

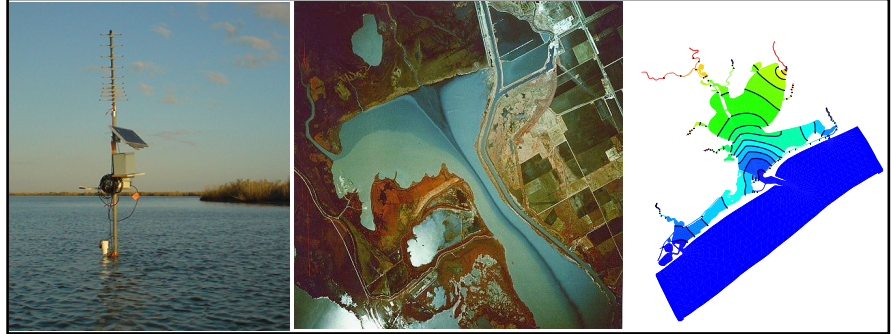
Bays & Estuaries Program

Surface Water Resources Division

Water Science and Conservation

Mission Statement

To maintain a continuous data collection, modeling, and analytical study program focused on evaluating the freshwater inflow requirements necessary to maintain the health of Texas bays and estuaries



Statutory Authority

Statutes in the Texas Water Code support the data collection, analytical studies, and modeling activities conducted by the Bays & Estuaries Program. The first statute is linked to **TWDB Strategy 01-01-01** for the *Collection, Analysis, and Reporting of Environmental Impact Information* (for the state's bays and estuaries). The last three statutes relate to the Senate Bill 3 (SB3) process for developing environmental flow recommendations:

Texas Water Code §§ 16.012 - Studies, Investigations, Surveys

Texas Water Code §§ 15.4063 - Environmental Flows Funding

Texas Water Code §§ 11.02361 - Texas Environmental Flows Science Advisory Committee

Texas Water Code §§ 11.02362 - Development of Environmental Flow Regime Recommendations

Team Goals

1. Maintain a hydrologic database of historical inflows into Texas bays and estuaries.
2. Collect, archive, and disseminate water quality data from representative sites located in Texas bays and estuaries.
3. Advance the development and application of hydrodynamic and conservative and non-conservative transport models for Texas bays and estuaries.
4. Monitor the effects of and provide information about freshwater inflow needs to support a sound ecological environment for use in water resources planning and management.
5. Provide emergency response information for oil spills in coastal areas.
6. Administer Research and Planning Fund contracts to improve our understanding of bays and estuaries in support of the tri-agency freshwater inflow needs program and the Senate Bill 3 environmental flows process.
7. Seek external funding to support activities that advance our knowledge of specific bay and estuary systems in order to better understand processes occurring in coastal regions.

Major Programs

Freshwater Inflow Studies –TWDB serves as a partner agency for data collection, analysis, and hydrodynamic modeling associated with understanding freshwater inflow needs of Texas estuaries.

In Texas, until recently, freshwater inflow studies were guided solely by Texas Water Code §§11.147, which defines **beneficial inflows** as "*a 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.*" As written, this created a foundation for developing the management goals and scientific studies upon which freshwater inflow recommendations were based. Early efforts were focused on answering the question: *How much water is needed to provide a beneficial inflow?* The resulting methodology, known as the **State Methodology**, has seven components (listed below) aimed to answer this question. Historically, TWDB was responsible for the first six components, which still drive many of our ongoing programs. Texas Parks & Wildlife Department (TPWD) was responsible for the final step and publishing of the resulting freshwater inflow recommendations.

In 2007, passage of Senate Bill 3 Environmental Flows legislation shifted the focus of the State's freshwater inflow studies from determining the *beneficial inflows* necessary to support a sound ecological environment to determining a comprehensive *freshwater inflow regime* which provides for geographic, seasonal, and inter-annual variation of recommended inflows.

