HUMBOLDT BAY

SEA LEVEL RISE
ADAPTATION PLANNING PROJECT

Adaption Planning Working Group

Meeting

April 30, 2014

- Coastal Ecosystems Institute of Northern California
- Humboldt Bay Harbor, Recreation, and Conservation District
- Humboldt County Public Works Department
- Northern Hydrology and Engineering
- Trinity Associates

AGENDA

1. Introductions/Announcements: [15]

2. Remaining APWG meetings: [15]

3. General Adaptation Strategies: [30]

4. Agricultural Lands Adaptation Strategies/Measures: [60]

Introductions and Stakeholder Updates/Announcements

Humboldt Bay

Harbor, Recreation & Conservation District

Home | Divisions | Commission | I Want To | Contact

Humboldt Bay Sea Level Rise Adaptation Planning Project

April 2014 Inundation Maps: Zip file download

Contents

http://humboldtbay.org/humboldt-bay-sea-level-rise-adaptation-planning-project#overlay-context=humboldt-bay-sea-level-rise-adaptation-planning-project

APWG Meetings, Discussion Themes, White Papers
&
Adaptation Plan

An adaptation plan will be prepared that identifies generalized strategies for the region in response to sea level rise and provide sites specific examples of these strategies.

April 30th 2014

- *Review and discuss estimated local or relative sea level rise projections*
- *Review regional assets at risk under existing conditions and 100 year event*
- *Review and discuss general adaptation strategies*
- *Discuss specific assets at risk, adaptation strategies, and measures for agricultural lands and uses*

June 25th 2014

- *Review and discuss regional assets at risk with 0.5 meter of sea level rise and 100 year event*
- *Review and discuss near (2030) and mid-term (2050) adaptation strategies and measures*
- *Discuss regional integration of Local Coastal Program updates to address sea level rise by Humboldt County, City of Eureka and City of Arcata*

August 27th 2014

- *If continued from last meeting discuss regional integration of Local Coastal Program updates to address sea level rise by Humboldt County, City of Eureka and City of Arcata*
- *Discuss vulnerability and adaptation strategies and measures for regional transportation systems*

October 29th 2014

- *Review draft Humboldt Bay Sea Level Rise Adaptation Plan*
- *Review and discuss regional assets at risk with 1.0 and 2.0 meters of sea level rise and 100 year events*
- *Discuss long-term (2070-2100) adaptation strategies*
- *Discuss organization of the Humboldt Bay Sea Level Rise Adaptation Symposium*
- *Discuss continuation of the Adaptation Planning Working Group*

November 17th 2014

- *Hold Humboldt Bay Sea Level Rise Adaptation Planning Project's 2nd Public Meeting*

January 7th 2015

- *Review final Humboldt Bay Sea Level Rise Adaptation Plan*
- *Review final Humboldt Bay Sea Level Rise Vulnerability Assessment report*
- *Discuss organization of the Humboldt Bay Sea Level Rise Adaptation Symposium*
- *Discuss continuation of the Adaptation Planning Working Group*

Regional Adaptation Strategies for Sea Level Rise on Humboldt Bay

Humboldt Bay Sea Level Rise Adaptation Planning Project

The goal of the project is to support informed decision-making and encourage a unified, consistent regional adaptation strategies to address the hazards associated with sea level rise in the Humboldt Bay region.

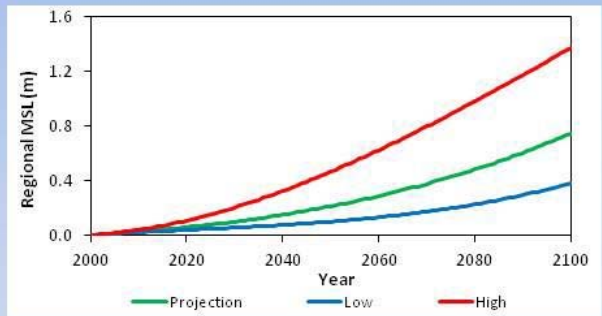
Estimated Rates of Local or Relative Sea Level Rise
Jeff Anderson-Northern Hydrology & Engineers

Sea-Level Rise Projections for Humboldt Bay Region

Sea-Level Rise Projections Based on National Research Council (2012) Study

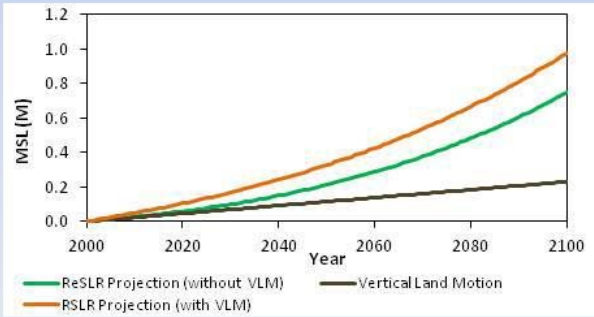
Regional mean sea-level rise (ReSLR) projections for different scenarios in Humboldt Bay Region without vertical land motion effect

	ReSLR Projections Relative to Year 2000 (cm (in))		
Year	Low	Projection	High
2030	3.9 (1.5)	9.9 (3.9)	21.3 (8.4)
2050	10.9 (4.3)	21.4 (8.4)	46.2 (18.2)
2100	38.6 (15.2)	75.1 (29.6)	137.9 (54.3)



Relative mean sea level rise (RSLR) projections for different scenarios in Humboldt Bay with vertical land motion effect (VLM at North Spit gage = -2.30 mm yr^{-1} downward)

	RSLR Projections Relative to Year 2000 (cm (in))		
Year	Low	Projection	High
2030	12.5 (4.9)	16.8 (6.6)	27.3 (10.7)
2050	21.4 (8.4)	32.8 (12.9)	58.1 (22.9)
2100	61.2 (24.1)	97.7 (38.5)	160.4 (63.2)



