Evaluation of the Proposal for Widening and Deepening the Matagorda Ship Channel

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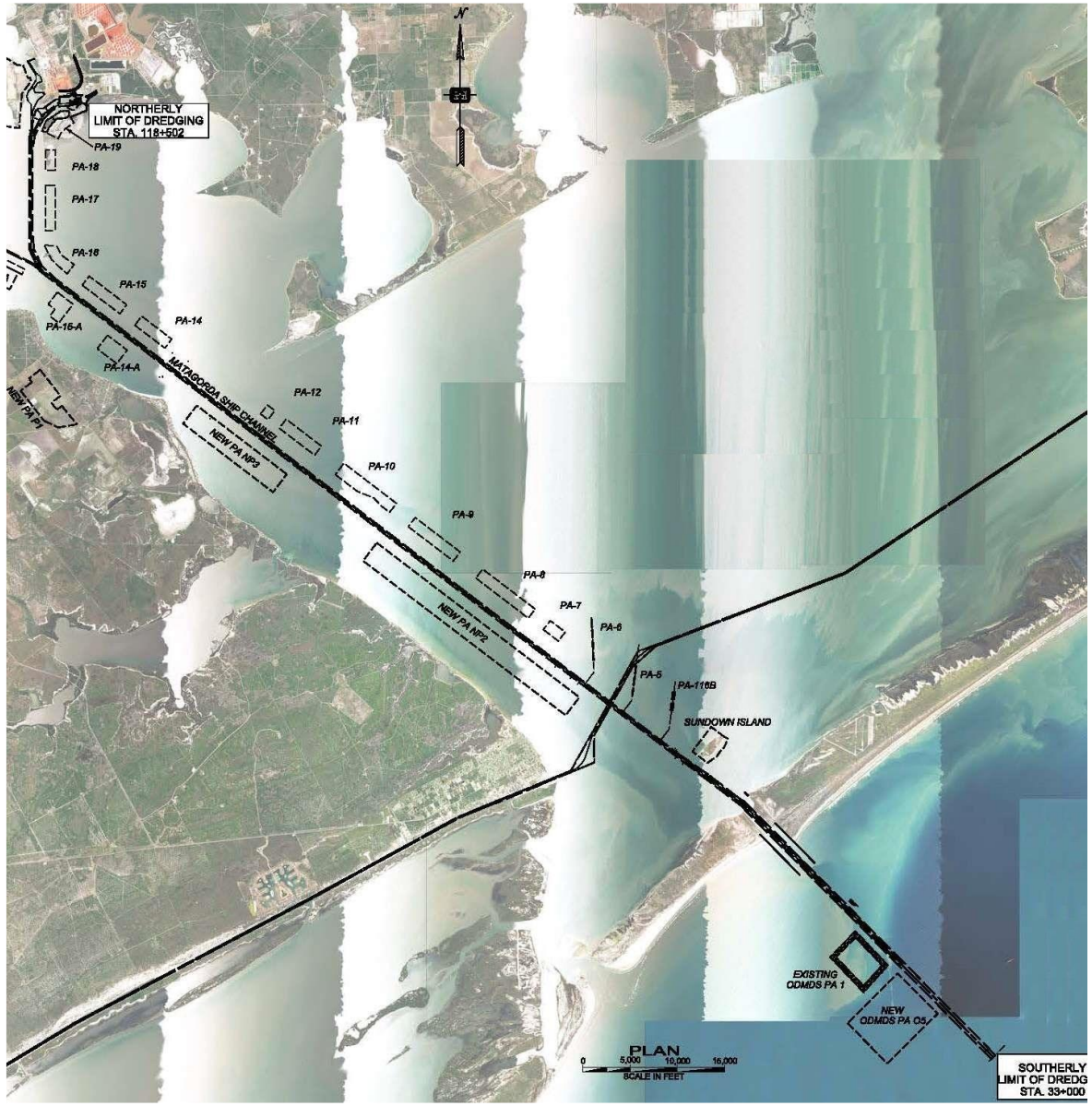
https://mbmtrust.com/project-summaries/

Acknowledgements

- Funding by the Matagorda Mitigation Trust
  - Report found at:
  - https://mbmtrust.com/project-summaries/
  - https://mbmtrust.com/media/dnid4urx/mbmt-ship-channel-dredging-evaluation-016-final-report-10-05-21.pdf
- Conversations with Formosa Plastics, Inc.
  - Rick Crabtree
  - John Pastuck
  - Bill Harvey

What's proposed?

From Maglio, Public Presentation, 11 March 2021



- Extend entrance channel by 13,000'
- Deepen entrance channel from 40' to 49' MLLW
- Widen entrance channel from 300' to 550' bottom width
- Deepen bay side channel from 38' to 47'
- Widen bay side channel from 200' to 300' bottom width
- Increase turning basin from 1000 x 1000 to 1200 ft diameter

From Maglio, Public Presentation, 11 March 2021

What's Proposed?

