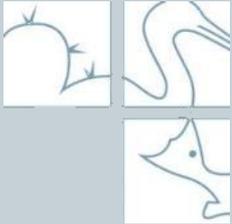


# Balancing Freshwater Inflows in a Changing Environment

Collaborating for Water Conservation on the Texas Coast



**Sally Palmer, Dr. Kiersten Madden, Dr. Ed Buskey, Dr. Lindsay Scheef, Dr. Zack Darnell, Kimberly Bittler, Kristin Hicks**

Mission-Aransas National Estuarine Research Reserve, University of Texas Marine Science Institute



**Dr. Tarla Rai Peterson, Dr. Bill Grant, Chara Ragland, Paulami Banerjee**

Texas A&M University – College Station



**Dr. George Ward**

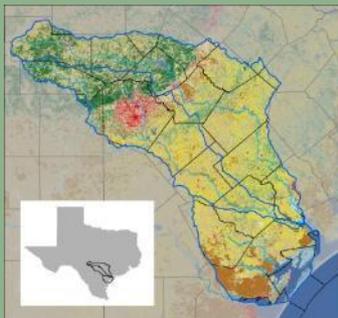
The University of Texas at Austin, Center for Research in Water Resources

# Freshwater Inflows: Determining flow regimes in the face of land use, climate change, and other unknowns



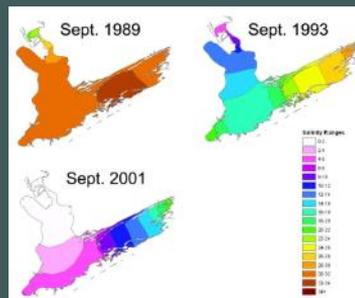
## OBJECTIVE 1

Examine the effects of land use and climate change on freshwater inflows to the Guadalupe-San Antonio and Mission-Aransas.



## OBJECTIVE 2

Improve inputs to the TxBLEND salinity model of the Texas Water Development Board.



## OBJECTIVE 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.



## OBJECTIVE 4

Develop shared systems learning among the local stakeholders and scientists for construction of a system dynamics model.

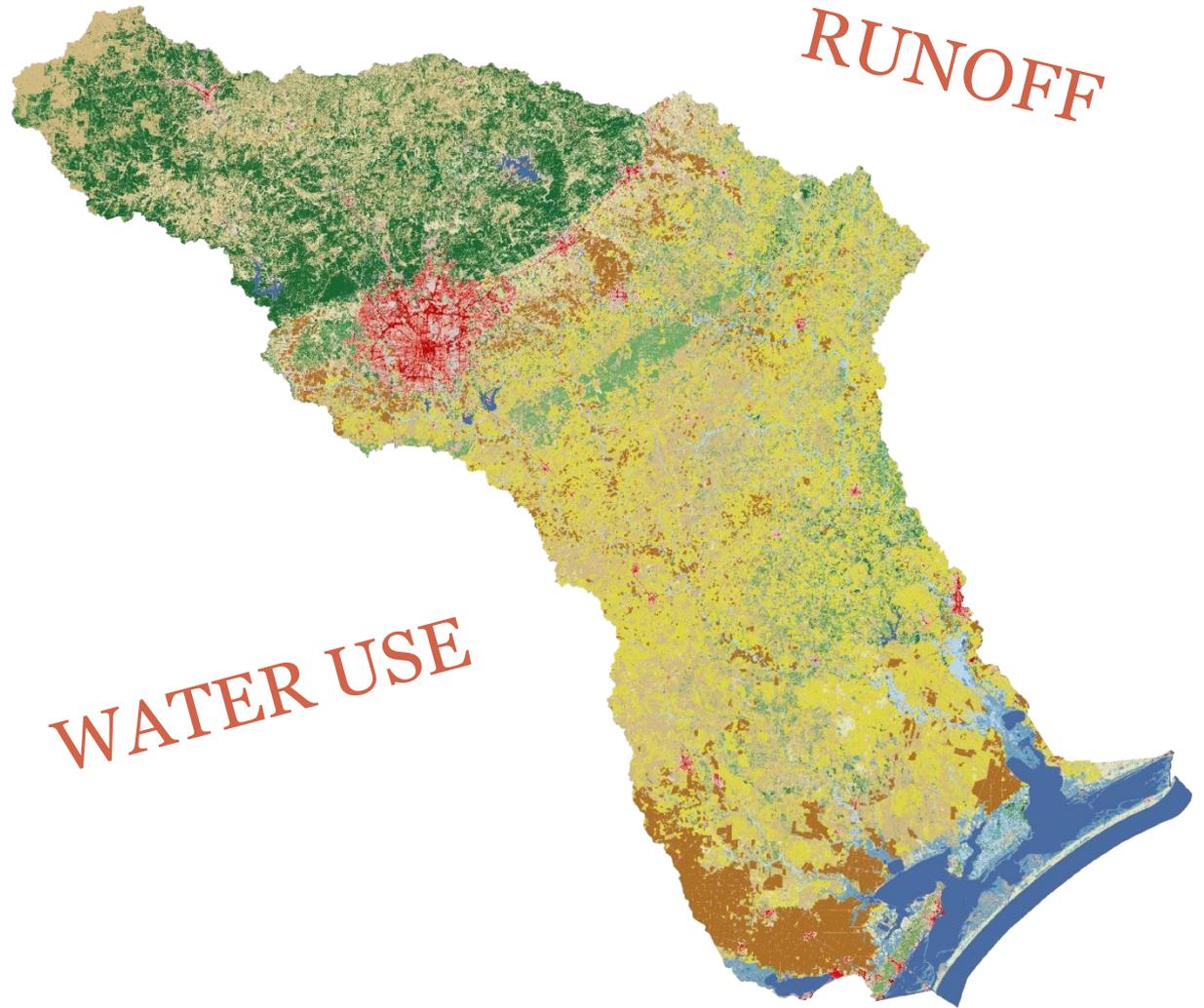


# Objective 1

Examine the effects of land use and climate change on freshwater inflows to the Guadalupe-San Antonio and Mission-Aransas.

## Land Use/Land Cover

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Hay/Pasture
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands



## Objective 1

Examine the effects of land use and climate change on freshwater inflows to the Guadalupe-San Antonio and Mission-Aransas.



What time horizon(s) would you like to see included in the land use and climate change modeling?

1. **2020 (32%)**
2. 2040 (23%)
3. **2060 (34%)**
4. 2080 (6%)
5. 2100 (5%)

Which of the following approaches would you prefer to see used for the land use and climate modeling?

1. Monthly (3%)
2. Seasonal (9%)
3. Annual (0%)
4. Monthly & Seasonal (16%)
5. Monthly & Annual (3%)
6. **Seasonal & Annual (50%)**
7. **Monthly, Seasonal, & Annual (19%)**

Which climate change scenarios would you prefer to see used for the climate change and land use modeling?

1. A2 (High) (6%)
2. A1B (Medium) (18%)
3. B1 (Low) (3%)
4. **A2 & B1 (High & Low) (21%)**
5. **All three (53%)**



## Objective 1

Examine the effects of land use and climate change on freshwater inflows to the Guadalupe-San Antonio and Mission-Aransas.

