Number	Priority	TABLE 2. Description of Work Plan Tasks (Tasks, or subtasks, shaded in gray are identified as having high priority and funding initially will be sought, including through a request to the EFAG, to accomplish these tasks)
		Rivers and Streams
1		**Describe relationships between flow, and physical, chemical, and biological structure and function of the streams and how these relationships support ecological health.** **Coordinating Agencies: Primarily TPWD with TWDB, and TCEQ** Describe role of flow in ecological health of the stream. This is an overarching goal that should be accomplished by combining information collected from 2011 through early 2020 with earlier data. The 2021 work plan report should summarize the results of the monitoring and studies conducted in the basins for this adaptive management process and obtained from other sources. The focus of the report should be on the relationships between flows and ecological health in a minimum of two representative streams in each of the Lavaca-Navidad, upper Colorado, and lower Colorado River basins. Revised environmental flow regime recommendations will be developed for sites identified by the BBEST. Completed 2020.
Sub 1		• **Identify stream locations and estuaries not included in the BBEST environmental flow regime report that should be analyzed for relationships between flow and environmental health.** Desk-top study based in part on review of expected water demands and availability identified by the regional water planning process. Identify water bodies that may have future applications for diversions. Identification of additional locations for environmental flow analysis will be summarized in reports done in 2013 and 2018.
Sub 2	Yes	• **Review best available science for determining environmental flow regimes for streams.** Literature review and discussion with experts in relevant fields of study. Appropriate enhancements will be applied to the determination of new environmental flow regimes and modification of existing environmental flow regimes. This effort will include evaluation of HEFR and possible approaches to refine or replace HEFR. These reviews should be summarized in reports prepared in 2016 and 2020 which conclude with recommendations for approaches to use in determining future environmental flow recommendations or for verifying existing environmental flow recommendations.
2		**Describe key biological features of environmental flow regimes** **Coordinating agency: TPWD**
Sub 1		• **Describe ecological services provided by perennial pools.** Special study on at least two streams in the upper Colorado River basin and at least one stream in each of the Lavaca-Navidad and lower Colorado River basins. Some monitoring programs do

		not collect information from perennial pools when there is no flow. In some cases there will be difficulty accessing streams when there is no flow and the perennial pool is not near the established monitoring site. Existing monitoring programs should continue monitoring physical, chemical, and biological conditions when streams form perennial pools.
Sub 2*		• **Describe relationships between aquatic biota (including riparian and floodplain species) and flow.** Although this is a broad category of endeavor, it is important to identify plant or animal species, guilds, or communities considered representative of environmental health and begin literature review, focused sampling, and analysis to understand flow regimes which sustain them. Identify two aquatic and two riparian plant and/or animal species, guilds, or communities in each of the upper Colorado, Lavaca-Navidad, and lower Colorado basins on which to focus study. Study will include literature review and focused sampling whether by special study, monitoring, or a combination of the two. This work will continue by identifying two more aquatic and two more riparian species, guilds, or communities in each of the basins on which to focus work for the next ten years (2021 through 2030). These studies may be focused if necessary on a minimum of two streams in each basin. The length of time it takes for some riparian plants like trees and aquatic organisms like mussels to respond to environmental changes may complicate data collection and interpretation. ○ **Identify flow regime components and quantities necessary to sustain mussels and compare to flow regimes identified as being necessary to sustain fish communities.** Focus on distribution of mussels, their life stages, life cycles, and relationships to flow with greater emphasis initially on threatened or endangered species. There may be more funding for this work, particularly through the US Fish and Wildlife Service's State Wildlife Grant program than for other monitoring described here since the US Fish and Wildlife Service is considering listing some mussel species pursuant to the Endangered Species Act. ○ **Describe relationships between Guadalupe bass and flow and blue suckers and flow.** Site and species specific studies of habitat use, age structure, community structure, distribution of different life stages, stimulation of spawning, food web interactions, and relationships between those features and flows. This work should be conducted on at least two streams in the upper Colorado basin which have self-sustaining populations of Guadalupe Bass, the state fish of Texas and a state-listed threatened species. Blue suckers should be studied in the lower Colorado River. Consider significance, if any, of aquifer outflow for blue sucker. ○ **Determine if there are relationships between toxic golden algae blooms and flow in the upper Colorado basin.** The upper Colorado River, Beals Creek, and the lower reaches of the Concho River and Elm Creek have experienced substantial mortality of fish in the past from toxic golden algal blooms. An organization representing the upper Colorado basin should participate on the TPWD's Golden Alga Task Force. This organization should collaborate, whenever possible, in helping evaluate the life history of golden alga in basin and encourage adequate consideration of the relationship between flow and toxic blooms. Routine golden alga monitoring should be added to a minimum of two streams in the upper Colorado basin, including the Colorado River upstream of Lake Ivie. These sites preferably should be sites with water chemistry and flow monitoring. The episodic nature of toxic blooms complicates this task since years may pass without a bloom occurring.
Sub 3	Yes	• **Describe relationships between physical habitat and flow.** Special studies to measure water depth, velocity, and substrate