Mitigation

Habitat Type	Acreage Impacted	Acreage Created	Responsible Action
Oyster Reef	129.2		Dredging/Placement
Oyster Reef		130	Mitigation
Bay Bottom	3927		Placement
Offshore Bottom	2053		Placement

Report, Section 5.4.5, Cumulative Effects

- Not expected to have significant adverse effects to resources in the study area
- Majority of impacts associated with these projects would be temporary, and some result in positive impacts for the area
- Most substantial impact would be potential for increased salinity and tidal amplitude in the bay, which could affect shoreline habitat
- Expected salinity changes are not outside the normal ranges for the species present in the system and changes in tidal amplitude are fairly minor

Source: USACOE 2019 Feasibility Report and Environmental Impact Statement, Review of Completed Projects, Calhoun and Matagorda Counties

Scope of Current Study

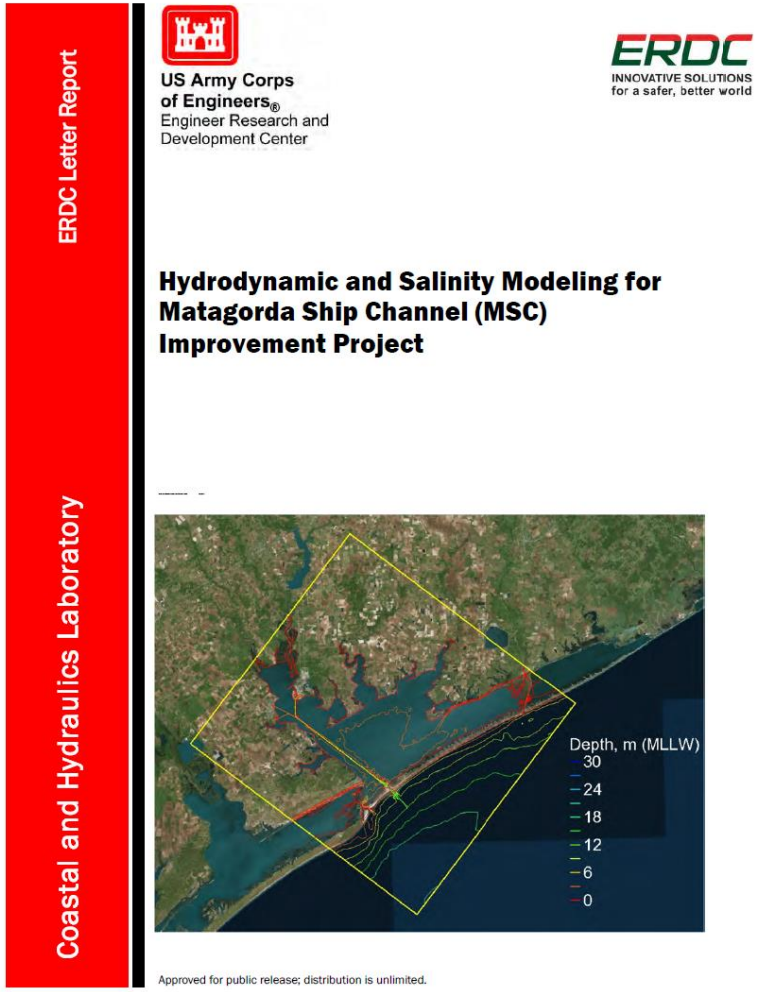
- No new sampling or data analysis
- Review of existing documents
- Issues
  - Physical
    - Bathymetry, Circulation, Storm Surge
    - Salinity
    - Groundwater
  - Ecological
    - Placement on habitats
    - Turbidity effects
    - Mercury mobilization
    - Interactions between turbidity, mercury, and plastics

Hydrodynamic and Salinity Model

Sources Reviewed

Lin, L., Islam, M.S., and White, T.E., 2018. Hydrodynamic and Salinity Modeling for Matagorda Ship Channel (MSC) Improvement Project. ERDC Letter Report, US Army Corps of Engineers, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory.

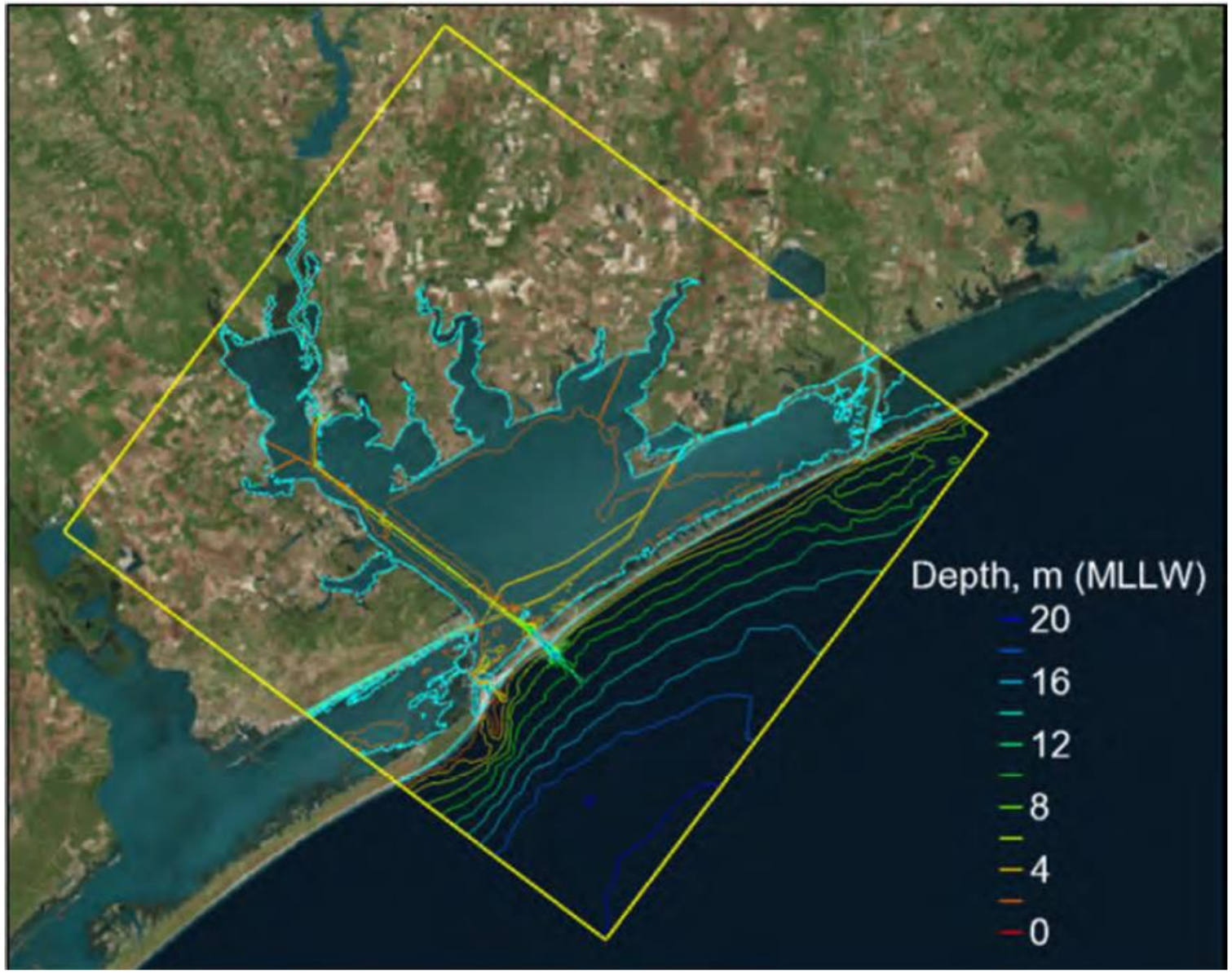
“The general effect of the proposed ship channel configuration to water surface elevations, current velocities, and salinity changes is relatively small to cause any navigation and environmental issues. Future studies are commended for investigation of sediment transport and potential increase of channel shoaling rate due to the proposed ship channel improvement project.”



