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CHAPTER 7.0 :LONG TERM PROTECTION OF THE STATE'S WATER RESOURCES, AGRICULTURAL RESOURCES, AND NATURAL RESOURCES

7.1 *Long-term Protection of the State's Water Resources*

The population of the region is expected to increase by over 300 percent over the next 50 years. In order to meet the associated DMI water demands, the Rio Grande Regional Water Planning Group has identified three goals aimed at curbing DMI water use through conservation and diversification: (1) optimize the supply of water available from the Rio Grande, (2) reduce projected DMI water demands through expanded water conservation programs, and (3) diversify water supply sources for DMI use through appropriate development of alternate water supply sources (i.e., reuse of reclaimed water, groundwater, desalination, etc.).

Chapter 2 of this report contains projected demands data provided by TWDB. Chapter 3 of this report gives an in-depth analysis of current and future water supplies for each WUG.

Past regional water planning studies included estimated water savings due to water conservation in the overall demand figure for each Water User Group (WUG). In this round of regional planning, the TWDB has determined that "reductions due to the installation of water-efficient plumbing fixtures in new construction, as well as from the replacement of older fixtures, will be included in the Regional Water Plans based on data provided by the TWDB." These measures are treated as a requirement for each municipal WUG thereby reducing per-capita water demand throughout the extent of the planning study. In addition, the Regional Planning Group recognizes the effect of additional conservation measures on the water supply in the region. For this reason, Advanced Water Conservation was recognized as a Water Management Strategy. This strategy consists of public information, school education, and residential clothes washer conversion. Any additional conservation measures will be treated as Advanced Water Conservation. Water conserved actually decreases overall demand resulting in less potential supply needed to meet that demand. This strategy is explained in more detail in Chapter 4.

Optimizing the supply of water available from the Rio Grande is another important aspect of protecting the State's water resources since the river is the main source for both DMI use and irrigation use. As populations grow, irrigable land is lost and the associated irrigation water demand is also reduced. Logically, large portion of the region's future DMI water supply will come from the Rio Grande. Municipalities can acquire Rio Grande water rights through purchase, urbanization, and contract. Chapter 2 explains projected reductions in irrigation demand. By 2060, irrigations demands are expected to decrease by 227,898 acre-feet. Since irrigation water rights can be converted to DMI use on a two-to-one basis, an additional CMI Rio Grande water supply of 113,949 acre-feet is possible. However, not all of this water is feasible for conversion to DMI use. A portion should be retained to reduce existing irrigation deficits.

Diversifying water supply sources for DMI use will also aid in protecting the State's water resources. Water management strategies such as brackish and seawater desalination, potable and non-potable reuse, and groundwater development will reduce the impact on existing water sources for DMI use, especially the Rio Grande.

7.2 Long-term Protection of the State's Agricultural Resources

Over the next 20 years, an irrigation water supply deficit of over 410,000 acre-feet is projected. Considering the effects of urbanization on irrigable land, this deficit may decline slightly, to 210,000 acre-feet by 2060. (This information can be seen in the Irrigation Water User Group supply/deficit tables in the appendix.) In Chapter 4, the Rio Grande RWPG recommends two Water Management Strategies (WMSs)—on-farm conservation and conveyance system improvements--to reduce this impact. On-farm improvements include field-level water measurement, installation of poly or gated pipe, and improved water management practices. Conveyance system improvements include installation of no-leak gates, water measurement, canal linings, and conversion of canals to pipelines. Potential water savings associated with on-farm improvements is 274,000 acre-feet, while conveyance system improvements could yield savings of 243,000 acre-feet[1]. In the long run, total water savings associated with both strategies would allow irrigators to offset water supply deficits. However, the implementation timeframe will not offer immediate relief.

Another factor in maintaining and supplementing irrigation water supplies is Mexico's compliance with the 1944 treaty with the U.S. Even though Mexico is in the midst of repaying its water debt, there is little assurance future compliance should the region be gripped by another severe drought. Due to Mexico's breach of its treaty obligations from 1992 to 2002, Texas A&M studies have shown that the Lower Rio Grande Valley lost nearly $1 billion in decreased economic activity and 30,000 jobs as a direct result of that shortfall.[2]

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[1] Fipps, Guy. "Potential Water Savings in Irrigated Agriculture for the Rio Grande Planning Region (Region M)." May 6, 2005.

[2] Press Release. Marzulla & Marzulla: Attorneys at Law. "Texas Water Rights Holders Still Seeking $500 Million in Compensation for Economic Injuries Caused by Mexico". March 14, 2005.

7.3 *Long-term Protection of the State's Natural Resources*

Environmental flow needs are in the forefront of all issues dealing with long-term protection of the Texas' natural resources. As water is diverted from the Rio Grande, river flows also drop. With the potential for increasing reliance on the Rio Grande, the issue of maintaining and/or increasing environmental flows should be a concern now and in coming years.

One possibility for maintaining and increasing environmental flows is the purchase or donation of Rio Grande water rights for environmental usage into the Texas Water Trust. These water rights could be managed to produce sufficient flows throughout the region. However, this option may not be viable because of the current water rights purchase and transfer structure.

Even though environmental flows on the Rio Grande were previously discussed, flows in the Arroyo Colorado and other regional estuaries are equally as important.

Given the WUG format currently being implemented by the TWDB, no option exists to formally allocate projected water supplies for environmental use. Alternatively, environmental flows in the Rio Grande could be included as a separate WUG in the next round of regional planning to ensure minimums would be met in a manner consistent with all other WUGs.

International cooperation (i.e., Mexico's) is critically needed to maintain flow levels. The United States Fish and Wildlife Service is currently in talks with Mexico regarding the introduction of fish to the Rio Grande. Even though this is the case, if the United States were to implement an environmental flow program without Mexico's participation, the desired effect would be significantly reduced.

Another of the region's critical environmental issues is the growth of Salt Cedar and other invasive plants such as Water Hyacinth and Hydrilla, among others. Salt Cedar has begun to make its way through the region. Water Hyacinth and Hydrilla are already well established. Unfortunately, eradication methods are both costly and physically strenuous. The natural rise and fall of water elevation in rivers and streams somewhat curtails these plants by drowning out new seedlings. However, in areas of minimal water flow, a perfect scenario exists for invasive plant growth.

7.4 *Supplemental Evaluation of Potential Long-Term Changes in Freshwater Inflows to the Lower Laguna Madre Estuary*

The National Wildlife Federation (NWF) has approached the Lower Rio Grande Planning Group with a proposal to supplement the assessment of potential cumulative effects of regional water plan implementation on the Lower Laguna Madre Estuary. This would be accomplished by calculating changes in freshwater inflow expected to the Lower Laguna Madre Estuary with the Region M Plan in place, comparing these inflows to two baselines, and providing two ecologically-based assessments. The baselines for comparison include freshwater inflows under “Natural” and “Present” conditions. The two ecologically-based assessments rely, in part, upon the freshwater inflow recommendations of the Texas Parks and Wildlife Department and the TWDB and focus upon spring/early summer freshwater inflow pulses and drought periods during the months of March through October as used in a recent NWF publication.

As indicated in Attachment 7-2, there is no significant impact to the freshwater inflows into the Laguna Madre as a result of this region’s Water Management Strategies. Even with an increase in wastewater reuse, this is offset with an increase in population and subsequent wastewater flows.

ATTACHMENT 7-1

CHECKLIST FOR COMPARISON OF THE REGIONAL WATER PLAN TO APPLICABLE WATER PLANNING REGULATIONS

The purpose of this attachment is to help determine how the Regional Water Plan is consistent with long-term protection of the water, agricultural, and natural resources of the State of Texas. Accordingly, the following checklist includes a regulatory citation (Column 1) for all subsections and paragraphs contained in the applicable portions of water planning regulations:

- 31 TAC Chapter 358.3
- 31 TAC Chapter 357.5
- 31 TAC Chapter 357.7
- 31 TAC Chapter 357.8
- 31 TAC Chapter 357.9

CHECKLIST FOR REVIEW OF 2006 IPPS		
Rule	**Description (See Rule or Contract for Complete Description)**	**Chap.**
Chapter 357	**REGIONAL WATER PLANNING GUIDELINES**	
§357.5	**Guidelines for Development of Regional Water Plans**	Exhibit B
§357.5(d)(1)&(2)	Use state population and water demand projections that have been adopted by the TWDB board	Chapter 2 Sections 2.2 & 2.3
§357.5(e)(1)	Adjusted WMSs for appropriate environmental water needs	Chapter 4 Chapter 5 Chapter 7
§357.5(e)(2)	Provided WMSs to be used during a drought of record	Chapter 4 Chapter 6
§357.5(e)(3)	Protected water rights, water contracts and option agreements. May consider amendments of water rights, contracts etc.	Chapter 4 Chapter 7
§357.5(e)(4)	Specific recommendations of WMSs were based on analysis and comparison of all potentially feasible WMSs	Chapter 4 Sections 4.3, 4.5, & 4.7
§357.5(e)(4)	Prior to identifying potentially feasible WMSs, RWPG documented its process for identifying potentially feasible WMSs	Chapters 4,10 Sections 4.0 & 4.1
§357.5(e)(5)	Incorporated water conservation and drought contingency planning	Chapters 4,6 Sections 4.4 & 4.5.4
§357.5(e)(6)	Conducted planning to achieve efficient use of existing water supplies	Chapter 4 Chapter 6

