

Over 30 Years of Freshwater Inflow Research in the Lower Laguna Madre

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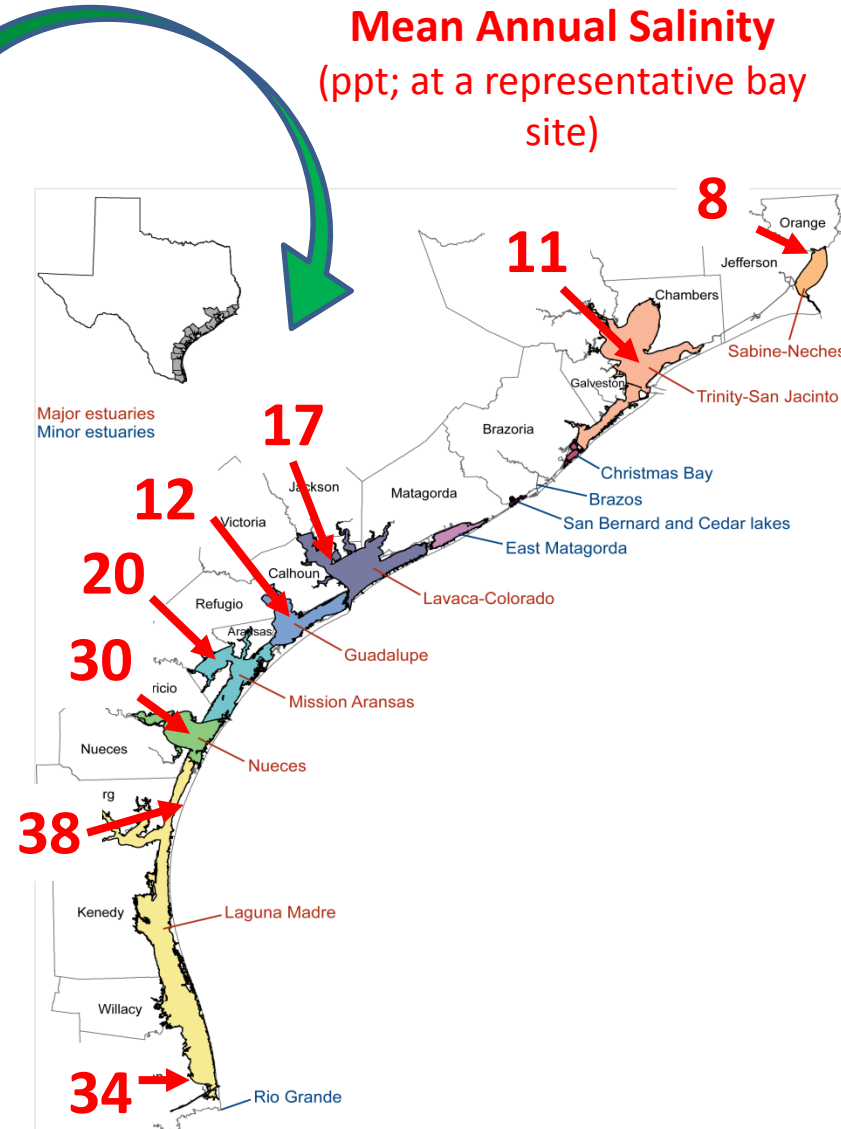
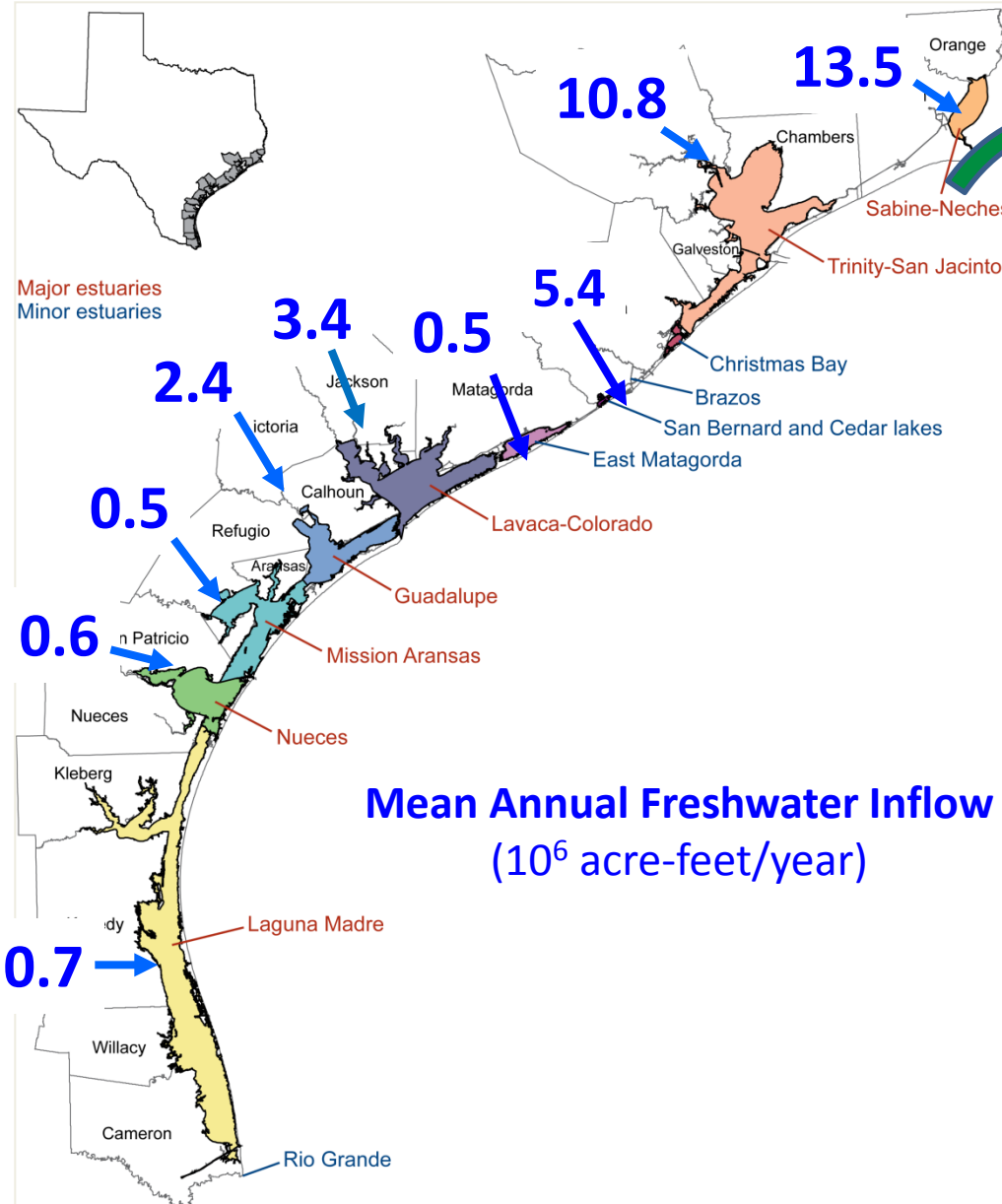
Lower Rio Grande Valley 18th Annual Water Quality

