Section IV - Water Supply Operations

4.0 Final Permit and Conforming Changes

The Texas Commission on Environmental Quality (Commission) issued its Final Order dated September 16, 2016, approving issuance of Water Use Permit No. 5851 (System Operation Permit) to the Brazos River Authority (BRA). On November 30, 2016, the System Operation Permit was issued by the Commission.

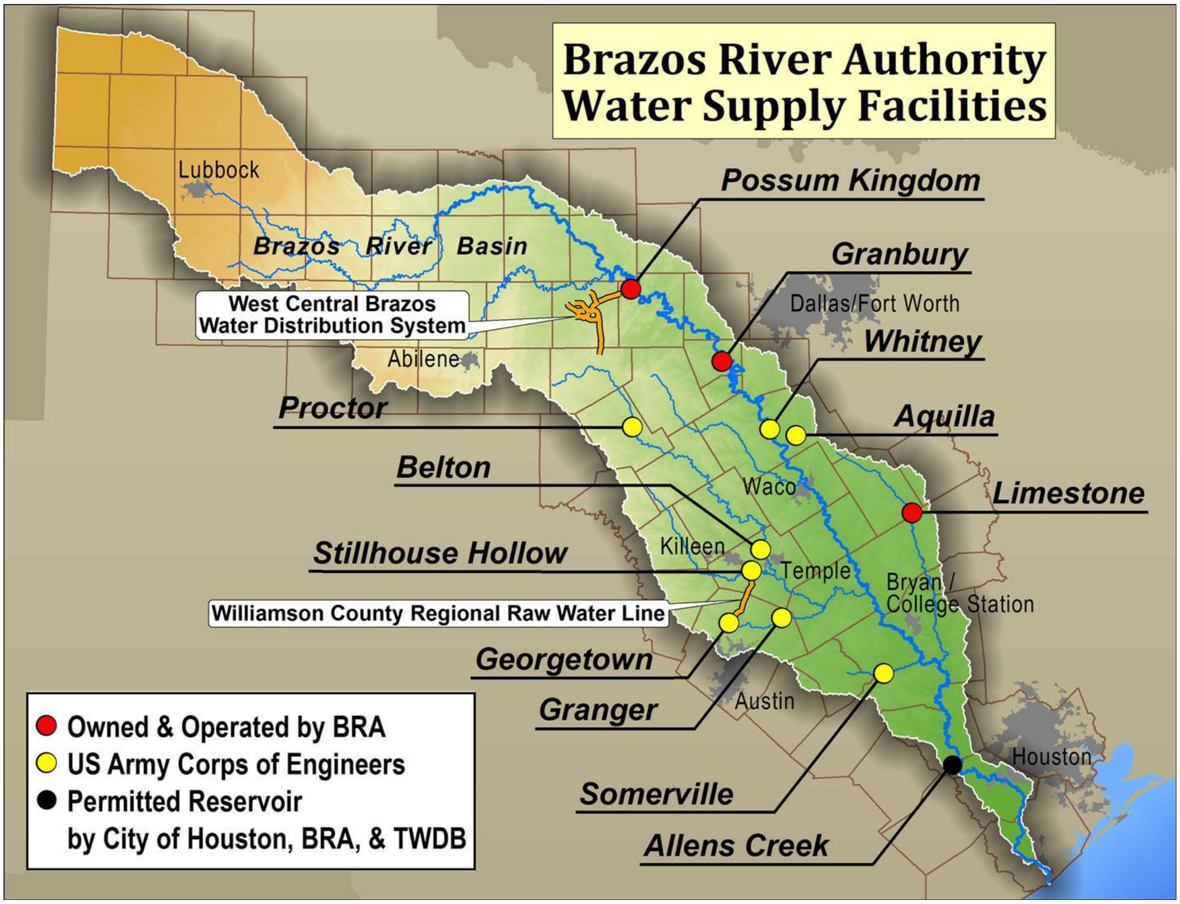
The Final Order issued by the Commission on September 16, 2016 directed that conforming changes be made to the WMP to align it with the Final Order and the System Operation Permit. The conforming changes to the WMP required some changes to Section IV of this Technical Report. These changes are included and described in new Section 4.6, and one corresponding change made in Section 4.4.2.2.

All other portions of Section IV remain in the form considered in the 2015 hearing conducted by the State Office of Administrative Hearings (SOAH) and subsequently by the Commission.

4.1 Water Supply System Overview

BRA water supply operations involve a number of components including physical operation of the reservoirs as well as compliance with permits and contract requirements. As detailed in Section 2, facilities and infrastructure currently associated with the BRA's raw water supply operations include Lakes Possum Kingdom, Granbury, Whitney, Aquilla, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Limestone, Somerville, the WCRRWL connecting Lake Stillhouse Hollow to Lake Georgetown, and the WCBWDS, which delivers water from Possum Kingdom Lake to Stephens and Eastland Counties. Figure 4.1 shows the reservoir and pipeline locations.

Figure 4.1



The BRA operates the water supply system in accordance with its water rights and water supply contracts to meet the needs of its customers. This includes making releases from reservoir storage for downstream customer water supply needs, accounting for lakeside customer diversions, performing daily reservoir water accounting, passing inflow for environmental purposes, accounting for senior water right holders during low flow conditions, passing excess runoff and flood flows through the three reservoirs owned and operated by BRA (Lakes Possum Kingdom, Granbury and Limestone), and conveying water through the BRA’s raw water pipelines (WCRRWL and WCBWDS). These various aspects of reservoir and pipeline operations are addressed in Sections 4.1 and 4.2.

The remainder of Section 4 describes BRA water supply operations in greater detail, including operations under the proposed System Operation Permit. WAM results comparing current conditions and existing operations to future conditions under the proposed System Operation Permit are presented (Section 4.3). Additionally, analyses and discussion related to the special conditions for environmental flows in the WMP and other requirements of the proposed System Operation Permit are discussed (Section 4.4). Finally, the BRA's Drought Contingency Plan and Water Conservation Plan are addressed, as they apply to water supply operations (Section 4.5).

4.1.1 Reservoir Operations

The BRA's system of reservoirs is operated to store water during periods when streamflow is high in order to make that water available for use later during droughts or prolonged periods of low flow. The BRA coordinates releases for downstream customers with their own water rights when the natural flow of the river is not available to meet their demands under their own water rights. Other downstream customers do not have their own water rights, so their diversions must currently be completely supplied from upstream reservoir releases. Based on the customer's request, the BRA determines the timing and magnitude of water to be released and the reservoir(s) from which the release will be made. Depending on the reservoir, the BRA coordinates releases with the USACE Reservoir Control Office or through the BRA Project Office. The USACE is responsible for physically making water supply releases at USACE-owned reservoirs, at the request of the BRA. The BRA Project Office performs the same duties at the three reservoirs owned by BRA.

The following sections discuss constraints on releases and operational considerations related to the management of the BRA reservoir system.

4.1.2 Release Constraints

Release constraints include various legal and structural limitations on reservoir operations. Legal constraints specific to reservoir operations are set out in BRA's state water right permits, along with contracts entered into with the USACE or with BRA water supply customers. Physical constraints are associated with infrastructure limitations that impact the ability to release water. Additional information that summarizes release considerations related to physical infrastructure limitations at reservoirs is presented in

Section 4.1.3.2. The remainder of this Section 4.1.2 addresses various legal constraints on BRA reservoir releases.

USACE Drawdown Limits – These drawdown limits are outlined in contractual agreements between the USACE and BRA; BRA is authorized to use storage space above these elevations. Table 4.1 specifies the space allocated to the BRA for water storage in each of the USACE-owned reservoirs.

Table 4.1- USACE Reservoir Drawdown Limits

Reservoir	Drawdown Limit (ft-msl)
AQUILLA	No Limit
BELTON	540
GEORGETOWN	699
GRANGER	440
PROCTOR	1142[1]
SOMERVILLE	210[1]
STILLHOUSE HOLLOW	532[1]
WHITNEY	520

[1]USACE approval is required for use when elevation is below drawdown limit.

Other Contractual Drawdown Limits – Prior to the construction of Lake Limestone and Lake Granbury, BRA's original contracts with the predecessor companies of Luminant (TXU) laid out the terms and amount of water made available as well as the conditions for the sale of bonds and several construction issues. The terms in each original agreement set forth minimum water levels in the respective lakes that the BRA would make its best efforts to maintain. Contractual drawdown limits included in the two TXU contracts are specified in Table 4.2.

Table 4.2 - Contractual Drawdown Limits

Contractual Agreement	Drawdown Limit (ft-msl)
TXU Limestone agreement	Maintain Lake Limestone above 330 ft[1]
TXU Granbury agreement	Maintain Lake Granbury above 675 ft[1]

[1]It is specifically agreed that water will not be withdrawn from the reservoir if it would cause the water to fall below the specified drawdown limit.

Minimum Flow Requirements – Two of the eleven existing water rights associated with existing reservoirs in the BRA's System contain special conditions with minimum flow requirements for the protection of senior water rights or for environmental benefit. Table

4.3 lists the minimum flow requirements contained in BRA's existing water rights associated with Lakes Aquilla and Limestone.

Table 4.3 - Minimum Flow Requirements	
Reservoir	**Minimum Flow Requirement (cfs)**
Lake Limestone	2-6 (varies depending on inflows)
Lake Aquilla	0.5 (when Aquilla Creek* is below 0.5 cfs)
*As measured at the USGS gage 08093360 downstream of the dam.	

Minimum flow requirements for Lakes Limestone and Aquilla are specified in special conditions contained in COA 12-5165 and COA 12-5158, respectively. The minimum flow requirement from Lake Limestone serves to provide for downstream senior water rights. Special conditions in Lake Aquilla's COA 12-5158 require that a minimum of 0.5 cfs be released from the dam for domestic and livestock uses and for the benefit of fish and wildlife.

Minimum flow requirements existed under the FERC license (FERC License 1490-003-Texas) for Possum Kingdom Lake. Table 4.4 below contains the minimum flow requirements specified in the Possum Kingdom Lake FERC license that required BRA to maintain a release schedule, except when inflow to Possum Kingdom Lake was less than the defined minimum release value. In such instances, the release could be adjusted downward to match inflow. Additionally, temporary deviations from this release requirement could be made to accommodate maintenance or operational issues associated with Possum Kingdom Lake's Morris Sheppard Dam. The Possum Kingdom Lake minimum flow requirements were developed during the FERC relicensing of the project in the late 1980s to early 1990s. The BRA's surrender of this FERC license was effective on March 12, 2014. However, the BRA is committed to continuing the minimum flow requirements that were set out in the FERC license, specified in Table 4.4. Operationally, minimum flows released from Possum Kingdom Lake are recaptured and dedicated for water supply needs at Lake Granbury and Lake Whitney when vacant storage exists at those reservoirs.

Table 4.4 - Possum Kingdom Lake Minimum Flow Requirements[1] The required release is the lesser of reservoir inflow or the value listed below.			
Reservoir Elevation (ft)	March 1 through June 30 (cfs)	July 1 through September 30 (cfs)	October 1 through February 28/29 (cfs)
1,000 – 994.5	100	75	50
994.49 – 990.0	50	37.5	25
below 990.0	20[2]	20[2]	20[2]

[1]Minimum Low Flow Requirements per Article 402 of FERC License 1490-003-Texas [2]Estimated leakage through the dam. This quantity assumes no releases from the dam.

Special conditions within the water right for the permitted Allens Creek Reservoir (Permit No. 2925B) specify that inflows from the Allens Creek watershed shall be passed through the reservoir whenever flow at the Richmond gaging station (when corrected to deduct upstream reservoir releases by the BRA to provide water under contract downstream of the Richmond gage) is less than 1,100 cfs. The BRA has the option of substituting the passage of inflows from the Allens Creek watershed with an equal quantity of water released by the BRA from upstream System reservoirs. A copy of Permit No. 2925B is included in Appendix A-1.

System Operation Order – The System Operation Order (System Order) was originally issued by the TCEQ's predecessor agency in 1964 and gives the BRA the flexibility to operate certain reservoirs in the Brazos River basin as a system. The System Order provisions have been incorporated into the BRA's water rights for lakes Possum Kingdom, Granbury, Whitney, Aquilla, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Limestone and Somerville. The permitted Allens Creek Reservoir is not included in the System Order. The total sum of the BRA's priority diversion rights for the 11 reservoirs included in the System Order is 661,901 acft/yr. The System Order allows diversion from any reservoir to exceed the priority right for that reservoir as long as:

- The sum of BRA's annual diversions from the 11 reservoirs included in the System Order does not exceed 661,901 acft.
- The annual amount diverted from that reservoir does not exceed the sum of the amounts authorized for all purposes for the reservoir.

Table 4.5 shows the annual diversion limits under the System Order at each reservoir for each authorized purpose.

Table 4.5 - System Order Permitted Reservoir Withdrawal[1]						
Reservoir	**Priority Diversion (acft/yr)**	**Max Permitted Annual Reservoir Withdrawal (acft/yr)**				
		MU	**IN**	**IR**	**MI**	**Total[2]**
POSSUM KINGDOM	230,750	175,000[3]	250,000	250,000	49,800	724,800
GRANBURY	64,712	40,000[4]	45,000	14,500	500	100,000
WHITNEY	18,336	25,000	25,000	0[5]	0[5]	50,000
AQUILLA	13,896	17,000	18,200	0[5]	200	35,400
PROCTOR	19,658	18,000	17,800	18,000	200	54,000
BELTON	100,257	95,000	150,000	149,500	500	395,000
STILLHOUSE HOLLOW	67,768	74,000	74,000	73,700	300	222,000
GEORGETOWN	13,610	16,500	16,400	4,100	100	37,100
GRANGER	19,480	30,000	29,800	5,500	200	65,500
LIMESTONE	65,074	69,500	77,500	70,000	500	217,500
SOMERVILLE	48,000	49,500	50,000	50,000	500	150,000

[1]Annual use cannot exceed the cumulative authorized total of 661,901 acft.
[2]All diversions and use of water from an individual reservoir in excess of the priority diversion amount in any one calendar year shall be charged against the sum of the amounts designated as priority rights in the other reservoirs included in the System Order.
[3]Not more than 5,240 acft of municipal authorization may be transferred to the Trinity River basin for municipal use by the BRA's service area customers.
[4]Not more than 20,000 acft of the municipal authorization may be transferred to the Trinity River basin for municipal use by the BRA's service area customers.
[5]Diversions are not authorized for these types of uses.

The System Order specifies that each System reservoir will be excluded from operation under the System Order when the BRA's permitted storage in the reservoir is less than 30 percent full, so long as BRA permitted storage in any other reservoir that can meet system needs is above 30 percent full. Once all System reservoirs are below 30 percent full, normal system operations can continue. The original intent of this provision was to limit the impact of system operation on local needs; however, local demands at some reservoirs are large enough that the 30 percent limitation is not sufficient to protect local supplies. At other reservoirs, local demands are low enough that the 30 percent limit may not be necessary to protect local use.

The proposed System Operation Permit allows for the modification of the System Order. Alterations to the System Order to address the issues mentioned above are discussed in Section 4.3.5 – System Order Modification.

Excess Flows – The BRA has the ability under COA 12-5166A, referred to as the Excess

Flows Permit, to utilize 100,000 acft/yr for municipal purposes, 450,000 acft/yr for industrial purposes, and 100,000 acft/yr for irrigation purposes (650,000 acft/yr total) of unappropriated flows on a non-priority basis. Additional information regarding the Excess Flows Permit can be found in Section 2.2.3 of this Technical Report. Like the System Order, water diverted under the Excess Flows Permit must be assigned to the priority rights of one of BRA's System Order reservoirs. The permit does not provide additional diversion rights over 661,901 acft/yr.

Interbasin Transfer – The BRA has existing authorizations for the transfer of water from the Brazos River basin to the Trinity River basin and the San Jacinto-Brazos coastal basin. Interbasin transfer authorizations within the BRA's existing water rights are outlined below:

- COA 12-5167 authorizes the transfer of up to 30,000 acft/yr for municipal purposes and 170,000 acft/yr for industrial purposes from the Brazos River basin to the San Jacinto-Brazos coastal basin. The "interbasin transfer" permit has been incorporated into the water rights for Lakes Possum Kingdom, Granbury, Whitney, Aquilla, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Limestone and Somerville.
- COA 12-5155 (Possum Kingdom Lake water right) authorizes the transfer of up to 5,240 acft/yr of water to the Trinity River basin for municipal purposes.
- COA 12-5156 (Lake Granbury water right) authorizes the transfer of up to 20,000 acft/yr of water to the Trinity River basin for municipal purposes.

Permit 5730 authorizes up to 25,000 acft/yr of water to be transferred from the Colorado River basin into the Brazos River basin for use in Williamson County. This transfer is implemented by a BRA contract with the LCRA. The proposed System Operation Permit would authorize exempt interbasin transfer and use of water under the permit in the adjoining San Jacinto-Brazos coastal basin and the Brazos-Colorado coastal basin. The permit would allow the transfer of water to the part of the geographic area of any county or municipality or a retail public utility's retail service area that is partially within the Brazos River basin for use on a firm and non-firm basis in that part of the geographic area of the county or municipality or that contiguous part of the utility's retail service area within the Trinity, Red, Colorado, Guadalupe, Lavaca and San Jacinto River basins.

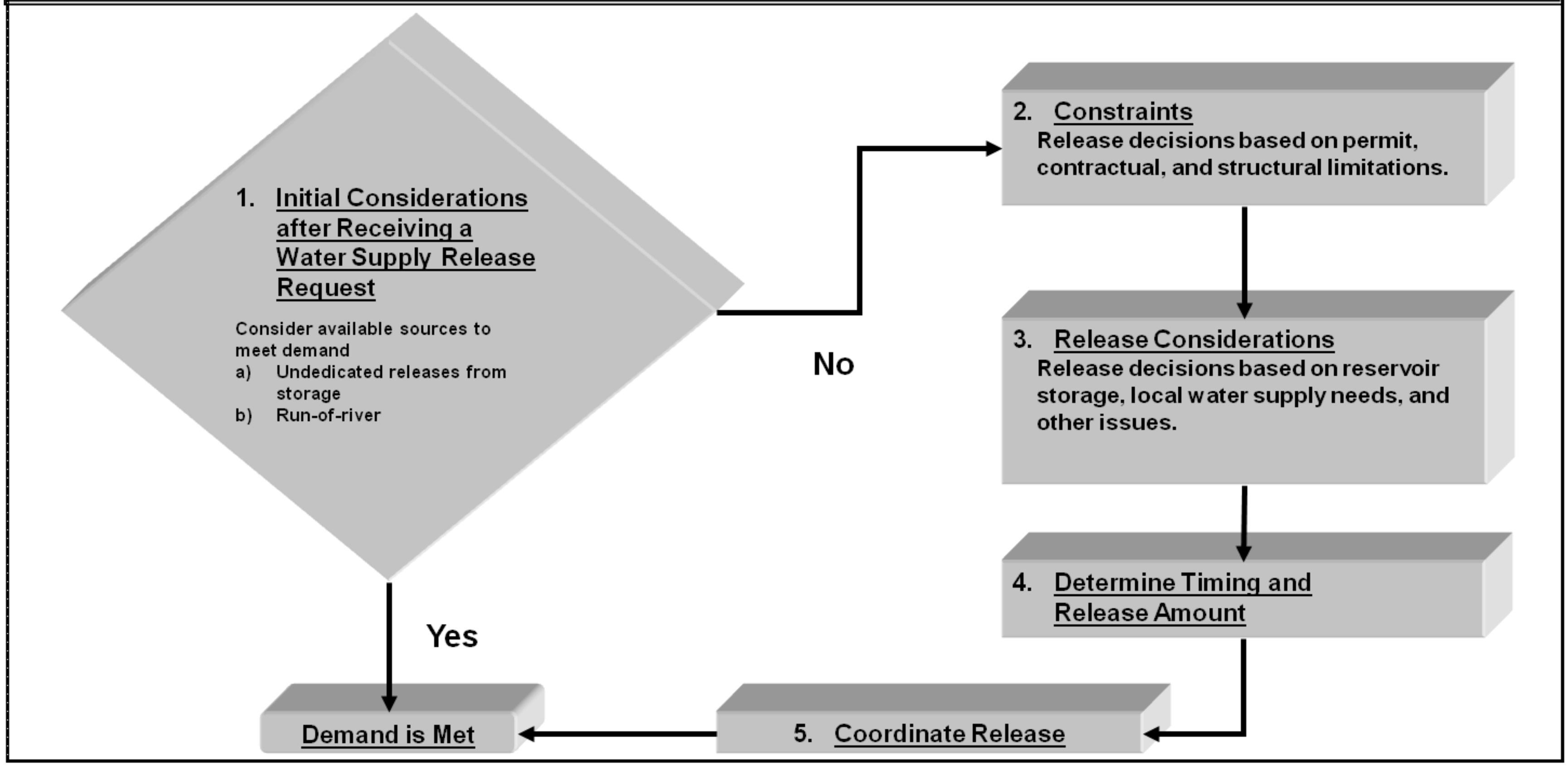
Proposed System Operation Permit – The application for Permit No. 5851, referred to as the proposed System Operation Permit, was submitted to TCEQ in 2004. Both the System Order and the proposed System Operation Permit authorize certain reservoirs in the Brazos River basin to be operated as a system. However, a major difference between the System Order and the proposed System Operation Permit is that the proposed System Operation Permit would recognize the additional water that is made available only through BRA's system operation. Section 2.4 of this Technical Report discusses the amounts and sources of additional water that is available through the proposed System Operation Permit.

4.1.3 Operational Considerations

BRA reservoir releases for water supply are largely driven by downstream water demands from municipal, steam electric and industrial users. During dry months, downstream customers with their own water rights may request releases of stored water if flows are not sufficient to meet their needs under their own water rights. Downstream customers that do not have their own water rights must be supplied from upstream reservoir releases. The standard terms of the BRA's water supply contracts give BRA the discretion to determine from which reservoir(s) water should be supplied in each circumstance; the customer is not contractually entitled to receive water from a particular source. While considering which reservoir(s) from which to make downstream water supply releases, certain management decisions must be made to operate the reservoirs for maximum benefit. The BRA has developed general guidelines for daily reservoir operations. Release decisions are made to provide for beneficial use of the water downstream while at the same time considering local water supply needs around the reservoir(s), environmental needs, and recreational uses.

The process for evaluating a request for a water supply release is outlined in Figure 4.2. Initial considerations in meeting a particular downstream demand are to determine if undedicated releases from storage (i.e. leakage or spills) or run-of-river flows (if using the proposed System Operation Permit) can meet the demand. If the demand is still not met through these sources then a reservoir release must be initiated to deliver water downstream. A determination of the timing and amount of the release is calculated based on the reservoir location and the location of the customer. Reservoir release decisions are constrained by limitations of existing permits and contracts as well as the structural limitations of the reservoirs. Typically, the larger reservoirs (the Possum Kingdom-Granbury-Whitney subsystem, Belton, Stillhouse Hollow, Limestone, and Somerville) are used to meet most downstream customer needs. Smaller reservoirs with high local area water use (Proctor, Georgetown, and Aquilla) are typically not used to meet large downstream water supply needs, in an effort to preserve that storage for the local use. Lake Granger has a relatively small local demand. However, as one of the four smallest reservoirs in the basin, it is typically not used to meet large downstream water supply needs. Releases are made regularly from Lake Proctor for irrigation customers immediately downstream.

Figure 4.2 – Reservoir Release Guidance



4.1.3.1 Coordination of Releases

When a decision is made for a downstream water supply release, the release is coordinated with the appropriate project site, externally or internally, depending on whether the reservoir is owned by the BRA or USACE. Customers are informed of the release so they will know when to expect the water to arrive at their intake location.

If a release is to be made from a BRA reservoir, the BRA contacts lake staff and schedules the release; the BRA lake staff will then open gates accordingly.

If a release is to be made from a USACE reservoir, BRA contacts the USACE Reservoir Control Office in Fort Worth and schedules the release; the USACE Reservoir Control Office then contacts appropriate USACE Lake Office staff to initiate the release.

4.1.3.2 Undedicated Releases from Storage

Undedicated releases from storage are releases of water from a reservoir that are not always allocated for customer water supply use downstream. Undedicated releases, including leakage, voluntary minimum flow releases, excess water supply releases, flood releases and/or hydropower generation are used first to meet a downstream water supply demand. When available in sufficient quantities at needed locations, dedicating these sources to meet a customer's demand improves operational efficiency of the System and increases the beneficial use of water from the System. Once dedicated for meeting a downstream customer's water needs, these releases are assigned to BRA's water rights and the customer's contract.