Modeling Approach

- USACE Coastal Modeling System (CMS)
- Simulate hydrodynamics and salinity variation in entire Matagorda Bay system
- Physical processes modeled for the MSC study are water surface elevation, current, and salinity
- Model grid had been developed by previous USACE studies (Kraus et al. 2006; Maynord et al. 2011) and updated with the latest topography and bathymetric data available
- Model runs are in 2D
- Runs for various scenarios with as is conditions and dredged channel conditions for comparison

Model Domain



From Lin et al. 2018

Model Calibration and Validation

- Model calibration conducted for 3-week period in September 2005
- Latest available topography/bathymetry conditions were used with wind, wave, water level, river discharge, and salinity data measured in September 2005
- Water level RMSE 0.1 m or greater for modeled and measured comparison (note that tide range is about 0.25 m)
- Modeled salinity RMSE generally higher than 1.5 ppt compared to measured
- 2-week period for validation followed the calibration period with about the same results

From Lin et al. 2018

Modeling Scenarios

Table 1. List of modeling scenarios (Lin et al. 2018).

River Inflow Condition	Present/Future Water Level and MSC Configuration			
	PWOP (present without project)	**PWP (present with project)**	**FWOP (future without project)**	**FWP (future with project)**
Hurricane Rita (2005)	X	X	X	X
Hurricane Harvey (2017)	X	X	X	X
High river flow	X	X	X	X
Medium river flow	X	X	X	X
Low river flow	X	X	X	X

- Physical processes modeled for the MSC study are water surface elevation, current, and salinity
- Present water level is the 2024 projected MLLW (2017 MLLW + 0.061 m)
- Future water level is 2074 projected MLLW (2017 MLLW + 0.573)
- Land cover or morphological changes caused by sea level rise not considered