Management & Planning Conference

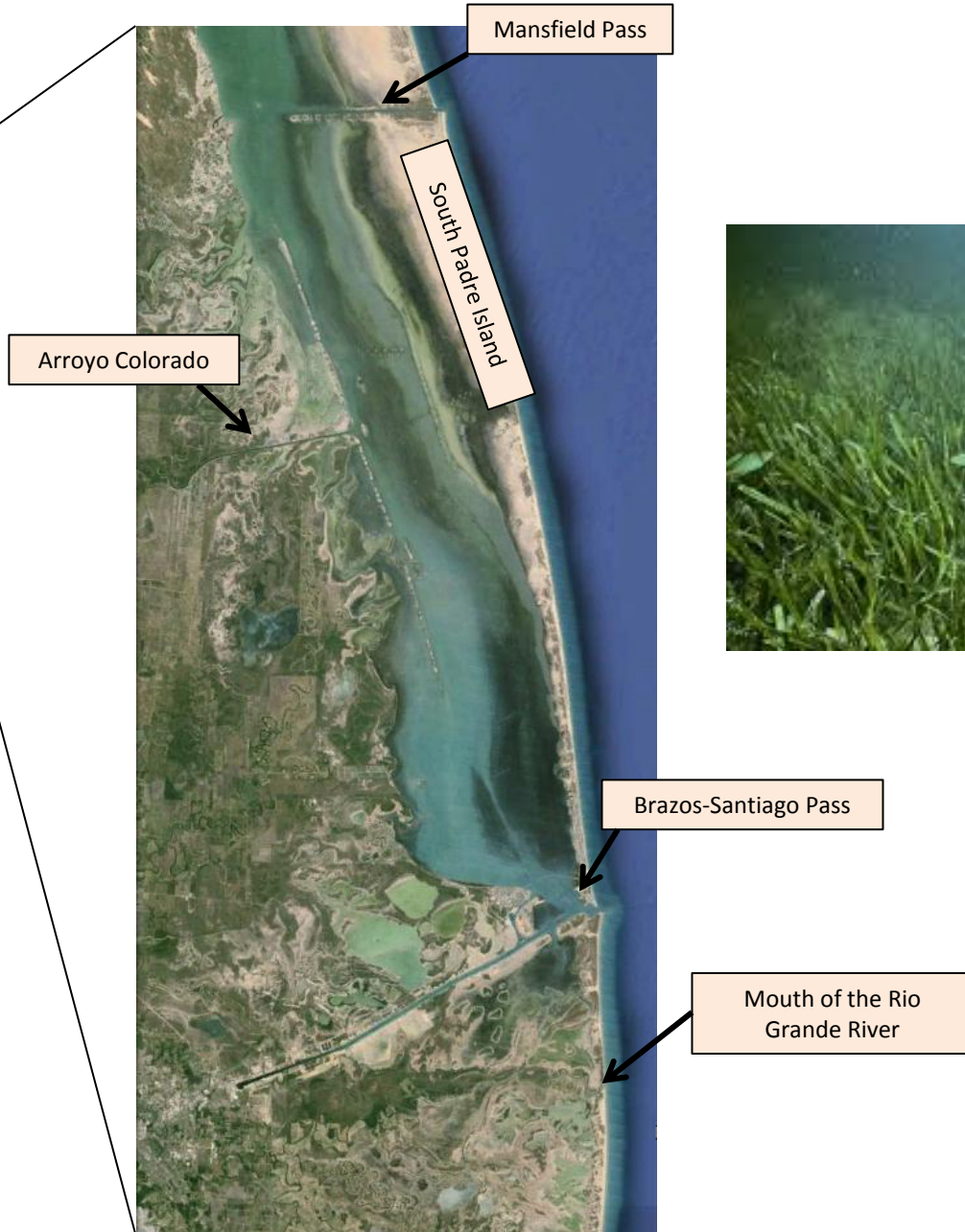
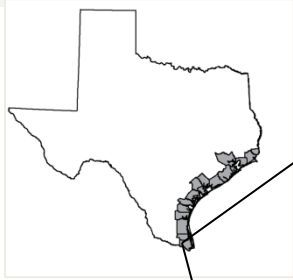
May 19, 2016

The statements contained in this presentation are my current views and opinions and are not intended to reflect the positions of, or information from, the Texas Water Development Board, nor is it an indication of any official policy position of the Board.

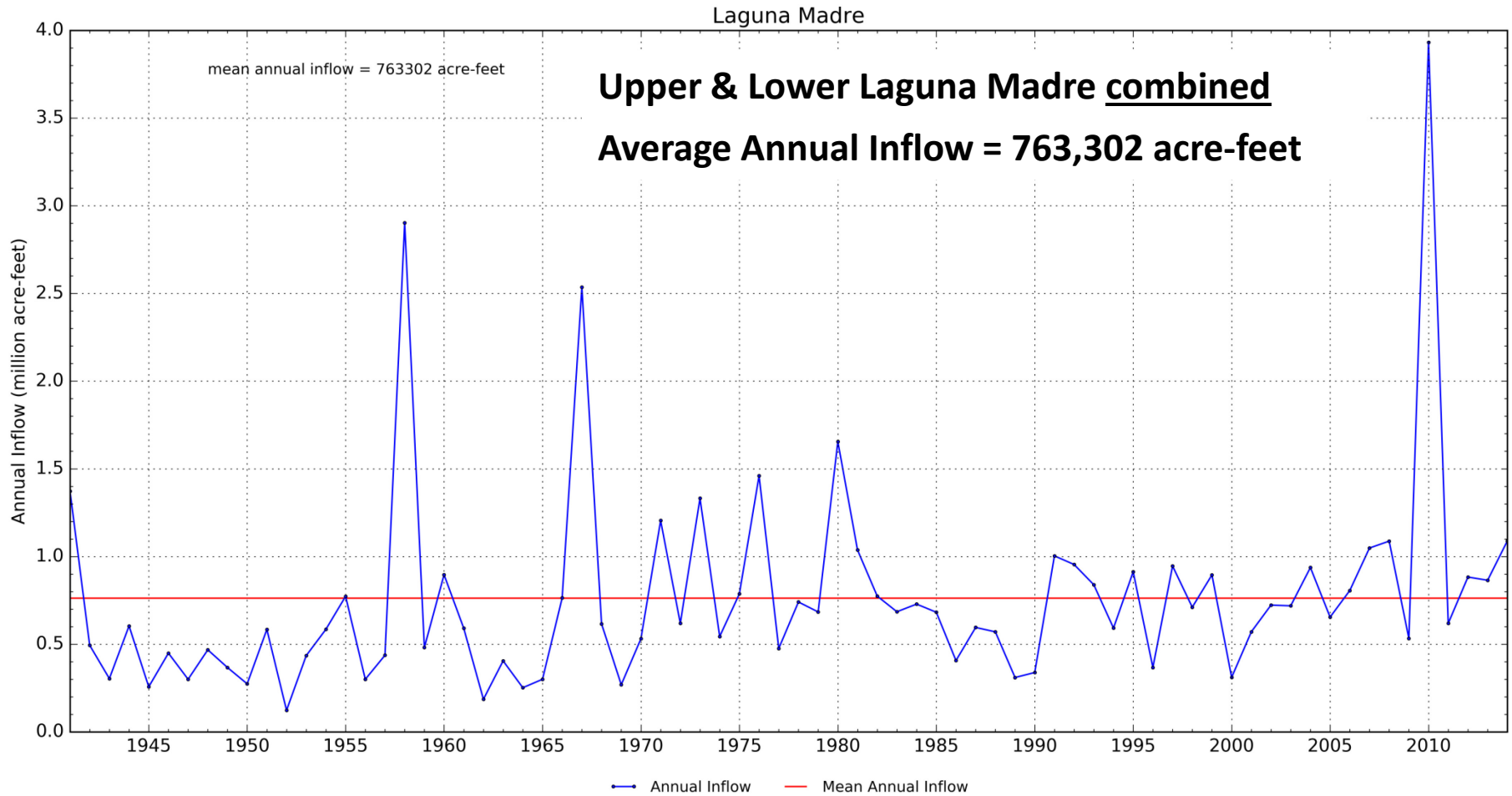
Average Annual Freshwater Inflow and Salinity in Texas Estuaries