Leakage - Leakage consists of water that is escaping from a reservoir downstream when no active release is being made. Estimated leakage for each System reservoir is shown in Table 4.6.

Table 4.6 – Estimated Leakage of System Reservoirs	
Reservoir	**Leakage (cfs)**
Possum Kingdom Lake	20
Lake Granbury	3
Lake Whitney	25
Lake Aquilla	1
Lake Proctor	0
Lake Belton	3
Stillhouse Hollow Lake	1
Lake Georgetown	0
Lake Granger	0
Lake Limestone	0
Lake Somerville	1

Voluntary Minimum Flow Releases - In addition to the required minimum flow releases described above in Section 4.1.2, low flow releases are normally maintained at both Lake Granger and Lake Granbury, although no regulatory requirements exist for these releases. The release from Lake Granger is usually held at about 4 cfs for downstream domestic and livestock water needs. At Lake Granbury a mean daily release of up to 25 cfs is used to benefit downstream environmental needs.

Excess Gate Releases – Due to the design and/or operational condition of the outlet works, for some reservoirs there is a minimum amount of water that can be released. Release capacities for each System reservoir are outlined in the reservoir release options summary found in Appendix F-2. When a dedicated release is made in excess of a downstream customer's demand, the excess amount can be allocated to meet other downstream needs. For instance, the City of Temple is a BRA customer that diverts its water from the Leon River just downstream of Lake Belton. The outlet works at Lake Belton, when open, are not capable of releasing less than 20 cfs. Since Temple's demand is at times less than 20 cfs, the excess release is available to meet other customer demands further downstream.

The incremental release capability of each reservoir is also a factor that is considered for meeting downstream customer water supply needs, particularly when downstream demands are located in the lower basin where releases could be made from multiple reservoirs. In some instances, it may not be possible to release the exact amount requested by the customer from a single reservoir. In these cases, multiple reservoirs may be utilized to avoid a release in excess of the downstream demand. A main objective when determining which reservoir(s) to make water supply releases from, considering the physical constraints in release capacities, is to conserve water in storage.

Flood Releases - The BRA-owned reservoirs (Possum Kingdom, Granbury, and Limestone) are water supply reservoirs, and they do not have dedicated flood storage capacity. When these reservoirs are full, releases are made during flood events to pass inflows. The Operations Procedure for Controlled Releases, found in Appendix F-1, establishes the procedures and guidelines for passing inflows through BRA-owned reservoirs during a flood event. Flood releases from USACE reservoirs (Whitney, Aquilla, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger and Somerville) are managed by the USACE Reservoir Control Office in Fort Worth.

Hydropower Generation – Hydroelectric power generation at Lake Whitney is administered through the Southwestern Power Administration (SWPA), a federal agency that operates within the Department of Energy. The SWPA is contracted with the BEPC to provide energy. Releases by BEPC for hydropower production occur independently of BRA. However, when the BRA needs a release from Lake Whitney to meet a downstream water customer demand, the USACE will typically make the release through Lake Whitney's hydropower facilities to provide the dual benefit for water supply and energy production. Such a release is accounted for against BRA's water rights. Any water released for hydropower production in excess of a BRA water supply request is available as unappropriated run-of-river flows for downstream water rights.

Hydropower generation at Possum Kingdom Lake ceased in August 2007. The generation station, including the turbines, was taken out of service and BRA's FERC license surrender was effective on March 12, 2014.

Modifications to Morris Sheppard Dam at Possum Kingdom Lake have been made to provide the BRA with a reliable means to continue to pass significant quantities of water through the dam without having to rely on the generation facilities or the flood gates. Installation of a Controlled Outlet Conduit (COC) in the space originally provided for a third penstock was initiated in Spring 2012. The modification allows controlled releases of up to approximately 2,500 cfs, which is sufficient for meeting downstream water supply needs without the necessity to use the flood gates. The COC was operational as of December 2012.

4.1.3.3 Channel Losses

When a downstream customer makes a request for water that cannot be satisfied except through a reservoir release, the BRA releases what the customer requests plus the amount needed to cover the estimated channel losses from the reservoir to the diversion location downstream.

The BRA uses the bed and banks of the Brazos River and its tributaries to deliver stored water to downstream customers. As the water moves downstream, some of it may be lost in transit. Transportation losses may result from evaporation, filling of storage in the river, infiltration into the bed and banks of the river, or unauthorized diversions. These losses can vary with time of year, dryness, temperature, location, and other factors.

Estimated incremental travel times and incremental channel losses used for water supply deliveries are summarized in Table 4.7. These numbers are used as guidance when determining water supply deliveries. However, they are averages, and actual losses could be significantly greater or less, depending on hydrologic conditions. Consideration is given to channel losses when making release decisions.

Table 4.7 Summary of Estimated Channel Losses and Travel Times for Average Conditions

Reach	BRA Incremental Travel Time (days)	BRA Incremental Losses (%)	Incremental Distance (river miles)
Possum Kingdom to Palo Pinto gage	0.51	0.52	20.2
Palo Pinto gage to Dennis gage	1.96	1.98	77.5
Dennis gage to Lake Granbury	1.53	1.20	47.3
Lake Granbury to Glen Rose gage	1.70	0.84	31.2
Glen Rose gage to Lake Whitney	4.30	1.86	68.9
Lake Whitney to Aquilla Creek/Brazos confluence	0.56	0.45	25.3
Lake Aquilla to Aquilla Creek gage	0.12	0.11	5.0
Aquilla Creek gage to Aquilla Creek/Brazos confluence	0.44	0.39	18.2
Aquilla Creek/ Brazos confluence to Waco gage	0.44	0.30	16.9
Waco gage to Highbank gage	1.39	0.94	53.6
Lake Proctor to Leon Rv at Gatesville gage	4.27	48.50	129.1
Leon Rv at Gatesville to Lake Belton	2.73	2.60	82.3
Lake Belton to Leon Rv nr Belton gage	0.19	0.16	3.5
Leon Rv nr Belton gage to Little River gage	0.91	0.89	19.1
Lake Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0.14	0.05	3.0
Lampasas Rv nr Belton gage to Little River gage	0.95	0.53	18.9
Little River to Little/San Gabriel confluence	1.72	2.39	51.5
Lake Georgetown to N San Gabriel gage	0.03	0.02	1.0
N San Gabriel gage to Lake Granger	0.97	0.78	35.5
Lake Granger to Laneport Gage	0.13	0.13	5.0
Laneport Gage to Little/San Gabriel confluence	0.68	0.67	26.2
Little/San Gabriel confluence to Little Rv at Cameron gage	0.36	0.50	10.7
Cameron gage to Brazos/Little confluence	1.12	1.56	33.6
Highbank gage to Brazos/Little confluence	0.90	0.61	34.6
Brazos/Little confluence to Bryan gage	0.80	0.86	30.9
Bryan gage to Brazos/Yegua confluence	0.99	1.06	38.1
Lake Somerville to Yegua gage	0.07	0.07	1.3
Yegua gage to Brazos/Yegua confluence	1.01	1.03	18.8
Brazos/Yegua confluence to Brazos/Navasota confluence	0.43	0.46	16.6
Lake Limestone to Easterly gage	1.21	0.88	25.8
Easterly gage to Brazos/Navasota confluence	5.31	3.62	105.7
Brazos/Navasota confluence to Hempstead gage	0.87	0.93	33.4
Hempstead gage to Richmond gage	2.62	2.82	101.0
Richmond gage to Rosharon gage	0.92	0.98	35.3
Rosharon gage to Gulf of Mexico	1.47	1.58	56.7

The TCEQ uses WAMs to evaluate water right applications for the appropriation of surface water. TCEQ's WAM model for the Brazos River basin utilizes estimated average incremental losses that are consistent with BRA's incremental channel losses in Table 4.7. During the development of the WMP, the BRA reviewed travel times observed during the 2011 drought. The estimated travel times in Table 4.7 for downstream water supply deliveries are updated as a result of this review.

When a customer initiates or changes a water supply release request, they specify a timeframe during which they will be pumping. The BRA then determines a start and stop time for the release based on the travel time from the reservoir to the customer's intake. Historical release data are reviewed to determine the time it takes for the release to reach downstream gages between the reservoir and the customer's location.

4.1.3.4 Lakeside Intake Elevations

The BRA, its customers, and associated parties are all responsible for determining when lake levels approach important elevations associated with specific water supply intake structures. Customers are encouraged to report critical elevations associated with their intake structures to BRA. Although there is no guarantee that water supply release decisions will be made that can maintain elevations above intake structures, the operational level of known structures will be considered prior to initiating a water supply release.

4.1.3.5 Recreational Benefit

Although the primary purpose of the BRA's System reservoirs is for water supply, an effort is made to coordinate water supply releases to benefit or avoid negatively impacting recreational activities, when possible. For example, during scheduled water supply releases from Possum Kingdom Lake and Lake Granbury, the release rate and timing may be adjusted to accommodate downstream recreational interests. In some cases during dry conditions, however, negative impacts to lakeside and river recreation are unavoidable.

4.1.3.6 Lake Proctor Operation

Lake Proctor normally functions as a stand-alone reservoir. Demands from the reservoir (lakeside and immediately downstream) are near the available yield of the reservoir, and there are no other alternative BRA sources available in the area. Since water supply releases from Lake Proctor are expected to be limited to the local irrigation customers immediately downstream (except for perhaps emergency or other unique situations), the storage in Lake Proctor is not relevant to use under the System Operation Permit in most situations. The current local downstream demands on Lake Proctor are met from storage and will not be satisfied from run-of-river diversions under the System Operation Permit.

4.2 Pipeline Operations

Williamson County Regional Raw Water Line (WCRRWL) - During the 1990s the BRA entered into an agreement with several customers in Williamson County to construct the 28-mile, 48-inch diameter WCRRWL to convey raw water from Lake Stillhouse Hollow to Lake Georgetown. Construction of the pipeline was completed in 2004. The pipeline was put into operation for the first time during the 2006 drought, delivering a total of 11,535 acft to Lake Georgetown for use by the cities of Round Rock and Georgetown and the Chisholm Trail Special Utility District.

The WCRRWL intake infrastructure was designed for three phases of development. Each phase requires the installation of additional pumping capacity. The second phase of development was completed and placed into service in June 2011. The WCRRWL is currently capable of transferring approximately 45,000 acft/yr from Lake Stillhouse Hollow to Lake Georgetown. When the need arises, installation of the third phase of pumps will provide the capability to transfer over 60,000 acft/yr.

Pumping trigger levels are reviewed and established annually for operation of the WCRRWL. The trigger levels are based on lake elevations at Lake Georgetown. The BRA utilizes spreadsheet-based models to assist in decision making and for the development of the operational trigger levels. These spreadsheet models support planning and operational decision making by accounting for variable energy cost structures, increasing demand, and uncertain hydrologic patterns. It is important to understand that there is not a single optimal solution that is cost-effective amidst these multiple uncertainties, but rather, opportunities to make informed decisions that account for risk and uncertainty in a quantitative and defensible way. The spreadsheet models capitalize on advanced computing techniques to provide guidance to hone the phasing and operation of the pumping station to improve its cost-effectiveness and provide reliability into the future. The report entitled "Williamson County Regional Raw Water System Transmission and Operation Models" documents the models and is attached in Appendix D-1.

West Central Brazos Water Distribution System (WCBWDS) – The WCBWDS consists of approximately seventy-five miles of pipeline predominately located in Stephens County. The pipeline was constructed in four phases, from 1975 through 1985, by Kerr-McGee Oil & Gas Onshore to transport raw water from Possum Kingdom Lake to various take points for oil recovery flood operations. The pipeline's diameter varies in size from 3 inches to 36 inches. In 2002, Kerr-McGee Oil & Gas Onshore sold the pipeline system and the associated right-of-way to the BRA. The BRA continues to provide water for oil recovery flood operations as well as providing water for agricultural irrigation through the pipeline. Beginning in 2013, the Stephens Regional Special Utility District diverts water through the line to serve municipal customers in and around the City of Breckenridge. The system was originally designed and built to convey approximately 17 MGD (approximately 19,000 acft/yr). With the existing pump configuration, the system's firm capacity is approximately 8 MGD (approximately 8,962 acft/yr), and the total capacity is about 13 MGD (approximately 14,563 acft/yr). Pump intakes are currently set at an elevation of 964.3 ft-msl.

Improvements to the WCBWDS pipeline system are ongoing and will continue as needed while meeting applicable TCEQ regulations. As future water demands increase, the pipeline system will need to undergo major upgrades and rehabilitation. These improvements will occur in phases as the water demands increase in the WCBWDS service area.

4.3 Proposed System Operation Permit

The BRA operates its Water Supply System in accordance with its water rights and water supply contracts to meet the needs of its customers. As discussed above, this includes making releases from reservoir storage for customer water supply needs, accounting for lakeside customer diversions, daily reservoir water accounting, releasing water to provide for environmental flow requirements, accounting for senior water right holders during low flow conditions, passing excess runoff and flood flows through the three reservoirs owned and operated by the BRA (Possum Kingdom, Granbury, and Limestone), and conveying water through its raw water pipelines (WCRRWL and WCBWDS).

Initially, there will be little change in the BRA's water supply operations following approval of the System Operation Permit. The proposed System Operation Permit provides additional flexibility in reservoir operations and access to run-of-river flows and wastewater return flows. The proposed System Operation Permit changes the way the BRA accounts for and tracks water use through accounting plans. Details of the Accounting Plan can be found in Section 5 (Water Rights Accounting and Reporting) of this Technical Report.

Diversions of run-of-river flows under the proposed System Operation Permit are permitted when the environmental flow conditions outlined in the WMP are met at specific measurement points (USGS gaging stations), and when such diversions would not impair senior water rights. In cases under which BRA customer run-of-river diversions are curtailed and the demand is still present at the downstream diversion location, releases from storage will be made. Additional information and discussion related to environmental flow conditions is found in Section 4.4 below.

"System Operation" refers to the coordinated use of multiple sources of water to provide additional yield, supply water at lower costs, or provide other benefits. System Operation of the BRA System is authorized in the System Order and will be authorized by the System Operation Permit. The System Order, which is described in more detail in Sections 2.2.2, 4.1.2 and 4.3.5, allows for water to be diverted from one reservoir but assigned to another under certain conditions. The System Operation Permit will allow, among other things, the coordinated use of BRA System reservoirs and run-of-river flows to provide additional supply. Additional information on the proposed System Operation Permit may be found in Section 2.2.7 and Section 2.4 of this Technical Report.

Section 4.3.1 describes modeling performed to compare how the BRA System operates under current demands and authorizations, how the BRA would operate its System with the proposed System Operation Permit in place under expected 2025 conditions, and how the BRA may operate its System in the future with expected 2060 conditions. The current and 2025 scenarios show expected operations under the initial WMP. The 2060 scenarios are intended as a look forward to how BRA may operate its System in the future. These operational analyses will be updated in future WMPs.

The purposes for the demand scenario modeling in this section are to (1) evaluate range of annual water use under the System Operation Permit; and (2) compare the degree of change in river flow and lake levels between varying demand assumptions.

The remainder of this Section 4.3 describes various aspects of the modeling. Section 4.3.1 gives an overview of the modeling. Section 4.3.2 discusses the use of return flows in the models. Section 4.3.3 describes how flows are used in the model. Section 4.3.4 discusses reservoir drawdowns from the various modeling scenarios. Section 4.3.5 discusses recommended revisions to the System Order.

4.3.1 Operational Demand Scenario Modeling

Five different Operational Demand Scenarios were developed for this WMP:

- *Scenario 1 – Current Conditions.* This scenario uses 2011 demands, 2012 sediment conditions in BRA and other major reservoirs, and existing infrastructure and permits. Existing infrastructure includes existing BRA reservoirs and the WCRRWL linking Lake Georgetown to Lake Stillhouse Hollow. 2011 demands are the highest historical demands from the BRA System. Scenario 1 uses current levels of return flows represented by the average reported from 2008 to 2011. Return flows are treated like natural river flow and distributed in priority order.

- *Scenario 2 – 2025 Conditions.* This scenario uses expected 2025 demands, 2025 sediment conditions in BRA and other major reservoirs, existing infrastructure, and existing permits plus the proposed System Operation Permit. Scenario 2 was run with two different return flow options. The first return flow option uses all available return flows, which is the BRA's preferred approach, and the second option limits return flows to those originating from BRA sources or treatment facilities, which is the TCEQ ED's preferred approach. This scenario assumes that by 2025 return flows will be equal to the currently permitted wastewater discharges, less flows that have already been committed to reuse projects. All return flows are distributed in priority order.

- *Scenario 3 – 2025 Conditions with Comanche Peak Expansion.* This scenario is identical to Scenario 2 except it also includes water use for the proposed expansion of the CPNPP (Units 3 and 4). Like Scenario 2, this scenario is run with the two return flow options, all return flows and only return flows from BRA sources.

- *Scenario 4 – 2060 Conditions.* This scenario uses expected 2060 demands, 2060 sediment conditions in BRA reservoirs and other major reservoirs, existing permits plus the proposed System Operation Permit, and existing infrastructure plus additional infrastructure as proposed in the State Water Plan. Additional infrastructure includes Allens Creek Reservoir, a pipeline connecting Lake Belton to Lake Stillhouse Hollow, groundwater use in the Williamson County area, and the ability to divert water from both Lake Georgetown and Lake Granger to meet Williamson County customer demands. Like Scenarios 2 and 3, this scenario is run with the two return flow options, all return flows and only return flows from BRA sources. Return flows are assumed to be identical to those used in the 2025 scenarios; this is a conservative assumption, because return flows in 2060 are likely to be higher.

- *Scenario 5 – 2060 Conditions with Comanche Peak Expansion.* This scenario is identical to Scenario 4 except it also includes water use for the proposed CPNPP expansion. Like all of the demand scenarios except Scenario 1, this scenario is run with the two return flow options, all return flows and only return flows from BRA sources.

Scenario 1 only uses one return flow option. Scenarios 2 through 5 each have two sub-scenarios because of the two return flow options – the ED's approach and BRA's approach. Including the sub-scenarios there are nine total operational scenarios, each of which requires a separate modeling run.

Demands used in the five Operational Demand Scenarios are based on data from the 2011 Region G and Region H Regional Water Plans, information from BRA's contract and water use records, and operational studies conducted for the proposed expansion at CPNPP. Section 3.3 discusses the development of these demands in more detail. Appendix G-1 contains detailed demands by river reach. Table 4.8 shows the total demand for each Operational Demand Scenario and the extent to which those demands are met by current BRA contracts.

Table 4.8 BRA Operational Demand Scenarios				
Scenario No.	**Demand Scenario**	**Total Demand (acft/yr)**	**Demands Met by Current Contracts (acft/yr)[1]**	**Additional Demands (acft/yr)[2]**
1	Current (2011 Demands)	487,851	487,851	-
2	2025 without CPNPP Expansion	582,162	466,480	115,682
3	2025 with CPNPP Expansion	636,085	493,927	142,158
4	2060 without CPNPP Expansion	736,532	535,444	201,138
5	2060 with CPNPP Expansion	826,684	562,841	263,843

[1] Demands that can be satisfied from the BRA's current water supply contracts.
[2] Projected demands that are not covered by the BRA's existing water supply contracts, including demands that could be satisfied by the Allens Creek Reservoir and the proposed System Operation Permit.

Each of these Operational Demand Scenarios was modeled using a modified version of the TCEQ Brazos Basin Water Availability Model (Brazos-WAM), Full Authorization or "Run 3." The Brazos-WAM is a hydrologic computer model of the entire Brazos River basin that includes every permanent water right in the basin. The Brazos-WAM uses historical monthly naturalized hydrology from 1940 to 1997. More generally, the WAM is an application of the WRAP developed by Dr. Ralph Wurbs of Texas A&M University. This model is specifically designed to simulate operations under the priority rights system used in the State of Texas.

The "Operational Models" used to model Scenarios 1 through 5 include several modifications to the TCEQ Brazos-WAM. The modifications include (i) those used to calculate the firm yields of System reservoirs discussed in Section 2.3 of this Technical Report, namely reduction in reservoir storage volume due to sedimentation, for BRA reservoirs and other major reservoirs; (ii) removal of COA 12-2939 (a non-consumptive right that was owned and abandoned by BRA); (iii) modeling only the storage in Lake Whitney above elevation 520 feet; and (iv) addition of instream flow releases from Possum Kingdom Lake and Lake Granbury, which are described in Section 2.3 and detailed in Appendix G-2.

Modeling of the proposed System Operation Permit is based on the models developed by the BRA and TCEQ for analyzing the permit application. This modeling includes the environmental flow conditions derived from SB3 rules adopted by TCEQ and found in Subchapter G, Chapter 298 of Title 30 of the Texas Administrative Code (adopted Feb. 12, 2014). These environmental flow criteria vary according to hydrologic condition and geographic location as defined in those TCEQ rules.

Other major modifications included in the Operational Models are:

- *Modeling of demands by reach instead of water rights.* The original Brazos-WAM models the permitted diversions diverted directly from each of the lakes. The Operational Models use expected diversions for BRA water rights. Diversions are located where the customer demand is located, either lakeside or downstream of a BRA reservoir. All other water rights are assumed to operate at their full permitted diversions.

- *Use of multiple reservoirs to meet demands.* The Operational Models use any reservoir located above a diversion point to supply demands rather than a single source. For example, demands at Lake Granbury can be met either directly from Lake Granbury, by releases from Possum Kingdom Lake upstream, or by a combination of both.

- *Backup of existing customer rights.* Several of the larger BRA customers have their own water rights as well as a contract(s) for water from BRA. These customers include the GCWA, Dow Chemical, NRG, the City of Temple, the TMPA and Alcoa. The supplies for these customers may need to be supplemented from the BRA System during drought conditions, either because these entities rely on run-of-river diversions, do not have sufficient storage, or both. The Operational Models assume that these customers use their own water rights first, relying on water from the BRA to meet the demand that is not being met from their own supplies. In most cases, the existing contracts are sufficient to meet the projected 2025 and 2060 demands for these entities. However, growth in the area currently served by GCWA will cause water demand to exceed current contract amounts by

2025. Therefore, for these modeling scenarios GCWA was not limited to its existing contract with BRA. More information on assumed future water demands may be found in Section 3.3.

- *Lake Whitney hydropower.* The TCEQ Brazos-WAM does not include hydropower generation at Lake Whitney. The BRA does not have authority over releases from Lake Whitney for hydropower production, but to the extent possible, the BRA coordinates its water supply releases with hydropower releases to meet needs downstream of Lake Whitney. In the Operational Models, hydropower releases are included and distributed in priority order unless they are also being dedicated for downstream use by BRA customers.
- *Use of the Excess Flows Permit.* COA 12-5166 (as amended) is BRA's non-priority water right that authorizes the use of run-of-river flows at locations in the lower Brazos basin. Diversions under this permit must be charged to one of BRA's existing reservoir rights. This water right is not included in the TCEQ Brazos-WAM. Currently, NRG is the only BRA customer that uses water authorized under this permit. In the scenarios with Allens Creek Reservoir (Scenarios 4 and 5), the Excess Flows Permit is also used to supplement diversions from the Brazos River under the existing Allens Creek water right.
- *Use of run-of-river flows.* The proposed System Operation Permit will allow BRA customers that are not located at a reservoir to use run-of-river flows as long as the applicable environmental flow criteria are met. This assumption only applies to Scenarios 2 through 5, which assume use of the System Operation Permit. In Scenario 1, water for these customers must be released from a BRA reservoir. The only exception in Scenario 1 is for NRG, which is located at one of the diversion points authorized in the Excess Flows Permit.

Additionally, updates to the net evaporation rates for the TCEQ Brazos-WAM were made by TCEQ in February 2014 and were incorporated into the Operational Models. More information on these modifications and other assumptions used for these demand modeling scenarios may be found in Appendix G-2.

Because of the complexities of the Operational Models, diversions under the various BRA water right authorizations (priority diversions from reservoirs, System Order, System Operation Permit, or Excess Flows Permit) are determined in an Excel spreadsheet post-processor that assigns diversions to water rights using the raw output of the WRAP model. The methodology for this assignment is described in detail in Appendix G-2.

