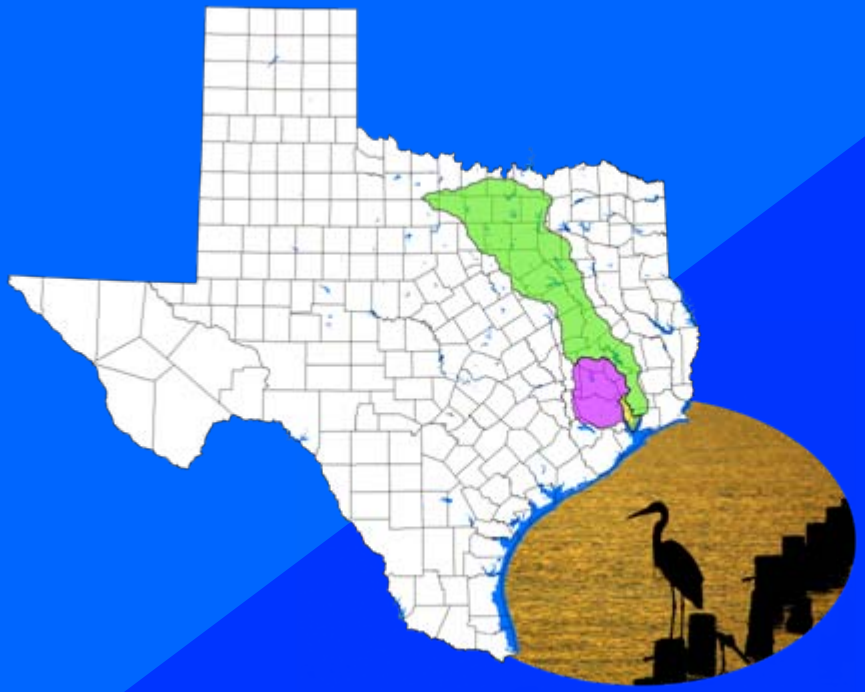
Trinity-San Jacinto BBEST Development of Freshwater Inflow Recommendations



Presented to SAC

January 13, 2010

Freshwater Inflow Process

- Significant effort went into the development of the freshwater inflow recommendations
- Recognize that no science is perfect, but must meet the mandates set forth by SB3
- Ultimately BBEST did not reach consensus on a single recommendation
  - Presented herein is rationale for why our confidence in the science eroded to the point that we felt it necessary to submit an alternative recommendation

BBEST Legislative Mandate

- "(m) Each basin and bay expert science team shall develop **environmental flow analyses** and a **recommended environmental flow regime** for the river basin and bay system for which the team is established through a collaborative process designed to achieve a consensus. In developing the analyses and recommendations, the science team must consider all reasonably available science, without regard to the need for the water for other uses, and the science team's recommendations must be based solely on the best science available."