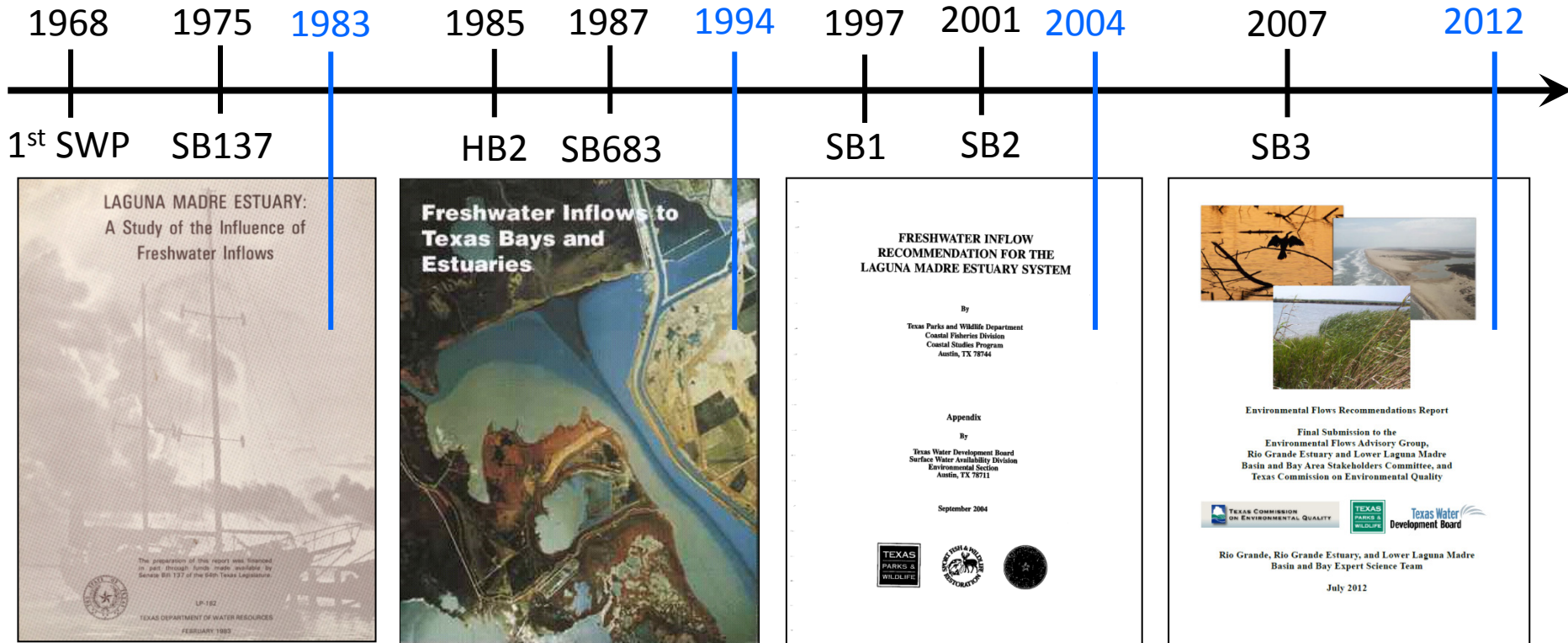
Lower Laguna Madre Ecosystem



Average Annual Inflow to Laguna Madre 1941 - 2014



Timeline of Freshwater Inflow Studies in the Laguna Madre



Texas Water
Development Board



Website: <http://www.twdb.texas.gov/surfacewater/bays/index.asp>

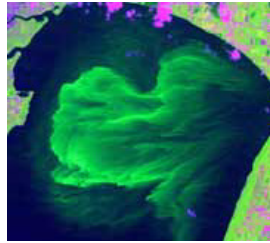
Email: coastal-data@twdb.texas.gov

1983, LP 182 - A study of the Influence of Freshwater Inflows

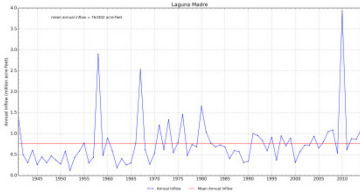
Methodology:



Fisheries Harvest



Water Quality & Nutrient Analysis

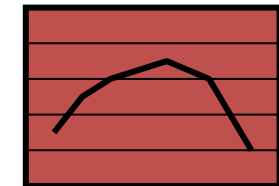


Hydrology & Salinity



Primary & Secondary Bay Production

Regression Analyses

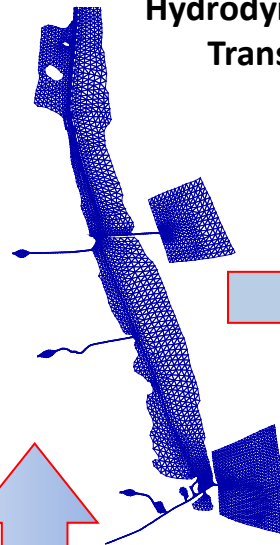


Optimization Model

Goal: Maintain the productivity of economically important and ecologically characteristic fish & shellfish species

Harvest Species: Red drum, Seatrout, Black drum, White shrimp, Brown and Pink shrimp (self-reported commercial landings data)

Hydrodynamic & Salinity Transport Model

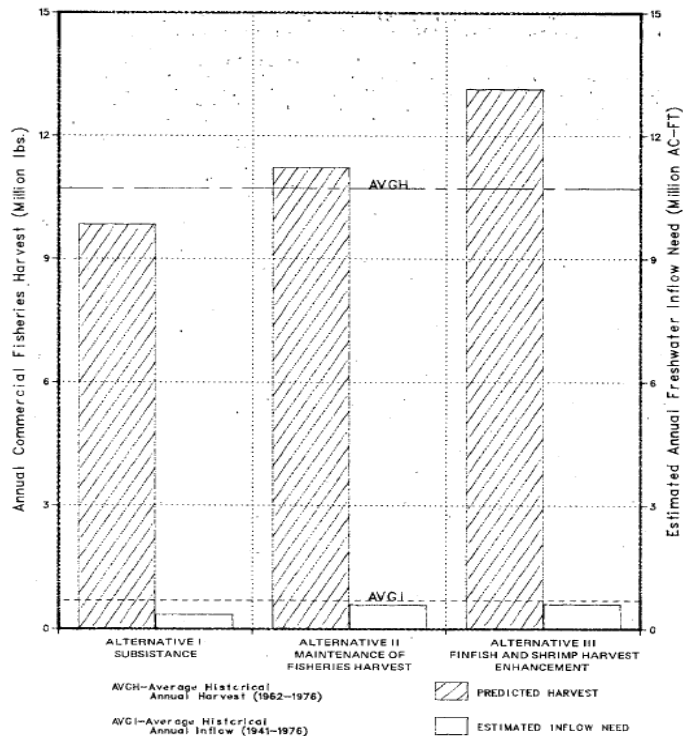


Recommendations

1983, LP182 - Inflow Recommendations for the Lower Laguna Madre

Three management scenarios representing different ecological functions:

- 1) Alternative I: Provide Salinity Gradient
- 2) Alternative II: Maintain Fisheries Harvest
- 3) Alternative III: Maximize Fisheries Harvest



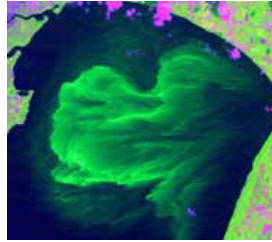
Management Goal	Freshwater Inflow Acre-Feet/Year	Percentile of Historical Inflow 1977-2010
Alternative I:	306,250	16 th
Alternative II:	527,970	68 th
Alternative III:	532,000	69 th

Longley (1994) Report on State Methodology

Objectives & Constraints



Fisheries Regression Analysis



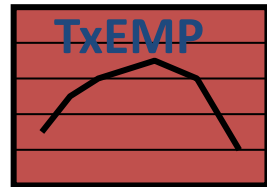
Nutrient Analysis



Sediment Analysis



Hydrographic Survey

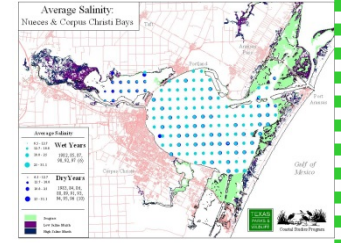


Optimization Model

Verification



Fisheries Needs Analysis

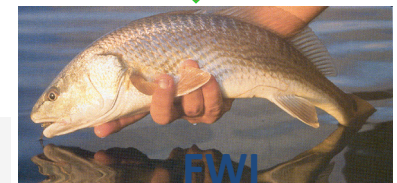
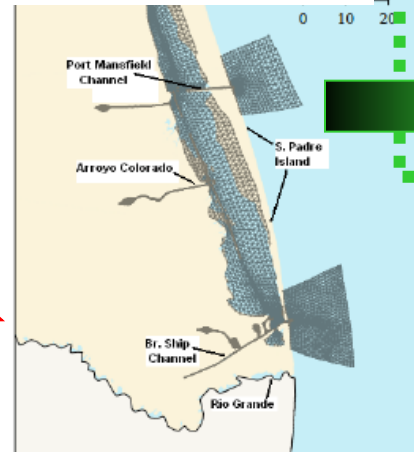


Hydrology



Habitat Analysis

TxBLEND
Hydrodynamic & Salinity
Transport Model



Recommendations

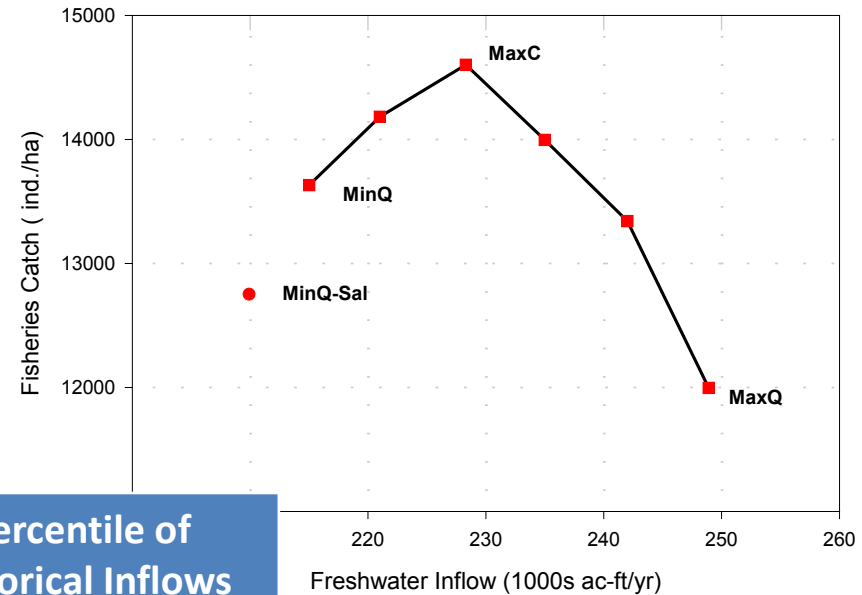
2004 - Inflow Recommendations for the Lower Laguna Madre (TWDB)

Goal: Maintain the unique biological communities and ecosystem characteristics of a “healthy” Laguna Madre system.

