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EXECUTIVE SUMMARY

Purpose of Study

In the January 2006 Lower Colorado Regional Water Planning Group (LCRWPG) Water Plan, the availability of existing surface water supplies in the Colorado River Basin were originally calculated using the Run 3 Version of the Texas Commission on Environmental Quality's (TCEQ) Colorado River Basin Water Availability Model (WAM), dated November 2004. In addition to the standard WAM Run 3, the Regional Planning Group also authorized the development of an alternative WAM run which was referred to as the "No Call" WAM Run 3. The No Call WAM was developed as a result of a request from the Region F Planning Group. The November 2004 WAM indicated a lack of water available on a firm yield basis in a number of Region F's reservoirs as compared to the last planning cycle. The modeling that was to be conducted would be a "WHAT IF" scenario which would generally assume that, during the 50-year planning period, certain large downstream senior water rights holders would not call for water they were legally entitled to by virtue of their priority and would instead allow that water to be impounded in upstream Region F reservoirs.

While the Region K group adopted the adjusted numbers for use in determining Region K surpluses and shortages for the current planning cycle, significant concerns remained. The purpose of this report is to review the concerns as well as additional technical issues as part of a re-evaluation of the TCEQ Colorado River WAM, and to determine whether a more appropriate alternative version of the WAM could be created to more accurately determine the surface water availabilities of the Lower Colorado River. An alternative model, if approved by the TWDB, would be used in current and future rounds of planning to determine availabilities and evaluate water management strategies.

Methodology

The tasks for this report were shared by the consultants for Region K, the City of Austin, and the Lower Colorado River Authority (LCRA). Each consultant was responsible for providing a technical memorandum summarizing their analysis and findings.

Results

The water availability model adopted by the planning group for use in determining surface water availabilities in current and future rounds of planning is known as the *Region K WAM Run 3 Cutoff Model*. The model is a modified version of the TCEQ WAM Run 3, where the basin is essentially divided into two parts, an upper basin and a lower basin. The dividing point is the dams for Ivie Reservoir and Lake Brownwood. All of the water rights are managed according to Prior Appropriation Doctrine, except that all of the water rights in the upper basin are considered senior to the water rights in the lower basin. As the model is a Run 3 version, all of the water rights are represented with their full authorization amounts. This model better reflects the actual and historical operating conditions and existing contractual agreements between LCRA and certain upper basin water right holders than the TCEQ WAM and even the "No Call" WAM developed for the 2006 Region K Plan does. The model's use was approved by TWDB on March 11, 2008.

Availabilities were calculated for reservoir firm yields, including the specific components of the Highland Lakes system, and the major run-of-river rights for the decades 2010 through 2060. Comparisons to the results presented in the 2006 Region K Plan were made. Overall, total availability increased slightly for all decades except 2060, as compared to the 2006 Region K Plan.

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Once the availabilities were determined, the supplies were calculated for the water user groups (WUGs) and were compared to the WUG demands from the 2006 Plan. (Population and demand numbers will not be revised until the next phase of planning.) This provided a second method of viewing what effects the revised WAM had on the Region K numbers. The supply numbers for livestock, manufacturing, and mining uses did not change at all. The supply numbers for municipal use, irrigation use, and steam-electric use were smaller than in the 2006 Plan. The supplies decreased even though the overall availability increased as a result of the way the supplies are calculated. The additional availability can be used for future water management strategies.

Looking at the supply shortage changes by county was another method of analysis. Six of the fourteen counties in Region K had supply shortage changes: Colorado County, Fayette County, Llano County, Matagorda County, Mills County, and Wharton County. Eight counties had supply shortages that remained the same as in the 2006 Region K Plan: Bastrop County, Blanco County, Burnet County, Gillespie County, Hays County, San Saba County, Travis County, and Williamson County.

The three counties that showed an increased shortage as compared to the 2006 Region K Plan were Llano County, Matagorda County, and Mills County. Llano County had an increased municipal shortage from a reduced firm yield for the City of Llano reservoir. Mills County also had an increased municipal shortage from a reduced firm yield for the City of Goldthwaite reservoir. Matagorda County had an increased irrigation shortage from the June 29, 1913 priority date for the Gulf Coast run-of-river irrigation water right.

Recommendations

The purpose of this study was to evaluate other alternative surface water availability models for the Colorado River, choose the model that most appropriately reflects the actual and historical operating conditions and existing contractual agreements between LCRA and certain upper basin water right holders, use the model to determine the revised availabilities, and compare those availabilities to the ones determined in the 2006 Region K Plan.

The model chosen is the Region K WAM Run 3 Cutoff Model, which more accurately reflects the conditions of the Colorado River than either the TCEQ WAM or the "No Call" WAM developed for the 2006 Region K Plan. The model's use was approved by TWDB on March 11, 2008. With continued updates, it is currently recommended that this model be used to determine surface water availabilities of the Colorado River now and in future planning cycles.

Overall, the 2006 Region K Plan and the 2008 Region K WAM Cutoff model total availability numbers are very similar. Through its review, input, and recommendations related to this Task 1 process, the planning group has indicated the effort put forth to create the Region K WAM Cutoff model has been valuable in advancing the group's understanding of the surface water availability for the Colorado River Basin. The acceptance of the Cutoff modeling assumption allows the TCEQ WAM to be modified in a manner that alleviates the problems which were created by the modeling assumptions used in the 2006 round of planning. The information provided from the revised model can be a new starting point for surface water availability estimation as part of the 2011 Plan. Despite the overall similarities in total water availability with the 2006 Region K Plan, the preliminary supply estimates presented in this study indicate both increases and decreases in run-of-river water availability at the level of individual water rights as compared to the supply estimates in the 2006 Plan. The largest shortage increase created by the revised model was located in irrigation in Matagorda County, specifically for the Gulf Coast run-of-river water right. Percentage-wise, all of the irrigation run-of-river water rights with the June 29, 1913 priority

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date were reduced in the revised model as compared to the 2006 "No-Call" model. The Garwood irrigation water right, with the most senior priority date of November 1, 1900, showed an increase in availability from the results of the 2006 "No-Call" model, with that water most likely coming from the availability decrease in the less senior irrigation water rights. Although there are supply differences on an individual water right basis between the two models, the similarity in water availability on an aggregate regional basis gives confidence in the performance of the Cutoff modeling assumption. The individual differences in water right supplies are likely attributable to the manner in which the two models achieve a redistribution of inflows between the upper and lower Colorado basins, with 2008 Region K WAM Cutoff model offering an improvement in model representation of real-world operations. Efforts to expand current strategies or create new strategies to address these new shortages will occur during the next phase of planning.