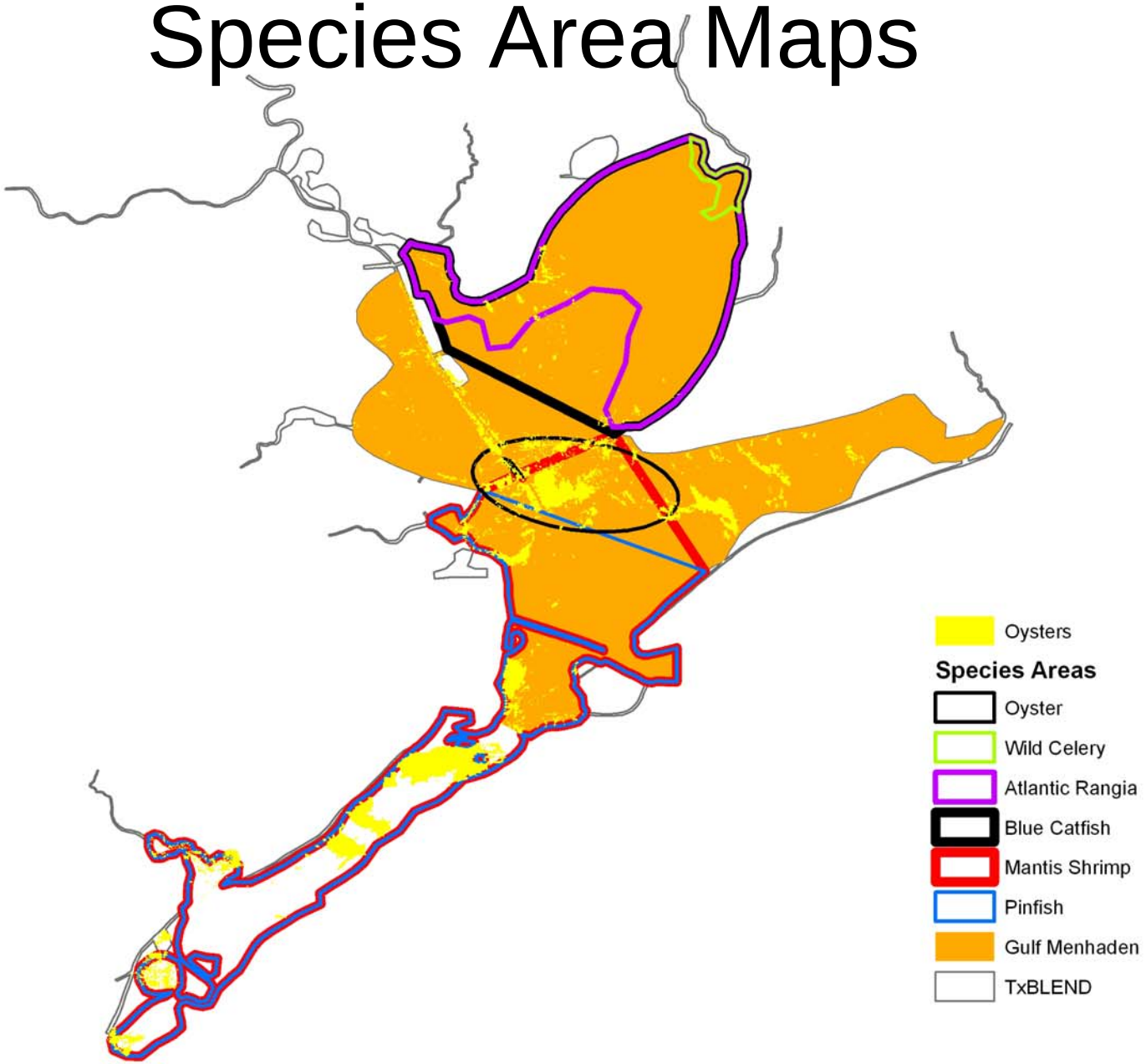
- "(15) 'Environmental flow analysis' means the application of a scientifically derived process for **predicting the response of an ecosystem to changes in instream flows or freshwater inflows**."

- (16) "Environmental flow regime" means **a schedule of flow quantities** that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that **are shown to be adequate to support a sound ecological environment** and to **maintain** the productivity, extent, and persistence of key aquatic habitats in and along the affected water bodies."