§357.5(e)(6)	Explored opportunities and benefits of regional water supply facilities or providing regional management of regional facilities	Chapter 4
§357.5(e)(6)	Coordinated actions of local and regional water resource management agencies	Chapter 1 Chapter 4 Chapter 10
§357.5(e)(6)	Provided substantial involvement by the public in the decision-making process and provide full dissemination of planning results	Chapter 10
§357.5(e)(7)(A)	Specific factors were considered to initiate a drought response for each water supply source designated in §357.7(a)(3)	Chapter 6
§357.5(e)(7)(B)	Actions to be taken as part of the drought response	Chapter 6 Attachments
§357.5(e)(8)	Effect of the regional water plan on navigation	Chapter 7
§357.5(f)	Prepared the regional water plan to be consistent with all laws applicable to water use in the RWPA	Chapter 4 Chapter 7
§357.5(h)	For special water resources, protected water rights, water supply contracts, etc. for demands outside the RWPA	Chapter 4
§357.5(h)	For special water resources, provided holders of interests in water rights, water supply contracts, etc. notice of and an opportunity to comment on the scope of work and proposed water plan.	Chapter 10
§357.5(i)	Consider emergency transfers of surface water to meet non-municipal use pursuant to TWC §11.139	Chapter 4 Chapter 7
§357.5(k)(1)	Consider existing plans and information, including the following:	
§357.5(k)(1)(A)	Water conservation plans	Chapter 6 Attachments
§357.5(k)(1)(B)	Drought contingency plans	Chapter 6 Attachments
§357.5(k)(1)(C)	Information from water loss audits - N/A until 2011 Regional Water Plans	
§357.5(k)(1)(D)	Certified groundwater conservation district management plans	Chapter 3 Chapter 4
§357.5(k)(1)(E)	Publicly available plans of major agricultural, municipal, manufacturing and commercial water users	Chapter 3 Chapter 4
§357.5(k)(1)(F)	Water management plans	Chapter 3 Chapter 4
§357.5(k)(1)(G)	Water availability requirements promulgated by a county commissioners court pursuant to TWC §35.019	Chapter 3 Chapter 4
§357.5(k)(1)(H)	Any other information available from existing local or regional water planning studies	Chapter 3 Chapter 4

§357.5(k)(2)	Considered existing programs and goals, including the following:	
§357.5(k)(2)(A)	The state Clean Rivers Program	Chapter 3 Chapter 5
§357.5(k)(2)(B)	The federal Clean Water Act	Chapter 3 Chapter 5
§357.5(k)(2)(C)	Other planning goals, including but not limited to regionalization of water and wastewater services, where appropriate	Chapter 4 Chapter 5
§357.5(l)	Considered environmental water needs including instream flows and bay and estuary inflows	Chapter 3 Chapter 4 Chapter 7
§357.7	**Regional Water Plan Development**	
§357.7(a)(1)	Prepared description of regional water planning area, including:	Chapter 1
§357.7(a)(1)(A)	Wholesale water providers	Chapter 1
§357.7(a)(1)(B)	Current water use (for identified water use categories)	Chapter 1
§357.7(a)(1)(C)	Identified water quality problems	Chapter 1
§357.7(a)(1)(D)	Sources of groundwater and surface water including springs important for water supply or natural resource protection	Chapter 1
§357.7(a)(1)(E)	Major demand centers	Chapter 1
§357.7(a)(1)(F)	Agricultural and natural resources	Chapter 1
§357.7(a)(1)(G)	Social and economic aspects: current population and economic activities (primary and ones depend. on natural water resources)	Chapter 1
§357.7(a)(1)(H)	Assessed current preparations for drought	Chapter 1
§357.7(a)(1)(I)	Summarized existing regional water plans	Chapter 1
§357.7(a)(1)(J)	Summarized recommendations in state water plan	Chapter 1
§357.7(a)(1)(K)	Summarized of local water plans	Chapter 1
§357.7(a)(1)(L)	Any threats to agricultural and natural resources due to water quantity or water quality problems related to water supply	Chapter 1
§357.7(a)(2)	Presented current and projected population and water demands for the following:	Chapter 2
§357.7(a)(2)(A)(i)	Cities with populations greater than 500 people	Chapter 2
§357.7(a)(2)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 2
§357.7(a)(2)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 2
§357.7(a)(2)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 2

§357.7(a)(2)(B)	Categories of water use for WWPs considering counties and river basins. Include WWP's contractual obligations and demands.	Chapter 2
§357.7(a)(2)(C)	How water-saving plumbing fixtures (per Chapter 372 of Health and Safety Code) impact projected municipal water use	Chapter 2
§357.7(a)(3)	Evaluated water supplies legally and physically available during drought of record using TWDB approved methods	Chapter 3
§357.7(a)(3)(A)(i)	Cities with populations greater than 500 people	Chapter 3
§357.7(a)(3)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 3
§357.7(a)(3)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 3
§357.7(a)(3)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 3
§357.7(a)(3)(B)	Categories of water use for WWPs considering counties and river basins	Chapter 3
§357.7(a)(4)	Analyzed water supplies and demands	Chapter 3
§357.7(a)(4)(A)	Compared water demands developed in §357.7(a)(2) with current supplies developed in §357.7(a)(3) to determine surpluses and needs.	Chapter 3
§357.7(a)(4)(A)(i)	Cities with populations greater than 500 people	Chapter 4
§357.7(a)(4)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 4
§357.7(a)(4)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 4
§357.7(a)(4)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 4
§357.7(a)(4)(A)	Evaluated social and economic impact of not meeting needs and report by RWPA and river basin.	Chapter 5
§357.7(a)(4)(B)	Categories of water use for WWPs considering counties and river basins	Chapter 4
§357.7(a)(5)	Developed Water Management Strategies	
§357.7(a)(5)(A)(i)	Cities with populations greater than 500 people	Chapter 4
§357.7(a)(5)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 4

§357.7(a)(5)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 4
§357.7(a)(5)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 4
§357.7(a)(5)(B)	Categories of water use for WWPs considering counties and river basins	Chapter 4
§357.7(a)(5)(C)	Water Management Strategies not selected for WUGs or WWPs with need	Chapter 4
§357.7(a)(5)(C)(i)	Evaluation of WMSs must be shown and reasons given why no WMSs are feasible	Chapter 4
§357.7(a)(5)(C)(ii)	If political subdivision does not participate in planning process, has RWPG adopted equitable and reasonable terms of participation?	Chapter 4
§357.7(a)(6)	Presented data in additional reporting units, such as splitting a county into two, if desired by the RWPG	Chapter 4
§357.7(a)(7)	Evaluated all Water Management Strategies the RWPG determines to be potentially feasible:	Chapter 4
§357.7(a)(7)(A)	RWPG considered water conservation practices for each need identified in §357.7(a)(4)	Chapter 4
§357.7(a)(7)(A)(i)	Water conservation practices must be included for each WUG to which TWC §11.1271 applies in a manner consistent with §11.1271	Chapter 4
§357.7(a)(7)(A)(ii)	The RWPG shall adopt water conservation practices that exceed §11.1271 for affected WUGs or document the reason	Chapter 4
§357.7(a)(7)(A)(iii)	The highest practicable level of water conservation and efficiency achievable for interbasin transfers to which TWC §11.085(l) applies	Chapter 4
§357.7(a)(7)(A)(iv)	Considered strategies in response to an issues identified through water loss audits	Not available for 2006 RWP
§357.7(a)(7)(B)	RWPG considered drought management measures for each need identified in §357.7(a)(4)	Chapter 4
§357.7(a)(7)(B)	Drought management measures must be included for each WUG to which TWC §11.1272 applies in a manner consistent with §11.1272	Chapter 4
§357.7(a)(7)(B)	The RWPG shall adopt drought management measures that exceed §11.1272 for affected WUGs or document the reason	Chapter 4
§357.7(a)(7)(C)	Reuse of wastewater	Chapter 4
§357.7(a)(7)(D)	Expanded use of existing supplies: systems optimization, conjunctive use, reallocation of reservoir storages, voluntary redistribution, etc.	Chapter 4

§357.7(a)(7)(E)	New supply development: construction and improvement of surface water and groundwater resources, brush control, etc.	Chapter 4
§357.7(a)(7)(F)	Interbasin transfers	Chapter 4
§357.7(a)(7)(G)	Other measures	Chapter 4
§357.7(a)(8)	Evaluated all Water Management Strategies the RWPG determines to be potentially feasible	
§357.7(a)(8)(A)(i)	Quantitative reporting of quantity, reliability, and cost of water delivered and treated for end user's requirements	Chapter 4
§357.7(a)(8)(A)(ii)	Quantitative reporting of environmental factors including effects on environmental water needs, wildlife habitat, etc.	Chapter 4
§357.7(a)(8)(A)(iii)	Quantitative reporting of impacts on agricultural resources	Chapter 4
§357.7(a)(8)(B)	Impacts on other water resources of the state including other WMSs and groundwater surface water relationships	Chapter 4
§357.7(a)(8)(C)	Discussed how threats to agricultural and natural resources identified in §357.7(a)(1)(L) will be addressed or affected	Chapter 4
§357.7(a)(8)(D)	Other factors deemed relevant by the RWPG including recreational impacts	Chapter 4
§357.7(a)(8)(E)	Equitable comparison and consistent application of all WMSs the RWPGs determine to be potentially feasible for each need	Chapter 4
§357.7(a)(8)(F)	Consideration of the provisions in TWC §11.085(k)(1) for interbasin transfers of surface water, including summing needs	Chapter 4
§357.7(a)(8)(G)	Third party impacts from voluntary redistributions of water and moving water from rural and agricultural areas	Chapter 4
§357.7(a)(8)(H)	Consideration of water pipelines and other facilities that can be used for water conveyance as described in §357.7(a)(1)(M)	Chapter 4
§357.7(a)(9)	WMSs described in sufficient detail to allow state agencies to make financial or regulatory decisions to determine consistency	Chapter 4
§357.7(a)(10)	Regulatory, admin., or legislative recommendations that RWPG believes are needed and desirable to meet purpose of SB 1	Chapter 8
§357.7(a)(11)	Chapter consolidating the water conservation and drought management recommendations of the RWP	Chapter 6