Method: State Methodology described in Longley (1994)

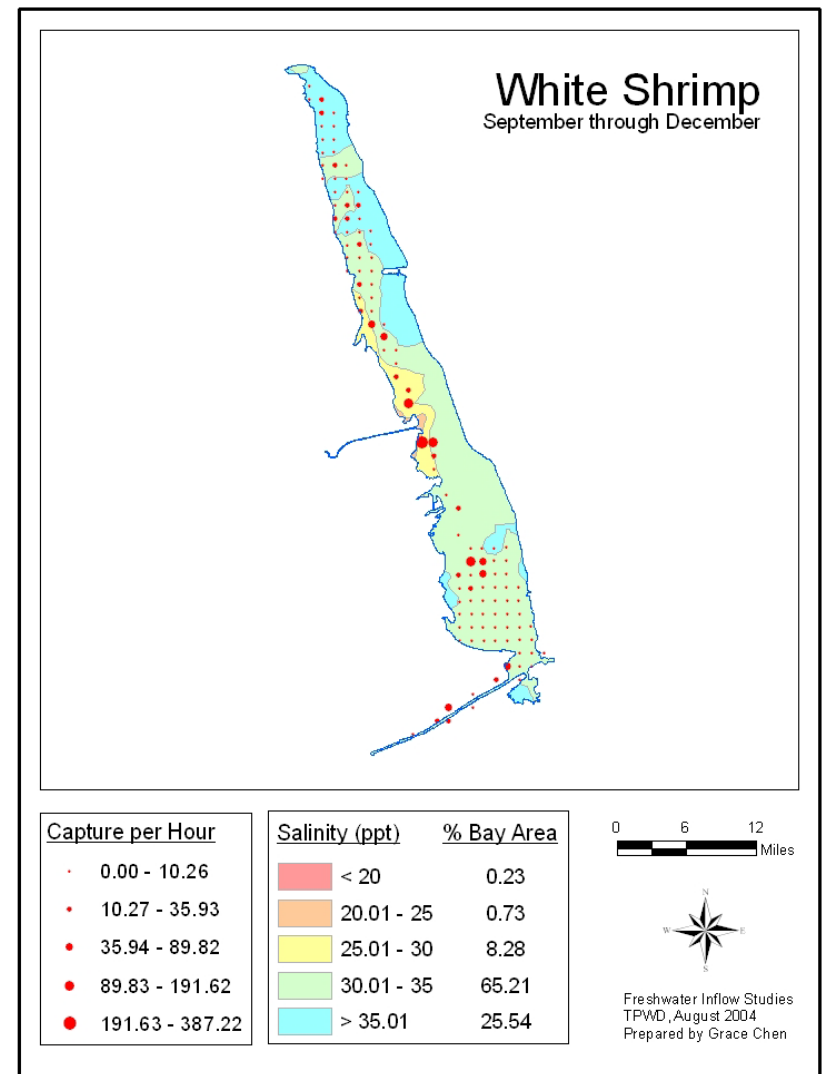
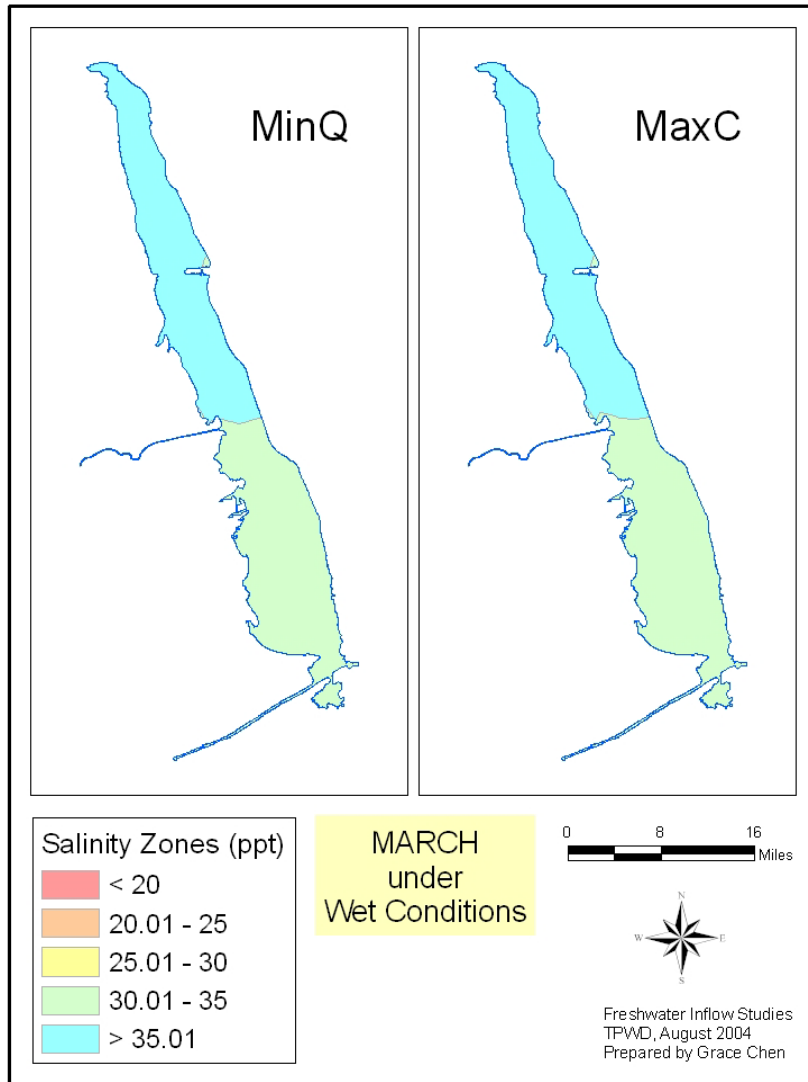
Harvest Species: Blue Crab, Brown Shrimp, White Shrimp, Atlantic Croaker, Spot, and Pinfish (TPWD Coastal Fisheries Data)

TxEMP model solutions for the Lower Laguna Madre



Management Goal	Inflow Acre-Feet/Year	Percentile of Historical Inflows 1977-2010
MinQ-Sal (Critical FWI)	209,890	0
MinQ (Maintain Fisheries)	214,950	0
MaxC (Max Catch)	228,340	0
MaxQ	248,900	2 ND

2004 - Verification of Inflow Recommendations for the Lower Laguna Madre (TPWD)

