



HUMBOLDT BAY

SEA LEVEL RISE

ADAPTATION PLANNING PROJECT

Public Meeting - November 12, 2013

“Forecast: Rising Tides on Humboldt Bay”

Funding: State Coastal Conservancy

Co-sponsors: Humboldt Bay Harbor, Recreation and Cons. District
Humboldt County

Technical studies: Northern Hydrology & Engineering

Lead planner: Trinity Associates

Administration: Coastal Ecosystems Institute of Northern California

Adaptation planning working group: Various agencies

The background of the slide is a close-up photograph of water with numerous small, concentric ripples. The ripples create a textured, shimmering effect with varying shades of light blue and grey. The text is centered horizontally and vertically over this background.

GLOBAL SEA LEVEL RISE

The background of the slide is a close-up photograph of water with numerous small, concentric ripples. The water is a light blue-grey color, and the ripples create a textured, wavy pattern across the entire frame.

RELATIVE SEA LEVEL RISE

SEA LEVEL RISE IMPACTS

1. **Flooding**
 - Shoreline Erosion/Breaching
 - Shoreline Overtopping
 - Rising Groundwater
2. **Salt Water Intrusion**



King Tide 2012 Fields Landing

MAD RIVER SLOUGH

An aerial photograph showing a complex network of waterways and marshland. A large, winding body of water, the Mad River Slough, dominates the center and right side of the frame. To the left, a large, dark green area of water is visible. A long, narrow, light-colored strip of land or a dike runs horizontally across the lower middle of the image, separating the large body of water on the left from the slough system. The surrounding land is a mix of green marsh and brown, exposed mudflats. The water in the sloughs appears murky and brownish. The overall scene depicts a coastal wetland area during a high tide event.

King Tide 2003

Photo Credit; Times Standard

SOUTH BAY



King Tide 2010

MAD RIVER SLOUGH



King Tide 2004

ARCATA BAY



King Tide 2006

SWAIN SLOUGH



King Tide 2010

LISCOM SLOUGH



King Tide 2012

Humboldt Bay Sea Level Rise Adaptation Planning Project

Phase I:

Existing Conditions-Shoreline Inventory and Mapping

Phase II:

**Vulnerability Assessment-Sea Level Inundation and
Groundwater Modeling, and Adaptation Planning**

PHASE I

ASSESS EXISTING CONDITIONS

Shoreline Inventory & Mapping

Trinity Associates
McBain & Trush
Northern Hydrology & Engineering
2010-2013

Tuluwat King Tide 2010

An aerial photograph of Arcata Bay, a large, irregularly shaped body of water with a complex network of sloughs and channels. The bay is surrounded by a mix of green agricultural fields, some urban development, and forested areas. To the left, the dark ocean meets the shore with white surf. The text 'Mad River Slough' is overlaid in the upper left, 'ARCATA BAY' is in the upper right, '55 miles' is below it, and 'Eureka Slough' is on the right side.

Mad River Slough

ARCATA BAY

55 miles

Eureka Slough

Elk River
Slough

EUREKA BAY

26 miles

Image © 2012 TerraMetrics
Image USDA Farm Service Agency

Image © 2012 DigitalGlobe

Data © 2012 Google Inc. All rights reserved.

Google earth

SOUTH BAY

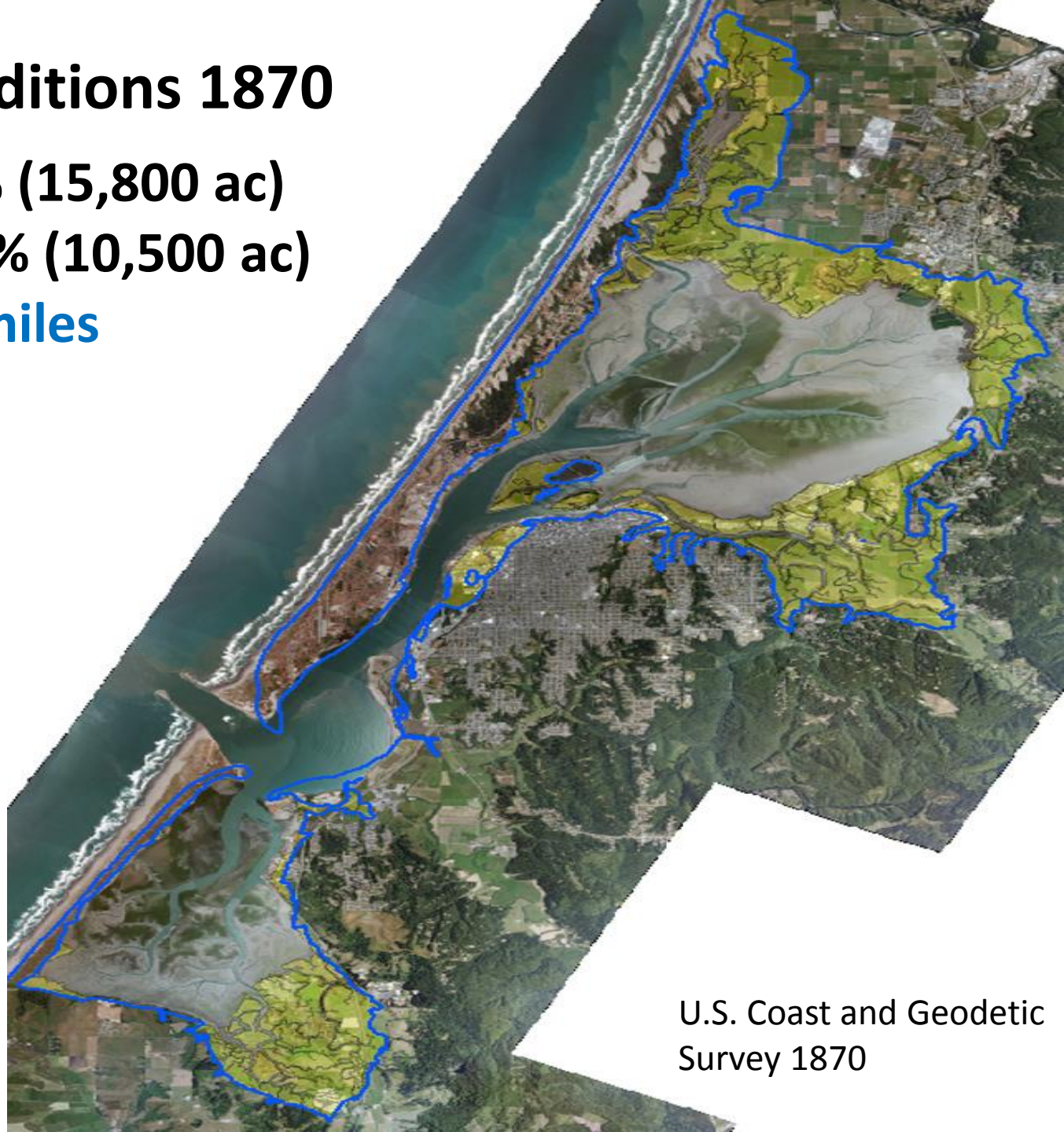
22 miles

Image © 2012 GeoEye
Image USDA Farm Service Agency
Image © 2012 DigitalGlobe
Image © 2012 TerraMetrics

Google earth

Historical Conditions 1870

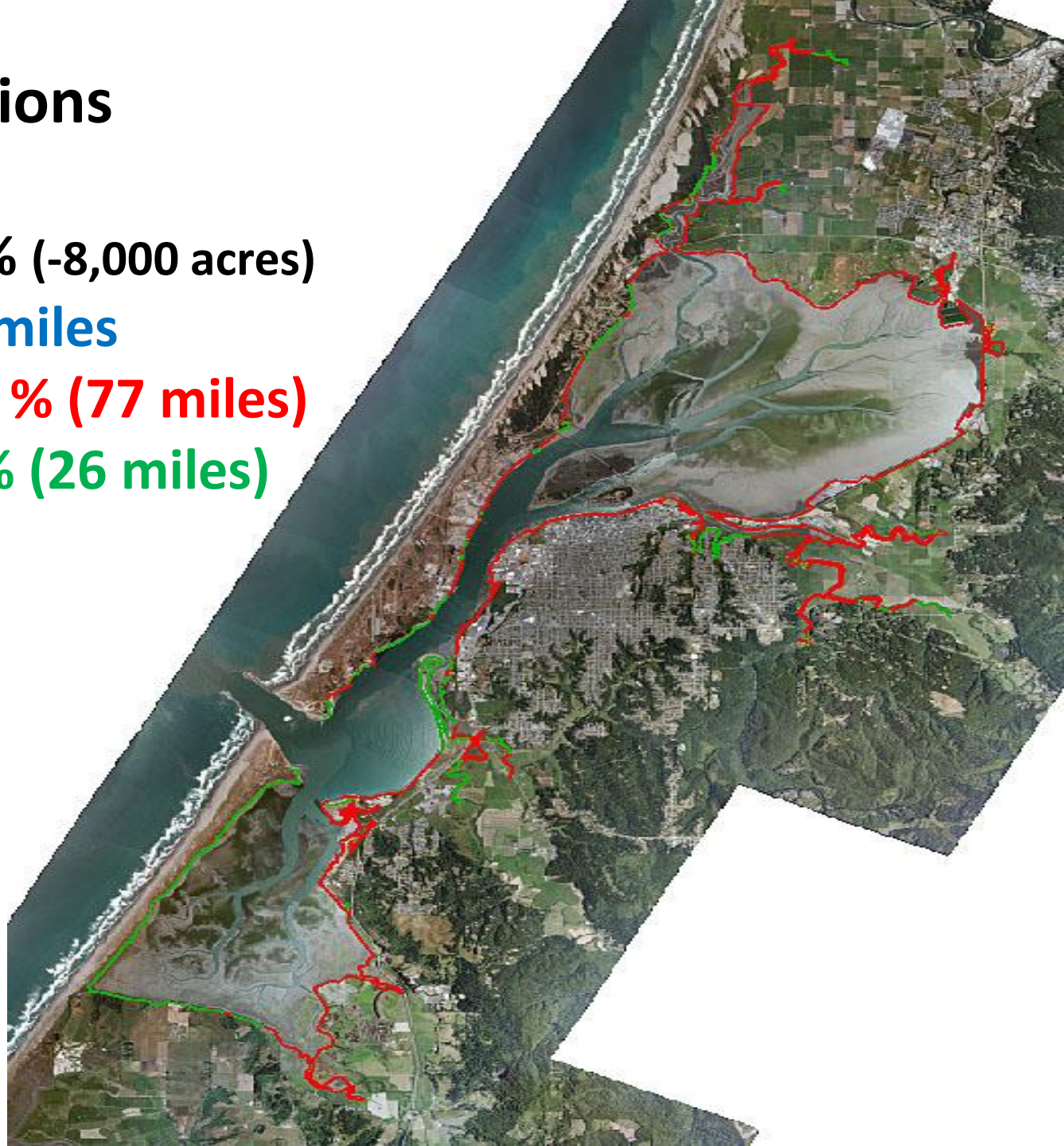
- Open Bay 60% (15,800 ac)
- Salt Marsh 40% (10,500 ac)
- Shoreline 60 miles