**Timeframe:**  
2020, 2060

**Emissions:**  
A2 (High), B1 (Low)

**Approach:**  
Annual, Seasonal

# SCENARIOS

### Scenario 1

A2 (High)  
2020  
Annual

### Scenario 2

A2 (High)  
2020  
Fall

### Scenario 3

A2 (High)  
2020  
Winter

### Scenario 4

A2 (High)  
2020  
Spring

### Scenario 5

A2 (High)  
2020  
Summer

### Scenario 6

A2 (High)  
2060  
Annual

### Scenario 7

A2 (High)  
2060  
Fall

### Scenario 8

A2 (High)  
2060  
Winter

### Scenario 9

A2 (High)  
2060  
Spring

### Scenario 10

A2 (High)  
2060  
Spring

### Scenario 11

B1 (Low)  
2020  
Annual

### Scenario 12

B1 (Low)  
2020  
Fall

### Scenario 13

B1 (Low)  
2020  
Winter

### Scenario 14

B1 (Low)  
2020  
Spring

### Scenario 15

B1 (Low)  
2020  
Summer

### Scenario 16

B1 (Low)  
2060  
Annual

### Scenario 17

B1 (Low)  
2060  
Fall

### Scenario 18

B1 (Low)  
2060  
Winter

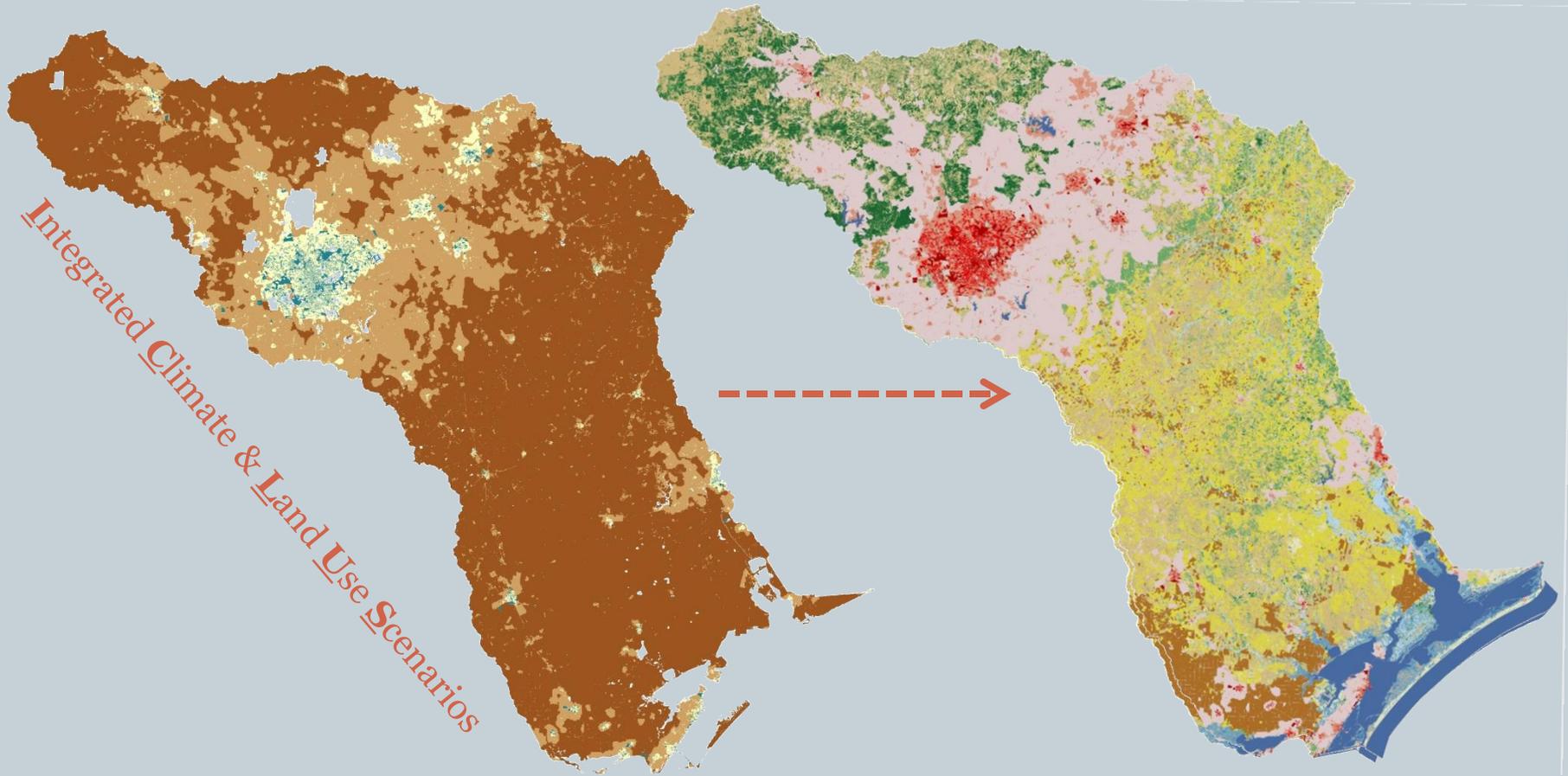
### Scenario 19

B1 (Low)  
2060  
Spring

### Scenario 20

B1 (Low)  
2060  
Spring

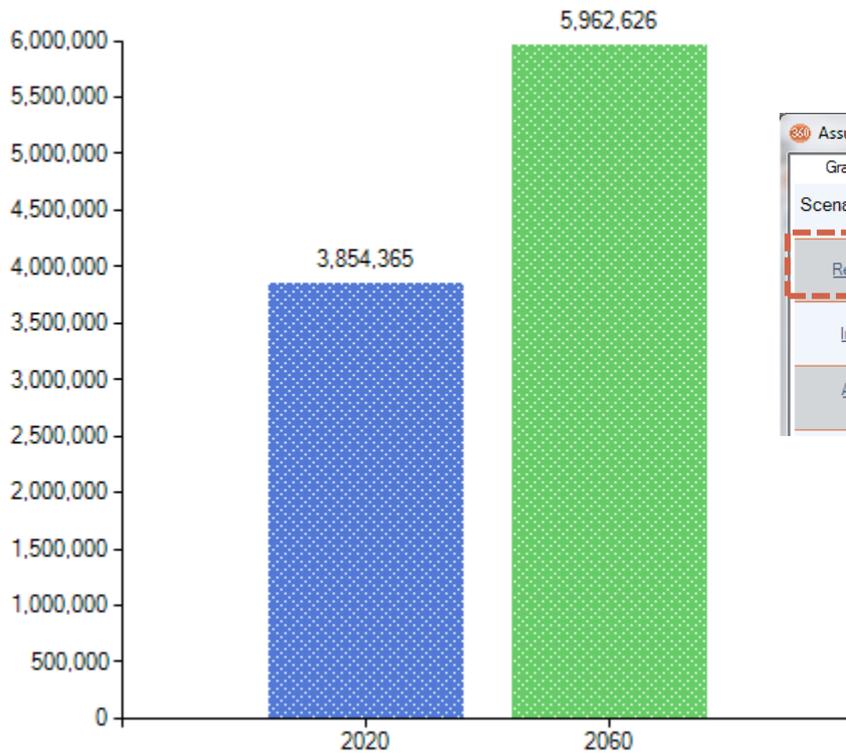
# Changing Landscape . . .



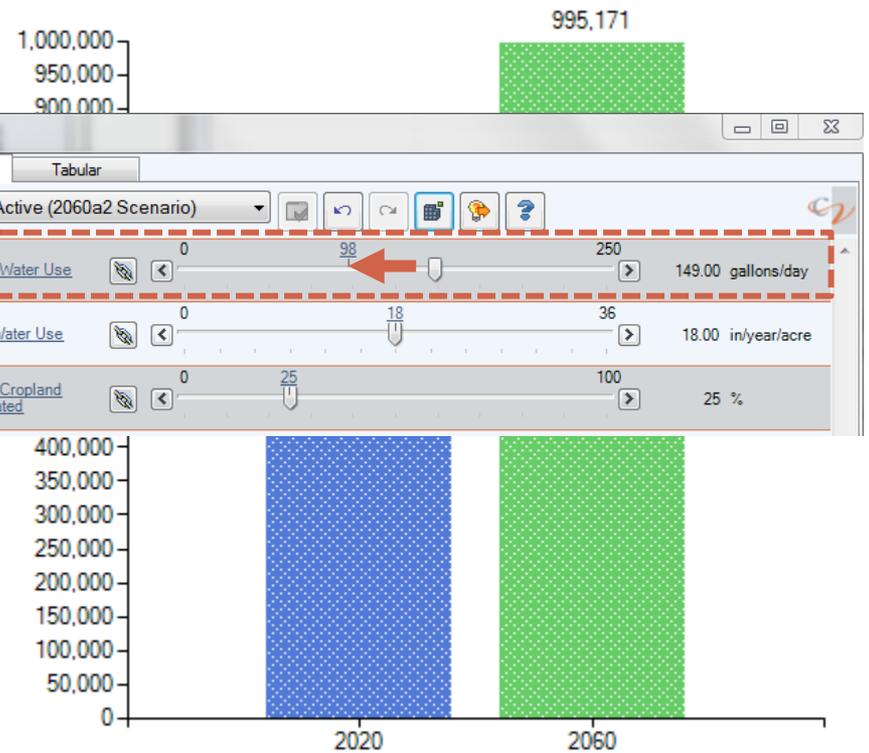
# Indicator: Population & Residential Water Use