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1.0 PURPOSE OF STUDY

In the January 2006 Lower Colorado Regional Water Planning Group (LCRWPG) Water Plan, the availability of existing surface water supplies in the Colorado River Basin were originally calculated using the Run 3 Version of the Texas Commission on Environmental Quality's (TCEQ) Colorado River Basin Water Availability Model (WAM), dated November 2004. The results of that analysis were presented in *Tables 3.1* through *3.3* in the 2006 Region K Plan.

In addition to the standard TCEQ WAM Run 3, the LCRWPG also authorized the development of an alternative WAM run which was referred to as the "No Call" WAM Run 3. The No Call WAM was developed as a result of a request from the Region F Planning Group. The November 2004 TCEQ Run 3 WAM indicated a lack of water available on a firm yield basis in a number of Region F's reservoirs as compared to the last planning cycle. The No Call WAM appropriated the water to the two regions more accurately and addressed the current operations of the river system. The results of that analysis were presented in *Tables 3.1a* through *3.3b* in the 2006 Region K Plan.

The water availability modeling using the November 2004 TCEQ Run 3 WAM showed a significant increase in the amount of firm yield and run of river water in the Lower Basin as compared to the amount shown as being available in the 2001 plan. There are a number of possible explanations for these differences. Region F, which includes the upstream portion of the Colorado Basin, also used the November 2004 Colorado Basin WAM for 2006 water plan development. Under the Run 3 scenario, many of the reservoirs in Region F showed little to no firm yield. These reservoirs are the only source of supply to numerous communities in Region F, and the water supply scarcities are such that there are currently few additional economically viable alternatives for supply. One strategy that Region F identified to meet these needs was subordination of downstream senior water rights in Region K, and some Region F members approached Region K water rights holders regarding this issue. The issue of subordination and why it is appropriate is addressed in the 2006 Region K Plan.

The issues noted above were presented to the LCRWPG. Both the Region F and Region K groups recognized the need for coordination between the two regions. Due to the lack of time and funding, it was suggested that the impacts of temporarily implementing a "No Call" assumption could be examined as a potential "quick fix" in order to meet the mandatory deadlines of the 2006 planning cycle. Consequently, Planning Group members voted to proceed with a joint modeling effort on the part of Region F and Region K consultants. The modeling that was to be conducted would be a "WHAT IF" scenario which would generally assume that, during the 50-year planning period, certain large downstream senior water rights holders would not call for water they were legally entitled to by virtue of their priority and would instead allow that water to be impounded in upstream Region F reservoirs.

The joint modeling effort proposal was presented to the Region K group in the following manner:

1. Region K would be able to review the numbers produced from the joint modeling effort and determine whether to use those revised numbers for the shortages and surpluses analysis in place of the numbers calculated by the November 2004 WAM.

2. The effort would be a planning exercise only. No legal positions would be changed or waived as a result of this exercise. No downstream water right holders would be asked or required to formally cede or amend any of their water rights as a result of this planning exercise. In other words, the availability adjustments would have no legal effect and would be temporary in nature.

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While the Region K group adopted the adjusted numbers for use in determining Region K surpluses and shortages for the current planning cycle, significant concerns remained:

1. Due to the time frame and technique employed, the numbers that were developed were approximations that may still have some amount of error in them. One clear example of this is that junior water rights in Region K that were not subject to the No Call assumption appeared to experience an increase in reliability, which should not have occurred. Further, the Planning group had remaining questions about the assumptions used by Region F's consultants for allocation of water among various users within Region F itself and the use of safe yield, which could have affected availability of water in Region K to some degree.

2. Overall, the No Call modeling approach resulted in an allocation of stored water among LCRA firm customers and environmental commitments that does not represent the LCRA's likely operations to meet existing legal commitments to provide firm water. Some of the inaccuracies that were experienced in the model were a result of the model using a monthly time step and other simplifying assumptions embedded in the underlying WAM. The WAM's treatment of environmental flow requirements in LCRA's Water Management Plan, for example, appeared to send additional flow during a month even if the commitment was satisfied mid-month. Further, the modeling approach assumed that the biggest impact should be borne by the most junior of these water rights, that being the LCRA's rights for Lakes Buchanan and Travis. This assumption resulted in apparent shortages in Highland Lakes firm commitments largely as a result of the manner in which the WAM allocates firm supply from the Highland Lakes to LCRA's various customers and the environment. LCRA, in reality, does not operate its system of various water rights today in that manner. Because LCRA's irrigation customers are largely served through annual interruptible contracts instead of long-term, firm contracts, a No Call assumption that takes more water from the LCRA's irrigation run-of-river rights while preserving more of the Highland Lakes firm yield would probably have been more appropriate if time had allowed for further refinement of the No Call model approach.

3. There was concern among the group members regarding the impact of the No Call assumption on environmental flows. Two critical issues of concern are as follows. First, the timing of the request and the availability of the numbers was such that there was neither time nor budget for a thorough review of the impact on the environmental flows in the basin. Second, the No Call assumption appeared to suggest that LCRA would not have any interruptible water supply available to meet environmental flow needs. While the group recognized that a full water rights and contract demand without return flows is not projected to occur for some time and consequently, interruptible supply and return flows would, in fact, be available during this planning period to meet some level of environmental flow needs, members felt that a thorough review and analysis of the impact of the No Call assumption on instream flows and bay and estuary inflows was needed as soon as possible.

4. There had been a lengthy debate among the regional planning group members concerning the inclusion of the No Call adjustments in the water availability chapter in the Region K Plan. Region K normally operates on a consensus basis, with all members agreeing to move forward with actions, although some may have reservations. With this issue, there was a clear division among the group. Some members expressed frustration that the short timeframe of the joint-modeling effort made it very difficult to develop a thorough understanding of the results and impacts. Further, members struggled with whether the No Call adjustments should be handled as a management strategy instead of an adjustment to the availability in Region K.