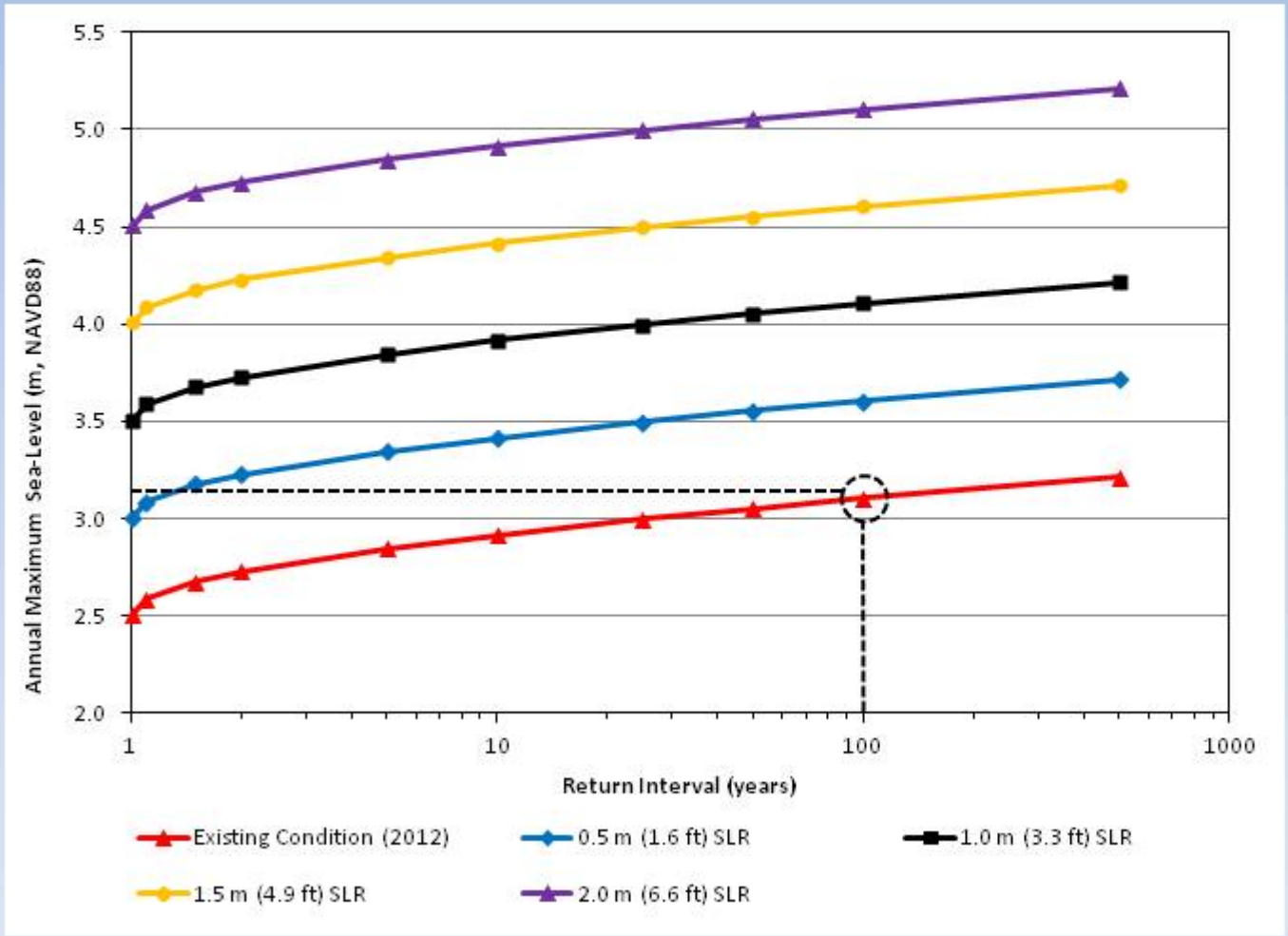
Vulnerability/Risk Time Frame

Near-term => 2030 ~ 0.5’
Mid-term => 2050-2075 ~ 1.0-2.0’
Long-term => 2100 ~ 3.0’

As low-lying areas are permanently inundated by daily tides, most existing land uses and infrastructure will become inoperable.