		types of key riverine habitats (riffles, runs, pools, glides, backwaters, oxbows) for representative sections of two streams in the upper Colorado basin, two streams in the Lavaca-Navidad basin, and one stream in the lower Colorado basin. These data will be linked to information about changes in habitat quality and availability when flows change through hydrologic modeling. Studies will be repeated every five years to track changes in physical habitat possibly resulting from changes in flow regime. Factors possibly complicating this analysis include human alterations to physical habitat like channel clearing and shaping for flood control, invasion of noxious plants (giant cane, salt cedar) or animals that alter physical habitat.
Sub 4*		• **Describe upstream-downstream connectivity and lateral connectivity of streams with the floodplain and aquatic features like wetlands, backwaters, sloughs, and oxbows under different flow conditions.** Special study acquiring and reviewing aerial photography for each stream under different flow conditions. Information collected would include location of dams and places where perennial pools form under low flow conditions. It would also include locations where streams flood into important aquatic features outside the channel. This process should be applied initially to streams analyzed by the BBEST in developing its flow regime recommendations and any other streams the BBASC believes are important to analyze. Analysis should be repeated every 10 years on a subset of the initial streams studied. These analyses should be conducted as much as possible in partnership with analysis of aerial photography for other purposes.
Sub 5*		• **Identify ecological effects of overbank flows and flows that reach, or almost reach, flood stage elevation but do not overbank.** The BBASC recommended that pulse flows nearing flood stage elevation should be allowed to occur at their historical frequency. Physical, chemical, and biological monitoring associated with floods should be conducted. These data should be used to evaluate the relation between ecological effects and environmental health of the streams. Because these events occur relatively infrequently, monitoring should be implemented whenever possible on streams in both basins. The infrequent nature of these events will support the need for extensive literature review of the ecological effects of these types of events. Obstacles to completion of this task will be their relatively infrequent nature, and logistic challenges in safely sampling episodic, short-lived events during potentially hazardous conditions. The frequency of overbank flows and floods that reach the flood stage elevation over the period from 2010 – 2019 should be compared to the BBEST's overbank and the BBASC's flood stage elevation flow recommendations.
3		**Describe relationships between groundwater and stream flow.** **Coordinating agency: TWDB** This may require creation of long-term groundwater monitoring locations combined with special studies analyzing relationships between groundwater levels, stream flows, groundwater withdrawals, land cover/use patterns, and meteorological conditions for specific streams. Monitoring should be designed to last preferably until at least 2071. Special studies analyzing relationships between groundwater levels, stream flows, and groundwater withdrawals, combined with a review of monitoring data should be conducted every 10 years. These studies should be conducted on a minimum of two representative watersheds in each of the upper Colorado and Lavaca-Navidad river basins and on at least one watershed in the lower Colorado basin. Lack of rainfall monitoring in specific