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5. During the process, the group identified several technical issues with the WAM (discussed below) that could affect the magnitude or ultimate need for a No Call assumption.

A number of technical issues regarding the WAM had been identified as requiring further consideration and analysis. Due to the lack of time and funding, it was not possible to fully explore these issues in time for them to be addressed in the 2006 plan. The Region K group recommended, however, that these issues be further examined during future rounds of planning. These issues generally include enhancements to the WAM routines, updates to the datasets, and a review of fundamental assumptions. Some specific examples of issues that were identified for further review include:

a. The WAM's approach to modeling environmental flow restrictions on water rights

b. The naturalized flows used in the WAM

c. The WAM's incorporation (or lack thereof) of channel gains and losses

d. The WAM's treatment (or lack thereof) of "futile call" issues

e. The WAM's incorporation of existing subordination or similar agreements and ability to model these types of agreements

f. The WAM's backup of Austin's steam electric water rights with LCRA stored water

g. The WAM's backup of STPNOC's steam electric water rights with LCRA stored water

h. The WAM's representation of a zero firm yield for several major reservoirs in the basin

It is recognized that a few of the above listed issues have been under investigation for betterment of the model. For example, during May 2005, TCEQ revised some of the naturalized flow estimates for the Lower Basin; however, it was not feasible to incorporate the revision in the datasets in the last round of planning.

The purpose of this report is to review the technical issues listed above as part of a re-evaluation of the TCEQ Colorado River WAM, and to determine whether a more appropriate alternative version of the WAM could be created to more accurately determine the surface water availabilities of the Lower Colorado River. An alternative model, if approved by the TWDB, would be used in current and future rounds of planning to determine availabilities and evaluate water management strategies.

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2.0 METHODOLOGY

The tasks for this report were shared by the consultants for Region K, the City of Austin, and the Lower Colorado River Authority (LCRA). Each consultant was responsible for providing a technical memorandum summarizing their analysis and findings. These technical memorandums are provided in *Appendix A.*

The City of Austin consultant (Hoffpauir Consulting) conducted a detailed review of the hydrologic and water right information in the TCEQ Colorado River WAM, and addressed the technical issues mentioned both previously in this report and in the 2006 Region K Plan. This technical memorandum is provided in *Appendix A.*

The LCRA consultant (TRC/Brandes) conducted an evaluation of water availability models for the Colorado River Basin. The evaluation provided descriptions, comparisons, advantages, and disadvantages of several alternative water availability models. The memorandum was used for discussion purposes in determining which of the models the planning group thought would be the best alternative for determining surface water availabilities. This technical memorandum is provided in *Appendix A*.

The Region K consultant provided support and review of the above-mentioned analyses, as well as researched relevant water right, agreement, and amendment information that required updating since the 2006 Region K Plan. The Region K consultant recommended which water availability model the planning group should adopt, requested approval of said model from TWDB, and used the model to determine new surface water availabilities and shortages and compared them to the ones reported in the 2006 Region K Plan. The results of the model will be discussed later in *Section 3.0 Results*. The technical memorandum discussing the updated water right, agreement, and amendment information is provided in *Appendix A*. A description of the model as well as the request and approval letters for allowing the use of the model are all provided in *Appendix B*.

Please note that the availability results from this approved model are preliminary and should be considered unofficial for the 2011 Region K Plan. There are still a number of issues the Region K Water Modeling Committee needs to deliberate on before final supply numbers for the 2011 plan can be developed and brought before Region K for consideration for approval. Outstanding issues include:

- status of any recent changes TCEQ has made to the Colorado River WAM
- clarification of adjustments to the naturalized inflow file,
- possibility of using updated Freshwater Inflow Needs Study (FINS) or other LCRA Water Management Plan (WMP) environmental flow criteria that are not in the current TCEQ Water Availability Model
- other issues to be determined

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3.0 RESULTS

The water availability model adopted by the planning group for use in determining surface water availabilities is labeled as *5) LCRA No-Call Cutoff Run 3 WAM* in the TRC/Brandes technical memorandum shown in *Appendix A*. Once adopted by the planning group, the name was revised to the *Region K WAM Run 3 Cutoff Model*. The model is a modified version of the TCEQ WAM Run 3, where the basin is essentially divided into two parts, an upper basin and a lower basin. The dividing point is the dams for Ivie Reservoir and Lake Brownwood. All of the water rights are managed according to Prior Appropriation Doctrine, except that all of the water rights in the upper basin are considered senior to the water rights in the lower basin. All of the water rights are represented with their full authorization amounts. This model better reflects the actual and historical operating conditions and existing contractual agreements between LCRA and certain upper basin water right holders than the TCEQ WAM and even the "No Call" WAM developed for the 2006 Region K Plan does. A detailed description of the model is provided in *Appendix B*. The model's use was approved by TWDB on March 11, 2008. The request and approval letters are also provided in *Appendix B*. All results provided in this study should be considered preliminary and unofficial for the 2011 Region K Plan.

3.1 HIGHLAND LAKES SYSTEM

Availabilities were calculated for reservoir firm yields, including the specific components of the Highland Lakes system, and the major run-of-river rights for the decades 2010 through 2060. *Table 3.1* below displays the availability results of the components of the Highland Lakes System from the Region K Cutoff Model. The decrease in the Uncommitted System Yield throughout the decades is due to increased sedimentation in Lakes Buchanan and Travis.