Humboldt Bay North Spit Sea-Levels

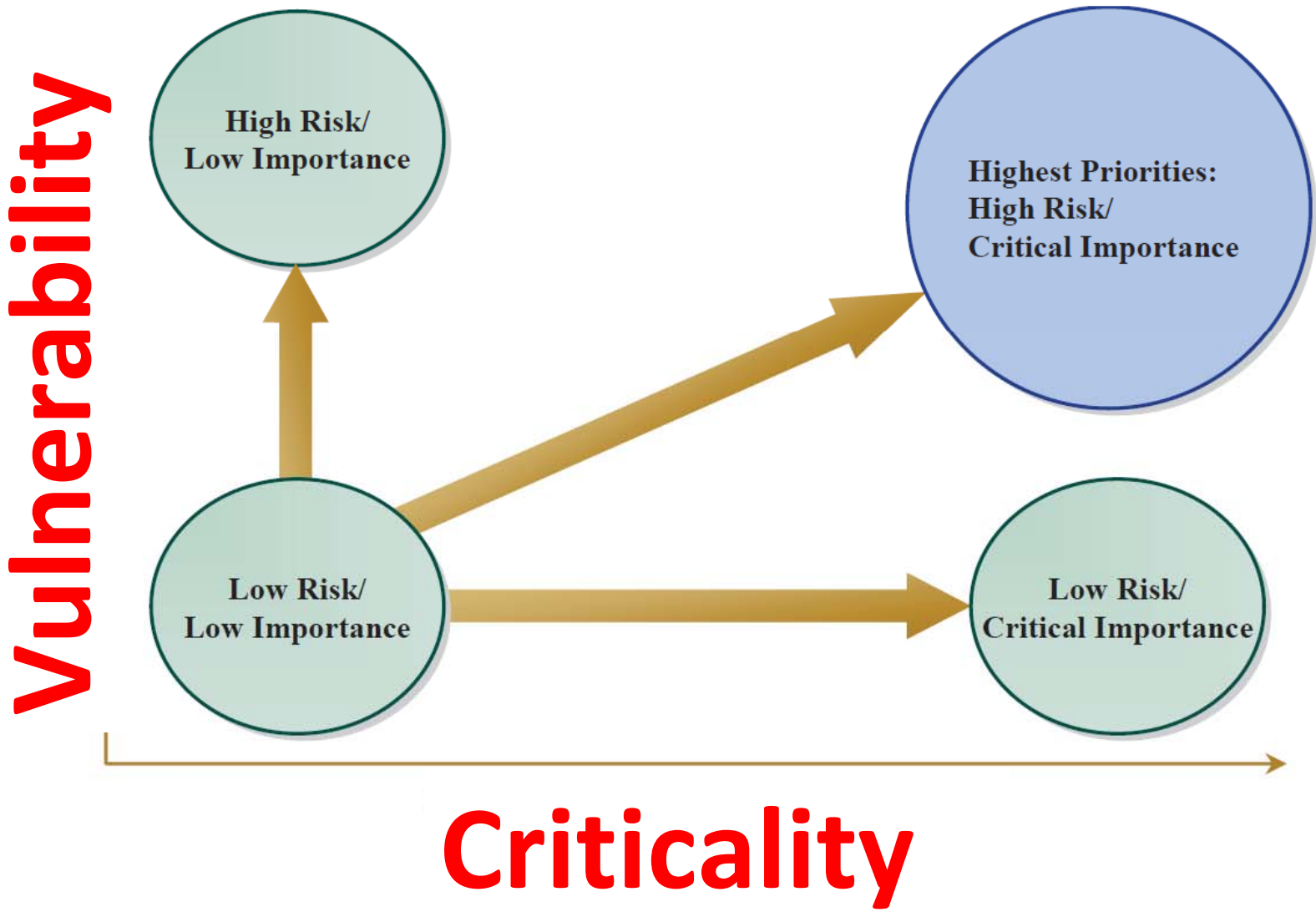
Extreme Sea-Levels with Sea-Level Rise



Why should we be concerned with Sea-Level Rise

- Immediate concerns are related to coastal flooding
- Sea-level rise gradually increases extreme water levels (not static like 100-yr riverine flood levels)
- For example, the 100-yr extreme sea-level becomes the 1-yr level with 0.5 m SLR
- To put this into perspective, since 1912 the North Spit Tide Gauge has seen about 0.47 m of SLR
- So what was a 100-yr extreme sea-level in 1912 is today the 1-yr level or about the mean monthly high tide

Figure 5.6 Degree of risk and importance of system or facility performance inform the level of adaptation investment.



Sea Level Rise:
Existing Conditions + 100 year event

Criticality Rating High

Vulnerability-Value Rating: High/High

<u>Utilities</u>: HBMWD Water Lines, Eureka Water Lines, PG&E Gas Lines, and PG&E Electric Transmission Towers

Vulnerability-Value Rating: Moderate/High

<u>Transportation</u>: Highway 101 (AB/SB)

Vulnerability-Value Rating: Low/High

<u>Utilities</u>: Arcata WWTF, and Fuel Depot

<u>Transportation</u>: Highway 255, Old Arcata Rd., and Navy Base Rd.,

<u>Cultural Resource</u>: Wiyot's Tuluwat Village World Renewal Ceremonial Site

GENERAL ADAPTATION STRATEGIES: Education, Protection, Relocation, and Regulation

EDUCATION

Education is the first adaptation strategy to employ:

- **We need to convey what areas on Humboldt Bay are vulnerable under existing tidal conditions and extreme events, as well as with sea level rise.**

- **It is important to identify what properties, infrastructures, or services are at risk as soon as appropriate vulnerability data and maps are available.**

- **Need to rate asset criticality to prioritize adaptation strategies and measures**

PROTECTION

- **Near-term: 2014-2030 = 7 inches RSLR Estimation Plus 100 year Event**
- **Short-term: 2030-2050 = 13 inches RSLR Estimation Plus 100 year Event**
- **Mid-term: 2050-2075 = 24 inches RSLR Estimation Plus 100 year Event**
- **Long-term: 2075-2100 = 39 inches RSLR Estimation Plus 100 year Event**