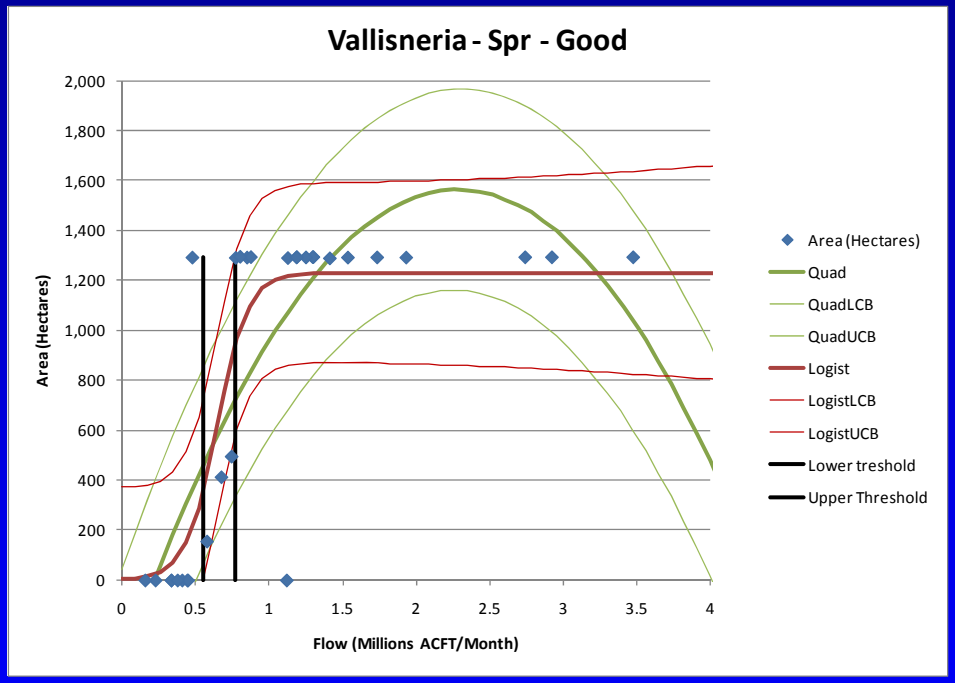
Identified Biological Indicators for Evaluating Freshwater Inflow Needs to Galveston Bay. Emphasis was placed on the sessile organisms: wild celery, Atlantic Rangia and oyster parasites and predators.

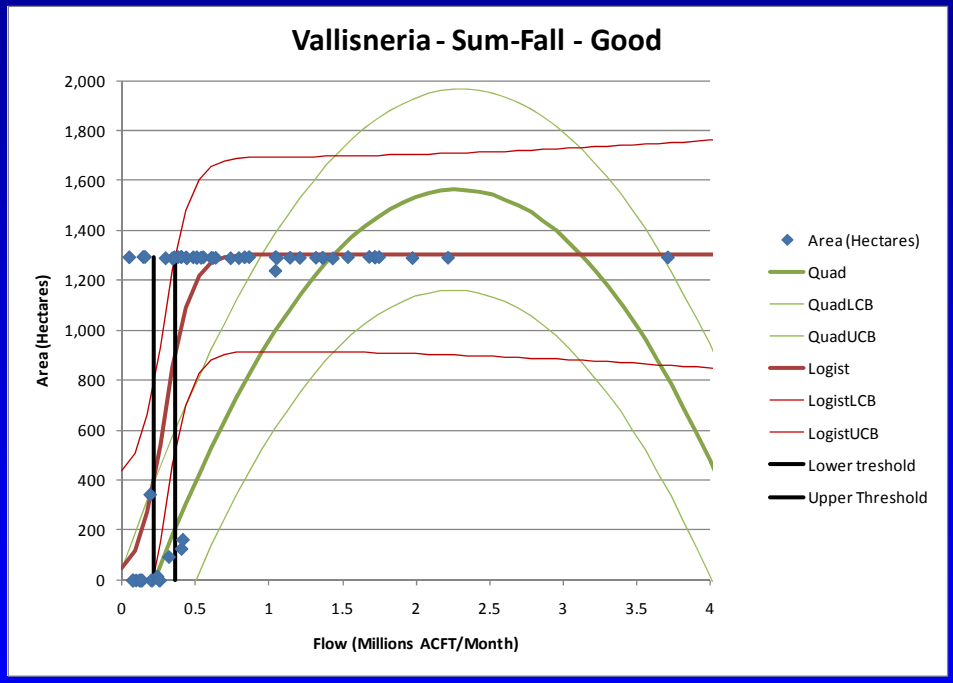
	Common Name	Scientific Name	Criterion	Period of Concern
Habitat Indicator	Wild Celery	*Vallisneria americana*	<5 psu for germination and establishment	Spring
	"	"	<10 psu for survival	Summer and Fall
Low Salinity Indicators	Atlantic Rangia	*Rangia cuneata*	2 – 10 psu for spawning and larval survival	Spring and Fall
	Gulf menhaden	*Brevoortia patronus*	5 – 15 psu for occurrence as forage fish	Winter and Spring
	Blue catfish	*Ictalurus furcatus*	<10 psu for occurrence as predator	Single pulse in winter or spring
High Salinity Indicators	Mantis shrimp	*Squilla empusa*	>25 psu for abundance	Summer - Fall
	Pinfish	*Lagodon rhomboides*	>25 psu for abundance	Summer - Fall
Oyster Health Indicators	Dermo and oyster drill impacts on oyster	Dermo= *Perkinsus marinus* Oyster drill= *Stramonita haemastoma* Oyster= *Crassostrea virginica*	10 – 20 psu to prevent excessive parasitism and predation	July - September
	"	"	<5 psu to remove parasite load from central reefs	2 weeks at 10 year intervals