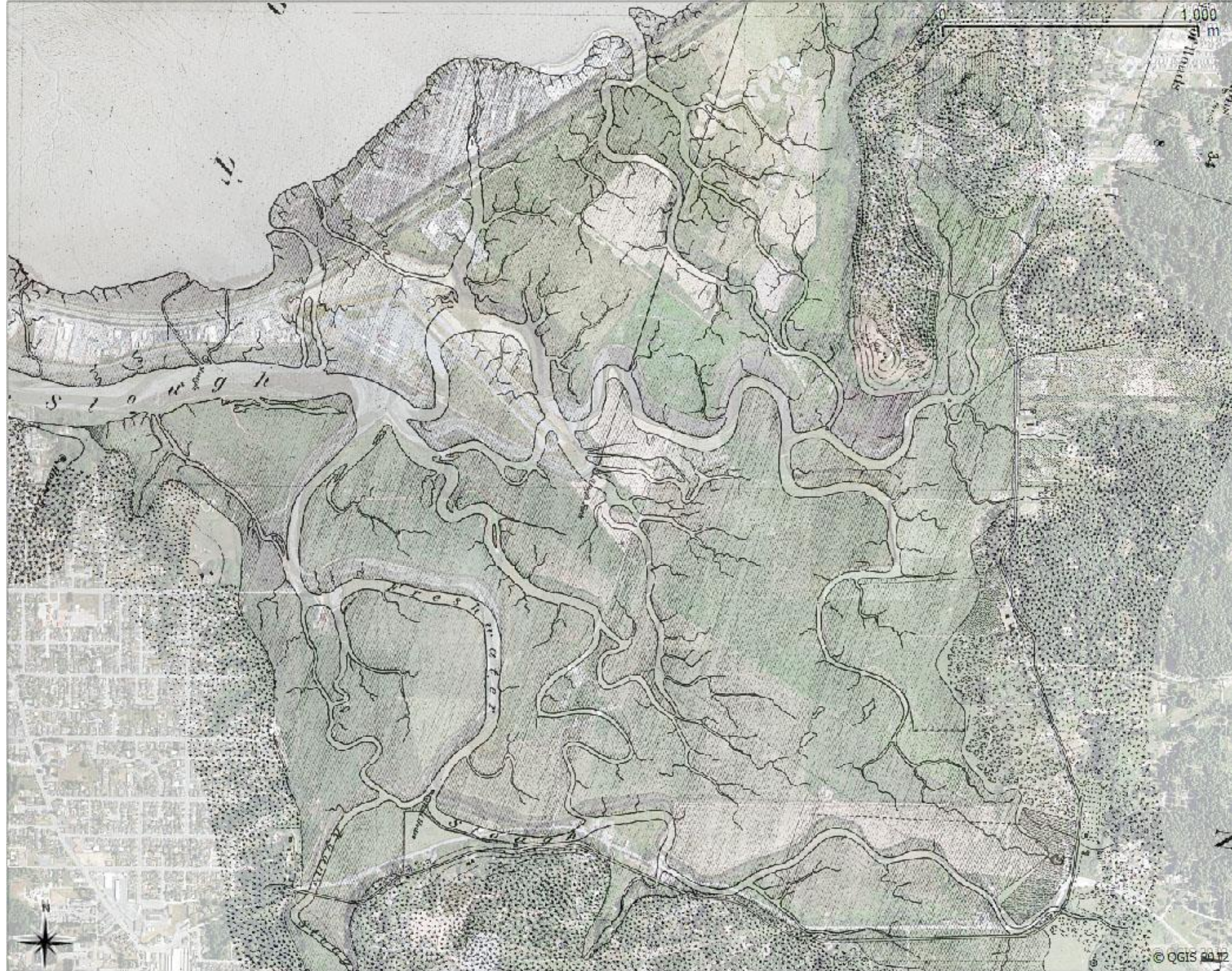
U.S. Coast and Geodetic
Survey 1870

Current Conditions

- Open Bay 90%
- Salt Marsh 10% (-8,000 acres)
- Shoreline 102 miles
 - Artificial 75 % (77 miles)
 - Natural 25% (26 miles)