§357.7(a)(12)	Described the major impacts of WMSs on key parameters of water quality important to the use of the water resource	Chapter 5
§357.7(a)(13)	Chapter describing how the Plan is consistent with long-term protection of water, agricultural, and natural resources	Chapter 7
§357.7(a)(14)	Chapter describing the financing needed to implement the WMSs. How local governments and others will pay for WMSs.	Chapter 9
§357.7(c)	Regional water plan includes a model water conservation plan pursuant to TWC §11.1271	Chapter 6
§357.7(d)	Regional water plan includes a drought contingency plan pursuant to TWC §11.1272	Chapter 6
§357.8	**Ecologically Unique River and Stream Segments**	
§357.8(a)	Recommendation package containing physical description and site characterization submitted to and evaluated by TPWD	Chapter 8
§357.8(c)	Impact of RWP on unique river and stream segments, comparing current conditions and conditions with WMSs	Chapter 8
§357.9	**Unique Sites for Reservoir Construction**	
§357.9	Description of the sites, reasons for the unique designation, and expected beneficiaries of water supply to be developed	Chapter 8
§357.10	**Format of Information to be Presented in RWPs**	
§357.10(a)(1)	Technical report and data prepared pursuant to rules and Exhibit B	Appendix
§357.10(a)(2)	Executive summary that documents the key RWP findings and recommendations	Attached to Report
§357.10(a)(3)	Summaries of comments from TWDB, any federal or state agency, and the public with RWPG response	Chapter 10
§357.10(b)	Transfer copies of all data and reports to TWDB	RWP
§357.10(b)	To extent possible data shall be in digital format per Exhibit B	RWP
§357.10(b)	One copy of all reports shall be in digital format per Exhibit B	RWP
§357.11	**Adoption of RWPs by RWPGs**	
§357.11(a)	IPP submitted in electronic and paper format as specified in Exhibit B	RWP
§357.11(a)	RWPG certification that IPP is complete and adopted by the RWPG	RWP
§357.12	**Notice and Public Participation**	
§357.12(a)(1)	Public meeting prior to preparation of the RWP	Chapter 10
§357.12(a)(2)	Opportunities for public input during preparation of	Chapter 10

	RWP	
§357.12(a)(3)	Public hearing following adoption of initially prepared RWP	Chapter 10
§357.12(a)(5)	Notice published in newspaper of general circulation before 30th. day preceding date of public hearing and mailed to the following:	Chapter 10
§357.12(a)(5)(A)	Mayors of municipalities with population of 1000 or more	Chapter 10
§357.12(a)(5)(B)	County judges of counties located in whole or part of RWPA	Chapter 10
§357.12(a)(5)(D)	Retail public utilities that serve any part of RWPA or receives water from RWPA	Chapter 10
§357.12(a)(5)(E)	Holders of water rights for surface water diverted from RWPA	Chapter 10
§357.12(a)(6)	Notices shall include the following:	Chapter 10
§357.12(a)(6)(A)	Date, time and location of the public hearing	Chapter 10 Section 10.1
§357.12(a)(6)(B)	Summary of the proposed action to be taken	Chapter 10 Section 10.1
§357.12(a)(6)(C)	Name, telephone number, and address of the person for questions and requests for additional information	Chapter 10 Section 10.1
§357.12(a)(6)(D)	That RWPG will accept written and oral comments at hearing	Chapter 10 Section 10.1
§357.12(a)(6)(D)	How public may submit written comments separate from hearing	Chapter 10 Section 10.1
§357.12(a)(6)(D)	Deadline for submitting written comments not earlier than 30 days after the hearing	Chapter 10 Section 10.1
§357.12(b)	Copies of RWP available for public inspection at least one month before hearing at the following locations:	Chapter 10 Section 10.1
§357.12(b)	At least one public library in each county	Chapter 10 Section 10.1
§357.12(b)	Either the county courthouse's law library, county clerk's office, or some other accessible place within the county courthouse	Chapter 10 Section 10.1
§357.12(b)	Notice shall include locations of copies of RWP	Chapter 10 Section 10.1
§357.14	**Approval of RWP by the Board**	
§357.14(2)(B)	RWP must include water conservation and drought management practices that incorporate §357.7(7)(a)(A), a(B), (c), and (d)	Chapter 4 Section 4.5.4 Chapter 6
§357.14(2)(C)	Consistent with long-term protection of water, agricultural, and natural resources	Chapter 5 Chapter 7
§357.14(3)	No interregional conflict exits	Chapter 3 Chapter 4

Chapter 358	**STATE WATER PLAN DEVELOPMENT**	
§358.3	**Guidelines**	
§358.3(b)	Development of the state and regional water plans shall be guided by the following principles:	
§358.3(b)(1)	Identified policies and actions to meet water needs and to respond to drought conditions to assure sufficient water supply for Texas	Chapter 4 Chapter 7
§358.3(b)(2)	Decision-making open to and accountable to the public; based on accurate, objective and reliable information	Chapter 4 Chapter 10
§358.3(b)(3)	Considered effects of policies or WMS on public interest, water supply, and those entities that provide water supply	Chapter 4 Chapter 5 Chapter 7
§358.3(b)(4)	Considered all WMS the board considers potentially feasible that are cost effective and which are consistent with long-term protection of water, agricultural, and natural resources	Chapter 4 Chapter 7
§358.3(b)(5)	Opportunities that encourage and result in voluntary transfers of water, including regional water banks, sales, leases etc.	Chapter 4
§358.3(b)(6)	Balance of economic, social, aesthetic, and ecological viability	Chapter 4
§358.3(b)(8)	Orderly development, management, and conservation of water resources	Chapter 4 Chapter 7
§358.3(b)(9)	Principles that all surface water is held by the state, use is via rights administered by the TCEQ, and prior appropriation applies	Chapter 3 Chapter 4
§358.3(b)(10)	Protection of existing water rights, water contracts, and option agreements	Chapter 3 Chapter 4
§358.3(b)(11)	Principal that use of groundwater is governed by the right of capture, unless under a local groundwater management district	Chapter 3
§358.3(b)(12)	Considered recommendations of river and stream segments of unique ecological value	Chapter 8
§358.3(b)(13)	Considered recommendation of sites of unique value for the construction of reservoirs	Chapter 8
§358.3(b)(14)	Coordinate water planning and management activities of local, regional, state and federal agencies	Chapter 4
§358.3(b)(15)	Designated water quality and related water uses shown in the state water quality plan should be improved or maintained	Chapter 5

§358.3(b)(16)	Coordination of water planning/management activities of RWPGs to identify common needs, issues, and/or problems and working together to resolve conflicts equitably and fairly	Chapter 3 Chapter 4
§358.3(b)(17)	Describe WMSs in sufficient detail for state agencies to make financial/regulatory decisions that are consistent with the RWP	Covered by §357.7(a)(9)
§358.3(b)(18)	Evaluated alternative WMS using environmental criteria	Chapter 4
§358.3(b)(19)	Considered environmental water needs including instream flows and bay and estuary inflows	Chapter 7
§358.3(b)(20)	Planning consistent with all laws applicable to water use	Chapter 3 Chapter 4
§358.3(b)(21)	Inclusion of ongoing water development projects for which TCEQ has issued a permit	Chapter 3 Chapter 4
Exhibit B	**GUIDELINES FOR REGIONAL WATER PLAN DEVELOPMENT**	
PART 1	**Regional Water Plan Tasks and Requirements for Deliverables**	
1.2	Requirements for Deliverables	
1.2.1	Introduction	
1.2.1	All computer files and formats 100 percent compatible with PC-type computers.	RWP
1.2.1	Copies of electronic files (disc or CD) and electronic file lists and file description print outs (including metadata files).	RWP
1.2.1	Formats of all computer files shall be compatible with the widely distributed versions of the following programs:	RWP
1.2.1	Word processor files - Microsoft Word (MS Office 97 or newer)	RWP
1.2.1	GIS coverages - Arc/Info (7.21 or newer)	RWP
1.2.1	GIS shape files – Arc View (3.1 or newer)	RWP
1.2.1	Database files - Microsoft Access (MS Office 97 or newer)	RWP
1.2.1	Internet browsers – Internet Explorer (5.5 or newer) or Netscape (6 or newer)	RWP
1.2.1	Spreadsheets Files - Microsoft Excel (MS Office 97 or newer)	RWP
1.2.1	Graphs, bar-charts, pie-charts - Microsoft Excel (MS Office 97 or newer)	RWP
1.2.1	Drawings and graphs shall be provided in an Encapsulated PostScript format with tiff preview using Pantone process colors	RWP

1.2.2	Data Units	
1.2.2	The following units shall be used, although equivalents in other units may be shown simultaneously:	
1.2.2	Land area - square miles (mi^2)	RWP
1.2.2	Water area - acres (ac)	RWP
1.2.2	Water volume - acre-feet (ac-ft)	RWP
1.2.2	Demand and supply rates - acre-feet per year (ac-ft/yr)	RWP
1.2.2	Treatment plant capacities - million gallons per day (mgd)	RWP
1.2.2	Water use per capita - gallons per capita per day (gpcd)	RWP
1.2.2	Stream flows and reservoir releases - cubic feet per second (cfs)	RWP
1.2.2	Pumping rates - gallons per minute (gpm) or million gallons per day (mgd)	RWP
1.2.2	Cost – 2002 US Dollars (Engineering News Record (ENR) Construction Cost Index)	Chapter 4
1.2.3	Maps	
1.2.3	Minimum requirements of the maps are:	
1.2.3	Figures should be designed so that a black and white photocopy of the original is readable	RWP
1.2.3	Maps shall include title, border, and a title box that includes the Planning Group letter name, map name and number, and date prepared	RWP
1.2.3	For maps drawn to scale, the scale shall be clearly shown and clearly labeled including a scale bar.	RWP
1.2.3	Reference source of both the base map and any substantial additions to the base map.	RWP
1.2.3	Where possible, all maps shall be developed from source maps available from TWDB	RWP
1.2.5	Data Time Frame and Time Steps:	
1.2.5	Time periods and increments shall be 2000 (current year) and 2010, 2020, 2030, 2040, 2050, and 2060 for planning	RWP
1.2.7	Initially Prepared and Adopted Regional Water Plans	
1.2.7	The RWP will consist of the following:	
1.2.7	Executive summary of 30 pages or less	ES
1.2.7	Ten chapters:	
1.2.7	Planning area description	Chapter 1
1.2.7	Population and water demand projections	Chapter 2
1.2.7	Water supply analysis	Chapter 3
1.2.7	Identification, evaluation, and selection of WMS based on needs	Chapter 4