Sub 1	Yes	areas combined with inadequate information about runoff rates, plant uptake rates, and interception of runoff before it infiltrates the ground will complicate this analysis. • **Determine relationships between groundwater withdrawals from the Carrizo-Wilcox and the Gulf Coast aquifers, and flows to rivers.** These studies would start as desk-top analysis but additional field work should be conducted if more data are needed. These studies should be conducted on tributaries in addition to the main rivers or streams. Studies should be designed to help provide data suitable for use in both WAM and GAM modeling efforts, including efforts to understand historical and current relationships and to facilitate predictions of future relationships.
4*		**Describe relationships between water chemistry and flow regime components.** **Coordinating agency: TCEQ** Considerable water chemistry monitoring is currently done and some data are analyzed on a regular basis for the Clean Rivers Program and the federally-required biennial water quality inventory. Current analysis focuses on possible point and nonpoint sources of contaminants. When data indicate the presence of harmful levels of certain parameters, the current analysis should be expanded to determine the role flow regimes play in determining those levels. Existing monitoring programs should be encouraged to collect water chemistry data over a wider range of flow conditions than may normally be done. For example, water chemistry should be measured when flow stops and as long as perennial pools persist and when streams have higher than normal flow or are flooding. Analysis of relationships with flow should focus on at least the following parameters: temperature, pH, specific conductance, dissolved oxygen, nitrate + nitrate, total phosphorus, and chlorides. Two obstacles associated with this task involve ensuring safe sampling under high flow and flood conditions and obtaining access to perennial pools that may form at different locations than currently used monitoring locations when a stream stops flowing.
5	Yes	**Increase understanding of how different factors affect calculation of flow regime components and hydrologic conditions over time.** **Coordinating agency: Colorado-Lavaca BBEST** This desk-top study of flows and climate should evaluate different periods-of-record data sets, parameterizations of HEFR, hydrologic conditions, and hydrologic condition triggers. The BBEST did some evaluation of different periods of record and HEFR parameterizations. Those analyses however were necessarily limited because of the relatively short time the BBEST had in which to produce flow regimes. Apply to a minimum of two sites in each of the upper Colorado, lower Colorado, and Lavaca-Navidad basins. Consideration will be given to how well the hydrologic condition represents the actual flow regime, the ability of the hydrologic condition and triggers to represent the natural variability of flows, and the ease with which the hydrologic triggers can be used by the regulated community.

		This will also include review of flow data collected principally by the USGS. Preliminary flow data review will be conducted every three years and recommendations will be issued regarding the continuation of monitoring at gages and the addition of flow monitoring at new sites. Natural flow patterns may be relatively long and may be influenced by several different global climate drivers, ex. Southern Pacific Oscillation, North Atlantic Oscillation, etc.
6	Yes	**Determine how groundwater development activities, as listed in the then current State and relevant Regional Water Plan, might influence river flows and the physical and hydrologic connections between surface water and groundwater.** **Coordinating agency: TWDB** Review groundwater development possibilities identified in regional water plans and the state water plan. These studies would start as desk-top studies involving prioritization of possible water development activities to evaluate. These desk-top studies would compile and review available information about groundwater, stream flow, and possible links between the two in the area of the planned groundwater development. As necessary, field studies would be conducted to provide needed information. Possible groundwater development activities are likely to occur distant from sites for which environmental flow regimes have been identified. Groundwater/surface water linkages between the location of the possible groundwater development and the site where environmental flow standards have been set should be understood.
7*		**Research best methods to determine sediment transport and channel maintenance of streams for which environmental flow standards have been set.** **Coordinating agency: TWDB** Desk-top study of the best, currently available science on sediment transport and channel maintenance. It will evaluate applicability of the best available science for the types of streams in the Colorado and Lavaca-Navidad basins. This effort will guide future analysis of flow regimes needed to maintain the existing, dynamic channel morphology.
Sub 1	Yes	• **Describe changes in geomorphology, i.e. trends in channel elevation, longitudinal profile, width, floodplain width, stream form, bed sediment size, and the role the flow regime contributes to those changes.** Utilize available data and aerial photography for at least two representative streams in each of the three basins. Review of available literature will guide identification of additional field data and/or aerial photography to be collected. Indicators of change in channel morphology and levels useful in identifying ecologically harmful changes in channel morphology will be identified. The cumulative impacts of multiple, relatively small, diversions on channel morphology should be evaluated in this analysis. Limited availability and resolution of Lidar data that measures ground surface elevation along with the dynamic nature of stable channels could complicate this analysis.