Engineered versus Nature-based Solutions

Inter Connectivity of Assets

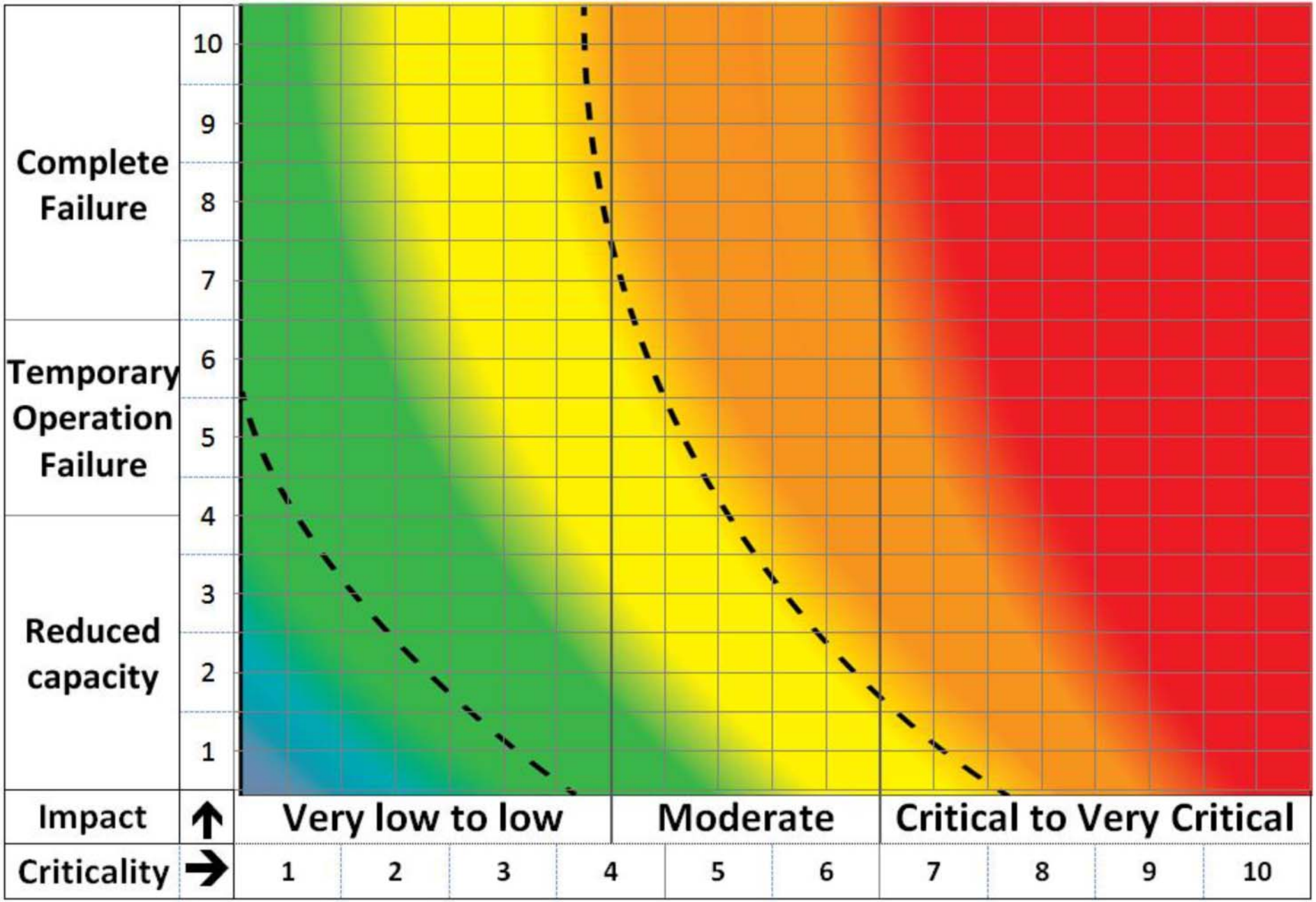


Exhibit 2-6 Impact – Asset Criticality Matrix or "Heat Sheet"

RELOCATION: When/How to Finance

- **Critical Infrastructure: Utilities, Transportation, Fuel, Communications, and Dikes/Levees**
- **Land Uses: Urban-Residential, Commercial, Industrial, and Public Facilities; Rural-Agriculture, Utilities and Transportation**
- **Property: Public and Private**
- **Resources: Cultural, Historical, Natural and Coastal**

REGULATION

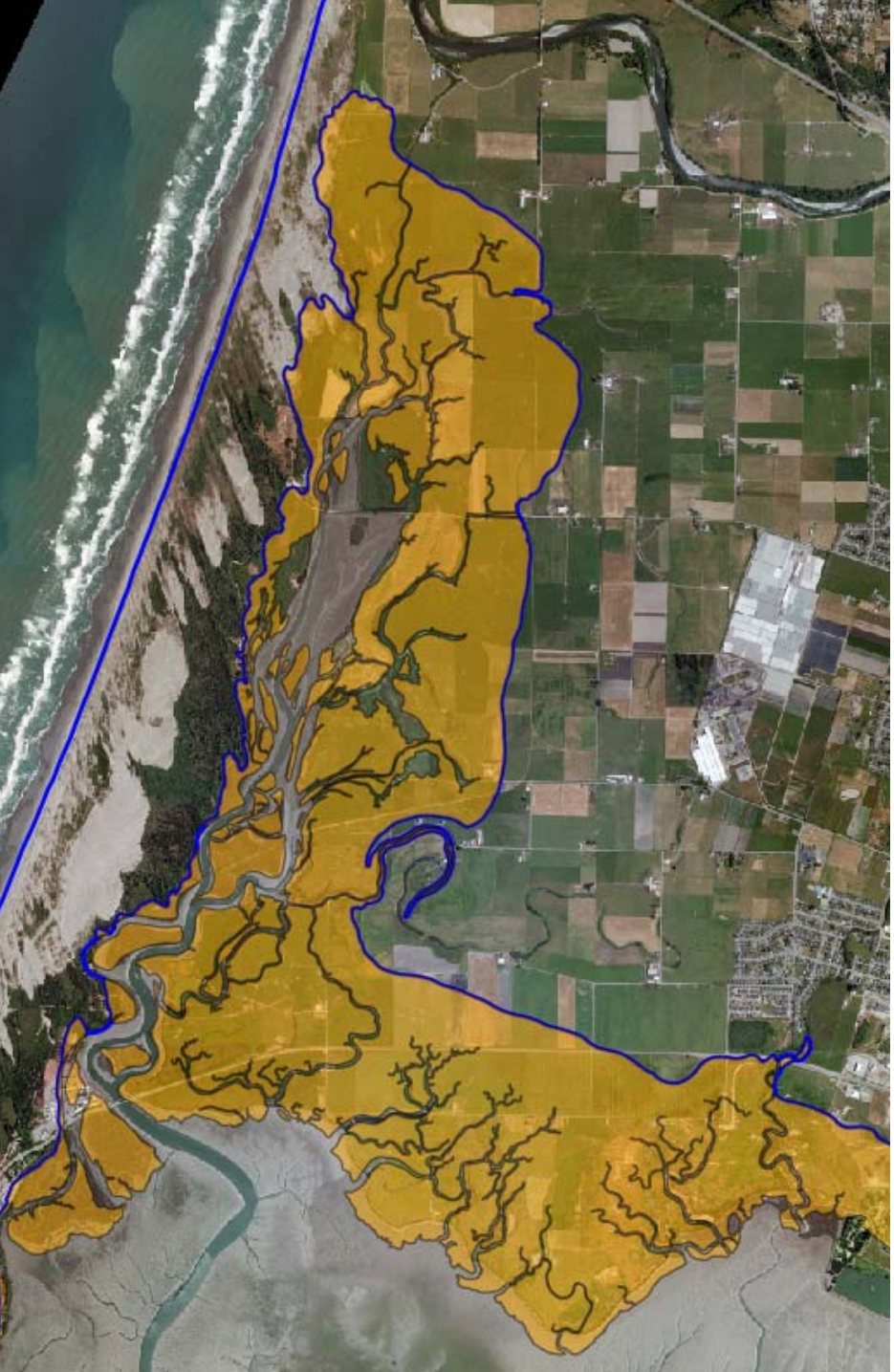
- **Establish Appropriate Planning Time Horizons.**

- **Critical Infrastructure Capitol Improvement Programs: Utilities, Transportation, Fuel, Communications, and Dikes/Levees**

- **Land Uses:**
  Urban-Residential, Commercial, Industrial, and Public Facilities;
  Rural-Agriculture, Natural Resources, Recreation, and Cultural Resources

On Humboldt Bay
the Most Vulnerable Areas
to Sea Level Rise
are the Diked Former Tide Lands and
Lands that have Subsided