Assumes 149 gall/person/day

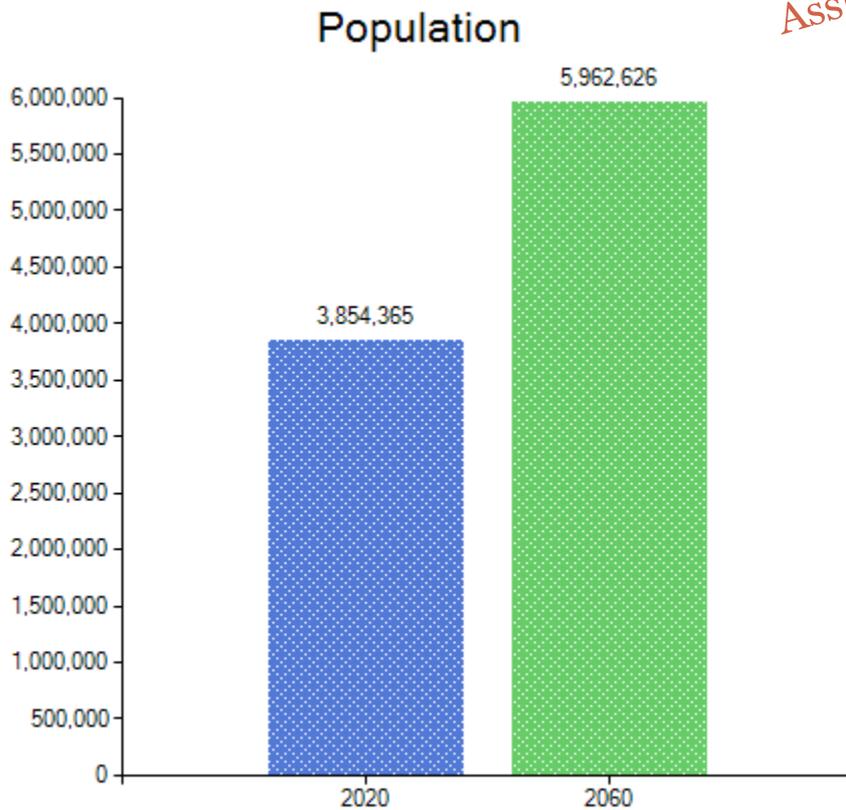
### Population



### Residential Water Use

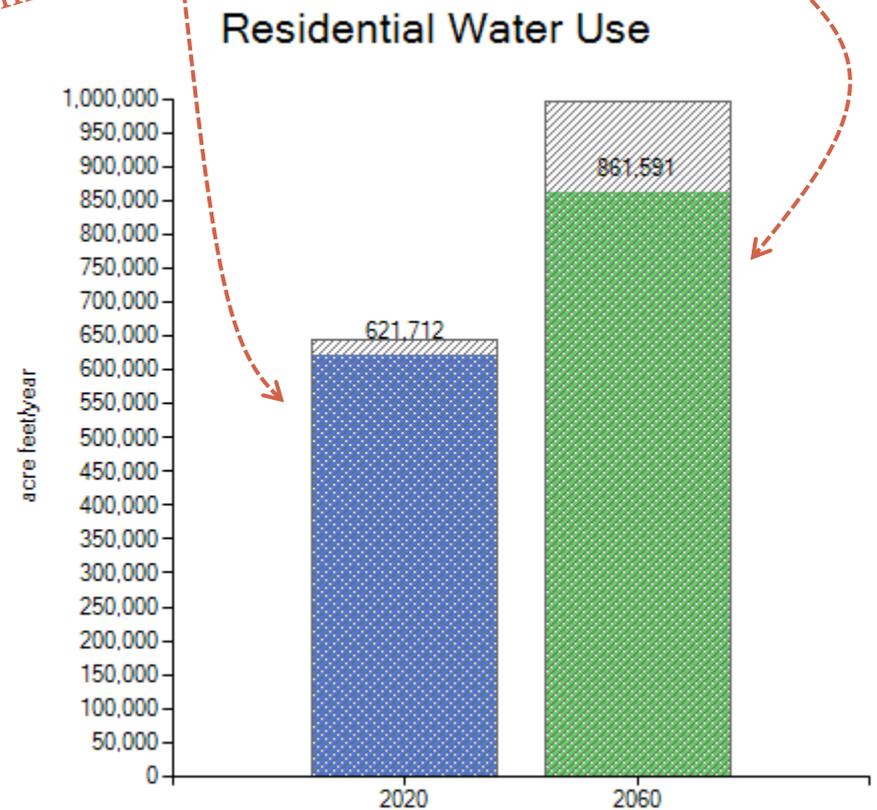


# Indicator: Population & Residential Water Use

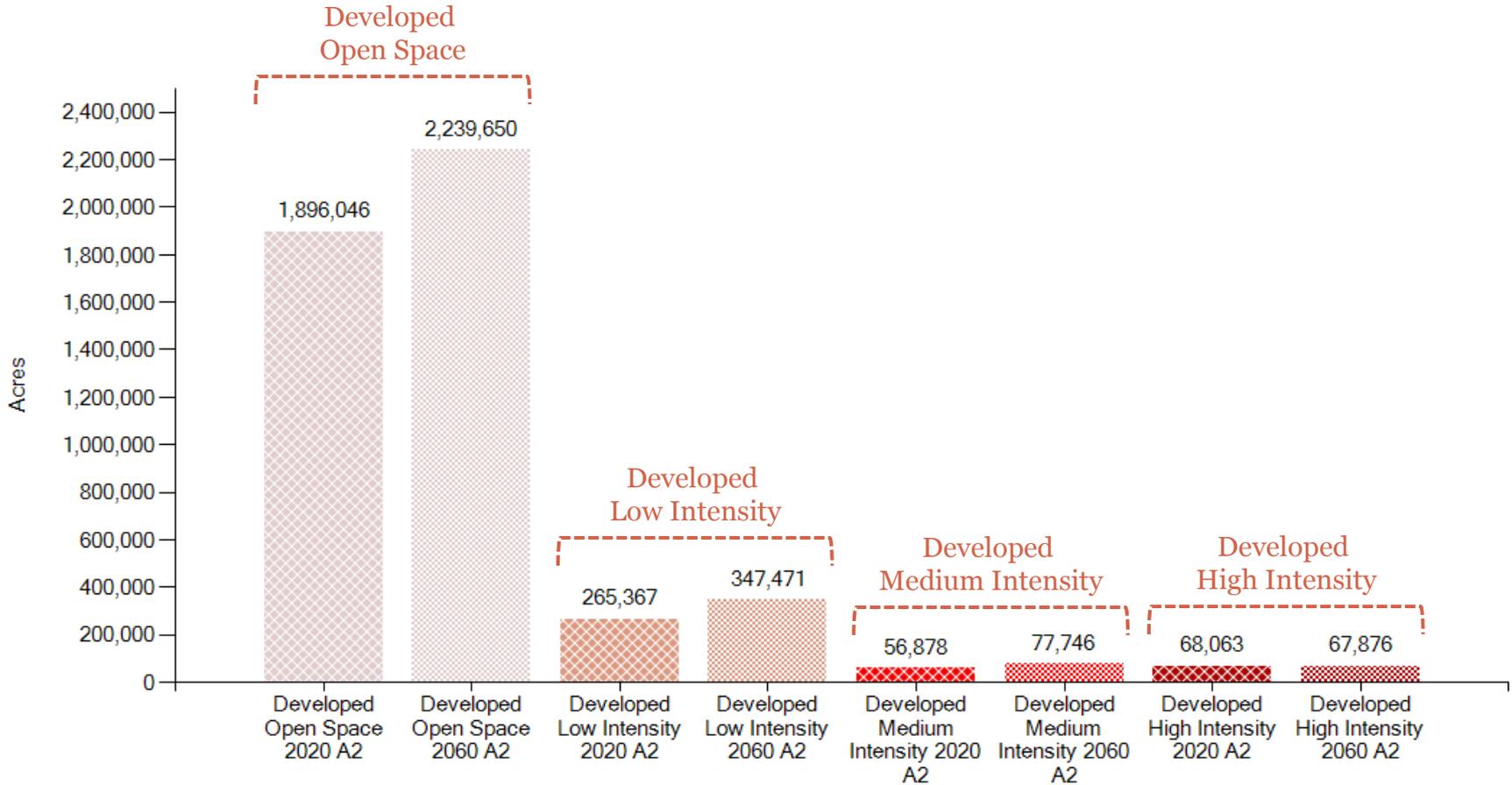


*Assumes 143 gall/person/day*

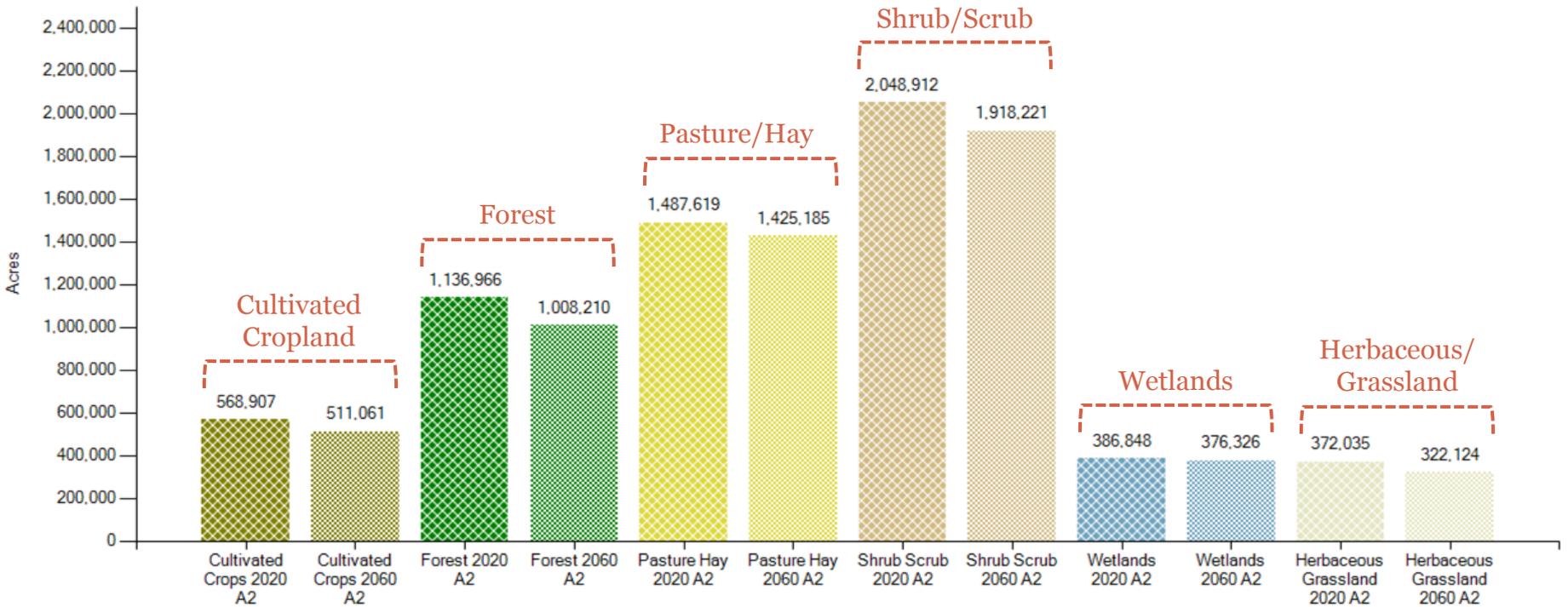
*Assumes 129 gall/person/day*



# Indicator: Land Use



# Indicator: Land Cover



# Indicator: Irrigation Water Use



**Irrigation Water Use =**

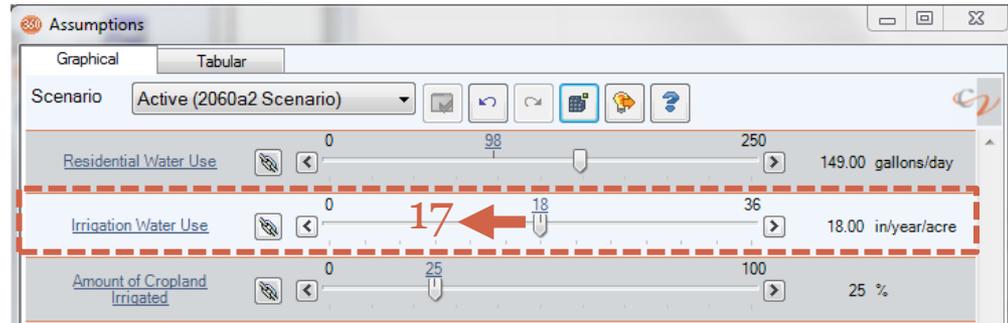
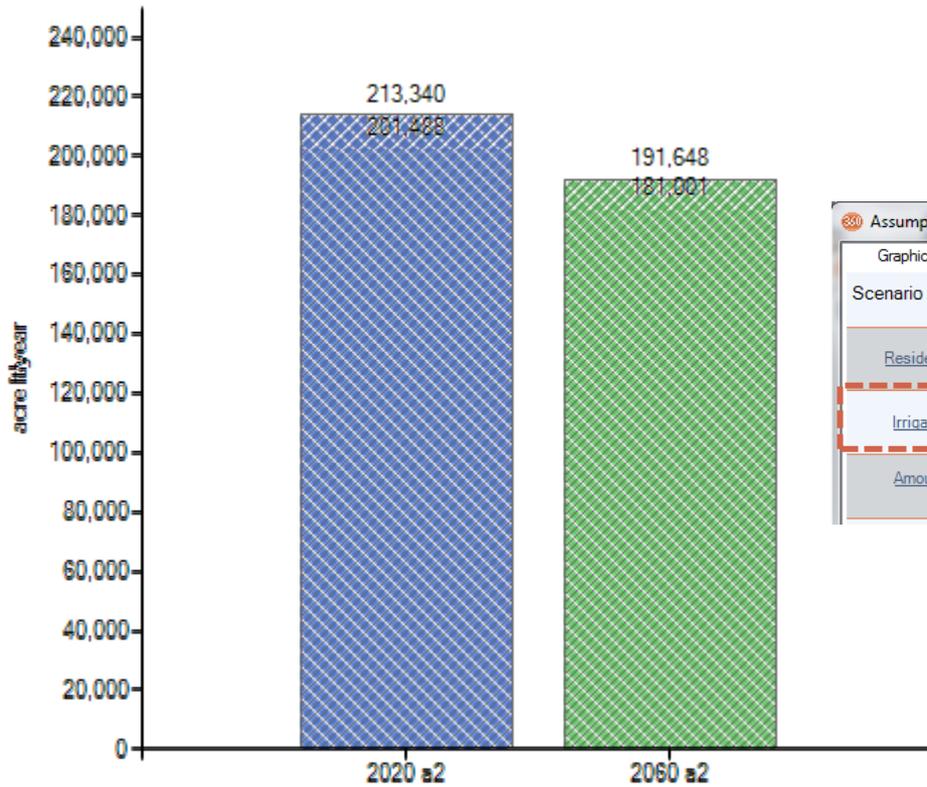
Acres of Cropland \* Water Use Assumption (inches/acre/year) \* % of Acres  
Irrigated Assumption

Source: “Status and Trends of Irrigated Agriculture in Texas” (TWRI, 2012)

# Indicator: Irrigation

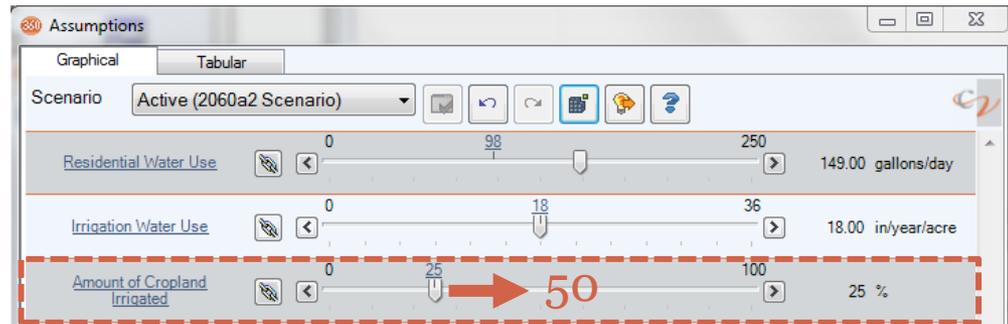
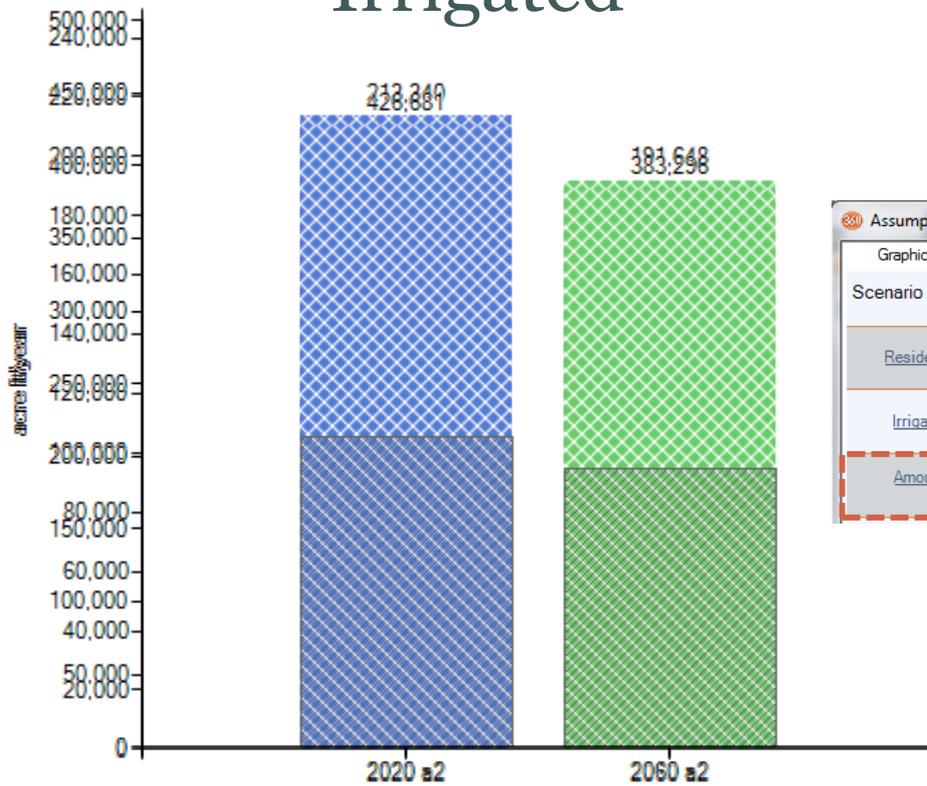