Species Area Maps



When salinity is within desired zones Vallisneria (Trinity Only)





Necessary Seasonal Attainment Criteria to assess historic frequency

Species	Spring	Summer	Fall
Rangia	1 out of 3 months		1 out of 3 months
Vallisneria	1 out of 3 months	2 out of 3 Months	2 out of 3 Months
Oyster alt.		2 out of 3 months	

Freshwater Inflow Process

- Period of Record for Hydrodynamic model (1983-2005)
  - wet hydrologic period
  - Based on preliminary results, apply a -6% adjustment factor to frequency of occurrence of recommended flow amount.

- Utilize as check on flow recommendations:
  - flow/area relationships for mobile organisms
  - Frequency of occurrence of preventative dermo conditions

B&E Process

- Evolved to point where complexity of results compounded significant issues:
  - representation of the ecological health of Galveston Bay
  - incorporation of uncertainty
  - determination of attainment frequencies
  - Predictability not achieved: default to historical record
- B&E Subcommittee's process remains incomplete.

Representation of Sound Ecological Environment

- Difficulty accounting for competing needs for multiple species
  - Optimization
    - multiple management targets, including harvest
  - Constraints to maintain historical proportions

Derivation of Freshwater Inflow Recommendations

Watershed/ Season	Spring	Summer	Fall
Trinity	Vallisneria	Vallisneria	Vallisneria
San Jacinto	Rangia	Oyster	Rangia
Total Galveston Bay Watershed	Rangia	Oyster	Rangia

Maintenance of Sound Ecological Environment for the Galveston Bay System

- Lacking scientific rationale behind identification of the single indicators of estuarine health

- Not demonstrated such flows produce a sound ecological environment for the Galveston Bay system

Sensitivity/Uncertainty

- Uncertainties not addressed
  - Statistical significance of statistical regressions
  - *Vallisneria area* at outer fringe of modeled area
    - Precision less within Trinity Bay
  - Gage flow may be inaccurate by 5-10%.


Romayor Gage
River mile 86
Wild Celery Area
~1600 ha.
Galveston Bay
~160,000 ha.
TWDB Trinity Bay
Datasonde
~6.5 mi. away
N
1 in = 12 miles

Issues Contributing to lack of Confidence in Supporting Science

- Mobile organism check not performed
- Coastal inflows by subtraction
- HEFR for ‘non-necessary’ months
- Calculation and application of frequencies
- Gulf Menhaden as single indicator species for winter season
- Organism salinity niches

