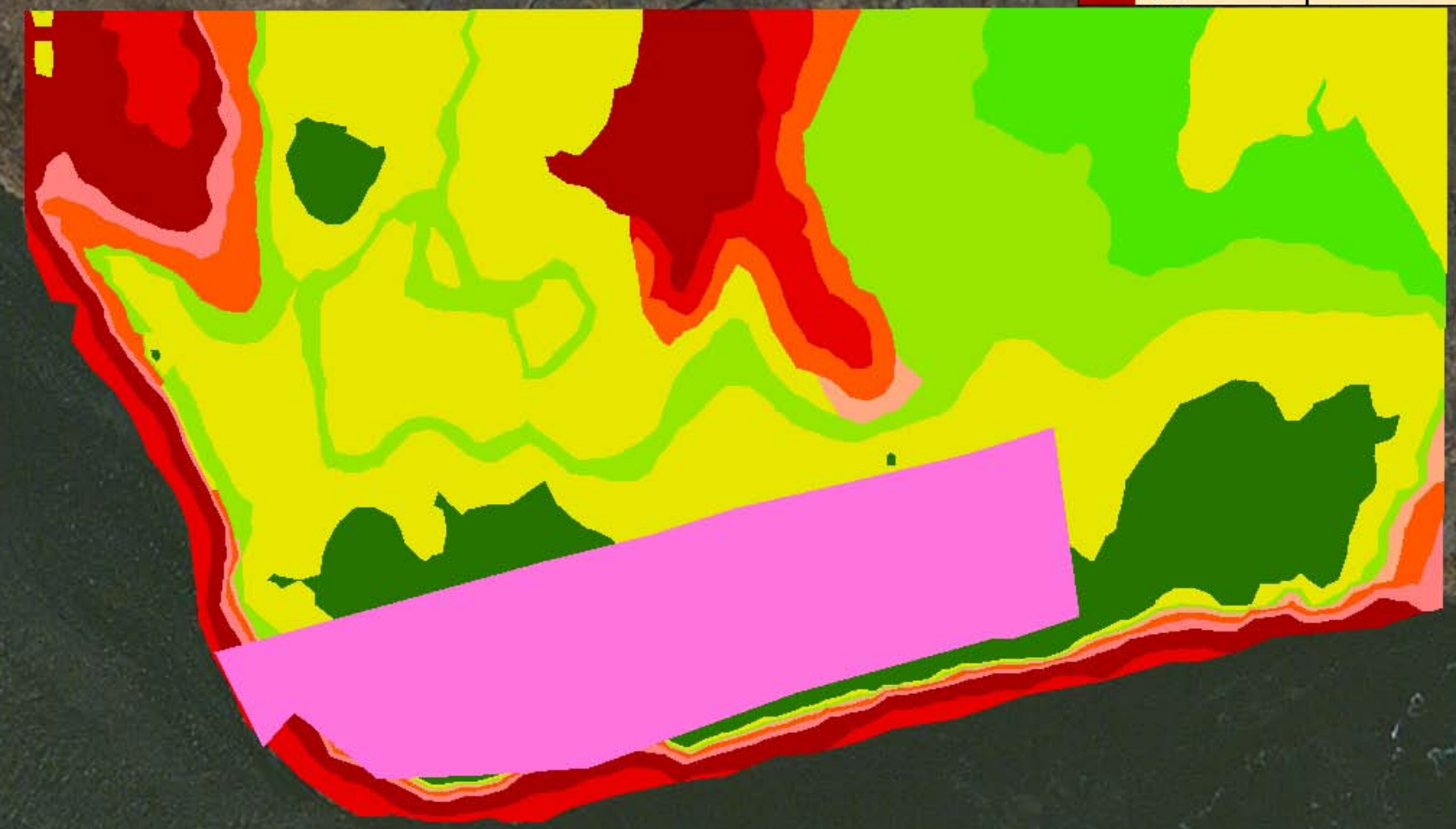

Fortescue BaySIPP AOI
n=807 points
N
Bearing Capacity Score
-1
0
Canopy Cover Score
0
Blade Height Score
-0.5
0
Vulnerbility Score
-0.5
0.5
1
1.5
2
3
4
5
6
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
Non-Marsh/Upland
0 12.5 25 50 75 100
Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Fortescue BaySIPP AOI
n=807 points

0 12.5 25 50 75 100
Meters

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

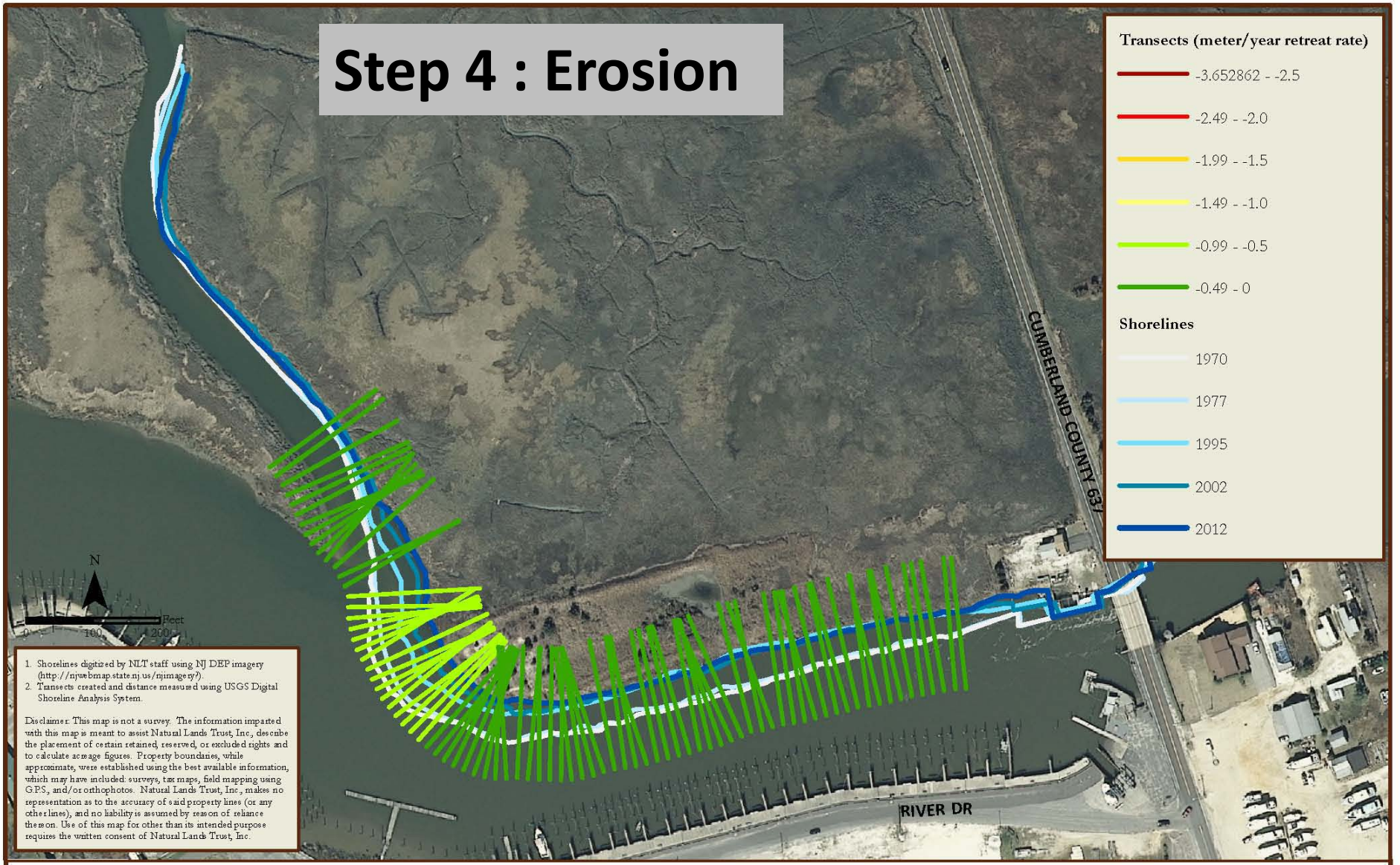
Fortescue BaySIPP AOI
n=807 points



0 12.5 25 50 75 100
Meters

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Step 4 : Erosion



1. Shorelines digitized by NLT staff using NJ DEP imagery (http://njwebmap.state.nj.us/njimagery2).
2. Transects created and distance measured using USGS Digital Shoreline Analysis System.

Disclaimer: This map is not a survey. The information imparted with this map is meant to assist Natural Lands Trust, Inc., describe the placement of certain retained, reserved, or excluded rights and to calculate acreage figures. Property boundaries, while approximate, were established using the best available information, which may have included: surveys, tax maps, field mapping using G.P.S., and/or orthophotos. Natural Lands Trust, Inc., makes no representation as to the accuracy of said property lines (or any other lines), and no liability is assumed by reason of reliance thereon. Use of this map for other than its intended purpose requires the written consent of Natural Lands Trust, Inc.