Tables 4.9a through 4.9i below are summaries of the minimum, maximum, and average annual use from each reach for the nine Operational Demand Scenario modeling runs (one return flow option for Scenario 1 and two return flow options for each of the Scenarios 2 through 5). These tables show how water is used, both geographically and by authorization (existing BRA water rights or proposed System Operation Permit). The numbers in these tables indicate the *source* of the water use and are not necessarily indicative of the location where the water is used. (For information on demands by location refer to Appendix G-2). For example, the use at Possum Kingdom includes both the water that was used lakeside at the reservoir and water released downstream for use elsewhere. The tables show the minimum, maximum and average annual water use at each location under the existing BRA water rights (Existing Rights) or the proposed System Operation Permit (SysOps), as well as the total in each reach (Total). Existing rights include all existing BRA reservoir rights, the Excess Flows Permit, the System Order, and also the Allens Creek Reservoir in Scenarios 4 and 5. For comparison purposes, these tables include a year with average hydrology (1983) and the maximum use year (1956). Reaches that contain reservoirs are highlighted with red text.

The totals are for individual years and are not necessarily the sum of the minima or maxima. Minima and maxima do not necessarily occur in the same year for all reaches. For example, in Table 4.9b the minimum System Operation Permit use is zero in most reaches, with the exception of the Richmond to Gulf of Mexico reach, where it is 7,706 acft/yr. The minimum diversion in the Richmond to Gulf of Mexico reach occurs in 1988. In 1988, a total of 9,220 acft were diverted under the System Operation Permit. However, this is not the minimum for all years. The minimum year for all diversions under the System Operation Permit is 1984, where 9,173 acft were used under the System Operation Permit. In 1984, 7,884 acft were diverted between Richmond and the Gulf of

Mexico, with the remaining diversions occurring upstream.

Table 4.9a shows current conditions without the proposed System Operation Permit (Scenario 1). Therefore all uses in the SysOps columns are zero.

Table 4.9a - Summary of Water Use by Reach
Scenario 1 Current Conditions
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	9,156	98,643	31,062	0	0	0	9,156	98,643	31,062	47,651	0	47,651	71,162	0	71,162
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dennis gage to Lake Granbury Dam	16,971	66,005	47,613	0	0	0	16,971	66,005	47,613	31,074	0	31,074	24,503	0	24,503
Lake Granbury Dam to Glen Rose gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total above Glen Rose Gage	*75,161*	*129,756*	*78,675*	*0*	*0*	*0*	*75,161*	*129,756*	*78,675*	*78,725*	*0*	*78,725*	*95,664*	*0*	*95,664*
Glen Rose gage to Lake Whitney Dam	963	44,733	8,443	0	0	0	963	44,733	8,443	3,683	0	3,683	44,733	0	44,733
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Aquilla	6,832	6,832	6,832	0	0	0	6,832	6,832	6,832	6,832	0	6,832	6,832	0	6,832
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total above Highbank Gage	*87,216*	*147,229*	*93,950*	*0*	*0*	*0*	*87,216*	*147,229*	*93,950*	*89,240*	*0*	*89,240*	*147,229*	*0*	*147,229*
Lake Proctor	8,203	8,203	8,203	0	0	0	8,203	8,203	8,203	8,203	0	8,203	8,203	0	8,203
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	43,683	149,228	55,205	0	0	0	43,683	149,228	55,205	43,913	0	43,913	149,228	0	149,228
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Stillhouse Hollow	11,674	89,700	25,247	0	0	0	11,674	89,700	25,247	14,431	0	14,431	89,700	0	89,700
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	17,072	37,030	30,607	0	0	0	17,072	37,030	30,607	35,378	0	35,378	17,124	0	17,124
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	4,255	26,723	8,332	0	0	0	4,255	26,723	8,332	9,760	0	9,760	7,815	0	7,815
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Somerville	4,102	69,555	11,791	0	0	0	4,102	69,555	11,791	6,055	0	6,055	4,102	0	4,102
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	52,653	63,062	53,672	0	0	0	52,653	63,062	53,672	52,676	0	52,676	56,349	0	56,349
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	0	28,000	18,042	0	0	0	0	28,000	18,042	21,056	0	21,056	0	0	0
Total above Richmond Gage	*274,668*	*479,750*	*305,048*	*0*	*0*	*0*	*274,668*	*479,750*	*305,048*	*280,711*	*0*	*280,711*	*479,750*	*0*	*479,750*
Richmond gage to Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total above Gulf of Mexico	*274,668*	*479,750*	*305,048*	*0*	*0*	*0*	*274,668*	*479,750*	*305,048*	*280,711*	*0*	*280,711*	*479,750*	*0*	*479,750*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.
Scenario 1 shows current conditions prior to the System Operation Permit. Therefore all "SysOps" use is zero.

Table 4.9b- Summary of Water Right Diversions by Reach
Scenario 2 - 2025 Conditions Without CPNPP Expansion, All Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	45,666	176,859	69,979	0	0	0	45,666	176,859	69,979	77,641	0	77,641	176,859	0	176,859
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	368	180	0	368	180	0	123	123	0	0	0
Dennis gage to Lake Granbury Dam	9,210	53,431	21,777	0	0	0	9,210	53,431	21,777	9,210	0	9,210	27,390	0	27,390
Lake Granbury Dam to Glen Rose gage	0	0	0	0	379	187	0	379	187	0	123	123	0	17	17
Total above Glen Rose Gage	*82,317*	*204,249*	*91,756*	*0*	*747*	*367*	*82,929*	*204,266*	*92,123*	*86,851*	*246*	*87,097*	*204,249*	*17*	*204,266*
Glen Rose gage to Lake Whitney Dam	1,105	26,351	5,292	0	0	0	1,105	26,351	5,292	3,945	0	3,945	26,351	0	26,351
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	3,918	2,331	0	3,918	2,331	0	2,806	2,806	0	0	0
Lake Aquilla	10,186	10,186	10,186	0	0	0	10,186	10,186	10,186	10,186	0	10,186	10,186	0	10,186
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	453	0	760	453	0	608	608	0	0	0
Total above Highbank Gage	*95,656*	*240,786*	*107,234*	*0*	*5,425*	*3,151*	*99,295*	*240,803*	*110,385*	*100,982*	*3,660*	*104,642*	*240,786*	*17*	*240,803*
Lake Proctor	9,069	9,069	9,069	0	0	0	9,069	9,069	9,069	9,069	0	9,069	9,069	0	9,069
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	46,372	133,227	66,911	0	0	0	46,372	133,227	66,911	55,379	0	55,379	126,843	0	126,843
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	11,347	4,163	0	11,347	4,163	0	1,054	1,054	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	71	0	196	71	0	70	70	0	0	0
Lake Stillhouse Hollow	24,743	77,650	49,368	0	0	0	24,743	77,650	49,368	42,647	0	42,647	65,430	0	65,430
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	3	0	8	3	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	5,794	37,100	25,022	0	9,374	853	5,794	46,474	25,875	28,576	0	28,576	5,794	0	5,794
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	3,507	30,712	9,266	0	0	0	3,507	30,712	9,266	5,905	0	5,905	9,677	0	9,677
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	213	0	350	213	0	315	315	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Somerville	3,263	57,147	11,534	0	0	0	3,263	57,147	11,534	6,783	0	6,783	18,576	0	18,576
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	50,981	71,376	52,892	0	0	0	50,981	71,376	52,892	51,080	0	51,080	56,002	0	56,002
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,288	811	0	1,288	811	0	1,186	1,186	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	0	28,000	19,349	0	6,319	2,268	0	32,857	21,617	26,852	3,670	30,522	0	0	0
Total above Richmond Gage	*305,782*	*532,177*	*350,645*	*0*	*26,529*	*11,534*	*329,932*	*532,194*	*362,178*	*327,273*	*9,957*	*337,230*	*532,177*	*17*	*532,194*
Richmond gage to Gulf of Mexico	0	0	0	7,706	53,676	37,790	7,706	53,676	37,790	0	48,606	48,606	0	10,101	10,101
Total above Gulf of Mexico	*305,782*	*532,177*	*350,645*	*9,173*	*75,213*	*49,323*	*375,923*	*542,294*	*399,968*	*327,273*	*58,563*	*385,836*	*532,177*	*10,117*	*542,294*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9c- Summary of Water Right Diversions by Reach
Scenario 2 - 2025 Conditions Without CPNPP Expansion - ED's Approach to Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	49,864	191,187	72,343	0	0	0	49,864	191,187	72,343	78,039	0	78,039	191,187	0	191,187
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	368	176	0	368	176	0	123	123	0	0	0
Dennis gage to Lake Granbury Dam	9,068	66,026	21,212	0	0	0	9,068	66,026	21,212	9,068	0	9,068	32,108	0	32,108
Lake Granbury Dam to Glen Rose gage	0	0	0	0	379	180	0	379	180	0	123	123	0	17	17
Total above Glen Rose Gage	*84,681*	*223,296*	*93,555*	*0*	*747*	*356*	*85,293*	*223,312*	*93,911*	*87,108*	*246*	*87,354*	*223,296*	*17*	*223,312*
Glen Rose gage to Lake Whitney Dam	1,462	26,922	5,933	0	0	0	1,462	26,922	5,933	8,317	0	8,317	25,590	0	25,590
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	3,918	2,250	0	3,918	2,250	0	2,481	2,481	0	0	0
Lake Aquilla	10,186	10,186	10,186	0	0	0	10,186	10,186	10,186	10,186	0	10,186	10,186	0	10,186
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	441	0	760	441	0	608	608	0	0	0
Total above Highbank Gage	*96,669*	*259,072*	*109,674*	*0*	*5,425*	*3,047*	*101,761*	*259,088*	*112,720*	*105,611*	*3,335*	*108,946*	*259,072*	*17*	*259,088*
Lake Proctor	9,069	9,069	9,069	0	0	0	9,069	9,069	9,069	9,069	0	9,069	9,069	0	9,069
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	46,372	158,502	70,416	0	0	0	46,372	158,502	70,416	55,474	0	55,474	158,502	0	158,502
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	11,347	4,028	0	11,347	4,028	0	1,054	1,054	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	70	0	196	70	0	70	70	0	0	0
Lake Stillhouse Hollow	24,743	83,180	50,752	0	0	0	24,743	83,180	50,752	42,647	0	42,647	65,430	0	65,430
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	3	0	8	3	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	5,794	37,100	25,044	0	9,374	853	5,794	46,474	25,897	28,576	0	28,576	5,794	0	5,794
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	3,507	36,609	8,731	0	0	0	3,507	36,609	8,731	6,366	0	6,366	3,507	0	3,507
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	205	0	350	205	0	315	315	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Somerville	3,263	52,058	12,822	0	0	0	3,263	52,058	12,822	9,185	0	9,185	3,263	0	3,263
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	50,981	56,730	52,310	0	0	0	50,981	56,730	52,310	51,080	0	51,080	56,002	0	56,002
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,288	790	0	1,288	790	0	1,186	1,186	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	0	28,000	18,968	0	6,319	2,212	0	32,857	21,180	25,704	2,573	28,277	0	0	0
Total above Richmond Gage	*305,992*	*560,639*	*357,786*	*0*	*26,177*	*11,206*	*330,369*	*560,655*	*368,993*	*333,712*	*8,535*	*342,247*	*560,639*	*17*	*560,655*
Richmond gage to Gulf of Mexico	0	0	0	7,706	53,676	36,554	7,706	53,676	36,554	0	42,564	42,564	0	9,502	9,502
Total above Gulf of Mexico	*305,992*	*560,639*	*357,786*	*9,173*	*75,213*	*47,761*	*376,907*	*570,158*	*405,547*	*333,712*	*51,099*	*384,811*	*560,639*	*9,519*	*570,158*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9d- Summary of Water Right Diversions by Reach
Scenario 3 - 2025 Conditions With CPNPP Expansion, All Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	109,208	205,796	145,582	0	0	0	109,208	205,796	145,582	156,216	0	156,216	205,796	0	205,796
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	341	169	0	341	169	0	66	66	0	0	0
Dennis gage to Lake Granbury Dam	17,800	68,732	35,957	0	0	0	17,800	68,732	35,957	22,840	0	22,840	45,754	0	45,754
Lake Granbury Dam to Glen Rose gage	0	0	0	0	362	175	0	362	175	0	81	81	0	17	17
Total above Glen Rose Gage	*177,334*	*251,551*	*181,540*	*0*	*703*	*344*	*177,686*	*251,567*	*181,884*	*179,057*	*147*	*179,203*	*251,551*	*17*	*251,567*
Glen Rose gage to Lake Whitney Dam	1,168	22,235	4,305	0	0	0	1,168	22,235	4,305	4,321	0	4,321	22,235	0	22,235
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	3,918	2,267	0	3,918	2,267	0	2,481	2,481	0	0	0
Lake Aquilla	10,186	10,186	10,186	0	0	0	10,186	10,186	10,186	10,186	0	10,186	10,186	0	10,186
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	439	0	760	439	0	608	608	0	0	0
Total above Highbank Gage	*189,639*	*283,971*	*196,030*	*0*	*5,330*	*3,050*	*194,070*	*283,988*	*199,080*	*193,564*	*3,236*	*196,799*	*283,971*	*17*	*283,988*
Lake Proctor	9,069	9,069	9,069	0	0	0	9,069	9,069	9,069	9,069	0	9,069	9,069	0	9,069
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	44,964	136,571	62,558	0	0	0	44,964	136,571	62,558	55,379	0	55,379	136,571	0	136,571
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	11,347	4,170	0	11,347	4,170	0	1,054	1,054	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	71	0	196	71	0	70	70	0	0	0
Lake Stillhouse Hollow	24,743	75,149	47,622	0	0	0	24,743	75,149	47,622	42,647	0	42,647	65,430	0	65,430
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	3	0	8	3	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	5,794	37,100	25,013	0	9,374	853	5,794	46,474	25,866	28,576	0	28,576	5,794	0	5,794
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	3,507	32,542	7,775	0	0	0	3,507	32,542	7,775	5,707	0	5,707	9,825	0	9,825
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	207	0	350	207	0	315	315	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Somerville	3,263	51,312	9,249	0	0	0	3,263	51,312	9,249	4,122	0	4,122	11,435	0	11,435
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	50,981	79,258	52,624	0	0	0	50,981	79,258	52,624	51,080	0	51,080	56,002	0	56,002
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,288	795	0	1,288	795	0	1,186	1,186	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	0	28,000	18,995	0	6,428	2,313	0	32,857	21,308	24,640	3,670	28,310	0	0	0
Total above Richmond Gage	*396,917*	*578,097*	*428,935*	*0*	*27,558*	*11,462*	*414,247*	*578,114*	*440,398*	*414,784*	*9,532*	*424,316*	*578,097*	*17*	*578,114*
Richmond gage to Gulf of Mexico	0	0	0	2,441	17,447	12,316	2,441	17,447	12,316	0	15,281	15,281	0	4,965	4,965
Total above Gulf of Mexico	*396,917*	*578,097*	*428,935*	*3,911*	*43,516*	*23,778*	*426,499*	*583,079*	*452,714*	*414,784*	*24,813*	*439,597*	*578,097*	*4,981*	*583,079*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9e- Summary of Water Right Diversions by Reach
Scenario 3 - 2025 Conditions With CPNPP Expansion, ED's Approach to Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	112,996	235,510	147,886	0	0	0	112,996	235,510	147,886	168,312	0	168,312	235,510	0	235,510
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	341	166	0	341	166	0	66	66	0	0	0
Dennis gage to Lake Granbury Dam	11,210	70,663	34,877	0	0	0	11,210	70,663	34,877	11,210	0	11,210	43,423	0	43,423
Lake Granbury Dam to Glen Rose gage	0	0	0	0	362	169	0	362	169	0	81	81	0	17	17
Total above Glen Rose Gage	*177,340*	*278,933*	*182,763*	*0*	*703*	*335*	*177,652*	*278,950*	*183,098*	*179,522*	*147*	*179,669*	*278,933*	*17*	*278,950*
Glen Rose gage to Lake Whitney Dam	887	24,707	4,817	0	0	0	887	24,707	4,817	4,782	0	4,782	24,707	0	24,707
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	3,918	2,176	0	3,918	2,176	0	2,062	2,062	0	0	0
Lake Aquilla	10,186	10,186	10,186	0	0	0	10,186	10,186	10,186	10,186	0	10,186	10,186	0	10,186
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	422	0	760	422	0	608	608	0	0	0
Total above Highbank Gage	*190,177*	*313,827*	*197,765*	*0*	*5,379*	*2,934*	*194,405*	*313,843*	*200,699*	*194,490*	*2,817*	*197,307*	*313,827*	*17*	*313,843*
Lake Proctor	9,069	9,069	9,069	0	0	0	9,069	9,069	9,069	9,069	0	9,069	9,069	0	9,069
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	44,964	145,841	65,602	0	0	0	44,964	145,841	65,602	55,474	0	55,474	145,841	0	145,841
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	11,347	4,026	0	11,347	4,026	0	1,054	1,054	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	69	0	196	69	0	70	70	0	0	0
Lake Stillhouse Hollow	25,255	83,185	48,602	0	0	0	25,255	83,185	48,602	42,647	0	42,647	65,430	0	65,430
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	3	0	8	3	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	5,794	37,100	24,930	0	9,374	789	5,794	46,474	25,718	28,576	0	28,576	5,794	0	5,794
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	3,507	32,240	8,070	0	0	0	3,507	32,240	8,070	5,710	0	5,710	3,507	0	3,507
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	199	0	350	199	0	304	304	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Somerville	3,263	65,116	10,517	0	0	0	3,263	65,116	10,517	4,984	0	4,984	3,263	0	3,263
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	50,981	56,514	52,256	0	0	0	50,981	56,514	52,256	51,080	0	51,080	56,002	0	56,002
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,281	770	0	1,281	770	0	1,186	1,186	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	0	28,000	18,749	0	6,319	2,105	0	32,857	20,854	24,640	2,854	27,494	0	0	0
Total above Richmond Gage	*398,054*	*602,732*	*435,559*	*0*	*24,656*	*10,894*	*417,434*	*602,749*	*446,453*	*416,671*	*8,287*	*424,957*	*602,732*	*17*	*602,749*
Richmond gage to Gulf of Mexico	0	0	0	2,441	17,447	11,950	2,441	17,447	11,950	0	15,221	15,221	0	3,939	3,939
Total above Gulf of Mexico	*398,054*	*602,732*	*435,559*	*3,911*	*40,490*	*22,844*	*428,864*	*606,688*	*458,403*	*416,671*	*23,508*	*440,178*	*602,732*	*3,956*	*606,688*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9f- Summary of Water Right Diversions by Reach
Scenario 4 - 2060 Conditions Without CPNPP Expansion, All Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	50,172	205,559	73,634	0	0	0	50,172	205,559	73,634	82,406	0	82,406	205,559	0	205,559
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	368	175	0	368	175	0	123	123	0	0	0
Dennis gage to Lake Granbury Dam	12,490	53,773	27,162	0	0	0	12,490	53,773	27,162	12,490	0	12,490	32,342	0	32,342
Lake Granbury Dam to Glen Rose gage	0	0	0	0	379	182	0	379	182	0	123	123	0	17	17
Total above Glen Rose Gage	*91,936*	*237,902*	*100,796*	*0*	*747*	*357*	*92,683*	*237,919*	*101,153*	*94,897*	*246*	*95,143*	*237,902*	*17*	*237,919*
Glen Rose gage to Lake Whitney Dam	1,724	29,996	7,818	0	0	0	1,724	29,996	7,818	9,974	0	9,974	29,996	0	29,996
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	6,529	3,716	0	6,529	3,716	0	4,132	4,132	0	0	0
Lake Aquilla	13,337	13,337	13,337	0	0	0	13,337	13,337	13,337	13,337	0	13,337	13,337	0	13,337
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	435	0	760	435	0	608	608	0	0	0
Total above Highbank Gage	*107,186*	*281,235*	*121,951*	*0*	*8,036*	*4,508*	*115,222*	*281,252*	*126,459*	*118,208*	*4,986*	*123,194*	*281,235*	*17*	*281,252*
Lake Proctor	9,986	9,986	9,986	0	0	0	9,986	9,986	9,986	9,986	0	9,986	9,986	0	9,986
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	64,322	151,441	89,042	0	0	0	64,322	151,441	89,042	80,806	0	80,806	106,316	0	106,316
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	16,341	5,610	0	16,341	5,610	0	0	0	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	65	0	196	65	0	70	70	0	0	0
Lake Stillhouse Hollow	48,104	87,776	66,216	0	0	0	48,104	87,776	66,216	63,070	0	63,070	63,436	0	63,436
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	2	0	8	2	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	4,957	37,100	24,830	0	11,496	1,501	4,957	48,596	26,331	32,307	0	32,307	4,957	0	4,957
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	5,357	24,557	11,378	0	0	0	5,357	24,557	11,378	12,755	0	12,755	16,470	0	16,470
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	202	0	350	202	0	315	315	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	2,500	1,508	0	2,500	1,508	0	2,142	2,142	0	0	0
Lake Somerville	3,415	61,896	15,459	0	0	0	3,415	61,896	15,459	11,911	0	11,911	20,618	0	20,618
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	51,010	56,521	52,416	0	0	0	51,010	56,521	52,416	51,154	0	51,154	56,521	0	56,521
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,756	1,054	0	1,756	1,054	0	1,616	1,616	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	28,000	108,834	56,323	10	28,581	3,462	32,857	137,415	59,785	39,301	2,573	41,875	99,650	22,856	122,506
Total above Richmond Gage	*369,999*	*659,189*	*447,600*	*2,049*	*39,047*	*17,913*	*404,822*	*682,062*	*465,512*	*419,498*	*11,704*	*431,202*	*659,189*	*22,873*	*682,062*
Richmond gage to Gulf of Mexico	0	0	0	13,894	134,460	88,809	13,894	134,460	88,809	0	107,423	107,423	0	13,894	13,894
Total above Gulf of Mexico	*369,999*	*659,189*	*447,600*	*20,013*	*165,906*	*106,722*	*532,682*	*695,956*	*554,321*	*419,498*	*119,127*	*538,625*	*659,189*	*36,767*	*695,956*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9g- Summary of Water Right Diversions by Reach
Scenario 4 - 2060 Conditions Without CPNPP Expansion, ED's Approach to Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	47,705	210,103	75,417	0	0	0	47,705	210,103	75,417	82,768	0	82,768	210,103	0	210,103
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	368	170	0	368	170	0	123	123	0	0	0
Dennis gage to Lake Granbury Dam	11,190	56,846	26,969	0	0	0	11,190	56,846	26,969	11,190	0	11,190	30,758	0	30,758
Lake Granbury Dam to Glen Rose gage	0	0	0	0	379	176	0	379	176	0	123	123	0	17	17
Total above Glen Rose Gage	*91,936*	*240,861*	*102,385*	*0*	*747*	*345*	*92,565*	*240,877*	*102,730*	*93,958*	*246*	*94,205*	*240,861*	*17*	*240,877*
Glen Rose gage to Lake Whitney Dam	1,913	40,669	8,404	0	0	0	1,913	40,669	8,404	9,342	0	9,342	40,669	0	40,669
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	6,529	3,563	0	6,529	3,563	0	4,132	4,132	0	0	0
Lake Aquilla	13,061	13,337	13,332	0	0	0	13,061	13,337	13,332	13,337	0	13,337	13,337	0	13,337
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	425	0	760	425	0	608	608	0	0	0
Total above Highbank Gage	*107,186*	*294,867*	*124,122*	*0*	*8,036*	*4,333*	*115,222*	*294,883*	*128,455*	*116,637*	*4,986*	*121,623*	*294,867*	*17*	*294,883*
Lake Proctor	9,986	9,986	9,986	0	0	0	9,986	9,986	9,986	9,986	0	9,986	9,986	0	9,986
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	64,322	153,370	92,499	0	0	0	64,322	153,370	92,499	80,901	0	80,901	103,000	0	103,000
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	16,341	5,434	0	16,341	5,434	0	0	0	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	63	0	196	63	0	70	70	0	0	0
Lake Stillhouse Hollow	48,104	87,776	65,502	0	0	0	48,104	87,776	65,502	63,070	0	63,070	68,106	0	68,106
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	2	0	8	2	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	5,024	37,100	24,638	0	11,496	1,463	5,024	48,596	26,102	32,307	0	32,307	5,169	0	5,169
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	5,357	21,263	11,396	0	0	0	5,357	21,263	11,396	12,755	0	12,755	15,021	0	15,021
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	199	0	350	199	0	315	315	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	2,500	1,473	0	2,500	1,473	0	2,142	2,142	0	0	0
Lake Somerville	3,415	58,330	16,458	0	0	0	3,415	58,330	16,458	14,529	0	14,529	15,634	0	15,634
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	51,019	56,571	52,558	0	0	0	51,019	56,571	52,558	51,154	0	51,154	56,521	0	56,521
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,746	1,030	0	1,746	1,030	0	1,616	1,616	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	28,000	114,854	60,002	10	43,261	3,904	32,857	152,095	63,905	48,848	2,528	51,375	99,650	32,573	132,223
Total above Richmond Gage	*370,002*	*667,953*	*457,160*	*1,328*	*43,600*	*17,902*	*404,822*	*700,542*	*475,062*	*430,187*	*11,658*	*441,845*	*667,953*	*32,589*	*700,542*
Richmond gage to Gulf of Mexico	0	0	0	9,232	134,460	84,785	9,232	134,460	84,785	0	97,972	97,972	0	18,350	18,350
Total above Gulf of Mexico	*370,002*	*667,953*	*457,160*	*10,560*	*165,906*	*102,688*	*531,554*	*718,892*	*559,847*	*430,187*	*109,631*	*539,818*	*667,953*	*50,939*	*718,892*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9h- Summary of Water Right Diversions by Reach
Scenario 5 - 2060 Conditions With CPNPP Expansion, All Return Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	113,316	235,311	151,775	0	0	0	113,316	235,311	151,775	166,028	0	166,028	235,311	0	235,311
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	341	163	0	341	163	0	66	66	0	0	0
Dennis gage to Lake Granbury Dam	20,489	69,001	37,614	0	0	0	20,489	69,001	37,614	20,982	0	20,982	50,864	0	50,864
Lake Granbury Dam to Glen Rose gage	0	0	0	0	362	169	0	362	169	0	81	81	0	17	17
Total above Glen Rose Gage	*170,488*	*286,175*	*189,389*	*0*	*703*	*332*	*170,868*	*286,191*	*189,721*	*187,010*	*147*	*187,157*	*286,175*	*17*	*286,191*
Glen Rose gage to Lake Whitney Dam	2,090	32,102	9,140	0	0	0	2,090	32,102	9,140	13,002	0	13,002	24,283	0	24,283
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	6,529	3,578	0	6,529	3,578	0	3,436	3,436	0	0	0
Lake Aquilla	13,337	13,337	13,337	0	0	0	13,337	13,337	13,337	13,337	0	13,337	13,337	0	13,337
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	430	0	760	430	0	608	608	0	0	0
Total above Highbank Gage	*187,632*	*323,795*	*211,866*	*0*	*7,990*	*4,339*	*194,100*	*323,812*	*216,205*	*213,349*	*4,191*	*217,540*	*323,795*	*17*	*323,812*
Lake Proctor	9,986	9,986	9,986	0	0	0	9,986	9,986	9,986	9,986	0	9,986	9,986	0	9,986
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	64,509	153,821	89,163	0	0	0	64,509	153,821	89,163	80,835	0	80,835	106,316	0	106,316
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	16,341	5,594	0	16,341	5,594	0	0	0	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	65	0	196	65	0	70	70	0	0	0
Lake Stillhouse Hollow	47,744	88,501	66,942	0	0	0	47,744	88,501	66,942	64,073	0	64,073	63,436	0	63,436
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	2	0	8	2	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	4,995	37,100	24,690	0	12,411	1,615	4,995	49,511	26,306	32,303	0	32,303	4,995	0	4,995
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	5,357	24,557	10,603	0	0	0	5,357	24,557	10,603	11,757	0	11,757	16,432	0	16,432
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	201	0	350	201	0	304	304	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	2,500	1,488	0	2,500	1,488	0	2,142	2,142	0	0	0
Lake Somerville	3,415	63,813	16,194	0	0	0	3,415	63,813	16,194	11,911	0	11,911	42,224	0	42,224
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	51,010	56,521	52,360	0	0	0	51,010	56,521	52,360	51,154	0	51,154	56,521	0	56,521
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,756	1,051	0	1,756	1,051	0	1,616	1,616	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	28,000	116,808	58,377	10	45,668	3,975	32,857	154,502	62,351	38,436	2,573	41,009	99,650	19,244	118,894
Total above Richmond Gage	*463,458*	*723,354*	*540,182*	*2,005*	*46,007*	*18,331*	*494,703*	*742,615*	*558,513*	*513,804*	*10,897*	*524,701*	*723,354*	*19,261*	*742,615*
Richmond gage to Gulf of Mexico	0	0	0	18,802	134,460	86,989	18,802	134,460	86,989	0	107,212	107,212	0	33,168	33,168
Total above Gulf of Mexico	*463,458*	*723,354*	*540,182*	*20,807*	*165,952*	*105,320*	*611,519*	*775,782*	*645,502*	*513,804*	*118,109*	*631,913*	*723,354*	*52,428*	*775,782*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