Potential Sea Level Rise Impacts

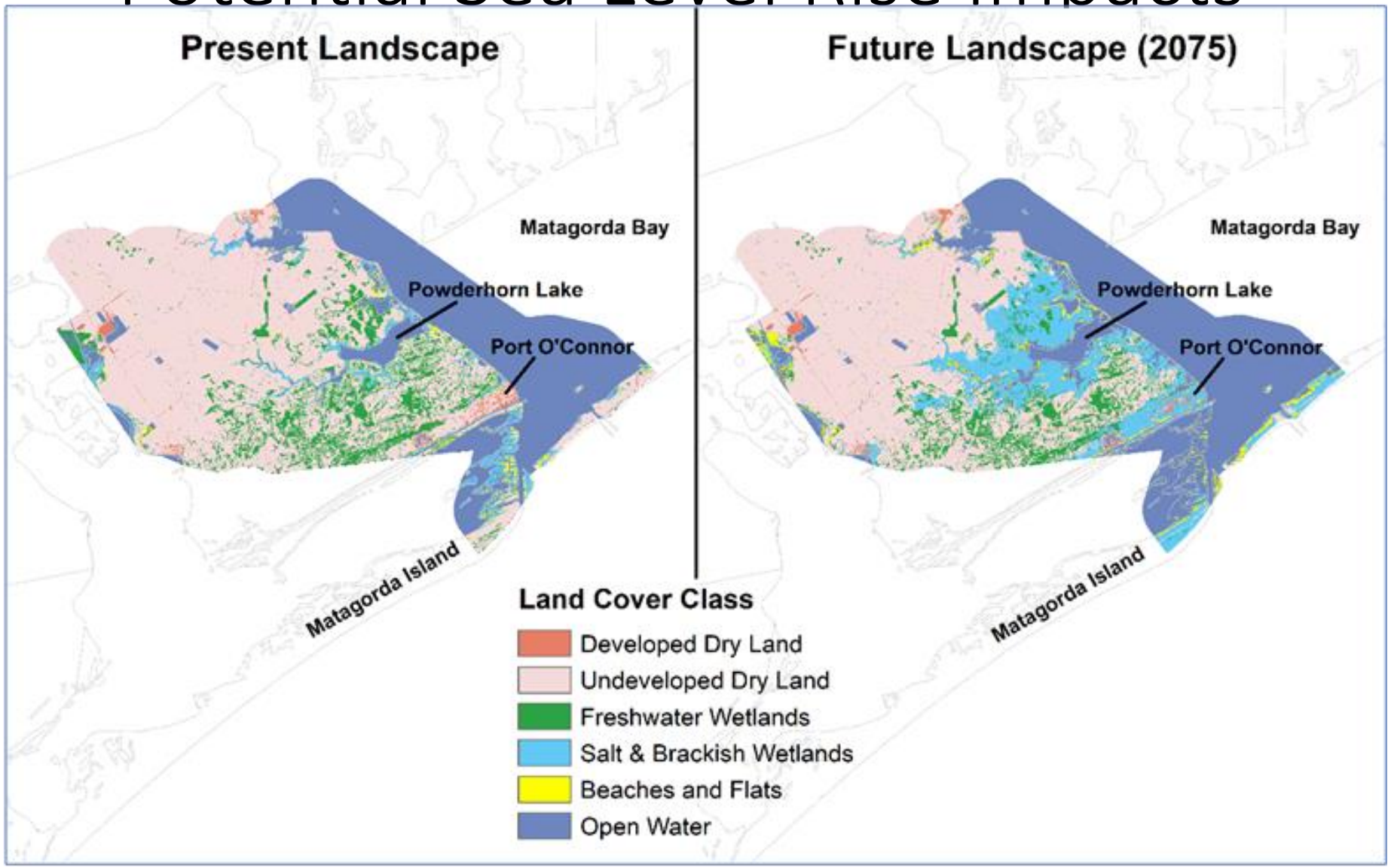


Figure 1. Present landscape vs. future landscape in 2075 with 0.535 m of RSLR in the Powderhorn Lake area. The present landscape is based on the US FWS National Wetland Inventory (NWI) dataset and the future landscape is developed using SLAMM.

Some Key Modeling Results

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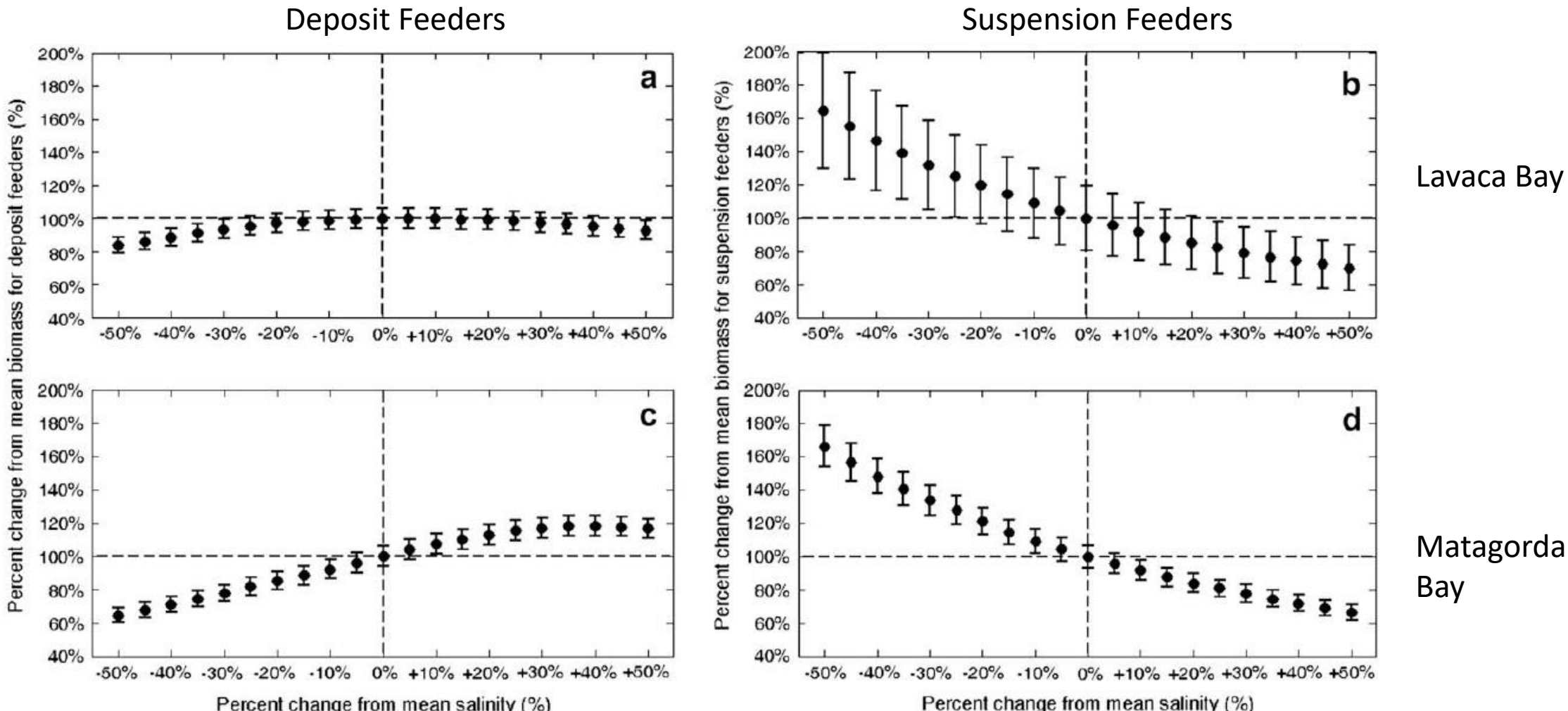
- Differences in water level with and without channel improvement projects is ±0.05 m. This amount could impact intertidal environments in some places.
- Maximum current speeds with and without channel improvement projects is within ±0.2 m/s for all three river flow conditions, and ±0.5 m/s for Hurricane Harvey inflow condition. Current speed of ±0.1 m/s is enough to keep fine-grained sediment suspended for longer leading to increased turbidity, and ±0.5 can lead to enhanced shoreline and channel erosion.
- Difference in model salinities with and without projects is up to 2 PPT which might not have significant consequence now but could be a problem in the future as climate change can have a compounding effect