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2012 Aerial Photography

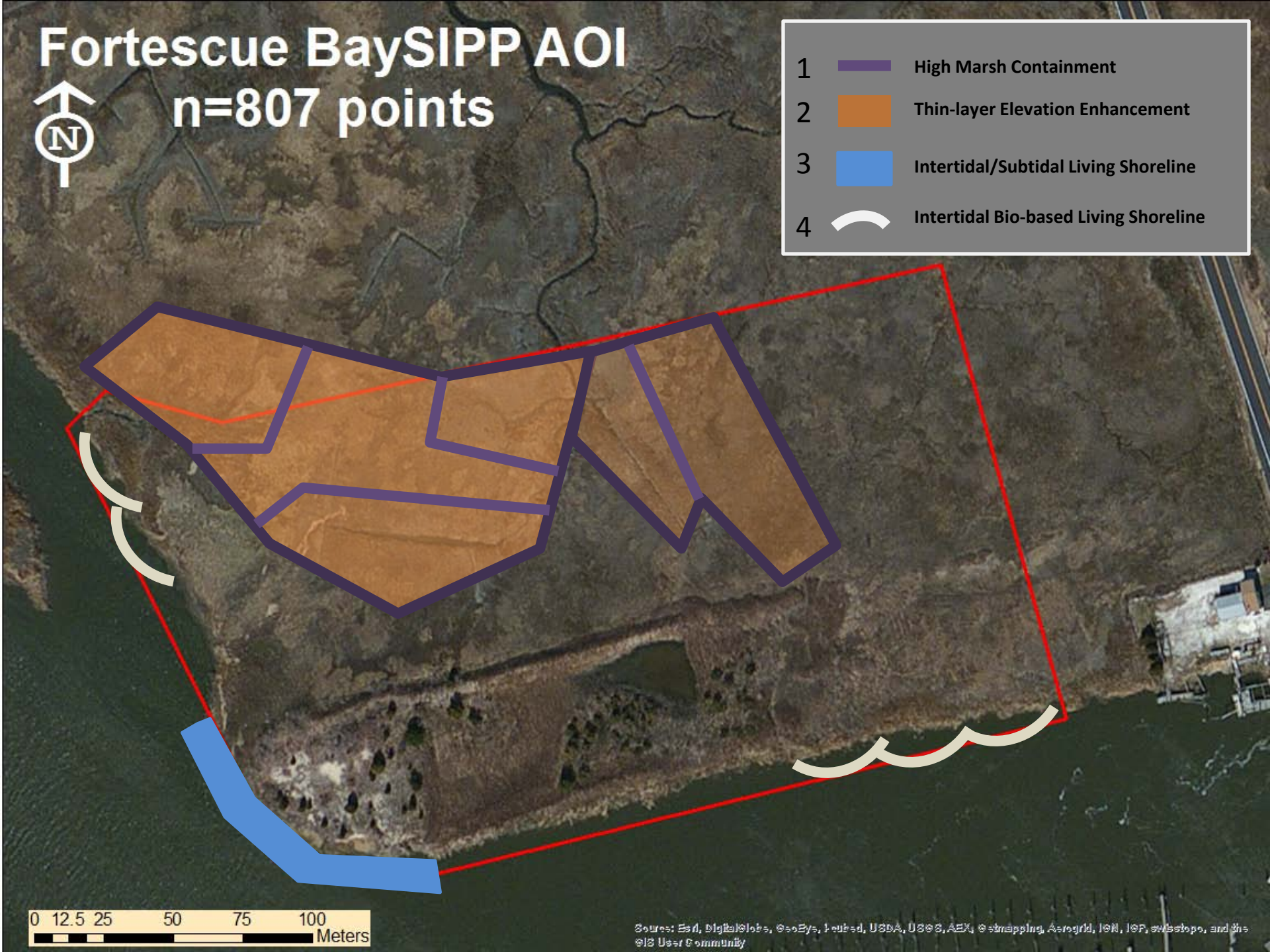
BAYSIPP SHORELINE RETREAT STUDY

FORTESCUE SITE

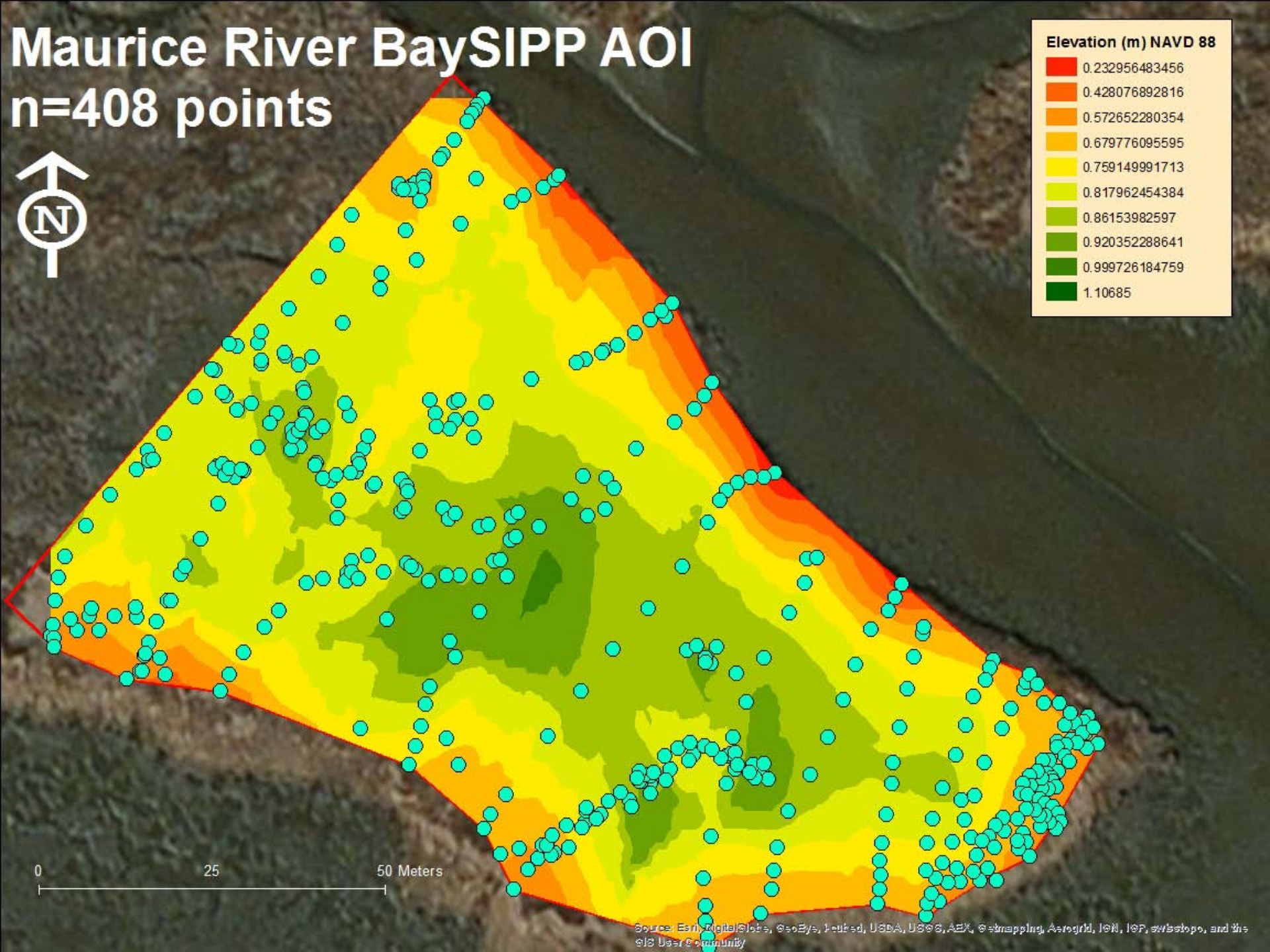
Downe Township, Cumberland County, NJ

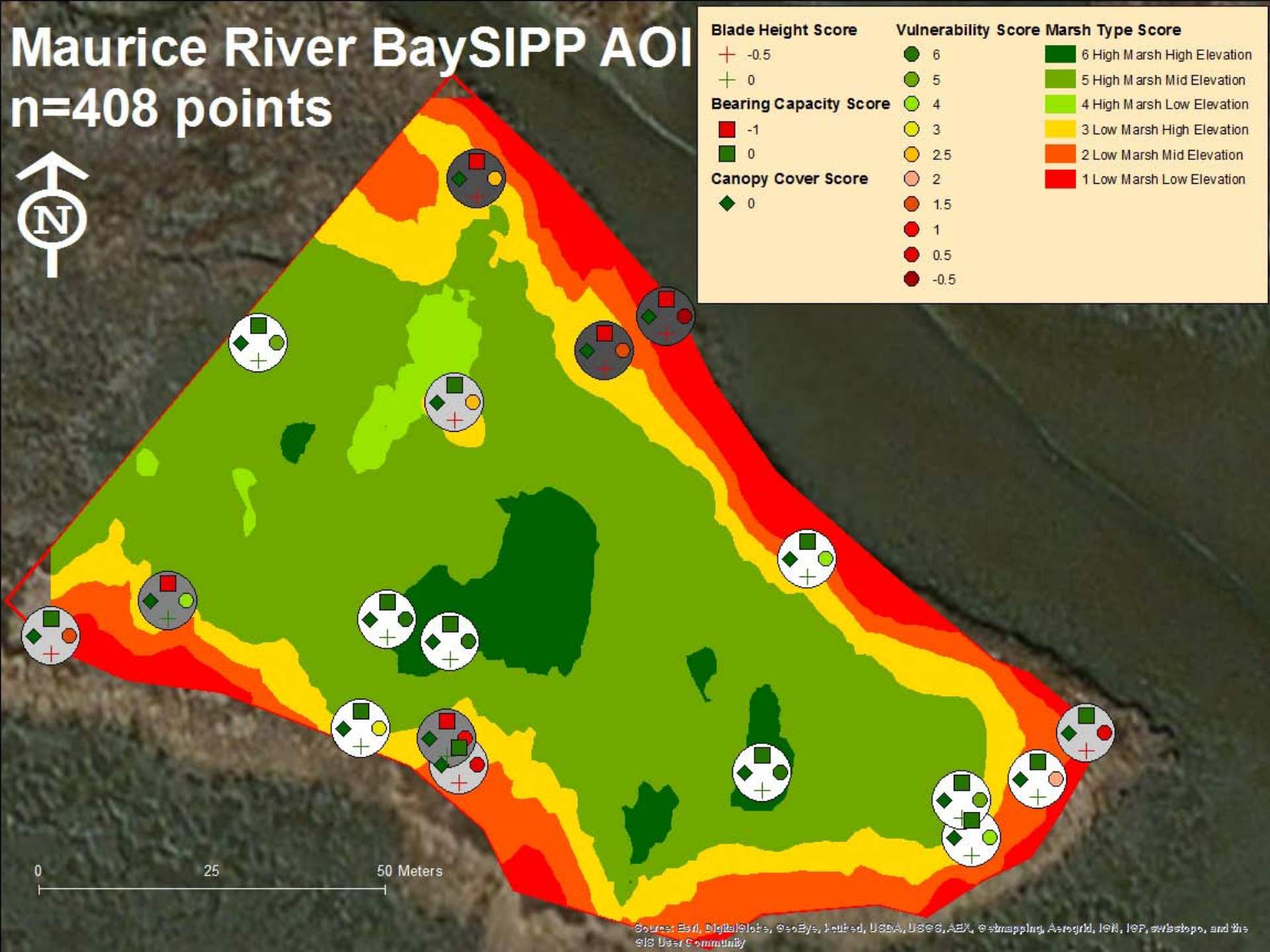
Compiled By: Natural Lands Trust 10/30/14

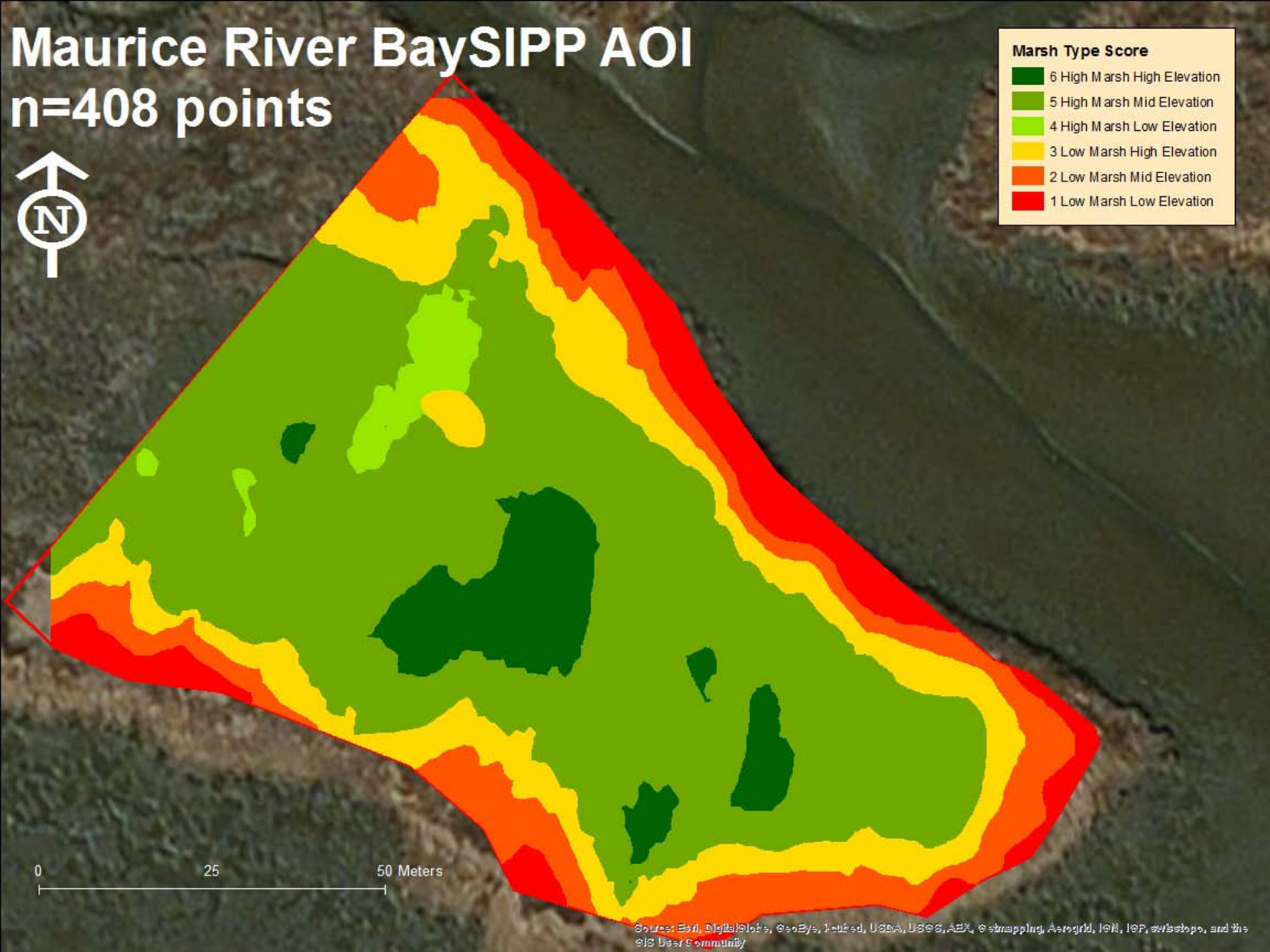
PARTNERSHIP FOR THE DELAWARE ESTUARY INC.