Table 4.9i- Summary of Water Right Diversions by Reach
Scenario 5 - 2060 Conditions With CPNPP Expansion, ED's Approach to Flows
Values in acft/yr

Reach	Existing Rights			SysOps			Total			Average Year (1983)			Max Year (1956)		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Existing Rights	SysOps	Total	Existing Rights	SysOps	Total
Possum Kingdom Lake	113,798	259,371	153,784	0	0	0	113,798	259,371	153,784	160,423	0	160,423	259,371	0	259,371
Possum Kingdom Lake Dam to Palo Pinto gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palo Pinto gage to Dennis gage	0	0	0	0	341	160	0	341	160	0	66	66	0	0	0
Dennis gage to Lake Granbury Dam	15,839	75,324	37,003	0	0	0	15,839	75,324	37,003	18,371	0	18,371	58,801	0	58,801
Lake Granbury Dam to Glen Rose gage	0	0	0	0	362	163	0	362	163	0	81	81	0	17	17
Total above Glen Rose Gage	*174,106*	*318,172*	*190,787*	*0*	*703*	*323*	*174,159*	*318,189*	*191,110*	*178,794*	*147*	*178,940*	*318,172*	*17*	*318,189*
Glen Rose gage to Lake Whitney Dam	2,090	34,680	10,280	0	0	0	2,090	34,680	10,280	18,436	0	18,436	34,680	0	34,680
Lake Whitney Dam to Aquilla Cr/Brazos Rv confluence	0	0	0	0	6,529	3,455	0	6,529	3,455	0	3,436	3,436	0	0	0
Lake Aquilla	12,960	13,337	13,330	0	0	0	12,960	13,337	13,330	13,337	0	13,337	13,337	0	13,337
Lake Aquilla Dam to Aquilla Creek gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr gage to Aquilla Cr/Brazos Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquilla Cr/ Brazos confluence to Highbank gage	0	0	0	0	760	414	0	760	414	0	608	608	0	0	0
Total above Highbank Gage	*199,529*	*366,189*	*214,397*	*0*	*7,861*	*4,192*	*203,795*	*366,206*	*218,589*	*210,566*	*4,191*	*214,757*	*366,189*	*17*	*366,206*
Lake Proctor	9,986	9,986	9,986	0	0	0	9,986	9,986	9,986	9,986	0	9,986	9,986	0	9,986
Lake Proctor Dam to Leon Rv at Gatesville gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leon Rv at Gatesville to Lake Belton Dam	64,509	167,180	92,812	0	0	0	64,509	167,180	92,812	80,930	0	80,930	103,000	0	103,000
Lake Belton Dam to Leon Rv nr Belton gage	0	0	0	0	16,341	5,433	0	16,341	5,433	0	0	0	0	0	0
Leon Rv nr Belton gage to Little River gage	0	0	0	0	196	63	0	196	63	0	70	70	0	0	0
Lake Stillhouse Hollow	46,409	88,578	66,290	0	0	0	46,409	88,578	66,290	66,307	0	66,307	65,878	0	65,878
Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	0	0	0	0	8	2	0	8	2	0	1	1	0	0	0
Lampasas Rv nr Belton gage to Little River gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little River gage to Little Rv/San Gabriel Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Georgetown	4,806	37,100	24,361	0	12,140	1,504	4,806	49,240	25,865	30,504	0	30,504	4,806	0	4,806
Lk Georgetown Dam to N San Gabriel gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N San Gabriel gage to Lake Granger Dam	5,357	24,557	8,722	0	0	0	5,357	24,557	8,722	9,321	0	9,321	15,611	0	15,611
Lake Granger Dam to Laneport gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laneport gage to Little Rv/San Gabriel confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little/San Gabriel confluence to Little Rv at Cameron gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cameron gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highbank gage to Brazos/Little Rv confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos Rv/Little Rv confluence to Bryan gage	0	0	0	0	350	193	0	350	193	0	304	304	0	0	0
Bryan gage to Brazos/Yegua Crk confluence	0	0	0	0	2,500	1,427	0	2,500	1,427	0	2,142	2,142	0	0	0
Lake Somerville	3,415	56,549	16,652	0	0	0	3,415	56,549	16,652	7,513	0	7,513	25,564	0	25,564
Lake Somerville Dam to Yegua Crk gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yegua Cr gage to Brazos Rv/Yegua Cr confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazos/Yegua confluence to Brazos/Navasota confluence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Limestone	51,019	56,521	52,498	0	0	0	51,019	56,521	52,498	51,154	0	51,154	56,521	0	56,521
Lake Limestone Dam to Easterly gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easterly gage to Brazos/Navasota confluence	0	0	0	0	1,746	1,003	0	1,746	1,003	0	1,616	1,616	0	0	0
Brazos Rv/Navasota confluence to Hempstead gage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hempstead gage to Richmond gage	28,000	117,010	61,376	10	49,148	4,542	32,857	157,982	65,918	42,250	2,573	44,823	99,650	26,432	126,082
Total above Richmond Gage	*463,320*	*747,205*	*547,094*	*2,749*	*49,519*	*18,360*	*496,328*	*773,654*	*565,454*	*508,533*	*10,897*	*519,430*	*747,205*	*26,449*	*773,654*
Richmond gage to Gulf of Mexico	0	0	0	3,816	134,460	82,950	3,816	134,460	82,950	0	103,181	103,181	0	26,320	26,320
Total above Gulf of Mexico	*463,320*	*747,205*	*547,094*	*6,565*	*164,090*	*101,310*	*620,705*	*799,973*	*648,404*	*508,533*	*114,078*	*622,610*	*747,205*	*52,768*	*799,973*

Notes: Reaches highlighted in red contain reservoirs
Use is shown at the source of the water and not the location where the water is used. Some of the use shown at reservoirs may actually be releases from the reservoir used downstream.

In these tables, note that a few reaches such as Lake Proctor or Lake Aquilla have the same minimum, maximum and total use throughout the simulation. These reservoirs have relatively large diversions compared to the firm yield of the reservoir, and there are no other BRA sources that can be used to meet the demands at these locations. Therefore the modeling runs assume that these reservoirs will operate independently of other sources in the BRA System. For most other reaches, the water use varies throughout the simulation. There are three reasons for this. First, there are many BRA customers who can be provided with water from multiple sources and permits. For example, customers at Lake Granbury can be provided with water directly from Lake Granbury or with water released downstream from Possum Kingdom Lake. The water from these sources could be provided either from the reservoirs' existing authorizations (COA 12-5155 for Possum Kingdom, and COA 12-5156 for Lake Granbury), or from the System Operation Permit. Second, as discussed above, there are several large BRA customers that have their own water rights. Most of the time these customers use water from their own rights; however, during dry periods these customers will call for releases of water from the BRA System. Third, some BRA customers that currently must exclusively use releases from reservoirs can, in Scenarios 2 through 5, use run-of-river flows authorized under the proposed System Operation Permit as long as applicable environmental flows criteria are met and senior rights are not impaired. During drier times, water to satisfy these needs must be released from upstream reservoirs. Because the water use in these tables is identified by the source of the water and permit authorizations, the variability indicates the extent to which multiple sources of water and multiple permits are used to meet demands in the BRA System.

Note that in Table 4.9a (Scenario 1), the only non-reservoir reach that has water use is the Hempstead gage to Richmond gage. This is the use of the Excess Flows Permit by NRG, the only currently authorized use of run-of-river flows in the BRA System. Currently, BRA has no authorization to make use of run-of-river flows in other reaches, so customer demands in those reaches must be met by releases from System reservoirs. That is why there is no use in the other reaches in Table 4.9a.

Tables 4.9b through 4.9i (Scenarios 2 through 5) assume that the System Operation

Permit has been granted and is being used to supply water. Note that there is some water use in all reaches that have a BRA customer demand. The proposed System Operation Permit allows the BRA to make use of run-of-river flows as long as environmental flow criteria are being met and senior rights are not impaired. When environmental flow criteria are not met (or when water is reserved for seniors), there is no diversion of run-of-river water; hence the minimum entry in most reaches is zero. The exception is the Richmond to Gulf of Mexico reach, where some run-of-river water is available even during extreme drought years under current and 2025 conditions. Under 2060 conditions, the water reported in the Hempstead to Richmond reach includes water used from Allens Creek Reservoir.

Figures 4.3a through 4.3c show the annual water use from the model for Scenario 1, Scenario 3 with all return flows, and Scenario 5 with all return flows. These figures illustrate how the various BRA authorizations are used under current, 2025 and 2060 conditions. Other scenarios show similar trends and are included in Appendix G-4. Under current conditions (Figure 4.3a), the typical demand from the BRA System would be between 280,000 and 290,000 acft/yr. During drier periods, demands will be higher, approaching 400,000 acft/yr. Demands are higher in drier years because several of the BRA's largest customers supplement their own water rights with water from the BRA System during dry periods. The highest demands occur during the 1950s drought, which is the drought-of-record for most of the Brazos River basin. The highest demand from the BRA System is 479,750 acft in 1956, at the end of the 1950s drought. This water use is slightly higher than the 2011 water use from the BRA System, which was used as the baseline for Scenario 1. Water use is slightly higher because in the model TMPA did not fully use their contract water in 2011 but did fully use their contracts in 1956.

Figure 4.3a – Annual Demand Scenario 1 – Current Conditions

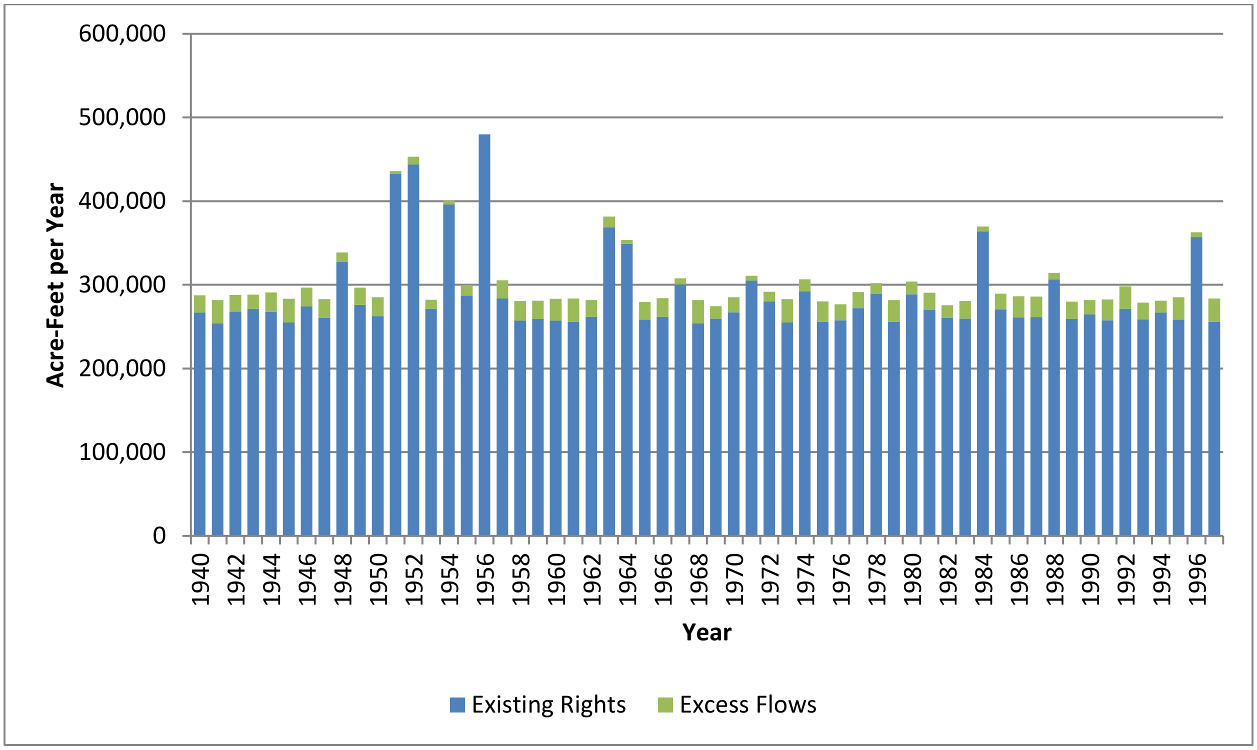


Figure 4.3b – Annual Demand Scenario 3 – 2025 Conditions with Comanche Peak Expansion – All Return Flows

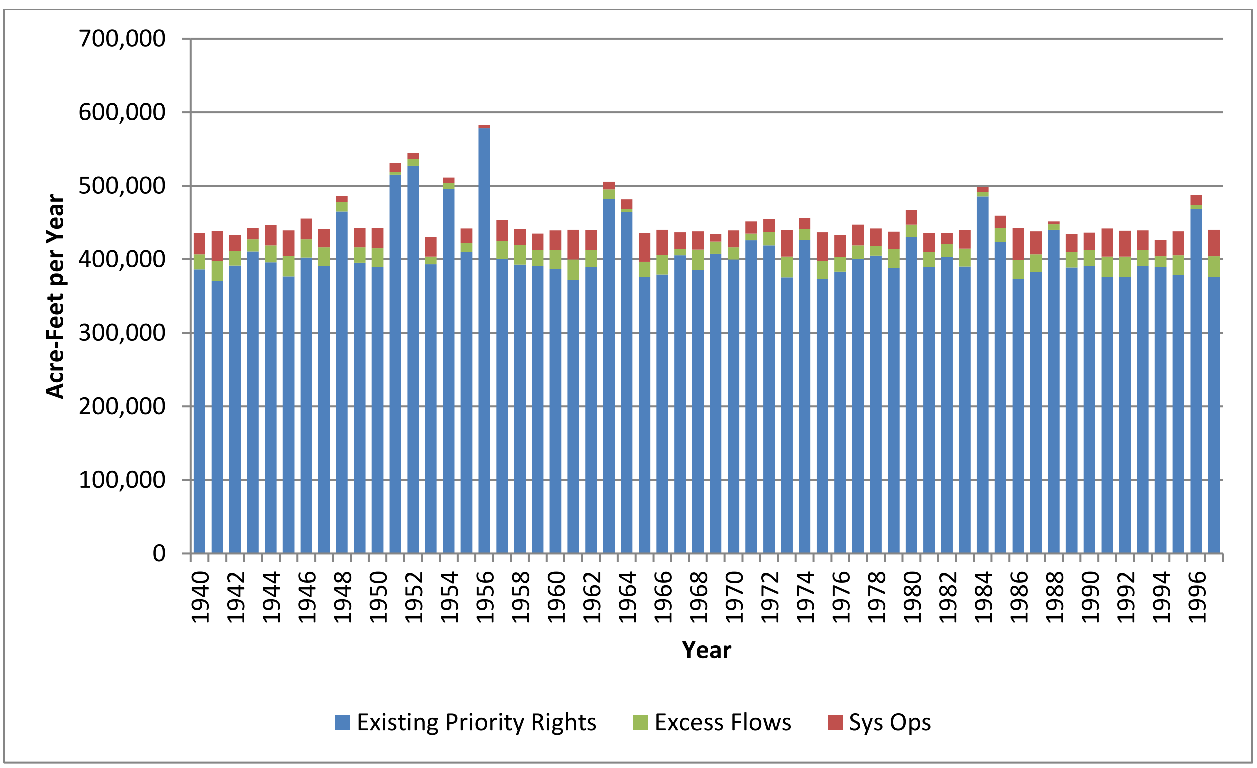
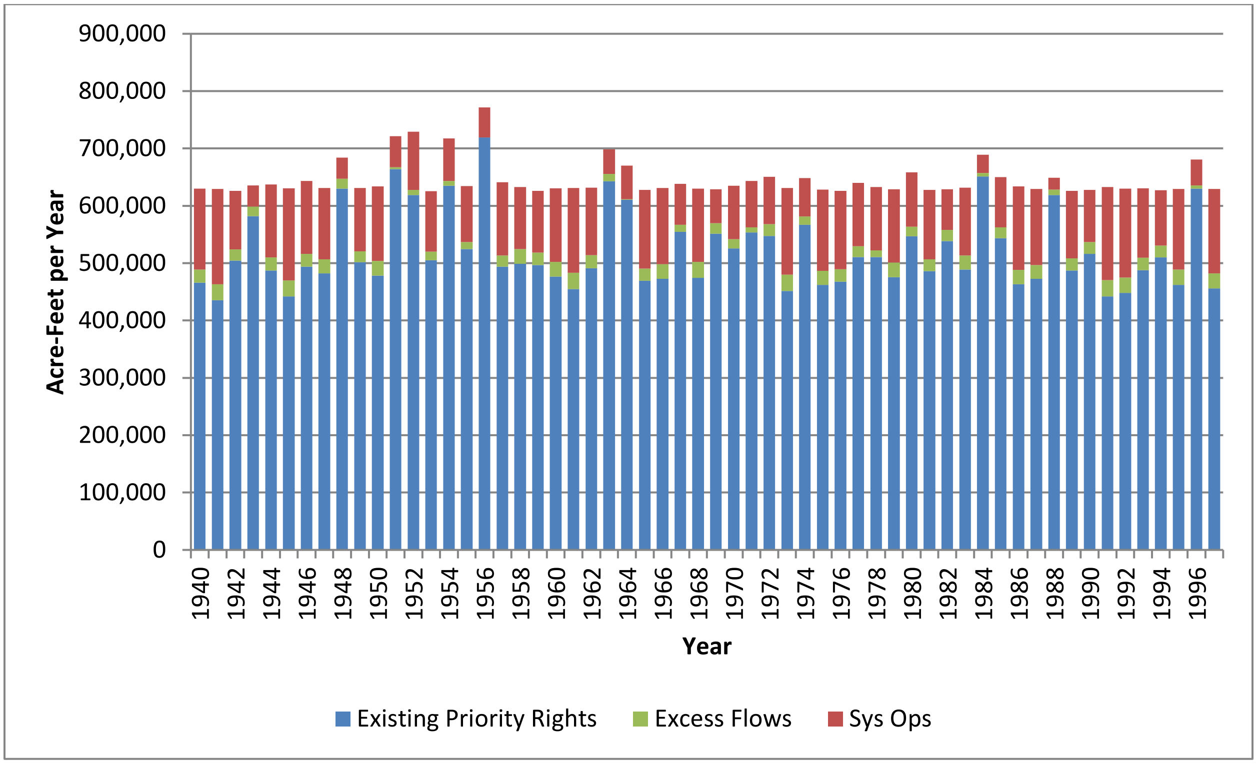


Figure 4.3c – Annual Demand Scenario 5 – 2060 Conditions with Comanche Peak Expansion – All Return Flows



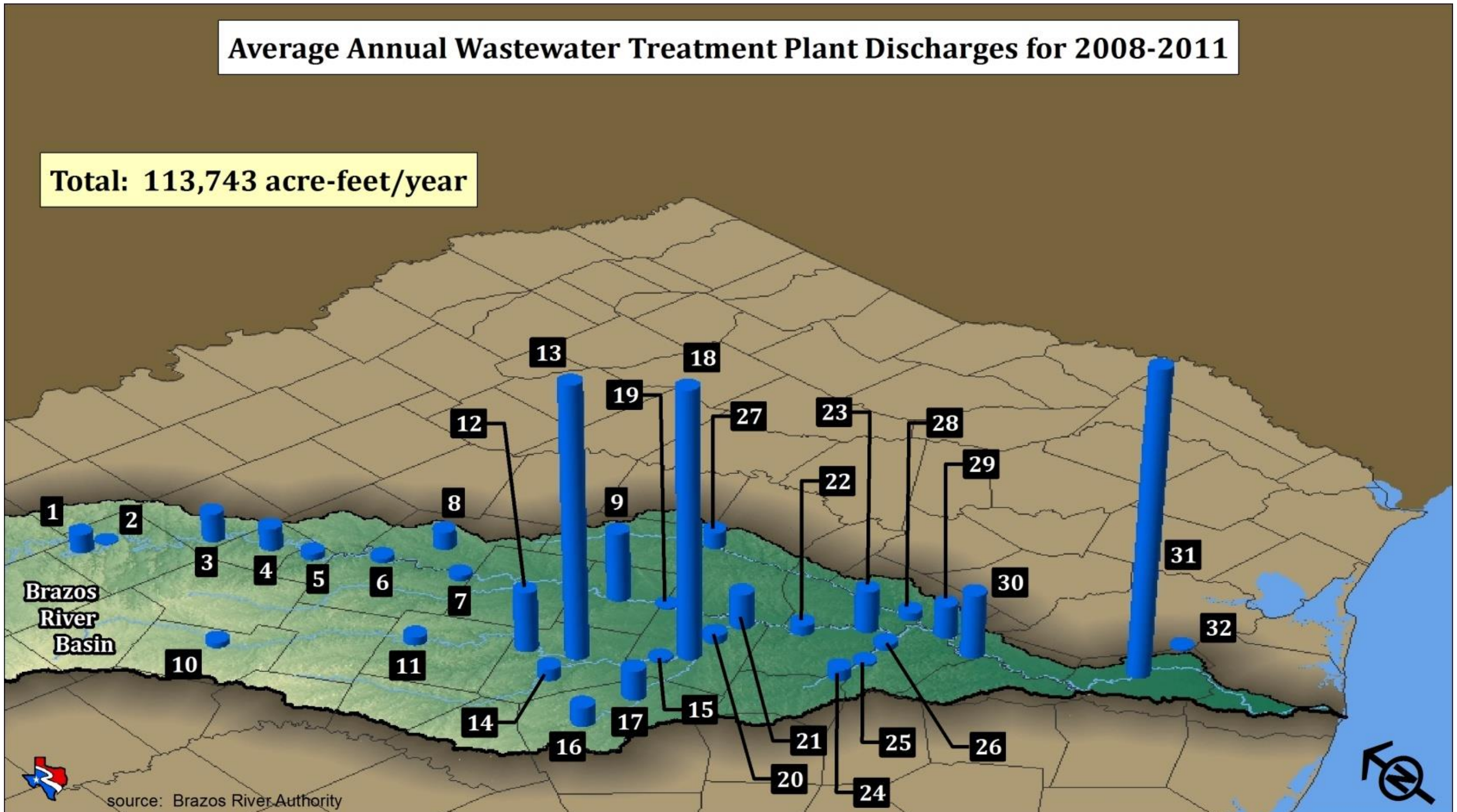
4.3.2 Reuse of Return Flows

In the context of this WMP, "reuse" refers to the use of return flows that have been discharged from a municipal wastewater treatment plant, manufacturing process, or other returns of water that have been diverted but not consumed. This type of reuse is often called "indirect reuse." In the Operational Demand Scenarios modeling runs described in this Section 4.3, indirect reuse is implemented by adding return flows to the natural flows in the Brazos-WAM.