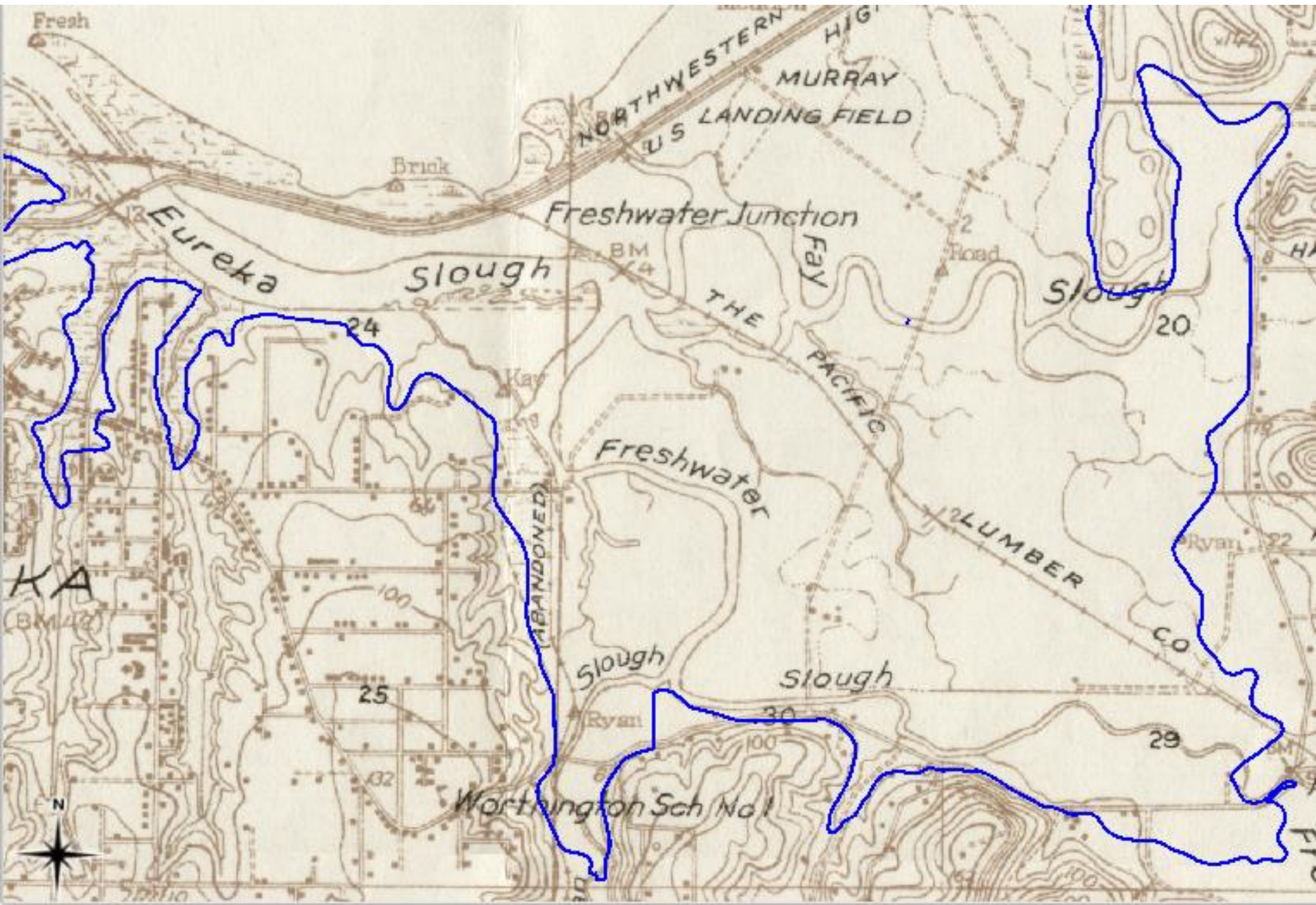




Eureka Slough 1870



Eureka Slough 1933



Eureka Slough 1948



Eureka Slough 1958



Eureka Slough 1970

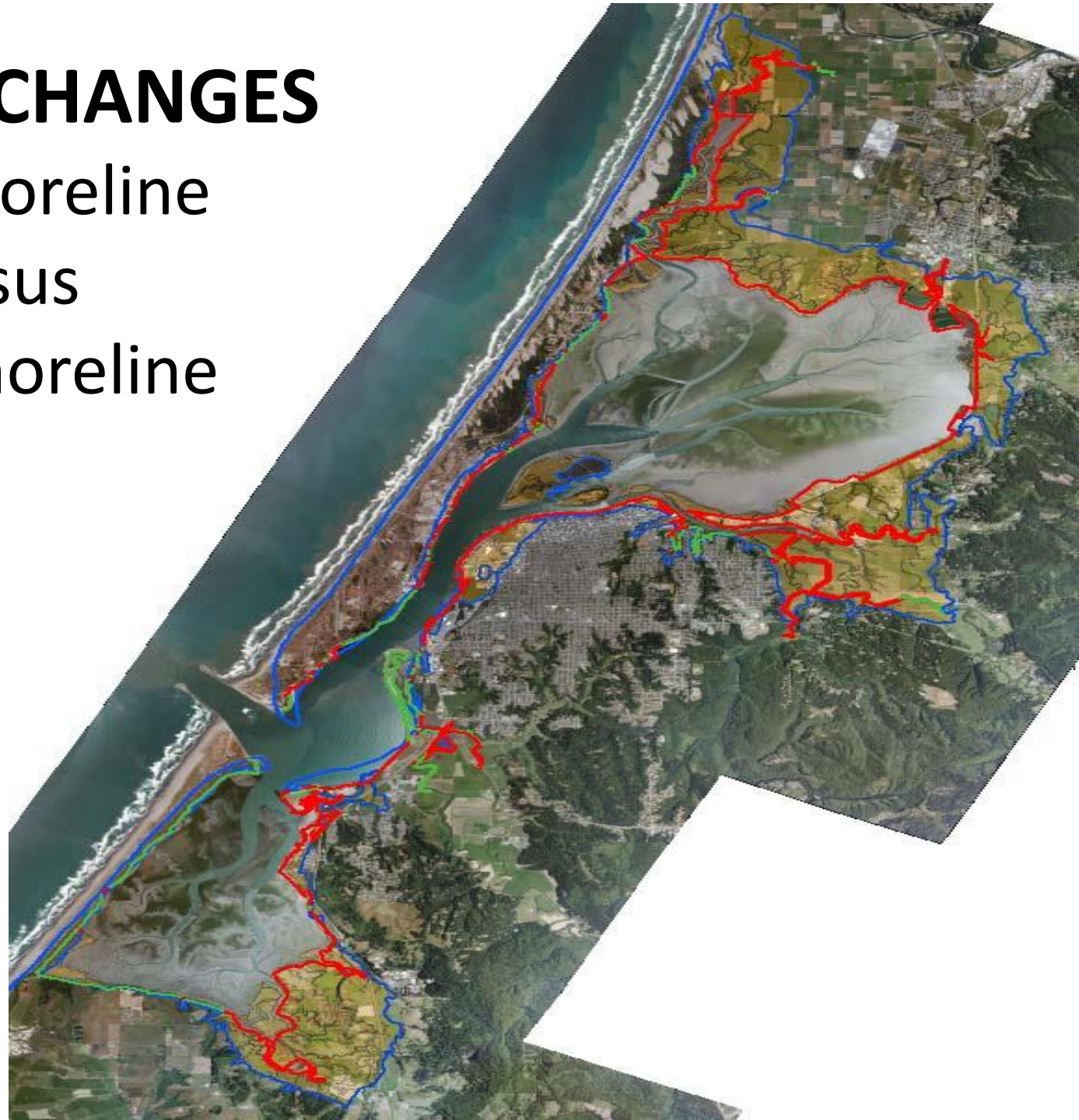


Eureka Slough 2009



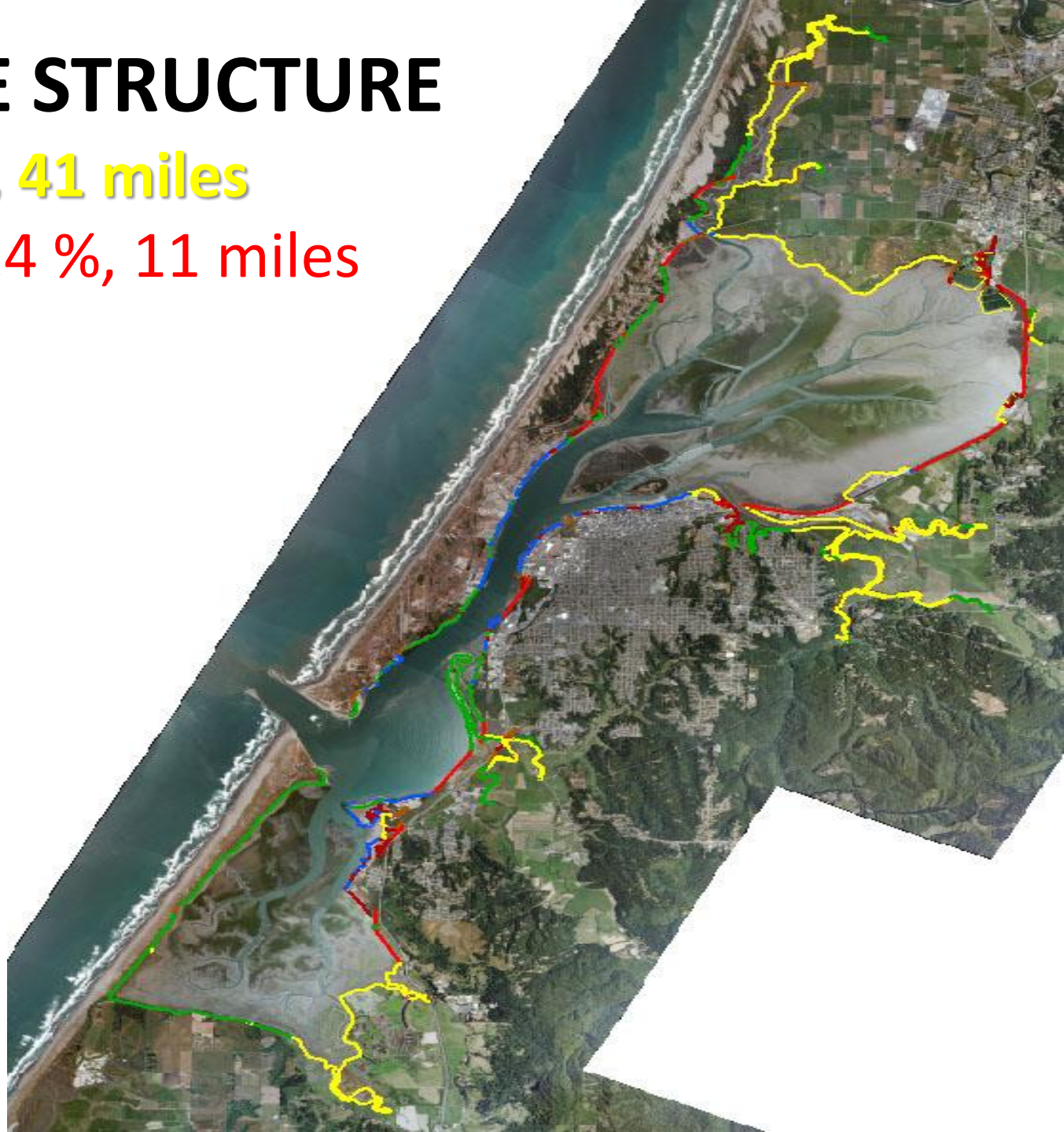
HISTORIC CHANGES

1870 Shoreline
versus
2009 Shoreline



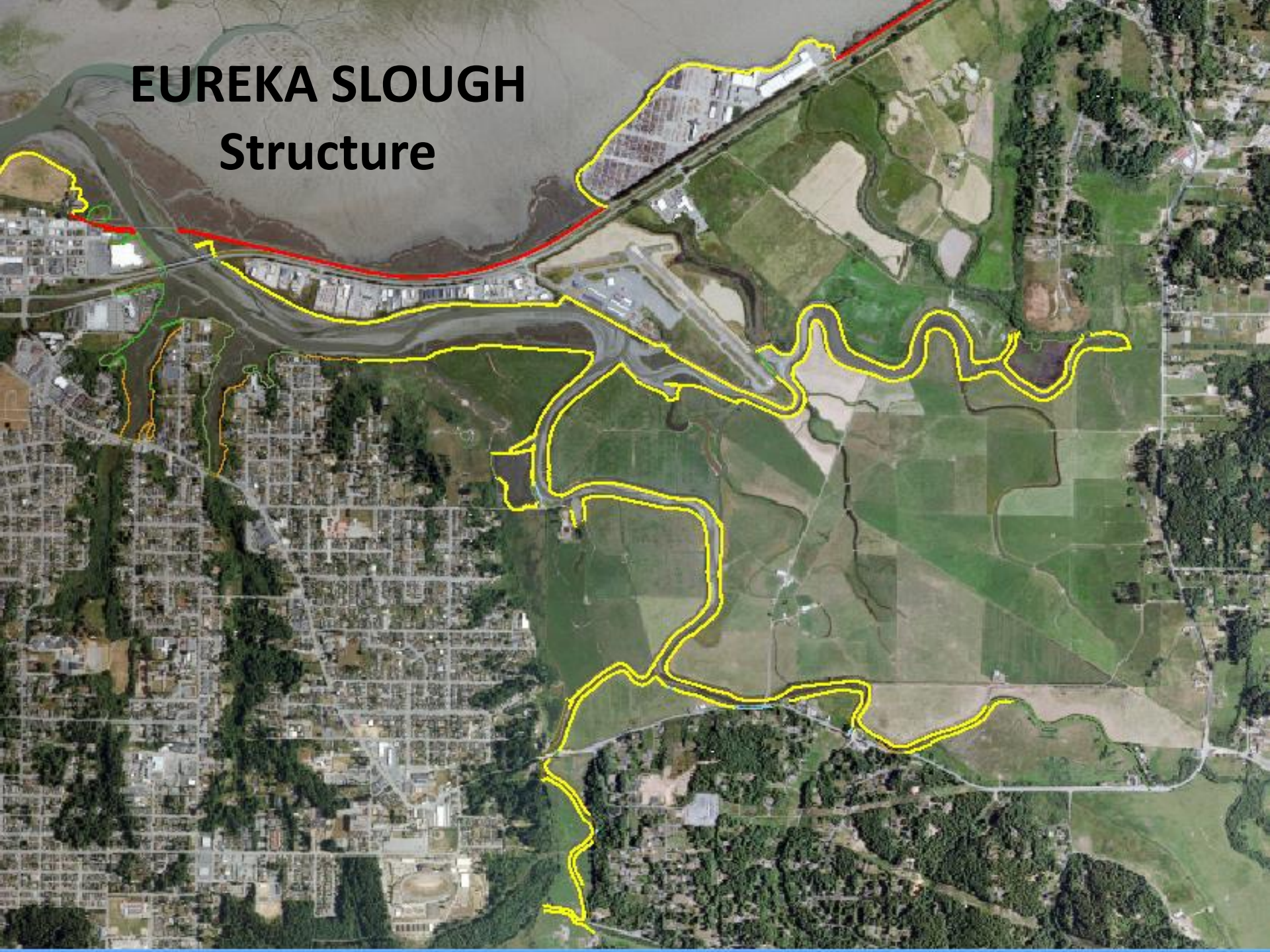
SHORELINE STRUCTURE

- Dike = 53%, 41 miles
- Railroad = 14 %, 11 miles

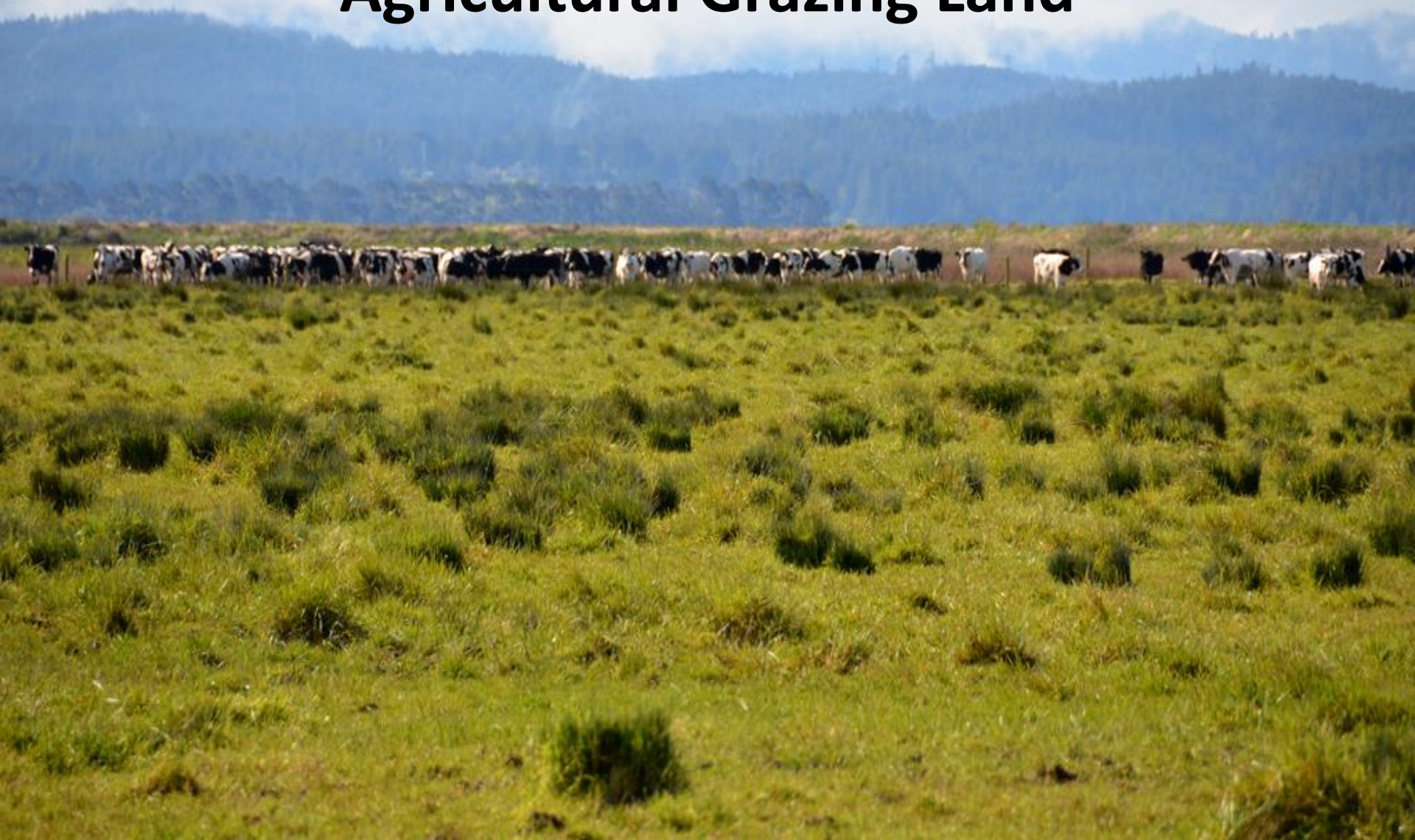


EUREKA SLOUGH

Structure



Diked Former Tidelands are Agricultural Grazing Land



Diked Former Tidelands are Wildlife Grazing Land



Photo credit; Eric Nelson HBNWR

Diked Former Tidelands are Seasonal Freshwater Wetlands



Photo credit; Eric Nelson HBNWR

Unmaintained Dike

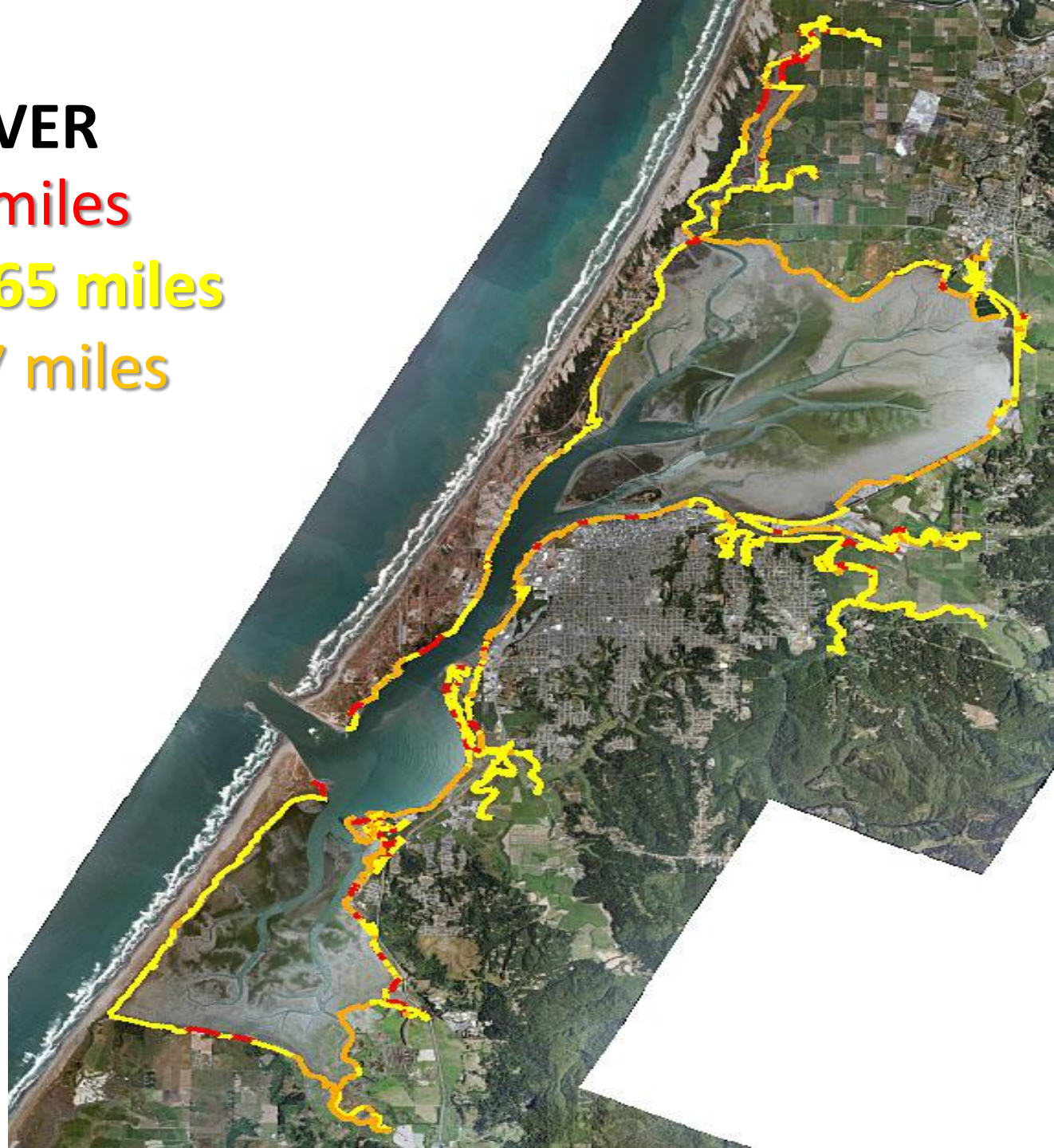


Exposed Dike



SHORELINE COVER

- Exposed = 9 miles
- Vegetated = 65 miles
- Fortified = 27 miles



EUREKA SLOUGH

Dike Cover



Vegetated Dike



Vegetated Dike & Salt Marsh Bench



Exposed Dike



Fortified Dike

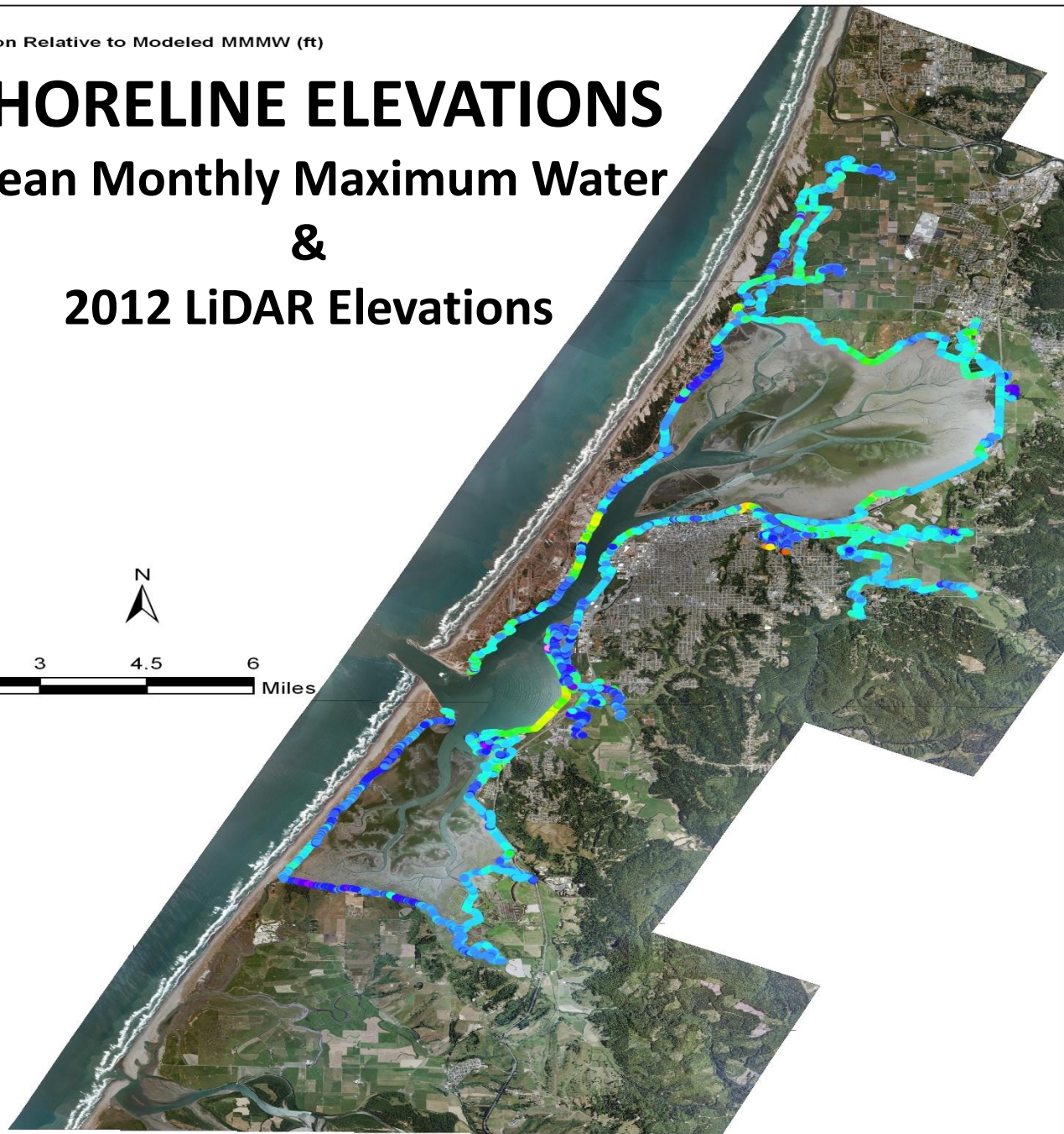
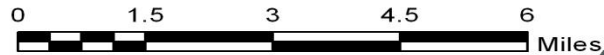


Average Elevation Relative to Modeled MMMW (ft)