Fortescue BaySIPP AOI
n=807 points
N
1 High Marsh Containment
2 Thin-layer Elevation Enhancement
3 Intertidal/Subtidal Living Shoreline
4 Intertidal Bio-based Living Shoreline
0 12.5 25 50 75 100
Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

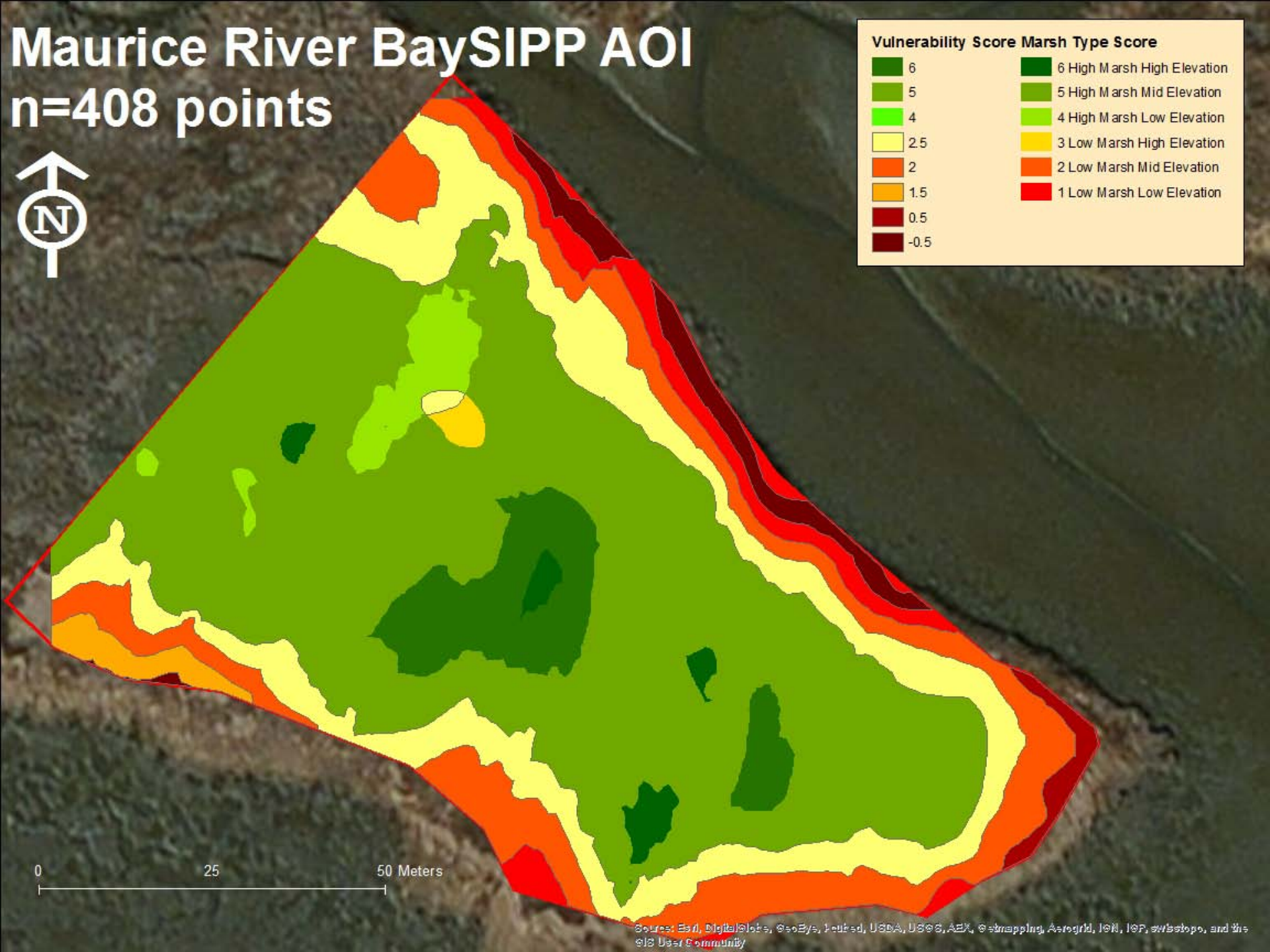

Maurice River BaySIPP AOI
n=408 points
N
0
412.5
825 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

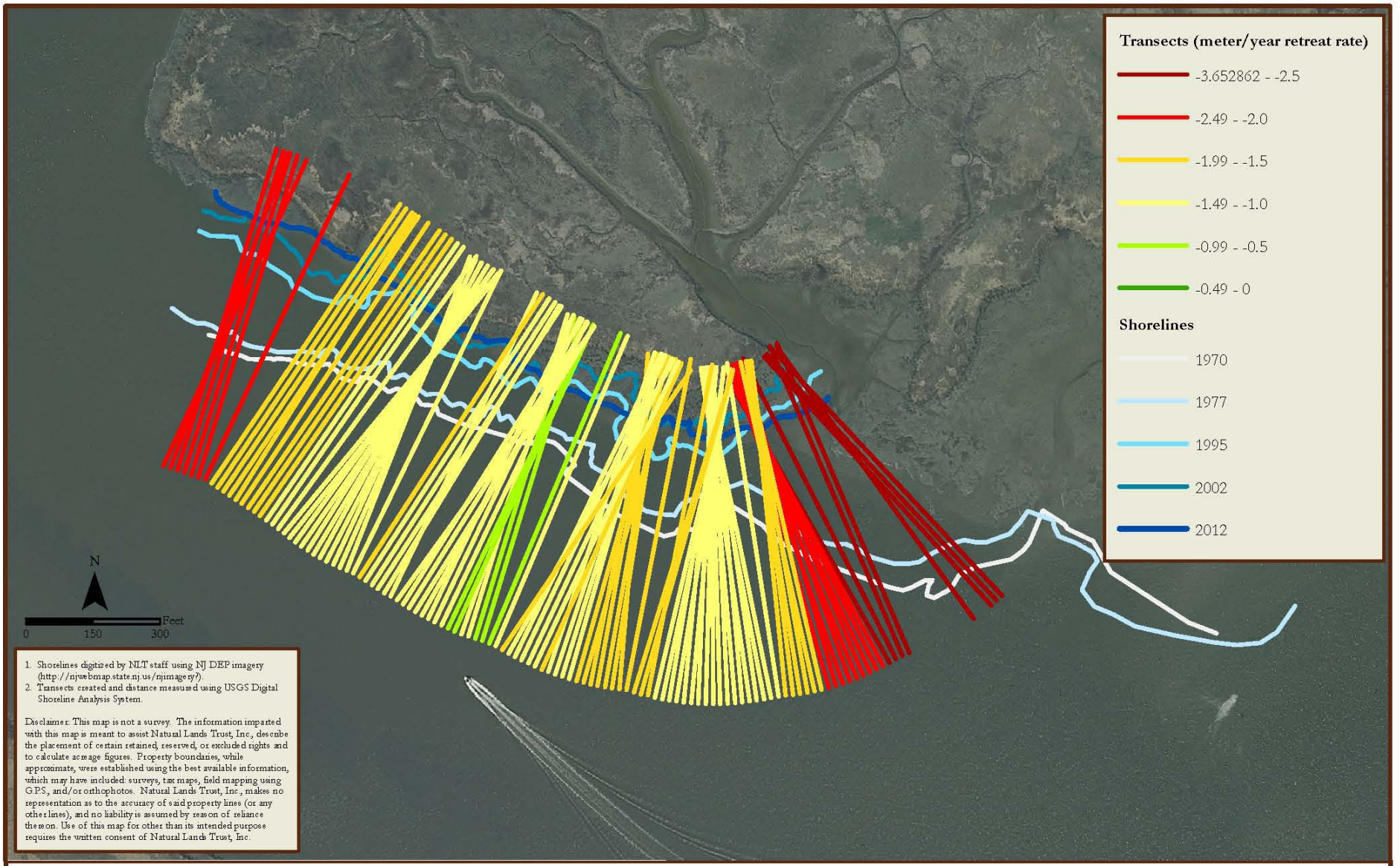

Maurice River BaySIPP AOI
n=408 points
N
Elevation (m) NAVD 88
0.232956483456
0.428076892816
0.572652280354
0.679776095595
0.759149991713
0.817962454384
0.86153982597
0.920352288641
0.999726184759
1.10685
0
25
50 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Maurice River BaySIPP AOI
n=408 points
Blade Height Score
-0.5
0
Bearing Capacity Score
-1
0
Canopy Cover Score
0
Vulnerability Score
6
5
4
3
2.5
2
1.5
1
0.5
-0.5
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
N
0
25
50 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Maurice River BaySIPP AOI
n=408 points
N
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
0
25
50 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Maurice River BaySIPP AOI
n=408 points





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BAYSIPP SHORELINE RETREAT STUDY