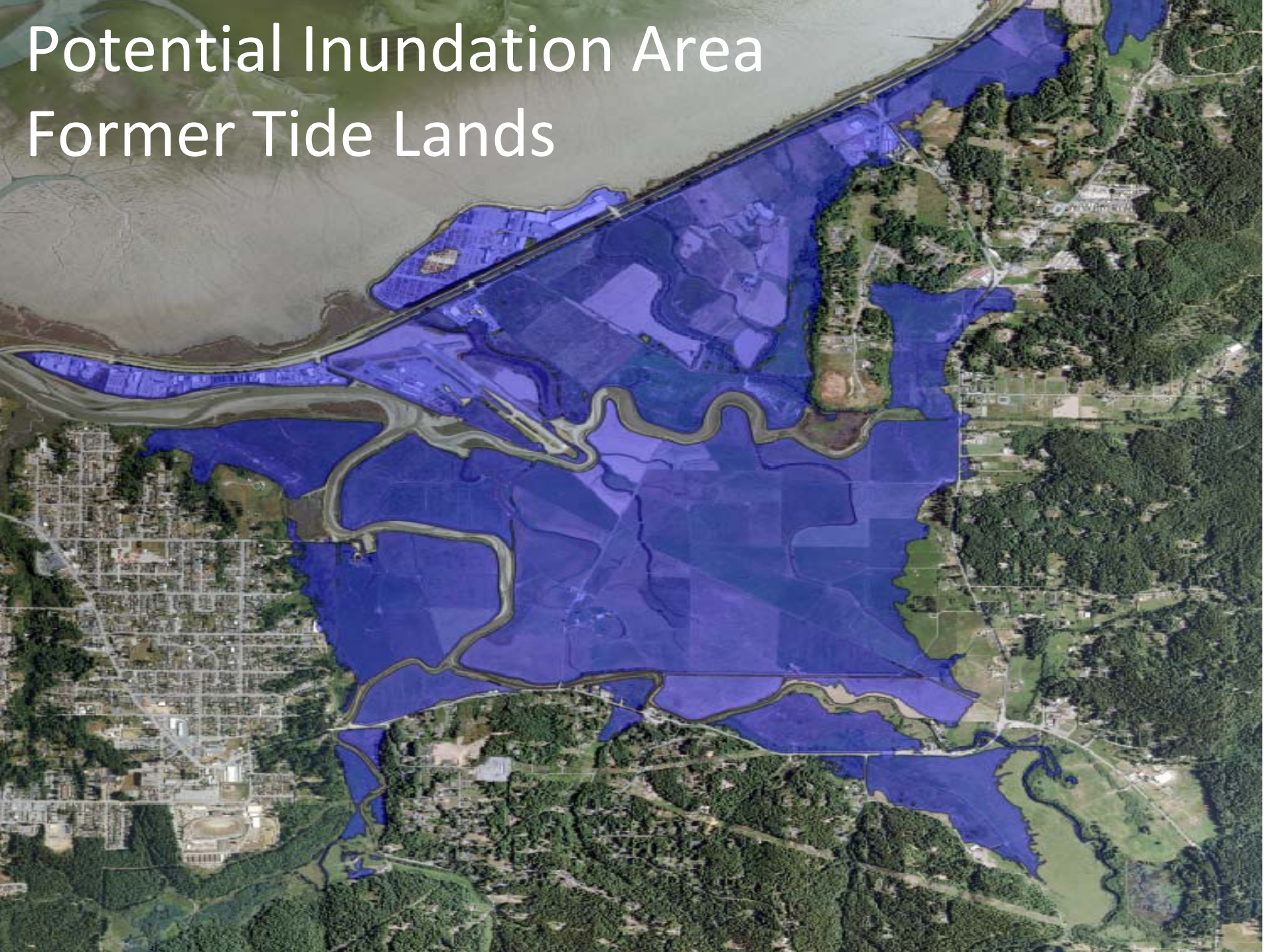
Can agricultural lands and uses on Humboldt Bay adapt to SLR?



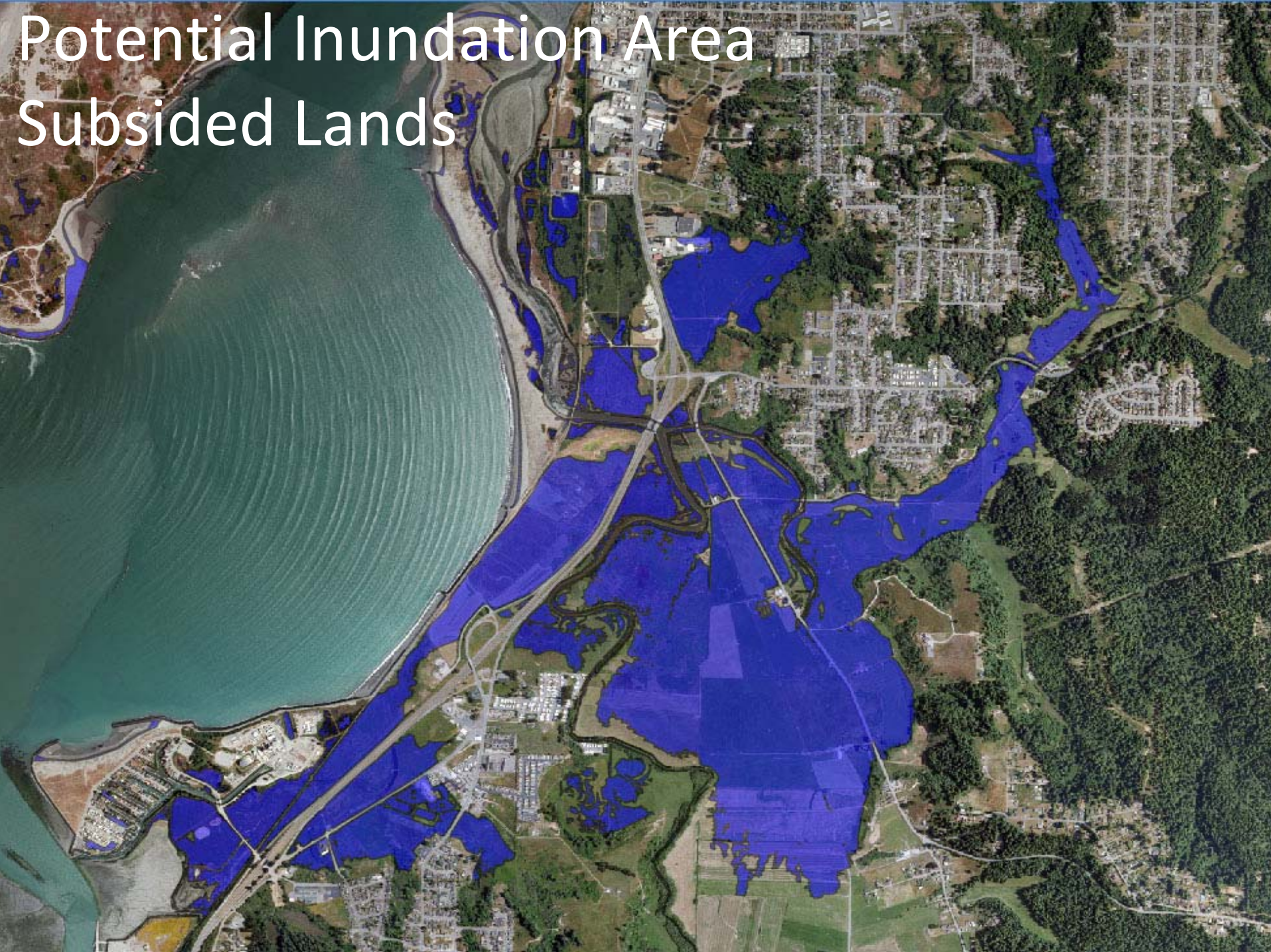
Agricultural Land Types:

- Former Tidelands
- Subsided Lands
- Alluvial Bottom

Potential Inundation Area
Former Tide Lands



Potential Inundation Area
Subsided Lands



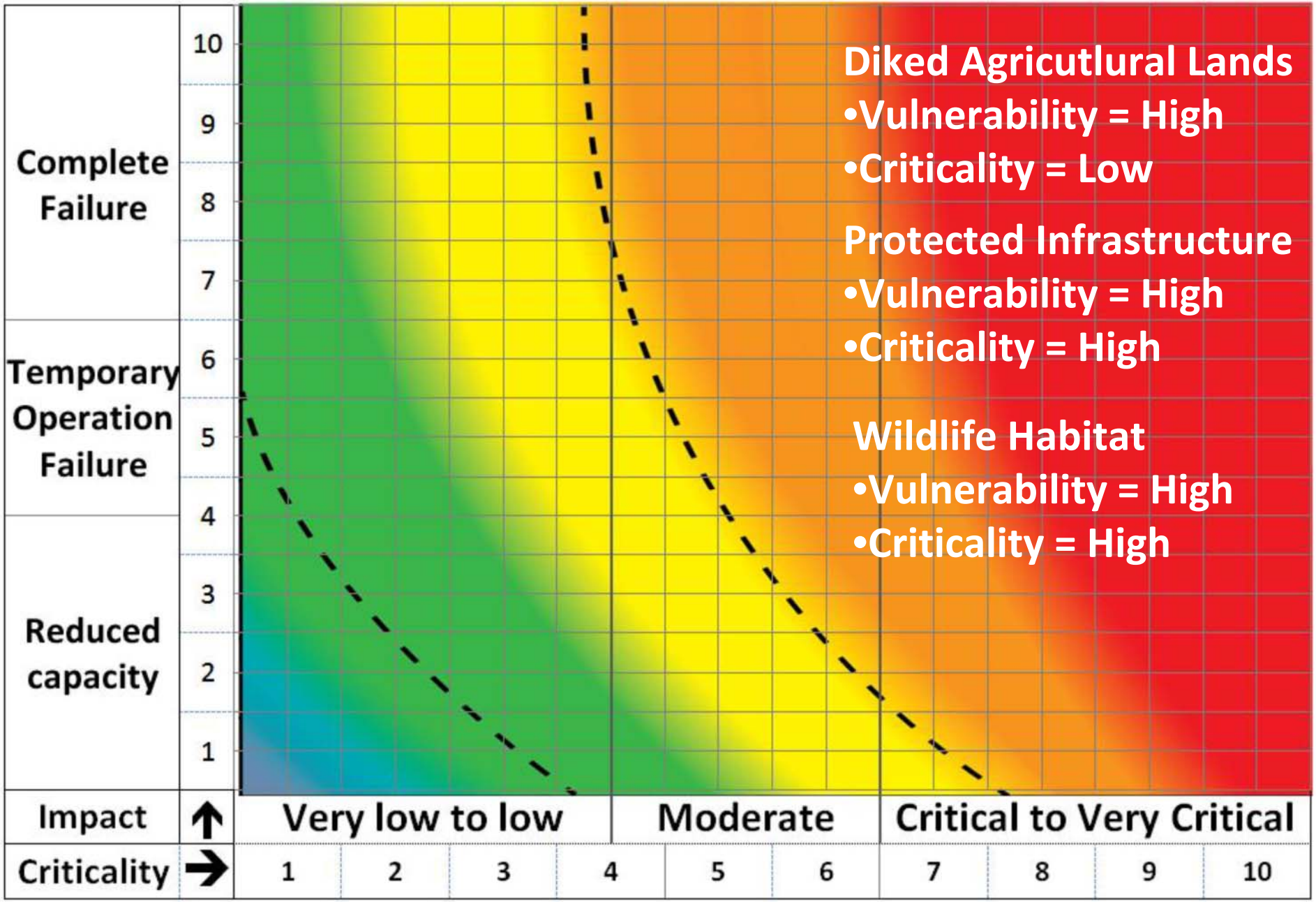
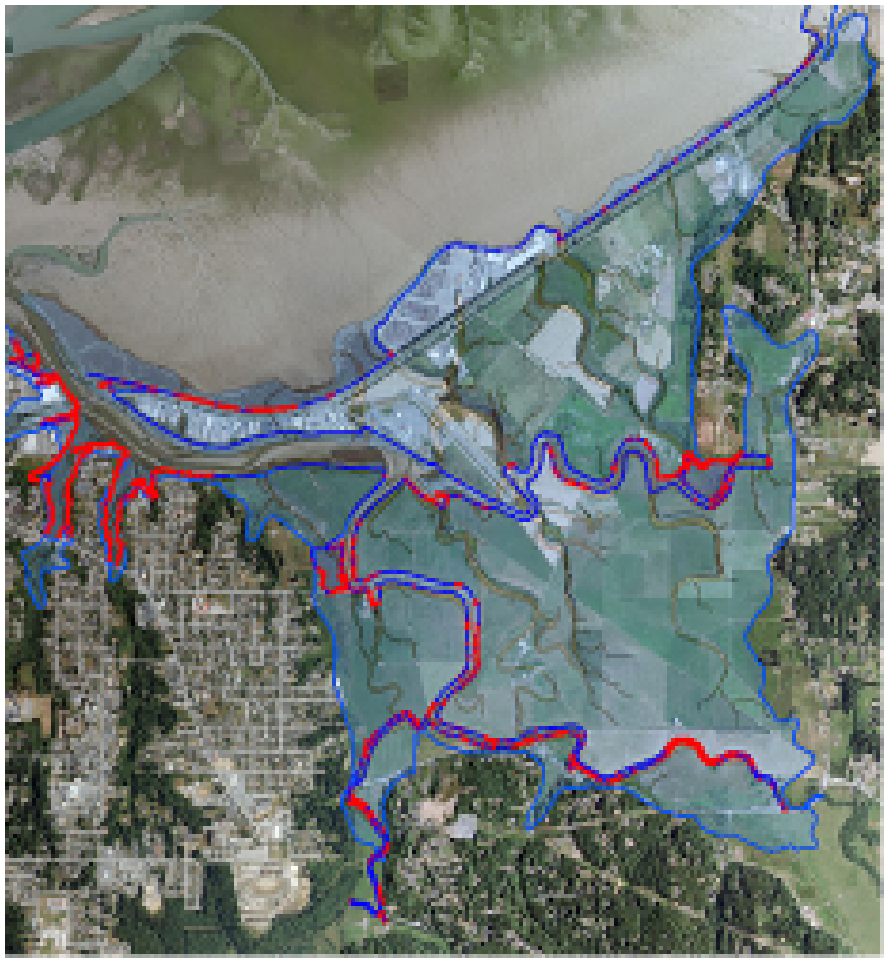
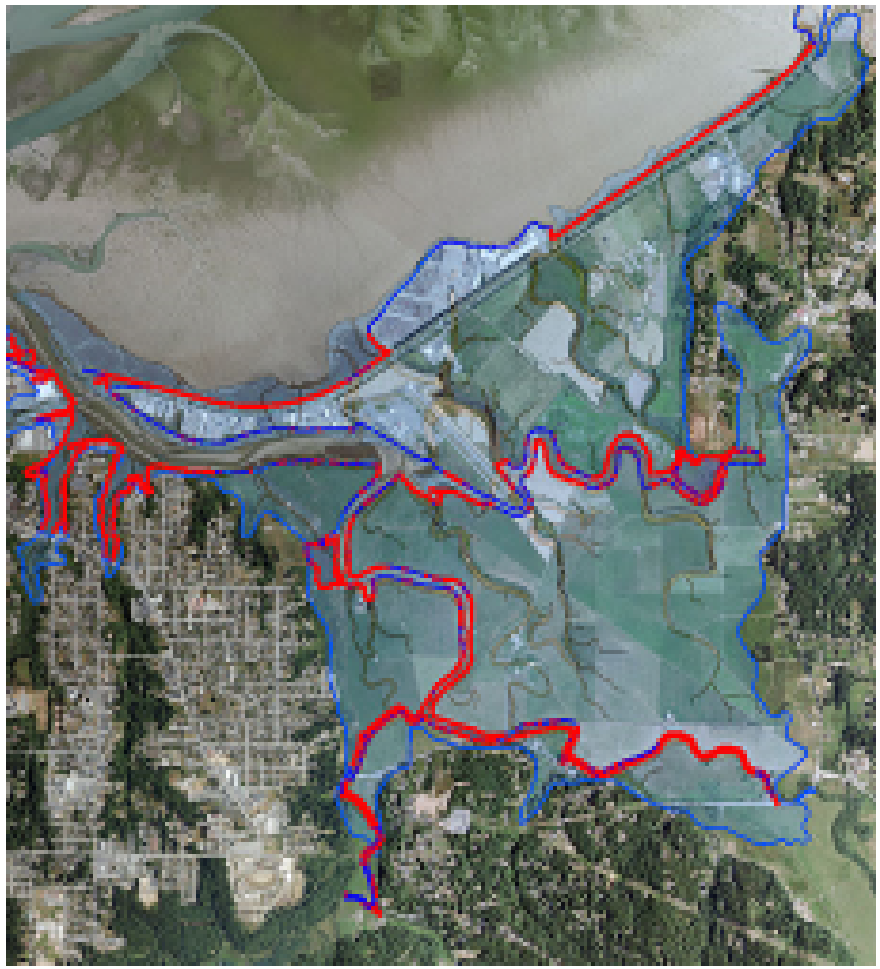