1.2.7	Impacts of WMSs on key parameters of water quality and impacts of moving water from rural and agricultural areas	Chapter 5
1.2.7	Consolidated water conservation and drought management recommendations	Chapter 6
1.2.7	Description of how the RWP is consistent with long-term protection of water, agricultural and natural resources	Chapter 7
1.2.7	Unique stream segments/reservoir sites/Legislative recommendations	Chapter 8
1.2.7	Report on water infrastructure funding recommendations	Not due until 1/6/2006
1.2.7	Adoption of RWPs	Chapter 10
PART 2	**Introduction to Regional Water Planning Data**	
2.1	Overview	
2.1	Access and update data in DB07 via the internet	RWP
2.1	Data in the final RWP cannot contradict DB07	RWP
2.2	General Requirements	
2.2	Water availability determined as the maximum amount of water from current source during DOR , after accounting for legal constraints and management philosophies	Chapter 3
2.2	Water supply determined as the volume of water for a WUG or WWP from existing and connected water sources as of January 1, 2002 or anticipated prior to end of current planning cycle	Chapter 3
2.2	Data submitted shall be accurate and the best available	RWP
PART 3	**Water Sources**	
3.1	Introduction	
3.1	Document all current water sources and their water availability	Chapter 3
3.1.1	Sources identified and quantified by county and basin location	Chapter 3
3.2.1	Sources not over-allocated on a permanent basis; Sum of supplies on county-basin basis does not exceed DOR availability	Chapter 3
3.2.2	Groundwater	Chapter 3
3.2.2	Calculated largest amount of groundwater that can be pumped annually without violating most restrictive physical, regulatory or policy condition	Chapter 3
3.2.2	TWDB's GAM used to determine groundwater availability	Chapter 3
3.2.3	Surface Water	Chapter 3

3.2.3	Surface water availability for lakes and reservoirs reported as firm yield, TCEQ-permitted yield or operational supply	Chapter 3
3.2.3	Documented any modifications of input data set for WAM Run 3 to reflect return flows and changed conditions	Chapter 3
3.2.3.b	TCEQ's official WAM Run 3 used to determine firm yields of reservoirs	Chapter 3
3.2.3.c	Reservoir firm yield developed in accordance with eight criteria in 3.2.3.c as applicable	Chapter 3
3.2.3.d	TCEQ's official WAM Run 3 used to determine firm diversions from diversion sites	Chapter 3
3.2.3.e	Firm diversion developed in accordance with five criteria in 3.2.3.e as applicable	Chapter 3
3.3	Required Data Elements - Form 1	Chapter 3
3.3	RWP shall document the sources of information and methodologies used to estimate source availability values	Chapter 3
3.3	RWP shall list all water rights permit numbers for each availability source	Chapter 3
3.3	All water used by a WUG must be attributed to one or more sources	Chapter 3
3.3	DB07 Form 1 - Sources completed in accordance with Section 3.3 of Exhibit B	DB07
PART 4	`	
4.1	Introduction	
4.1	All required WUGs shall be included in the Water User Group Form	DB07
4.2.6	Water quality considered as a factor in evaluation of WMS	Chapter 4
4.2.6	Cost of water delivered and treated to end user requirements included for all potentially feasible WMS	Chapter 4
4.2.7.a	Conservation WMS that achieves the most practicable, achievable level of water conservation and efficiency included for each WUG or WWP that will obtain water from a new IBT	Chapter 4
4.2.7.b	Conservation WMS identified by type of measure, estimated savings, timeline and anticipated costs	Chapter 4
4.2.8.c	Use site-specific studies if available, if not the 1997 Consensus Criteria for environmental flows for WMS needing new permits	Chapter 4
4.2.9	Costs of Strategies	Chapter 4

4.2.9	Calculation of debt service in accordance with Exhibit B	Chapter 4
4.2.9	Capital costs to include construction costs, engineering, land and easements, environmental, interest during construction, and purchased water cost (if applicable)	Chapter 4
4.2.9	Annual costs to include operations and maintenance, power cost, purchased water cost (if applicable), and debt service	Chapter 4
4.2.9	Total costs to be discounted and shown in terms of present value	Chapter 4
4.3	DB07 Form 2 - Water User Groups completed in accordance with Section 4.3 of Exhibit B	DB07
PART 5	**Data by Wholesale Water Providers**	
5.1	Introduction	
5.1	All WWPs must be included in the Wholesale Water Providers form	DB07
5.1	All the WWPs contractual or non-contractual obligations throughout the 50-year planning horizon must be included	Chapter 3
5.2.2	If a recipient shows a need, WWP must include a WMS to address that need	Chapter 4
5.3	DB07 Form 3 - Wholesale Water Providers completed in accordance with Section 5.3 of Exhibit B	DB07

ATTACHMENT 7-2

BAYS IN PERIL: Evaluating the Effects of the 2006 Region M Water Plan on Freshwater Inflows to the Lower Laguna Madre Estuary of Texas.

by the National Wildlife Federation
in cooperation with NRS Consulting Engineers

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Evaluating the Effects of the 2006 Region M Water Plan on Freshwater Inflows to the Lower Laguna Madre Estuary of Texas.

Introduction

Texas coastal estuaries, where freshwater from inland runoff mixes with the salty waters of the Gulf of Mexico, support an amazing abundance of wildlife. Young fish, shrimp, and crabs feed and hide in brackish estuary waters until they are mature enough to survive in the Gulf of Mexico. Resident and migratory birds by the thousands rest and feed in estuarine marshes. In fact, 95 percent of the Gulf's recreationally and commercially important fish and other marine species rely on estuaries during some part of their life cycle.

Although the estuaries that line the Texas coast are highly variable with regard to freshwater inflow volumes, salinity regimes, and other important characteristics, there is little doubt that freshwater is an important requirement. The southernmost estuary, the Laguna Madre is typified by lower inflows and higher salinities than others up the coast. However, adequate freshwater inflows are still needed to maintain the estuary's function as a nursery and habitat for a vast array of marine life.

The Texas Water Development Board (TWDB) rules for regional water planning require an evaluation of the plan's consistency with long-term protection of the state's water, agricultural, and natural resources. Obviously a critical component of that evaluation for the Lower Rio Grande Region is an assessment of the Region M plan's potential effects on the Lower Laguna Madre. In early 2005 the National Wildlife Federation (NWF) approached the Lower Rio Grande Regional Water Planning Group (LRGWPG) with a proposal to assess these potential cumulative effects. This would be accomplished by calculating changes in freshwater inflow expected to the Lower Laguna Madre Estuary with the Region M Plan in place at the ultimate 2060 time frame and assessing the ecological significance of these changes. The NWF has developed a two-step method for accomplishing such assessments which was applied to the other principal estuaries of the Texas coast in a report issued in late 2004[1].

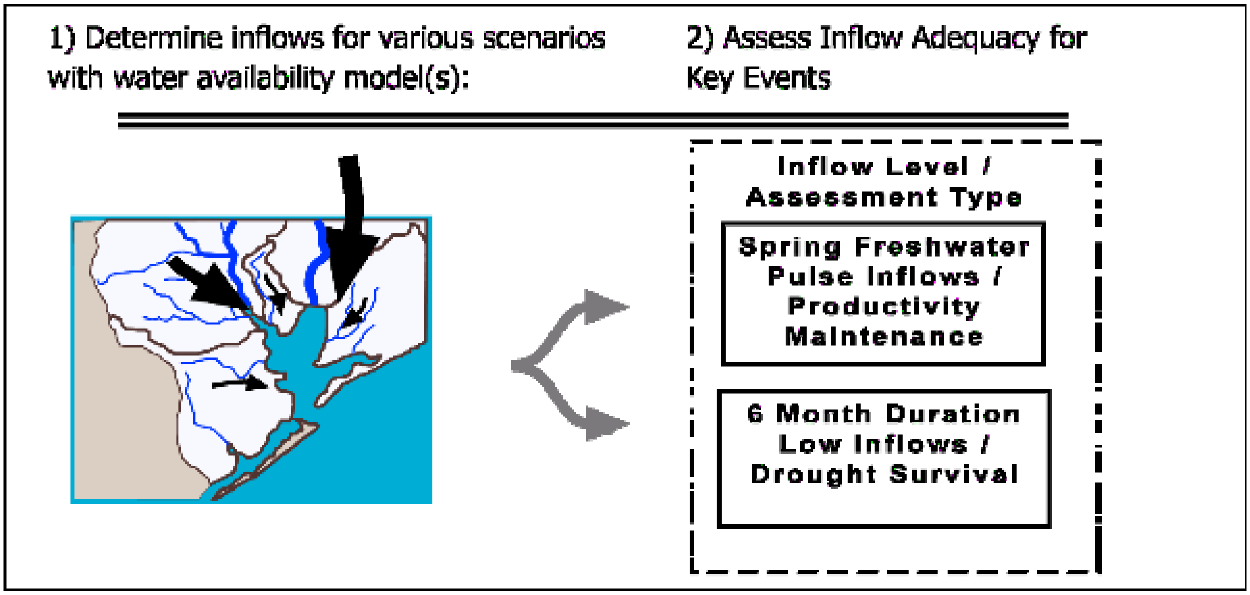
Figure 7.2-1 is a basic illustration of the NWF method. The initial step is to calculate freshwater inflows for various scenarios including "year 2060 with the regional plan implemented" conditions. This step is accomplished with the Texas Commission on Environmental Quality's water availability model (WAM) that performs predictions of streamflows in the Nueces-Rio Grande coastal basin under various scenarios. The Nueces-Rio Grande coastal basin is the official hydrological name of the area draining to the Lower Laguna Madre. The name refers to the geographic location, lying between the Nueces river basin to the north and the Rio Grande basin to the south. Much of the lower three counties of the Lower Rio Grande Region lies in the area of the Nueces-Rio Grande coastal basin. The results of this first step also provide the ability to compare the "with plan" conditions to two baselines: "Natural" and "Current use" conditions.

In the second step of the NWF method, two evaluations of the ecological significance of these inflow changes are performed. The two ecologically-based assessments rely, in part, upon the

[1] Johns, N.D., Hess, M., Kaderka, S., McCormick, L., & McMahon, J., "Bays in Peril, A Forecast for Freshwater Flows to Texas Estuaries," National Wildlife Federation, October 2004.

freshwater inflow recommendations of the Texas Parks & Wildlife Department (TPWD) and the TWDB.[2] The criteria in this step focus upon spring / early summer freshwater inflow pulses and also drought periods during the months of March through October. More details on each step are provided below.