MAURICE RIVER SITE

Maurice River Township, Cumberland County, NJ

Compiled By: Natural Lands Trust 10/30/14

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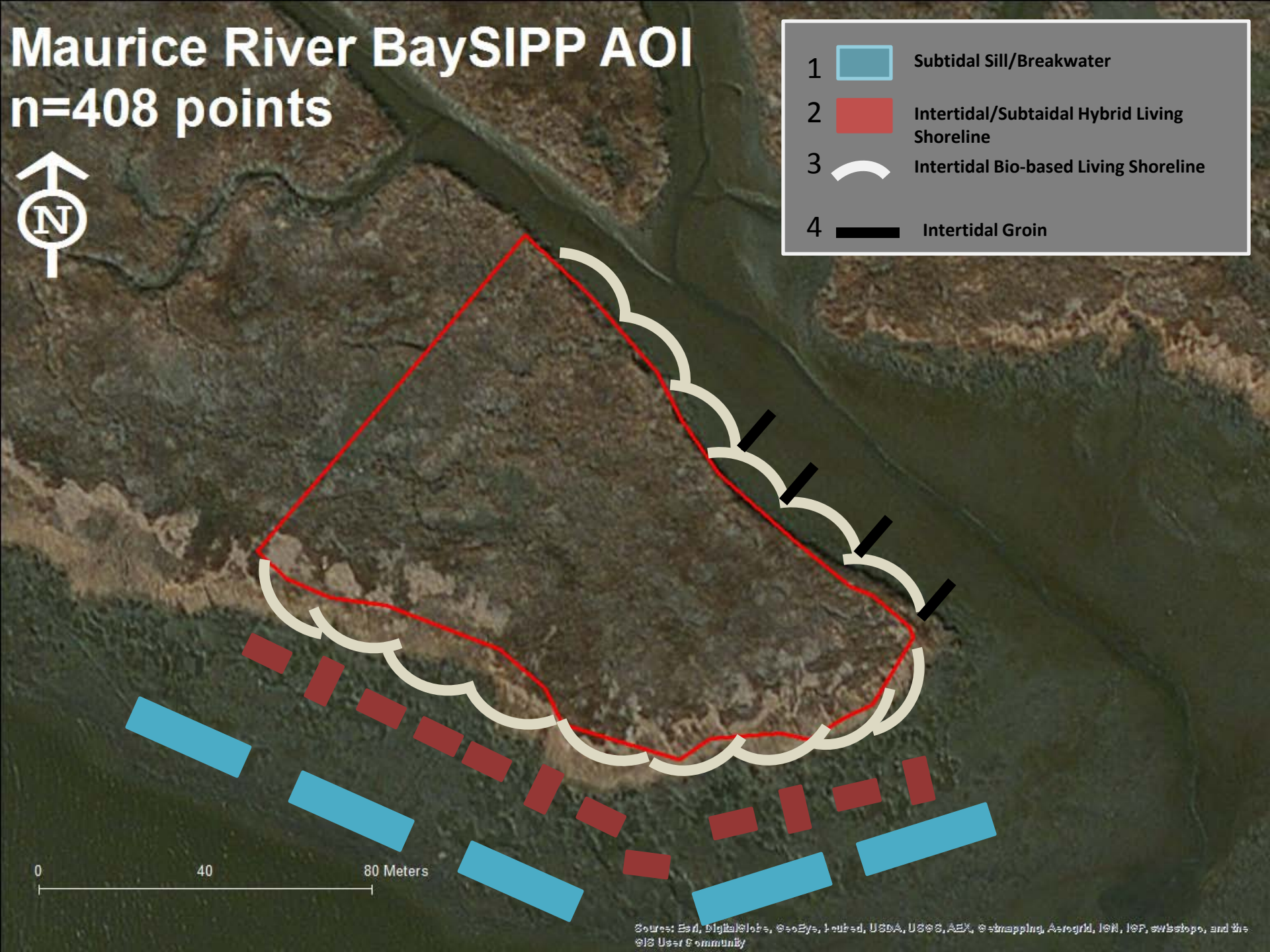
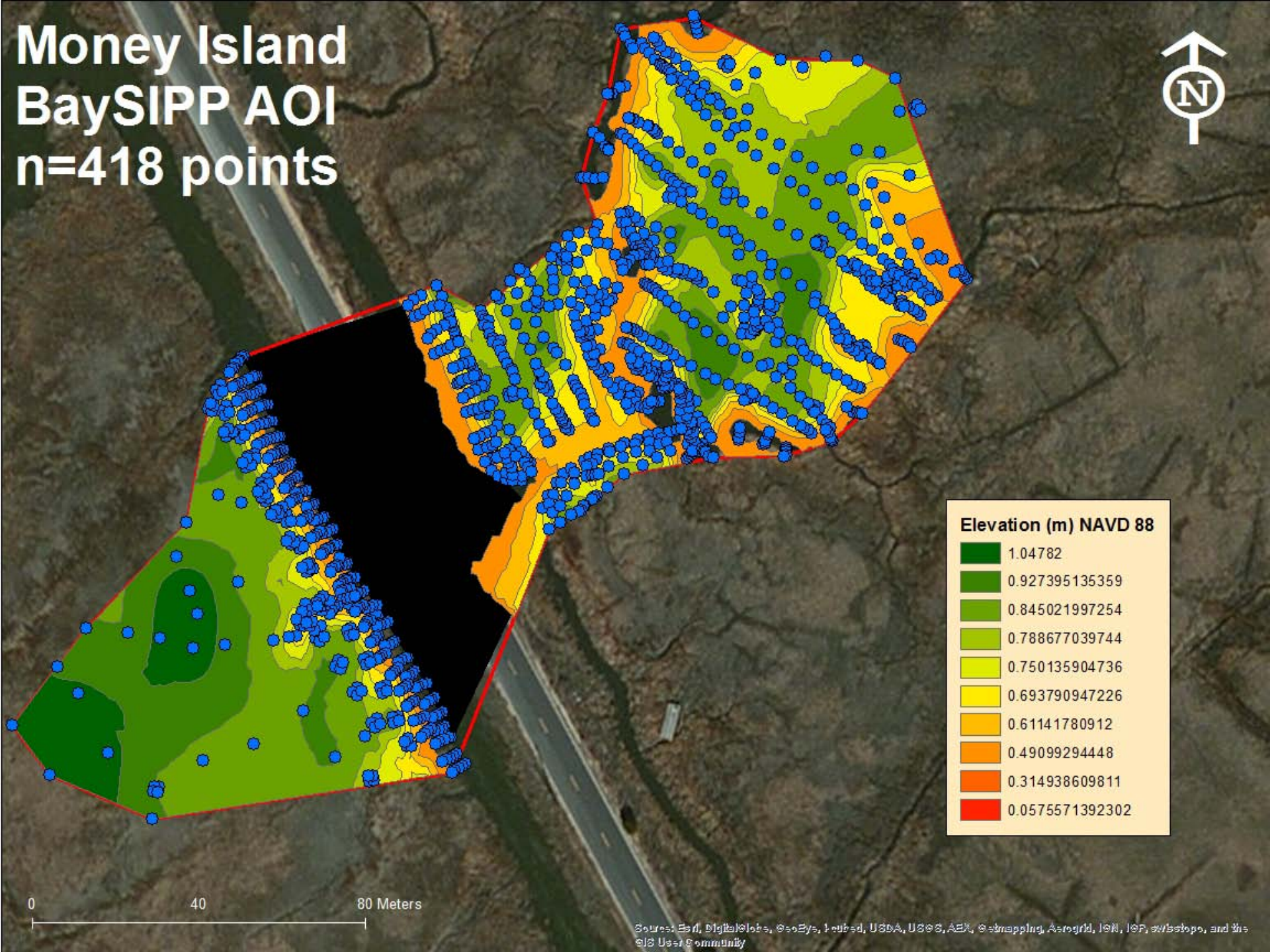
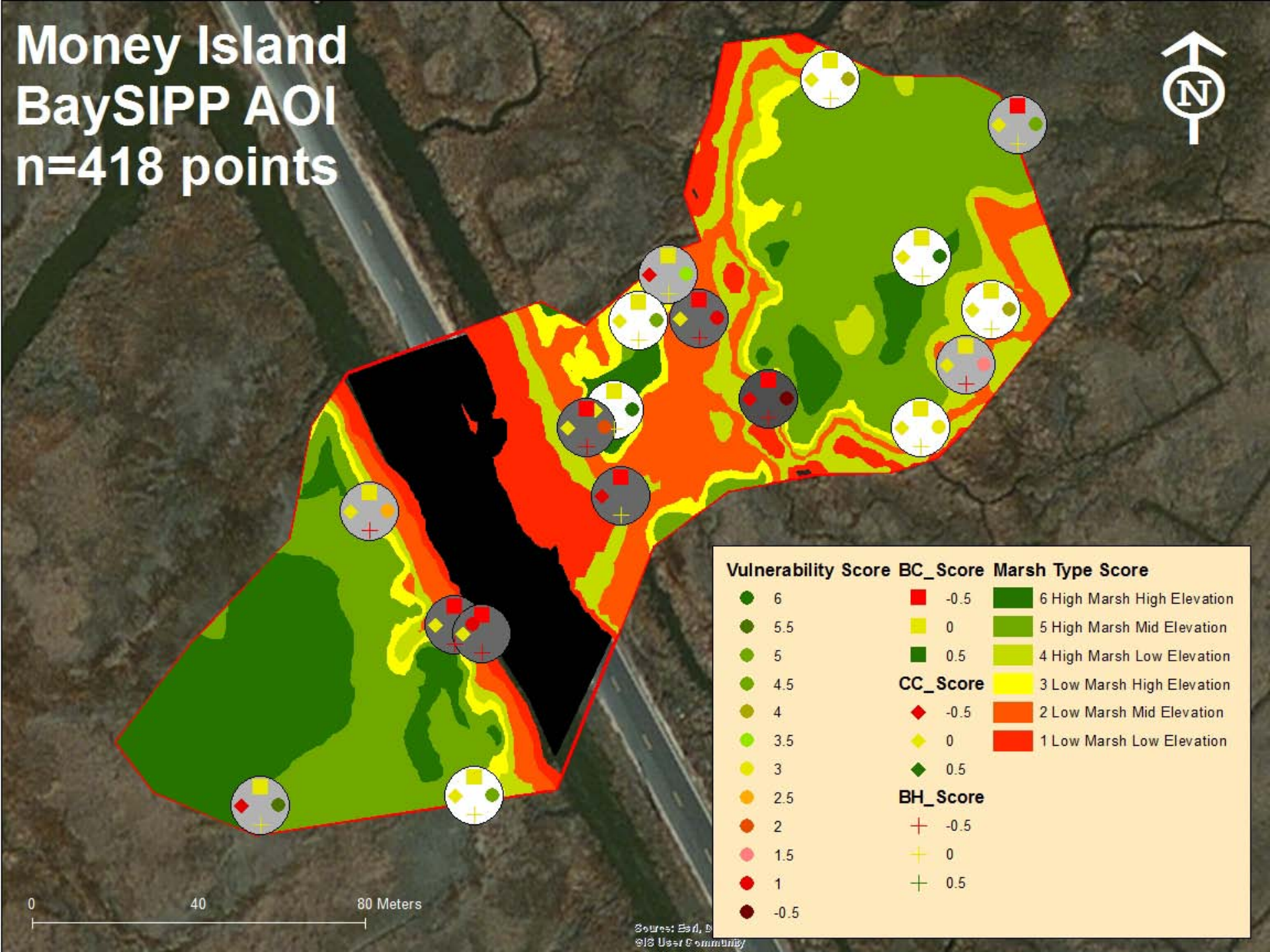
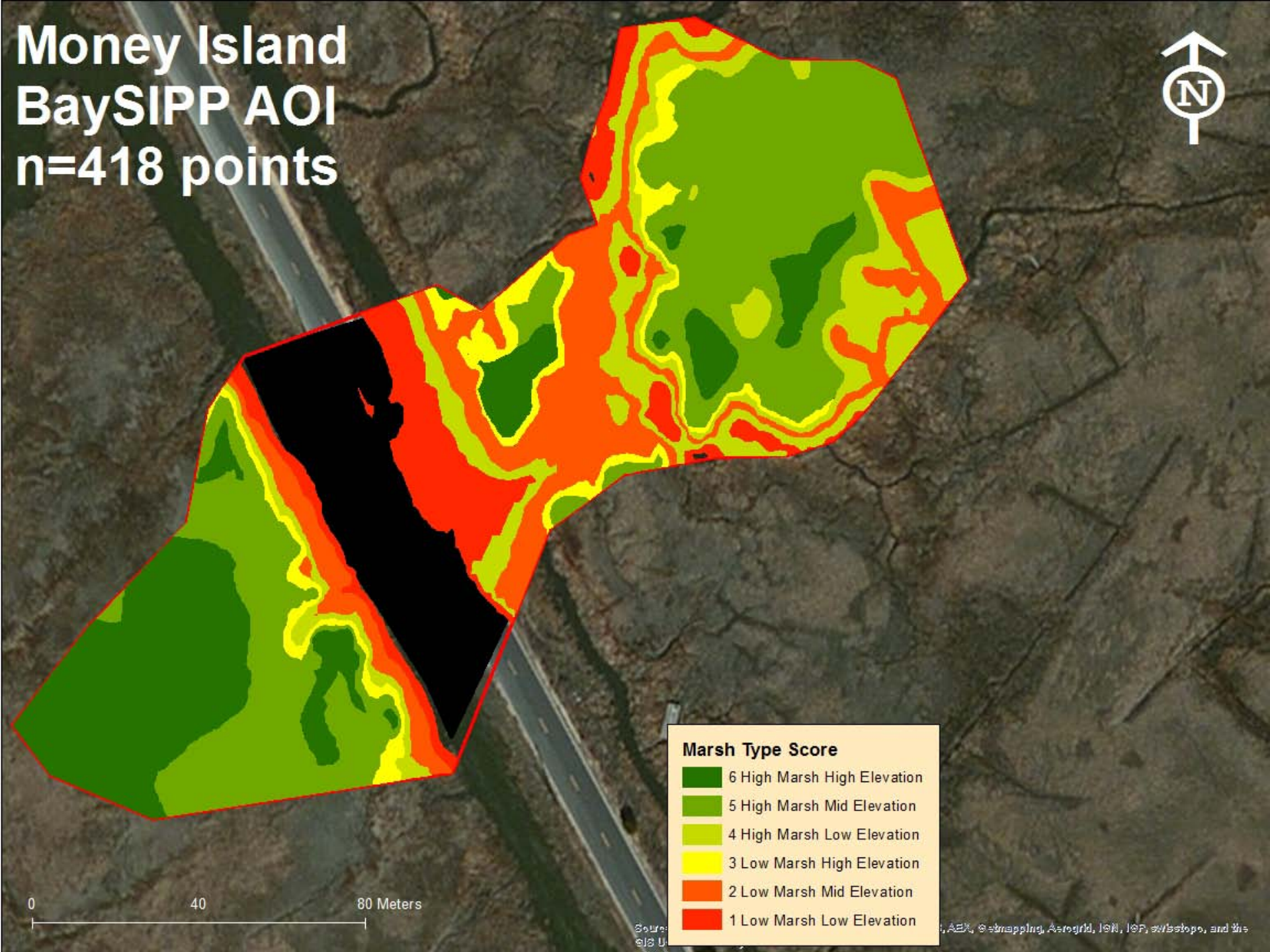
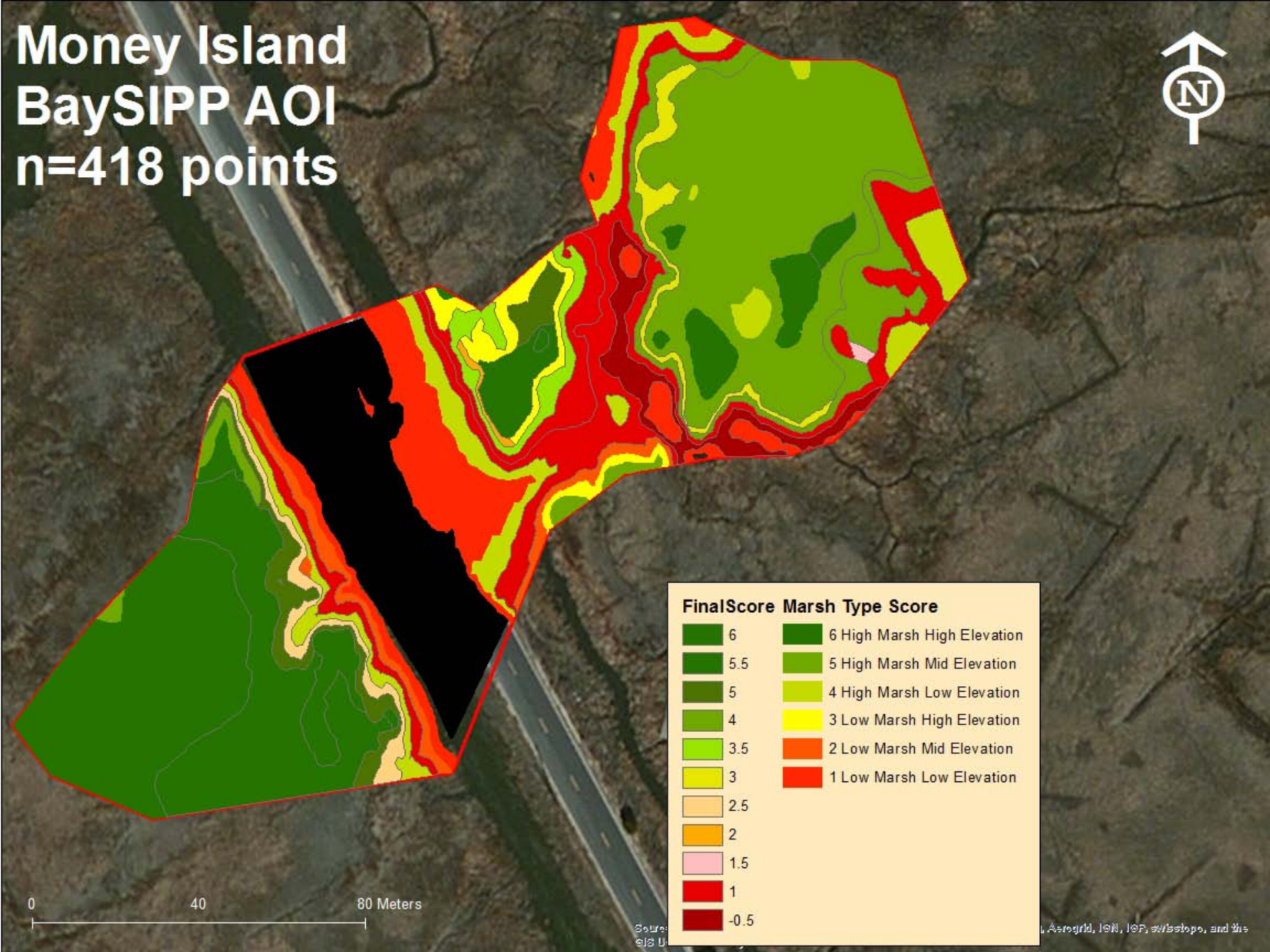