Table 3.1 Components of the Highland Lakes System Firm Yield

Entity or Use	Region K Cutoff Model Results (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
O.H. Ivie Reservoir Yield Reduction	0	0	0	0	0	0
Backup of City of Austin Water Rights [1]	79,603	87,897	87,860	87,860	87,860	87,884
Highland Lakes Contracts	85,789	85,789	85,789	85,789	85,789	85,789
LCRA Cooling Water [1]	64,551	64,551	64,551	64,551	64,551	64,551
STP Nuclear Operating Company [1, 2]	27,506	32,960	32,480	32,480	32,480	32,840
Instream Flow Requirements [1]	25,081	18,453	18,453	18,453	18,453	18,453
Bay and Estuary Flow Requirements [1]	28,093	6,395	6,395	6,395	6,395	6,395
Additional Highland Lakes Contracts [1]	62,072	62,071	62,071	62,071	62,071	62,071
Total System Commitment	372,695	358,116	357,599	357,599	357,599	357,983
Uncommitted System Yield	29,411	30,511	24,711	19,111	13,111	7,211
Total System Yield	**402,106**	**388,627**	**382,310**	**376,710**	**370,710**	**365,194**

Notes: Colorado WAM provided by TCEQ, August 2007, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, November 2007
Drought-of-Record (DOR) is May 1945 to April 1957 (12 years) for 2010; May 1947 to April 1957 (10 years) for all other decades
[1] These values were averaged over the DOR
[2] Results vary from 0 ac-ft/year to 87,600 ac-ft/year during the DOR

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A description of the entities that are components of the Highland Lakes System is taken from the 2006 Region K Plan:

O.H. Ivie Reservoir Yield Reduction

Freese & Nichols, Inc. (FNI) took the O.H. Ivie subordination out when they modeled the No Call assumption.

Backup of City of Austin Water Rights

The three LCRA backup amounts for the City of Austin municipal water rights were summed. These water rights are 61405471005RMBU, 61405471005LMBU, and 61405489003MBU.

Highland Lakes Contracts

The amount listed in the 1999 LCRA Water Management Plan was used.

LCRA Cooling Water

The availability for water rights 61405480001, 61405473001, and 61405474001 was summed.

STP Nuclear Operating Company

This is water right 61405437001BU. The available supply of backup water for STP from the Highland Lakes is limited to 20,000 ac-ft/yr (as a 5-year rolling average) with two generating units in operation (as is the case through 2015) and to 40,000 ac-ft/yr (as a 5-year rolling average) with any additional generating units in operation (beginning in the year 2016).

Instream Flow Requirements

In 1992, LCRA, working with the state natural resource agencies, completed an instream flow needs study. The study was later approved by the Texas Water Commission, predecessor agency to the TCEQ, as incorporated into LCRA's Water Management Plan. The results of that study included two sets of instream flow needs: Critical and Target instream flow needs. The quantity of water committed by the LCRA Highland Lakes System under the Water Management Plan to instream flows consists of (1) the passage of inflows to meet the Target and Critical instream flow criteria that might otherwise be available to store in the Highland lakes; and, (2) the release of stored water to help meet the Critical instream flow criteria. In order to determine the quantity of inflow the LCRA Highland Lakes System bypassed for instream flows in the WAM, the quantity of inflow available to the LCRA's Highland Lakes System before and after an environmental need is engaged, is computed and the inflow reduction to the LCRA Highland Lakes System due to each environmental need is attributed as water bypassed for each environmental need. To determine the quantity of additional stored water released for critical instream flows, the exact quantity of water released from the LCRA Highland Lakes System Storage to help meet each environmental need is extracted from the WAM output and attributed as stored water released for each environmental need. Once all of these components have been extracted and tabulated, the total quantity of water dedicated to instream flows is determined.

The 1999 LCRA Water Management Plan states:

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"Total commitments of the Combined Firm Yield from the Highland Lakes for instream flow maintenance will be an average of 12,860 acre-feet per year, with a maximum of 36,720 acre-feet in any one year; 58,700 acre-feet in any two consecutive years; 76,800 acre-feet in any three or four consecutive years; 106,100 acre-feet in any five consecutive years and 128,600 acre-feet in any six to ten consecutive years."

Bay and Estuary Flow Requirements

This amount was the DOR average of BEC-IN (Bay and Estuary Critical – In) minus BEC-OT (Bay and Estuary Critical – Out) from the model output (10,845 ac-ft in the year 2000 scenario).

Critical inflow is the amount of water needed to provide a fishery sanctuary habitat near the mouth of the Colorado River during times of drought. From this sanctuary, fish, shellfish and oysters could be expected to recover and repopulate the bay when more normal weather conditions return.

The 1999 LCRA Water Management Plan states:
"Total commitments of the Combined Firm Yield from the Highland Lakes for bays and estuaries (estuarine inflows) will be an average of 3,090 acre-feet per year, with a maximum of 11,200 acre-feet in any one year; 19,700 in any two consecutive years; 24,200 acre-feet in any three or four consecutive years; 28,200 acre-feet in any five consecutive years and 30,900 acre-feet in any six to ten consecutive years. The total firm stored water commitment for both purposes (instream flow and bays and estuaries) will be an average of 15,950 acre-feet per year. Estimated interruptible stored water supplied during the critical drought for both purposes will be an additional 40,060 acre-feet per year."

Additional Highland Lakes Contracts

This amount includes contracts LCRA is maintaining that were not included in the 1999 Water Management Plan that have separate water rights associated with them. The components are the Cities of Cedar Park, Leander, Lometa, Pflugerville, and the Brazos River Authority.

Uncommitted System Yield

This was determined by subtracting the Highland Lakes Contracts amount (85,789 ac-ft) from the LCRA remaining firm yield (61405482001C) in the WAM. This amount includes any additional firm commitments LCRA has made since the 1999 WMP was approved that do not have separate water rights associated with them.

Highland Lakes

The total system yield decreases over time due to sedimentation of the reservoirs. The Highland Lakes firm yield is equal to the Total System Yield minus the O.H. Ivie Reservoir commitment, and is shown in *Table 3.2*.

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Table 3.1A below displays the availability results for the components of the Highland Lakes System from the 2006 Region K Plan using the No Call Model.