Figure 7.2-1 National Wildlife Federation's method for assessing freshwater inflow status of Texas estuaries.



At its April 2005 meeting the LRGWPG approved in concept this cooperative work. Several subsequent meetings and phone discussions were held between NWF and the Region's consultant in order to carry out these analyses. This section describes these supplemental evaluations of potential long-term changes, at the 2060 time frame, of freshwater inflows to the Lower Laguna Madre Estuary with implementation of the 2006 Region M water plan

Elements of the Region M water plan that will affect freshwater inflows.

There are approximately 325,000 ac-ft/yr in new municipal water supplies proposed in the 2006 Region M water plan. All of this except approximately 19,000 ac-ft/yr of advanced water conservation can affect either freshwater inflows to the Lower Laguna Madre or streamflows in the Rio Grande. Alteration in flows on the Rio Grande are beyond the scope of the present evaluation. For Nueces-Rio Grande coastal basin streams draining to the Lower Laguna Madre there are no major dams, diversions, or other water management strategies proposed that can cause changes in streamflows. However, many of the proposed water management strategies can influence freshwater inflow through alteration of wastewater discharges based upon supplies imported from the Rio Grande basin or groundwater. Many of Region's growing municipalities lie in the Nueces-Rio Grande coastal basin and will have greatly altered wastewater discharge into the streams that drain to the Laguna Madre.

[2] TPWD & TWDB, "Freshwater Inflow Recommendation for the Laguna Madre Estuary of Texas."

For example, the type of municipal water management strategy with the largest proposed volume in the 2006 Region M water plan is the conversion of water currently used for irrigation into the municipal use category. This amounts to about 140,000 ac-ft/yr in the whole region[3]. While most irrigated agriculture has little or no return flow, most municipal use will return about 60% to rivers and streams typically. For the Lower Rio Grande Region, the region-wide annual average value is 63%[4]. Other water management strategies proposed that will alter wastewater discharges to Nueces-Rio Grande coastal basin streams are increased pumping of groundwater[5], desalination of brackish groundwater and seawater, and a portion of the supply from the Brownsville Weir[6]. Another type of water management strategy in the 2006 Region M water plan that can affect freshwater inflow is reuse of wastewater. While reuse can be an efficient water use, it also reduces the return flows of wastewater. In some cases such return flows are all that keep some streams flowing during drier times.

Of the total proposed changes in municipal water supply, not all of this will affect the Nueces-Rio Grande coastal basin and the Lower Laguna Madre. For instance major water supplies are proposed for Laredo, but this will not affect the Nueces-Rio Grande coastal basin. It is necessary to narrow down the proposed water management strategies to those that will potentially effect the Lower Laguna Madre. The key was to first select the municipalities and other municipal water user groups (ie currently rural, but urbanizing counties) that either currently discharge, or in the future will discharge, to streams that drain to the Lower Laguna Madre. .Detailed information was provided by Region M's consultant (and found in Appendix C of the plan) regarding the proposed water management strategy(ies) for each municipal water user group. In conjunction with the Region M consultant, NWF was able to compile Figure 7.2-2 which shows the locations of current and future discharges that will affect Nueces-Rio Grande coastal basin streams and the Lower Laguna Madre.

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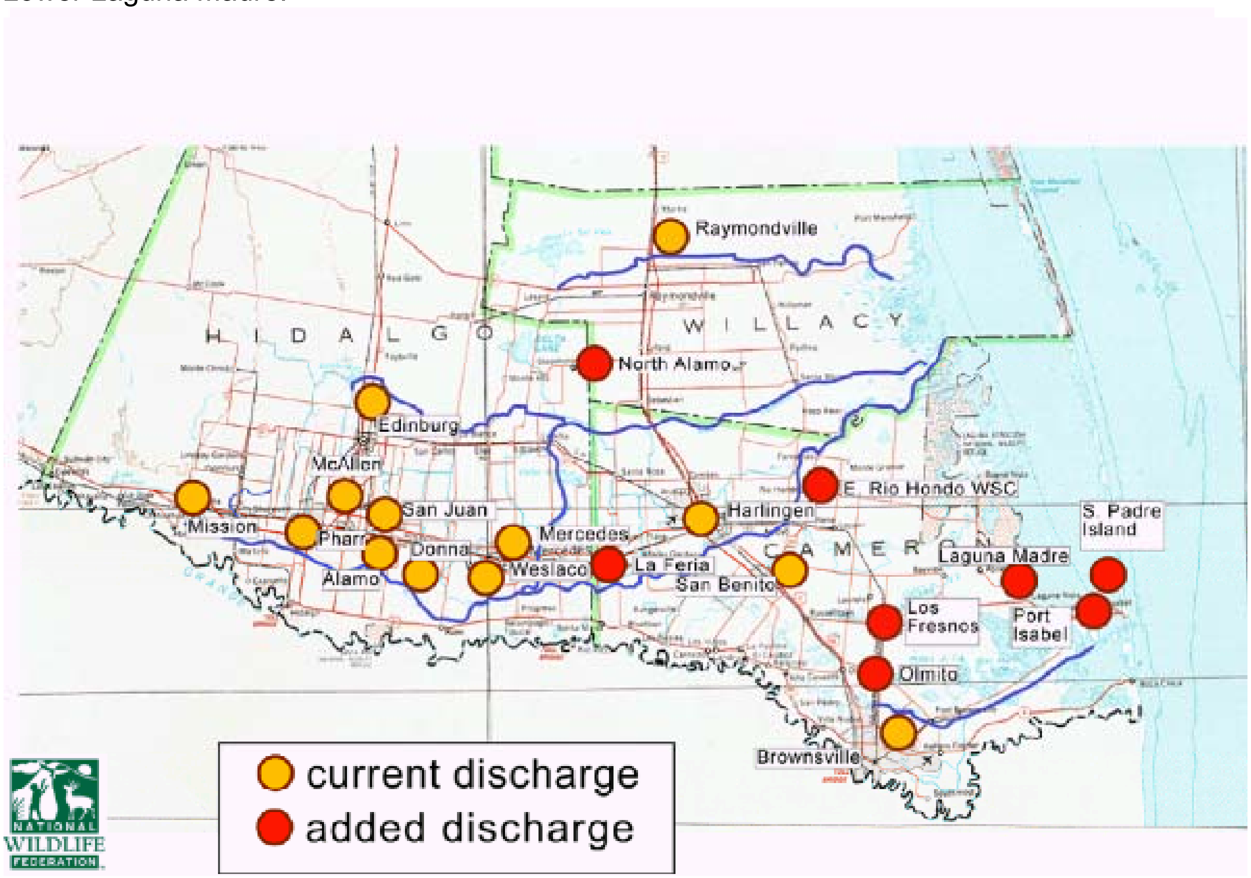
[3] data provided by NRS Consulting Engineers, November 2005

[4] spreadsheet provided by NRS Consulting Engineers, November 2005.

[5] emerging research at Texas A&M in Kingsville and UT in Port Aransas on this topic is finding a discharge pathway from the Gulf Coast Aquifer to the lower Texas estuaries. Therefore any increase in return flows from groundwater pumping to surface water streams may be offset by long-term loss of aquifer discharge to the coastline. However, this is beyond the scope of this evaluation. In these analyses, groundwater for municipal use was discharged as surface water addition.

[6] NRS Engineers estimates that approximately 80% of the growth in Brownsville will be on the north side of the city and the wastewater resulting from this will likely end up discharging to the Brownsville Ship Channel and reach the Lower Laguna Madre. Personal communication December 9, 2005.

Figure 7.2-2 Locations of current and future wastewater discharges to streams draining to the Lower Laguna Madre.



The list of current discharges and their respective volumes are shown in Table 7.2-1. The entities included in this table are those which are included in the Nueces-Rio Grande coastal basin WAM "current conditions" data set[7].

[7] There are probably more wastewater discharges than in this list of fourteen entities. The original guidance from TCEQ on WAM development required all entities with permits greater than 1mgd to be included (though their actual discharges might not be 1mgd). Table 2-1 in the Nueces Rio Grande WAM report, prepared in 2002 by PBS& J Engineers, list about 125 entities with permits, including many other municipal entities such as Rio Hondo, Los Fresnos, and Olmitto. Apparently the actual levels of discharge for most of these were negligible although the criteria for narrowing the list to just the given fourteen was not documented.

Table 7.2-1 Original municipal water user groups with wastewater discharges in the Nueces-Rio Grande (NRG) coastal basin WAM.

	Water user group	total current effluent (ac-ft/yr)	total current effluent (mgd)	WAM point of discharge	WAM point terminus at Lower Laguna Madre	common name of this stream pathway
1	Raymondville	662.9	0.59	V20010	V10000	East or North Main Floodway
2	Edinburg	2959.1	2.64	W20200	W10000	Main Floodway
3	Weslaco	1903.8	1.70	W20160	W10000	Main Floodway
4	McAllen	1560.6	1.39	W20190	W10000	Main Floodway
5	Mercedes	1227.2	1.10	X20060	X10000	Arroyo Colorado
6	San Benito	1323	1.18	X20020	X10000	Arroyo Colorado
7	Mission	2348.6	2.10	X20130	X10000	Arroyo Colorado
8	Harlingen	4463.3	3.98	X20040	X10000	Arroyo Colorado
9	Donna	1026.8	0.92	X20080	X10000	Arroyo Colorado
10	Pharr	3205.9	2.86	X20110	X10000	Arroyo Colorado
11	McAllen	7474.9	6.67	X20120	X10000	Arroyo Colorado
12	San Juan	734.7	0.66	X20100	X10000	Arroyo Colorado
13	Alamo	1016.5	0.91	X20090	X10000	Arroyo Colorado
14	Brownsville	5133.7	4.58	Y10150	Y10000	other to Laguna Madre
	Total	35,041.0	31.28			

Table 7.2-2 details the proposed additional water supplies for these existing dischargers and other municipal groups that will discharge to the Nueces-Rio Grande coastal basin in the future with the Region M plan implemented. The final columns to the right of Table 7.2-2 show the change in wastewater volumes resulting from the proposed water supply strategies. These are based on return flow factor of 63% for conventional wastewater discharge and a loss factor of 27% for reuse water supplies[8].