Maurice River BaySIPP AOI
n=408 points
N
1 Subtidal Sill/Breakwater
2 Intertidal/Subtaidal Hybrid Living Shoreline
3 Intertidal Bio-based Living Shoreline
4 Intertidal Groin
0
40
80 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

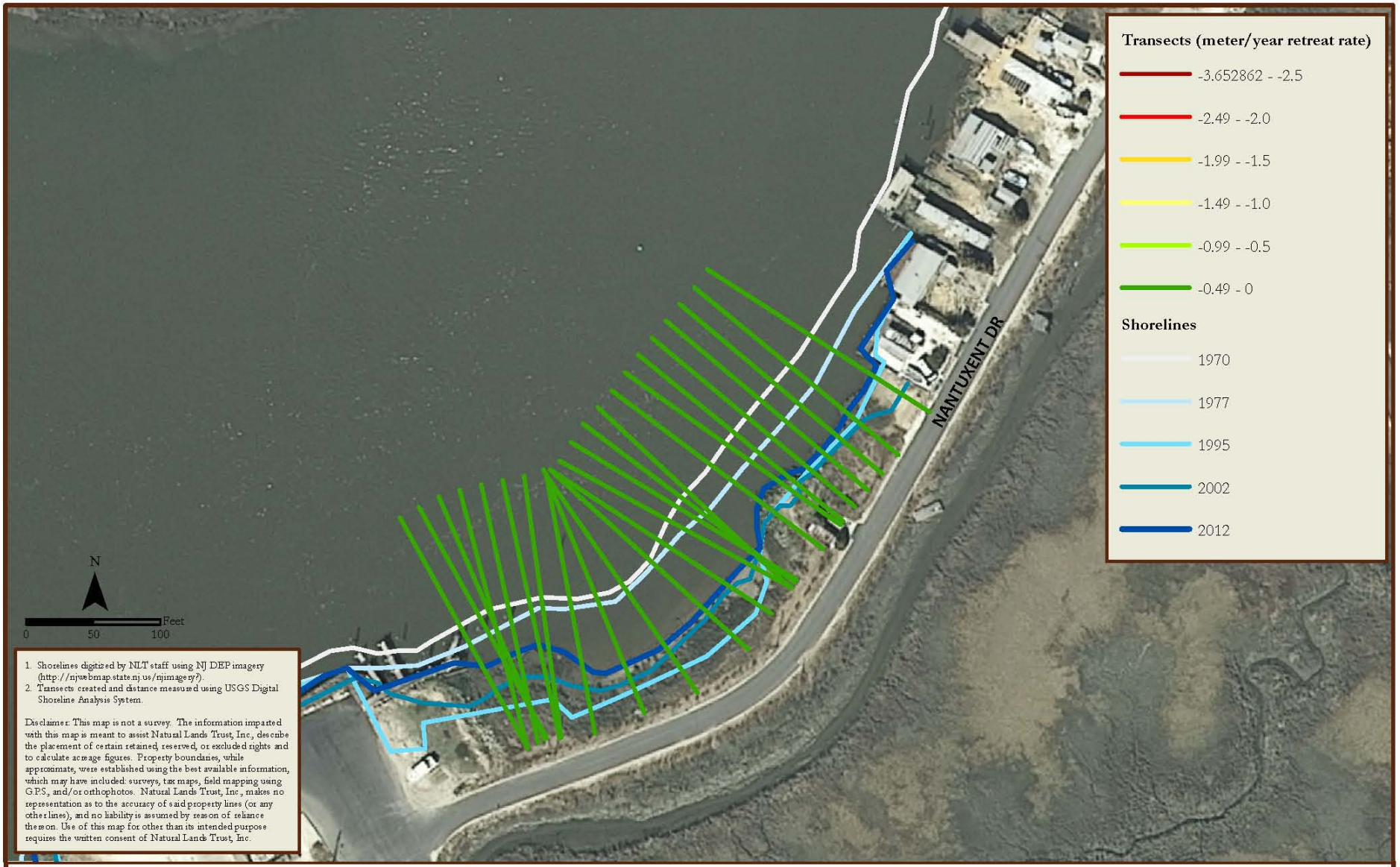

Money Island
BaySIPP AOI
n=418 points
N
0
415
830 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Money Island
BaySIPP AOI
n=418 points
N
Elevation (m) NAVD 88
1.04782
0.927395135359
0.845021997254
0.788677039744
0.750135904736
0.693790947226
0.61141780912
0.49099294448
0.314938609811
0.0575571392302
0
40
80 Meters
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Money Island
BaySIPP AOI
n=418 points
N
Vulnerability Score
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
-0.5
BC_Score
-0.5
0
0.5
CC_Score
-0.5
0
0.5
BH_Score
-0.5
0
0.5
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
0
40
80 Meters


Money Island
BaySIPP AOI
n=418 points
N
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
0
40
80 Meters


Money Island
BaySIPP AOI
n=418 points
N
FinalScore
6
5.5
5
4
3.5
3
2.5
2
1.5
1
-0.5
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
0
40
80 Meters



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2012 Aerial Photography

BAYSIPP SHORELINE RETREAT STUDY

MONEY ISLAND SITE

Downe Township, Cumberland County, NJ

Compiled By: Natural Lands Trust 10/30/14

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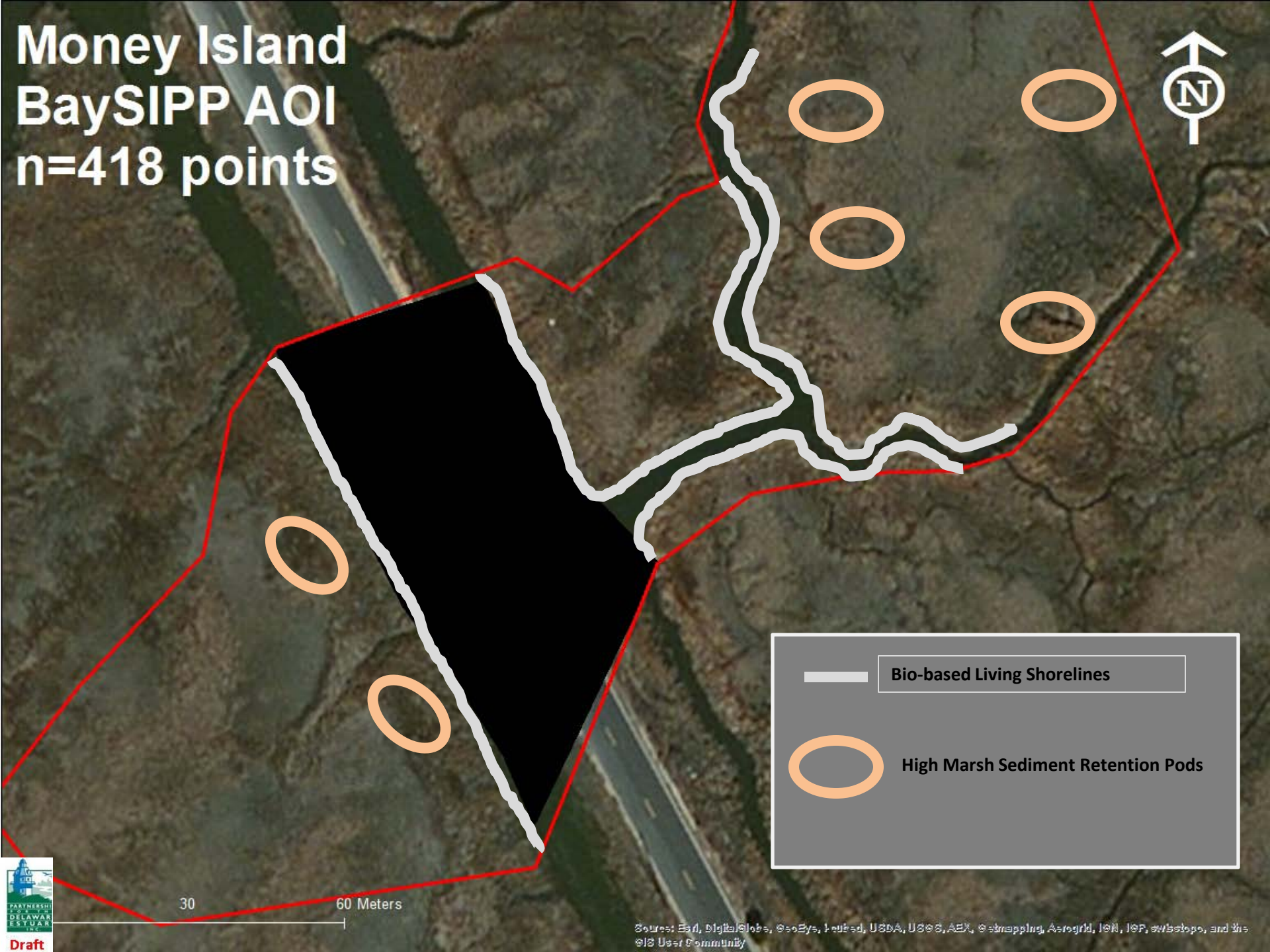