The TCEQ Brazos-WAM Full Authorization model, used as the basis for this study, assumes that all existing diversions are diverted and consumed unless returning part of the diversion is specifically required by a water right. Essentially, that model assumes 100% direct reuse of return flows with nothing returned to the stream. Historical return flows have been eliminated from the hydrology used in the model. However, return flows do exist in the Brazos River basin and have a significant impact on the availability of water and the operation of the BRA System. The proposed System Operation Permit will authorize the use of at least some of these return flows, under either the BRA's preferred return flows approach or the ED's preferred approach. Return flows have been added to the Operational Models used for Scenarios 1 through 5. These return flows are assumed to be distributed based on the priority of each water right – the same way that natural flows are distributed in the model.

The return flows in Scenario 1 are the average reported return flows from 2008 to 2011 for plants with a permitted discharge of more than 0.25 MGD, as reported to TCEQ. Figure 4.4 shows the magnitude of these discharges by location in the basin. A few smaller plants that are either owned by the BRA or obtain water from a BRA source were included as well. Industrial discharges of once-through cooling water were not included. Return flows for currently permitted indirect reuse projects were also not included as part of these flows. These omitted projects involve indirect reuse by the City of Abilene, City of Cleburne, City of Waco, City of College Station and City of Bryan. To be conservative, all of the return flows for these cities were excluded, even though not all of that water may currently be reused. The City of Round Rock's direct reuse was accounted for by subtracting an annual average of 2.3 MGD from the total return flows of the Brushy Creek Regional Wastewater Treatment Plant, which treats the city's effluent. The total annual return flows used in Scenario 1 are 113,743 acft/yr.

Figure 4.4 (Scenario 1)



Map Number, River Reach Description, Average Annual Wastewater Treatment Plant Discharges for 2008-2011 values are acre-feet per year

1. Possum Kingdom Lake	1,536	11. Lk Proctor dam to Gatesville gage	674	22. Brazos-Little conf. to Bryan gage	809
2. Possum Kingdom Lk dam to Palo Pinto gage	49	12. Leon Rv at Gatesville gage to Lake Belton dam	4,923	23. Bryan gage to Brazos-Yegua conf.	3,423
3. Palo Pinto gage to Dennis gage	2,330	13. Leon Rv nr Belton gage to Little Rv gage	22,192	24. Lake Somerville	891
4. Dennis gage to Lake Granbury dam	1,830	14. Stillhouse Hollow Lake	980	25. Lake Somerville dam to Yegua Creek gage	177
5. Lake Granbury dam to Glen Rose gage	553	15. Little Rv gage to Little-San Gabriel conf.	221	26. Yegua Creek gage to Brazos-Yegua conf.	478
6. Glen Rose gage to Lake Whitney dam	380	16. Lake Georgetown dam to N San Gabriel gage	1,589	27. Lake Limestone	1,331
7. Lake Whitney dam to Aquilla-Brazos conf.	423	17. N San Gabriel gage to Lake Granger dam	2,444	28. Easterly gage to Brazos-Navasota conf.	629
8. Lake Aquilla	1,453	18. Laneport gage to Little-San Gabriel conf.	21,809	29. Brazos-Navasota conf. to Hempstead	2,663
9. Aquilla-Brazos conf. to Highbank gage	5,652	19. Little-San Gabriel conf. to Little Rv at Cameron	692	30. Hempstead gage to Richmond gage	5,236
10. Lake Proctor	460	20. Highbank gage to Brazos-Navasota conf.	116	31. Richmond gage to Gulf of Mexico	24,740
\WaterSupply\Basin\ReturnFlows\RF-8x11-Current.mxd 10-25-12		21. Cameron gage to Brazos-Little conf.	2,900	32. Oyster Creek to Gulf of Mexico	160

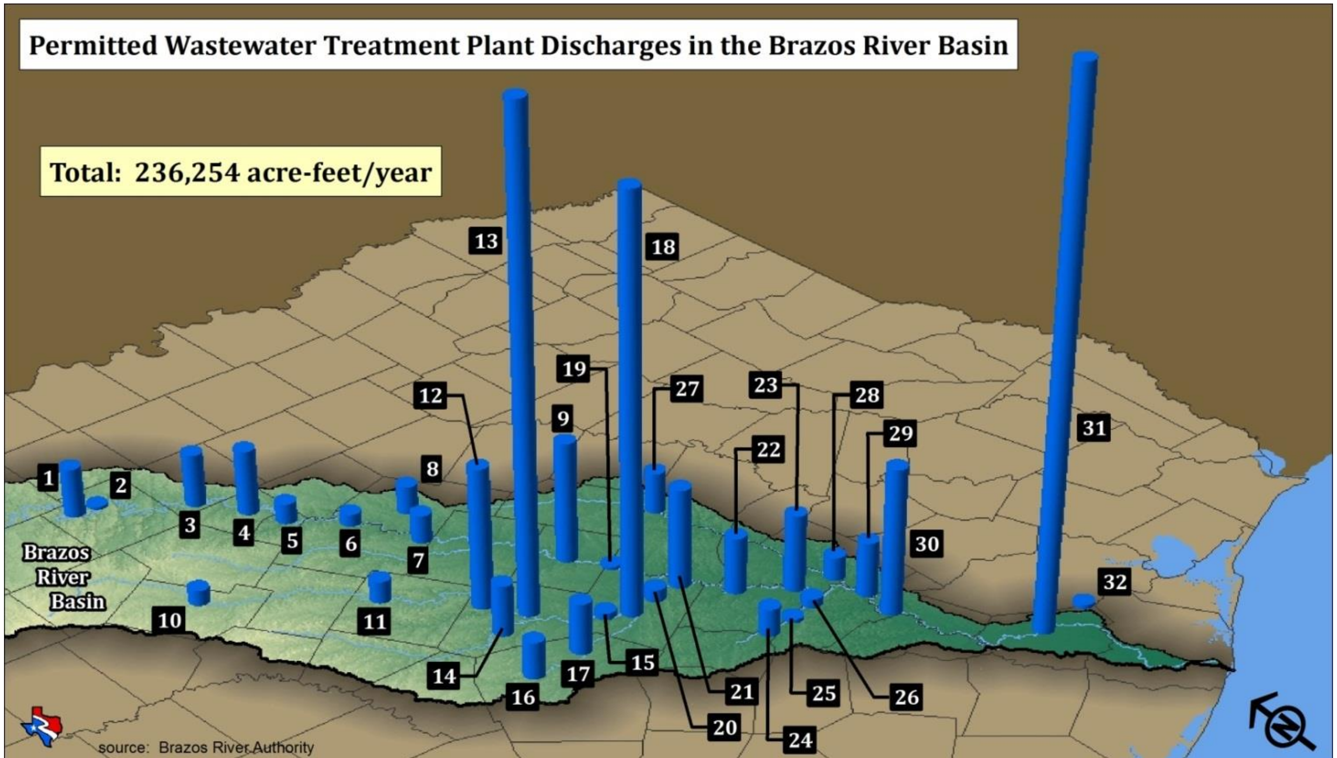
Scenarios 2 through 5 each use two options to model return flows. The first option includes all return flows discharging at the maximum amount authorized in the respective plants' discharge permits. It is assumed that by 2025 return flows will be at least equal to the amount that is currently permitted to be discharged. Like Scenario 1, return flows from entities that currently have a reuse authorization have been excluded, as have return flows from once-through cooling. These return flows are distributed in the model in priority order in the same way that natural flows are distributed. This is the return flows approach preferred by the BRA. Under this option, return flows total 236,254 acft/yr in 2025. Figure 4.5 shows the magnitude of those return flows by location.

This approach to reuse in Scenarios 1 through 5 is different than the approach used in the new appropriation modeling in Section 2.4 of this Technical Report. In the new appropriation models, return flows were included for permitted dischargers and the permits were explicitly modeled using historical monthly minimum return flows from 2007 to 2011.

The second option, the ED's preferred return flows approach, includes only discharges that originate from BRA water supply sources or from treatment plants owned or operated by the BRA. To be conservative the modeling assumes that all of the water is distributed in priority order, including return flows originating from BRA water supply sources or treatment plants owned or operated by the BRA. As with the other scenarios, currently permitted reuse projects and once-through cooling are excluded. Under this option, return flows total 108,432 acft/yr in 2025. Figure 4.6 shows the magnitude of those return flows by location.

Note that these figures show that return flows are mostly concentrated in the Little River system and in the lower portions of the Brazos basin.

Figure 4.5 (Scenarios 2 through 5, BRA Approach to Return Flows)



Map Number, River Reach Description, Permitted Wastewater Treatment Plant Discharges in the Brazos River Basin values are acre-feet per year

1. Possum Kingdom Lake	4,316	11. Lk Proctor dam to Gatesville gage	1,939	22. Brazos-Little conf. to Bryan gage	4,987
2. Possum Kingdom Lk dam to Palo Pinto gage	258	12. Leon Rv at Gatesville gage to Lake Belton dam	12,385	23. Bryan gage to Brazos-Yegua conf.	6,725
3. Palo Pinto gage to Dennis gage	4,662	13. Leon Rv nr Belton gage to Little Rv gage	42,799	24. Lake Somerville	2,410
4. Dennis gage to Lake Granbury dam	5,716	14. Stillhouse Hollow Lake	4,483	25. Lake Somerville dam to Yegua Creek gage	336
5. Lake Granbury dam to Glen Rose gage	1,779	15. Little Rv gage to Little-San Gabriel conf.	588	26. Yegua Creek gage to Brazos-Yegua conf.	797
6. Glen Rose gage to Lake Whitney dam	1,076	16. Lake Georgetown dam to N San Gabriel gage	3,250	27. Lake Limestone	3,569
7. Lake Whitney dam to Aquilla-Brazos conf.	2,465	17. N San Gabriel gage to Lake Granger dam	4,483	28. Easterly gage to Brazos-Navasota conf.	2,017
8. Lake Aquilla	2,453	18. Laneport gage to Little-San Gabriel conf.	35,954	29. Brazos-Navasota conf. to Hempstead	4,819
9. Aquilla-Brazos conf. to Highbank gage	10,546	19. Little-San Gabriel conf. to Little Rv at Cameron	1,076	30. Hempstead gage to Richmond gage	12,862
10. Lake Proctor	1,340	20. Highbank gage to Brazos-Navasota conf.	280	31. Richmond gage to Gulf of Mexico	46,779
		21. Cameron gage to Brazos-Little conf.	8,752	32. Oyster Creek to Gulf of Mexico	353

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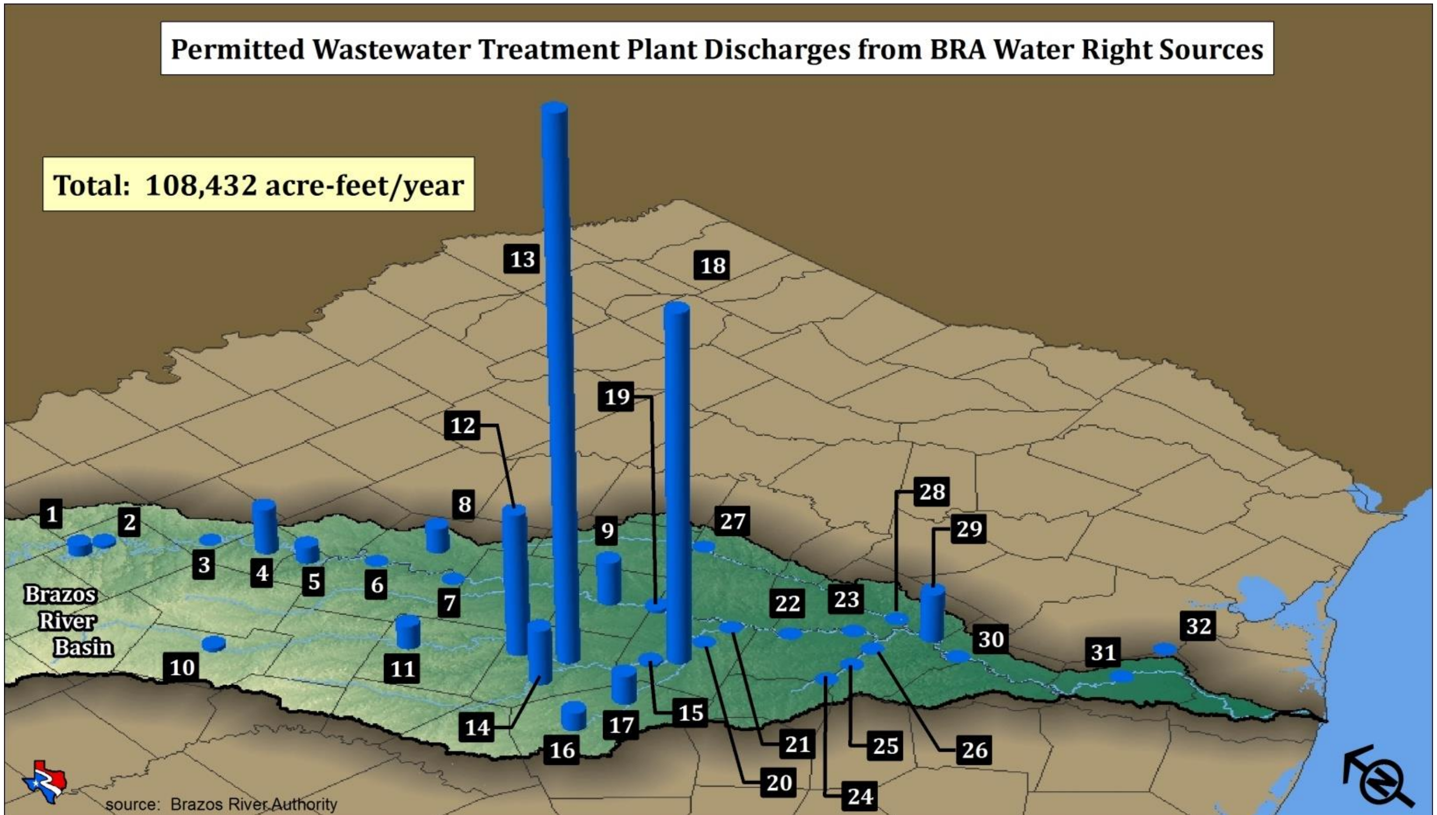
Figure 4.6 (Scenarios 2 through 5, Executive Director's Approach to Return Flows)



Map Number, River Reach Description, Permitted Wastewater Treatment Plant Discharges from BRA Water Right Sources values are acre-feet per year

1. Possum Kingdom Lake	897	11. Lk Proctor dam to Gatesville gage	1,932	22. Brazos-Little conf. to Bryan gage	0
2. Possum Kingdom Lk dam to Palo Pinto gage	258	12. Leon Rv at Gatesville gage to Lake Belton dam	11, 532	23. Bryan gage to Brazos-Yegua conf.	0
3. Palo Pinto gage to Dennis gage	0	13. Leon Rv nr Belton gage to Little Rv gage	42,315	24. Lake Somerville	0
4. Dennis gage to Lake Granbury dam	3,703	14. Stillhouse Hollow Lake	4,455	25. Lake Somerville dam to Yegua Creek gage	0
5. Lake Granbury dam to Glen Rose gage	1,364	15. Little Rv gage to Little-San Gabriel conf.	182	26. Yegua Creek gage to Brazos-Yegua conf.	0
6. Glen Rose gage to Lake Whitney dam	0	16. Lake Georgetown dam to N San Gabriel gage	1,457	27. Lake Limestone	0
7. Lake Whitney dam to Aquilla-Brazos conf.	0	17. N San Gabriel gage to Lake Granger dam	2,331	28. Easterly gage to Brazos-Navasota conf.	0
8. Lake Aquilla	2,029	18. Laneport gage to Little-San Gabriel conf.	27,863	29. Brazos-Navasota conf. to Hempstead	3,979
9. Aquilla-Brazos conf. to Highbank gage	3,524	19. Little-San Gabriel conf. to Little Rv at Cameron	0	30. Hempstead gage to Richmond gage	0
10. Lake Proctor	331	20. Highbank gage to Brazos-Navasota conf.	280	31. Richmond gage to Gulf of Mexico	0
\WaterSupply\Basin\ReturnFlows\RF-8x11-Permitted-BRA.mxd 10-25-12		21. Cameron gage to Brazos-Little conf.	0	32. Oyster Creek to Gulf of Mexico	0

4.3.3 Use of River Flow

Under its existing water rights, the BRA is able to impound river flows in its reservoirs and make a limited, non-priority use of flows at selected locations authorized in the Excess Flows Permit (COA 12-5166, as amended). Currently, NRG is the only customer that can use Excess Flows Permit diversions. Demands for other customers located downstream of a BRA reservoir(s) must be met by reservoir releases regardless of the quantity of flow in the river. Under this WMP, river flows may be diverted once environmental flow criteria have been met, so long as senior water rights are not impaired. The System Operation diversions in Tables 4.9a through 4.9i in reaches without reservoirs (indicated by black text) are all from river flows. Note that most of the diversions of river flows are expected to occur below the Hempstead gage.

Comparisons of statistics for the regulated flows from the nine Operational Demand Scenario modeling runs at the Brazos River at Glen Rose, Brazos River near Highbank, Brazos River at Richmond, Brazos River at Rosharon, Little River near Cameron, Yegua Creek near Somerville, and Navasota River near Easterly gages are included in Appendix G-4. Regulated flows are the actual river flows that would be measured by a stream gage. These statistics show how flows are expected to change given the assumptions used in the modeling.

4.3.4 Reservoir Drawdowns

Tables 4.10a through 4.10l contain statistics for reservoir elevations for each of the BRA System reservoirs for the nine Operational Demand Scenario modeling runs. Tables 4.10m through 4.10n show the same statistics, but for the total storage in the BRA System. These tables illustrate the changes in reservoir elevation and System storage given the different assumptions used in Scenarios 1 through 5. The differences in elevation between the return flow options (BRA's approach or the ED's approach) are the direct result of having lower levels of return flows in the model. Less water is available to fill reservoirs and more water must be used from the BRA System reservoirs to meet demands. With a few exceptions, there is very little difference in elevation in most reservoirs, with median storage about the same across all scenarios. In general, the most noticeable change is to the lowest reservoir elevations.

Over time, most reservoirs are expected to be drawn down more during dry periods because of increased demands. The exception is Lake Georgetown, which is a relatively small reservoir with a large demand that is supplemented by water pumped into the reservoir from Lake Stillhouse Hollow. Elevations in Lake Georgetown are governed by the operation of that pipeline. Lake Stillhouse Hollow shows the most increase in drawdown due to increased demands of all reservoirs, primarily because of the increased demand at Lake Georgetown. The other lakes in the Little River system, Lakes Belton and Granger, show some increased drawdown as well.

The proposed CPNPP expansion will increase demands from the Granbury-Possum Kingdom system. For the Operational Demand Scenario modeling in this Section 4.3, it was assumed that the expansion would require 90,152 acft/yr, with approximately 40.29% of that water returning to Lake Granbury, for a net demand of 53,827 acft/yr. This increased demand would be met from a combination of existing BRA water rights in Possum Kingdom and Granbury plus the additional authorizations provided by the proposed System Operation Permit. Scenarios with the CPNPP expansion (Scenarios 3 and 5) show some increased drawdown during dry periods at Possum Kingdom and Lake Granbury due to the significant increase in demand for the new generation units.

Elevations at Lake Proctor and Lake Limestone remain relatively constant over time because demands from these sources are not expected to increase significantly.

The modeling performed for Scenarios 1 through 5 assumes that demands are constant in each year of the simulation. However, during drought demands would be reduced in accordance with the BRA's Drought Contingency Plan (DCP). Because this study assumes higher demands during drought than would actually occur, impacts on reservoir drawdowns are conservative. The actual impacts would probably be less because of the implementation of the BRA's DCP.