Table 3.1A Components of the Highland Lakes System Firm Yield (2006 Region K Plan)

Entity or Use	2006 Region K Plan "No Call" Results (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
O.H. Ivie Reservoir Yield Reduction	0	0	0	0	0	0
Backup of City of Austin Water Rights [1]	110,046	109,442	108,838	108,234	107,630	107,026
Highland Lakes Contracts	79,452	80,334	81,126	81,918	82,710	83,500
LCRA Cooling Water [1]	64,551	64,551	64,551	64,551	64,551	64,551
STP Nuclear Operating Company [1]	38,111	38,162	38,213	38,264	38,315	38,363
Instream Flow Requirements [1]	18,024	17,387	16,750	16,113	15,476	14,838
Bay and Estuary Flow Requirements [1]	9,863	8,881	7,899	6,917	5,935	4,952
Additional Highland Lakes Contracts [1]	61,408	61,409	61,410	61,411	61,412	61,412
Total System Commitment	381,455	380,166	378,787	377,408	376,029	374,642
Uncommitted System Yield	0	0	0	0	0	0
Total System Yield	**381,455**	**380,166**	**378,787**	**377,408**	**376,029**	**374,642**

Notes: Colorado WAM provided by TCEQ, November 2004, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, July 2004
Drought-of-Record (DOR) is May 1945 to April 1957 (12 years)
The values for 2010 through 2050 were determined by interpolation
[1] These values were averaged over the DOR

Table 3.1B below shows a comparison of the calculated availabilities using the Region K Cutoff Model and the 2006 Region K Plan No Call Model. The Region K Cutoff Model showed a total system yield that varied between an increase of 20,651 ac-ft/yr and a decrease of 9,448 ac-ft/yr, depending on the decade. The Region K Cutoff Model also showed a significant decrease in the Backup to the City of Austin and South Texas Nuclear Project availabilities. The decrease in the Backup of City of Austin availability is offset by the increase in the City of Austin run-of-river availability, which can be seen in *Tables 3.3A* and *3.3B*. The instream flows and bay and estuary flows increased substantially from the 2006 Region K Plan in 2010, but that is due greatly to the inclusion of Target flows as well as the Critical flows in the calculation versus the 2006 Region K Plan, which only included the Critical flows. The 2006 Region K Plan No Call Model assumed zero interruptible supplies (Uncommitted System Yield), while the Region K Cutoff Model had Uncommitted System Yield available for all decades. Other than these changes, the results from both models were fairly similar, with respect to the components of the Highland Lakes System.

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Table 3.1B Components of the Highland Lakes System Firm Yield (Comparison)

Entity or Use	Region K Cutoff Results - 2006 "No Call" Results (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
O.H. Ivie Reservoir Yield Reduction	0	0	0	0	0	0
Backup of City of Austin Water Rights	-30,443	-21,545	-20,978	-20,374	-19,770	-19,142
Highland Lakes Contracts	6,337	5,455	4,663	3,871	3,079	2,289
LCRA Cooling Water	0	0	0	0	0	0
STP Nuclear Operating Company	-10,605	-5,202	-5,733	-5,784	-5,835	-5,523
Instream Flow Requirements	7,057	1,066	1,703	2,340	2,977	3,615
Bay and Estuary Flow Requirements	18,230	-2,486	-1,504	-522	460	1,443
Additional Highland Lakes Contracts	664	662	661	660	659	659
Total System Commitment	-8,760	-22,050	-21,188	-19,809	-18,430	-16,659
Uncommitted System Yield	29,411	30,511	24,711	19,111	13,111	7,211
Total System Yield	**20,651**	**8,461**	**3,523**	**-698**	**-5,319**	**-9,448**

3.2 RESERVOIR FIRM YIELDS

The estimated firm yields for all reservoirs within the Colorado River Basin, calculated using the Region K Cutoff Model, are presented below in *Table 3.2*, for the decades 2010 through 2060.

Table 3.2 Reservoir Firm Yield

Entity or Use	Region K Cutoff Model Results (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
Highland Lakes	**402,106**	**388,627**	**382,310**	**376,710**	**370,710**	**365,194**
City of Goldthwaite	0	0	0	0	0	0
City of Llano	0	0	0	0	0	0
Walter E. Long (Decker Lake)	0	0	0	0	0	0
Lake Bastrop	0	0	0	0	0	0
Lake Fayette	0	0	0	0	0	0
City of Lometa	0	0	0	0	0	0
STP Reservoir	0	0	0	0	0	0
Minor Reservoir Subtotal	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL	**402,106**	**388,627**	**382,310**	**376,710**	**370,710**	**365,194**

Notes: Colorado WAM provided by TCEQ, August 2007, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, November 2007
Drought-of-Record (DOR) is May 1945 to April 1957 (12 years) for 2010; May 1947 to April 1957 (10 years) for all other decades

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A description of the minor reservoirs is taken from the 2006 Region K Plan:

- The **City of Goldthwaite** owns and operates a two-reservoir system as part of its water supply facilities. The reservoirs include a small reservoir with a capacity of 40 ac-ft adjacent to the river and a larger reservoir with a capacity of 200 ac-ft, which is located off-channel. The city pumps water from the Colorado River into the smaller reservoir and then pumps it into the larger reservoir, from which water is drawn for treatment. The size of the reservoirs are relatively small in comparison to the city's water demand, which is projected to decline from approximately 580 ac-ft in the year 2000 scenario to 565 ac-ft in the year 2060. Based on the limited storage available, the firm yields of the reservoirs are dependent upon continued river flows throughout the year. It is estimated that the available storage would be depleted within four months once the river ceases flowing. Based on the Region K Cutoff Model, it was determined that the Goldthwaite reservoir system has a firm yield of 0 ac-ft/yr (water rights 61402553401, 61402553402, and 61402553001).

- The **City of Llano** owns and operates two reservoirs on the Llano River: City Lake and City Park Lake, both of which are small channel dams. The two reservoirs were estimated to have a combined capacity of 503 ac-ft in 1988. This is significantly less than the original design capacity of 700 ac-ft. The decreased capacity is due to sedimentation rates in the two reservoirs. The firm yield estimated by the Region K Cutoff Model was 0 ac-ft/yr (water rights 61401650001 and 61401650002).

- **Lake Walter E. Long (Decker Lake)** is owned and operated by the City of Austin. The lake is formed by a dam on Decker Creek, which is a tributary to the Colorado River in Travis County. The City of Austin uses Decker to supply cooling water for an electrical generating plant. The City of Austin supplements the water supply to Decker by pumping water from the Colorado River based on run-of-river rights and a water supply contract with LCRA for stored water from the Highland Lakes. Therefore, because the water from Decker Lake has already been accounted for in run-of-river and LCRA backup amounts, the firm yield of the lake itself in the Region K Cutoff Model is considered 0 ac-ft/yr.