Money Island
BaySIPP AOI
n=418 points
N
Bio-based Living Shorelines
High Marsh Sediment Retention Pods
30
60 Meters
Draft
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Different Marshes Have Different Issues

<u>Shoreline Retreat Comparison</u>

Maurice: very high rate

Money Island: creek edge erosion

Fortescue: less edge erosion

<u>Marsh Platform Vulnerability Comparison</u>

Fortescue: Interior marsh drowning/standing water

Money Island: Creek widening/intrusion

Maurice River: Fairly stable platform

Different Marshes Have Different Solutions

Marsh Futures Assessment Method

- Results match observational data
- Small investment of time and money
- **Method provides quantitative data that can be used to:**
  1. **Recommend site specific tactics**
  2. **Attract funding sources**
  3. **Gather data for permits**
  4. **Establish baseline conditions for future endeavors**

Acknowledgements

New Jersey Recovery Fund

EPA National Estuary Program

Members of BaySIPP Steering Committee

Rutgers Haskin Shellfish Research Laboratory

Partners:

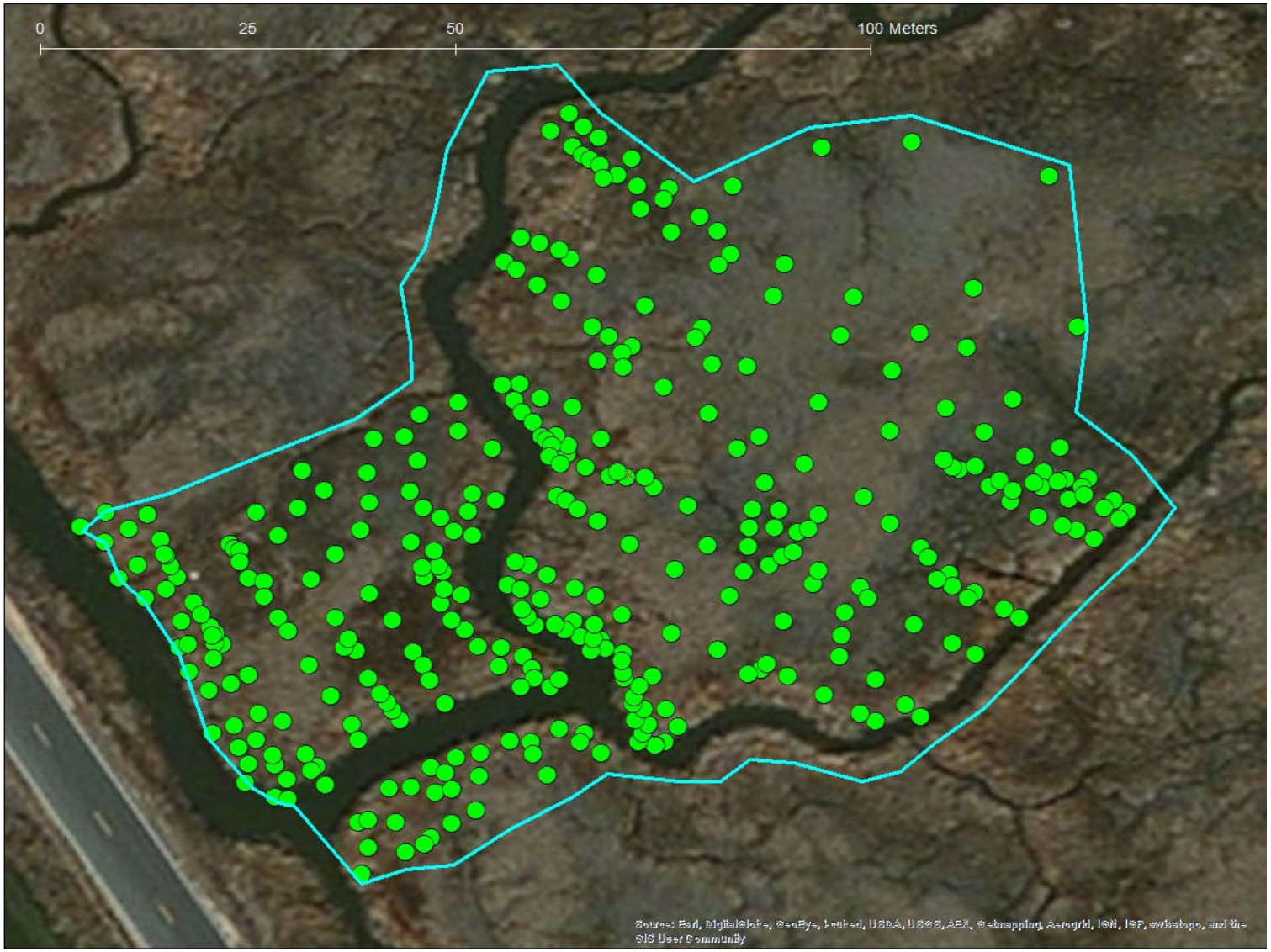
The Nature Conservancy (Moses Katkowski)

Natural Lands Trust (Diane Rosencrance, Megan Boatright)

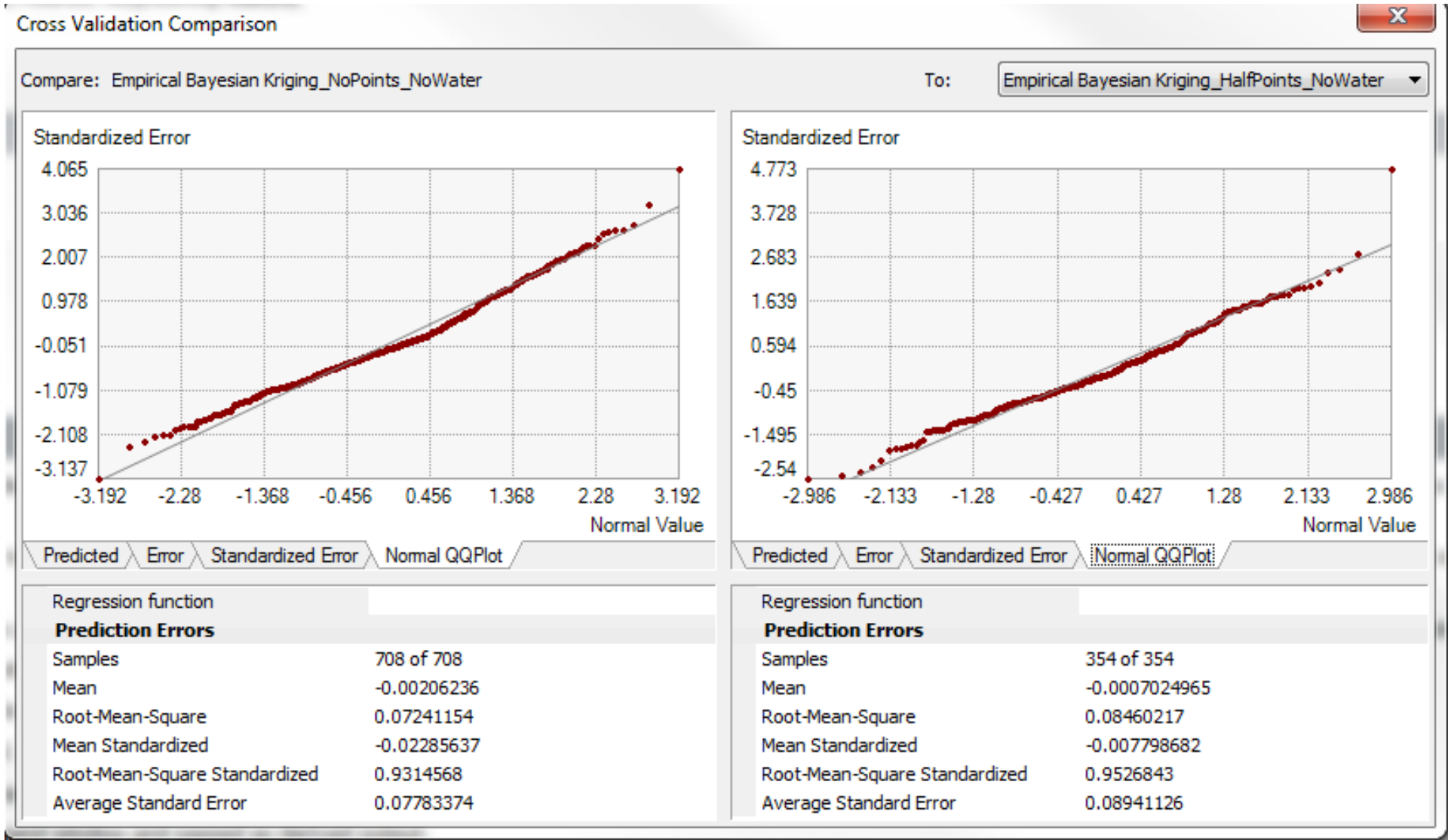
Methods Explanations

1. Point Density Needed to Characterize AOIs
2. RTK & LiDAR Comparison: Why RTK is needed
3. Choosing Breakpoints for Vegetation Scoring