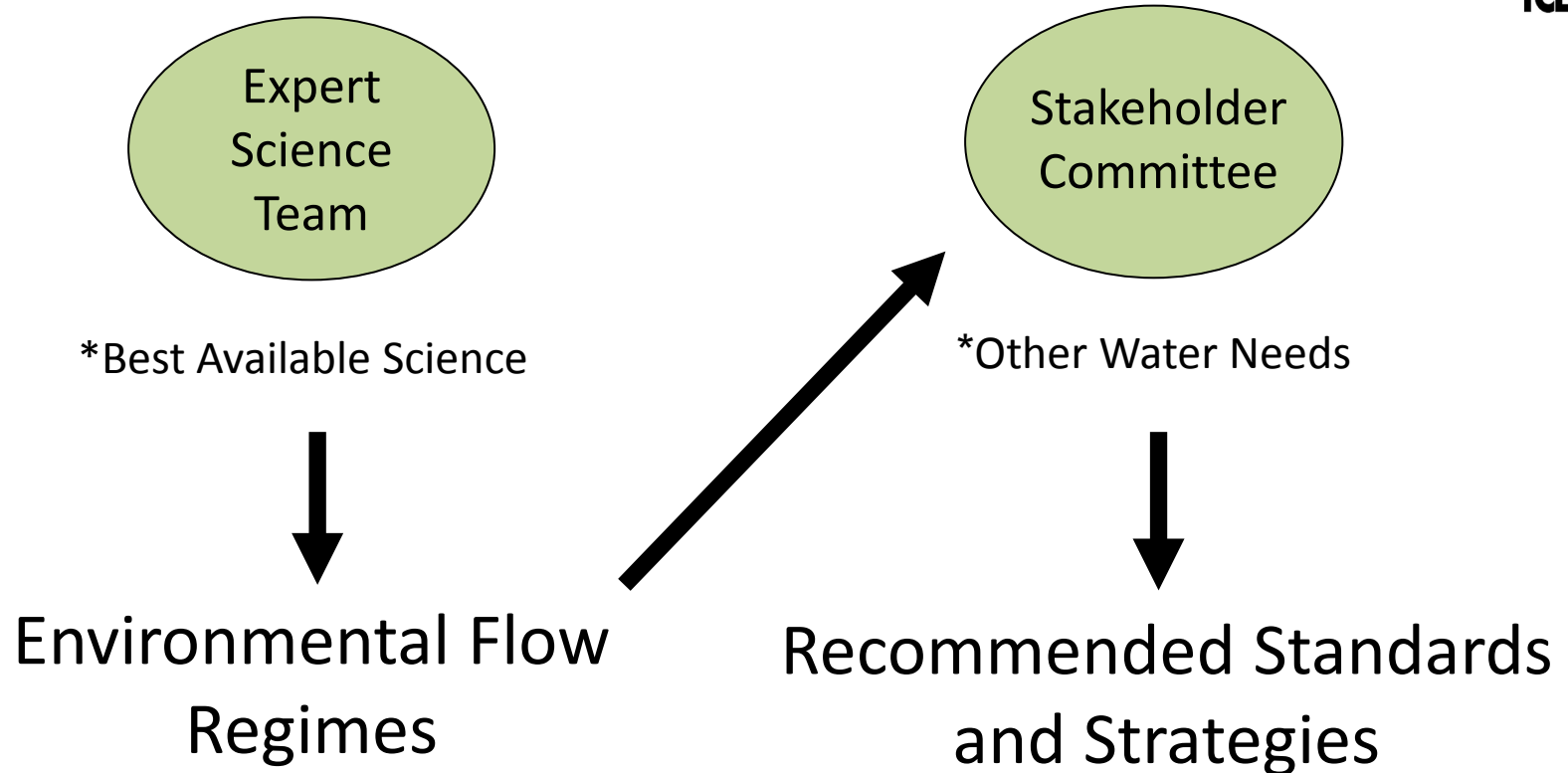


Texas Senate Bill 3 Process for Environmental Flows

Goal:

(1) How much water is needed to sustain a ***sound ecological environment*** in the state's rivers and estuaries?

(2) How can this water be protected?



2012 Senate Bill 3 – Expert Science Team Methodology

Goal: Provide an environmental flow regime that will maintain a sound ecological environment.

Focal Species: Seagrasses

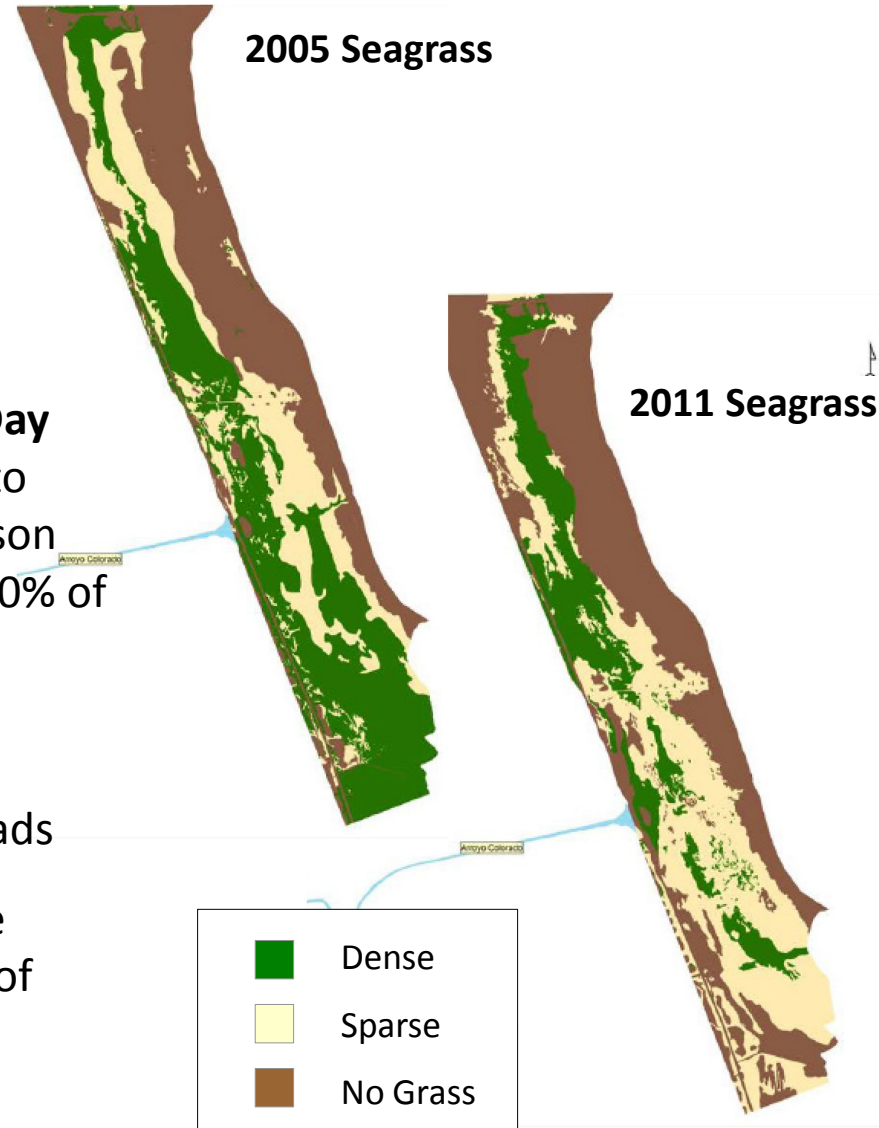
Halophila, Halodule, Thalassia, and Syringodium

Methodology:

1) Analysis of Natural Flows versus Modern Day Flows: Modern flows are elevated relative to natural flows, especially during the dry season (Oct – March). Natural flows were 11% to 40% of modern flows.

- High inflows, lower salinity conditions
- Inflows dominated by high nutrient loads

2) Seagrass change analysis: Percent coverage decreased by half from 2005 to 2011 (18% of study area).