Exhibit 2-6 Impact – Asset Criticality Matrix or "Heat Sheet"

Eureka Slough Diked Shoreline

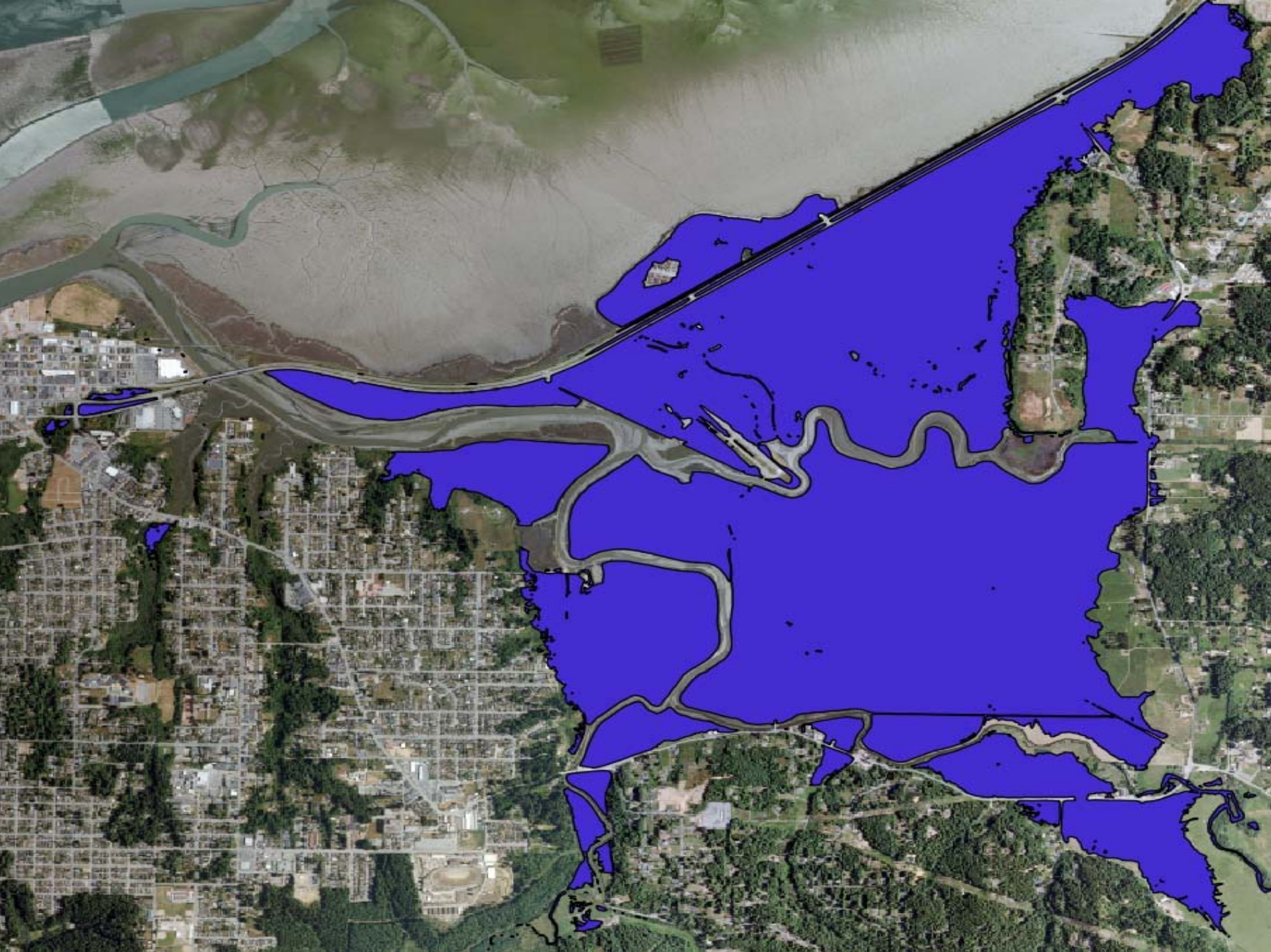
2.0’ SLR/9.74’ vs. 3.0’ SLR/10.74’





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.



Adaptation Strategies
Agricultural Lands

Education is important; the results of SLR vulnerability and risk assessments must be shared with agricultural property owners, stakeholders, government decision-makers and staff, and the public regarding what areas are vulnerable under existing tidal conditions and extreme events.

Adaptation Strategies
Agricultural Lands

Protection:

- Highly Vulnerable/Low Criticality
- Wildlife habitat is rated High Criticality
- Infrastructure is rated High Criticality
- Physically Possible to Protect: 2030 to 2050
- Economic Feasibility is low without subsidies
- Utilities may have ability to fund protection until they relocate infrastructure
- How, engineered or nature-based methods

Adaptation Strategies
Agricultural Lands

Relocation:

- Ultimately these lands will be inundated rendering existing uses and infrastructure inoperable
- Not an option for agricultural uses
- Managed retreat is viable for wildlife habitats
- Infrastructure can be elevated or relocated
- When, 2030-2050-2075?

Adaptation Strategies
Agricultural Lands

Regulation:

- At the hydrologic sub-unit scale
- LCP regulatory vehicles, CCA constraints
- Affect existing development to be relocated
- Prevent future development in vulnerable areas
- Programmatic solutions-regulatory relief

Adaptation Measures
"Protection"

1.Dikes could be raised 2 or 3 more feet.
2.Exposed diked shoreline reaches could be relocated inland and "living shorelines" created in front to provide protection.
3.Retrofitting top hinged tide gates with side hinged tide gates and enlarging the diameter of the inlet culvert can increase the efficiency of the water control structure to drain flooded agricultural lands through a greater range of tidal elevations. Adding more tide gates can also increase the amount of drainage during a tide cycle or from stormwater runoff.
4.Raising the surface elevation of compacted and subsided agricultural lands would make these lands much more resilient to rising groundwater and rising MLW and MLLW elevations, and thus able to support continued livestock and wildlife grazing activities.

Regulatory Constraints

1.While dikes could be raised, that would require increasing the footprint of the dike, which is not an allowable reason to place fill in a wetland. Armoring the dike would allow for a narrow footprint but not allowed if does not exist now. (PRC § **30233 and 30610**).

2.Where diked shoreline reaches are exposed to wind generated waves, they could be relocated inland and salt and freshwater marsh plains, “living shorelines,” could be created in front to provide protection. This would trigger the same regulatory constraints described above.

3.Importing clean fill material to raise the surface elevation of compacted and subsided agricultural lands would make these lands much more resilient to rising groundwater and rising MLW and MLLW elevations, and thus able to support continued grazing activities. Unfortunately, enhancing agricultural activities by placing fill to elevate the surface above groundwater or rising low tides is not an allowable fill in a coastal wetland pursuant to PRC § **30233**. This adaptation measure is also counter to achieving the policy in PRC § **30230** of restoring marine resources whenever feasible.

Justifying Adaptation Measures to Regulatory Constraints

1. Agricultural lands are not single purpose use areas.
2. Enhancing and protecting wildlife habitat is an allowable reason to place fill in a coastal wetland.
3. Agricultural lands can be sustained possibly to 2075 with the placement of fill, and perpetuating agricultural uses is a goal of the CCA pursuant to PRC § 30241 and 30242, which seek to protect and maintain agricultural lands from being converted to other uses.
4. The Coastal Act anticipated the need to balance policies that are brought into conflict under unique circumstances to protect coastal resources, such as agriculture, wetlands, wildlife habitat, and coastal infrastructure, and allow the Commission to weigh the net benefit derived to coastal resources from a proposed action (PRC § 30007.5).

Conclusion

- Dikes on agricultural lands provide protection to critical non-agricultural assets
- Agricultural uses on diked lands will be limited by RSLR to 2050 or possibly 2075 if adaptation measures are employed
- Partnerships will be required to finance implementation of adaptation measures
- Ultimately, Humboldt Bay will reclaim these diked agricultural lands

APWG Meeting Schedule: 2013-2015

2013	2014	2015
~~2/27~~	~~2/26~~	01/07
~~4/24~~	~~4/30~~	
~~(7/15)~~	6/25	
~~8/28~~	8/27	
~~10/30~~	10/29	