17 in/acre/year



# Indicator: Irrigation

50% of Cropland  
Irrigated

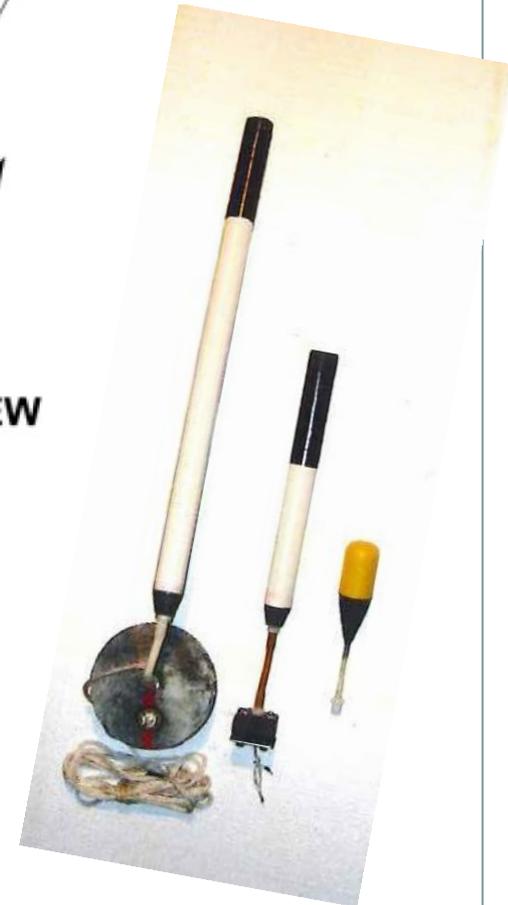
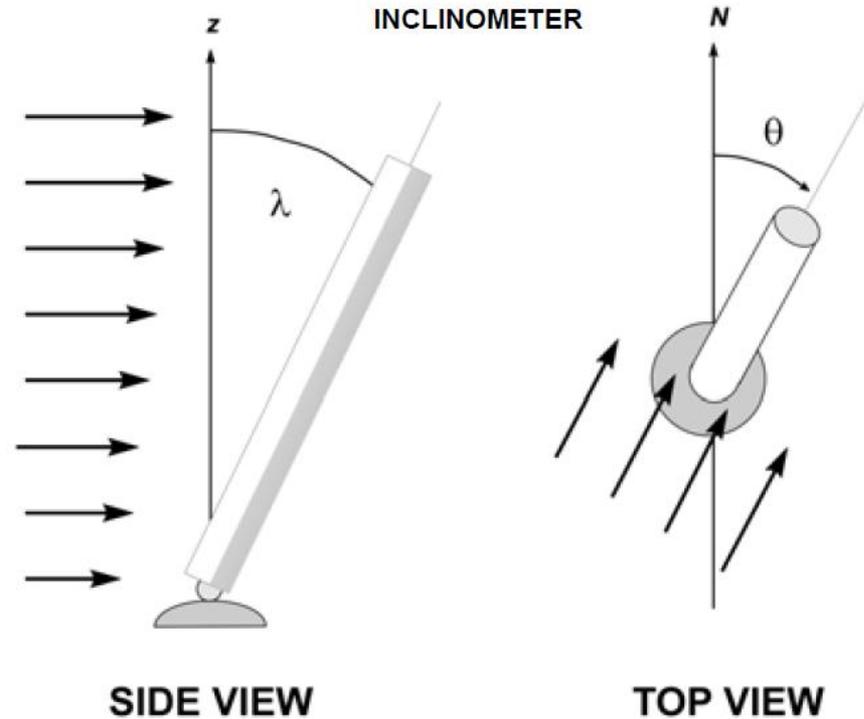




## Objective 2

Improve inputs to the TxBLEND salinity model of the Texas Water Development Board.