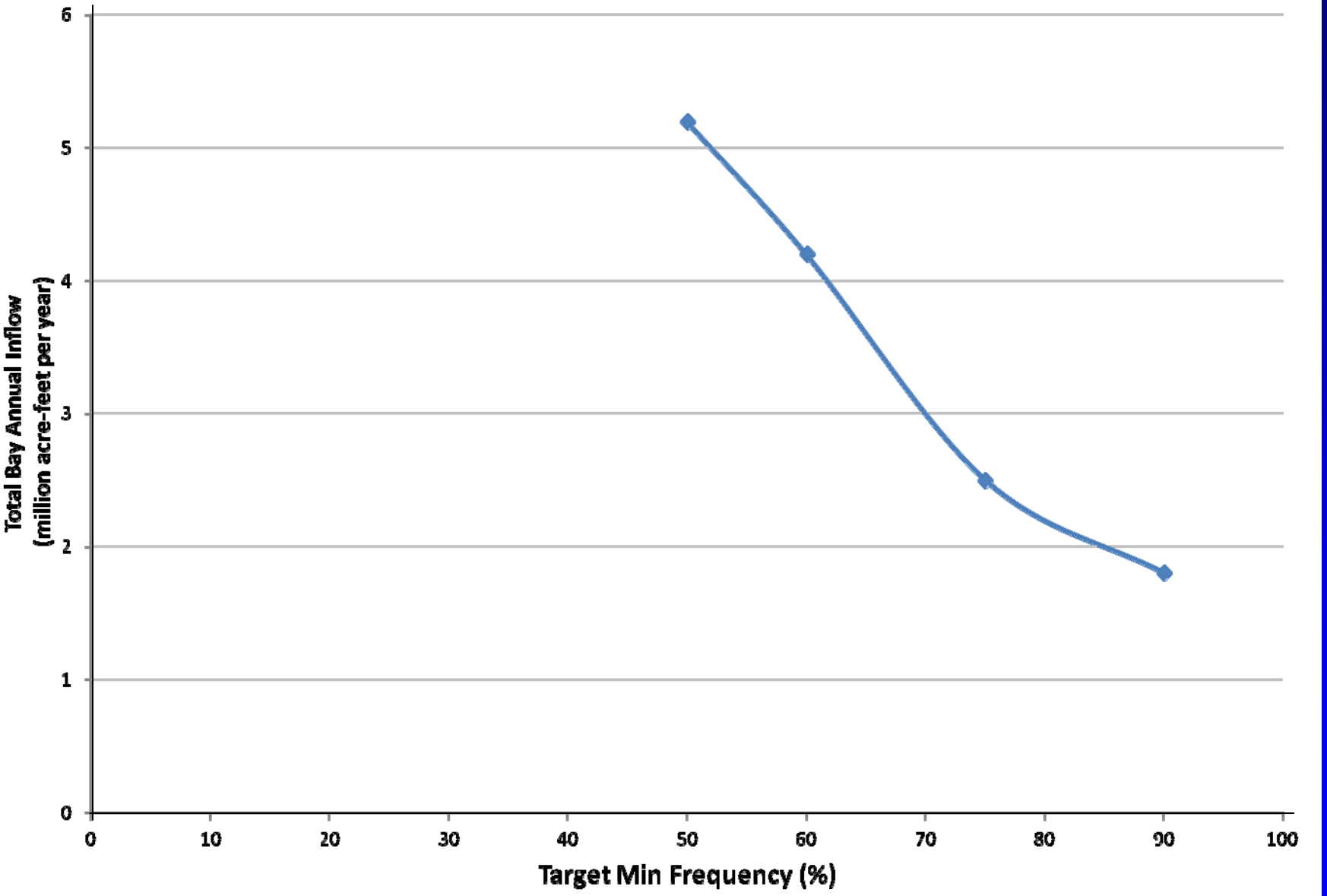
Recommendation

- Early within BBEST process
- Pre-existing approach
- The Region H Water Planning Group (RHWPG)
- GBFIG recommended a schedule of targets