While Table 7.2-2 gives the details of the many proposed water management strategies for twenty three municipal entities, Table 7.2-3 summarizes these changes for the "2060 with Region M plan" condition. Basically, there will be vast increase in wastewater discharges to the streams of the Nueces-Rio Grande coastal basin that feed freshwater to the Lower Laguna Madre. While these currently total about 35,000 ac-ft/yr (Table 7.2-1), they will increase to approximately 100,000 ac-ft/yr in 2060. Of course, much of this increased discharge (about 37,000 ac-ft[9]) will come at the expense of the Rio Grande basin.

[8] spreadsheet provided by NRS Consulting Engineers, November 2005.
[9] calculated as the sum of all irrigation conversion itemized in Table 7.2-2 times a return flow factor of 63%.

Table 7.2-2 Tabulation of changes in supplies for individual water user groups (WUGs) and corresponding change in discharge to Nueces-Rio Grande (NRG) coastal basin streams.

		Region M proposed water supply additions										NRS-NWF Calculation			
						Irrigation conversion			Desalination			change wastewater return flow			
	Water user group	Add. Gr'd-water	Non-Pot. Water Reuse	Pot. Water Reuse	B'ville Weir	Purch.	Urban-ization	Con-tracts	Brack. Gr'd-water	Sea-water	*total supply*	portion discharge to NRG stream [1]	conven-tional addtnl.. supply[2]	reuse waste-water supply[3]	net
Original entities with discharges in Nueces-Rio Grande WAM															
1	Raymondville								100		100	100%	63	0	63
2	Edinburg		4000			6619	0	348	25		10992	100%	4405	-1480	2925
3	Weslaco	500	1120			135		7			1762	100%	404	-414	-10
4	McAllen	1450	9893			7220		380	7841		26784	100%	10641	-3660	6981
5	Mercedes								560		560	100%	353	0	353
6	San Benito					789		42			831	100%	524	0	524
7	Mission		4548				11660		560		16768	100%	7699	-1683	6016
8	Harlingen								2022		2022	100%	1274	0	1274
9	Donna								50		50	100%	32	0	32
10	Pharr	100	50			8522	1300	449			10421	100%	6534	-19	6515
11	McAllen										0	100%	0	0	0
12	San Juan					7312		385			7697	100%	4849	0	4849
13	Alamo	100	500			451	2100	24	1255		4430	100%	2476	-185	2291
14	Brownsville	1000	500		20643	1793		129	6070		30135	80%	14936	-148	14788
SUBTOTALS		3150	20611	0	20643	32841	15060	1764	18483	0	112552		54189	-7589	46600
Other Reg M entities with surface discharges in Nueces-Rio Grande WAM to add.															
15	N. Alamo WSC (Hidalgo)					902			11201		12103	70%	5337	0	5337
16	N. Alamo WSC (Willacy)								11201		11201	50%	3528	0	3528
17	Port Isabel					1389		73	1463		2925	100%	1843	0	1843
18	S. Padre Island					3769		198			3967	100%	2499	0	2499
19	La Feria								280		280	100%	176	0	176
20	E. Rio Hondo WSC					95			906		1001	100%	631	0	631
21	Laguna Madre WSC					950		50	2000	864	3864	100%	2434	0	2434
22	Los Fresnos								997		997	100%	628	0	628
23	Olmito WSC					1723		91			1814	100%	1143	0	1143
SUBTOTALS		0	0	0	0	8828	0	412	28048	864	38152		18220	0	18220

notes: 1) NRS Engineers estimates that 80% of growth in Brownsville's discharge will be in Nueces-Rio Grande basin; discharges percentages for North Alamo WSC are NRS estimates for future reflecting partial conversion to surface water discharge in combination with dispersed septic system discharges. 2) based on 63% return flow factor applied to all supplies except reuse. 3) based on 27% net reduction for supplies based on reuse of wastewater.

Table 7.2-3 Summary of year 2060 effluent volumes for current (first fourteen) and future wastewater dischargers to streams of the Nueces-Rio Grande coastal basin that drain to the Lower Laguna Madre.

	Water user group	total effluent w. plan (ac-ft/yr)	total effluent w. plan (mgd)	WAM point at discharge	WAM point terminus at Lower Laguna Madre	common name of this stream pathway
Original entities with wastewater discharges in WAM						
1	Raymondville	726	0.65	V20010	V10000	East Main Floodway
2	Edinburg	5884	5.25	W20200	W10000	Main Floodway
3	Weslaco	1894	1.69	W20160	W10000	Main Floodway
4	McAllen	2747	2.45	W20190	W10000	Main Floodway
5	Mercedes	1580	1.41	X20060	X10000	Arroyo Colorado
6	San Benito	1847	1.65	X20020	X10000	Arroyo Colorado
7	Mission	8364	7.47	X20130	X10000	Arroyo Colorado
8	Harlingen	5737	5.12	X20040	X10000	Arroyo Colorado
9	Donna	1058	0.94	X20080	X10000	Arroyo Colorado
10	Pharr	9721	8.68	X20110	X10000	Arroyo Colorado
11	McAllen	13269	11.85	X20120	X10000	Arroyo Colorado
12	San Juan	5584	4.98	X20100	X10000	Arroyo Colorado
13	Alamo	3307	2.95	X20090	X10000	Arroyo Colorado
14	Brownsville	19922	17.78	Y10150	Y10000	Brownsville Ship Channel
	SUBTOTALS	81641	72.88			
Entities with new wastewater discharges to be added to WAM						
15	N. Alamo WSC (Hidalgo)	5337	4.76	V20010	V10000	East Main Floodway
16	N. Alamo WSC (Willacy)	3528	3.15	V20010	V10000	East Main Floodway
17	Port Isabel	1843	1.65	Y10100	Y10000	Direct
18	S. Padre Island	2499	2.23	Y10100	Y10000	Direct
19	La Feria	176	0.16	X20010	X10000	Arroyo Colorado
20	E. Rio Hondo WSC	631	0.56	X20000	X10000	Arroyo Colorado
21	Laguna Madre WSC	2434	2.17	Y10120	Y10000	Brownsville Ship Channel
22	Los Fresnos	628	0.56	Y10030	Y10000	Brownsville Ship Channel
23	Olmito WSC	1143	1.02	Y10030	Y10000	Brownsville Ship Channel
	SUBTOTALS	18220	16.26			
	TOTALS	99861	89.15			

Predicting freshwater inflows with the Nueces-Rio Grande coastal basin WAM.

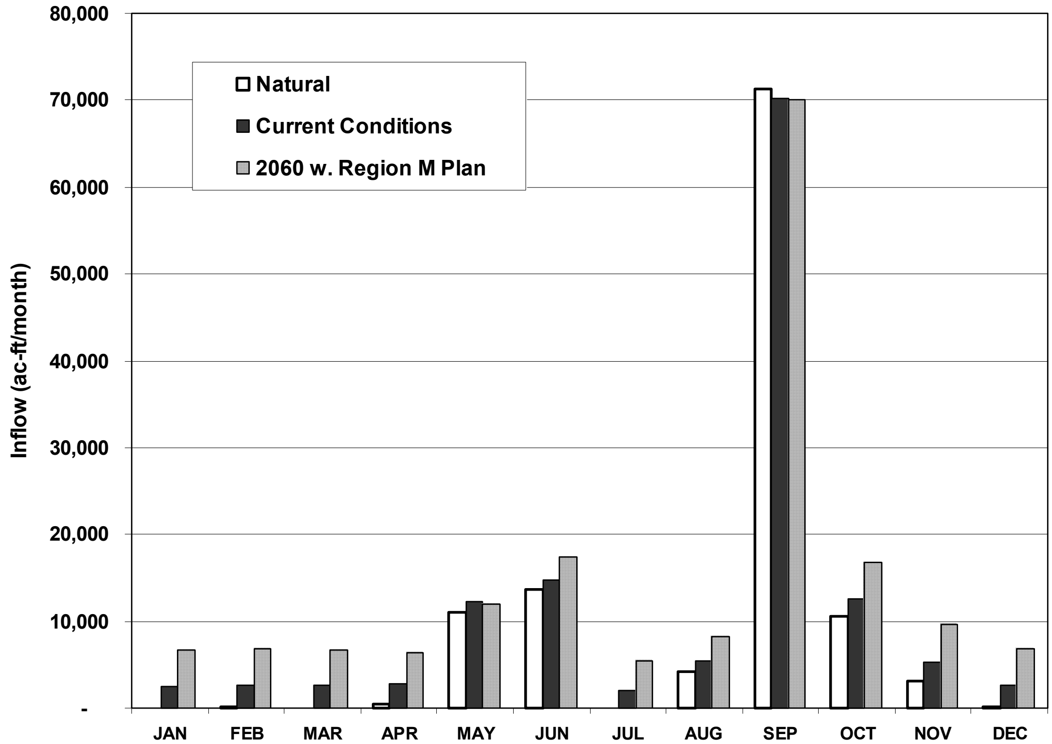
There already exist standard data from the TCEQ which allow determination of Lower Laguna Madre inflows under "natural" and "current conditions" with the Nueces-Rio Grande coastal basin WAM. For the "natural" scenario the WAM predicts what inflows to the estuary would have been if there were no dams or pipelines or other human-induced alterations in the streams' flow pattern, and if there were a repeat of past rainfall patterns. The Nueces-Rio Grande coastal basin WAM also can predict what freshwater inflows to the estuary would be with the same rainfall but with the "current use" scenario. Under this scenario, water use from surface water rights (irrigation, municipal, mining, other) is set to the maximum reported use of the previous ten years and wastewater discharges (those in Table 7.2-1) are at the minimum of the previous 5 years at the time the WAM data was assembled (about year 2000). Water rights use levels in this scenario are fairly low, at about 5,650 ac-ft/yr compared to the full authorization that the rights hold which is in the vicinity of 47,000 ac-ft/yr[10].