- **Lake Bastrop** is owned and operated by the LCRA. The lake is formed by a dam on Spicer Creek, which is a tributary to Piney Creek and the Colorado River in Bastrop County. The LCRA uses water from Lake Bastrop for cooling purposes at its Sam Gideon Power Generating Station. The LCRA supplements the water supply at this lake by pumping water into the lake from the Colorado River. The water pumped into the lake is stored water from the Highland Lakes. Therefore, because the water from Lake Bastrop has already been accounted for in run-of-river and LCRA backup amounts, the firm yield of the lake itself in the Region K Cutoff Model is considered 0 ac-ft/yr.

- **Lake Fayette** is owned and operated by the LCRA. The lake is formed by a dam on Cedar Creek, which is a tributary to the Colorado River in Fayette County. The LCRA uses water from Lake Fayette for cooling purposes at the Fayette Power Project. The LCRA supplements the water supply at this lake by pumping water into the reservoir from the Colorado River. A portion of the water pumped is run-of-river water rights held by the City of Austin, which is co-owner in the Fayette Power Project. The remainder of the water pumped into the reservoir is stored water from the Highland Lakes. Therefore, because the water from Lake Fayette has already been accounted for in run-of-river and LCRA backup amounts, the firm yield of the lake itself in the Region K Cutoff Model is considered 0 ac-ft/yr.

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- **Lometa Reservoir** is owned and operated by the LCRA. The reservoir is formed by a dam on Salt Creek, which is a tributary to the Colorado River in Lampasas County. The LCRA uses water from Lometa Reservoir for municipal purposes within the service area of the City of Lometa. The reservoir has a normal maximum operating capacity of 554.6 ac-ft. A maximum of 882 ac-ft of water is available for diversion from the Colorado River, including 476 ac-ft for municipal demands and 406 ac-ft to off set evaporative losses. Because this amount is allocated against the Highland Lakes firm yield, the reported firm yield of the Lometa Reservoir is 0 ac-ft/yr.

- **South Texas Project Reservoir**: The Main Cooling Reservoir associated with the South Texas Project Electric Generating Station is a 7,000-acre (surface area) off-channel reservoir located in Matagorda County. At the maximum design operating level, the reservoir has a capacity of 202,600 ac-ft, or 9.6 percent of the total capacity of Lakes Travis and Buchanan as stated in the LCRA Water Management Plan. The firm yield from the Region K Cutoff Model is considered to be 0 ac-ft/yr since the reservoir firm yield is supplied by the STP run-of-river right (STP Nuclear Operating Co. et al.) and LCRA stored water from Lakes Buchanan and Travis, and the amount of water from the run-of-river right and LCRA's Highland Lakes has already been included in the water availability analysis for Region K (refer to *Tables 3.1* and *3.3*). If both the run-of-river right and the reservoir firm yield were included, then the water would be double counted since the water available to the reservoir is based on the diversions from the river.

The estimated firm yields for all reservoirs within the Colorado River Basin, from the 2006 Region K Plan, using the No Call Model, are presented below in *Table 3.2A*.

Table 3.2A Reservoir Firm Yield (2006 Region K Plan)

Entity or Use	2006 Region K Plan "No Call" Results (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
Highland Lakes	**381,455**	**380,166**	**378,787**	**377,408**	**376,029**	**374,642**
City of Goldthwaite [1]	144	144	145	145	145	145
City of Llano [1]	178	169	160	151	142	135
Walter E. Long (Decker Lake)	0	0	0	0	0	0
Lake Bastrop	0	0	0	0	0	0
Lake Fayette	0	0	0	0	0	0
City of Lometa	0	0	0	0	0	0
STP Reservoir	0	0	0	0	0	0
Minor Reservoir Subtotal	**322**	**313**	**305**	**296**	**287**	**280**
TOTAL	**381,777**	**380,479**	**379,092**	**377,704**	**376,316**	**374,922**

Notes: Colorado WAM provided by TCEQ, November 2004, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, July 2004
Drought-of-Record (DOR) is May 1945 to April 1957 (12 years)
The values for 2010 through 2050 were determined by interpolation
[1] These values were averaged over the DOR

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Table 3.2B below shows a comparison of the reservoir firm yields determined using the Region K Cutoff Model and the 2006 Region K Plan No Call Model. Overall, the Region K Cutoff Model varied between an increased firm yield and a decreased firm yield, depending on the decade. The reservoir firm yields for the City of Goldthwaite and the City of Llano did show a decrease by using the Region K Cutoff Model versus using the 2006 Region K Plan No Call Model. In the 2006 Plan, the firm yields that were reported for those two reservoirs were based on an average over the Drought-of-Record period, instead of the minimum amount of water available in any given year, which is a more appropriate definition. The Region K Cutoff Model assumed the true definition of reservoir firm yield to determine the amount of water available.

Table 3.2B Reservoir Firm Yield (Comparison)

Entity or Use	Region K Cutoff Results - 2006 "No Call" Results (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
Highland Lakes	**20,651**	**8,461**	**3,523**	**-698**	**-5,319**	**-9,448**
City of Goldthwaite	-144	-144	-145	-145	-145	-145
City of Llano	-178	-169	-160	-151	-142	-135
Walter E. Long (Decker Lake)	0	0	0	0	0	0
Lake Bastrop	0	0	0	0	0	0
Lake Fayette	0	0	0	0	0	0
City of Lometa	0	0	0	0	0	0
STP Reservoir	0	0	0	0	0	0
Minor Reservoir Subtotal	**-322**	**-313**	**-305**	**-296**	**-287**	**-280**
TOTAL	**20,329**	**8,148**	**3,218**	**-994**	**-5,606**	**-9,728**

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3.3 MAJOR RUN-OF-RIVER RIGHTS

A comparison of the 2010 availabilities for major run-of-river rights holders calculated using the Region K Cutoff Model and the 2006 Region K Plan No Call Model are presented in *Table 3.3A*. The water availability presented in the table for most of the major run-of-river rights is based on the amount of run-of-river water that would be available during the driest year of the DOR. The water availability for the City of Austin and STNP water rights is based on the average water availability during the DOR period, due to contracted backup supply from LCRA.