Seven Components of Historical Freshwater Inflow Needs Studies Based on the State Methodology

1. Data collection/hydrographic surveys
2. Hydrodynamic and salinity transport modeling
3. Sediment analyses (to determine needs to maintain delta and wetland areas)
4. Nutrient analyses (to estimate nutrient needs for maintaining positive nutrient balance)
5. Fisheries analyses (to determine needs for maintaining long-term production)
6. Freshwater inflow optimization modeling using the Texas Estuarine Mathematical Programming Model (TxEMP, to determine the monthly distribution of inflows which satisfy all objectives, including fisheries maintenance)
7. Verification of needs (to evaluate inflow solutions to ensure maintenance of ecological health and productivity)

The B&E Program, by partnering with state and federal agencies, universities and private firms, supports several long- and short-term data collection efforts to assist with freshwater inflow studies.

Coastal Hydrology – This program maintains estimates of Total Surface Inflows and Freshwater Inflow Balances to Texas estuaries. B&E staff regularly compiles United States Geological Survey (USGS) stream gage data, TCEQ stream diversion and return flow data, National Weather Service rainfall and evaporation data, and TWDB evaporation data. Runoff from ungaged watersheds is computed with the Texas Rainfall-Runoff (TxRR) model. Summary data and information are provided on TWDB's web site or by request.

Hydrodynamic and Salinity Transport Modeling - To characterize physical processes and salinity transport in the bays, the B&E Program uses a variety of two-dimensional depth- averaged (*e.g.*, TxBLEND) and three-dimensional (*e.g.*, SELFE) hydrodynamic and salinity transport models to produce high-resolution, dynamic simulations of estuarine conditions over periods covering a year or more. Models are used in a variety of projects including freshwater inflow studies, oil spill

response, forecasts of bay conditions, salinity mitigation, and environmental impact evaluations. The B&E Program has the unique capability to develop and run hydrodynamic models, and the modeling services we provide are respected by our customers.

Estuary Monitoring and Datasonde Program – Water quality data collection is supported by the B&E Program, through General Revenue and Research & Planning Funds. Monitoring efforts provide basic water quality (primarily salinity) data at key locations in Texas major bays. The Datasonde Program is the primary effort and relies on a partnership with TPWD to service instruments. Collections began in 1986, with five of the original sites having been monitored continuously for over 20 years and another four sites for more than 10 years. Other cooperators assist with data collection at additional sites, including off-shore stations in the Gulf. B&E staff archive and disseminate resulting data. Additionally, using Research & Planning Funds, we contribute to the maintenance of 12 tide gages in the Texas Coastal Ocean Observation Network (TCOON) and support special studies which often provide useful water quality, bathymetric, hydrological, and biological data. Together, we refer to these collective efforts as the Estuary Monitoring Program, although specific efforts each have their own goals and procedures. Below is a list of active monitoring stations maintained or supported by the B&E Program in FY 2013.

Program Name	Cooperator	# of Active Water Quality Stations	# of Active Velocity Stations
Datasonde Program (all major bays and some minor bays)	Texas Parks & Wildlife Department	18	0
San Bernard Estuary	--	9	0
Matagorda Bay	NOAA/U.S. Coast Guard	0	1
Nueces Delta	USACE	17	1
Rio Grande Estuary	University of Texas-Pan American	3	0
Nearshore Salinity	Texas Automated Buoy System	3	0
TOTAL		48	3

Oil Spill Modeling - In partnership with the Texas General Land Office (TGLO), the B&E Program maintains and applies the TxBLEND hydrodynamic model to forecast bay currents in case of an oil spill in one of the major bays. Should an oil spill occur, simulated TxBLEND currents can be combined with winds and other information in a spill trajectory model to predict future movements of the spill. Oil spill emergency response teams coordinated by the TGLO use this information to deploy clean-up teams and other resources to minimize the spill’s impact.

Current Team Activities

The B&E Team is actively involved in data collection, data processing and archiving, hydrodynamic and hydrologic modeling and analysis, and supporting agency and customer requests for data, information, and analyses related to Texas bays and estuaries. Specific activities include:

1. Data collection in all major estuarine systems of Texas (major estuary, statutory)
2. Study of freshwater inflow needs in the San Bernard/Cedar Lakes and Rio Grande estuaries (minor estuary)
3. Study of salinity intrusion in the Brazos River estuary (USACE study)
4. Providing staff support to Senate Bill 3 activities (statutory)