Alternative Recommendation for Freshwater Inflows for the Galveston Bay System

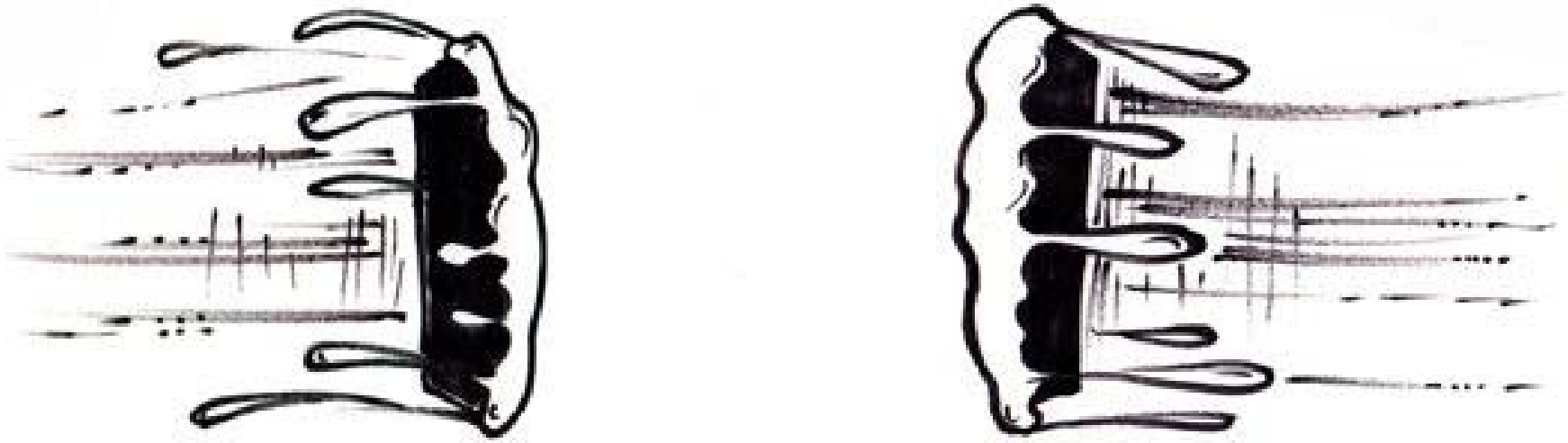
Inflow Scenario	Target (ac-ft/year)	Historical Frequency	Target Frequency
Max H	5.2 million	66%	50%
Min Q	4.2 million	70%	60%
Min Q-Sal	2.5 million	82%	75%
Min Historic	1.8 million	98%	90%

Region H Annual Inflow Targets Flow-frequency Graph Format



Recommendation (cont'd)

- State Methodology suffers significant weaknesses
- Incorporates uncertainty
- Anticipated adaptive management



BBEST's path to Consensus

Spare Slides

Freshwater Inflow Recommendations in relation to Instream Flow Recommendations

- Suggestions that the higher of freshwater or instream flow recommendations will dictate the required flows for the system.
- Arbitrary and not consistent with sound biological principles.
- Bay receives flows from Trinity, San Jacinto, and coastal watersheds, and responds accordingly.

Trinity-San Jacinto BBEST Freshwater Inflow Process

- Solicited proposals from BBEST members
- Component of SAC guidance for development of freshwater inflow recommendations is the application of a salinity-zonation approach
  - "quintessential estuary parameter"

Inflow → Salinity → Biology

- BBEST elected to combine two salinity-zonation approaches.

Incorrect Frequencies

- Calculated amounts presented are incorrect representation of historical frequencies of occurrence

Proposed Freshwater Inflow Amounts

Trinity

	Spring	Summer	Fall	Winter
Criterion	742,000	205,000	141,000	
Periodicity	1 of 3 months	2 of 3 months	2 of 3 months	
Annual Occurrence	18 of 23 years	12 of 23	11 of 23 years	
Recommended Annual Frequency	1 in 2 years	1 in 2 years	1 in 3 years	

Trinity (adjusted)

	Spring	Summer	Fall	Winter
Criterion	696,000	193,000	133,000	HEFR Table
Periodicity	1 of 3 months	2 of 3 months	2 of 3 months	
Recommended Annual Frequency	1 in 2 years	1 in 2 years	1 in 3 years	

San Jacinto

Season	Spring	Summer	Fall	Winter
Flow	302,000	257,000	250,000	
Periodicity	1 of 3 months	2 of 3	1 of 3	
Annual Occurrence	15 of 23 years	5 of 23	13 of 23	
Recommended Annual Frequency	1 in 2 years	1 in 5 years	1 in 2 years	

Historic Frequencies of Occurrence over 1983-2005 period

Watershed	Identification	Spring	Summer	Fall
Trinity	Criterion	742,000	205,000	141,000
	Periodicity	1 of 3 months	2 of 3 months	2 of 3 months
	Historic Count out of 23 years	18 of 23 years	17 of 23 years	8 of 23 years
	Historic Maximum Annual Duration between Events	3 years	2 years	8 years
San Jacinto	Criterion	302,000	257,000	250,000
	Periodicity	1 of 3 months	2 of 3 months	1 of 3 months
	Count out of 23 years	17 of 23 years	10 of 23 years	10 of 23 years
	Maximum Annual Duration between Events	4 years	7 years	8 years
Coastal	Criterion	455,000	196,000	244,000
	Periodicity	1 of 3 months	2 of 3 months	1 of 3 months
	Count out of 23 years	4 of 23 years	9 of 23 years	14 of 23 years
	Maximum Annual Duration between Events	8 years	5 years	3 years
Total Galveston Bay	Criterion	1,499,000	658,000	635,000
	Periodicity	1 of 3 months	2 of 3 months	2 of 3 months
	Count out of 23 years	16 of 23 years	17 of 23 years	6 of 23 years
	Maximum Annual Duration between Events	3 years	2 years	13 years