Will a 2 ppt salinity change matter?

- Long-term average is 22, so that is a 10% change
- More worms, and fewer shellfish, but by only 5-10%

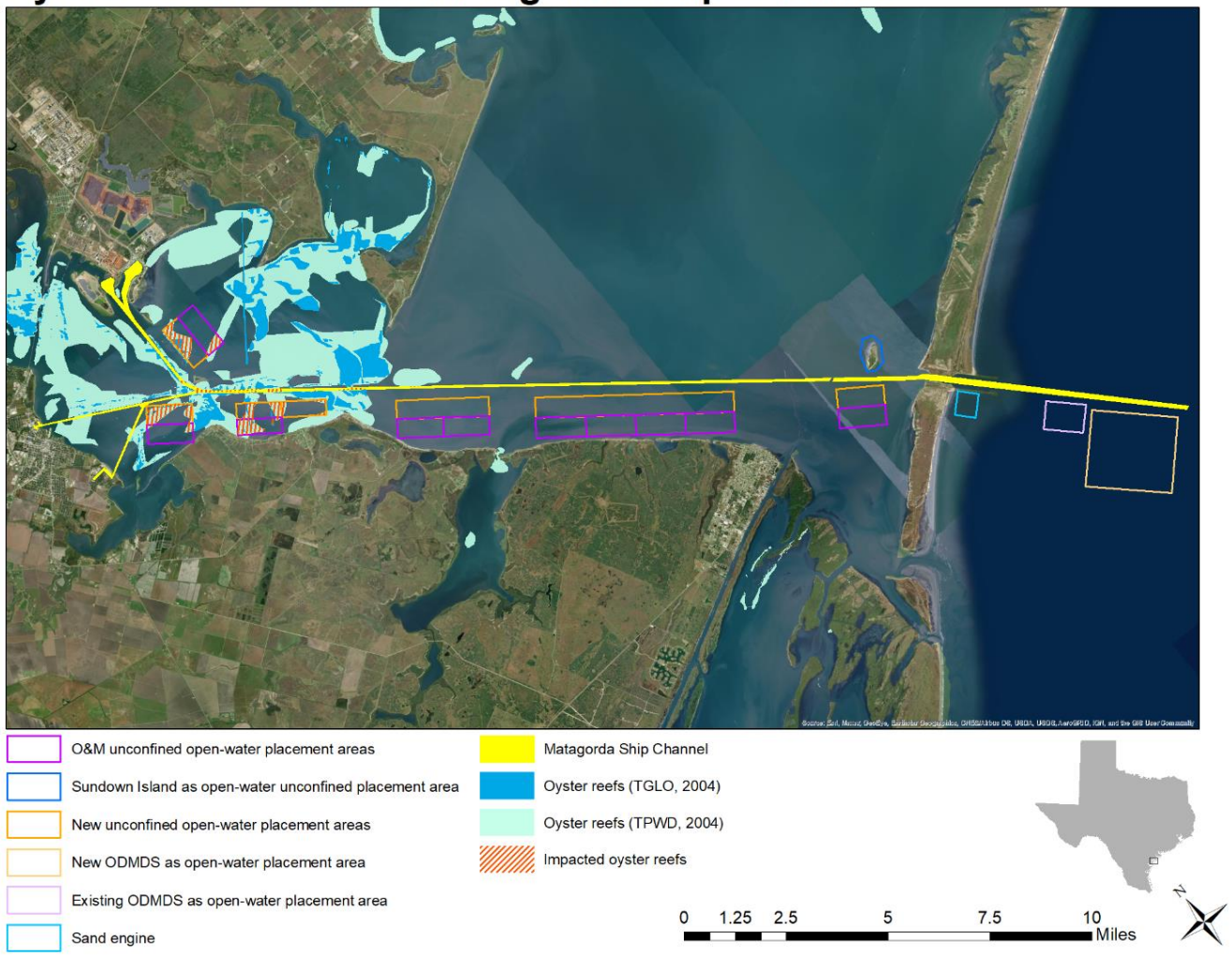


Groundwater Hydrology

- Existing channel already intercepts the shallow aquifer, so deepening will extend this
- Specific interactions will depend on location and conditions (hydraulic gradients, sediments, clay layers, and climate)
- There are data gaps:
  - Assess shallow subsurface confining layers
  - Long-term monitoring of groundwater quality
  - Evaluate groundwater discharge
  - Assess mercury solubility and mobility from deeper layers