Table 4.10a - Possum Kingdom Lake Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	986.1	983.1	977.9	977.1	975.2	981.0	977.2	971.9	961.4
5%	995.8	995.2	994.3	992.7	991.9	994.9	994.5	991.8	990.6
15%	998.5	998.5	998.3	996.6	996.3	998.4	998.1	996.3	996.0
30%	999.5	999.5	999.5	998.5	998.3	999.5	999.4	998.3	998.1
Median	1,000.0	1,000.0	1,000.0	999.6	999.6	1,000.0	1,000.0	999.6	999.5
70%	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
85%	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0
Max	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0

Table 4.10b - Lake Granbury Elevation Statistics
Values in ft-msl (BRA Datum)

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	685.1	684.2	681.2	680.4	678.1	683.5	681.3	679.4	677.9
5%	689.9	690.2	689.8	689.1	688.6	689.6	689.2	688.7	688.0
15%	691.7	691.7	691.6	690.9	690.9	691.6	691.4	690.8	690.7
30%	692.6	692.5	692.4	692.0	691.9	692.4	692.3	692.0	691.9
Median	693.0	693.0	693.0	693.0	693.0	693.0	692.9	693.0	693.0
70%	693.0	693.0	693.0	693.0	693.0	693.0	693.0	693.0	693.0
85%	693.0	693.0	693.0	693.0	693.0	693.0	693.0	693.0	693.0
Max	693.0	693.0	693.0	693.0	693.0	693.0	693.0	693.0	693.0

Table 4.10c - Lake Whitney Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0	520.0
5%	521.7	523.4	523.2	523.3	523.2	523.3	522.7	523.0	522.5
15%	523.1	524.8	524.9	524.7	524.6	524.9	524.6	524.7	524.4
30%	524.7	525.6	525.9	525.6	525.6	525.7	525.7	525.7	525.6
Median	527.3	527.3	527.2	527.0	526.8	527.1	527.0	526.9	526.8
70%	530.7	531.2	530.9	530.7	530.6	530.8	530.7	530.5	530.3
85%	533.0	533.0	533.0	533.0	533.0	533.0	533.0	533.0	533.0
Max	533.0	533.0	533.0	533.0	533.0	533.0	533.0	533.0	533.0

Table 4.10d - Lake Aquilla Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	527.5	522.8	522.3	522.8	522.3	512.2	505.4	509.9	505.4
5%	531.6	529.5	529.2	529.5	529.2	526.6	525.7	526.1	525.7
15%	534.3	533.7	533.5	533.7	533.5	532.8	532.4	532.7	532.4
30%	535.6	535.1	535.1	535.1	535.1	534.6	534.5	534.6	534.5
Median	536.9	536.7	536.6	536.7	536.6	536.3	536.2	536.3	536.2
70%	537.5	537.5	537.5	537.5	537.5	537.5	537.5	537.5	537.5
85%	537.5	537.5	537.5	537.5	537.5	537.5	537.5	537.5	537.5
Max	537.5	537.5	537.5	537.5	537.5	537.5	537.5	537.5	537.5

Table 4.10e - Lake Proctor Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	1,151.5	1,151.0	1,151.0	1,151.0	1,151.0	1,150.1	1,150.1	1,150.1	1,150.1
5%	1,156.0	1,155.8	1,155.7	1,155.8	1,155.7	1,155.4	1,155.4	1,155.4	1,155.4
15%	1,158.0	1,158.1	1,158.0	1,158.1	1,158.0	1,157.8	1,157.8	1,157.8	1,157.8
30%	1,159.9	1,159.8	1,159.8	1,159.8	1,159.8	1,159.7	1,159.7	1,159.7	1,159.7
Median	1,161.1	1,161.2	1,161.1	1,161.2	1,161.1	1,161.1	1,161.1	1,161.1	1,161.1
70%	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0
85%	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0
Max	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0	1,162.0

Table 4.10f - Lake Belton Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	561.9	567.3	565.9	567.9	566.1	549.4	544.0	549.3	544.7
5%	572.8	577.3	575.6	577.2	576.1	563.8	560.8	563.9	561.5
15%	587.3	586.0	585.1	587.1	586.1	583.3	582.0	582.9	581.7
30%	591.0	590.4	590.1	590.9	590.6	588.8	588.2	588.8	588.1
Median	593.2	592.9	592.7	593.1	592.9	591.9	591.8	591.9	591.8
70%	594.0	594.0	594.0	594.0	594.0	594.0	593.9	594.0	593.9
85%	594.0	594.0	594.0	594.0	594.0	594.0	594.0	594.0	594.0
Max	594.0	594.0	594.0	594.0	594.0	594.0	594.0	594.0	594.0

Table 4.10g - Lake Stillhouse Hollow Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	572.2	565.9	559.5	567.2	561.7	559.2	558.9	558.8	557.7
5%	601.4	589.2	585.5	589.5	586.5	579.6	580.1	578.3	578.6
15%	612.5	608.3	607.4	609.2	608.4	599.0	600.9	598.7	600.8
30%	618.8	616.3	615.5	616.8	616.3	612.7	612.3	612.8	612.3
Median	621.8	620.5	620.4	620.9	620.8	619.0	618.9	619.0	618.8
70%	622.0	622.0	622.0	622.0	622.0	621.9	621.8	621.8	621.9
85%	622.0	622.0	622.0	622.0	622.0	622.0	622.0	622.0	622.0
Max	622.0	622.0	622.0	622.0	622.0	622.0	622.0	622.0	622.0

Table 4.10h - Lake Georgetown Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	770.8	771.4	768.9	769.7	769.6	755.3	746.2	731.7	725.1
5%	774.5	776.0	775.5	775.6	776.1	781.5	781.5	780.9	780.3
15%	776.6	778.5	778.1	778.3	778.3	783.6	783.6	783.5	782.7
30%	778.9	781.1	781.0	781.1	781.1	785.3	785.2	785.0	784.6
Median	783.3	783.4	783.4	783.4	783.4	787.4	787.4	787.0	786.6
70%	788.8	787.6	787.5	787.6	787.5	790.3	790.2	790.0	790.0
85%	791.0	791.0	791.0	791.0	791.0	791.0	791.0	791.0	791.0
Max	791.0	791.0	791.0	791.0	791.0	791.0	791.0	791.0	791.0

Table 4.10i - Lake Granger Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	488.7	492.0	489.5	490.8	489.5	483.0	481.5	486.7	485.5
5%	496.1	497.5	497.3	497.5	495.7	497.8	496.4	498.4	497.6
15%	501.7	501.9	501.1	502.1	501.3	501.0	500.3	501.2	501.1
30%	503.4	503.2	503.1	503.4	503.2	503.0	502.6	503.2	503.2
Median	504.0	504.0	503.9	504.0	503.9	504.0	504.0	504.0	504.0
70%	504.0	504.0	504.0	504.0	504.0	504.0	504.0	504.0	504.0
85%	504.0	504.0	504.0	504.0	504.0	504.0	504.0	504.0	504.0
Max	504.0	504.0	504.0	504.0	504.0	504.0	504.0	504.0	504.0

Table 4.10j - Lake Somerville Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	224.7	228.0	227.8	228.6	224.9	227.6	226.1	225.1	225.7
5%	230.2	232.2	231.4	232.5	231.1	232.3	231.8	232.3	231.1
15%	235.9	235.9	235.3	236.2	235.9	235.3	235.0	235.2	234.4
30%	237.2	237.1	237.0	237.2	237.1	237.0	236.8	236.9	236.7
Median	237.9	237.8	237.8	237.9	237.9	237.6	237.5	237.6	237.5
70%	238.0	238.0	238.0	238.0	238.0	238.0	238.0	238.0	238.0
85%	238.0	238.0	238.0	238.0	238.0	238.0	238.0	238.0	238.0
Max	238.0	238.0	238.0	238.0	238.0	238.0	238.0	238.0	238.0

Table 4.10k - Lake Limestone Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	337.5	336.2	338.1	334.1	338.1	336.6	333.4	336.9	333.5
5%	349.6	349.7	349.5	349.6	349.5	349.6	348.8	349.6	348.8
15%	356.9	357.2	356.8	357.2	356.8	357.0	356.6	357.1	356.6
30%	359.9	360.0	359.9	360.0	359.9	359.9	359.8	359.9	359.8
Median	361.5	361.6	361.5	361.6	361.5	361.6	361.5	361.6	361.5
70%	362.9	362.9	362.9	362.9	362.9	363.0	362.9	363.0	362.9
85%	363.0	363.0	363.0	363.0	363.0	363.0	363.0	363.0	363.0
Max	363.0	363.0	363.0	363.0	363.0	363.0	363.0	363.0	363.0

Table 4.10l - Allens Creek Reservoir Elevation Statistics
Values in ft-msl

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 All Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min						100.5	99.1	97.7	82.0
5%						110.6	110.0	110.8	109.1
15%						117.5	116.8	117.3	116.5
30%						119.9	119.7	119.8	119.6
Median						121.0	121.0	121.0	121.0
70%						121.0	121.0	121.0	121.0
85%						121.0	121.0	121.0	121.0
Max						121.0	121.0	121.0	121.0

Table 4.10m - Total System Storage Statistics
Values in acft

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	825,031	777,621	686,778	735,950	659,578	543,982	478,780	492,977	410,076
5%	1,240,330	1,173,395	1,118,375	1,165,617	1,111,134	981,188	917,585	954,681	896,091
15%	1,571,148	1,478,650	1,450,686	1,452,498	1,431,922	1,353,264	1,320,919	1,318,007	1,287,311
30%	1,718,314	1,634,119	1,615,060	1,626,669	1,614,622	1,544,384	1,530,811	1,529,932	1,507,060
Median	1,806,259	1,722,368	1,719,317	1,716,674	1,711,639	1,658,560	1,648,048	1,644,004	1,634,065
70%	1,850,524	1,777,279	1,775,436	1,772,684	1,770,564	1,729,051	1,728,031	1,723,183	1,723,590
85%	1,870,174	1,798,703	1,798,408	1,796,296	1,795,985	1,757,034	1,756,881	1,755,260	1,754,872
Max	1,873,399	1,801,890	1,801,890	1,801,890	1,801,890	1,759,565	1,759,565	1,759,565	1,759,565

Table 4.10n - Total System Storage Statistics
Values as percent of Maximum Storage

Statistic	Scenario 1 - Current	Scenario 2 - 2025 All Return Flow	Scenario 2 - 2025 BRA Return Flow	Scenario 3 - 2025 w CPNPP All Return Flow	Scenario 3 - 2025 w CPNPP BRA Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 4 - 2060 BRA Return Flow	Scenario 5 - 2060 w CPNPP All Return Flow	Scenario 5 - 2060 w CPNPP BRA Return Flow
Min	44%	43%	38%	41%	37%	31%	27%	28%	23%
5%	66%	65%	62%	65%	62%	56%	52%	54%	51%
15%	84%	82%	81%	81%	79%	77%	75%	75%	73%
30%	92%	91%	90%	90%	90%	88%	87%	87%	86%
Median	96%	96%	95%	95%	95%	94%	94%	93%	93%
70%	99%	99%	99%	98%	98%	98%	98%	98%	98%
85%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Max	100%	100%	100%	100%	100%	100%	100%	100%	100%

4.3.5 System Order Modification

The System Order provisions are included in the water rights for the eleven existing reservoirs in the BRA System. The System Order has two main components. First, it allows the BRA to divert more than the authorized priority diversion from a given reservoir, limited to certain maximum amounts specified in each water right. Table 2.2 shows these limits for each reservoir. The total diversion from the BRA System cannot exceed the total priority diversions of the BRA System, or 661,901 acft/yr. Second, the System Order stipulates that releases for the purpose of system operations are limited to periods when a reservoir is more than 30 percent full. Once a reservoir drops below 30 percent, releases for system operations cannot occur until all other reservoirs in the BRA System are also below 30 percent. This limitation was designed to protect water supply for local uses. However, for some of the smaller reservoirs that are being fully used locally, this limitation could negatively impact water supply for local use.

For this WMP, the BRA proposes the following modifications to the System Order:

- *Lake Proctor.* Lake Proctor currently functions as a stand-alone reservoir and will seldom be used for system operation. Demands from the reservoir (lakeside and immediately downstream) are near the available yield of the reservoir, and there are no other alternative BRA sources available in the area. Lake Proctor is also located relatively far from the next downstream reservoir, Lake Belton. There are significant channel losses between Lake Proctor and Lake Belton. Since water supply releases from Lake Proctor are expected to be limited to the local irrigation customers immediately downstream (except for perhaps emergency or other unique situations), the storage in Lake Proctor is not relevant to use under the System Order in most situations. Other reservoirs should be allowed to use water under the System Order regardless of the storage in Lake Proctor.
- *Lake Aquilla.* Lake Aquilla is a relatively small reservoir, and it is seldom used for downstream water supply releases. Like Lake Proctor, the local area demand from Lake Aquilla is close to the available supply from the reservoir, and there currently is no alternative BRA supply for Lake Aquilla customers. This may change in the

future if the conservation storage of the reservoir, currently under review by the BRA and USACE, is increased. However, during the period covered by this WMP, system releases from Lake Aquilla will only occur during emergency or other rare situations. Other reservoirs should be allowed to use water under the System Order regardless of the storage in Lake Aquilla.

- *Lake Georgetown.* Lake Georgetown is the smallest reservoir in the BRA System. It is fully used to supply customers in rapidly growing Williamson County. Currently, demands exceed the available supply of the reservoir, and these demands are expected to grow significantly in the future. Water supply in Lake Georgetown is supplemented by a pipeline, the WCRRWL, which connects Lake Stillhouse Hollow with Lake Georgetown. Operation of the pipeline is described in Section 4.2. Currently, the BRA makes System Order diversions from Lake Georgetown when the reservoir is relatively full. This helps prevent pumped water from spilling out of Lake Georgetown. Pumping from Lake Stillhouse Hollow begins as reservoir storage drops. Because storage in Lake Georgetown is impacted by pipeline operations and is used infrequently for meeting downstream water supply needs, other reservoirs should be allowed to use water under the System Order regardless of the storage in Lake Georgetown.
- *Lake Whitney.* The BRA coordinates releases from storage with hydropower generation as much as possible, but the storage available to the BRA in Lake Whitney (50,000 acft) is a relatively small part of this large reservoir. BRA's permitted storage is less than ten percent of the reservoir's capacity at its normal operating level. BRA storage could be fully depleted with the reservoir remaining over 90 percent full. In order to efficiently use this source the BRA desires to be able to fully utilize this storage for system use whenever possible. Local demands from Lake Whitney are small and can be met by releases from either Lake Granbury or Possum Kingdom Lake. Therefore, the BRA requests that System Order use be allowed when BRA storage in Lake Whitney is below 30 percent even if other reservoirs in the BRA System are not below 30 percent.

- *Lakes Possum Kingdom, Granbury, Belton, Stillhouse Hollow, Granger, Limestone, and Somerville.* Along with Lake Whitney, these reservoirs are used for system operation to meet downstream water supply needs. BRA requests no changes to the System Order for these reservoirs except that their use under the System Order be independent of the storage capacity in Lakes Aquilla, Proctor, and Georgetown as described above. In the unlikely event that authorized BRA storage capacity in these seven reservoirs and Lake Whitney reaches 30 percent, system operation releases from these reservoirs and Lake Whitney should be allowed to continue irrespective of the amount of water in storage in Lakes Aquilla, Proctor, and Georgetown.

4.4 Environmental Flows under the Proposed System Operation Permit

The WMP contains special conditions relative to environmental flows. In order to divert run-of-river flows or impound water under the System Operation Permit, certain conditions must be satisfied at gaged locations within the basin. The environmental flow conditions of the WMP <u>do not</u> restrict operations under the BRA's existing permits. The environmental flow special conditions are based upon environmental flow rules for the Brazos River basin adopted by TCEQ in accordance with Senate Bill 3 (SB3). The proposed System Operation Permit requires that these special conditions in the WMP be adjusted, if necessary, to be consistent with future changes to Brazos River basin environmental flow rules developed through the SB3 process.

Section 4.4.2 below documents and discusses the current environmental flows special conditions contained in the WMP.

4.4.1 Operating Guidelines to Manage Impacts on Reservoir Fisheries from Reservoir Level Fluctuations

In connection with the System Operation Permit, and based on their 2011 Memorandum of Understanding, the BRA and the TPWD jointly conducted a study to develop operating guidelines to manage the frequency and magnitude of reservoir level fluctuations to avoid or minimize impacts on fisheries. This study is included as Appendix G-5. The operating guideline developed based on that study is as follows:

If possible, no reservoir should be maintained continuously at an elevation below the threshold shown in Table 4.11 for more than three consecutive years. If the running monthly annual average elevation falls below the threshold for three consecutive years, consideration should be given to excluding the reservoir from downstream releases until such time as the running monthly annual average reservoir elevation meets or exceeds the threshold elevation.

Table 4.11 - Threshold Elevation by System Reservoir

Reservoir	TOC* (ft-msl)	Threshold Elevation (ft-msl)	Drawdown from TOC (ft)
Aquilla	538	536	-2
Belton	594	578	-16
Georgetown	791	787	-4
Granbury	693	690	-3
Granger	504	504	0
Limestone	363	358	-5
Possum Kingdom	999	995	-4
Proctor	1162	1158	-4
Somerville	238	236	-2
Stillhouse Hollow	622	610	-12
Whitney	533	N/A	N/A

*TOC = Top of Conservation Pool

The WMP stipulates that the operating guideline is subject to temporary suspension if necessary for water supply purposes. In Lake Whitney, the BRA is severely limited in its ability to have any significant impact on the total capacity of the reservoir because the BRA's water rights are less than 22% of the total conservation storage (approximately 2 ft. of elevation when the reservoir is full). Therefore, Lake Whitney is excluded from the operating guideline.

The guideline defined above is not intended to be an annual operating plan for the BRA System reservoirs. The guideline is intended to help minimize potential impacts to fisheries resulting from low reservoir levels. Additionally, the guideline will provide direction to TPWD fisheries managers on how the BRA can be anticipated to manage the reservoirs and allow TPWD to minimize or mitigate impacts to fisheries, or adjust its management and stocking strategies.

It is important to note that the operating guideline is only one of the many considerations that the BRA takes into account with regard to operation of the System reservoirs, and the guideline cannot be considered in isolation from other factors. Across all System reservoirs, extenuating circumstances (e.g., damage to gates, maintenance on structures, etc.) may necessitate an unanticipated or intentional drawdown of an individual reservoir or restrict the ability to utilize the reservoir as part of the System for an extended period of time. Additionally, in the event of an extended, multi-year drought, the operating guideline defined above may be difficult or impossible to implement.

4.4.2 Environmental Flows Special Conditions

The WMP contains environmental flow provisions that limit the ability to divert and impound water authorized under the proposed System Operation Permit. These environmental flow provisions cover base and subsistence flow conditions, as well as high flow pulses (HFPs). Environmental flow conditions applicable to this WMP are derived from SB3 rules adopted by TCEQ for environmental flows protection (TAC Title 30, Part 1, Chapter 298, Subchapter G, §§298.450, 298.455, 298.460, 298.465, 298.470, 298.475, 298.480, 298.485, 298.490 (adopted Feb. 12, 2014)). Future changes to the measurement points, flow levels, hydrologic conditions and other environmental flow conditions in this WMP may be necessary to be consistent with future TCEQ amendments to adopted environmental flow rules for the Brazos River basin.

4.4.2.1 Measurement Point (MP) Locations and Flow Levels

Section 298.450 of Title 30 of the Texas Administrative Code contains instream flow standards for subsistence flows, base flows and HFPs that are included at each of the WMP measurement point locations within the basin.

Subsistence flow conditions apply at all times.

For the purposes of instream flow standards for base flows and HFPs, seasons are defined as:

Winter - November through February
Spring - March through June
Summer - July through October

Within each season, base flows and HFPs vary based on the hydrologic condition (Wet, Dry, or Average). The method for determining hydrologic condition follows the method outlined in Section 298.470 of Title 30 of the Texas Administrative Code. Hydrologic condition is a trigger that determines whether Dry, Average or Wet conditions are the applicable base or HFP requirements for each of the eleven measurement points. The hydrologic condition is defined by the Palmer Hydrological Drought Index (PHDI). The hydrologic condition is determined on the first day of each season based upon the PHDI values for applicable Climatic Divisions for the most recent month reported by the National Climatic Data Center (NCDC). Data for each division can be accessed from the NCDC website or directly from its FTP site (links current as of March 24, 2014):

- http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers.php
- ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv

The hydrologic condition will be determined for each measurement point based upon its location within one of three geographic areas within the Brazos River basin and based upon the criteria set forth in Table 4.12, which are derived directly from Section 298.470(c). The geographic area of each measurement point is determined based upon its location. A composite PHDI for each geographic area is calculated from the PHDI values for each Climatic Division according to the percentage area of each division included in the geographic area (Table 4.13); percentage area values in Table 4.13 are derived directly from Section 298.470(b). The calculated composite PHDI is compared to the criteria in Table 4.12 to determine whether a Dry, Average or Wet hydrologic condition is active at each measurement point.

Table 4.12 – PHDI criteria for calculating Hydrologic Conditions (30 TAC § 298.470(c))				
SB3 GEOGRAPHIC AREA	**AREA DESCRIPTION**	**DRY**	**AVERAGE**	**WET**
UPPER BASIN	Draining into Possum Kingdom Lake	Less than -1.78	-1.78 to 2.18	Greater than 2.18
MIDDLE BASIN	D/S of Possum Kingdom dam, U/S of Lake Whitney dam	Less than -1.95	-1.95 to 2.39	Greater than 2.39
LOWER BASIN	D/S of Lake Whitney dam	Less than -1.73	-1.73 to 2.13	Greater than 2.13
U/S = upstream; D/S = downstream				

Table 4.13 – Percentage of Climatic Division within each Geographic Area (30 TAC § 298.470(b))				
CLIMATIC DIVISION	**NCDC CLIMATIC DIVISION CODE**	**PERCENTAGE LOCATED IN UPPER BASIN**	**PERCENTAGE LOCATED IN MIDDLE BASIN**	**PERCENTAGE LOCATED IN LOWER BASIN**
High Plains	4101	2.7%	N/A	N/A
Low Rolling Plains	4102	64.7%	N/A	N/A
North Central	4103	32.6%	100%	61.9%
East Texas	4104	N/A	N/A	14.7%
Edwards Plateau	4106	N/A	N/A	5.7%
South Central	4107	N/A	N/A	13.2%
Upper Coast	4108	N/A	N/A	4.5%
N/A = not applicable				

The final hydrologic condition is difficult to set until final values are available. Final approved PHDI values for a month are typically available at the NCDC links above near the middle of each month; therefore, final hydrologic condition for a season will be determined after the season is underway. On the first day of the season, an interim hydrologic condition will be determined and will be used for BRA operations until approved PHDI values are available from NCDC and the final hydrologic condition for the season is determined.

To determine the interim hydrologic condition, interim PHDI values will be used. The interim PHDI values are published by the NCDC each week, and NCDC calculates these values using the most current available source data occurring in the month, supplemented with normalized historical data for the remainder of the month. Interim PHDI value data for each division can be accessed from the NCDC website (links current as of April 7, 2014):

- http://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers.php

- http://www1.ncdc.noaa.gov/pub/data/cmb/drought/weekly-palmers/

The environmental flow special conditions applicable to this WMP are included in Tables 4.14(a) through 4.14(l).