Adjustment for Period of Record Analyzed

Comparison of Occurrences for Total Galveston Bay Watershed
over Recent Period (1983-2005) and Total Period of Record (1941-2005)

Total Galveston Bay	Criterion	1,499,000	658,000	635,000
	Periodicity	1 of 3 months	2 of 3 months	2 of 3 months
	Count out of 23 years	16 of 23 years	17 of 23 years	6 of 23 years
	Maximum Annual Duration between Events	3 years	2 years	13 years
Total Galveston Bay - 1941-2005	Criterion	1,499,000	658,000	635,000
	Periodicity	1 of 3 months	2 of 3 months	2 of 3 months
	Count out of 65 years	34 of 65 years	37 of 65 years	14 of 65 years
	Maximum Annual Duration between Events	7 years	7 years	13 years

- Adjustment factor needs to be refined to 17%, 17%, and 5% for the spring, summer, and fall seasons, respectively.

Adjusted Historical Flow Frequencies

Adjusted Historical Flow Frequencies of Proposed Freshwater Inflow Targets for the Trinity, San Jacinto, and Coastal Watersheds

Watershed	Identification	Spring	Summer	Fall
Trinity	Criterion	742,000	205,000	141,000
	Periodicity	1 of 3 months	2 of 3 months	2 of 3 months
	Historic Count out of 23 years	14 of 23 years	13 of 23 years	7 of 23 years
	Historic Maximum Annual Duration between Events	3 years	2 years	8 years
San Jacinto	Criterion	302,000	257,000	182,000
	Periodicity	1 of 3 months	2 of 3 months	1 of 3 months
	Count out of 23 years	13 of 23 years	6 of 23 years	9 of 23 years
	Maximum Annual Duration between Events	4 years	7 years	4 years
Coastal	Criterion	455,000	196,000	244,000
	Periodicity	1 of 3 months	2 of 3 months	1 of 3 months
	Count out of 23 years	1 of 23 years	5 of 23 years	13 of 23 years
	Maximum Annual Duration between Events	8 years	5 years	3 years

Derivation of Coastal Flows

- Assertion that coastal flows are not a major determinant is misleading.
  - Under certain conditions coastal flows may be a significant contributor to freshwater inflows.
- No scientific rationale is provided as to why Coastal flow recommendations are developed differently (i.e. via subtraction from Total Galveston Bay developed amounts).
  - Presently unclear that if recommendations for each component watershed do not sum to the recommended flows for the Total Galveston Bay watershed, such a scenario is necessarily incorrect.
  - Difference may reflect the uncertainty in derived relations and variability of the constituent hydroclimatologies.
- Unclear that coastal flow recommendations are valid utilizing differential approach,
- Such uncertainty should be considered carefully if to be implemented.

Identification of Winter Flow Recommendation

- Use of Gulf menhaden did not receive consensus.
- No scientific rationale provided for the “reasonableness” of it as single indicator species for the entirety of Galveston Bay in the winter season.
- Menhaden’s preferred salinity niche, identified as an area within a range of salinity within Galveston Bay, is not only moving temporally, but spatially within large area.
  - Not demonstrated that BBEST interpretation of logistic regressions for sessile organisms in small areas is applicable for mobile organisms in larger areas.
- No scientific justification provided as to the appropriateness of apportioning total bay inflow amount through historical average proportional contributions.
- Trinity-San Jacinto BBEST has been unable to identify biological indicators that correlate with a flow requirement for the Winter season for individual watersheds.
- Additional scientific/ecologic/biologic information should be developed to inform upon winter recommendation through adaptive management.