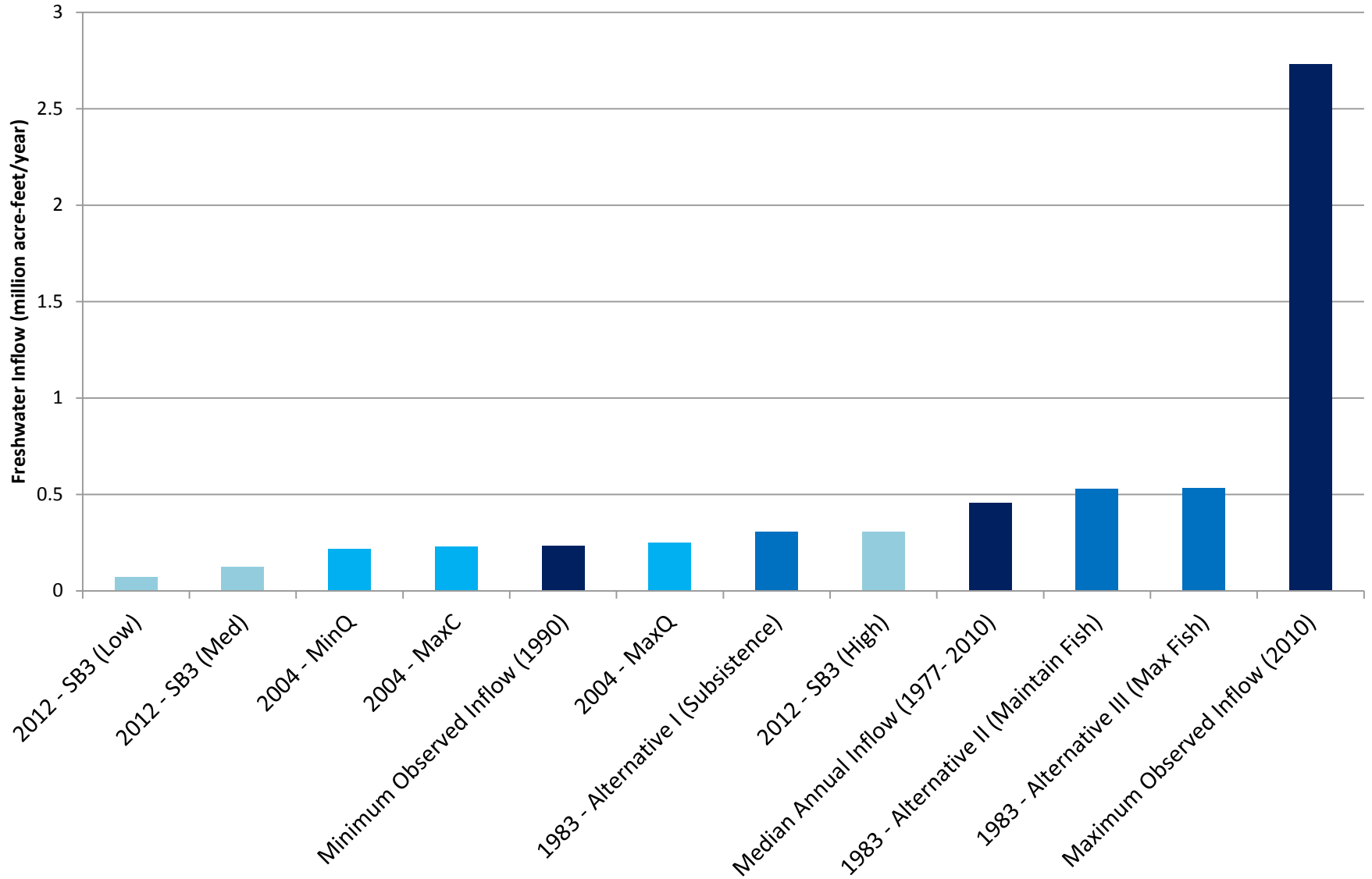


2012 Senate Bill 3 – Expert Science Team Freshwater Inflow Recommendations

Less freshwater inflow, Reduce nutrient loading, Improve water quality

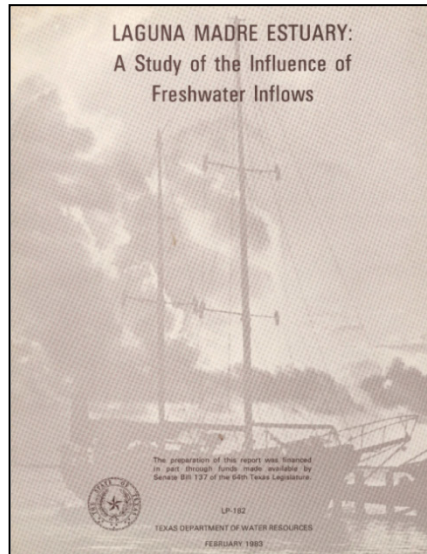
Freshwater Inflow Acre-Feet/Year	Percentile of Natural Flows	Percentile of Historical Inflows (1977 - 2010)
69,006	25 th	0
120,840	50 th	0
306,318	75 th	16 th

Comparison of All Freshwater Inflow Recommendations for the Lower Laguna Madre

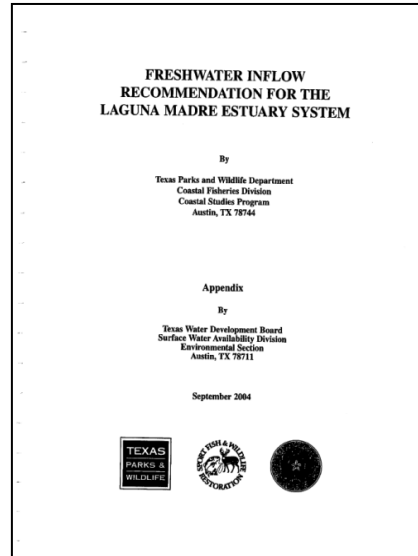


Summary for the Lower Laguna Madre

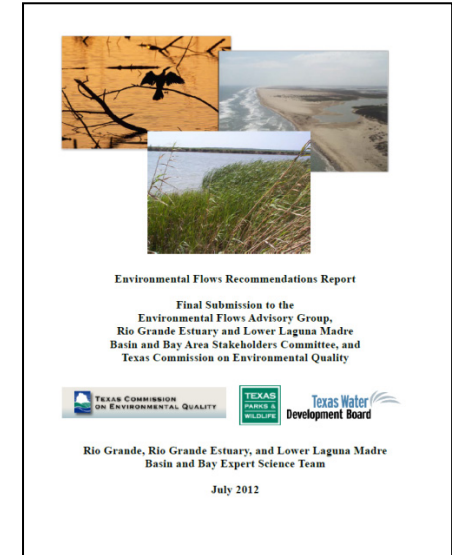
1983



2004



2012



Environmental Flow Standards for the Lower Laguna Madre were not specified in rules of the Texas Commission on Environmental Quality. Title 30, Texas Administrative Code (TAC), Subsection 299(H).

THANK YOU!

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A close-up photograph of hands being washed under a stream of water, with water splashing around the fingers. The background is a bright blue sky with light clouds. The image is framed with white, wavy borders at the top and bottom.