Table 3.3A Major Run-of-River Rights in the Colorado Basin 2010 Availability Comparison

Water Right ID Number	Water Right Holder	Maximum Permitted Diversion	Priority Date	Region K Cutoff (ac-ft/yr)	2006 Plan "No Call" (ac-ft/yr)	Difference (ac-ft/yr)
				2010	2010	2010
61405434201RR	LCRA - Garwood	133,000	Nov 1, 1900	130,141	111,740	18,401
61405475001LRRS	LCRA - Lakeside #1	52,500	Jan 4, 1901	10,405	10,570	-165
61405475001LRRL			Jun 29, 1913	1,573	6,274	-4,701
61405475001LRRR			Mar 8, 1938	0	0	0
61405475001LRRJ		78,750	Nov 1, 1987	553	2,925	-2,372
61405476003RRS	LCRA - Gulf Coast	228,570	Dec 1, 1900	14,476	14,554	-78
61405476003RRL			Jun 29, 1913	28,987	58,058	-29,071
61405476003RRR			Mar 8, 1938	0	0	0
61405476003RRJ		33,930	Nov 1, 1987	1,365	1,512	-147
61405476003JBU			Nov 1, 1987	0	0	0
61405477001RR	LCRA - Pierce Ranch	55,000	Sep 1, 1907	12,468	4,231	8,237
61405477001RRL			Jun 29, 1913	1,648	6,538	-4,890
61405477001RRR			Mar 8, 1938	0	0	0
61405475001WRR	LCRA - Lakeside #2	55,000	Sep 2, 1907	8,791	4,231	4,560
61405475001WRRL			Jun 29, 1913	1,648	6,538	-4,890
61405475001RRRR			Mar 8, 1938	0	0	0
61405471005SMRR	City of Austin - (mun.) [1]	250,000	Jun 30, 1913	148,431	119,734	28,697
61405471005SBU	City of Austin - (mun.) [1]		Jun 30, 1913	49,845	47,010	2,835
61405471005LMRR	City of Austin - (mun.) [1]	21,403	Jun 27, 1914	9,944	9,556	388
61405471001P	City of Austin - (stm.)	24,000	Jun 27, 1914	14,894	5,296	9,598
61405471002P	City of Austin - (stm.)		Jun 27, 1914	1,267	1,312	-45
61405489003M	City of Austin - (mun.) [1]	20,300	Aug 20, 1945	3,881	5,357	-1,476
61405489003P	City of Austin - (stm.)	16,156	Aug 20, 1945	0	315	-315
61405489003PBU	City of Austin - (stm.)		Aug 20, 1945	99	2,554	-2,455
61405437001RIV	STP Nuclear Operating Co. [1, 2]	102,000	Jun 10, 1974	51,811	49,039	2,772
61405434102	City of Corpus Christi	35,000	Nov 2, 1900	22,884	25,021	-2,137
Totals		**1,105,609**		**515,111**	**492,365**	**22,746**

Notes:

Region K Cutoff: WAM provided by TCEQ, August 2007, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, November 2

2006 "No Call": WAM provided by TCEQ, November 2004, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, July 2004

Drought-of-Record (DOR) is May 1945 to April 1957 (12 years) for both models

[1] These values were averaged over the DOR

[2] Annual results vary from 2,554 ac-ft/yr to 102,000 ac-ft/yr during the DOR

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A description of the major run-of-river rights is taken from the 2006 Region K Plan, with the exception of STP Nuclear Operating Company, whose description has been updated based on their recent settlement agreement with LCRA:

Irrigators

Garwood, Lakeside #1, Gulf Coast, Pierce Ranch, and Lakeside #2 each have several water rights, both run-of-river and backup. The run-of-river rights are listed in *Table 3.3A*. The run-of-river water rights were summed for each irrigator to determine which year in the model had the minimum total diversion. The water right amounts for that year are listed in the table.

City of Austin

The City of Austin has four municipal water rights shown in the table. These are 61405471005SMRR, 61405471005SBU, 61405471005LMRR, and 61405489003M. Because these water rights are backed up by LCRA each year, an average during the DOR was used.

The City of Austin has three steam-electric water rights shown in the table. These are 61405471001P, 61405471002P, and 61405489003P (61405489003PBU). The water availability for these rights was determined by using the minimum amount of water available in any year during the DOR.

STP Nuclear Operating Company et al.

The run-of-river water right, 61405437001RIV, was determined by taking the average over the DOR period. This was done because there is a contract for backup from LCRA, and there is a reservoir that allows for storage of water over the DOR period, rather than having to use the entire amount of water received in a particular year. The STNP diversion point is within the tidal reaches of the Gulf of Mexico. Required diversions at low flow rates during the DOR period will have a negative effect on the water quality diverted at this point.

Corpus Christi

The water availability for this run-of-river water right was determined by using the minimum amount of water available in any year during the DOR.

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Table 3.3B below shows the same comparison as *Table 3.3A*, but for 2060 values instead of 2010.

Table 3.3B Major Run-of-River Rights in the Colorado Basin 2060 Availability Comparison

Water Right ID Number	Water Right Holder	Maximum Permitted Diversion	Priority Date	Region K Cutoff (ac-ft/yr)	2006 Plan "No Call" (ac-ft/yr)	Difference (ac-ft/yr)
				2060	2060	2060
61405434201RR	LCRA - Garwood	133,000	Nov 1, 1900	130,141	111,740	18,401
61405475001LRRS	LCRA - Lakeside #1	52,500	Jan 4, 1901	10,405	10,570	-165
61405475001LRRL			Jun 29, 1913	1,573	6,274	-4,701
61405475001LRRR			Mar 8, 1938	0	0	0
61405475001LRRJ		78,750	Nov 1, 1987	520	2,925	-2,405
61405476003RRS	LCRA - Gulf Coast	228,570	Dec 1, 1900	14,476	14,554	-78
61405476003RRL			Jun 29, 1913	28,909	58,058	-29,149
61405476003RRR			Mar 8, 1938	0	0	0
61405476003RRJ		33,930	Nov 1, 1987	155	1,444	-1,289
61405476003JBU			Nov 1, 1987	0	0	0
61405477001RR	LCRA - Pierce Ranch	55,000	Sep 1, 1907	12,525	4,231	8,294
61405477001RRL			Jun 29, 1913	1,648	6,538	-4,890
61405477001RRR			Mar 8, 1938	0	0	0
61405475001WRR	LCRA - Lakeside #2	55,000	Sep 2, 1907	8,791	4,231	4,560
61405475001WRRL			Jun 29, 1913	1,648	6,538	-4,890
61405475001RRRR			Mar 8, 1938	0	0	0
61405471005SMRR	City of Austin - (mun.) [1]	250,000	Jun 30, 1913	143,859	121,062	22,797
61405471005SBU	City of Austin - (mun.) [1]		Jun 30, 1913	48,034	47,592	442
61405471005LMRR	City of Austin - (mun.) [1]	21,403	Jun 27, 1914	8,407	10,030	-1,623
61405471001P	City of Austin - (stm.)	24,000	Jun 27, 1914	14,894	5,361	9,533
61405471002P	City of Austin - (stm.)		Jun 27, 1914	1,267	741	526
61405489003M	City of Austin - (mun.) [1]	20,300	Aug 20, 1945	3,519	5,993	-2,474
61405489003P	City of Austin - (stm.)	16,156	Aug 20, 1945	0	304	-304
61405489003PBU	City of Austin - (stm.)		Aug 20, 1945	744	2,389	-1,645
61405437001RIV	STP Nuclear Operating Co. [1, 2]	102,000	Jun 10, 1974	46,349	48,791	-2,442
61405434102	City of Corpus Christi	35,000	Nov 2, 1900	22,884	25,021	-2,137
Totals		**1,105,609**		**500,748**	**494,387**	**6,361**