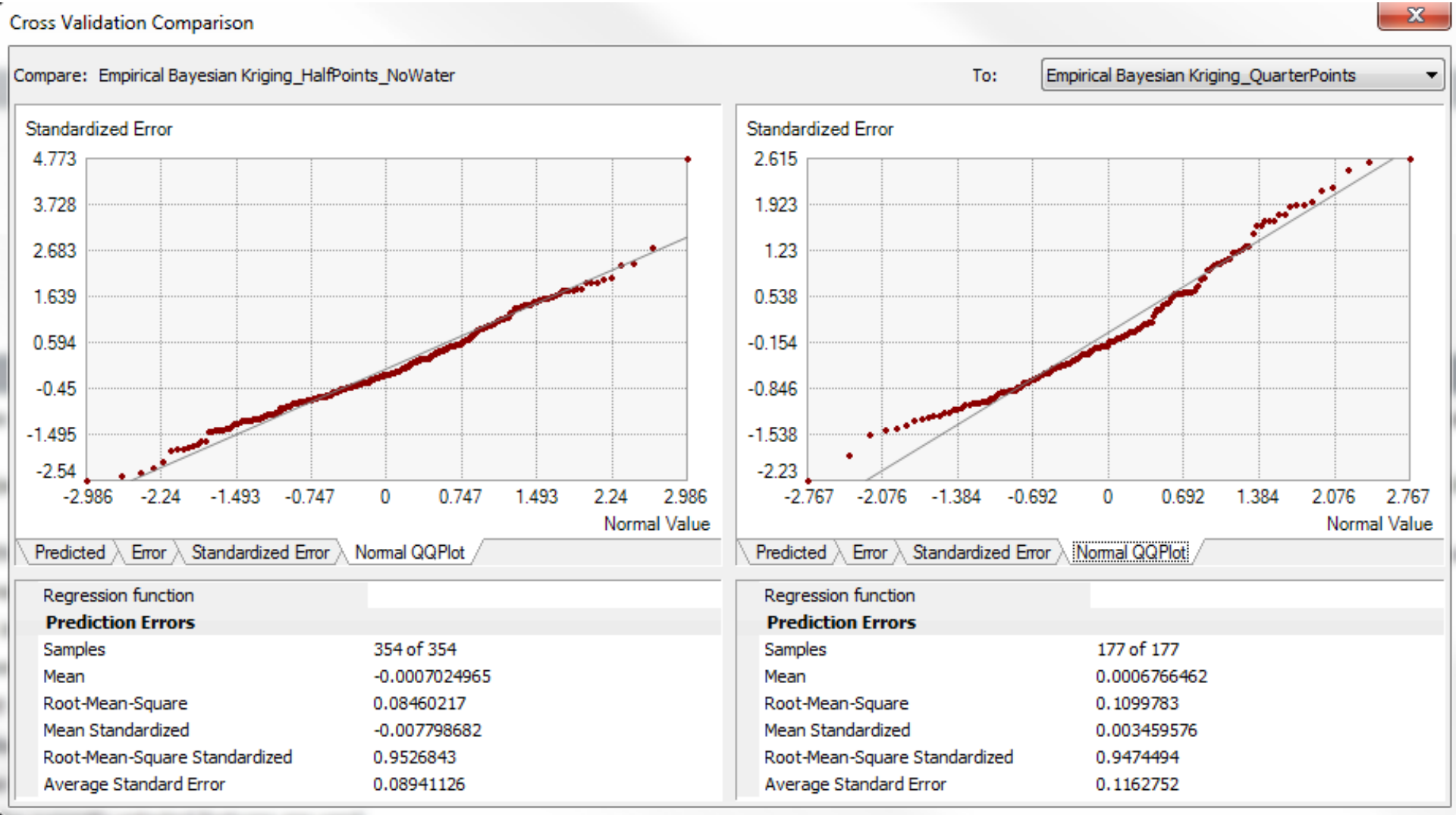
Survey: 6.5 Hours; 798 Points; 8000 m^2



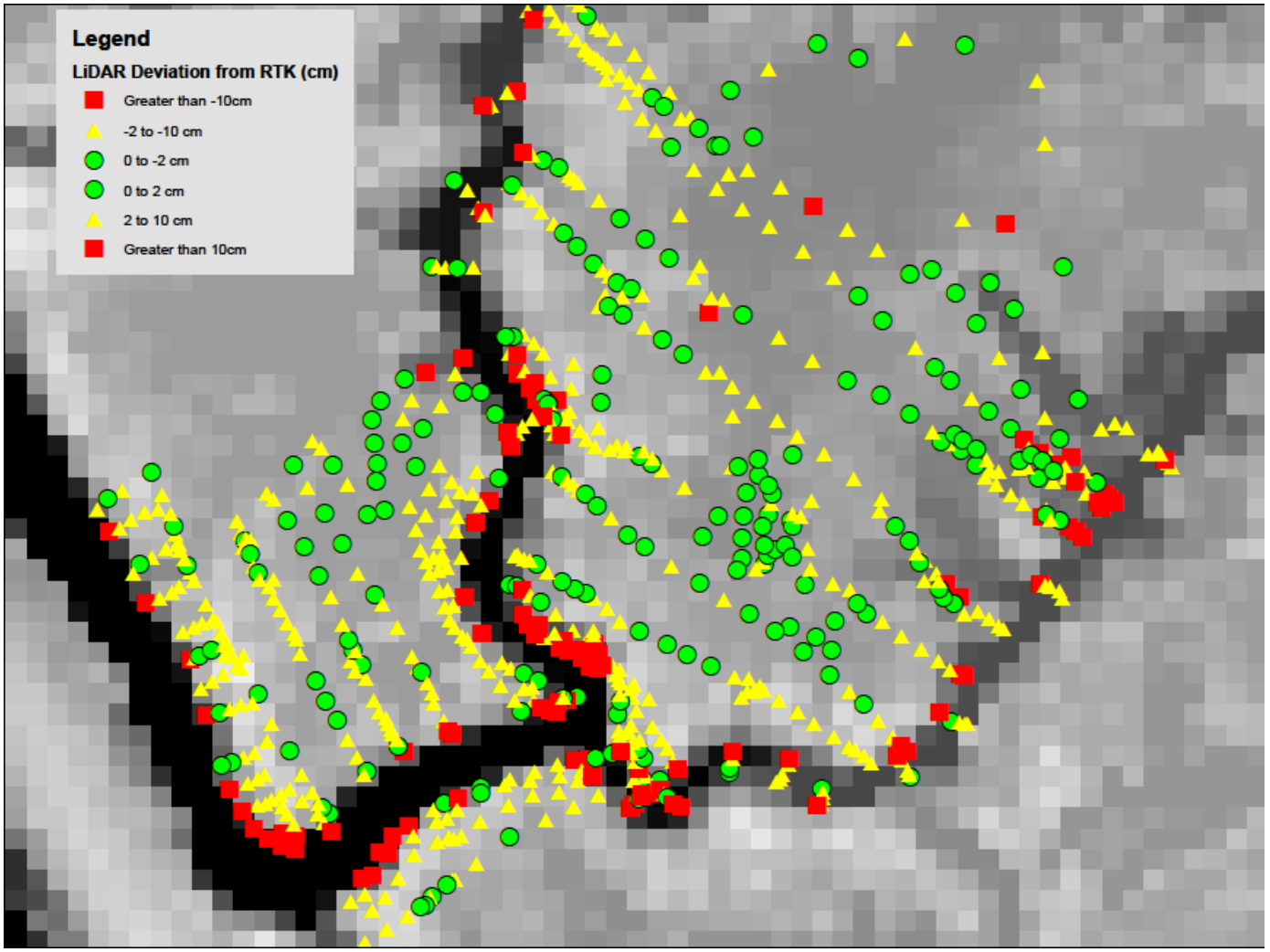
Model Comparison: 798 vs. 399 points:

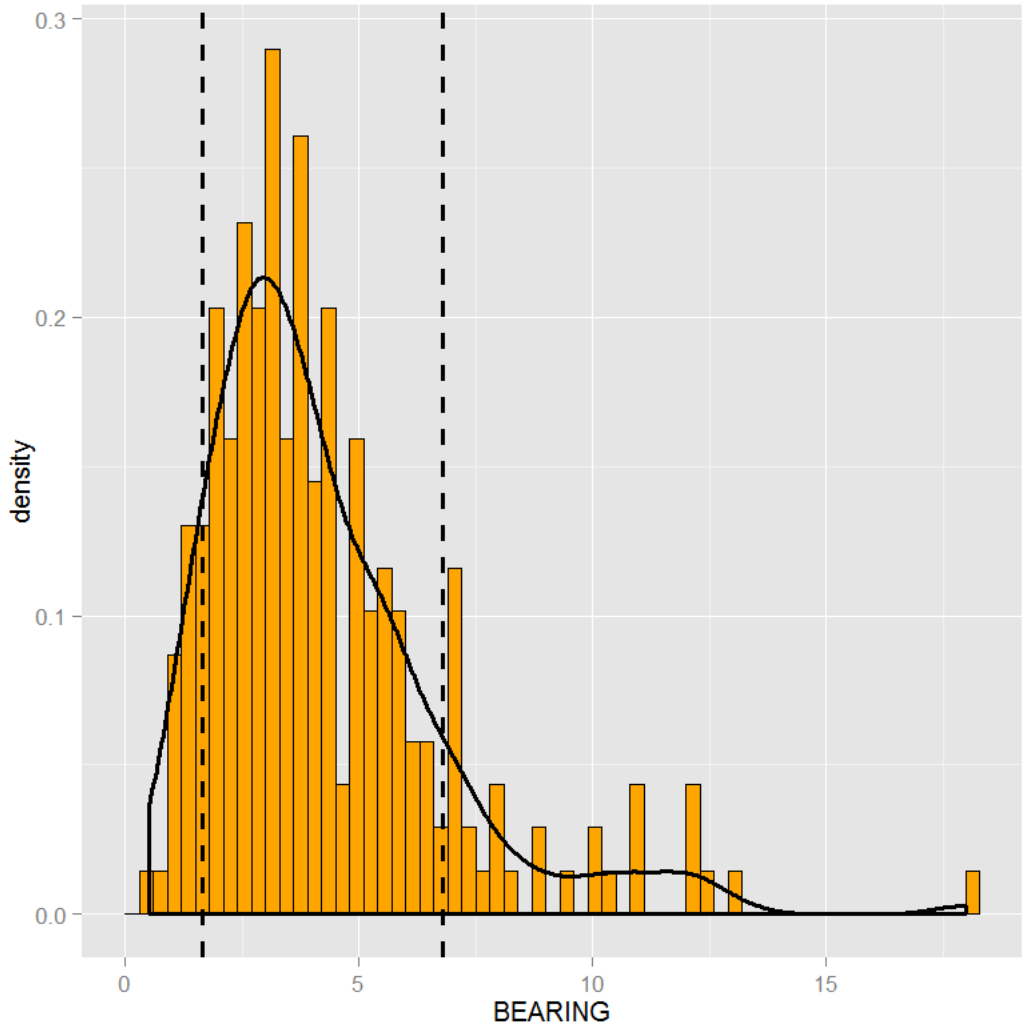


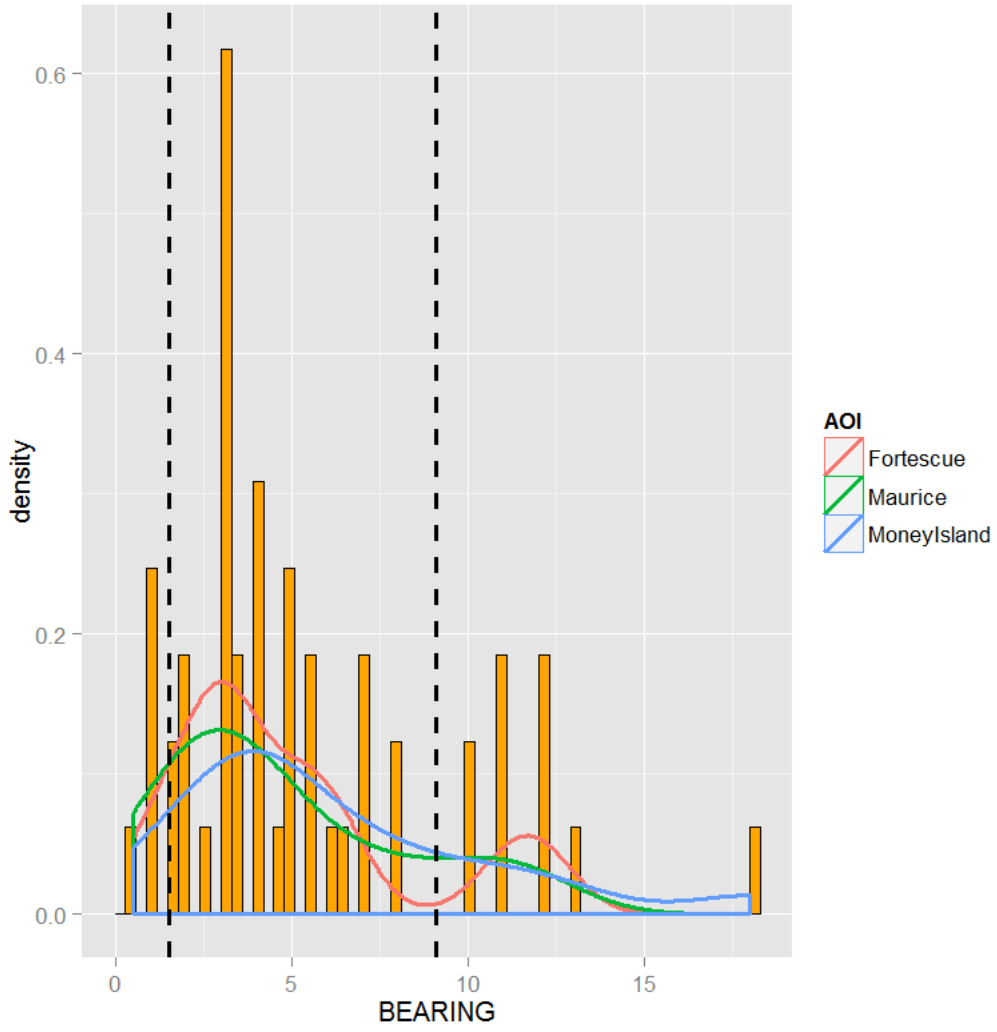
Model Comparison: 399 vs. 200 points:



RTK Vs. LiDAR


Legend
LiDAR Deviation from RTK (cm)
Greater than -10cm
-2 to -10 cm
0 to -2 cm
0 to 2 cm
2 to 10 cm
Greater than 10cm