### Tiltmeter

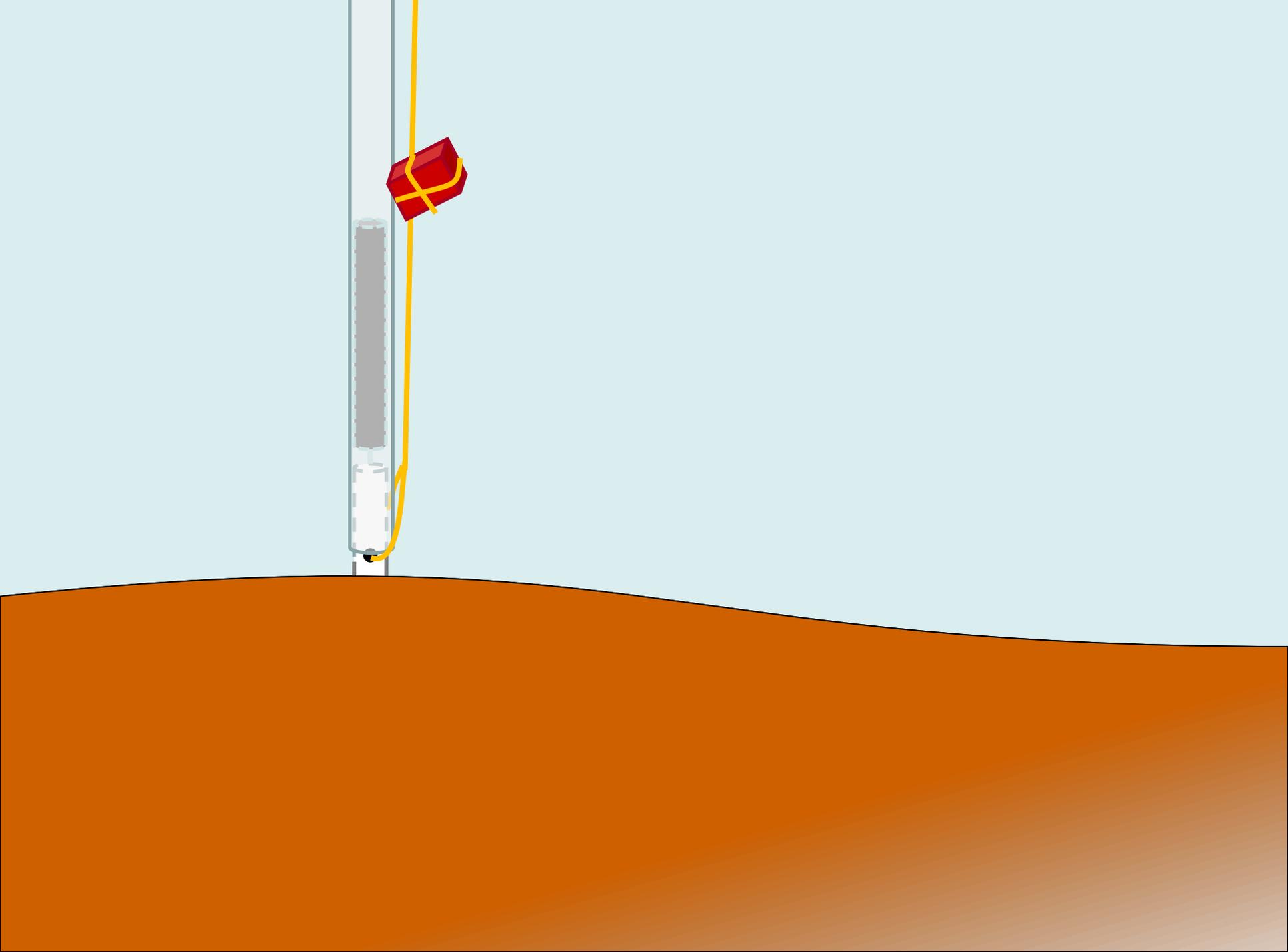


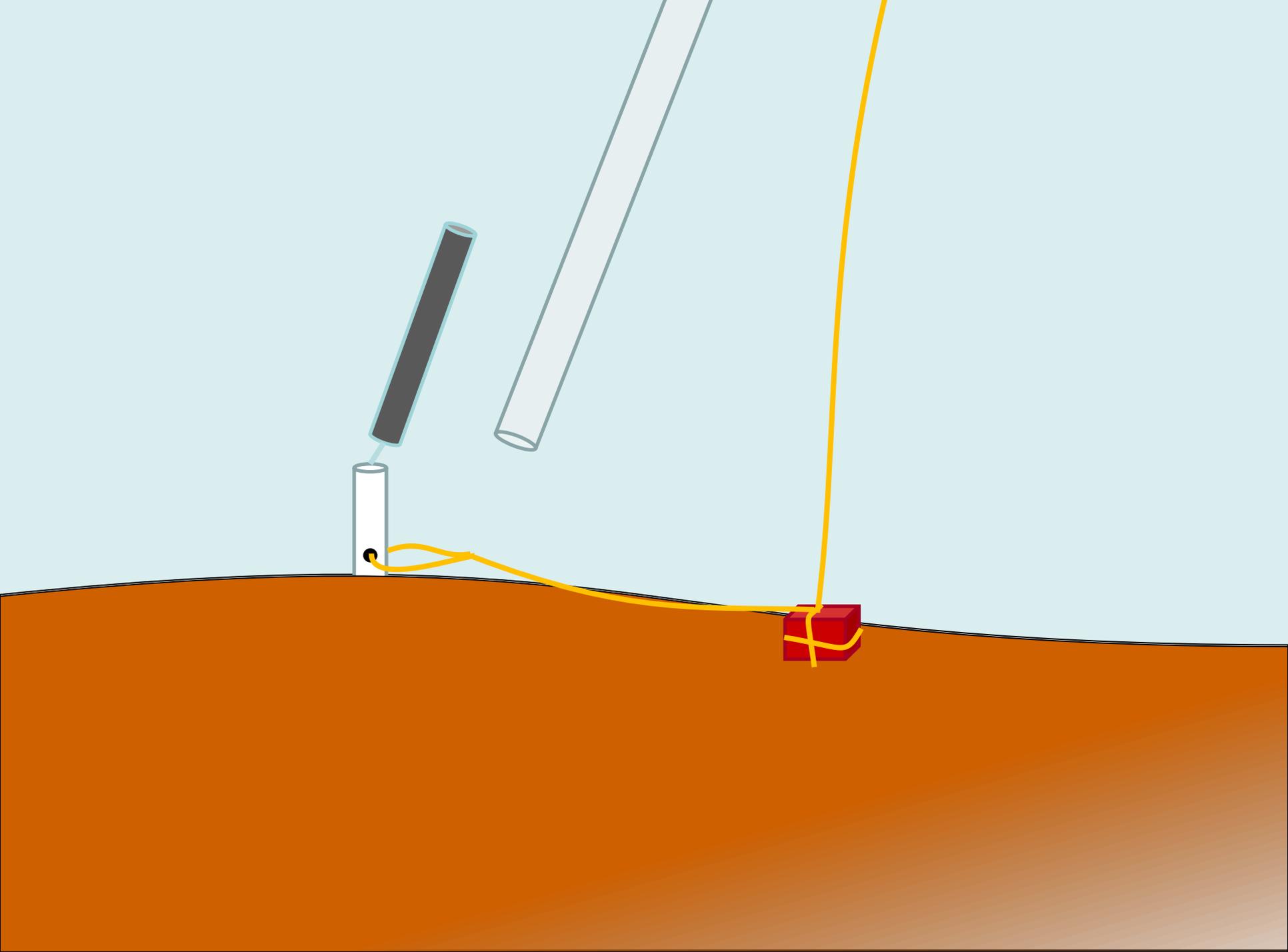


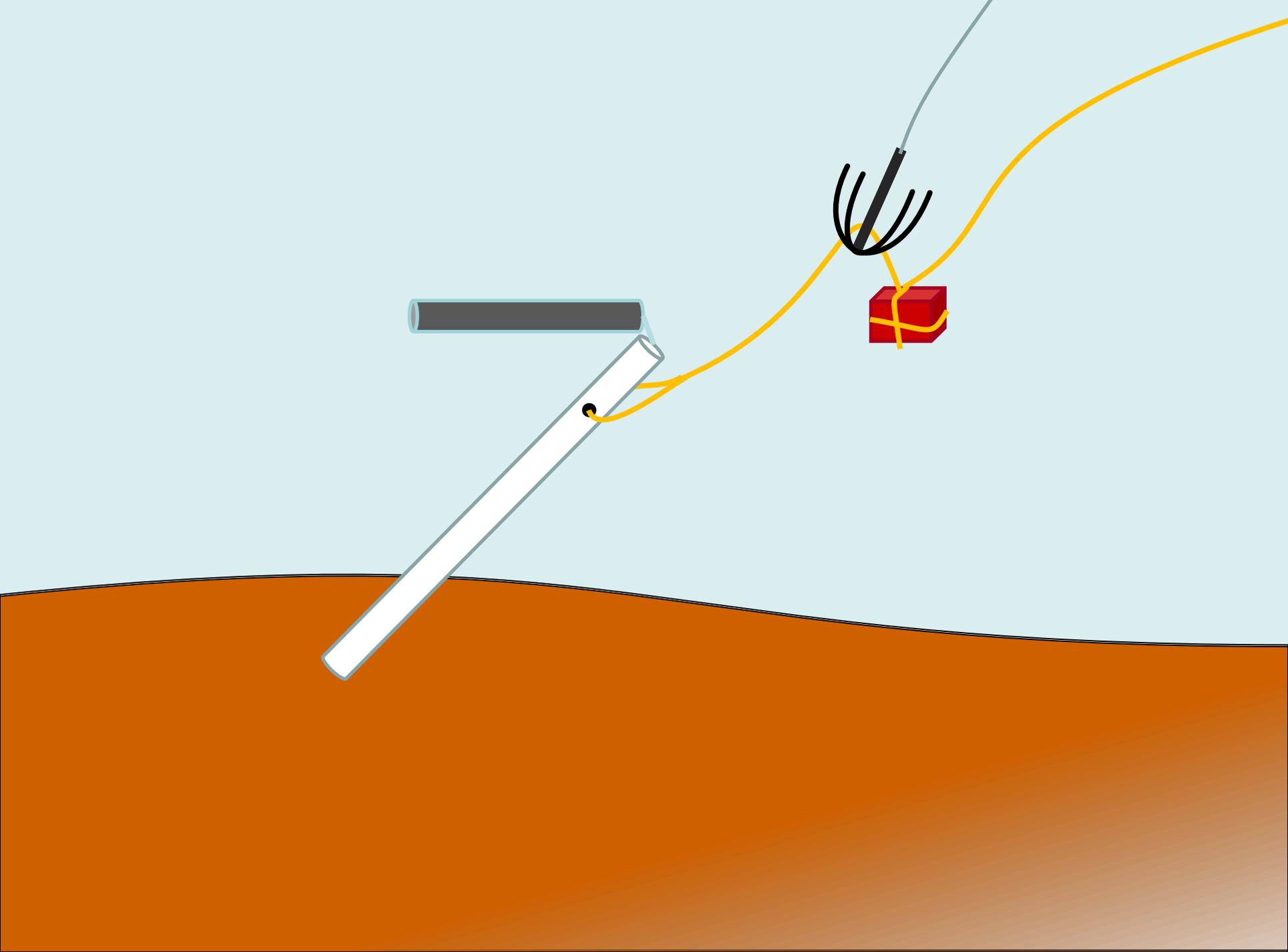
## Objective 2

Improve inputs to the TxBLEND salinity model of the Texas Water Development Board.











## Objective 2

Improve inputs to the TxBLEND salinity model of the Texas Water Development Board.

**Wind:**

Meters/second

**Current:**

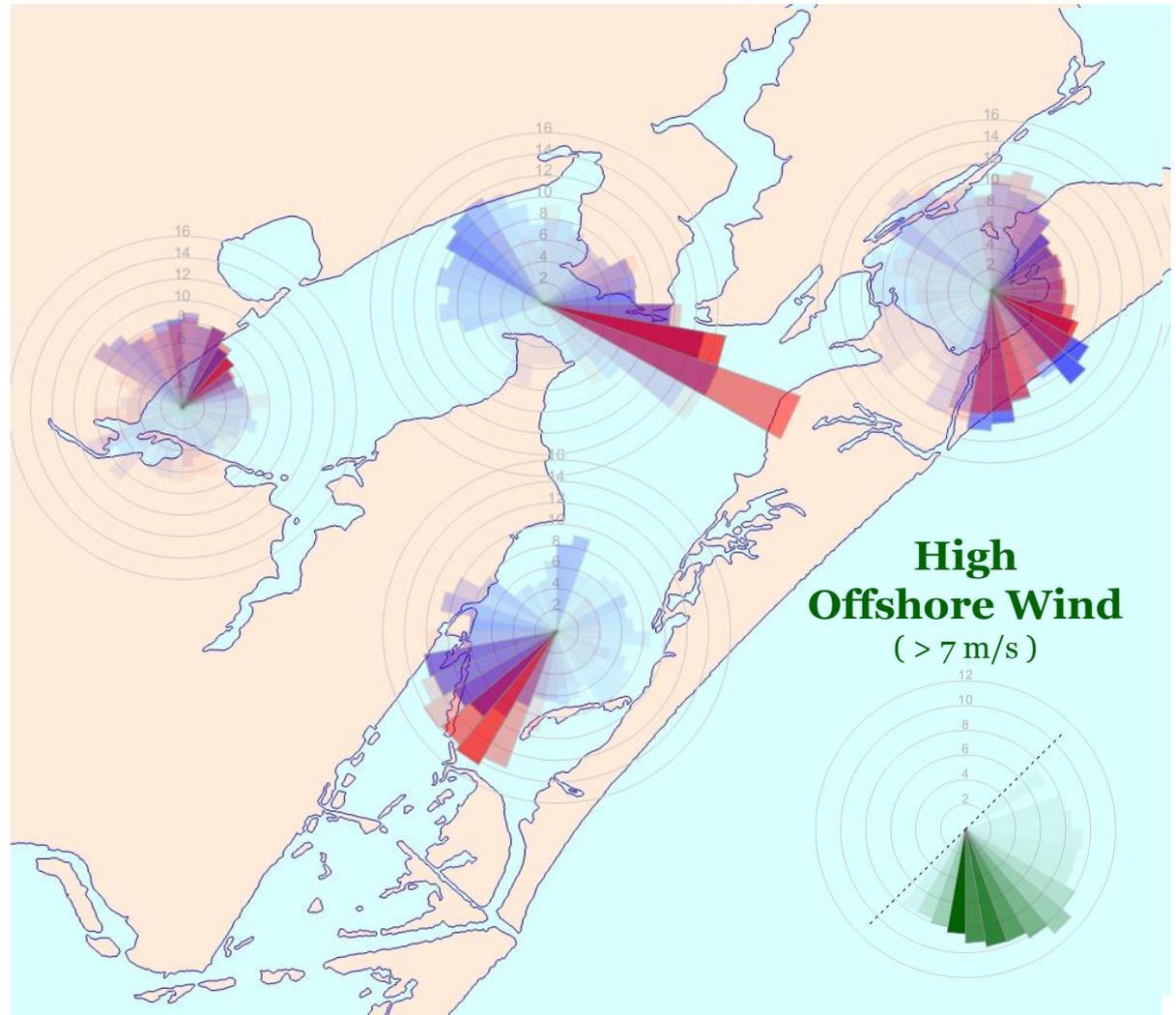
Centimeters/second

**Line length:**

Speed in a direction

**Line Color:**

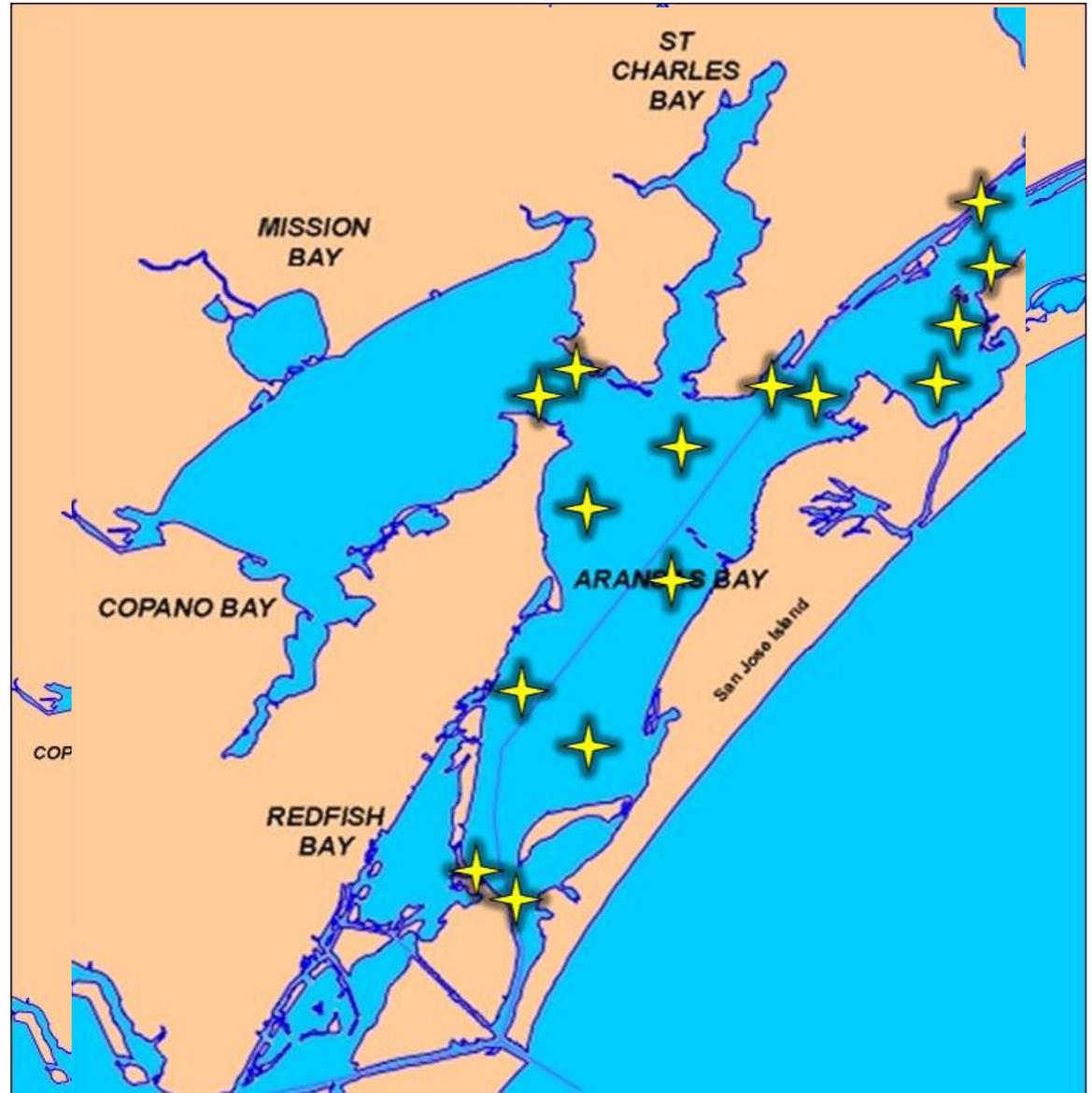
% time in a direction





## Objective 2

Improve inputs to the TxBLEND salinity model of the Texas Water Development Board.





## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

## Freshwater Indicator Species

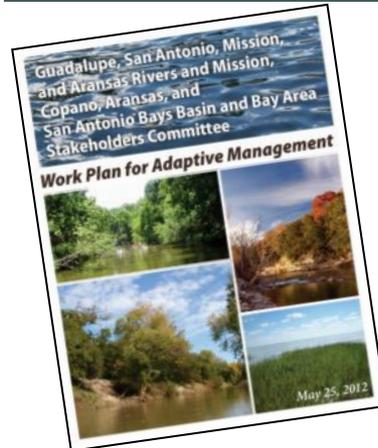
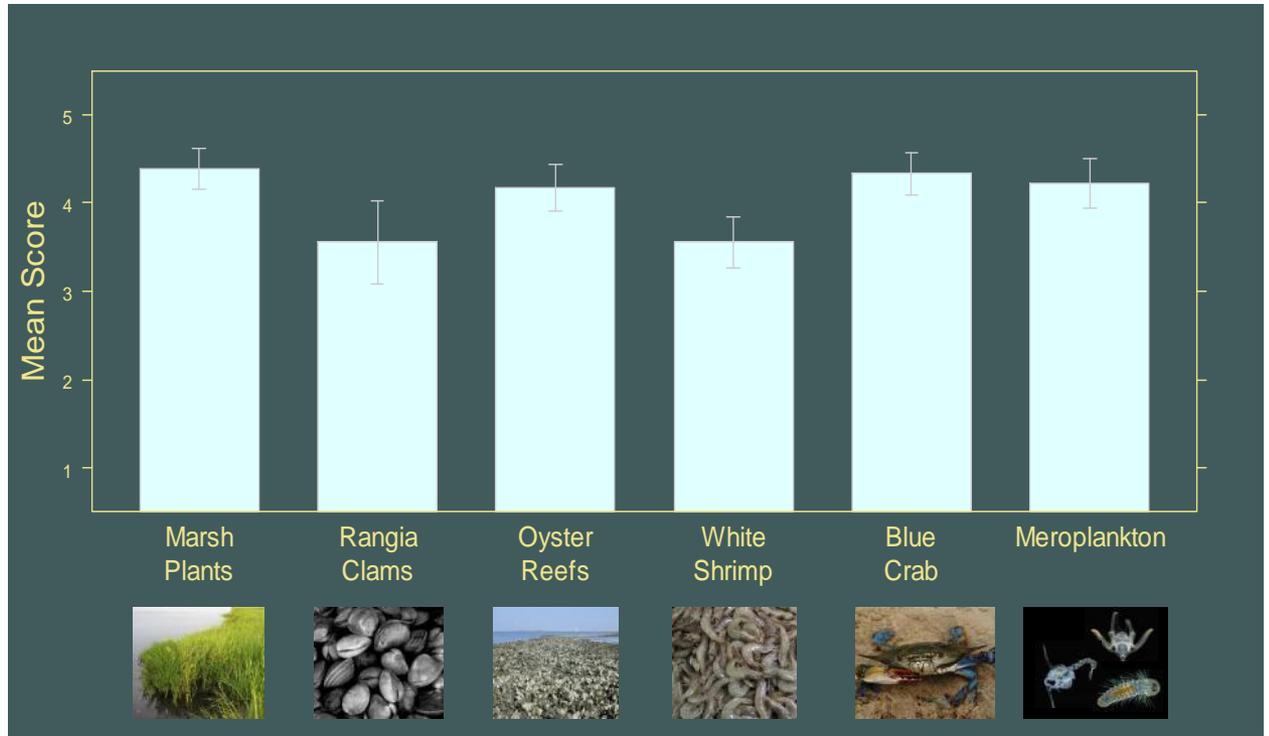




## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

## Freshwater Indicator Species





Data SIO, NOAA, U.S. Navy, NGA, GEBCO

©2010 Google

Texas Orthoimagery Program

27° 58.739' N 96° 58.543' W elev 0 m

Eye alt 61.75 km

17.8 km

Imagery Date: Jan 1, 2009

# Selective Tidal Stream Transport



## Phase 3 *Hydrodynamic Transport*

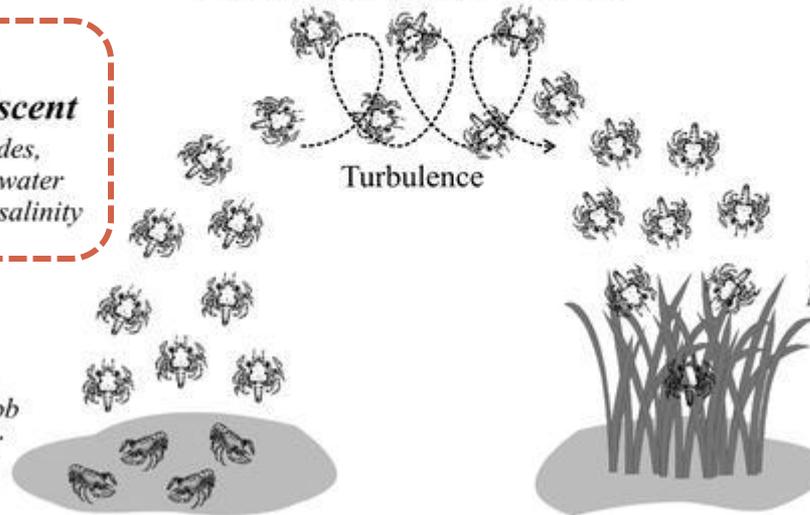
*Megalopae swim in response to high turbulence to maintain their position in the water column and are transported up-estuary by strong flood-tide currents.*

## Phase 2 *Vertical Migration/Ascent*

*During nocturnal flood tides, megalopae ascend into the water column in response to rising salinity*

## Phase 1 *Position Maintenance*

*During the day and nocturnal ebb tides, megalopae maintain their position near the bottom*



## Phase 4 *Settlement/Habitat Selection*

*Near the end of flood tide, megalopae are cued to settle by declining turbulence*



## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

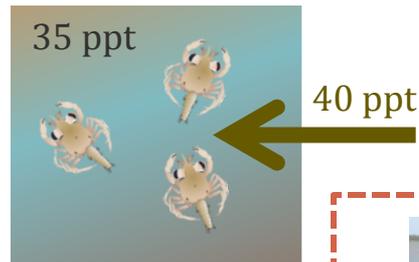
# Blue Crab Research



**LARGE-SCALE  
CITIZEN SCIENCE  
SURVEY OF DAILY  
MEGALOPAL  
SETTLEMENT**

### **DROUGHT**

Add **hypersaline** water



**SMALL-SCALE LAB  
EXPERIMENTS  
ASSESSING  
TRANSPORT  
BEHAVIOR AS A  
FUNCTION OF  
SALINITY**

**MONTHLY  
SURVEYS OF  
JUVENILE  
ABUNDANCE IN  
MESQUITE BAY**

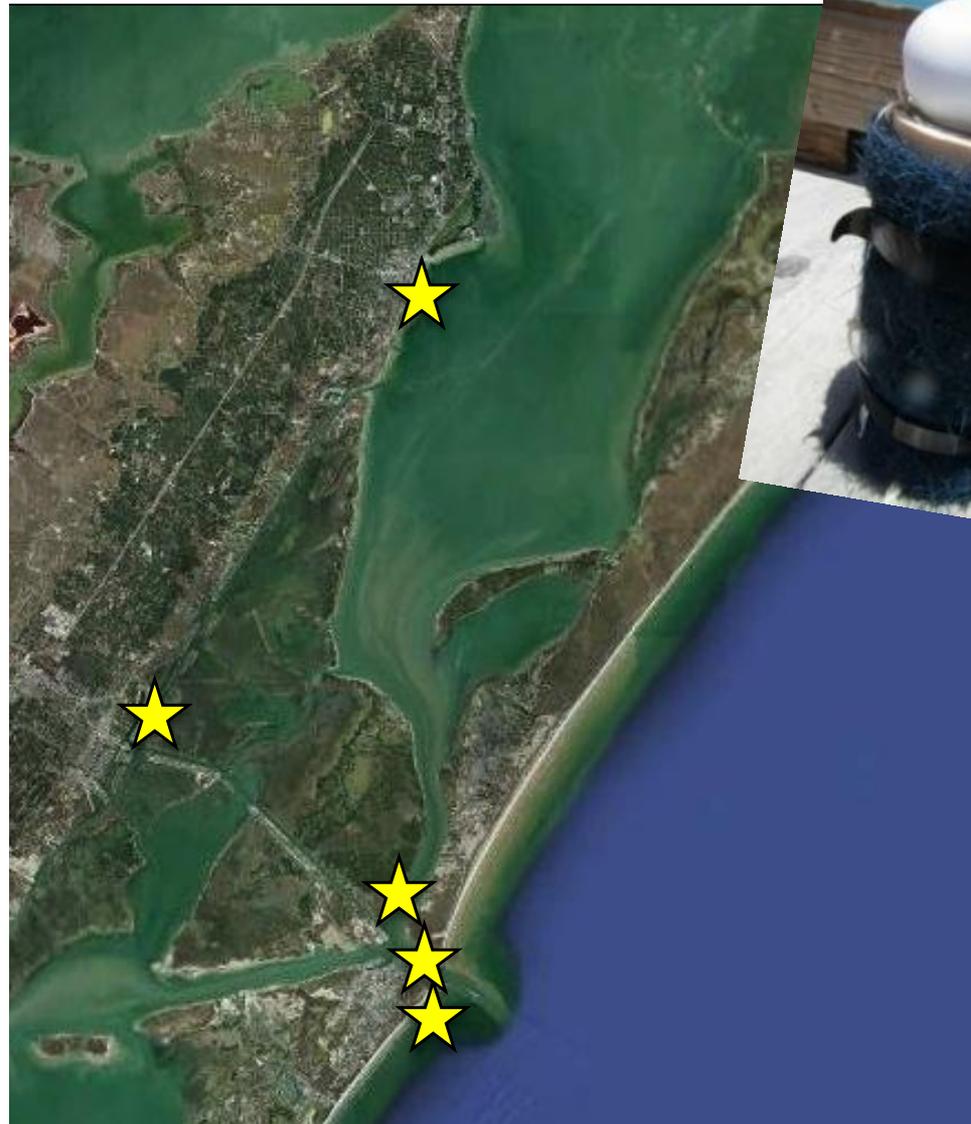




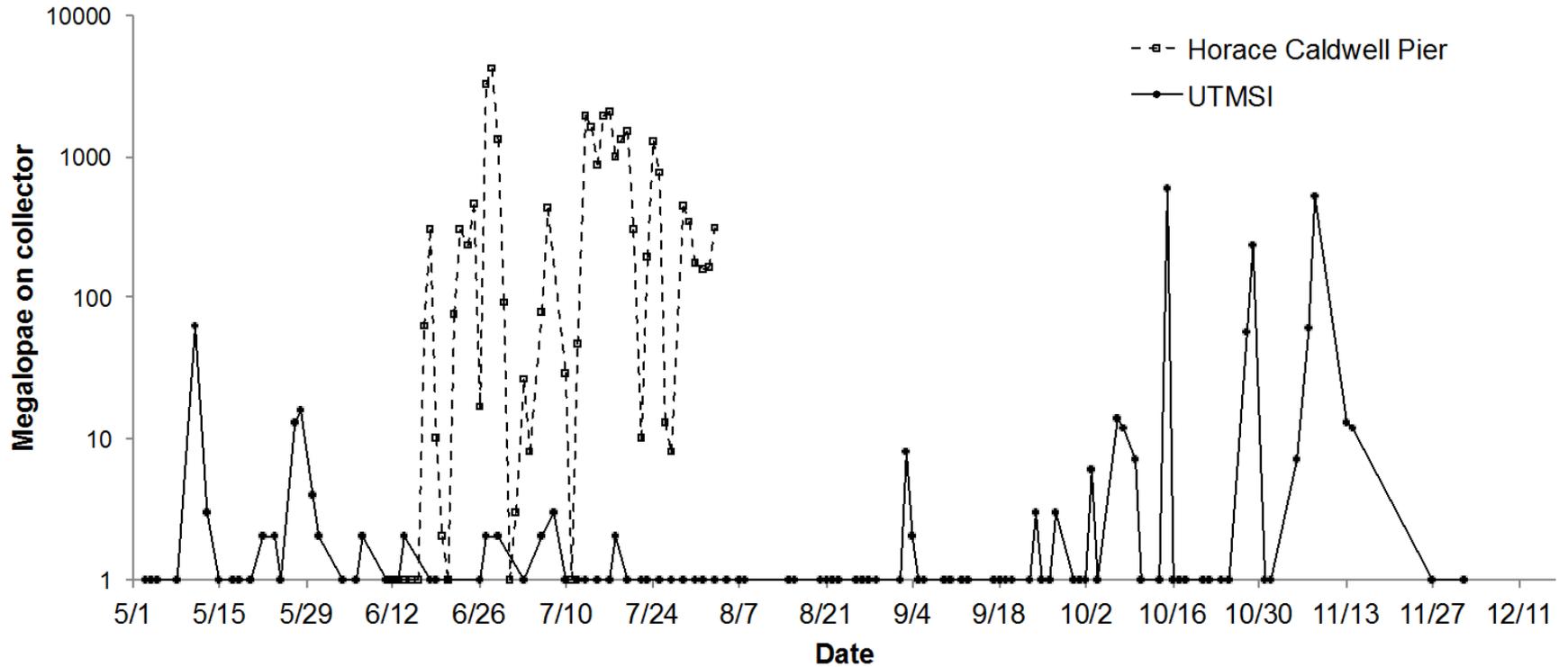
## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

