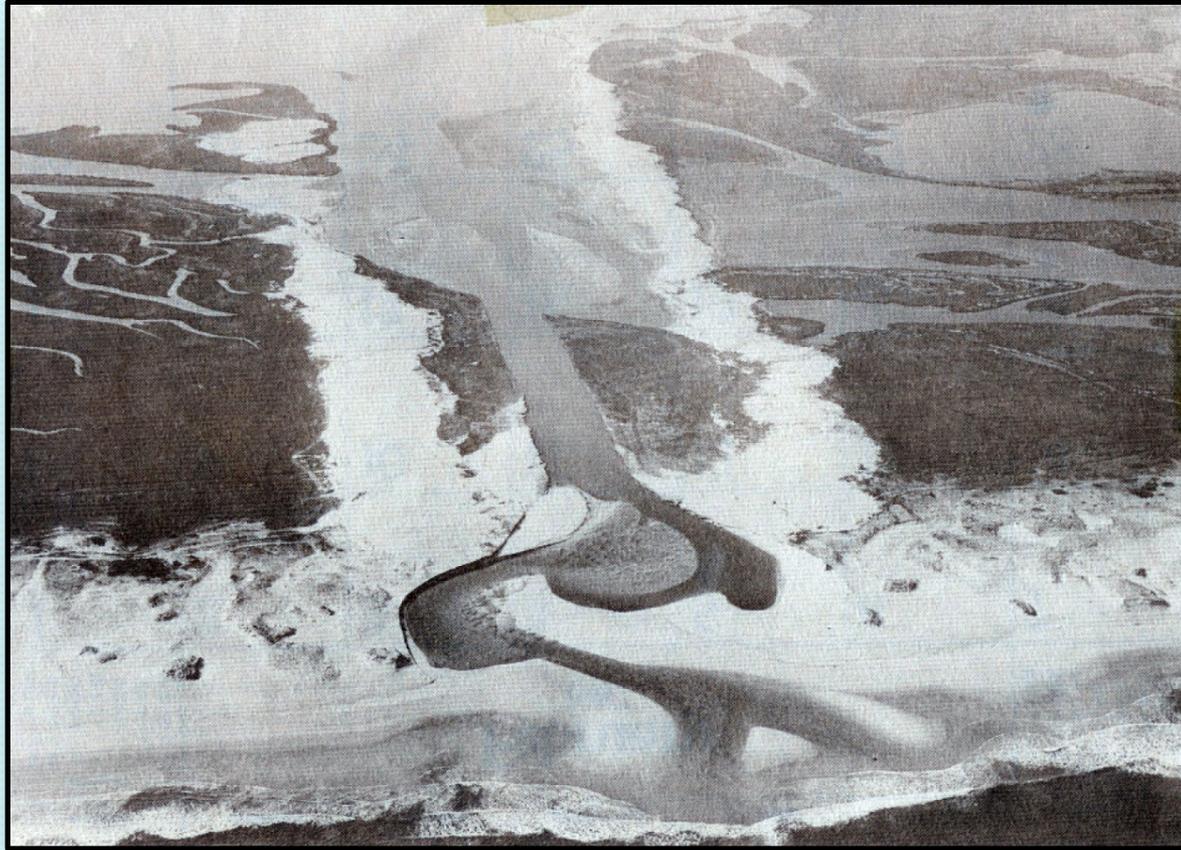


Indian River Bridge Wetland Mitigation

Ken Dunne, DelDOT
Justin Reel, RK&K Associates

Bridge History



Aerial photo taken of the Indian River Inlet around 1929 prior to the construction of Route 1.