SHORELINE ELEVATIONS

Mean Monthly Maximum Water & 2012 LiDAR Elevations





PHASE II

VULNERABILITY ASSESSMENT & ADAPTATION PLANNING

Trinity Associates

Coastal Ecosystems Institute of Northern California

Northern Hydrology & Engineering

Pacific Watershed Associates & Dr. Robert Willis

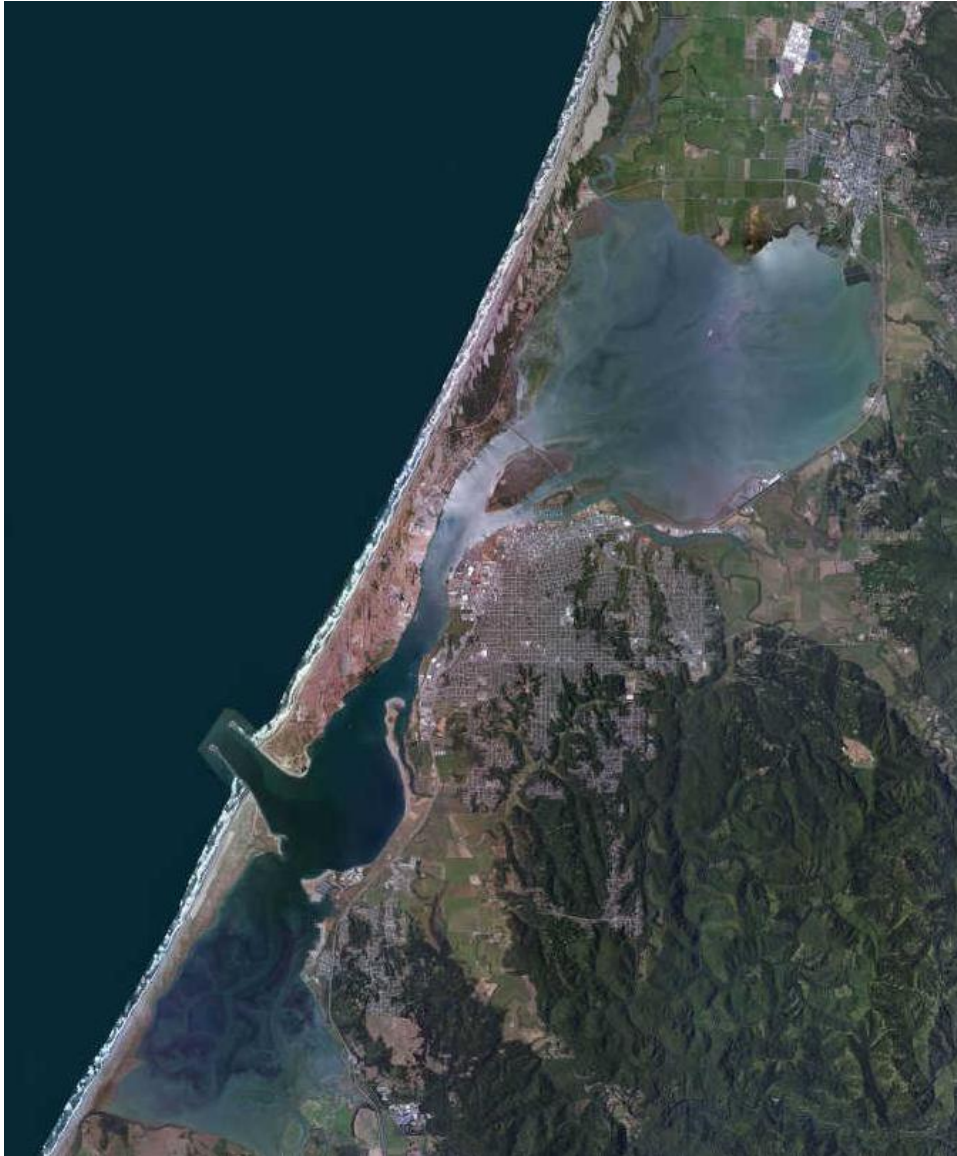
Humboldt Bay Harbor Recreation and Conservation District

Humboldt County Public Works Department

PHASE II PRODUCTS

- **Shoreline Vulnerability Rating and Mapping**
- **Sea-Level Inundation and Groundwater Modeling**
- **Potential Inundation Area Maps**
- **Adaptation Planning Case Studies
of Several Critical Assets**
- **Annual Public and Stakeholder Meetings**

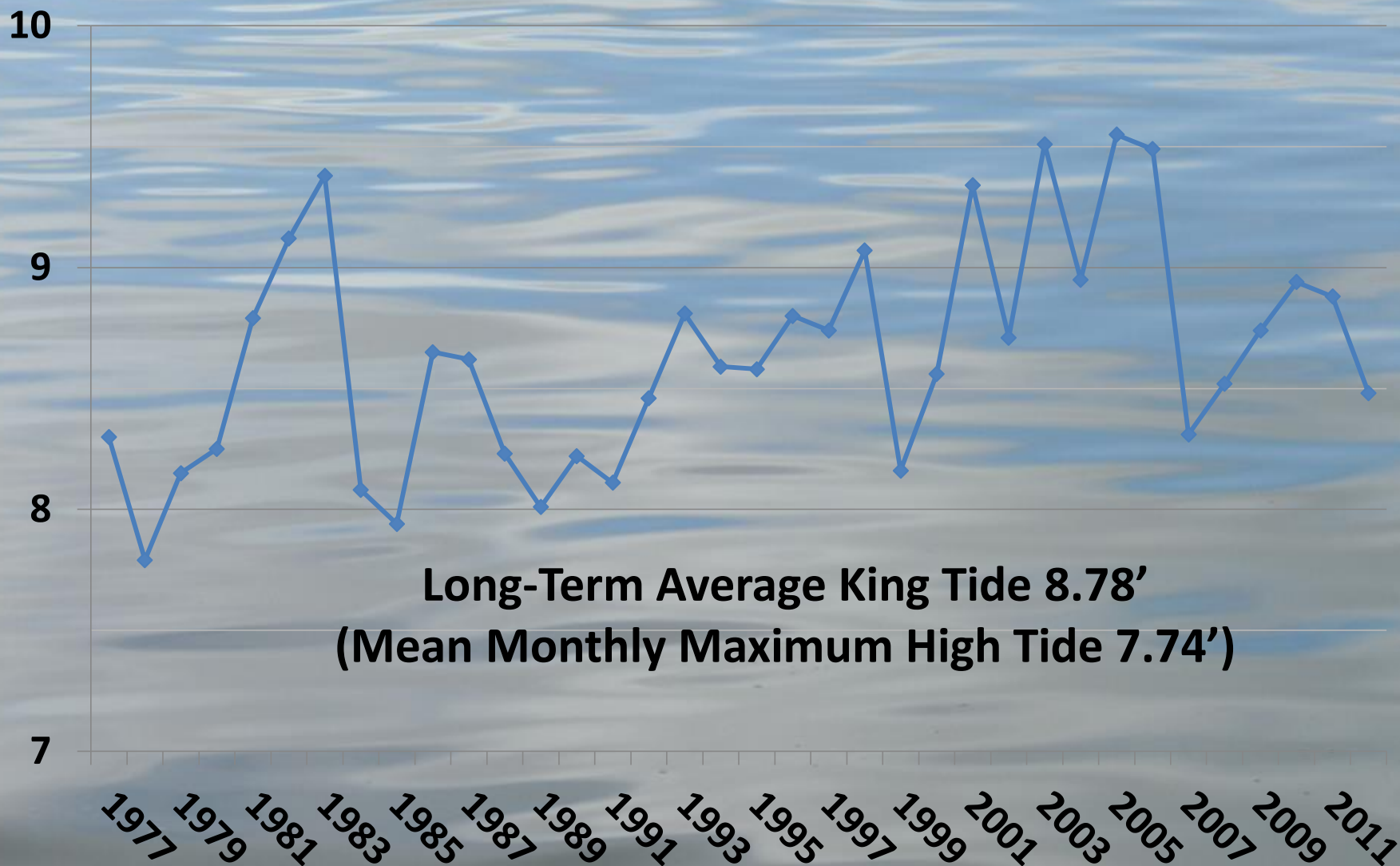
Humboldt Bay Sea-Level Rise Vulnerability Assessment



- Vulnerability: refers to the inability to withstand the effects of a hostile environment (Wikipedia)
- Vulnerability Assessment: Areas surrounding Humboldt Bay vulnerable to inundation from existing or future sea-levels but currently protected by infrastructure such as levees, railroad or road grades, etc