5. Conversion of rainfall-runoff models to utilize NEXRAD precipitation data (TWDB initiative)
6. Compilation of reservoir and stream information for the Texas Water Conditions report
7. Re-analysis of Galveston Bay freshwater inflow recommendations (United States Army Corps of Engineers (USACE) study)
8. Status & Trends of freshwater inflows to the San Antonio Bay system (conducted for the San Antonio Bay Partnership)
9. Improvement, validation, and documentation of TxBLEND models for major bay systems (statutory)
10. Evaluation and application of three-dimensional hydrodynamic models for use in Texas bays (statutory)
11. Study of drought effects on estuaries (USACE study)
12. Evaluation of nutrient and sediment budgets for the major bays (statutory)
13. Data collection of salinity and water level in the Nueces Delta (USACE study)

Important Facts

New Studies – With much of the work on Texas' major estuaries completed, the B&E Program has been working to develop new methods to determine freshwater inflow needs of the minor estuaries. Since wetlands are an essential feature in the productivity of estuarine systems, staff is extending the hydrodynamic models to consider wetting/drying and salinity conditions within fringing marshes. The work is being conducted along the mid-coast in the San Bernard National Wildlife Refuge and includes collecting surface and soil salinity measurements in the marsh to assist in model calibration. While surface water salinities can be simulated in the models, soil salinities cannot. Yet, it is the soil salinity that affects plant productivity and in turn overall ecosystem health. The goal is to tie freshwater inflows to marsh salinities to better assist in determining freshwater inflow needs of this and other estuaries. To our knowledge, this is a pioneering effort at collecting *in situ* time-series data from wetland soils.

Evaluation of Senate Bill 3 Environmental Flow Standards – With most of the major river basins having recently completed or nearly completed the first round of the SB3 process for developing environmental flow standards for estuaries, the B&E Program aims to begin working on evaluating the effects of the standards and recommendations on estuarine conditions and to begin working on SB3 recommended studies in support of adaptive management of the standards.

Recent Publications

Guthrie, C.G., Matsumoto, J., and Solis, R.S. 2012. *Analysis of the Influence of Water Plan Strategies on Inflows and Salinity in Galveston Bay*. Final report to the United States Army Corps of Engineers, Contract #R0100010015. Texas Water Development Board, Austin, Texas. pp 71.

Schoenbaechler, C., C.G. Guthrie, and Q. Lu. 2012. *Coastal Hydrology for the Trinity-San Jacinto Estuary. January 5, 2012*. Texas Water Development Board, Austin, Texas. 29 pp.

***Similar reports have been developed for the Brazos, East Matagorda, Matagorda, San Antonio, Mission-Aransas, Corpus Christi, and Laguna Madre bay systems. The Sabine report is in draft.*

Schoenbaechler, C., C.G. Guthrie, J. Matsumoto, and Q. Lu. 2011. *TxBLEND Model Calibration and Validation for the Laguna Madre Estuary. October 27, 2011*. Texas Water Development Board, Austin, Texas. 60 pp.

***Similar reports have been developed for the East Matagorda, Matagorda, San Antonio, Mission-Aransas, Corpus Christi, and Laguna Madre bay systems. The Sabine and Galveston reports are in draft.*

Upcoming Challenges

1. Developing new methodologies for determining freshwater inflow needs of minor estuaries (Christmas Bay, Brazos River, San Bernard/Cedar Lakes, East Matagorda, and Rio Grande).
2. Results of the Senate Bill 3 process suggest that the B&E Program needs to redirect efforts to support the evaluation of the recommended environmental flows and adopted standards and to identify sources of funding to support the monitoring, research, and analysis needs outlined in the adaptive management work plans.
3. Improving estimates of nutrient and sediment loadings as well as developing nutrient models for the estuaries. Presently, we are contracting with (1) the United States Geological Survey to collect sediment and nutrient loading data from two major rivers and (2) Texas A&M University to develop a Surface Water Assessment Tool to model estimates of nutrients in coastal streams and rivers. Recent funding cuts have caused us to scale back this program effort, despite having been recognized by all SB3 science teams as an information need.
4. Developing three-dimensional hydrodynamic and salinity transport models of the bays and extending existing models to perform better in upper estuarine locations and to simulate wetting and drying of fringing wetlands. Challenges include funding the necessary data collection required to support model calibration and validation.
5. Supporting necessary data collection and environmental flow studies given reductions in staff and funding.
6. Recruiting and retaining qualified staff given resource limitations.

Bays and Estuaries Website

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

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