# Blue Crab Research



# Daily Megalopal Abundance

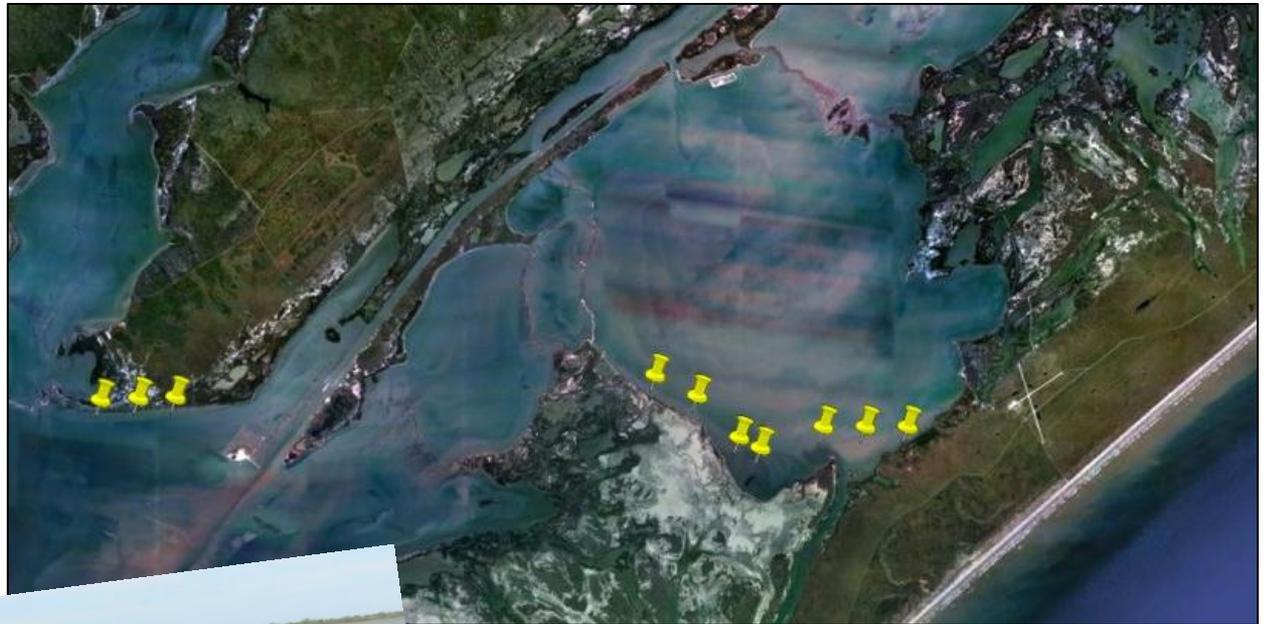




## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

# Blue Crab Research





## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

## Rangia Clam Research

**ARE THE  
POPULATIONS  
VIABLE?**

**WHERE  
ARE THEY?**

**ENVIRONMENTAL  
CONDITIONS WHERE  
THEY ARE FOUND?**

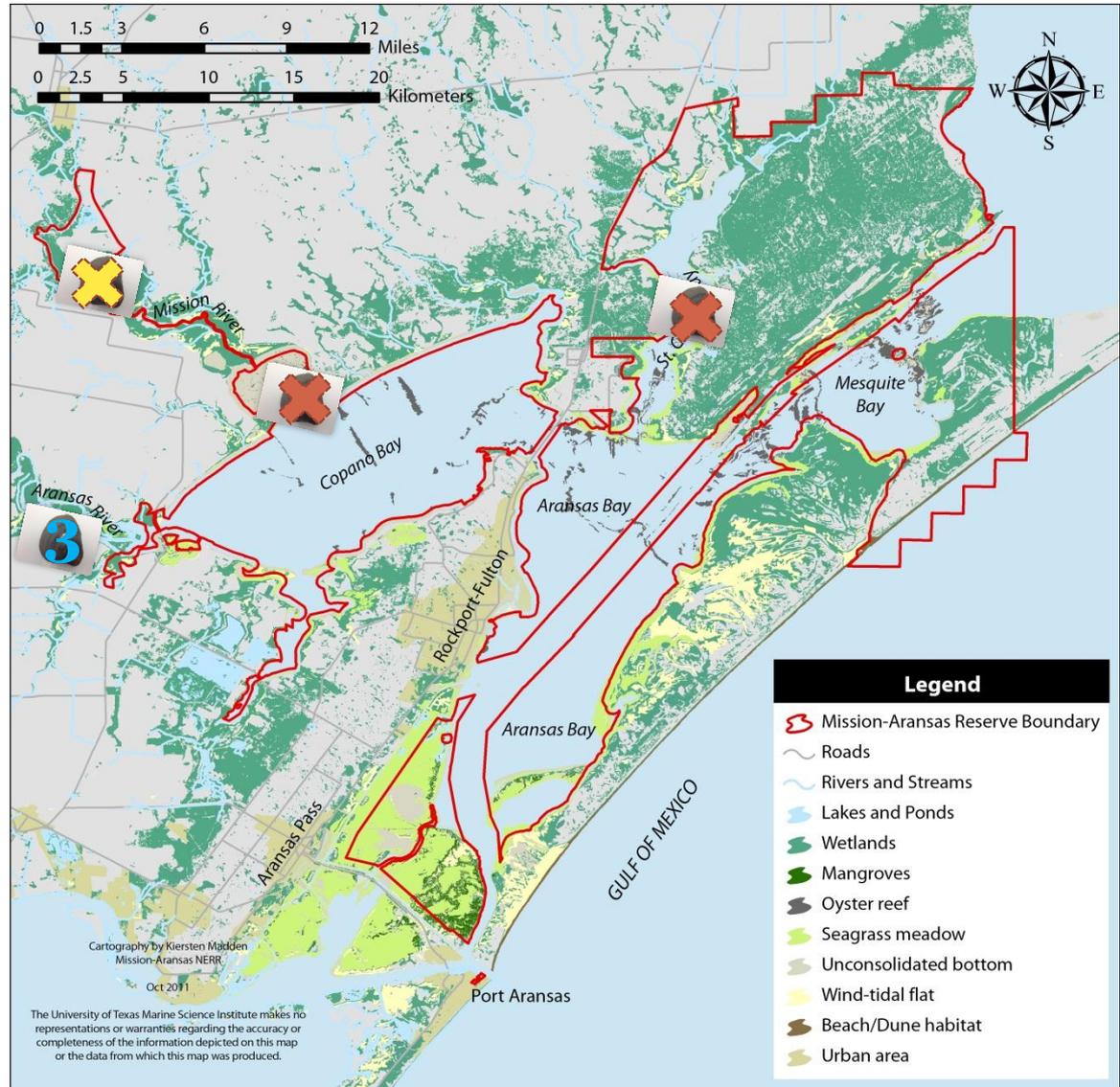




## Objective 3

Collaborate with intended users to identify and conduct a priority research project related to a focal species mentioned in the BBEST report.

# Rangia Clam Research





## Objective 4

Develop shared systems learning among the local stakeholders and scientists for construction of a system dynamics model.

## Mediated Modeling



Restoring the Gulf After Deepwater Horizon

# Implementing the RESTORE Act in Texas

## Workshop Description

Join us for a workshop exploring the RESTORE the Gulf Coast States Act and what it may mean for Texas. Sessions will provide an overview of the Act, including how it links with other regional restoration and recovery processes, and then focus on the various mechanisms it creates, opportunities for public participation, and local, state, and regional restoration priorities and principles. Participants will learn about the latest developments in Texas and have the opportunity to discuss priorities and potential next steps.

## Details

**Date:** Tuesday, July 16, 2013; 9:00 am – 4:00 pm  
**Location:** Visitors Center Auditorium, University of Texas Marine Science Institute (750 Channel View Drive, Port Aransas, TX)  
**Registration:** [Click here to register online](#) or email [hbwade@tamu.edu](mailto:hbwade@tamu.edu)

## Tentative Agenda

9:00 Welcome  
9:15 Overview of Gulf Restoration & Recovery Processes  
10:00 In-Depth Look at the RESTORE Act  
11:00 Participating in RESTORE Act Implementation in Texas  
12:00 Lunch (provided)  
1:00 Ocean and Coastal Restoration: Challenges & Priorities  
2:00 Local and Statewide Restoration Priorities  
2:45 Moving Forward: Next Steps  
3:45 Wrap-Up & Evaluations

Tuesday, JULY 16

9:00am - 4:00pm

UTMSI Auditorium

750 Channel View Dr.  
Port Aransas, TX 78373



# Questions?



**Paulami Banerjee – Texas A&M University College Station**

**Kimberly Bittler – University of Texas Marine Science Institute**

**Catherine Buchalski – University of New Hampshire**

**Dr. Ed Buskey – Mission-Aransas NERR**

**Dr. Zack Darnell – Mission-Aransas NERR**

**Dr. Ken Dunton – University of Texas Marine Science Institute**

**Dr. Bill Grant – Texas A&M University College Station**

**Kristin Hicks – Mission-Aransas NERR**

**Dr. Kiersten Madden – Mission-Aransas NERR**

**Sally Palmer – Mission-Aransas NERR**

**Dr. Tarla Rai Peterson – Texas A&M University College Station**

**Candace Peyton – Mission-Aransas NERR**

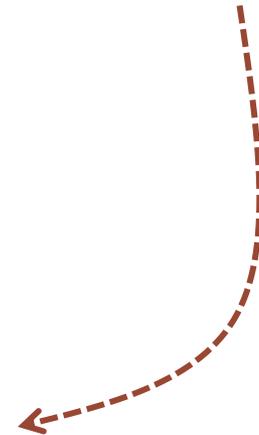
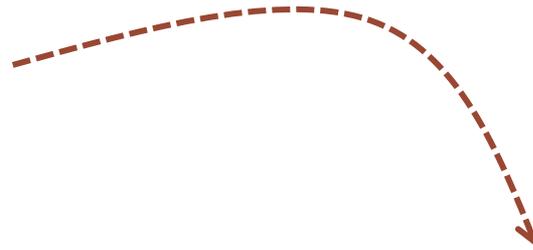
**Chara Ragland – Texas A&M University College Station**