HUMBOLDT BAY

Annual Maximum High Tide





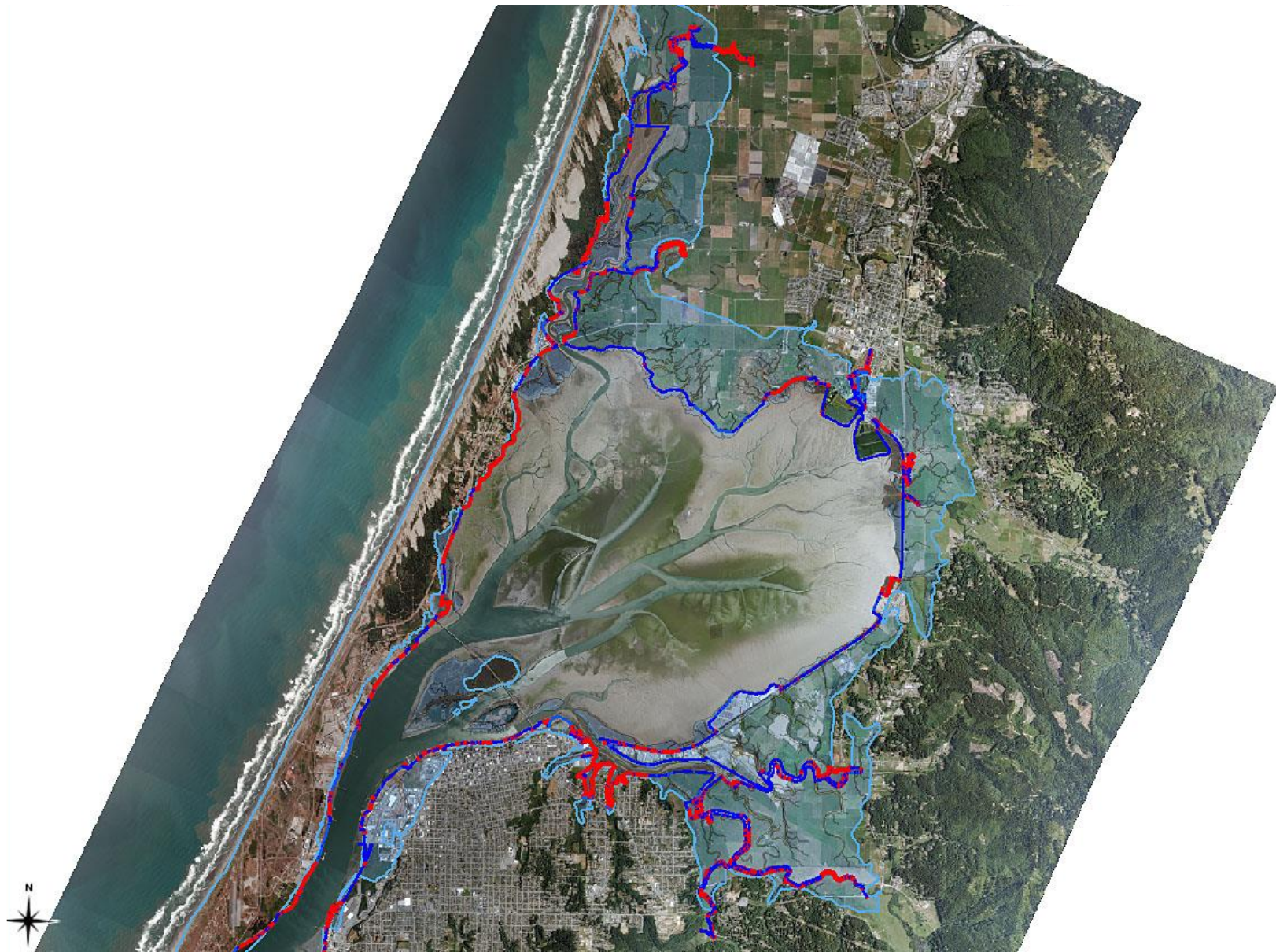
Mapped Eroding Shorelines

Mapped Shoreline Elevations

Average Annual Extreme High Tide: 8.78'



Sea Level Rise: 2.0'/9.74'



Sea Level Rise: 3.0' / 10.74'



Sea Level Rise: 6.0'/13.74'



Shoreline Vulnerability Rating

- **HIGHLY VULNERABLE = 59.0 miles**
- **MODERATELY VULNERABLE = 28.3 miles**
- **LOW VULNERABILITY = 14.0 miles**

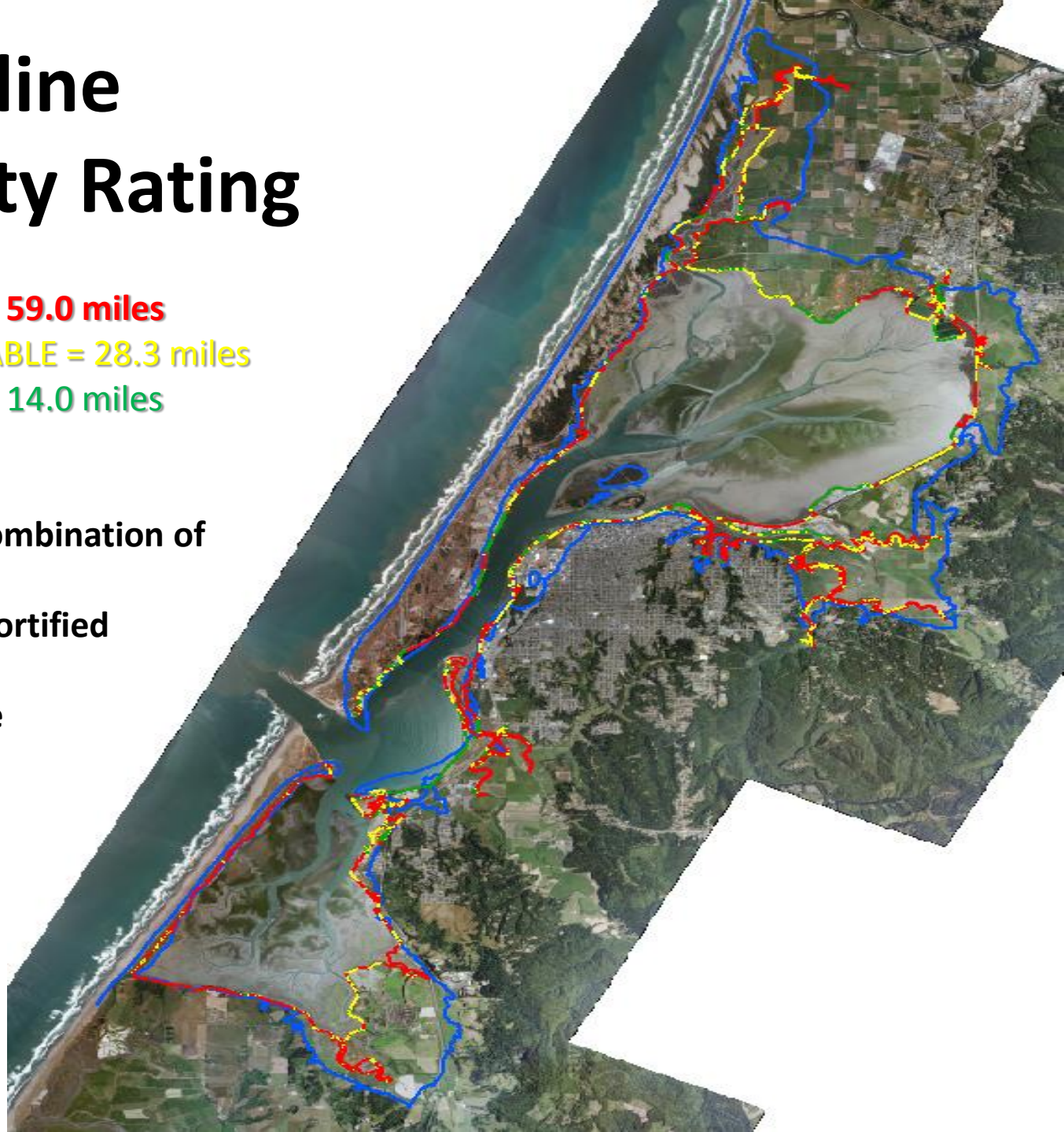
Vulnerability Rating = Combination of

1) Shoreline Cover:

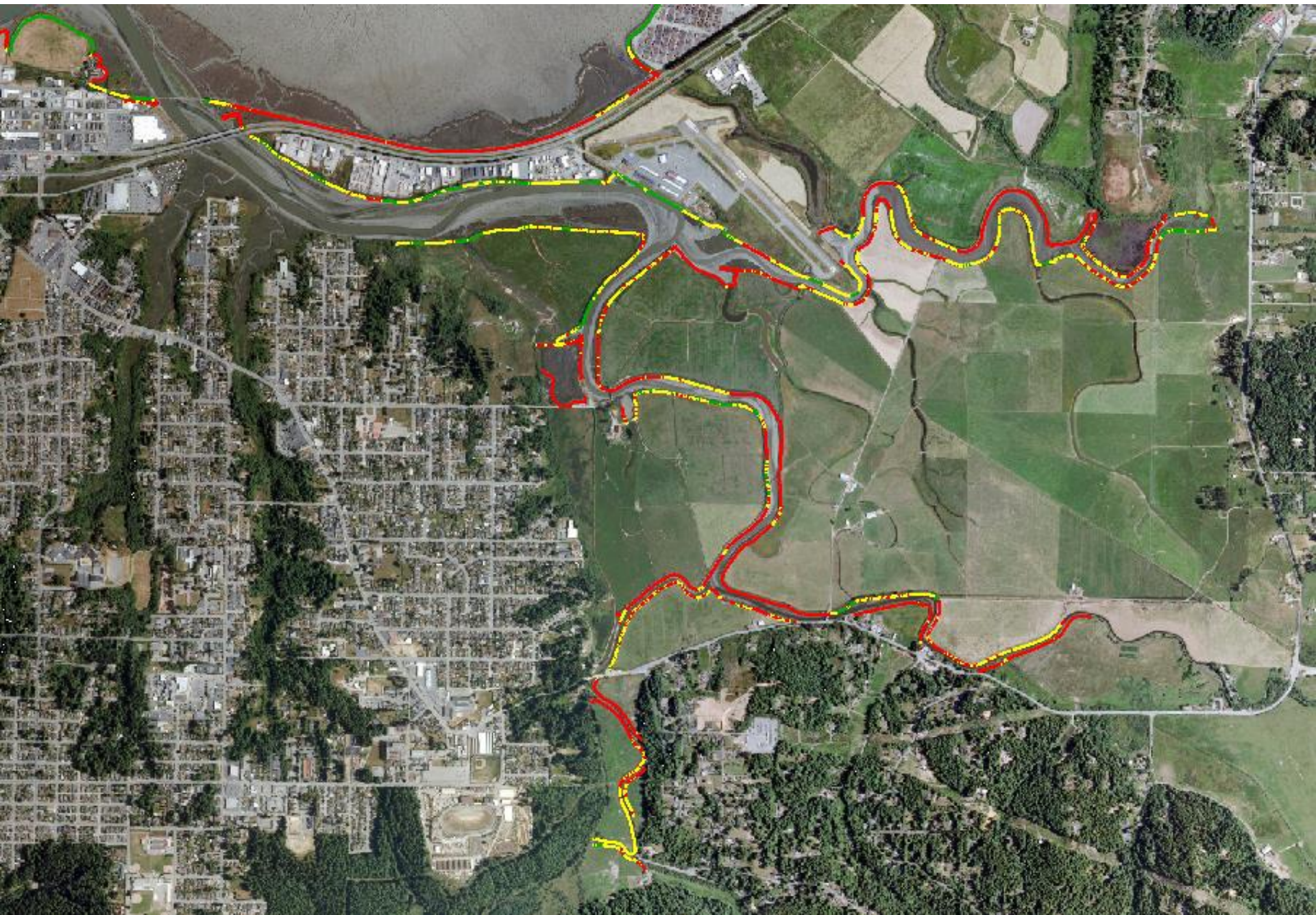
Eroding, Vegetated, Fortified

2) Shoreline Elevation:

in relation to Baseline
MMMh Elevation



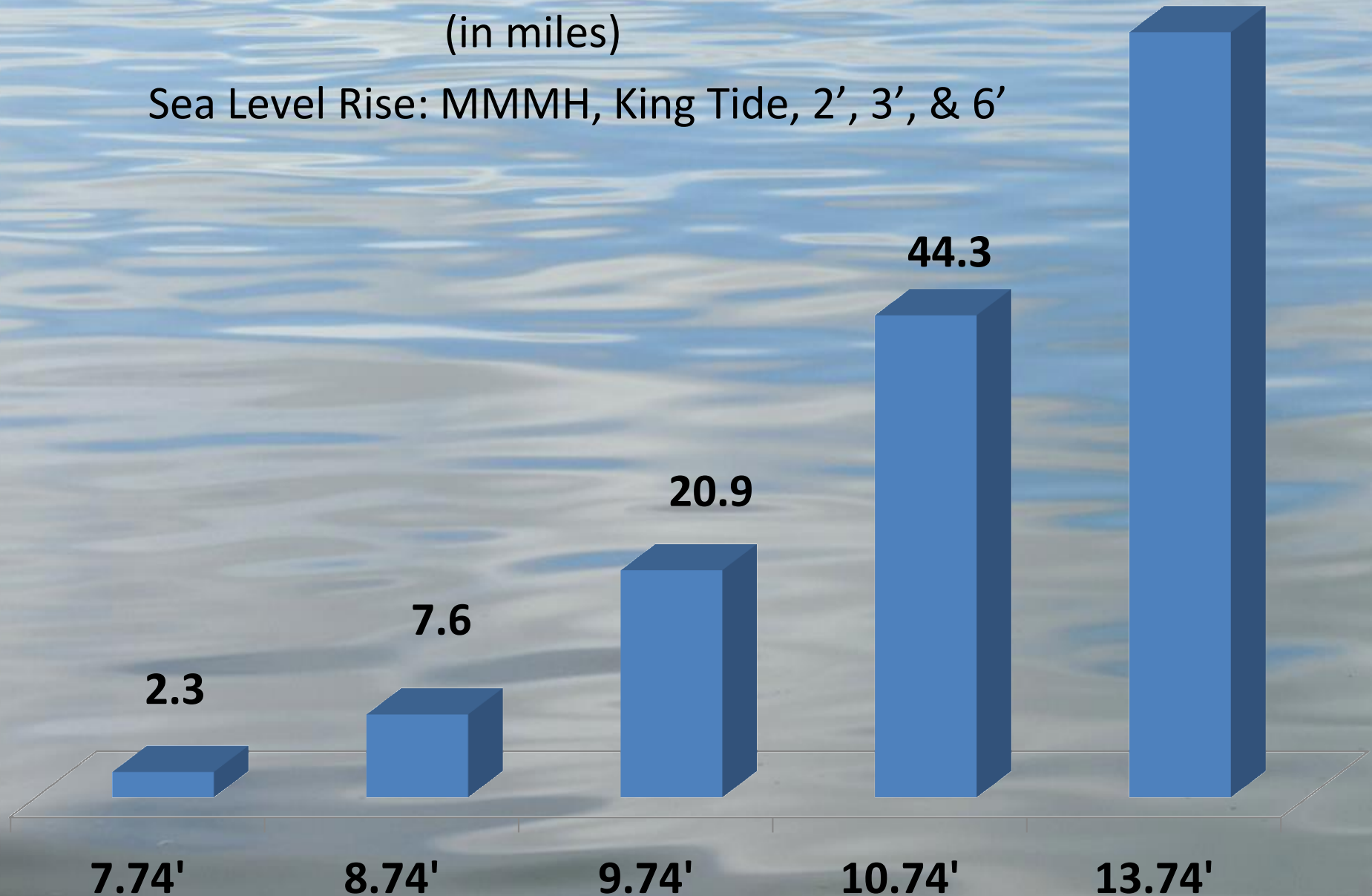
7.2 miles Highly Vulnerable



Artificial Shoreline Overtopping

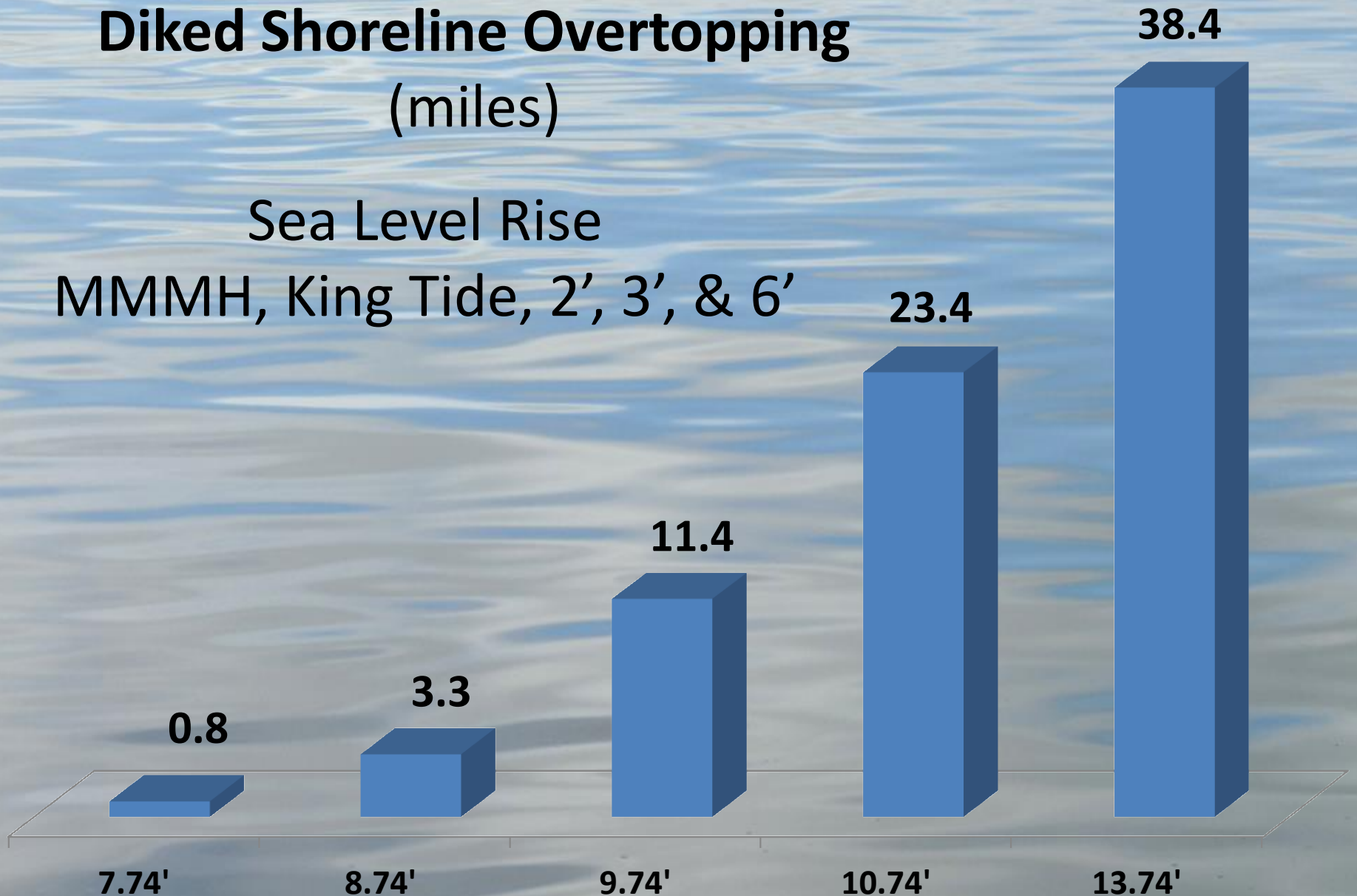
(in miles)

Sea Level Rise: MMMH, King Tide, 2', 3', & 6'



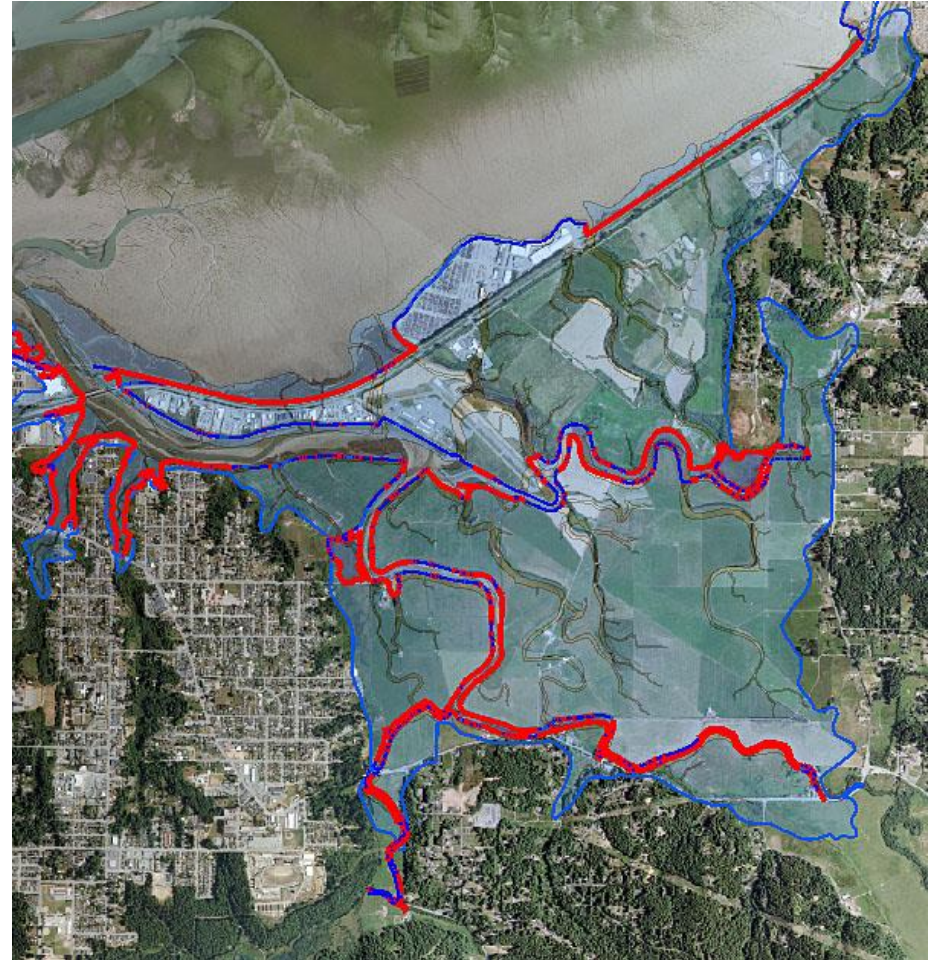
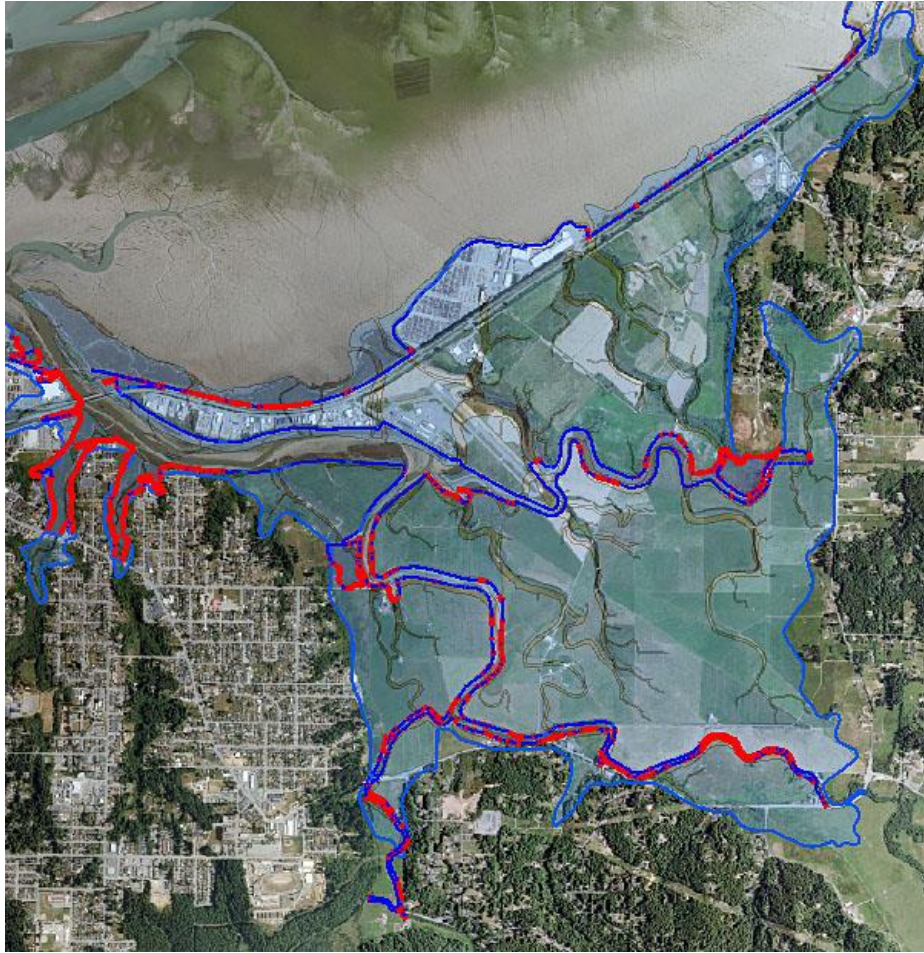
Diked Shoreline Overtopping (miles)

Sea Level Rise
MMMh, King Tide, 2', 3', & 6'



Eureka Slough Diked Shoreline

2.0' SLR/9.74' vs. 3.0' SLR/10.74'