0.3
0.2
0.1
0.0
density
0
5
10
15
BEARING

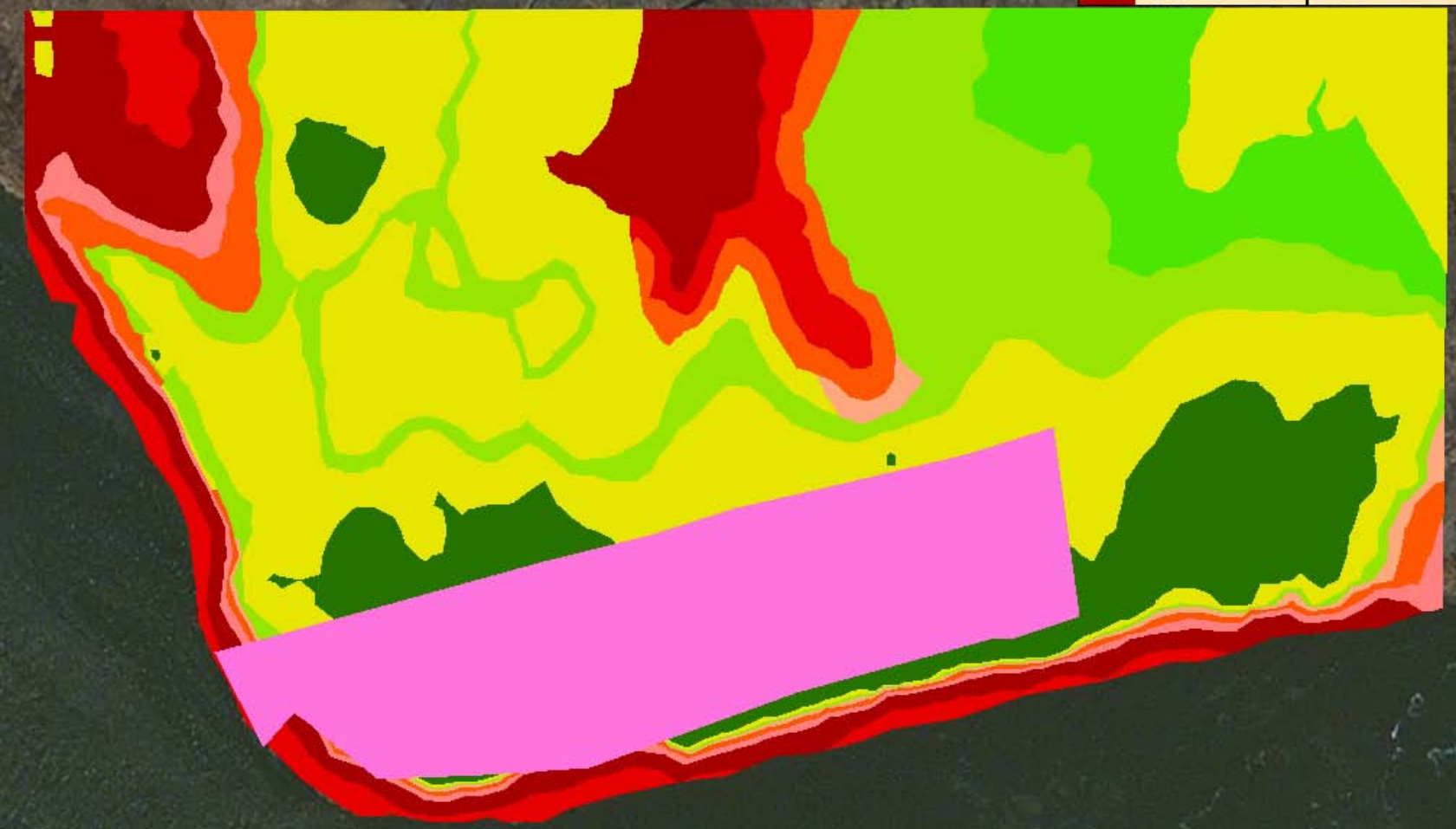

0.6
0.4
0.2
0.0
density
0
5
10
15
BEARING
AOI
Fortescue
Maurice
MoneyIsland

Metric Scoring

Table 1. Means, standard deviations (SD), thresholds (mean +1 SD), and adjusted thresholds for each metric. The units for blade height and bearing capacity centimeters, and canopy cover was assessed in kilo-lumens.

Metric	Mean	SD	Mean +SD	Adjusted Threshold	Score Adjustment Value
Blade Height	81.67	34.71	116.37	110.00	-0.5
Canopy Cover	32.80	21.05	53.85	53.85	-0.5
Bearing Capacity	4.22	2.58	6.80	6.00	-1.0

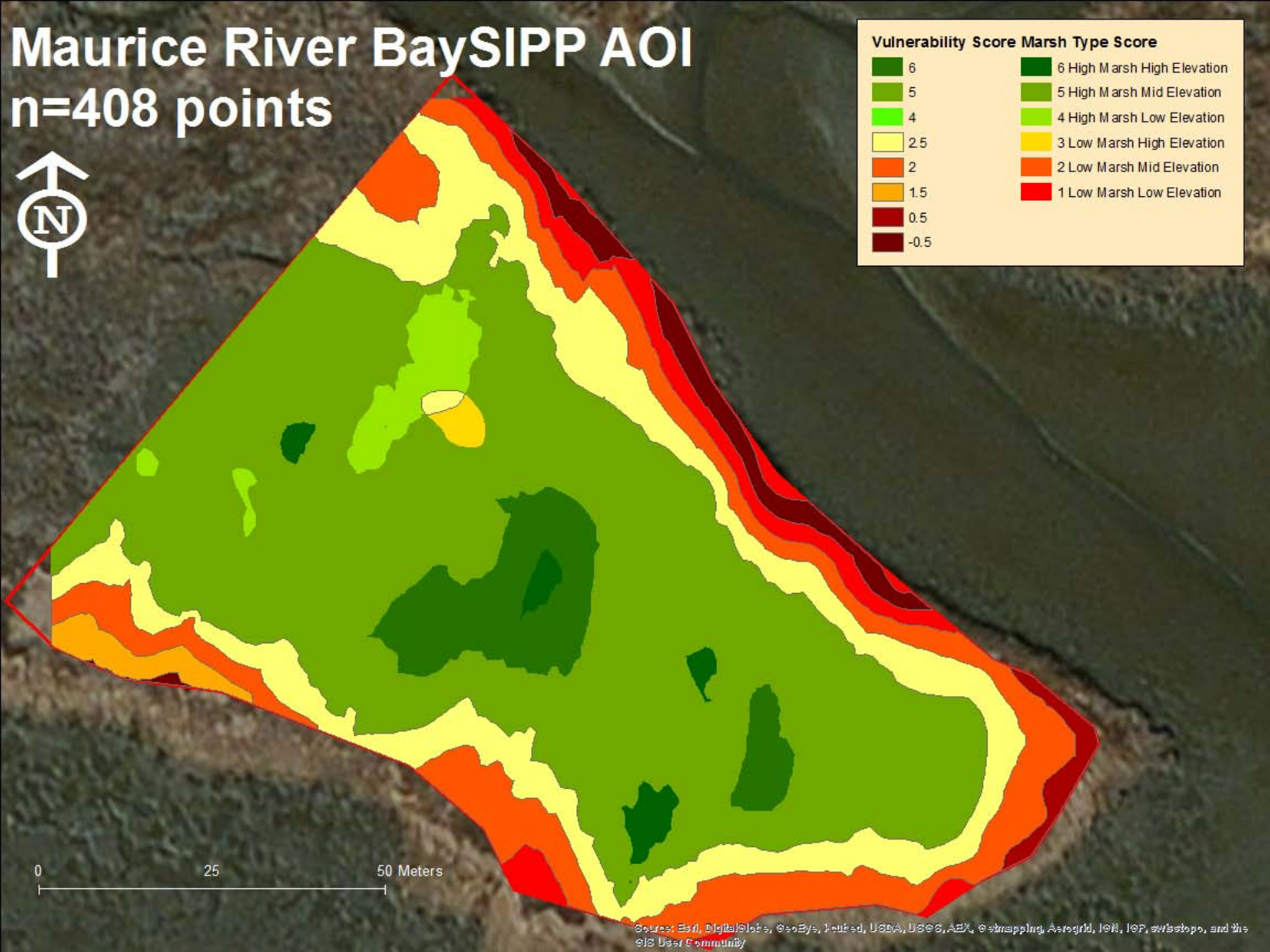
Fortescue BaySIPP AOI
n=807 points

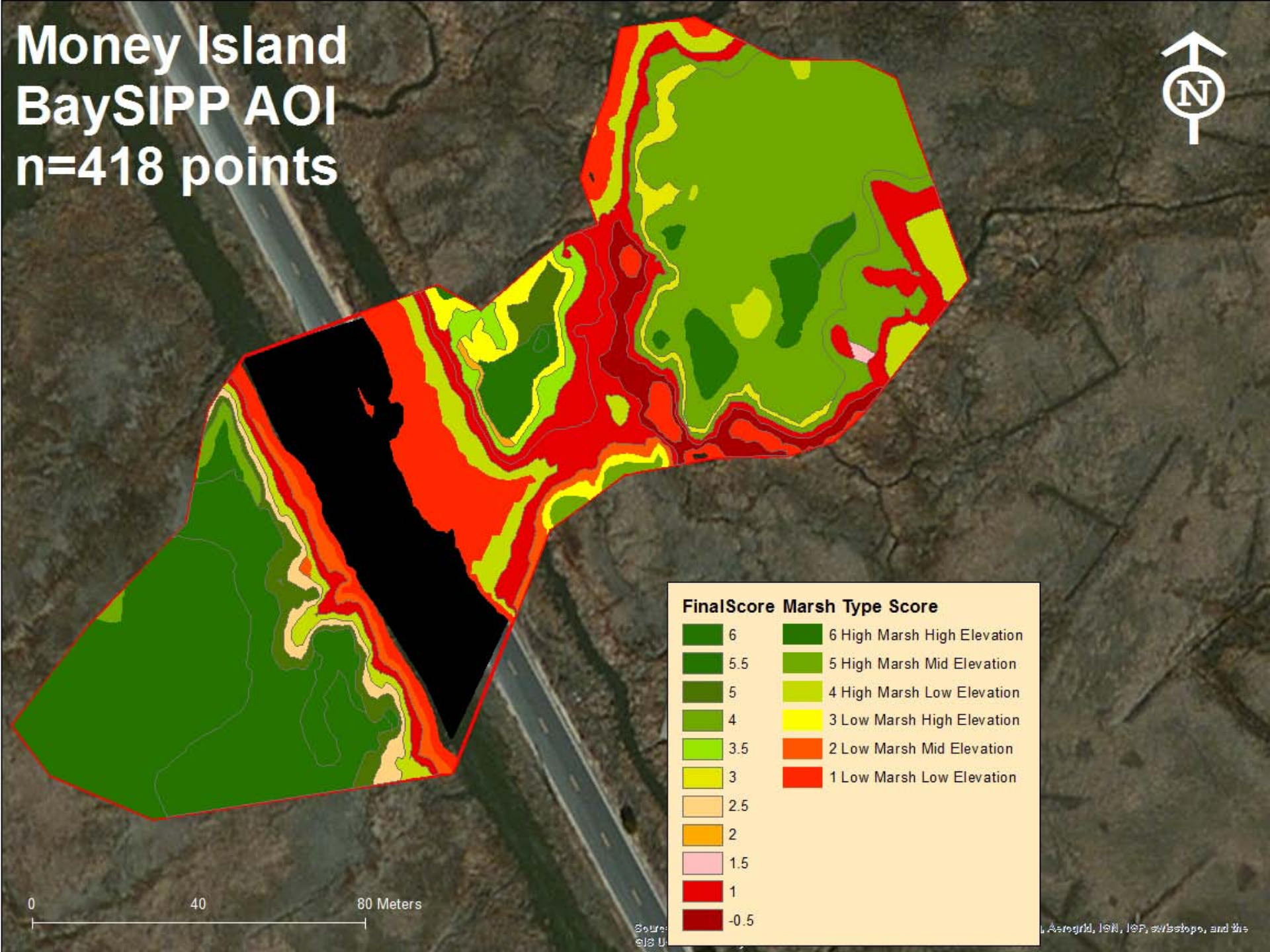


0 12.5 25 50 75 100
Meters

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Maurice River BaySIPP AOI
n=408 points




Money Island
BaySIPP AOI
n=418 points
N
FinalScore
6
5.5
5
4
3.5
3
2.5
2
1.5
1
-0.5
Marsh Type Score
6 High Marsh High Elevation
5 High Marsh Mid Elevation
4 High Marsh Low Elevation
3 Low Marsh High Elevation
2 Low Marsh Mid Elevation
1 Low Marsh Low Elevation
0
40
80 Meters