The remaining scenario is that of "2060 with the Region M plan." To model this scenario it is necessary to modify the Nueces-Rio Grande coastal basin WAM to reflect the changed wastewater discharge conditions described above in Table 7.2-3. After the changes in wastewater discharges were tabulated it was necessary to add these altered wastewater discharges into the WAM at the points indicated in the column labeled "WAM point at discharge." These points of discharge were determined in conjunction with Region M's consultant using available descriptions of the physical location of the so-called "control points" in the Nueces-Rio Grande coastal basin WAM. The data set used as a beginning point in this process was the standard TCEQ data representing full utilization of existing surface water rights. As mentioned above there is a great deal of water use authorized compared to current use levels. The motivation for use of this data was to get a picture of inflows with the maximum use levels possible in place as well as the changes in wastewater discharges.

The resulting inflows under these three scenarios are summarized in the next two figures. The first shows changes in median inflows. Median inflow is the level that is exceeded 50% of the time. The effects of the increased wastewater discharge can be seen in the graph in most months. The slight decline in "current" and "2060" conditions during the typically high flow month of September probably reflects the effects of off channel reservoirs or other storage capturing a portion of occasional higher flows. During lower flow months these would not be impeding flows and the wastewater discharge increases predominate.

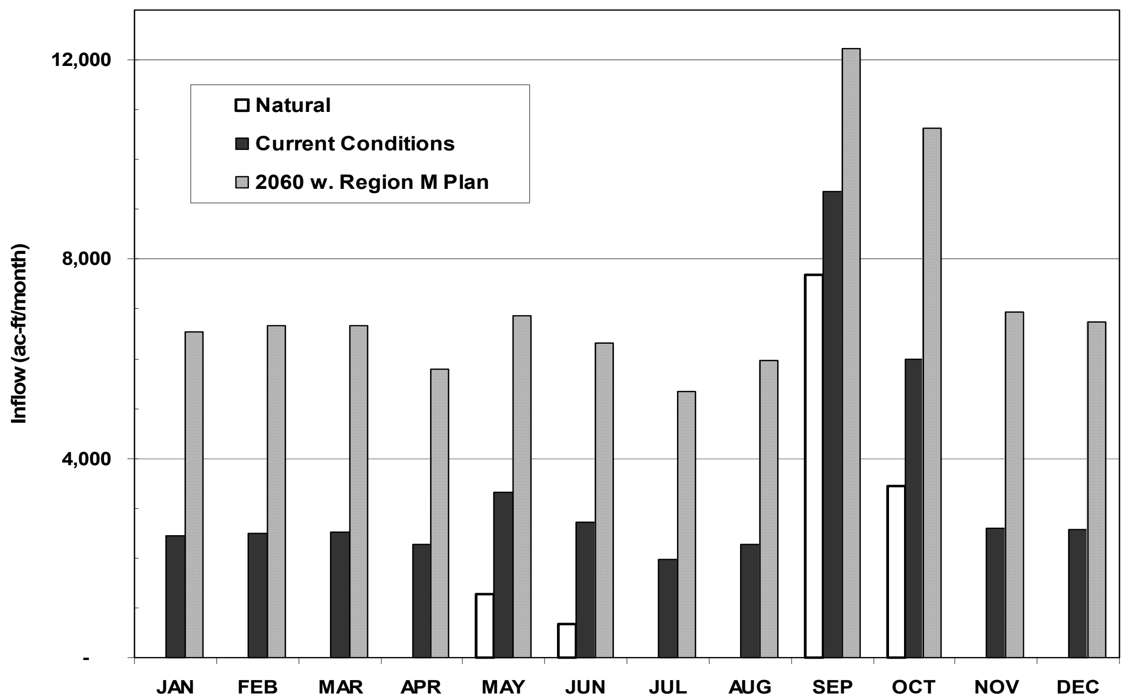
[10] NWF analysis of TCEQ's Run 8 and Run 3 data for Nueces-Rio Grande coastal basin water availability model.

Figure 7.2-3 Median inflow patterns to Lower Laguna Madre: natural, current, and year 2060 with Region M water plan conditions



While the medians represent one important measure of inflow patterns, for an area of scant rainfall it is also desirable to look at changes expected under low-flow conditions. Thus Figure 7.2-4 shows expected inflow patterns at the 25th percentile level. Inflow of the 25th percentile level is fairly low benchmark level: it is the flow that would be exceeded 75% of the time. For such low flows, the figure shows that natural inflows are non-existent in many months. This means that during 25% of the those months there would be no inflows under natural conditions. The inflows are increased in all months under both the "current" and the "2060 with plan" condition.

Figure 7.2-4 Low (25th percentile) inflow patterns to Lower Laguna Madre: natural, current, and year 2060 with Region M water plan conditions



Evaluating the ecological significance of the freshwater inflow changes to the Lower Laguna Madre.

While determining changes in the freshwater inflow pattern under the three scenarios is instructive, it is also desirable to understand the ecological significance of these changes. As a starting point, it is critical to recognize the high variability of Texas weather and the resulting fluctuation of freshwater inflows to any given estuary. Not only are inflows variable between years, but there are recognizable patterns of fluctuation within most years. Typically, there is a fairly pronounced peak in inflows during the spring to early summer period, followed by a marked decline during the summer months as hot dry weather often prevails over much of Texas. The low inflows of summer are quite often followed in late summer to early fall by another increase in flows, sometimes sizeable if associated with tropical storm activity. By referring to Figure 7.2-3 above for the Lower Laguna Madre current condition inflows, it is apparent that there is a minor peak in the April - July period that corresponds to spring/early summer and a pronounced September peak showing the influence of tropical storm activity.

To a great extent, Texas estuaries, like all ecosystems, are resilient and have adapted to some degree of variability and, indeed, depend on it. Because of this expected variability of freshwater inflow to our estuaries, both within a year and between years, NWF uses multiple measures of flow adequacy. With this ecologically-based evaluation approach in mind, we have focused on two key assessments for Texas estuaries as illustrated in the second panel of Figure 7.2-1 above. These assessments are both conducted using the estuary inflows predicted by the Nueces-Rio Grande coastal basin WAM.

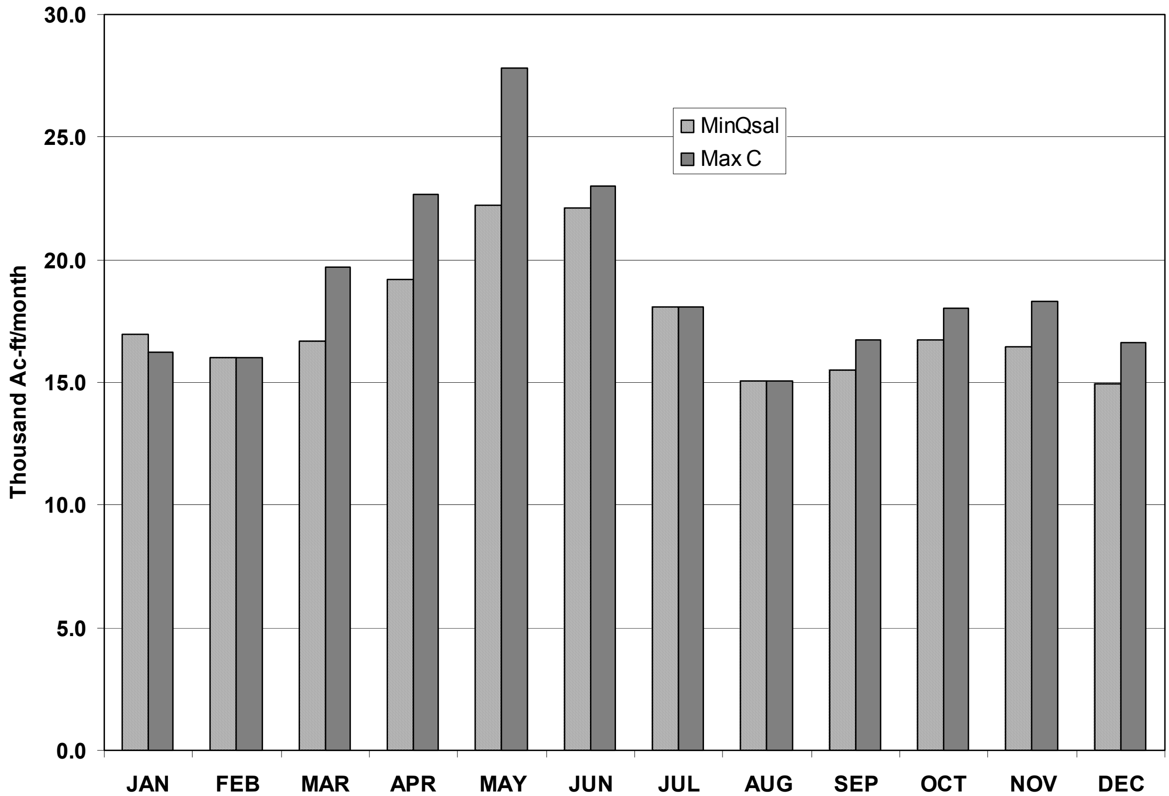
Spring / early summer freshwater pulse criteria

First, NWF examines how often adequate spring-to-early-summer pulses of inflows would occur. These "freshwater pulses", sometimes referred to as "freshetes" are generally indicated to support strong levels of reproduction and growth[11]. Thus, the 'freshwater pulse' evaluations represent an assessment of how well the estuaries would be expected to fare under '2060 with Region M plan' conditions during years that spring/early summer rainfall is in the normal to high range. For the analysis here, we identified a seasonal spring/early summer window of 4 consecutive months during which the occurrence of a 'freshwater pulse' would be assessed. The 4 months included were those with the highest consecutive 'target' level inflow criteria in the state's studies of freshwater inflow needs shown in Figure 7.2-5 (known as MaxC). This was an attempt to focus on the most critical 4-month spring/early summer period, occurring no later than July. For the Lower Laguna Madre the highest four consecutive months in this window are March – June. The sum of the target criteria for the 4 months was used as the benchmark or target volume for the freshwater pulse, which in this case totaled approximately 93,000 ac-ft.

For both the freshwater pulse" and low-inflow criteria discussed below, NWF first examined how often the inflows predicted under 'naturalized conditions' fell below each of the two inflow criteria. The Nueces-Rio Grande coastal basin WAM simulates a repeat of the weather patterns over the 51-year period of 1948-98. The frequency of periods of "below-criteria" inflows under "natural" conditions became a baseline for each estuary, because it reflects natural variations in inflows. Then, the NWF analysis examined how often the inflows predicted under the "current conditions" and "2060 with Region plan" scenarios for the same time period would fall below the inflow criteria.