8	Yes	**Evaluate and update the WAM, with particular emphasis on Run 3 and Run 8 for both the Colorado and Lavaca river basins, with a goal of the development of a daily time-step capability that could be employed for environmental flow assessment tasks.** **Coordinating agency: TCEQ** TCEQ would manage revision of the WAM model. Desk-top studies would follow, evaluating how the revised version would affect estimates of available flow and the recommended flow regimes. It is recognized that the daily time-step function might not be employed by TCEQ in evaluating water availability. The preferred outcome would be to develop a model that could be easily switched between a monthly and a daily time-step function. •
9	Yes	**Evaluate decline in flows in the upper Colorado Basin with a particular emphasis on understanding the apparent change in relationship between rainfall and river flow.** **Coordinating agency: TWDB** This task will initially involve evaluations of the relationship between rainfall and river and stream flow over time in order to gain a better understanding of how that relationship may have changed over the period for which records are available. Based on that improved understanding, the next phase is intended to help identify potential causes in that relationship.. It may be appropriate to involve regional experts with knowledge of flows and changes that have occurred over time in the area. .
		Bays
10	Yes	**Develop a method for obtaining site-specific commercial fishing harvest data and for maintaining appropriate confidentiality of those data and develop an approach for incorporating reliable commercial fisheries harvest data into the analysis of the relationship between freshwater inflows and species productivity.** **Coordinating agency: TPWD** Commercial fishermen indicate that reliable site-specific harvest data exist which are not currently available in government databases. However, at least some of those fishermen are concerned about sharing those data with governmental entities because of a desire to maintain the confidentiality of those data. Because reliable commercial harvest data tied to specific locations could be highly useful in augmenting current databases used in evaluating the relationship between species productivity and freshwater inflows, there is a need to find a way to obtain, review, and, as appropriate, incorporate those data. That will require at least a two-step process. First, TPWD will need to identify and/or develop a way to maintain the confidentiality of commercial harvest data voluntarily provided in this manner. It is possible that can't be accomplished under current statutes. Second, TPWD will need to assess the reliability of the data and, if determined to be adequately reliable, develop a way to incorporate those data into analyses

		of the relationship between freshwater inflows and species productivity.
11 Sub 1	Yes	**Refine estimates of freshwater flow to the bays.** **Coordinating agency: TWDB** Validate estimates of gaged and ungaged flow. Develop estimates of groundwater flow to the bays. Special studies may be necessary to collect rainfall runoff information from ungaged watersheds and particularly to measure how it changes with season and land cover. Special studies will be necessary to identify locations where groundwater inflow is entering the bay, estimate quantities, and characterize factors that influence groundwater inflow. Information on diversions and return flows should also be validated. The objective of this task is to increase confidence in estimates of freshwater inflow to the bays. • **Describe flows into Garcitas Creek and their sources with particular emphasis on the reach downstream of the USGS gage.** Evaluate how the flow regime in Garcitas Creek is changing because of changing agricultural practices. Identify how flow patterns in the past compare to existing flows and they are expected to change in the future. Recalculate the amount of freshwater Garcitas Creek is delivering to Lavaca Bay. This is primarily a desk-top study of existing flow and agricultural data (information on irrigation practices and changes in acreage in production). Field studies evaluating ungaged flow into Garcitas Creek downstream of the gage may be needed.
12 Sub 1	Yes	**Describe relationships between freshwater inflow to bays, and physical, chemical, and biological structure and function of the estuaries and how these relationships support ecological health.** **Coordinating agency: Primarily TPWD with support from TWDB, and TCEQ** This is an overarching goal that should be accomplished by combining information collected from 2011 through 2020 with earlier data. The 2021 work plan report should summarize the results of the monitoring and studies conducted for this adaptive management process and obtained from other sources. The report should focus on relationships between inflow and ecological health in Lavaca Bay, Matagorda Bay, and East Matagorda Bay. Work should also be conducted in Tres Palacios Bay and Powderhorn Lake. Planning should begin for freshwater inflow recommendations for Carancahua, Keller, Cox, Chocolate, and Turtle bays. Revised freshwater inflow regimes will be prepared for Lavaca and Matagorda bays, as appropriate, and freshwater inflow regimes will be prepared for East Matagorda and Tres Palacios bays, and Powderhorn Lake. • **Identify improvements made in methods for determining environmental flow regimes for estuaries.** Intensive literature review combined with expert meetings and consultation will be conducted to stay abreast of latest developments in this