DRAFT



DRAFT



Mad River Slough



Mean Monthly Maximum



100 Year Flood

Arcata Bay



Mean Monthly Maximum



100 Year Flood

Eureka Slough

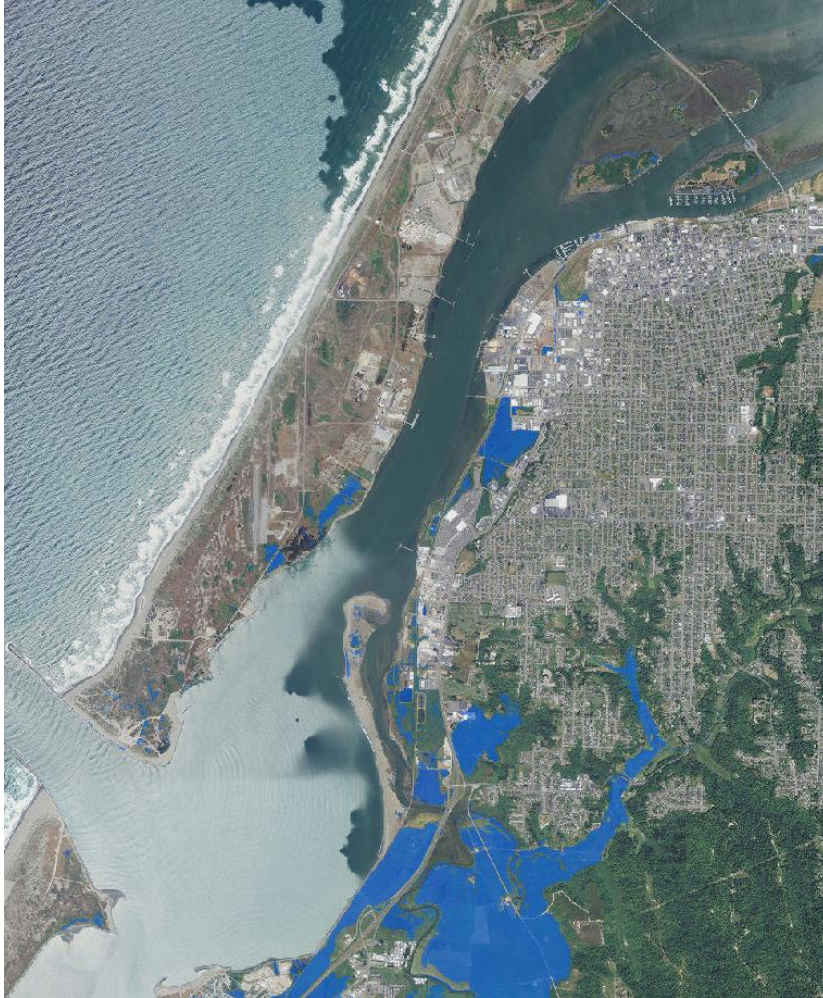


Mean Monthly Maximum



100 Year Flood

Eureka Bay



Mean Monthly Maximum



100 Year Flood

Elk River Slough



Mean Monthly Maximum



100 Year Flood

South Bay



Mean Monthly Maximum



100 Year Flood

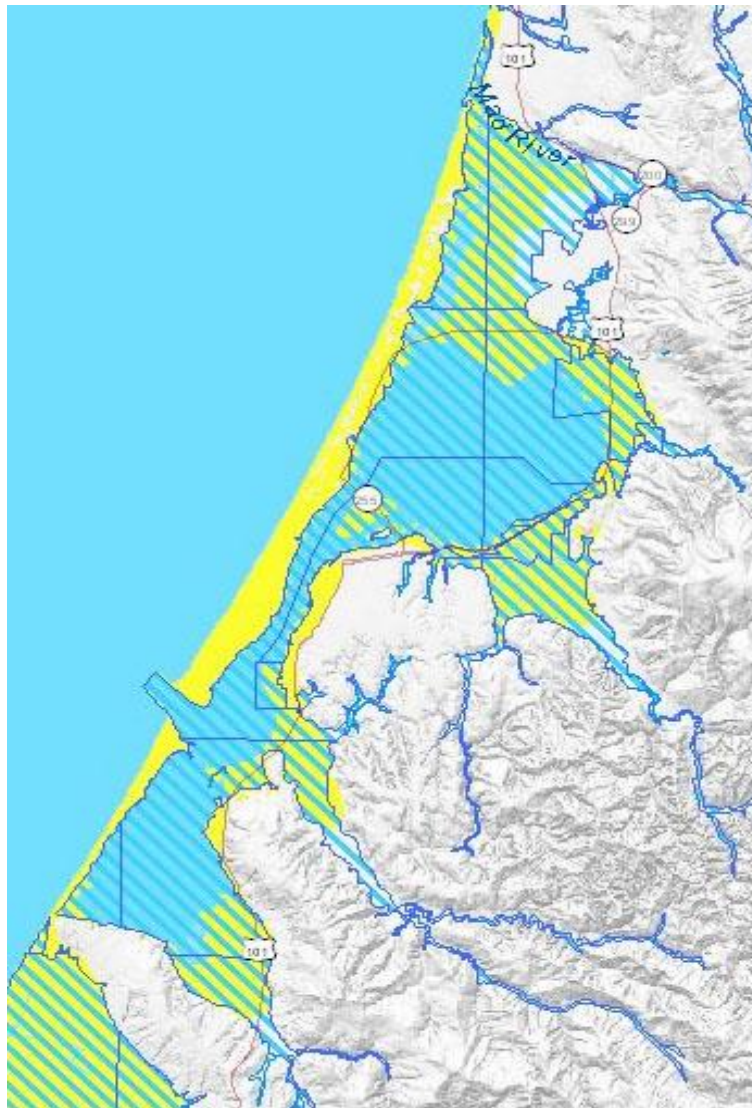
ADAPTATION PLANNING WORKING GROUP

- **State Coastal Conservancy**
- **Coastal Ecosystems Institute of Northern California**
- **Humboldt Bay Harbor, Recreation and Conservation District**
- **Humboldt County**
- **City of Eureka**
- **City of Arcata**
- **California Coastal Commission, North Coast District**
- **Wiyot Tribe**
- **Caltrans**
- **Department of Fish and Wildlife**
- **Humboldt Bay National Wildlife Refuge**
- **Bureau of Land Management**
- **U.S. Fish and Wildlife Service**
- **National Resources Conservation Service**

ADAPTATION PLANNING GOAL

To support informed decision-making and encourage a unified, consistent regional adaptation strategy to address impacts associated with sea level rise in the Humboldt Bay region.

Tsunami and FEMA Flood Zones & 2 Meter Sea Level Rise Inundation Area



SEA LEVEL RISE ADAPTATION PLANNING PROCESS



ASSESS

PLAN

IMPLEMENT

- ❖ **2013 California Coastal Commission Draft Sea-Level Rise Policy Guidance**
- ❖ **2012 California Climate Adaption Guidelines**
- ❖ **2012 Adapting to Sea Level Rise: A Guide for California's Coastal Communities**

MOSAIC OF COASTAL PLANNING AUTHORITIES

- ✓ Coastal Commission:
Retained and Federal
- ✓ Humboldt County
- ✓ City of Eureka
- ✓ City of Arcata
- ✓ Harbor District



VULNERABILITY & RISK ASSESSMENTS



PRIMARY IMPACT: SEA LEVEL RISE

SECONDARY IMPACTS:

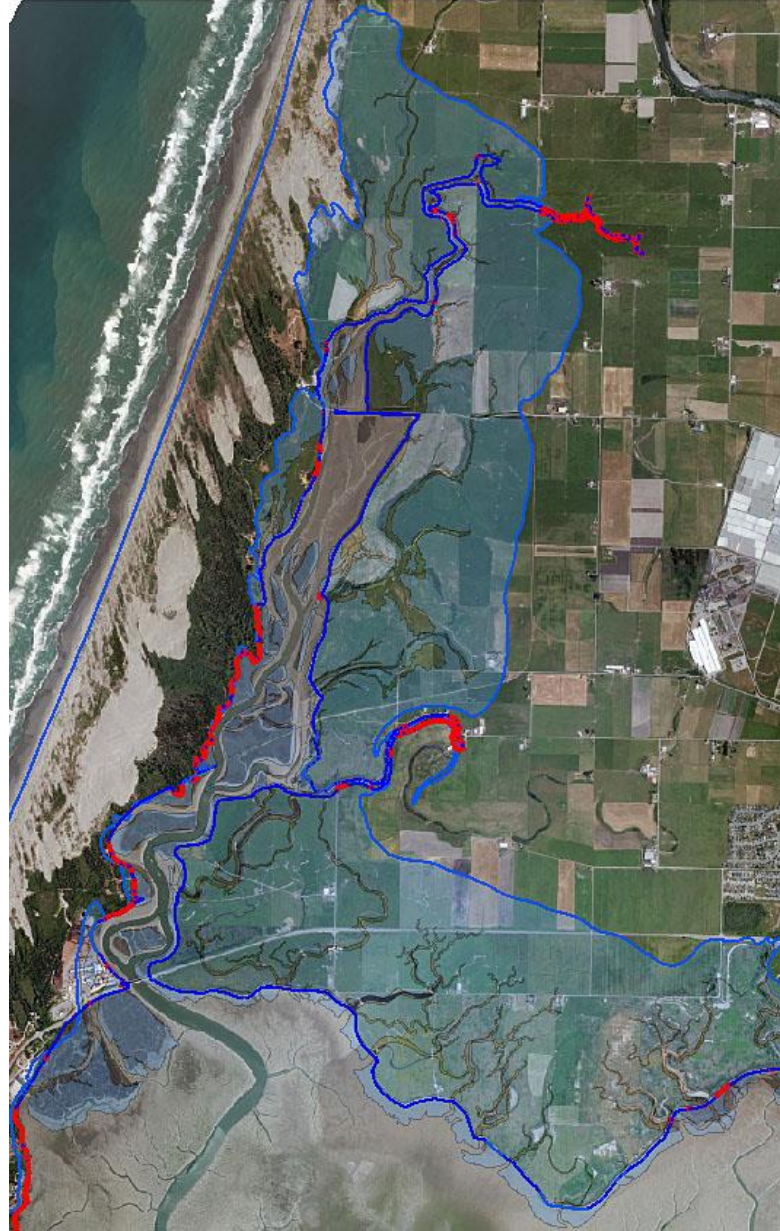
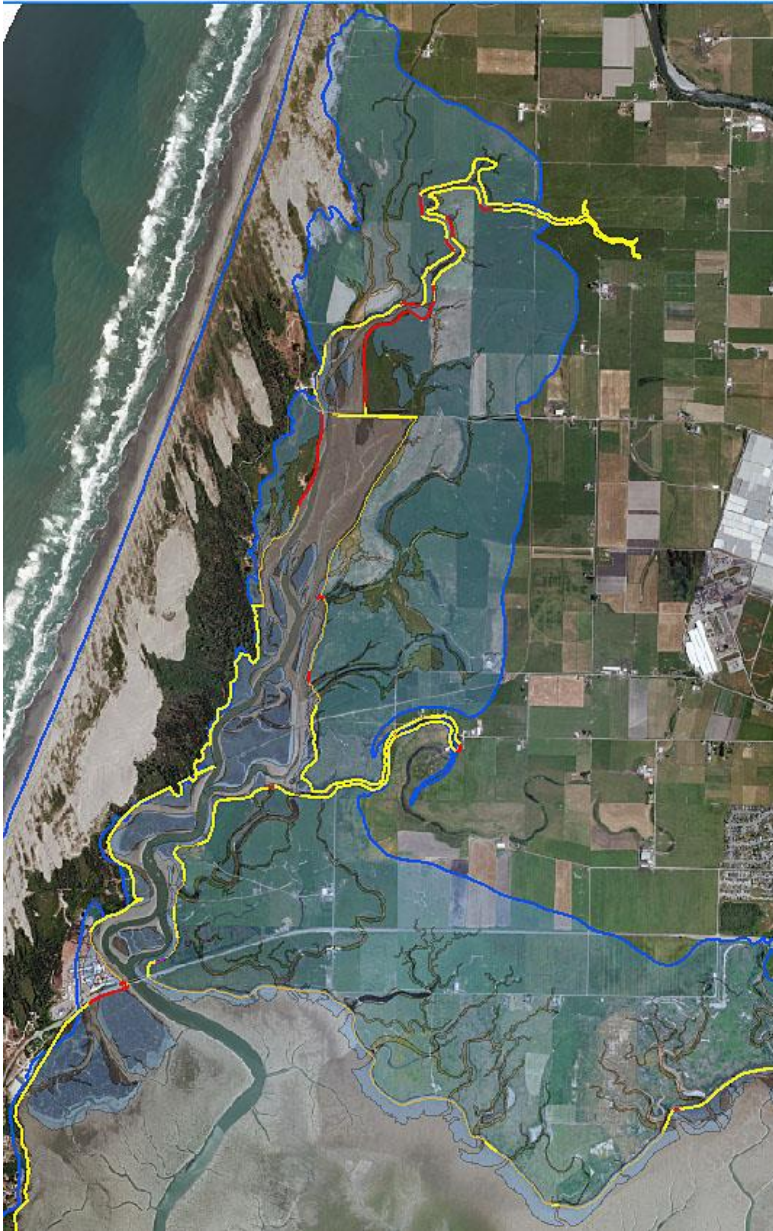
A. Flooding