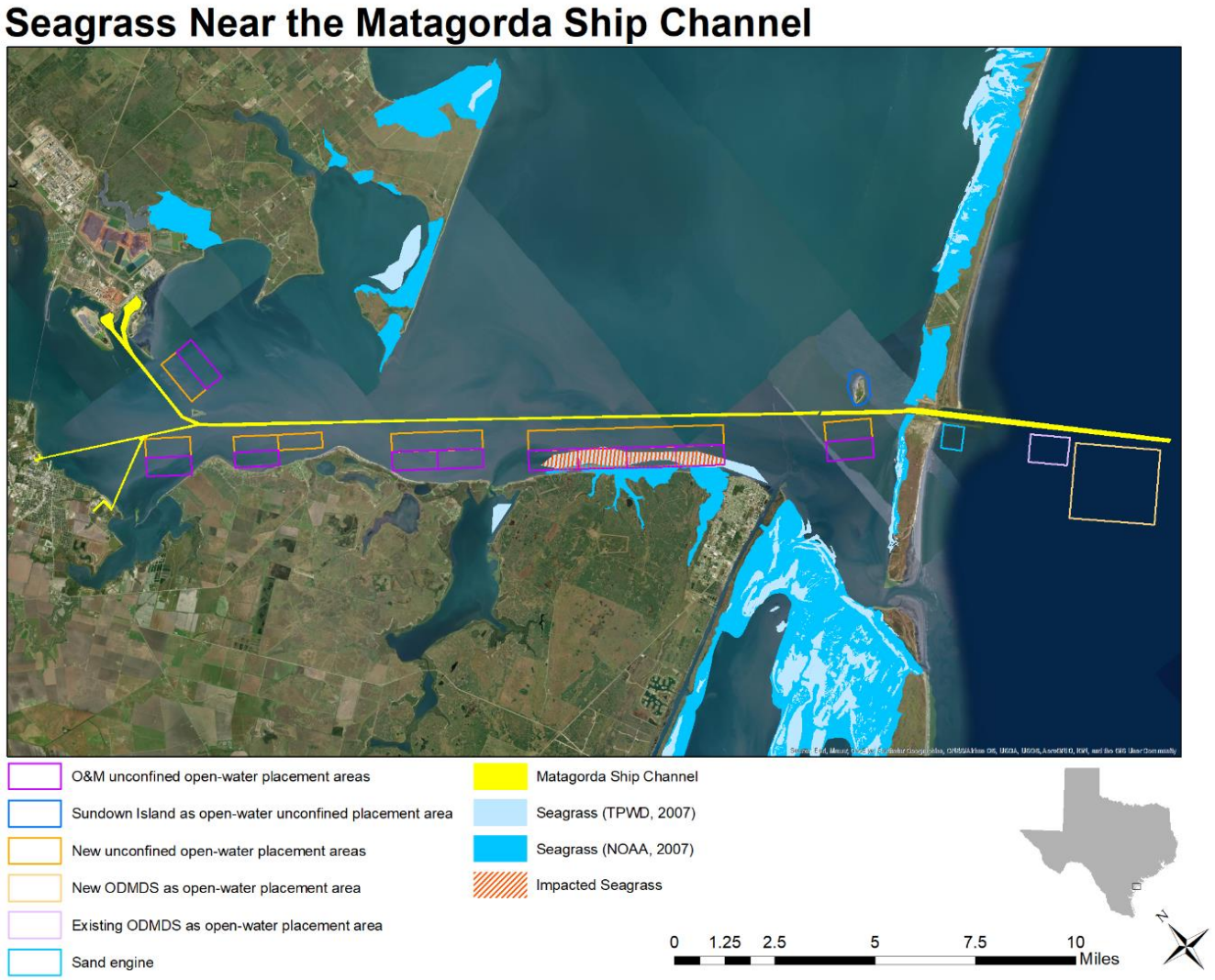
Habitats – Oyster Reefs

Oyster Reefs Near the Matagorda Ship Channel



- 838.6 acres of oyster reef will be directly impacted by construction
- Mitigation plan says only 129 acres impacted and contains only 130 acres for mitigation