**Dr. Lindsay Scheef – Mission-Aransas NERR**



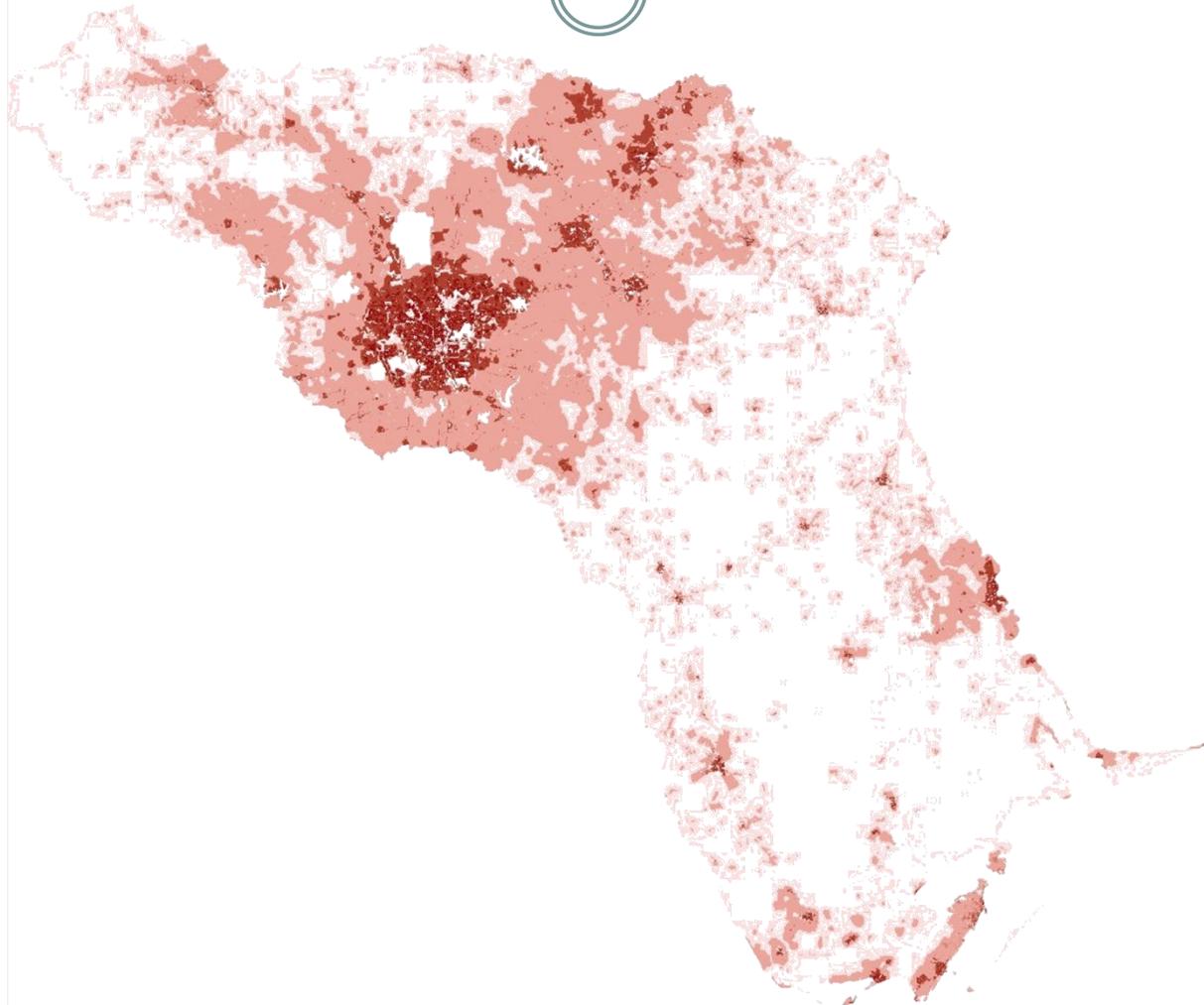
**NATIONAL ESTUARINE  
RESEARCH RESERVE SYSTEM  
SCIENCE COLLABORATIVE**

This project is funded by the National Estuarine Research Reserve System Science Collaborative, a partnership of the National Oceanic and Atmospheric Administration and the University of New Hampshire.



**NATIONAL ESTUARINE  
RESEARCH RESERVE SYSTEM  
SCIENCE COLLABORATIVE**

# People Per Acre





## Future Land Use

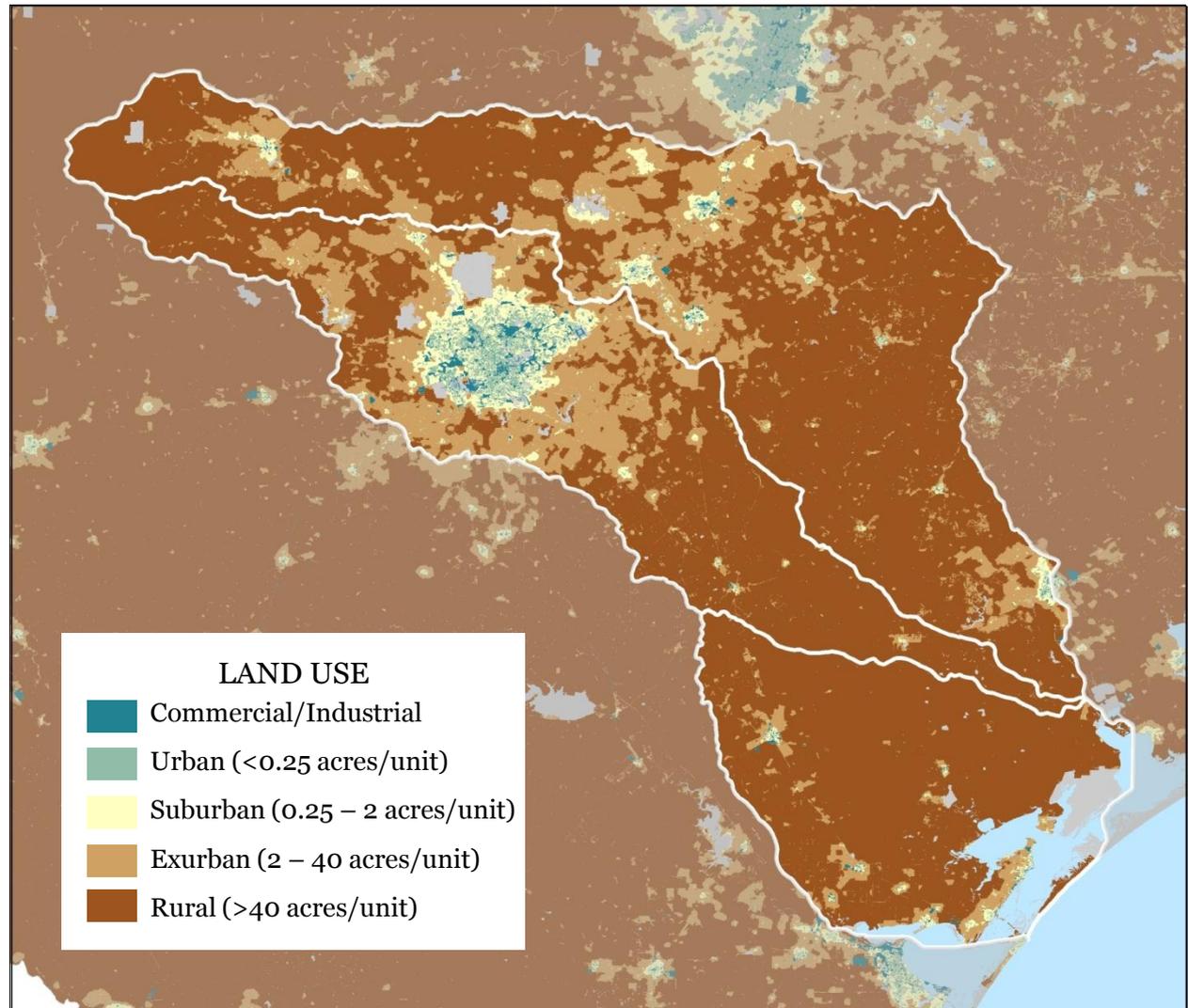
This scenario consists of a low population projection and a slightly compact development pattern, which results in the least altered landscape for most areas of the U.S..

B1: Rapid social development in developing regions.

Population rises rapidly until mid-century, then falls below replacement levels.

Fertility and average U.S. household size decrease.

Domestic migration is low, but net international migration is high.



**ICLUS: INTEGRATED CLIMATE AND LAND USE SCENARIOS**



## Future Land Use

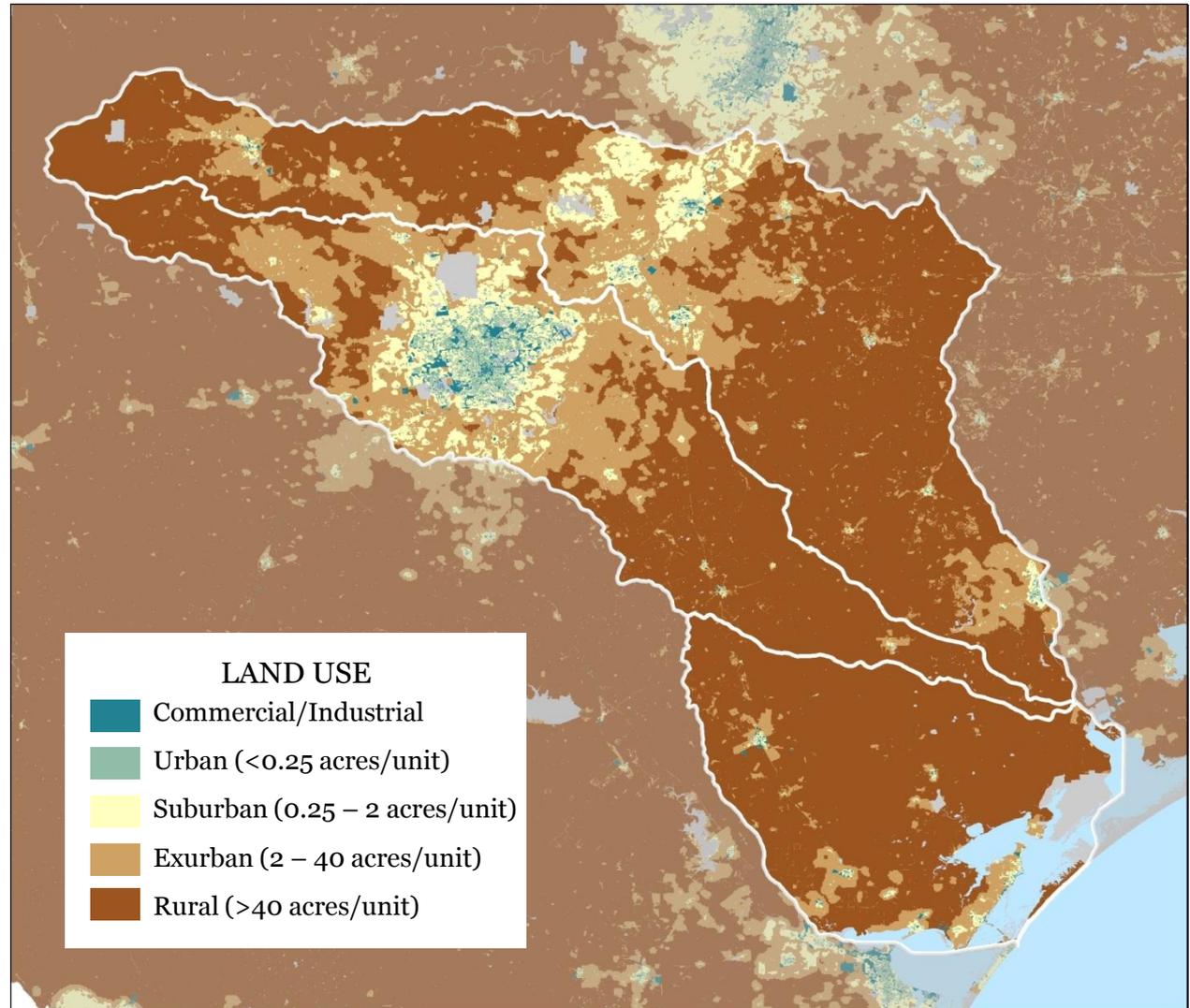
This is the highest ICLUS population projection and for most areas in the U.S. represents a “worst case” pattern of development.

A2: Slower rate of economic growth.

Restricted flow of people and ideas across regions.

Fertility and average U.S. household size increase.

Domestic migration is high, but net international migration is moderate.



**ICLUS: INTEGRATED CLIMATE AND LAND USE SCENARIOS**