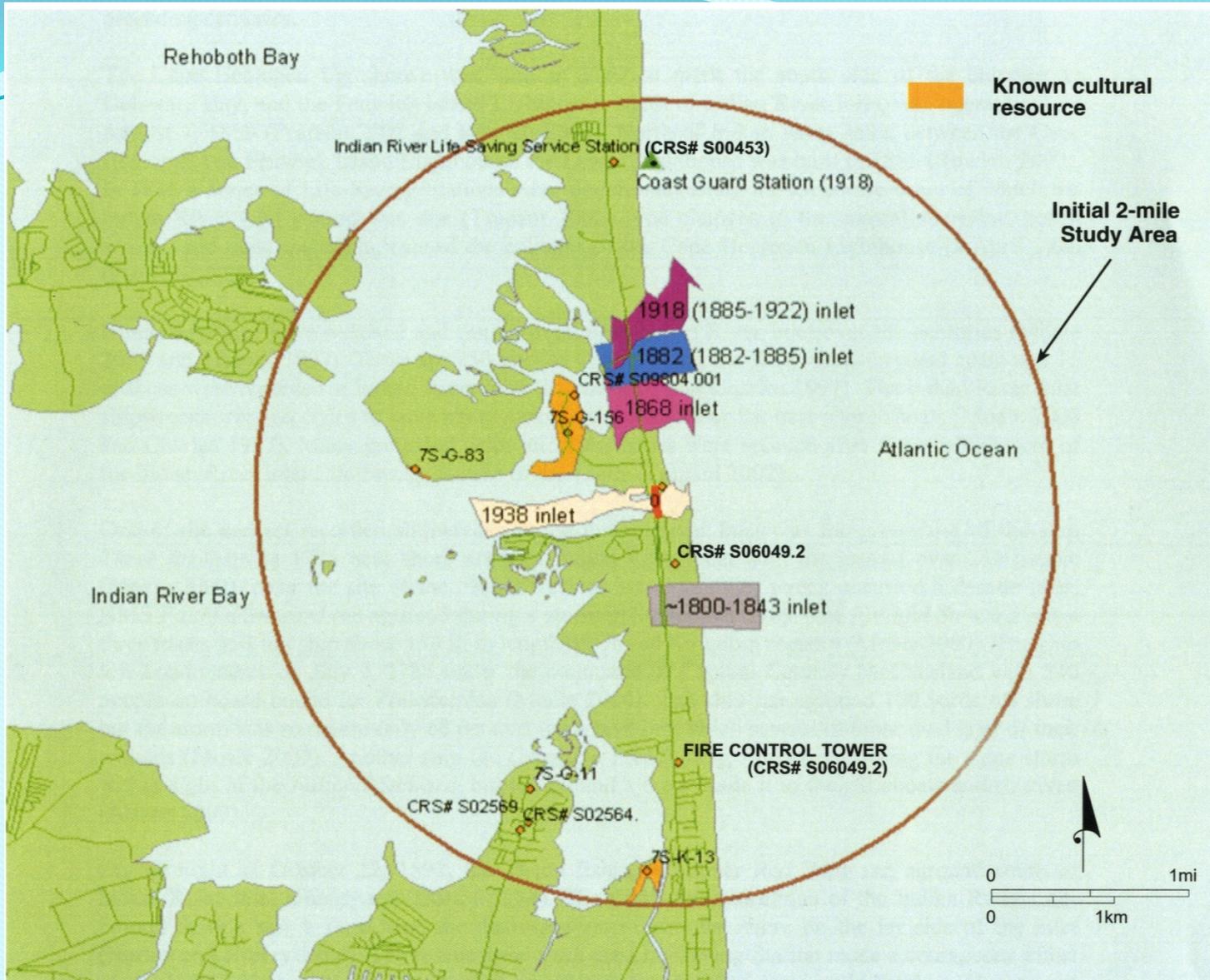


Figure 9. Map showing the locations of historic tidal inlets and cultural resources within the initial 2-mile study area.