[11] see inflow versus productivity relationships for white shrimp and crabs found in a recent study of Matagorda Bay in LCRA, 2005, Determination of Freshwater Inflow Needs for the Matagorda Bay system. Also see Texas Parks and Wildlife Department, 2002, Freshwater Inflow Recommendation for the Nueces Estuary.

Figure 7.2-5 The freshwater inflow criteria for the Lower Laguna Madre as developed by the Texas Water Development Board and Texas Parks and Wildlife Department.



Results of the freshwater inflow pulse analysis

As shown in Figure 7.2-3 above, median flows to the Lower Laguna Madre were predicted to change by about 1,000 to 2,000 ac-ft/month for the "current conditions" scenario as compared to "natural" conditions. For the "2060 with Region M plan" condition, flows in the Mar-June window increased by about 1,000 – 7,000 ac-ft. However, as shown in the following table, these flow changes do not result in great change in this inflow assessment criteria. Under the increased flows of the "current" and "2060 with Region M plan" scenarios the spring/early summer freshwater pulse inflow criteria is meet in only two additional years. The table also provides the supplemental results for consecutive years with a low freshwater pulse inflow. It would appear that the inflow changes ranging from 1,000 to 7,000 ac-ft/month are not very significant compared to the spring/early summer freshwater pulse benchmark volume of 93,000 ac-ft. In other words this inflow criteria volume is sufficiently high that the increases in wastewater volume alone do not greatly affect whether or not it is met: it remains primarily a weather-driven event.

Table 7.2-4 Key results of the Spring / early summer freshwater pulse analysis.

Criteria	Natural conditions	Current use conditions	2060 w. Region M Plan
*Number of yrs with inadequate 4 month spring/early summer Freshete**	31	29	29
Max. number consecutive yrs with inadequate 4 month Freshete	5	5	5

* key criteria used in NWF's Bays in Peril report.

Low-flow inflow criteria for the Lower Laguna Madre

Because of Texas' weather variability as discussed above, we also believe it is critical to look at how well the Lower Laguna Madre would fare during drier years. Accordingly, we undertook a second assessment focused on whether enough freshwater would be available to keep salinity conditions within reasonable tolerance ranges and enable sufficient populations of organisms such as fish, shrimp, and crabs to survive drought periods.

In addition to the 'target' criteria used in the spring/early summer freshwater pulse analysis, the state's freshwater inflow study results for each bay also include a set of lower inflow criteria knows as MinQsal. These inflows reflect the amount needed "…to avoid reproductive failure and loss of biodiversity…" during lower inflow periods[12]. As noted in the state's studies, for inflows between the target and the drought tolerance values "biological productivity and fisheries harvest … are significantly reduced from average historical levels." Basically, these inflows are calculated to maintain salinity levels in the estuaries within identified salinity bounds. Thus, inflows equaling drought-tolerance values would just maintain salinity levels within tolerance limits for key species at various points in the estuary. Inflows at these low levels would not be expected to maintain substantial fishery production over any extended period.

For this analysis, a period of six consecutive months below MinQsal inflow is used because such a period represents a significant portion of the life-cycle of several principal estuarine species. Under a half-year-long period of inflows below the MinQsal level, any area of lower salinity would be greatly compressed into regions near the mouths of Nueces-Rio Grande coastal basin streams. Upper estuary marshes could begin to become saltier. Direct effects on populations of fishery species (crabs, shrimp, and some finfish) would be anticipated due to lack of food and habitat, or to unfavorable salinities, especially if occurring in the spring/early summer period. Thus, a six-month consecutive period is considered in this assessment to be indicative of a serious deprivation of freshwater inflows. We also limited this analysis to periods of six consecutive months falling only within the March-October window because that window of time is particularly important for biological activity within Texas estuaries[13].

Results of the low-inflow analysis

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[12] MinQsal definition is from Powell, G., J. Matsumoto, and D. A. Brock. 2002. *Methods for Determining Minimum Freshwater Inflow Needs of Texas Bays and Estuaries*. Estuaries, Vol. 25, pg 1271.
[13] see discussion in Bays in Peril, op cit.

As shown in Figure 7.2-4 above low inflows (as measured by 25th percentile values) to the Lower Laguna Madre have changed appreciably in the "current conditions" scenario and are predicted to change much more in the "2060 with Region M plan" condition. However, these changes on the order of 2,000 to 7,000 ac-ft/month do not greatly affect the estuary as measured by this analysis for low inflows. There are slight improvements in two of the criteria below, but no change in two others, including the key criteria of six-consecutive months in the March-October window. It is quite surprising though, that even under "natural" conditions this key criteria was not met in 29 of 51 years. This may indicate that this evaluation criteria is an ill-suited yardstick for evaluating these inflow changes (more on this below).

Table 7.2-5 Key results of the low-flow analysis.

Criteria	Natural conditions	Current use conditions	2060 w. Region M Plan
Fraction of months with inflow not meeting MinQsal	44.8%	44.4%	43.0%
Low Flow Frequency - No. 6 month periods below MinQsal	29	29	26
*Low Flow Frequency - 6 mo. periods below MinQsal within Critical (Mar-Oct) months**	6	5	6
Duration Analysis - Longest Consecutive Month Period Below MinQsal	11	11	11

* key criteria used in NWF's Bays in Peril report.

Discussion

The results of our analysis indicate no problems for freshwater inflows to the Lower Laguna Madre. The key spring and early summer inflow pulses needed to support strong productivity would not be impacted significantly. Nor would the ability of the Nueces-Rio Grande coastal basin to provide low-flows during drought be altered very much. It should be kept in mind that much of the increase in wastewater discharge shown here is based on imports of water into the Nueces-Rio Grande coastal basin. These obviously come at the expense of the neighboring Rio Grande basin. We would hope that an analogous effort to evaluate flow needs and effects of the Region M plan can be undertaken there in the next cycle of regional water planning.

For the current analyses, the lack of changes in the ecological criteria is somewhat surprising, especially for low inflows given the magnitude of the flow changes expected in the lower range (Figure 7.2-4). There is one possible factor that may be leading to the seeming insensitivity of the analyses used here to the changes in inflows, especially low flows. As noted in the report accompanying the release of the Nueces-Rio Grande coastal basin WAM[14], there are essentially no streamflow gauges in this area. Thus any estimates of flows rest heavily on models which synthesize rainfall estimates into runoff estimates. In addition to the need for rainfall data, which

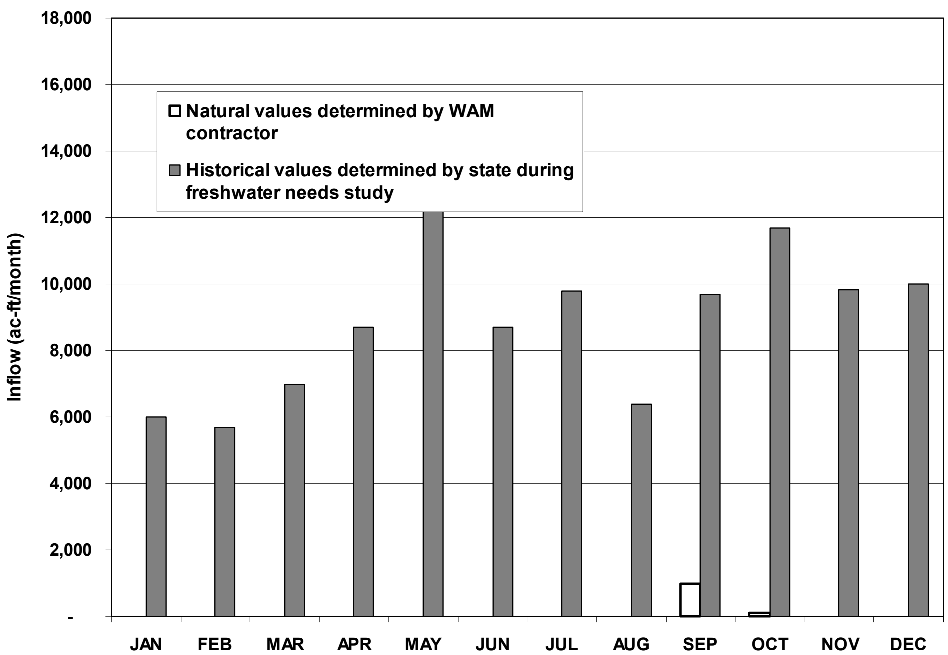
[14] PBS& J Engineers, 2002, Water availability model for the Nueces-Rio Grande coastal basin.

is usually scattered, such models are subject to many imprecisely know variables such as runoff factors related to land-use. Thus the natural inflow estimates in the WAM are largely based on such synthesized flows.

Similarly, when the state performed its study to relate freshwater inflows to measured productivity for the Lower Laguna Madre, it was necessary to estimate historical inflows. While these flows would have included historic return flows, it is probable that a predominant factor in this determination was the same need to develop flow estimates for this largely unguaged area.

There are only a few inflow levels that can be compared (medians, 10th percentiles, and 90th percentiles). To explore the possibility of flow estimating discrepancies, we have included an additional chart comparing extremely low inflows, namely the 10th percentile values, available for both the WAM and the state's inflow study.

Figure 7.2-6 Comparison of low-flow values for the Lower Laguna Madre as developed by the WAM contractor and state (Texas Water Development Board and Texas Parks and Wildlife Department).



While some difference in these would be expected, due to corrections for diversion and return flows in the historic data as compared to natural values, the size and constant nature of the changes here is disconcerting. The historic values are over 100,000 ac-ft greater for the whole year although there are only about 35,000 ac-ft/yr of known wastewater discharge currently according to the Nueces-Rio Grande coastal basin WAM report. We believe that there is some other fundamental difference at work in the derivation of these flow data and it quite likely rest in the rainfall-runoff synthesis. With further time and effort the origin of this discrepancy could be pursued and possibly an adjustment to either the state's inflow criteria values or the WAMs natural flow values made.

Acknowledgements

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