		field of science. New techniques will be evaluated and applied to the Colorado-Lavaca estuaries as appropriate.
Sub 2		• **Describe relationships between freshwater inflow, marsh, and the threatened diamond-back terrapin populations.** A special study would be conducted in upper Lavaca Bay to understand the relationship between this state-listed threatened species, its habitat, and freshwater inflows.
Sub 3		• **Describe the relationship between freshwater inflow and *Rangia* clam abundance in upper Lavaca Bay.** Anecdotal information suggests *Rangia* clams were very abundant in upper Lavaca Bay at one time. Field studies would be conducted to identify *Rangia* clam distribution, abundance, spawning, and life history patterns and relationships to freshwater inflows.
Sub 4		• **Describe the relationship between freshwater inflow, location and size of oyster reefs, and health of oysters in Lavaca Bay and Matagorda Bay.** Oysters would be mapped with side-scan sonar (this may be done by TPWD since it has acquired side-scan sonar capability). Dermo monitoring by the Oyster Sentinel program would be expanded to include more reefs over a broader range of salinities. Water quality monitoring (temperature, salinity, oxygen, and pH) would be conducted using continuously recording meters placed on the reefs in locations where Oyster Sentinel samples would be collected. Monitoring of commercial oyster harvest would be expanded to account for harvest effects on oyster reefs. TWDB, with its coast-wide salinity monitoring program, and TPWD, with its role in assisting the TWDB with salinity monitoring and its responsibility in measuring oyster populations and tracking harvest, will be key partners in this effort.
Sub 5		• **Evaluate relationships between freshwater inflow and the distribution, health, and abundance of seagrass in East Matagorda Bay and Matagorda Bay.** Field studies would map seagrass in both bay systems. Monitoring should be initiated in key seagrass beds in both bay systems using protocols identified by the interagency Seagrass Monitoring Workgroup. Additional sampling as appropriate would be identified to explain relationships between seagrass and freshwater inflow. This work may be complicated by the relatively turbid condition of the bays compared to other areas with seagrass which have more transparent water and where it is easier to see the seagrass and capture it in aerial photography.
Sub 6	Yes	• **Describe relationships between salinity and commercially important indicator species (e.g., white and brown shrimp, blue crab, and Gulf menhaden).** This study would be a desk-top review of existing inflow, salinity (TWDB), and abundance (TPWD) data. Field work may be identified and conducted as appropriate. This field work may include monitoring of larval life stages or habitats not typically sampled in existing monitoring programs. To the extent possible and appropriate, commercial harvest data obtained pursuant to Task 7, above, should also be considered.
Sub 7		**Identify marsh changes occurring in the Lavaca River and the Matagorda River deltas and relationship of those changes to freshwater inflow.** Conduct field studies including aerial photography designed to describe these changes. Placement of water quality and sedimentation monitoring equipment in key marsh locations may be necessary.
Sub 8	Yes	• **Evaluate achievement of the BBEST freshwater inflow recommendations in Matagorda Bay (based on the Matagorda Bay Health Evaluation recommendations) and ecological response to those freshwater inflow quantities and distribution.** Determine if ecological structure and functions identified as likely to be protected by the Matagorda Bay Health Evaluation, are responding as predicted with the salinity-based approach of MBHE. Are the abundance and recruitment of key species as predicted by MBHE criteria occurring? Are metrics of abundance and recruitment being reflected in response to "exceptional", "average", or "low" suitability years? This analysis may be complicated if the freshwater inflows are