February 10, 1948

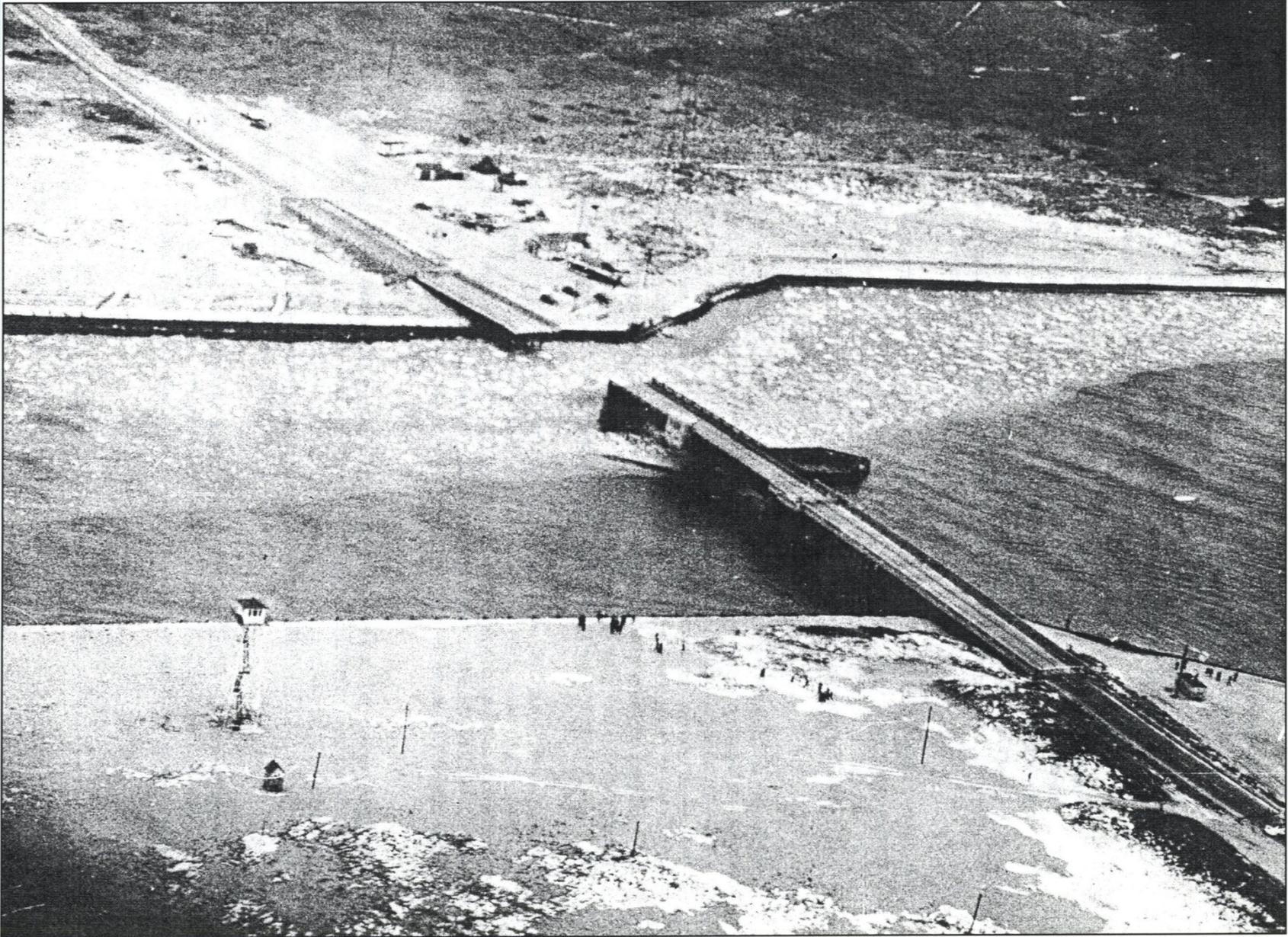


Figure 17. Aerial view of Cullen Bridge after destruction of south bridge trestle toward southwest. RG 1325. General Photo Collection: Transportation.

DeIDOT/DNREC PARKS PARTNERSHIP

Parks Identified Problem Sites:

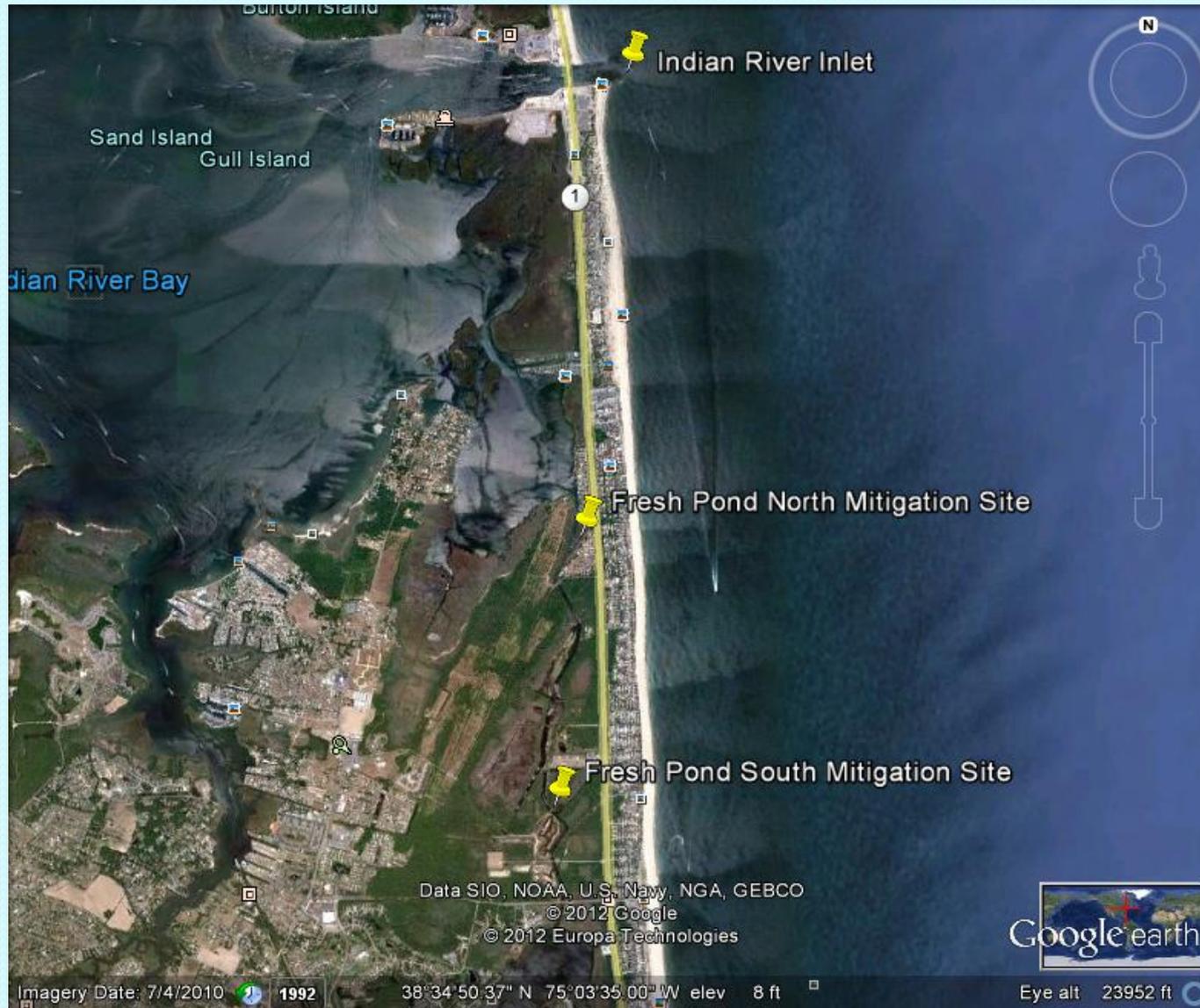
(1) Fresh Pond North: 7.2 Acres

Filled Land/Dredge Spoil/Old Tidal Marsh

(2) Fresh Pond South: 4.5 Acres

Borrow Pits and Debris

Indian River Bridge Wetland Mitigation



Fresh Pond North 2002



Evaluation of Fresh Pond North

- Unconstricted Tidal Flow
- Regular Tidal Cycle, Predictable
- Adjacent *Spartina alterniflora* Marsh as Reference
- Low Energy Signature
- Dredge Spoil/Filled Land/Sand

Reference Marsh

- (1) Establish Project's Master Survey Point in NGVD
- (2) Bio-benchmark the Reference Marsh to NGVD
 - 75 Pin Flag Points, Repeated Measurements:

Vegetative Structure

Hydrology

Drainage

Repetitive , Wordy, Judgmental, Opinionated

Never Edited - Goldilocks

Tide Gauge

- 3.5 Months Tide Gauge, Data Logger
- Tied to NGVD (Not Mean Low Water)
- Tides Appear to be Regular and Steady
- Portions of the “Bay” are not Regular and Steady
 - Pronounced Seasonal Shifts
 - Yearly Variation
 - Mean Low Water / Shift / Mean High Water

Bio-Benchmark and Tide Gauge Analysis

- Everything is Tied to Master Survey Point
- Reference Low Marsh Very Flat
- “Good” Elevations 0.20-0.60 NGVD
- Work the Tide Gauge Data
- Determine the Inundation Period Per 24 hours

Inundation Period Per 24 Hours

Huge Factor in Determining Marsh Structure

- Biomass Allocation / Plant Architecture / Flowering
- Marsh Plain and Morphology
- Landscape Energy Signature / Filter
- Interpretation Not Always Easy
- Catastrophic Failures
- Sedimentation Wildcard

Reference Marsh/Inundation Time

0.00 ft = 7.885 Hours/24 Hours

0.15 ft = 6.805 Hours/24 Hours

0.20 ft = 6.475 Hours/24 Hours * Goldilocks

0.55 ft = 4.015 Hours/24 Hours

0.60 ft = 3.69 Hours/24 Hours * Goldilocks

Marsh Tolerance is at Least 12-13 Hours Per Day (Literature)

Structure of the Reference Marsh is in Agreement with Tide Gauge Data

Low Inundation Time of Reference Marsh “Suggests”

- Maintaining Elevation
- Highly Protected Landscape Position

Begs Question? Where is the “Rest of the Marsh”

High Energy Filter or Something Else ?

Design Approach the Site

- Reference Marsh Approach
 - “Good” Elevation – Narrow Range
- Inundation Period Approach
 - Nice Regular Tides / Wider Range / Energy Filter Present?
- Constructability Filter - What Is Doable!!!!
 - What Grading Range and Grading Tolerance Can You Hold at Your Site?
 - Substrate Dependent
 - Is the Mitigation Site Still Viable or Approach Still Viable ???

Fresh Pond North

- Sediment is Packed Sand, 3-foot Excavation
- Possible to Hold Tight Grade and Tolerances
- Conservative Approach – Adopt the Reference Marsh
- Avoid “High Energy” Filter / Unknown Factors

Design Features

- Low Marsh Dominated by *Spartina alterniflora*.
- Low Marsh - Drain the Marsh Plain, No Ponding, No Soups
- Sloped, Grade Tolerance 0.25 – 0.45 +/- 0.1 foot
- Upland Interface - Long Gradual Slopes, 5:1 or Less
- Stabilize the Upland/Wetland Interface – “High Marsh”
- Energy Wave Signature at the Upland/Wetland Interface - Time

Tech Weenie Stuff

Dunne, et al. 1998: *Engineering Manual for Wetland Plant Establishment and Subgrade Preparation – US Army Corps of Engineers, Waterways Exp. Station*

- 1-Year Old Stock of *Spartina alterniflora*
- April Planting, 2-ft Centers, Tablet Fertilizer
- Strict As-Built Requirements, 20-foot Centers
- Goose Fencing – Rebar / No Mylar Tape
- Deep Disk *Panicum* Seeding Interface
- Use *Spartina patens* and *Distichlis* at Interface
- Wave Energy Signature



August 2006 – Grade to Drain





MAY 1 2006

August 2006



September 2007





June 2011



June 2011



June 2011 - Interface



February 2012



February 2012



Reference Marsh – Feb 2012



February 2012 - Interface



Energy Signature – February 2012



Fresh Pond North 2011



Fresh Pond North - Summary

- Very Protected Landscape Position
- Regular Tides
- Inundation Interval, 4-7 Hours/Day
- Sands Allowed Conservative/Reference Approach
- Not Inundation Period Approach, 4 – 12 Hours/Day

- If Organics/Peats, Likely Opened Grades to Lower Elevations