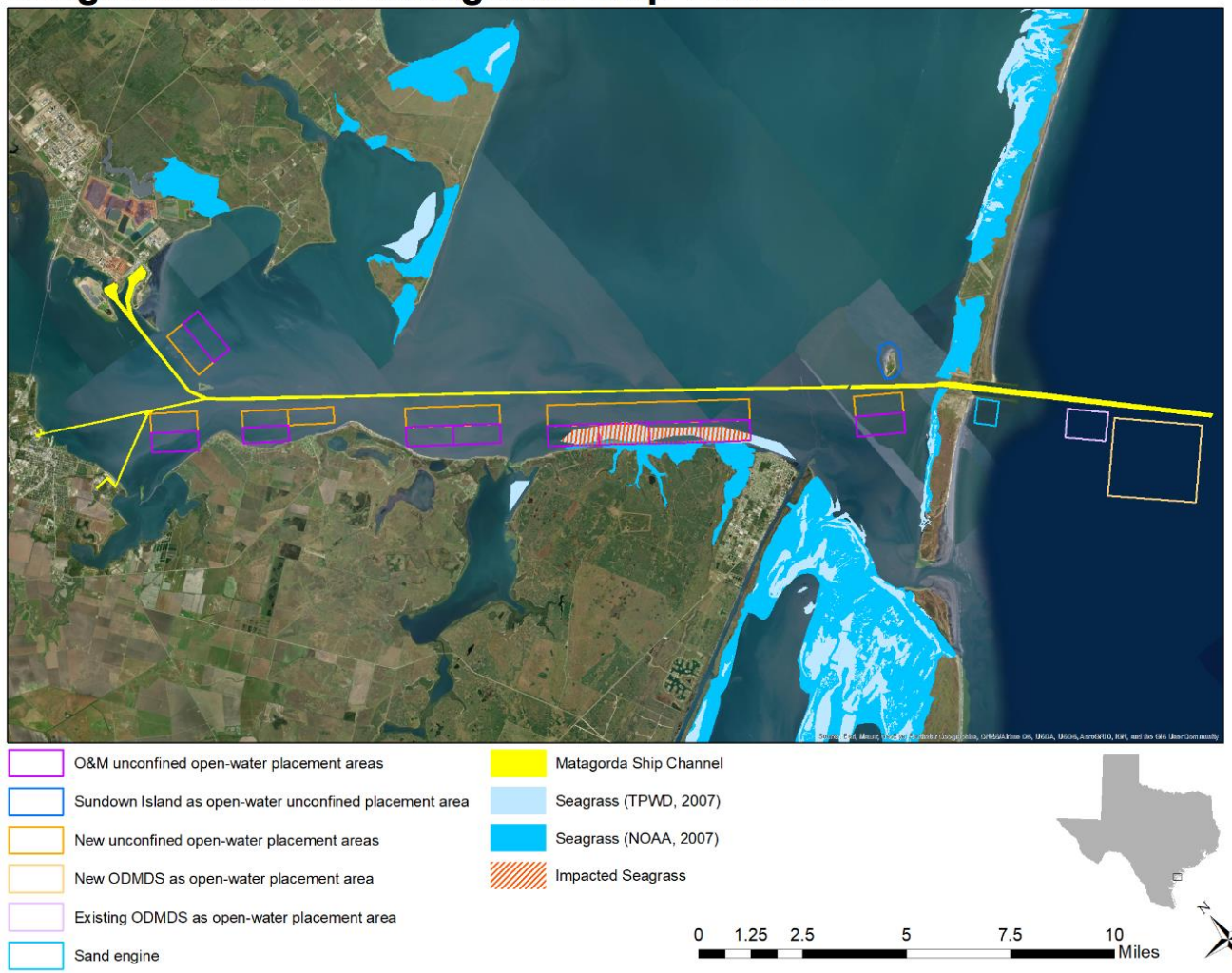
Habitats – Seagrass Beds



- 1017.4 acres of seagrass be directly impacted by construction
- Can take 3 years to recover
- Mitigation plan does not mention seagrass