- **Shoreline Erosion-Breaching**
- **Shoreline Overtopping**
- **Rising Groundwater**

B. Salt Water Intrusion

A HISTORICAL LEGACY

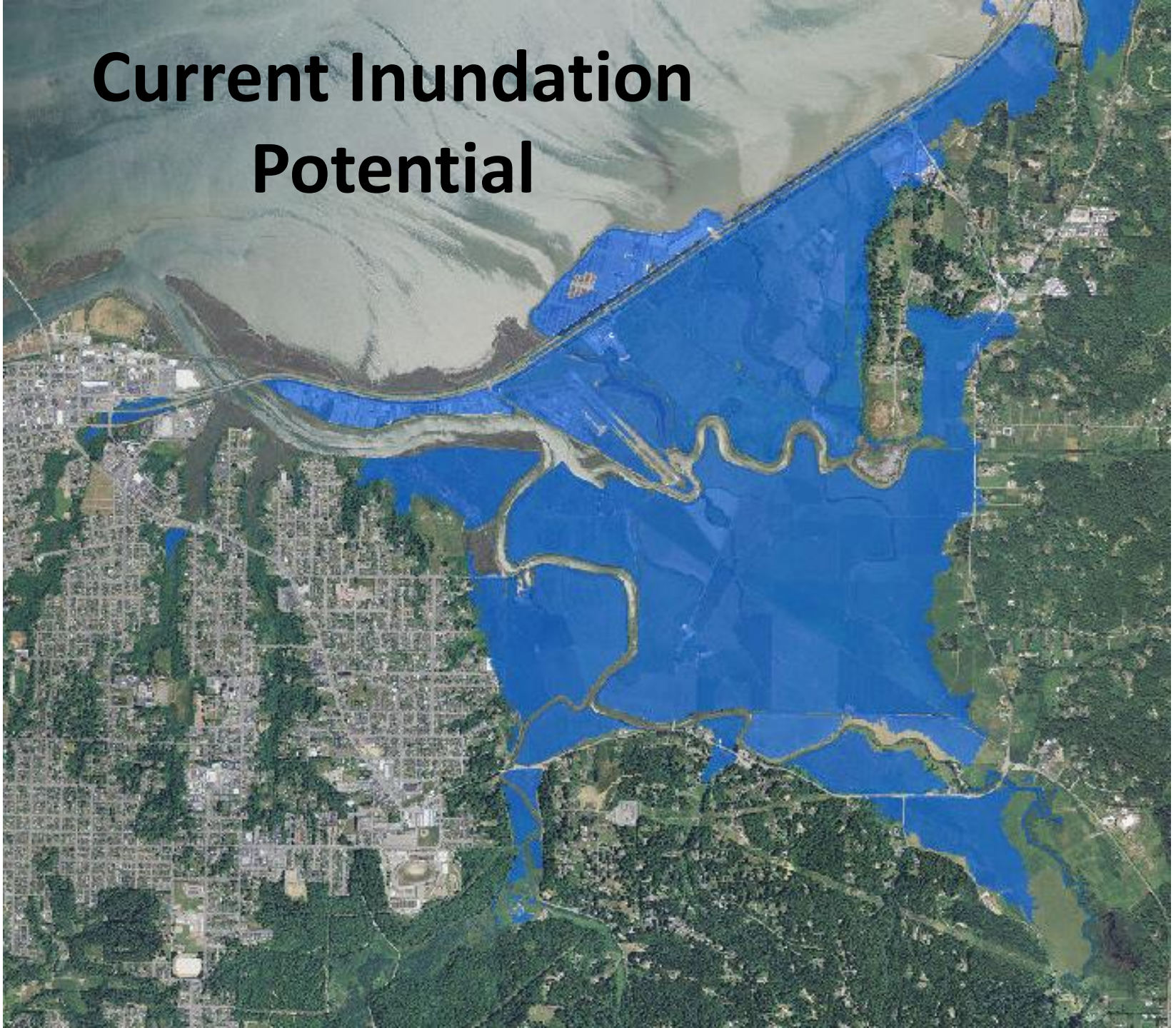
Dike Cover & Elevation



RISING SEA LEVELS & RISING GROUNDWATER



Current Inundation Potential



CRITICAL ASSETS AT RISK

Case Studies

A. Communities:

- ✓ **King Salmon**

B. Facilities & Services:

1. **Water and Wastewater**
 - ✓ **City of Eureka Wastewater**
 - ✓ **City of Arcata Wastewater & Marshes**
2. **Energy**
3. **Transportation**
 - ✓ **Highway 101 & Railroad Corridor**
4. **Communications**

KING SALMON



Arcata Wastewater Treatment



HIGHWAY 101 TRANSPORTATION CORRIDOR



OTHER ASSETS CATEGORIES

- **Structures**
- **Land Uses**
- **Private Property**
- **Historical/Cultural/
Archeological Resources**
- **Hazardous Material Sites**
- **Contaminated Lands**
- **Natural Areas and Natural Resources**

ADAPTIVE CAPACITY

```
graph TD; A[ADAPTIVE CAPACITY] --- B[Structure and Infrastructure Projects]; A --- C[Natural Systems Protections]; A --- D[Land Use Policies and Regulations]; A --- E[Public Education and Awareness]; A --- F[Financial Abilities];
```

Structure and
Infrastructure Projects

Natural Systems
Protections

Land Use
Policies and Regulations

Public Education and
Awareness

Financial Abilities

DEVELOP & IMPLEMENT ADAPTATION STRATEGIES



BASIC ADAPTATION PLANNING STRATEGY

We cannot manage or protect the shoreline parcel by parcel or jurisdiction by jurisdiction, we need to address entire hydrologic units and the entirety of Humboldt Bay.



Do we Invest in shoreline fortifications?



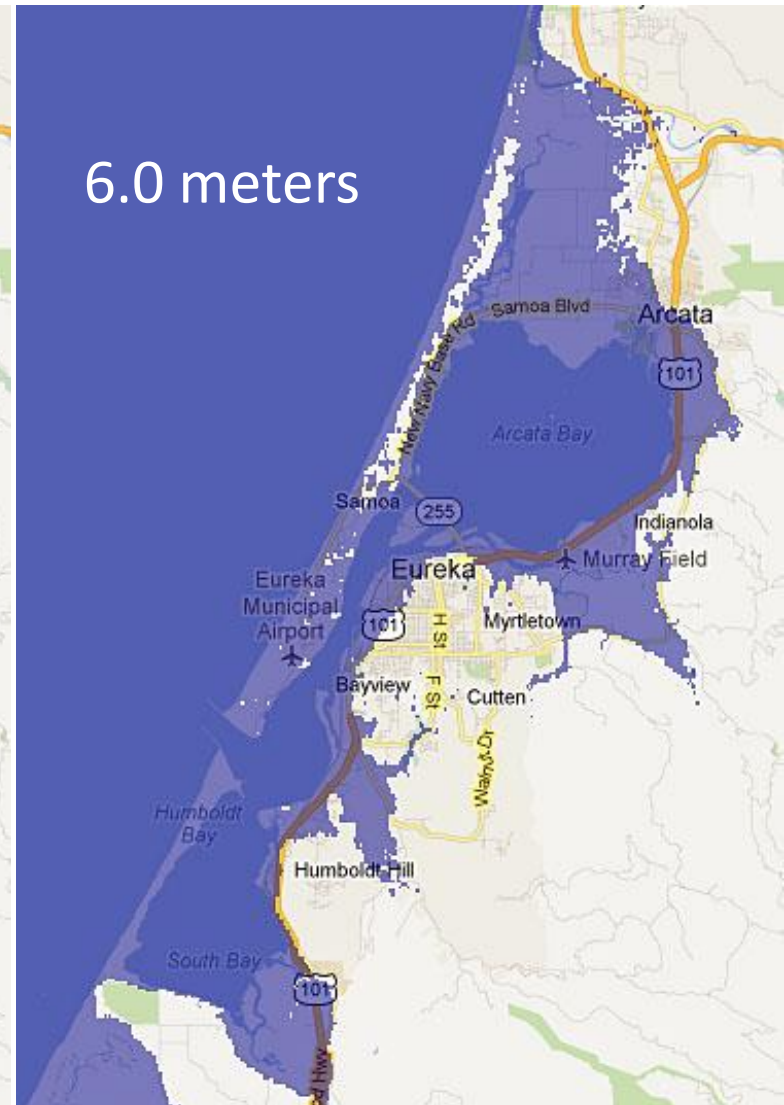
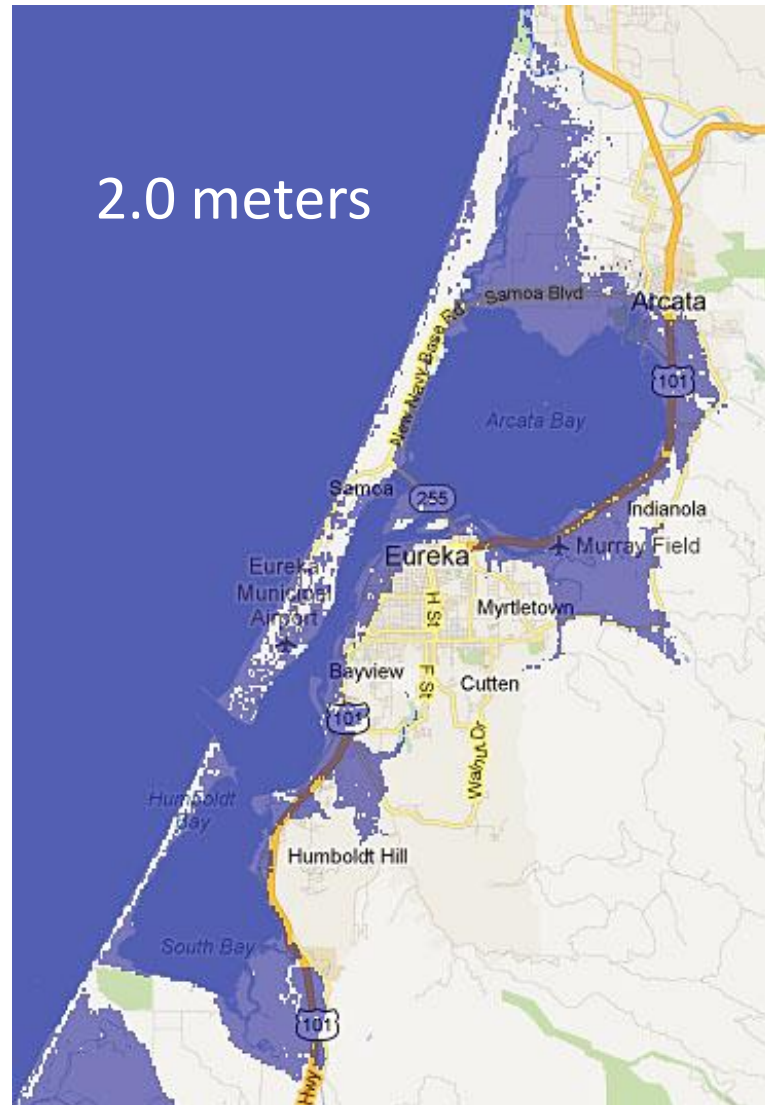
CITY OF ARCATA

Wastewater Facility Dike Rehabilitation

\$900,000.00/mile



Long-Term Sea Level Rise Inundation Zone





Humboldt Bay

Harbor, Recreation & Conservation District

Home

Divisions

Commission

I Want To

Contact



Quick Links

[Humboldt Bay Sea
Level Rise Adaptation
Planning](#)

Discover Humboldt Bay

Latest News

[Draft Restriction Letter - June
6th, 2013 \(.3 MB\)](#)

[Harbor District Looks to Samoa](#)

The Humboldt Bay
Harbor, Recreation and Conservation District Presents:

HUMBOLDT BAY SYMPOSIUM 2012



April 26-27, 2012
Wharfinger Building
Eureka Public Marina
1 Marina Way, Eureka, California

The Humboldt Bay Symposium was established to provide information to the public on a variety of topics related to Humboldt Bay including current scientific research, wetland restoration, maritime commerce developments, marine recreation activities and other current bay-related events.

If you are interested in anything Humboldt Bay, this is the Symposium for you!

Registration is \$15.00/day, lunch included.

Pre-registration deadline is April 20, 2012.

Space is limited - register early!

For more information contact the Humboldt Bay Harbor, Recreation and Conservation District
www.humboldt-bay.org 707 443 0801 dberman@portofhumboldt-bay.org

2015

Local Coastal Plan Updates and Related Planning Documents Sea Level Rise Policy

- Humboldt County LCP Update
- City of Eureka LCP Update
- City of Arcata LCP Update
- HBHRCD Humboldt Bay Management Plan Update

THANK-YOU