Table 4.14(a) - United States Geological Survey Gage 08088000, Brazos River near South Bend (30 TAC §298.480(a)(6))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	1 cfs	Dry	36 cfs	N/A	N/A	N/A
		Average	73 cfs			
		Wet	120 cfs			
Spring	1 cfs	Dry	29 cfs	1 per season Trigger: 1,260 cfs Volume: 7,280 af Duration: 10 days	2 per season Trigger: 1,260 cfs Volume: 7,280 af Duration: 10 days	1 per season Trigger: 2,480 cfs Volume: 15,700 af Duration: 13 days
		Average	60 cfs			
		Wet	100 cfs			
Summer	1 cfs	Dry	16 cfs	1 per season Trigger: 580 cfs Volume: 3,140 af Duration: 8 days	2 per season Trigger: 580 cfs Volume: 3,140 af Duration: 8 days	1 per season Trigger: 1,180 cfs Volume: 7,050 af Duration: 11 days
		Average	46 cfs			
		Wet	95 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(b) - United States Geological Survey Gage 08089000, Brazos River near Palo Pinto (30 TAC §298.480(a)(7))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	17 cfs	Dry	40 cfs	2 per season Trigger: 850 cfs Volume: 3,690 af Duration: 5 days	4 per season Trigger: 850 cfs Volume: 3,690 af Duration: 5 days 2 per season Trigger: 1,390 cfs Volume: 7,180 af Duration: 7 days	4 per season Trigger: 850 cfs Volume: 3,690 af Duration: 5 days 3 per season Trigger: 1,390 cfs Volume: 7,180 af Duration: 7 days
		Average	61 cfs			
		Wet	100 cfs			
Spring	17 cfs	Dry	39 cfs	2 per season Trigger: 1,400 cfs Volume: 6,600 af Duration: 6 days	4 per season Trigger: 1,400 cfs Volume: 6,600 af Duration: 6 days 2 per season Trigger: 3,370 cfs Volume: 20,200 af Duration: 10 days	4 per season Trigger: 1,400 cfs Volume: 6,600 af Duration: 6 days 3 per season Trigger: 3,370 cfs Volume: 20,200 af Duration: 10 days
		Average	75 cfs			
		Wet	120 cfs			
Summer	17 cfs	Dry	40 cfs	2 per season Trigger: 1,230 cfs Volume: 5,920 af Duration: 6 days	4 per season Trigger: 1,230 cfs Volume: 5,920 af Duration: 6 days 2 per season Trigger: 2,260 cfs Volume: 13,000 af Duration: 9 days	4 per season Trigger: 1,230 cfs Volume: 5,920 af Duration: 6 days 3 per season Trigger: 2,260 cfs Volume: 13,000 af Duration: 9 days
		Average	72 cfs			
		Wet	120 cfs			
cfs = cubic feet per second; af = acre-feet; N/A = not applicable						

Table 4.14(c) - United States Geological Survey Gage 08089100, Brazos River near Glen Rose (30 TAC §298.480(a)(8))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	16 cfs	Dry	42 cfs	2 per season Trigger: 930 cfs Volume: 5,400 af Duration: 8 days	4 per season Trigger: 930 cfs Volume: 5,400 af Duration: 8 days 2 per season Trigger: 1,700 cfs Volume: 10,800 af Duration: 10 days	4 per season Trigger: 930 cfs Volume: 5,400 af Duration: 8 days 3 per season Trigger: 1,700 cfs Volume: 10,800 af Duration: 10 days
		Average	77 cfs			
		Wet	160 cfs			
Spring	16 cfs	Dry	47 cfs	2 per season Trigger: 2,350 cfs Volume: 14,300 af Duration: 10 days	4 per season Trigger: 2,350 cfs Volume: 14,300 af Duration: 10 days 2 per season Trigger: 6,480 cfs Volume: 46,700 af Duration: 14 days	4 per season Trigger: 2,350 cfs Volume: 14,300 af Duration: 10 days 3 per season Trigger: 6,480 cfs Volume: 46,700 af Duration: 14 days
		Average	92 cfs			
		Wet	170 cfs			
Summer	16 cfs	Dry	37 cfs	2 per season Trigger: 1,320 cfs Volume: 7,830 af Duration: 8 days	4 per season Trigger: 1,320 cfs Volume: 7,830 af Duration: 8 days 2 per season Trigger: 3,090 cfs Volume: 21,200 af Duration: 12 days	4 per season Trigger: 1,320 cfs Volume: 7,830 af Duration: 8 days 3 per season Trigger: 3,090 cfs Volume: 21,200 af Duration: 12 days
		Average	70 cfs			
		Wet	160 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(d) - United States Geological Survey Gage 08096500, Brazos River near Waco (30 TAC §298.480(a)(10))						
Season	**Sub-sistence**	**Hydrologic Condition**	**Base**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	56 cfs	Dry	120 cfs	1 per season Trigger: 2,320 cfs Volume: 12,400 af Duration: 7 days	3 per season Trigger: 2,320 cfs Volume: 12,400 af Duration: 7 days	2 per season Trigger: 4,180 cfs Volume: 25,700 af Duration: 9 days
		Average	210 cfs			
		Wet	480 cfs			
Spring	56 cfs	Dry	150 cfs	1 per season Trigger: 5,330 cfs Volume: 32,700 af Duration: 10 days	3 per season Trigger: 5,330 cfs Volume: 32,700 af Duration: 10 days	2 per season Trigger: 13,600 cfs Volume: 102,000 af Duration: 14 days
		Average	270 cfs			
		Wet	690 cfs			
Summer	56 cfs	Dry	140 cfs	1 per season Trigger: 1,980 cfs Volume: 10,500 af Duration: 7 days	3 per season Trigger: 1,980 cfs Volume: 10,500 af Duration: 7 days	2 per season Trigger: 4,160 cfs Volume: 26,400 af Duration: 10 days
		Average	250 cfs			
		Wet	590 cfs			
cfs = cubic feet per second; af = acre-feet; N/A = not applicable						

Table 4.14(e) - United States Geological Survey Gage 08100500, Leon River near Gatesville (30 TAC §298.480(a)(11))						
Season	**Sub-sistence**	**Hydrologic Condition**	**Base**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	1cfs	Dry	9 cfs	N/A	N/A	2 per season Trigger: 100 cfs Volume: 540 af Duration: 6 days
		Average	20 cfs			
		Wet	52 cfs			
Spring	1 cfs	Dry	10 cfs	1 per season Trigger: 340 cfs Volume: 1,910 af Duration: 10 days	3 per season Trigger: 340 cfs Volume: 1,910 af Duration: 10 days	2 per season Trigger: 630 cfs Volume: 4,050 af Duration: 13 days
		Average	24 cfs			
		Wet	54 cfs			
Summer	1 cfs	Dry	4 cfs	1 per season Trigger: 58 cfs Volume: 220 af Duration: 4 days	3 per season Trigger: 58 cfs Volume: 220 af Duration: 4 days	2 per season Trigger: 140 cfs Volume: 600 af Duration: 6 days
		Average	12 cfs			
		Wet	27 cfs			
cfs = cubic feet per second; af = acre-feet; N/A = not applicable						

Table 4.14(f) - United States Geological Survey Gage 08104500, Little River near Little River (30 TAC §298.480(a)(13))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	55 cfs	Dry	82 cfs	1 per season Trigger: 520 cfs Volume: 2,350 af Duration: 5 days	3 per season Trigger: 520 cfs Volume: 2,350 af Duration: 5 days	2 per season Trigger: 1,600 cfs Volume: 11,800 af Duration: 11 days
		Average	110 cfs			
		Wet	190 cfs			
Spring	55 cfs	Dry	95 cfs	1 per season Trigger: 1,420 cfs Volume: 9,760 af Duration: 10 days	3 per season Trigger: 1,420 cfs Volume: 9,760 af Duration: 10 days	2 per season Trigger: 3,290 cfs Volume: 32,200 af Duration: 17 days
		Average	150 cfs			
		Wet	340 cfs			
Summer	55 cfs	Dry	84 cfs	1 per season Trigger: 430 cfs Volume: 1,560 af Duration: 4 days	3 per season Trigger: 430 cfs Volume: 1,560 af Duration: 4 days	2 per season Trigger: 1,060 cfs Volume: 5,890 af Duration: 8 days
		Average	120 cfs			
		Wet	200 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(g) - United States Geological Survey Gage 08106500, Little River near Cameron (30 TAC §298.480(a)(14))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	32 cfs	Dry	110 cfs	1 per season Trigger: 1,080 cfs Volume: 6,680 af Duration: 8 days	3 per season Trigger: 1,080 cfs Volume: 6,680 af Duration: 8 days	2 per season Trigger: 2,140 cfs Volume: 14,900 af Duration: 10 days
		Average	190 cfs			
		Wet	460 cfs			
Spring	32 cfs	Dry	140 cfs	1 per season Trigger: 3,200 cfs Volume: 23,900 af Duration: 12 days	3 per season Trigger: 3,200 cfs Volume: 23,900 af Duration: 12 days	2 per season Trigger: 4,790 cfs Volume: 38,400 af Duration: 14 days
		Average	310 cfs			
		Wet	760 cfs			
Summer	32 cfs	Dry	97 cfs	1 per season Trigger: 560 cfs Volume: 2,860 af Duration: 6 days	3 per season Trigger: 560 cfs Volume: 2,860 af Duration: 6 days	2 per season Trigger: 990 cfs Volume: 5,550 af Duration: 8 days
		Average	160 cfs			
		Wet	330 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(h) - United States Geological Survey Gage 08108700, Brazos River at SH21 near Bryan (30 TAC §298.480(a)(15))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	300 cfs	Dry	540 cfs	1 per season Trigger: 3,230 cfs Volume: 21,100 af Duration: 7 days	3 per season Trigger: 3,320 cfs Volume: 21,100 af Duration: 7 days	2 per season Trigger: 5,570 cfs Volume: 41,900 af Duration: 10 days
		Average	860 cfs			
		Wet	1,760 cfs			
Spring	300 cfs	Dry	710 cfs	1 per season Trigger: 6,050 cfs Volume: 49,000 af Duration: 11 days	3 per season Trigger: 6,050 cfs Volume: 49,000 af Duration: 11 days	2 per season Trigger: 10,400 cfs Volume: 97,000 af Duration: 14 days
		Average	1,260 cfs			
		Wet	2,460 cfs			
Summer	300 cfs	Dry	630 cfs	1 per season Trigger: 2,060 cfs Volume: 12,700 af Duration: 7 days	3 per season Trigger: 2,060 cfs Volume: 12,700 af Duration: 7 days	2 per season Trigger: 2,990 cfs Volume: 20,100 af Duration: 8 days
		Average	920 cfs			
		Wet	1,470 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(i) - United States Geological Survey Gage 08110500, Navasota River near Easterly (30 TAC §298.480(a)(16))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	1 cfs	Dry	9 cfs	1 per season Trigger: 260 cfs Volume: 1,610 af Duration: 9 days	3 per season Trigger: 260 cfs Volume: 1,610 af Duration: 9 days	2 per season Trigger: 800 cfs Volume: 5,440 af Duration: 12 days
		Average	14 cfs			
		Wet	23 cfs			
Spring	1 cfs	Dry	10 cfs	1 per season Trigger: 720 cfs Volume: 4,590 af Duration: 11 days	3 per season Trigger: 720 cfs Volume: 4,590 af Duration: 11 days	2 per season Trigger: 1,340 cfs Volume: 8,990 af Duration: 13 days
		Average	19 cfs			
		Wet	29 cfs			
Summer	1 cfs	Dry	3 cfs	N/A	N/A	2 per season Trigger: 49 cfs Volume: 220 af Duration: 5 days
		Average	8 cfs			
		Wet	16 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(j) - United States Geological Survey Gage 08111500, Brazos River near Hempstead (30 TAC §298.480(a)(17))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	510 cfs	Dry	920 cfs	1 per season Trigger: 5,720 cfs Volume: 49,800 af Duration: 10 days	3 per season Trigger: 5,720 cfs Volume: 49,800 af Duration: 10 days	2 per season Trigger: 11,200 cfs Volume: 125,000 af Duration: 15 days
		Average	1,440 cfs			
		Wet	2,890 cfs			
Spring	510 cfs	Dry	1,130 cfs	1 per season Trigger: 8,530 cfs Volume: 85,000 af Duration: 13 days	3 per season Trigger: 8,530 cfs Volume: 85,000 af Duration: 13 days	2 per season Trigger: 16,800 cfs Volume: 219,000 af Duration: 19 days
		Average	1,900 cfs			
		Wet	3,440 cfs			
Summer	510 cfs	Dry	950 cfs	1 per season Trigger: 2,620 cfs Volume: 17,000 af Duration: 7 days	3 per season Trigger: 2,620 cfs Volume: 17,000 af Duration: 7 days	2 per season Trigger: 5,090 cfs Volume: 40,900 af Duration: 9 days
		Average	1,330 cfs			
		Wet	2,050 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

Table 4.14(k) - United States Geological Survey Gage 08114000, Brazos River near Richmond (30 TAC §298.480(a)(18))						
Season	**Sub-sistence**	**Hydrologic Condition**	**Base**	**Dry Condition Seasonal Pulse**	**Average Condition Seasonal Pulse**	**Wet Condition Seasonal Pulse**
Winter	550 cfs	Dry	990 cfs	1 per season Trigger: 6,410 cfs Volume: 60,600 af Duration: 11 days	3 per season Trigger: 6,410 cfs Volume: 60,600 af Duration: 11 days	2 per season Trigger: 12,400 cfs Volume: 150,000 af Duration: 16 days
		Average	1,650 cfs			
		Wet	3,310 cfs			
Spring	550 cfs	Dry	1,190 cfs	1 per season Trigger: 8,930 cfs Volume: 94,000 af Duration: 13 days	3 per season Trigger: 8,930 cfs Volume: 94,000 af Duration: 13 days	2 per season Trigger: 16,300 cfs Volume: 215,000 af Duration: 19 days
		Average	2,140 cfs			
		Wet	3,980 cfs			
Summer	550 cfs	Dry	930 cfs	1 per season Trigger: 2,460 cfs Volume: 16,400 af Duration: 6 days	3 per season Trigger: 2,460 cfs Volume: 16,400 af Duration: 6 days	2 per season Trigger: 5,430 cfs Volume: 46,300 af Duration: 10 days
		Average	1,330 cfs			
		Wet	2,190 cfs			
cfs = cubic feet per second; af = acre-feet; N/A = not applicable						

Table 4.14(l) - United States Geological Survey Gage 08116650, Brazos River near Rosharon (30 TAC §298.480(a)(19))

Season	Sub-sistence	Hydrologic Condition	Base	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	430 cfs	Dry	1,140 cfs	1 per season Trigger: 9,090 cfs Volume: 94,700 af Duration: 12 days	3 per season Trigger: 9,090 cfs Volume: 94,700 af Duration: 12 days	2 per season Trigger: 13,600 cfs Volume: 168,000 af Duration: 16 days
		Average	2,090 cfs			
		Wet	4,700 cfs			
Spring	430 cfs	Dry	1,250 cfs	1 per season Trigger: 6,580 cfs Volume: 58,500 af Duration: 10 days	3 per season Trigger: 6,580 cfs Volume: 58,500 af Duration: 10 days	2 per season Trigger: 14,200 cfs Volume: 184,000 af Duration: 18 days
		Average	2,570 cfs			
		Wet	4,740 cfs			
Summer	430 cfs	Dry	930 cfs	1 per season Trigger: 2,490 cfs Volume: 14,900 af Duration: 6 days	3 per season Trigger: 2,490 cfs Volume: 14,900 af Duration: 6 days	2 per season Trigger: 4,980 cfs Volume: 39,100 af Duration: 9 days
		Average	1,420 cfs			
		Wet	2,630 cfs			

cfs = cubic feet per second; af = acre-feet; N/A = not applicable

4.4.2.2 Applicable Measurement Points for Reaches

Environmental flow conditions applicable to a diversion are determined based upon the reach in which the diversion is located. The applicable measurement point for each reach within the WMP area is identified in Table 4.15. Hydrologic condition (see Section 4.4.2.1) is determined for each reach based upon the SB3 Geographic Area in Table 4.15. The Segment ID references are provided for convenience in relating reaches, applicable measurement points and maximum diversion rates (see Section 4.4.4.2).

For diversions located upstream of the applicable measurement point gage, the daily maximum allowable System Operation Permit run-of-river diversion amount will be limited such that the daily flow at the measurement point gage is not reduced below the applicable environmental flow standards.

For diversions located downstream of a measurement point, the environmental flow requirement will be calculated by adding the aggregated downstream System Operation Permit diversion rate to the applicable environmental flow standard at the corresponding measurement point gage.

The maximum allowable System Operation Permit diversion amount within a reach applies to the aggregate of all diversions in the reach. An allowable System Operation Permit diversion, whether upstream or downstream of the reach's applicable measurement point, will not reduce flow below the environmental flow standard at a point immediately below BRA's point of diversion; additionally, it will not exceed the diversion rate provisions set forth in Section 4.4.4.2 below.

The Possum Kingdom and Lake Whitney dams are the dividing lines between the Upper and Middle Basins and the Middle and Lower Basins, respectively, as those are delineated under TCEQ's adopted SB3 rules for the Brazos basin. However, the primary impact on instream flows is downstream of these reservoirs. Thus, passage of inflows through the dams will be governed by the measurement point applicable to the reach immediately downstream of each respective dam.

Lakeside diversion of inflows under the System Operation Permit occurring within Possum Kingdom Lake or within Lake Whitney will be according to the applicable SB3 measurement point that lies upstream of each respective lake.

Table 4.15 WMP Reaches with Applicable SB3 Measurement Points

Reach	Applicable SB3 Measurement Point (MP)	Segment ID[+]	SB3 Geographic Area
Possum Kingdom Lake*	For Diversions within Possum Kingdom - Brazos River near South Bend; For Flows passing through Possum Kingdom Lake – Brazos River near Palo Pinto	Possum Kingdom Lake	Upper Basin
Possum Kingdom dam to Palo Pinto gage	Brazos River near Palo Pinto	A	Middle Basin
Palo Pinto gage to Dennis gage*	Brazos River near Palo Pinto	A	Middle Basin
Dennis gage to Lake Granbury dam*	For Diversions above and within Lake Granbury - Brazos River near Palo Pinto; For Flows passing through Lake Granbury – Brazos River near Glen Rose	A, Lake Granbury	Middle Basin
Lake Granbury dam to Glen Rose gage	Brazos River near Glen Rose	B	Middle Basin
Glen Rose gage to Lake Whitney dam*	For Diversions above and within Lake Whitney - Brazos River near Glen Rose; For Flows passing through Lake Whitney – Brazos River near Waco	B, Lake Whitney	Middle Basin
Lake Whitney dam to Aquilla Creek/Brazos confluence	Brazos River near Waco	C	Lower Basin
Lake Aquilla	Brazos River near Waco	AA	Lower Basin
Lake Aquilla dam to Aquilla Creek gage	Brazos River near Waco	Lake Aquilla	Lower Basin
Aquilla Creek gage to Aquilla Creek/Brazos confluence	Brazos River near Waco	AA	Lower Basin
Aquilla Creek/ Brazos confluence to Highbank gage*	Brazos River near Waco	C	Lower Basin
Lake Proctor	Leon River at Gatesville	Lake Proctor	Lower Basin
Lake Proctor dam to Leon Rv at Gatesville gage	Leon River at Gatesville	LA	Lower Basin
Leon Rv at Gatesville to Lake Belton dam*	For Diversions above and within Belton - Leon River at Gatesville; For Flows passing through Lake Belton – Little River near Little River	Lake Belton	Lower Basin
Lake Belton dam to Leon Rv nr Belton gage	Little River near Little River	LR	Lower Basin
Leon Rv nr Belton gage to Little River gage	Little River near Little River	LR	Lower Basin
Lake Stillhouse Hollow	Little River near Little River	Lake Stillhouse Hollow	Lower Basin
Lake Stillhouse Hollow Dam to Lampasas Rv nr Belton gage	Little River near Little River	LP	Lower Basin
Lampasas Rv nr Belton gage to Little River gage	Little River near Little River	LP	Lower Basin
Little River to Little/San Gabriel confluence	Little River near Cameron	LC	Lower Basin
Lake Georgetown	Little River near Cameron	Lake Georgetown	Lower Basin

Table 4.15 WMP Reaches with Applicable SB3 Measurement Points			
Reach	**Applicable SB3 Measurement Point (MP)**	**Segment ID[+]**	**SB3 Geographic Area**
Lake Georgetown dam to N San Gabriel gage	Little River near Cameron	GA	Lower Basin
N San Gabriel gage to Lake Granger dam	Little River near Cameron	Lake Granger	Lower Basin
Lake Granger dam to Laneport Gage	Little River near Cameron	GC	Lower Basin
Laneport Gage to Little/San Gabriel confluence	Little River near Cameron	GC	Lower Basin
Little/San Gabriel confluence to Little Rv at Cameron gage	Little River near Cameron	LC	Lower Basin
Cameron gage to Brazos/Little confluence*	Little River near Cameron	LD	Lower Basin
Highbank gage to Brazos/Little confluence	Brazos River at SH21 near Bryan	D	Lower Basin
Brazos/Little confluence to Bryan gage	Brazos River at SH21 near Bryan	D	Lower Basin
Bryan gage to Brazos/Yegua confluence	Brazos River near Hempstead	E	Lower Basin
Lake Somerville	Brazos River near Hempstead	Lake Somerville	Lower Basin
Lake Somerville dam to Yegua gage	Brazos River near Hempstead	YA	Lower Basin
Yegua gage to Brazos/Yegua confluence	Brazos River near Hempstead	YB	Lower Basin
Brazos/Yegua confluence to Brazos/Navasota confluence	Brazos River near Hempstead	E	Lower Basin
Lake Limestone	Navasota near Easterly	Lake Limestone	Lower Basin
Lake Limestone dam to Easterly gage	Navasota near Easterly	NA	Lower Basin
Easterly gage to Brazos/Navasota confluence*	Navasota near Easterly	NB	Lower Basin
Brazos/Navasota confluence to Hempstead gage	Brazos River near Hempstead	E	Lower Basin
Hempstead gage to Richmond gage	Brazos River near Richmond	F	Lower Basin
Richmond gage to Gulf of Mexico*	Brazos River near Rosharon	G and H	Lower Basin
* - Reach located downstream of applicable measurement point or measurement point is within reach. [+] - Segments do not include lake reaches			

4.4.3 Operational Considerations Related to Environmental Flows

The WMP special conditions related to environmental flows are based upon adopted TCEQ rules (TAC Title 30, Part 1, Chapter 298, Subchapter G, §§298.450, 298.455, 298.460, 298.465, 298.470, 298.475, 298.480, 298.485, 298.490 (adopted Feb. 12, 2014)), and are applicable at all times at MP locations identified above in Section 4.4.2.1.

Storage and diversion under the proposed System Operation Permit is contingent upon satisfying flow criteria for subsistence, base flow and high flow pulse levels at the MP applicable to the storage or diversion location (see Table 4.15 above). Related discussion is provided in Appendix G-6.

Depending on the hydrologic condition (Wet, Average or Dry as defined above in Section 4.4.2.1), under base flow conditions storage of water or the diversion and use of water authorized by the proposed System Operation Permit is authorized only when streamflow at the applicable flow gaging station MP exceeds the applicable flow standard for base flow. Storage or diversion and use of water is also authorized by the proposed System Operation Permit during subsistence flow conditions when flow is above the subsistence flow standard and below the applicable Dry base flow standard. Under base flow conditions, the measured flow amount at the applicable MP above the base flow standard may be diverted.

Under subsistence flow conditions, 50% of the measured flow amount at the applicable MP above the subsistence flow standard may be diverted.

Special conditions related to HFPs are also included in the WMP. HFP requirements do not apply when water is being impounded in a reservoir to refill storage that was originally depleted under the reservoir's individual water right or the System Order. HFP criteria are also not applicable when run-of-river diversion rates are lower than the diversion rate trigger levels (DRTLs) discussed below in Section 4.4.4.1. Storage and diversion of an HFP is contingent upon achieving HFP criteria at the MP applicable to the storage or diversion location.

The Accounting Plan (Section 5) includes procedures to track when water in a reservoir is being impounded under the System Operation Permit or under existing BRA water rights or the System Order.

An HFP is initiated when flows are greater than the pulse trigger flow. An HFP is terminated when either the volume amount has passed the applicable measurement point or the duration time has passed since the high flow pulse trigger level was initiated. Once an HFP is terminated, a succeeding pulse occurs any time the pulse trigger level is exceeded during or immediately following a succeeding storm event that creates a high flow pulse event at the applicable MP.

Water diverted under the proposed System Operation Permit should not prevent achievement of a seasonal schedule of individual HFPs. Tables 4.14a through 4.14k above define the pulse flow criteria required at each of the MPs.

Diversion or storage of water is authorized during a pulse as long as flow is not reduced below the pulse trigger flow, or after the number of pulse events in that season exceeds the pulse frequency criteria. When an HFP is passed or provided for at one of the defined MPs, credit may be applied for meeting one seasonal HFP frequency requirement at that measurement location. Accounting for HFP events is maintained in the Accounting Plan and is further discussed in Section 5 of this Technical Report.

For pulses arising upstream of a System reservoir, the default operational procedure will be to collect the pulse in lake storage if allowed under existing operational guidelines that consider lake elevation, flood pool and other factors. During operations related to the System Operation Permit, a pulse can be passed downstream to meet HFP criteria as long as it does not affect the USACE water control plan (see Section 4.4.6). All releases for environmental flows will be coordinated with the USACE Reservoir Control Office to prevent flooding, as strictly specified in the USACE water control plan and manual of operation as prescribed by the Secretary of the Army and as required by law.

4.4.4 Run-of-river Diversion Rates

4.4.4.1 Diversion Rate Trigger Levels (DRTLs)

The System Operation Permit WMP includes stepped trigger levels, where diversions at rates below certain thresholds are not required to meet HFP standards, pursuant to Section 298.485 of Title 30 of the Texas Administrative Code. Subsistence and base flow standards always apply to diversions under the System Operation Permit.

Of all the diversions contracted by the BRA, very few are large enough to impact pulse flows. Most diversions served by the BRA are very small in comparison to pulse flows. Considering that these small diversions, even in aggregate, have limited possibility of impacting achievement of pulse flows, Diversion Rate Trigger Levels (DRTLs) have been developed to identify thresholds below which HFP criteria do not apply to proposed System Operation Permit run-of-river diversions. These DRTLs are based upon pulse levels at each MP (Tables 4.14a through 4.14(l)) and are defined as 20% of the pulse trigger flow (Table 4.16).