Habitats – Open Bay

Seagrass Near the Matagorda Ship Channel

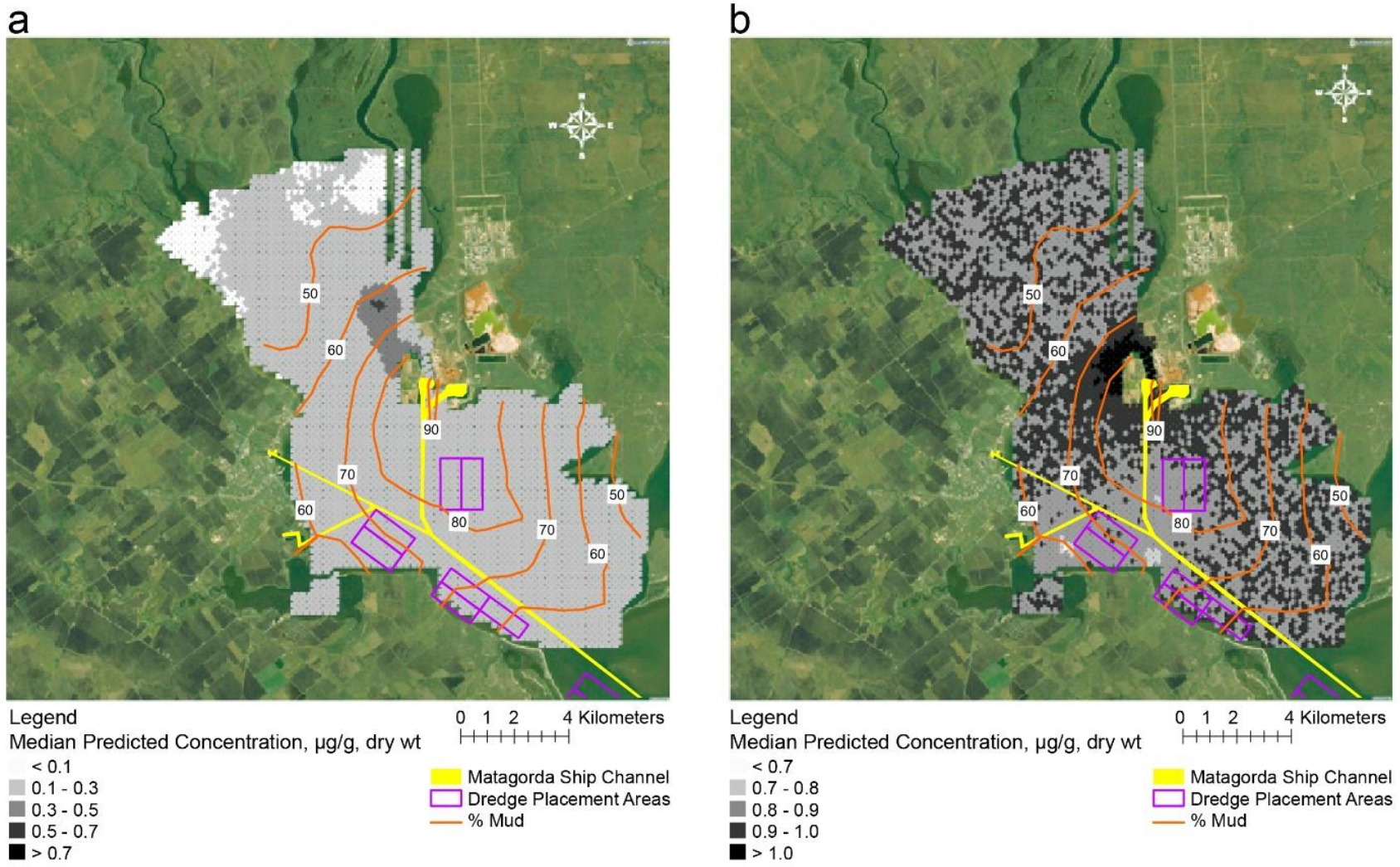


- Mitigation plan says 3927 ac will be impacted, no mitigation planned.
- Benthic communities typically recover within one year

Habitats - Turbidity

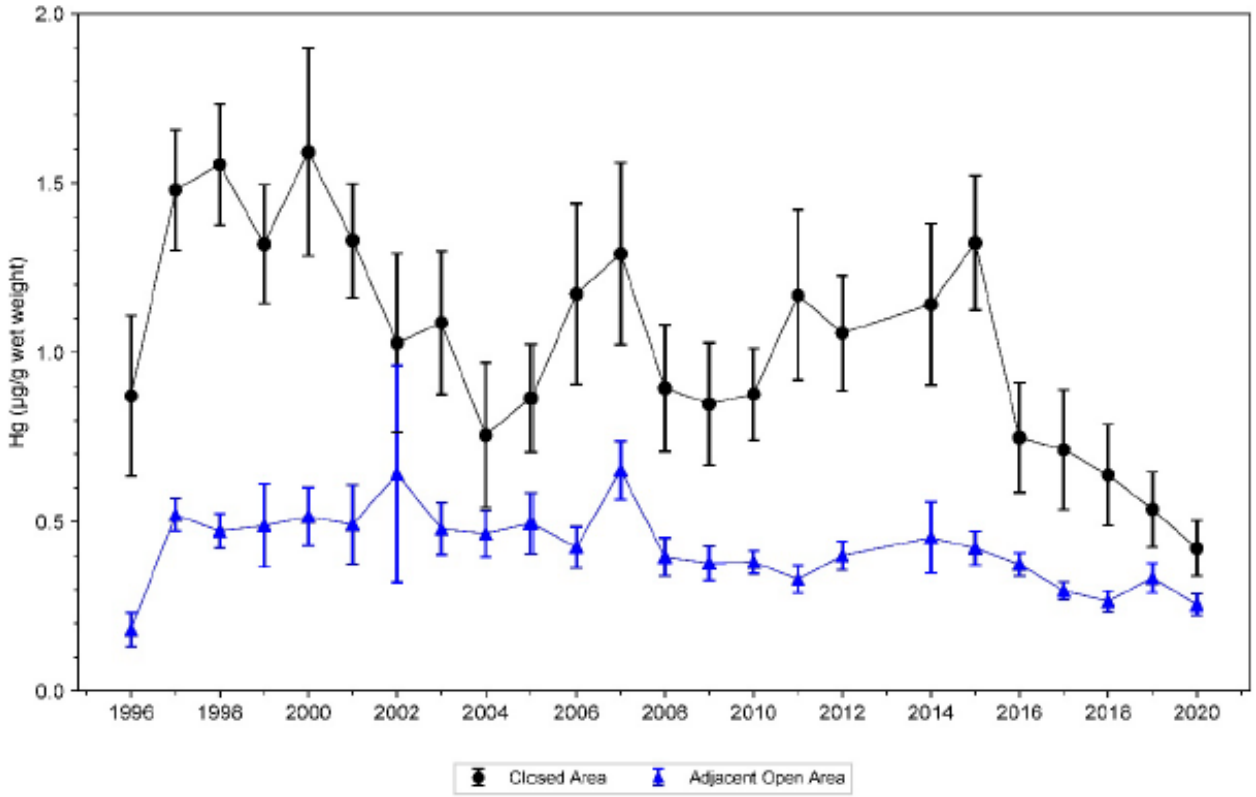
- Primary production
  - Return in 5 months
- Suspension feeders
  - Short-term
- Fish
  - Visual predators could be affected
  - Eggs are sticky, could attach to sediments and be deposited

Mercury



- Issues
  - Mobilization during dredging because of increased methylation
  - Bioaccumulation / biomagnification
  - Potential interaction with nutrient loading because of increased methylation
  - Burial by placement could be a benefit

Mercury



- Mercury in Red Drum has been decreasing
- Could it return to higher levels?

Interactions with Plastics

- Heavy metals and hydrophobic organic matter (Lee et al. 2014), adsorb on plastic surfaces in marine ecosystems and could act as vectors for the entry of metals and organic matter into marine food webs
- Metals have been shown to adsorb onto microplastics at concentrations that are several orders of magnitude higher than in the surrounding water, thus increasing the potential exposure to aquatic organisms

Conclusions

- Circulation and salinity changes could be problematic with future climate changes in shoreline or reduced inflow
- Turbidity impacts would be short-term, recovery times of months
- Bay bottom impacts would be long-term recovery times of year or more
- Impacts to seagrass and oyster would be larger than expected
  - Increase planned mitigation
- Mercury mobilization by dredging a concern, but placement will bury some further
  - Use placement to mitigate mobilization