WATER *for* **TEXAS**
2017 conference

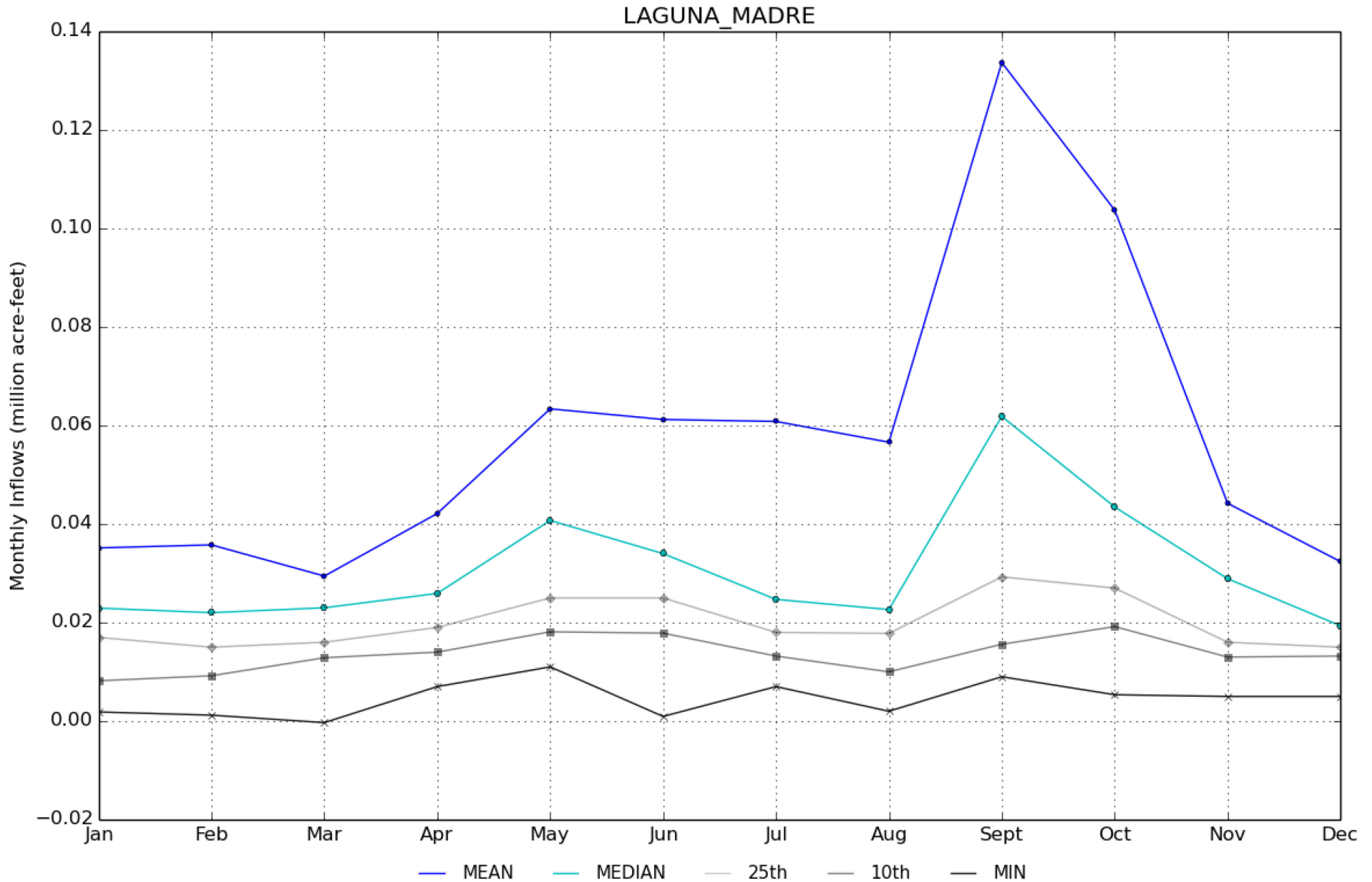
January 23-25, 2017

**AT&T Conference Center,
Austin, Texas**

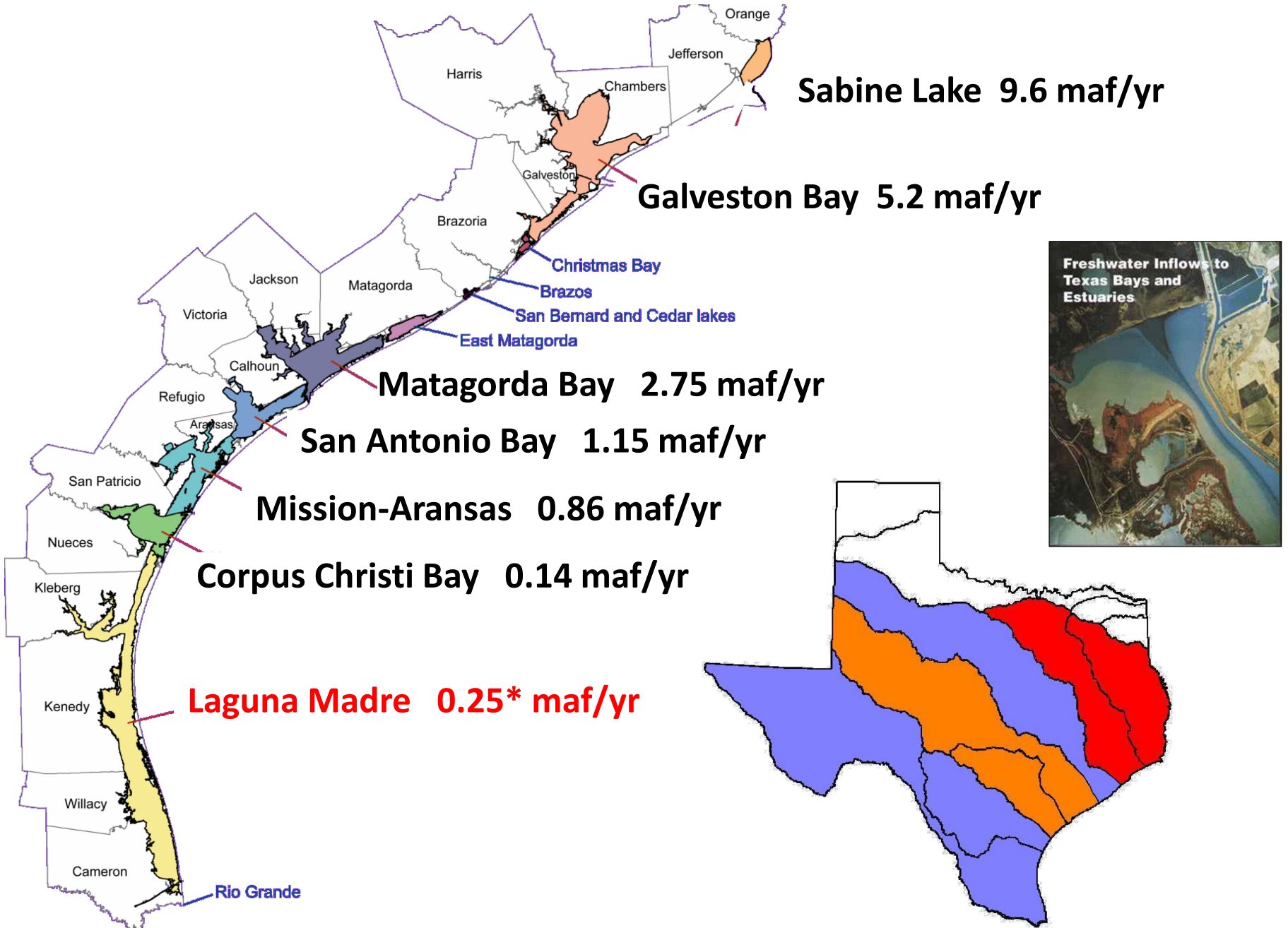
Hosted by the TWDB

WaterForTexas.twdb.texas.gov

Average Monthly Inflow Distribution



Existing Freshwater Inflow Recommendations for Texas Estuaries



2012 Senate Bill 3 – Freshwater Inflow Recommendations

Less freshwater inflow, Reduce nutrient loading, Improve water quality

Dry Season (October – March) Acre-Feet/Month				Wet Season (April – September) Acre-Feet/Month		
Percentile	Existing (1999-2008)	Natural	%Nat/Existing	Existing (1999-2008)	Natural	%Nat/Existing
25 th	16,872	3,613	21.4	21,214	7,888	37.2
50 th	19,610	5,695	29.0	31,213	14,445	46.3
75 th	25,504	12,901	50.6	51,620	38,152	73.9

Comparison of all FWI Recommendations for Lower Laguna Madre

Level	Recommended Inflow (maf/yr)	Study Report
SB3 (Low)	0.069	SB3 (2012)
2004 - MinQ	0.215	TPWD 2004
2004 - MaxC	0.228	TPWD 2004
Minimum Observed Inflow (1990)	0.234	TWDB #201101-L
2004 - MaxQ	0.249	TPWD 2004
LP 182 - Subsistence (Alternative I)	0.306	LP-182 (1983)
SB3 (High)	0.306	SB3 (2012)
Median Annual Inflow	0.455	TWDB #201101-L
LP 182 - Maintenance of Fisheries Harvest (Alternative II)	0.528	LP-182(1983)
LP 182 - Shrimp Harvest Enhancement (Alternative III)	0.532	LP-182(1983)
Maximum Observed Inflow (2010)	2.726	TWDB #201101-L

Early Rendition of a “Flow Regime”

TWC Section 11.147 (a) (1975) - Defines *Beneficial Inflows* As the “**Salinity, Nutrient, and Sediment Loading Regime** Adequate to Maintain an Ecologically Sound Environment in the Receiving Bay and Estuary System That is Necessary for **the Maintenance and Productivity of Economically Important and Ecologically Characteristic Sport or Commercial Fish and Shellfish Species and Estuarine Life** Upon Which Such Fish and Shellfish Are Dependent.”