The DRTL applies only to diversion of natural flows and return flows under the proposed System Operation Permit. It does not apply to contract deliveries of water released from upstream BRA reservoirs for downstream use.

Diversion rate magnitude is used to determine whether diversion restrictions under HFP conditions are necessary. Diversion rate magnitude is determined by calculating the sum of all diversions under the proposed System Operation Permit that occur within reaches having a common applicable MP.

Diversion rate magnitude is compared to the appropriate DRTL based on hydrologic condition, season and HFP requirements at the MP applicable for the reach (Table 4.15).

When reach-aggregated diversion rate magnitude is smaller than the DRTL, then HFP conditions do not apply.

Table 4.16 – Diversion Rate Trigger Levels (DRTLs) for Measurement Points

Measurement Point	Diversion Rate Trigger Levels (cfs) based upon 20% of pulse trigger at applicable Measurement Point			
	Season	**Dry**	**Average**	**Wet**
Brazos River near Palo Pinto	Winter	170 cfs	170 cfs (4/season) 278 cfs (2/season)	170 cfs (4/season) 278 cfs (3/season)
	Spring	280 cfs	280 cfs (4/season) 674 cfs (2/season)	280 cfs (4/season) 674 cfs (3/season)
	Summer	246 cfs	246 cfs (4/season) 452 cfs (2/season)	246 cfs (4/season) 452 cfs (3/season)
Brazos River near Glen Rose	Winter	186 cfs	186 cfs (4/season) 340 cfs (2/season)	186 cfs (4/season) 340 cfs (3/season)
	Spring	470 cfs	470 cfs (4/season) 1,296 cfs (2/season)	470 cfs (4/season) 1,296 cfs (3/season)
	Summer	264 cfs	264 cfs (4/season) 618 cfs (2/season)	264 cfs (4/season) 618 cfs (3/season)
Brazos River at Waco	Winter	464 cfs	464 cfs	836 cfs
	Spring	1,066 cfs	1,066 cfs	2,720 cfs
	Summer	396 cfs	396 cfs	832 cfs
Leon River at Gatesville	Winter	N/A	N/A	20 cfs
	Spring	68 cfs	68 cfs	126 cfs
	Summer	11.6 cfs	11.6 cfs	28 cfs
Little River near Little River	Winter	104 cfs	104 cfs	320 cfs
	Spring	284 cfs	284 cfs	658 cfs
	Summer	86 cfs	86 cfs	212 cfs
Little River near Cameron	Winter	216 cfs	216 cfs	428 cfs
	Spring	640 cfs	640 cfs	958 cfs
	Summer	112 cfs	112 cfs	198 cfs
Brazos River at SH21 near Bryan	Winter	646 cfs	664 cfs	1,114 cfs
	Spring	1,210 cfs	1,210 cfs	2,080 cfs
	Summer	412 cfs	412 cfs	598 cfs
Navasota River near Easterly	Winter	52 cfs	52 cfs	160 cfs
	Spring	144 cfs	144 cfs	268 cfs
	Summer	N/A	N/A	9.8 cfs
Brazos River near Hempstead	Winter	1,144 cfs	1,144 cfs	2,240 cfs
	Spring	1,706 cfs	1,706 cfs	3,360 cfs
	Summer	524 cfs	524 cfs	1,018 cfs
Brazos River near Richmond	Winter	1,282 cfs	1,282 cfs	2,480 cfs
	Spring	1,786 cfs	1,786 cfs	3,260 cfs
	Summer	492 cfs	492 cfs	1,086 cfs
Brazos River near Rosharon	Winter	1,818 cfs	1,818 cfs	2,720 cfs
	Spring	1,316 cfs	1,316 cfs	2,840 cfs
	Summer	498 cfs	498 cfs	996 cfs

N/A = Not Applicable

4.4.4.2 Diversion Rates by River Segment

Maximum System Operation Permit run-of-river diversion rates are identified in this Section to satisfy the requirements of Section 295.6 of Title 30 of the Texas Administrative Code. These maximum diversion rates apply to run-of-river diversions, which are aggregated at a segment level. Diversions will be by portable pump, stationary pump or gravity flow.

The environmental flow provisions, discussed in Section 4.4.2 above, limit BRA's ability to divert and impound water that is authorized under the proposed System Operation Permit. Environmental flow provisions cover base and subsistence flow conditions as well as HFPs, and protections during base and subsistence conditions are in force at all times. Guidelines for protections during HFP events have been developed based on diversion rate and are discussed in Section 4.4.4.1 above.

Maximum diversion rates identified in this section only apply to run-of-river diversions and do not apply to lakeside diversions for purposes of the proposed System Operation Permit.

Diversions downstream of System reservoirs are limited by infrastructure and typically rely on a constant release from a water supply reservoir. Due to the travel time from a reservoir to a diversion facility, daily variations in the release rate are not a practical consideration. However, the maximum diversion rates on individual contracts will be evaluated on a case-by-case basis by BRA during contract negotiations. Considerations to set the maximum diversion rate for a particular contract may include the customer's pumping infrastructure, off-channel storage, BRA's ability to deliver requested amounts to the diversion location, and the level of environmental protection afforded to the river reach.

During base flow conditions, run-of-river diversions under the proposed System Operation Permit are required to meet environmental flow conditions (see Section 4.4.2.1). BRA will make an operational decision at the time of a customer's request to divert. If run-of-river water under the proposed System Operation Permit is not available to meet the customer's request, then a release from storage will be used to satisfy the request. In providing contract water under the System Operation Permit, BRA will consider that river flows need to meet applicable environmental flow standards.

During HFP conditions, run-of-river diversions under the proposed System Operation Permit are required to conform to HFP requirements (see Section 4.4.2.1). Maximum diversion rates are addressed according to DRTLs (see Section 4.4.4.1), where the aggregated diversion rates within a river segment may be required to reduce pumping rates during pulse conditions. In most cases, pumping will not need to be reduced because storage releases will be made to satisfy the request for water supply.

Existing BRA contracts with river diversions were aggregated in river segments as defined in Table 4.17. A screening level for river diversions was calculated from the annual amount of the contracts, based upon five times the average daily diversion rate. Two categorical exceptions were applied when calculating the average daily diversion rate for existing BRA contracts: (1) the permitted diversion rate was used if the entity has its own water rights, and (2) irrigation contract amounts were spread across three months rather than across the entire year. All screening value diversion rates were aggregated within each river segment.

Considering the diversion rate of BRA contracts downstream of reservoirs (calculated above), a maximum aggregated segment diversion rate is assigned. These maximum anticipated rates are compared to DRTLs described above in Section 4.4.4.1, and the lowest DRTL is used as the maximum diversion rate unless the calculated diversion rate for existing BRA contracts within a particular river segment was greater. These limits on maximum anticipated aggregated diversion rates will be applied during the period of this initial WMP and are in addition to the diversion limitations associated with HFPs. Maximum diversion rates for stream segments are summarized in Table 4.17.

Table 4.17 – Maximum Aggregated Diversion Rate for River Diversions in Each Segment		
Segment ID	**Description**	**Max. Div. Rate (cfs)**
A	Possum Kingdom dam to headwaters Lake Granbury	170
B	Lake Granbury dam to headwaters Whitney Lake	186
C + AA	Whitney Lake dam to Brazos River Highbank, and Aquilla Lake dam to confluence with Brazos River	396
D	Brazos River Highbank to Little River to Brazos SH21	412
E	Brazos River Bryan to Hempstead, and Yegua Creek from Lake Somerville dam to confluence with Brazos River	524
F	Brazos River Hempstead to Brazos River Richmond	1000
G + H	Brazos River Richmond to Brazos River Rosharon, and Brazos River Rosharon to the Gulf of Mexico	1980
NA + NB	Lake Limestone dam to Navasota River Easterly, and Navasota River Easterly to confluence with Brazos River	160
LA+LB	Leon River from Proctor Lake dam to headwaters Belton Lake	90
LR + LP	Leon River from Belton Lake dam to Little River Little River, and Lampasas River from Stillhouse Hollow dam to Little River Little River	86
LC + LD + GA + GB + GC	Little River Little River to Little River Cameron to confluence with Brazos River, and North Fork San Gabriel River from Lake Georgetown dam to confluence with San Gabriel River, and San Gabriel River downstream to confluence with Little River	180

4.4.5 Uncertainties in High Flow Pulse Events

Operations under the System Operation Permit and WMP consider uncertainty in forecasting and accounting of HFP events. Uncertainty arises primarily because of the timing and distribution of precipitation patterns across the basin.

At this time, forecasting of HFPs is not explicitly incorporated into operations related to the proposed System Operation Permit. Existing protocols related to dam operation, flood control, and BRA's existing water right permits continue to govern the storage and release of storm event flood flows. The default operational strategy for the proposed System Operation Permit (as for the BRA's existing permits) will be to capture storm pulses entering a reservoir. Storm pulses may be passed to achieve an HFP applicable to the MP for the downstream reach.

Short-term forecasting may be required to coordinate an operational release pattern with current downstream flow patterns. Past experience with managing releases will reduce the chance that an intended pulse achievement will fail to occur at the intended, nearest MP. The major factors of uncertainty that BRA will consider when managing releases are travel time, pulse attenuation, and intervening flows.

Evaluation of pulses occurring at the MPs indicates that the flow management under the proposed System Operation Permit can have little impact on achievement of Brazos River HFPs (see Appendix G-6). Forecasting of pulse events is not necessary or recommended at this time.

4.4.6 Consultation with Corps of Engineers

BRA has consulted with USACE on the federal reservoir projects to determine whether overbanking flows can be safely managed to maintain a sound ecological environment. Overbank flows are the high flow pulse events that are large enough to connect the floodplain to the main river channel and may pose significant risk for flood damages. The USACE Reservoir Control Office, Fort Worth District operates nine flood control projects in the Brazos River basin providing protection to the major industrial, commercial, agricultural and residential areas along the Brazos River and its major tributaries. These projects are Lake Whitney, Lake Aquilla, Lake Waco, Lake Proctor, Lake Belton, Lake Stillhouse Hollow, Lake Georgetown, Lake Granger, and Lake Somerville. Releases are coordinated among the various flood control projects in the Brazos River basin to prevent flooding, as strictly specified in a water control plan and manual of operation as prescribed by the Secretary of the Army and as required by law.

On September 27, 2012, BRA representatives met with the USACE, Fort Worth District to consult on issues related to reservoir operation activities to support overbanking flows. While expensive and detailed studies would be required to make changes to the USACE water control plan and rule curves for flood regulation, flexibility is available up to the maximum control discharge at various streamgage locations, as summarized in Table 4.18. The USACE Reservoir Control Office does not have the ability to exceed the control discharge except as related to dam safety or an emergency situation. Streamflow at a control location downstream of a flood control reservoir may sometimes exceed the maximum control discharge due to intervening runoff. The USACE water control plan aims at tailoring reservoir releases in consideration of downstream intervening streamflow to minimize chances that the maximum control discharge is exceeded because of reservoir operations. For example, if the streamflow at the Aquilla Creek above Aquilla gage is at 3,000 cfs, with nothing being released from Lake Aquilla, a release from Lake Aquilla will be delayed until the streamflow at the downstream control drops below 3,000 cfs at the gage. When the streamflow at the Aquilla Creek above Aquilla gage is below 3,000 cfs, the release from Lake Aquilla may be adjusted to keep the total flow at the downstream control at or below a maximum of 3,000 cfs.

Table 4.18 - USACE Control Discharge

USGS Gage No.	Description	Abbreviation (Shef Code)	Maximum Control Discharge[1] (cfs)
8093100	Brazos Rv nr Aquilla, TX	AQLT2	N/A
8093360	Aquilla Ck abv Aquilla, TX	AQIT2	3,000
	Brazos Rv. below Lake Whitney to Bosque Rv.	AQLT2 + AQIT2	25,000[2]
8096500	Brazos Rv at Waco, TX	WBAT2	60,000
8099500	Leon Rv nr Hasse, TX	HSLT2	2,000
8100500	Leon Rv at Gatesville, TX	GAST2	5,000
8104500	Little Rv nr Little River, TX	LRIT2	10,000
8104700	N Fk San Gabriel Rv nr Georgetown, TX	GERT2	6,000
8105700	San Gabriel Rv at Laneport, TX	GGRT2	6,000
8106500	Little Rv nr Cameron, TX	CMNT2	10,000
8110000	Yegua Ck nr Somerville, TX	SMVT2	N/A
8110100	Davidson Ck nr Lyons, TX	LYNT2	N/A
	Yegua Ck. below Lake Somerville to Brazos Rv.	SMVT2 + LYNT2	2,500[2]
8110200	Brazos River at Washington	N/A	60,000
8111500	Brazos Rv nr Hempstead, TX	HPDT2	60,000
8114000	Brazos Rv at Richmond, TX	RMOT2	60,000

1. Maximum Control Discharge rates in the table are sometimes exceeded simply due to intervening downstream runoff.
2. The sum of the two upstream gages discharge (cfs) must be less than the Maximum Control Discharge value at this location.

USACE recognizes the ecological importance of overbank flows for shaping the channel and providing connection between the river channel and aquatic habitats in the floodplain, and is committed to assist the BRA in meeting WMP requirements to the extent possible.

4.4.7 Texas Water Trust

The Texas Water Trust was established by the Texas Legislature to hold water rights that are dedicated to environmental needs, including instream flows, water quality and fish and wildlife habitat. By a memorandum of understanding with TPWD, BRA agreed to dedicate up to 100,000 acft/yr of interruptible water supply (or its equivalent amount on a firm yield basis) from the System Operation Permit to the Texas Water Trust, with TPWD acting as trustee for the dedication.

The 100,000 acft/yr interruptible supply is measured at the Gulf of Mexico, before consideration of the impact of environmental flow conditions, and will be reduced proportionately if the System Operation Permit application is only partially granted. Like other water appropriated by the System Operation Permit, less of the 100,000 acft/yr supply would be available if it were diverted or used higher in the basin.

It is contemplated that BRA would make the dedicated water available for instream use at TPWD's direction, in much the same manner as it provides water for its other interruptible water contracts.

The Texas Water Trust dedication will require a subsequent amendment of the System Operation Permit, which will be subject to the requirements of Section 298.25(j) of Title 30 of the Texas Administrative Code. Under Texas law, the TCEQ cannot issue a new water right for instream flow uses, but it may amend an existing water right to authorize instream flow uses. Therefore, the actual dedication of the rights to the Texas Water Trust cannot occur until after the System Operation Permit is issued. At the time the dedication is sought, TPWD and BRA will jointly prepare an amendment to the WMP to address more specifically implementation of the dedication.

4.4.8 Annual Environmental Flows Achievement Report

In addition to the required Accounting Plan (see Section 5 of this Technical Report, and Appendices H-1 and H-2), an Environmental Flows Achievement Report will be generated by BRA and submitted to TCEQ once per year. The purpose of this annual report is to demonstrate that water storage and diversion under the System Operation Permit WMP does not impact achievement of the adopted environmental flow standards.

The Annual Environmental Flows Achievement Report will be a succinct summary that provides an assessment of storage and diversion of water under the System Operation Permit WMP with respect to the environmental flow standards at each measurement point (see Section 4.4.2.1), during the previous one-year period. Determination of achievement of applicable environmental flow standards (see Section 4.4.2.1) will be based upon approved daily discharge data reported at each measurement point's USGS gage during the one-year period.

If adopted environmental flow standards were not achieved during the reporting period, the report will identify whether operations under the System Operation Permit WMP caused the non-achievement. If operations under the System Operation Permit WMP appear to have caused non-achievement, then a recommendation will be included in the report that identifies how BRA will prevent further non-achievement resulting from operations under its System Operation Permit. BRA will develop a course of action for subsequent years to address the concern and modify operations under the System Operation Permit WMP in accordance with the recommendations, as appropriate to prevent further non-achievement.

4.5 Drought Contingency Plan and Water Conservation Plan

As a wholesale water supplier, the BRA is required under state law to adopt and submit a Drought Contingency Plan (DCP) (Appendix E-1) and a Water Conservation Plan (WCP) (Appendix E-2). The WCP is one document in two parts: Part 1 is required for wholesale water providers and Part 2 is required for systems supplying multiple irrigation users. The statute requires both the DCP and the WCP to be updated every five years to coincide with the regional water planning process. The processes to update the DCP and the WCP are independent and separate from the process by which the BRA's WMP is to be updated. BRA's DCP was last updated on October 29, 2012. BRA's WCP was last updated on April 28, 2014.

Four levels of potential drought severity are identified in BRA's DCP. As the water content of a reservoir or system of reservoirs drops below the defined trigger level, shown in Table

4.19, the DCP specifies actions to be conducted for each level of drought severity.

The WCP helps the BRA effectively convey to its customers the benefits of water conservation by outlining conservation measures and incorporating language in water supply contracts requiring and promoting conservation. Water conservation by BRA's customers can:

- Delay expensive capital investments to upgrade or expand existing water facilities;
- Delay the need for new or expanded wastewater treatment facilities;
- Conserve energy as less water needs to be treated, pumped, and distributed to the consumers;
- Reduce stream diversions, thereby enhancing water quality, environmental, and recreational functions; and
- Improve water levels in reservoirs.

Additionally, to the maximum extent possible within regulatory, institutional, and physical constraints, the BRA strives to optimize benefits from the System reservoirs through system operation and the coordinated use of excess unregulated flows.

Table 4.19 - Drought Severity Triggers in BRA's Drought Contingency Plan1			
Status	**Surface Elevation[2]**	**Water Storage[2]**	**Reservoir Drawdown**
	(ft msl)	**(acre-feet)**	**(ft)**
Lake Aquilla			
Top of Conservation (full)	537.5	43,715	0
Stage 1 Drought Watch	533.6	33,661	3.9
Stage 2 Drought Warning	530.1	25,573	7.4
Stage 3 Drought Emergency	525.8	17,486	11.7
Stage 4 Pro-rata Curtailment	523.1	13,385	14.4
Lake Proctor			
Top of Conservation (full)	537.5	43,715	0
Stage 1 Drought Watch	533.6	33,661	3.9
Stage 2 Drought Warning	530.1	25,573	7.4
Stage 3 Drought Emergency	525.8	17,486	11.7
Stage 4 Pro-rata Curtailment	523.1	13,385	14.4
Lake Belton			
Top of Conservation (full)	594	430,443	0
Stage 1 Drought Watch	587.2	357,268	6.8
Stage 2 Drought Warning	577.9	264,722	16.1
Stage 3 Drought Emergency	565.8	172,177	28.2
Stage 4 Pro-rata Curtailment	549.4	86,089	44.6
Lake Granger			
Top of Conservation (full)	504	49,161	0
Stage 1 Drought Watch	501.8	42,278	2.2
Stage 2 Drought Warning	498.3	30,971	5.7
Stage 3 Drought Emergency	493.7	19,664	10.3
Stage 4 Pro-rata Curtailment	489.7	12,321	14.3
Lake Limestone			
Top of Conservation (full)	363	199,882	0
Stage 1 Drought Watch	357.5	145,914	5.5
Stage 2 Drought Warning	354.7	118,933	8.3
Stage 3 Drought Emergency	351.4	91,953	11.6
Stage 4 Pro-rata Curtailment	346.2	57,657	16.8
Lake Proctor			
Top of Conservation (full)	1162	54,649	0
Stage 1 Drought Watch	1158.2	39,347	3.8
Stage 2 Drought Warning	1155.7	31,012	6.3
Stage 3 Drought Emergency	1152.3	22,677	9.7
Stage 4 Pro-rata Curtailment	1149.8	17,375	12.2

Table 4.19 - Continued			
Status	**Surface Elevation[2]**	**Water Storage[2]**	**Reservoir Drawdown**
	(ft msl)	**(acre-feet)**	**(ft)**
Lake Somerville			
Top of Conservation (full)	238	142,844	0
Stage 1 Drought Watch	234.8	114,275	3.2
Stage 2 Drought Warning	231.6	85,706	6.4
Stage 3 Drought Emergency	227.8	57,138	10.2
Stage 4 Pro-rata Curtailment	223.9	33,780	14.1
Lake Possum Kingdom, Lake Granbury, Lake Whitney[4]			
Top of Conservation (full)	N/A[3]	700,759[5]	N/A[3]
Stage 1 Drought Watch	N/A[3]	561,290[5]	N/A[3]
Stage 2 Drought Warning	N/A[3]	420,968[5]	N/A[3]
Stage 3 Drought Emergency	N/A[3]	280,645[5]	N/A[3]
Stage 4 Pro-rata Curtailment	N/A[3]	140,323[5]	N/A[3]
Lake Georgetown, Lake Stillhouse Hollow			
Top of Conservation (full)	N/A[3]	262,503[6]	N/A[3]
Stage 1 Drought Watch	N/A[3]	220,503[6]	N/A[3]
Stage 2 Drought Warning	N/A[3]	162,752[6]	N/A[3]
Stage 3 Drought Emergency	N/A[3]	105,001[6]	N/A[3]
Stage 4 Pro-rata Curtailment	N/A[3]	52,501[6]	N/A[3]
Brazos River Authority System			
Top of Conservation (full)	N/A[3]	1,883,761	N/A[3]
Stage 1 Drought Watch	N/A[3]	1,514,536	N/A[3]
Stage 2 Drought Warning	N/A[3]	1,140,639	N/A[3]
Stage 3 Drought Emergency	N/A[3]	766,741	N/A[3]
Stage 4 Pro-rata Curtailment	N/A[3]	413,416	N/A[3]

1. Triggers, excluding the Possum Kingdom-Granbury-Whitney system, derived for estimated year 2015 sedimentation conditions, 2015 demands, and current return flows.
2. Surface elevation and reservoir drawdown are not applicable because reservoirs are operated as a system. Their combined storage is a better drought indicator than individual elevations because elevations in each reservoir can be influenced by other reservoirs within the system. For example, water can be transferred from Lake Stillhouse Hollow to Lake Georgetown through a pipeline that connects the two lakes. Stillhouse Hollow could be completely full while Lake Georgetown was 15 feet low, or Georgetown could be completely full with Stillhouse Hollow being 2.5 feet low, and in both cases, the collective capacity of the reservoirs is 94% full. Using combined storage instead of individual reservoir elevations for the trigger levels allows the operation of the pipeline to be taken into account.
3. Elevation-Capacity Tables are included within the DCP (Appendix E-1).
4. Triggers derived for estimated year 2020 sedimentation conditions and 2020 demands. Operations in accordance with the Possum Kingdom-Granbury-Whitney Water Management Study were also considered in the development of the triggers.
5. Storages shown are for the combined conservation pool storage volume of Lakes Possum Kingdom, Granbury, and Whitney; BRA storage in Lake Whitney is limited to 50,000 acft.
6. Storages shown are for the combined conservation pool storage volume of Lakes Stillhouse Hollow and Georgetown.

4.6 Final System Operation Permit and Conforming Changes

4.6.1 System Order Modifications

The System Order and BRA's existing reservoir water rights require that when a reservoir drops below 30% capacity it not be operated as part of the System until all other System reservoirs have also dropped below 30% capacity. This limitation was designed to protect water supply for local uses, as explained in more detail in Section 4.3.5 above.

As directed, BRA filed applications to amend its existing reservoir water rights in conformity with the modifications of the 30% requirement set forth in Section 4.3.5, and those applications have been approved by TCEQ. Such amendments, copies of which have been added to WMP Technical Report Appendix A-1, shall be considered minor conforming amendments to those water rights.

4.6.2 Environmental Flows Special Conditions

The PHDI data used to determine the hydrologic condition is discussed in Section 4.4.2.1 above. In the past, the NCDC was the agency that routinely published PHDI data for the Climatic Divisions in Texas. Reorganization of the National Data Centers of NOAA has merged the NCDC into the National Centers for Environmental Information (NCEI). The URL used to access the PHDI data has changed and may continue to change in this transition. The most current URL (link current as of February 14, 2018) to the monthly and weekly PHDI is found in Appendix H of the WMP Accounting Plan, in Section H.3.11.

The measurement points for System Operation Permit diversions within reaches are discussed in Section 4.4.2.2 above. As required by Ordering Provision 2.b of the Commission's September 16, 2016 Final Order, an allowable System Operation Permit diversion, whether upstream or downstream of the reach's applicable measurement point, can not reduce flow below the environmental flow standard at a point immediately below BRA's point of diversion.