Sub 9 Sub 10		substantially different than the MBHE regime. • **Describe the relationship between freshwater inflow and sound environment in the coastal drainages of East Matagorda Bay.** The area of focus would be north of the Intracoastal Waterway and east of the Colorado River to Caney Creek. Field studies would be conducted with expected focus on the marsh communities in this area. Complicating factors for this task include absence of gaged stream flows in these watersheds and changing agricultural practices that may change amounts of irrigation return flow to the area. • **Identify methods to lower salinities in East Matagorda Bay without degrading the environmental condition of the bay.** This would be a desk-top study to identify techniques to lower salinity in the bay. Meetings with technical experts and stakeholders would be essential. Proposed alternatives may need to be addressed in an environmental impact statement under the National Environmental Protection Act. Additional monitoring or field studies may be identified.
13		**Describe the relationships between subsidence and salinity regimes in East Matagorda Bay.** **Coordinating agency: TWDB** Subsidence may be occurring in the East Matagorda Bay area. Field studies would be conducted to determine if subsidence was occurring and if so, its rate. If subsidence was substantial, field studies would be conducted to evaluate the effects of subsidence on freshwater inflow, salinity and ecological health.
14	Yes	**Improve the existing hydrodynamic model or use other hydrodynamic models to model hydrology, circulation, and salinity patterns for Matagorda, East Matagorda, and Lavaca Bays.** **Coordinating agency: TWDB** This would be a desk-top study to validate and refine prediction of salinity and other environmental factors at different inflows. Focus would be on ranges of inflows and areas of the bays (i.e. near shore) where modeling capability is weaker. This work would be limited by the cost associated with enhancing existing models or using new models. Additional field studies may be identified to support this effort. In particular, field studies may be required to get a better understanding of freshwater flows reaching the Intracoastal Waterway adjacent to East Matagorda Bay and of the amount of those flows, as well as flows from Caney Creek, that reach East Matagorda Bay. There also would be particular emphasis on the relationship between salinity in the marsh and adjacent open water in Matagorda and Lavaca bays.
Basin-wide		
15	Yes	**Implement a program to review effectiveness of strategies that could be used in areas where there may be inadequate amounts of water for an ecologically sound stream or estuary.**

		Coordinating organization: Colorado-Lavaca BBEST and Strategies Work Group Part of this program would involve the design of desk-top or field studies needed to determine strategy effectiveness in: 1) restoring or providing ecological structure and function provided by a sound flow regime, or 2) restoring environmentally sound flow regimes.
16	Yes	**Quantify the effects of sediment transport on delta formation in Lavaca and Matagorda Bays.** **Coordinating organization: TWDB** A key role of freshwater inflows is to replenish sediments reaching bay systems. That effect is most immediately reflected in the deltas formed adjacent to major inflow sources. Delta formation would be tracked over time, including through analysis, if possible, of historical responses between delta formation and freshwater inflows, reflecting changes in inflow patterns and the creation of upstream sediment traps. Future changes in delta formation would be measured and analyzed and, to the extent possible, tools for predicting changes in delta formation in response to future inflow changes and reductions in sediment load would be developed.

* For these tasks or subtasks, the following prioritization mechanism for locations is recommended, except to the extent that a particular aspect of the task or subtask otherwise establishes location priorities.

Tier 1 - Lavaca River, Tres Palacios Creek, Garcitas Creek;
Tier 2 - Navidad River, Sandy Creek, West Mustang Creek, East Mustang Creek;
Tier 3 - Onion Creek, Pedernales River, Llano River, San Saba River, Concho River, Pecan Bayou, South Concho River;
Tier 4 - Colorado River at Bastrop, Colorado River at Columbus, Colorado River at Wharton; Colorado at San Saba, and
Tier 5 - Colorado River at Ballinger, Colorado River at Silver, Elm Creek at Ballinger

As resources are available to conduct this work, those resources should be applied to Tier 1 streams decreasing in priority to Tier 5 streams. If resources become available for a particular stream, those resources should be applied to that stream regardless of which tier it is assigned to.

This prioritization is based on several factors. Tier 1 streams are shown by water availability modeling to have the most water potentially available for future appropriations. Tier 4 sites have already had intensive analysis of relationships between flow and ecology and have limited amounts of water potentially available for future appropriations. Tier 5 streams have such small amounts of water available for future appropriation that work in those streams should be minimized until higher tier streams are adequately studied. The BBASC is interested in ensuring all streams have environmentally sound flows regardless of their priority for analysis.