The Fundamental Scientific Basis of the Studies



The Fundamental Goal of the Recommendations

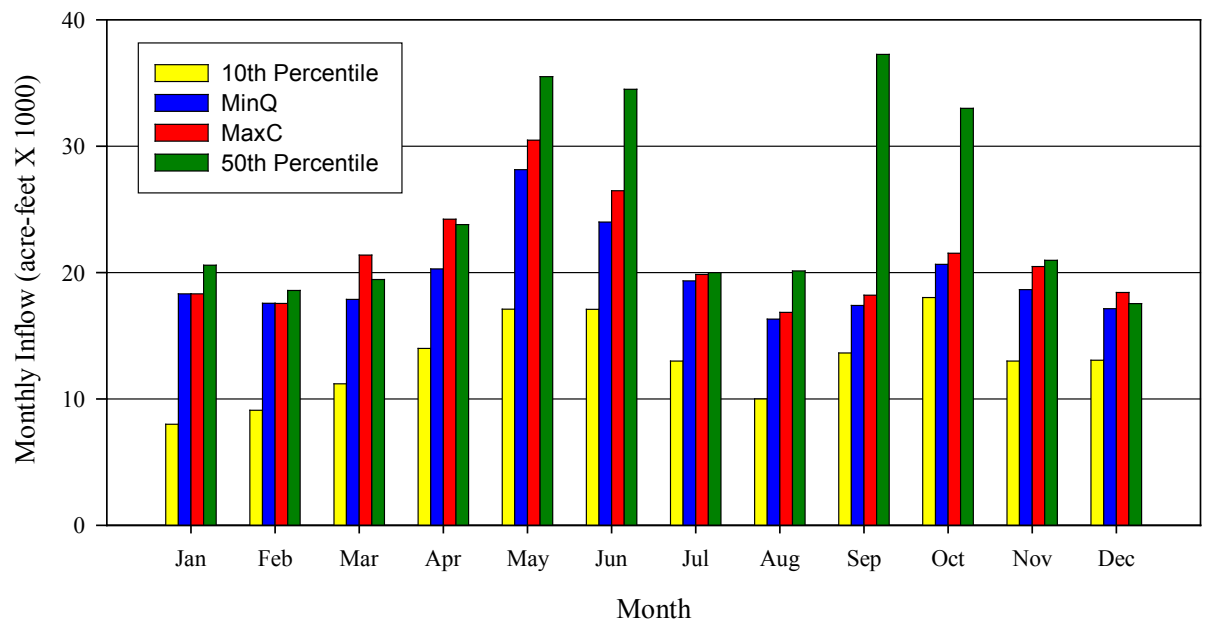
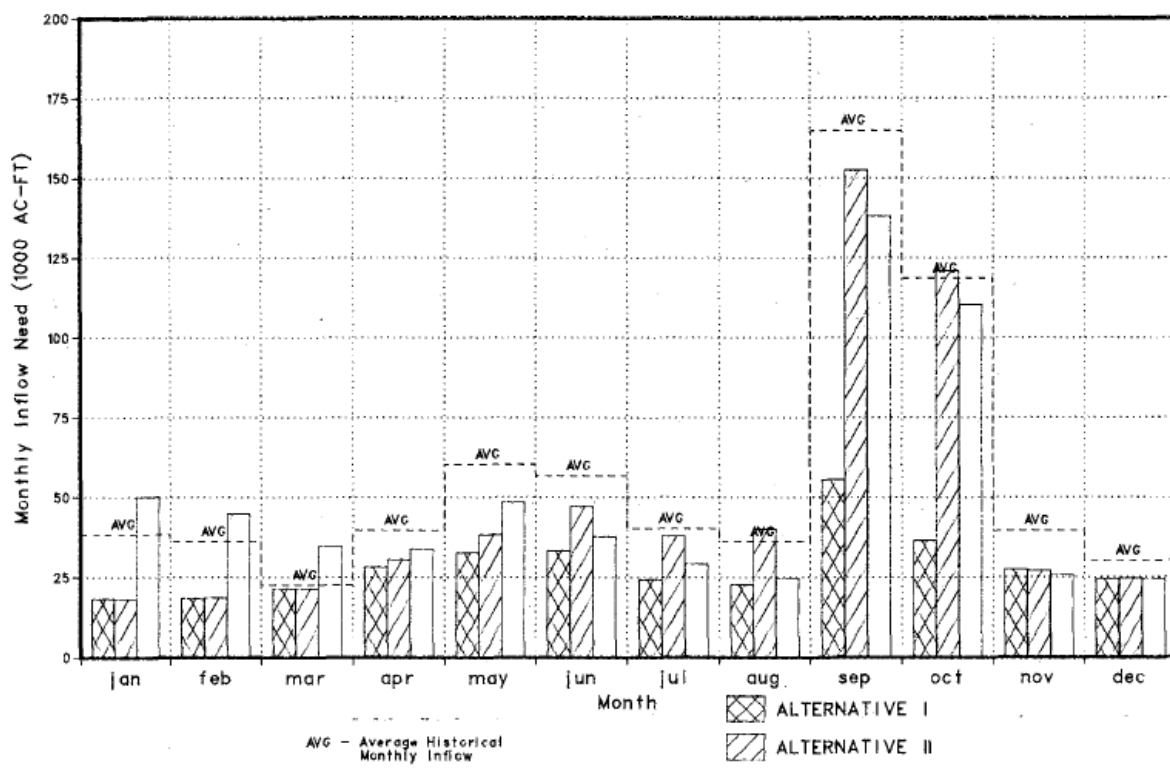
State Methodology

Strengths

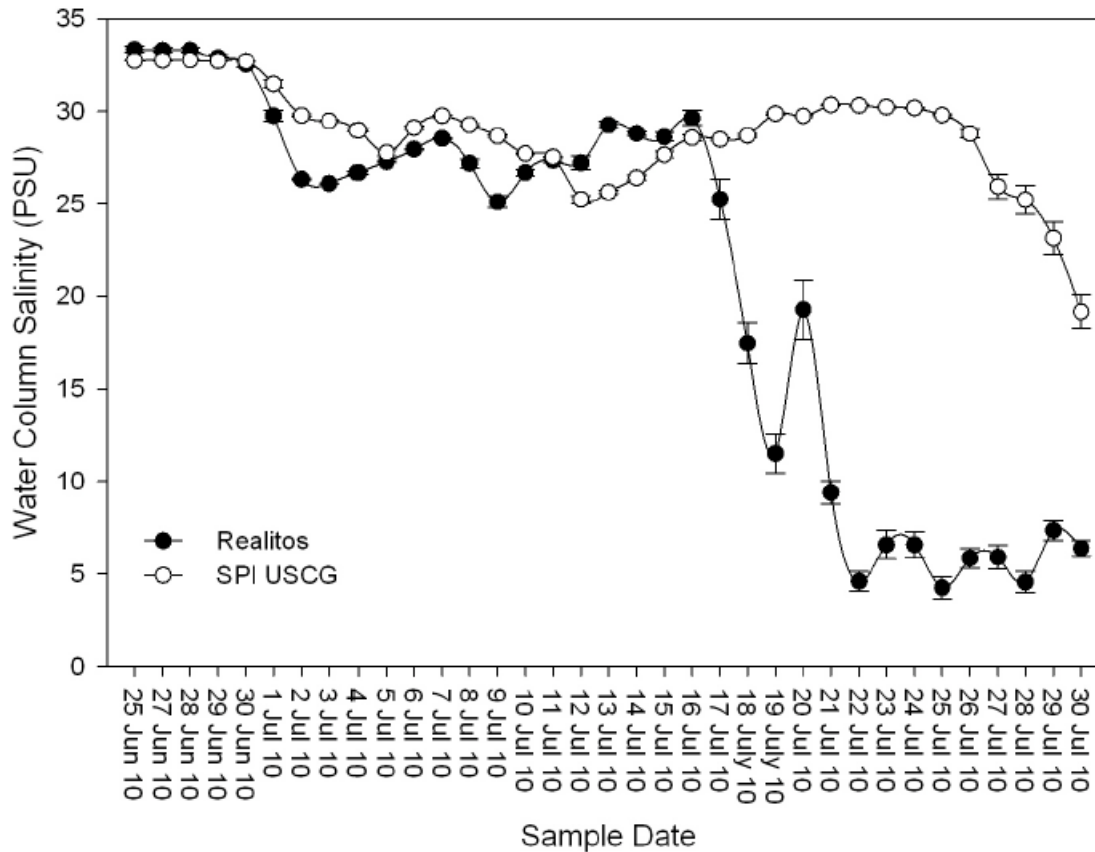
- *Easily understood objectives*
- *Sensible way to integrate disparate information*
- *Attempts to make best use of flow resource*
- *Constraints keep solution "reasonable"*
- *Optimization model is objective*

Weaknesses

- *Does not provide an inflow regime consistent with the requirements of Senate Bill 3*
- *Does not address low flow needs explicitly.*
- *Solution implies that flows must always be met (no attainment frequency)*
- *Species may not fully represent estuarine ecology*
- *Low predictive ability of harvest/abundance equations (complexity of ecological relationships)*
- *Commercial harvest data subject to numerous sources of error and are affected by factors having no relation to abundance*

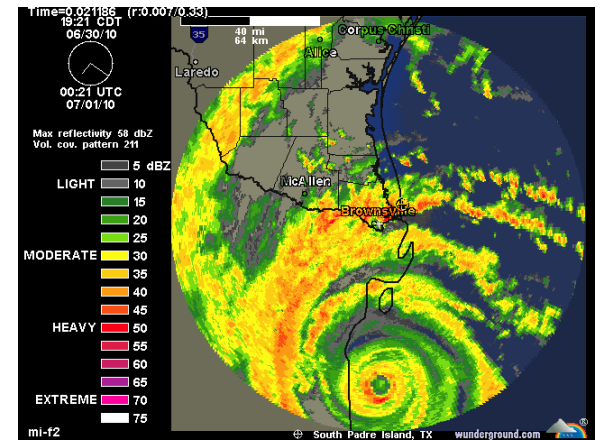


Large Freshwater Pulses Are Rare But Important

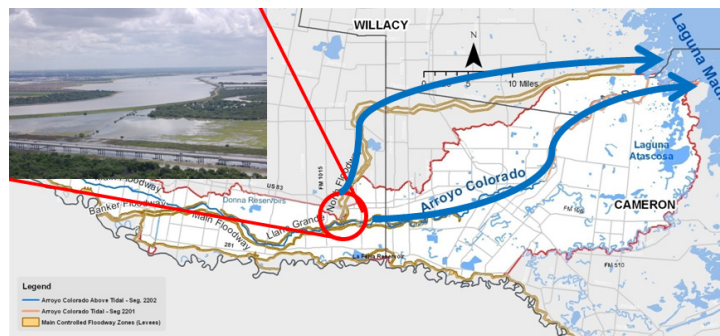


**Hurricane Alex
June 30, 2010**

**T.S. Hermine
September 7, 2010**



www.wunderground.com



Precipitation Deficit and Drought Occurrence in Texas