Notes:

Region K Cutoff: WAM provided by TCEQ, August 2007, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, November 2

2006 "No Call": WAM provided by TCEQ, November 2004, Run 3. WRAP program by Dr. Ralph Wurbs, Texas A&M University, July 2004

Drought-of-Record is May 1945 to April 1957 (12 years) for 2060 2006 Plan and May 1947 to April 1957 (10 years) for 2060 Region K Cutof

[1] These values were averaged over the DOR

[2] Annual results vary from 0 ac-ft/yr to 102,000 ac-ft/yr during the DOR

A table showing a comparison of availabilities for each decade from 2010 through 2060 for the major run-of-river rights can be found in *Appendix C*. Overall, the run-of-river water availability increased by approximately 23,000 ac-ft/yr for 2010, and 6,000 ac-ft/yr for 2060 from the 2006 Region K Plan. The water rights with the largest changes were the LCRA-Garwood and Gulf Coast irrigators, and the City of Austin municipal and steam electric rights.

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3.4 WHOLESALE WATER PROVIDER AVAILABILITY

The LCRA and the City of Austin are the two wholesale water providers whose supply is affected by the revised Colorado River WAM. The revised availabilities are discussed below.

The water available to LCRA is primarily associated with the Highland Lakes System and several senior run-of-river irrigation water rights in the lower basin. *Table 3.4* shows the water available to LCRA.

Table 3.4 Total Water Available to the Lower Colorado River Authority

Water Rights Holder	Water Availability During Drought of Record (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
LCRA - Garwood	130,141	130,141	130,141	130,141	130,141	130,141
LCRA - Lakeside #1	12,531	12,498	12,498	12,498	12,498	12,498
LCRA - Gulf Coast	44,827	43,540	43,540	43,540	43,540	43,540
LCRA - Pierce Ranch	14,116	14,173	14,173	14,173	14,173	14,173
LCRA - Lakeside #2	10,440	10,440	10,440	10,440	10,440	10,440
LCRA - Highland Lakes	402,106	388,627	382,310	376,710	370,710	365,194
Total	614,161	599,419	593,102	587,502	581,502	575,986

The City of Austin has run-of-river water rights to divert and use water from the Colorado River. Hydrologic conditions are such that Austin's full authorized diversion amount of water is not available to Austin under these water rights. As a result, the City of Austin has entered into a contract with LCRA to firm up these water rights with water stored in the Highland Lakes. *Table 3.5* contains a summary of the water available to the City of Austin.

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Table 3.5 Total Water Available to the City of Austin

Water Source (Water Right ID Numbers)	Water Rights Holder	Water Supply Source	Water Availability During Drought of Record (Ac-Ft/Yr)					
			2010	2020	2030	2040	2050	2060
61405471005SMRR	COA [1]	ROR - Municipal	148,431	143,846	143,846	143,846	143,846	143,459
61405471005SBU	COA 1	ROR - Municipal	49,845	48,034	48,034	48,034	48,034	48,034
61405471005LMRR	COA 1	ROR - Municipal	9,944	8,407	8,407	8,407	8,407	8,407
61405489003M	COA 1	ROR - Municipal	3,881	3,519	3,556	3,556	3,556	3,519
Municipal ROR Subtotal			212,101	203,806	203,843	203,843	203,843	203,419
61405471005RMBU	COA backup (LCRA) [1]	Highland Lakes	51,724	58,120	58,120	58,120	58,120	58,107
61405471005LMBU	COA backup (LCRA) [2]	Highland Lakes	11,459	12,996	12,996	12,996	12,996	12,996
61405489003MBU	COA backup (LCRA) [3]	Highland Lakes	16,419	16,781	16,744	16,744	16,744	16,781
Remaining Contract	LCRA Contract	Highland Lakes	33,296	33,297	33,297	33,297	33,297	33,697
LCRA Subtotal			112,899	121,194	121,157	121,157	121,157	121,581
Municipal & Manufacturing Total			**325,000**	**325,000**	**325,000**	**325,000**	**325,000**	**325,000**
61405471001P (Town Lake)	COA	ROR - Steam Electric	14,894	14,894	14,894	14,894	14,894	14,894
61405471002P (FPP)	COA	ROR - Steam Electric	1,267	1,267	1,267	1,267	1,267	1,267
61405489003P (Decker)	COA	ROR - Steam Electric	0	0	0	0	0	0
61405489003PBU (Decker)	COA	ROR - Steam Electric	99	744	744	744	744	744
Town Lake Contract	LCRA Contract	Highland Lakes	7,839	7,839	7,839	7,839	7,839	7,839
Decker Contract	LCRA Contract	Highland Lakes	16,057	15,412	15,412	15,412	15,412	15,412
FPP & Sandhill Contract	LCRA Contract	Highland Lakes	3,500	3,500	3,500	3,500	3,500	3,500
Steam Electric Total			**43,656**	**43,656**	**43,656**	**43,656**	**43,656**	**43,656**
TOTAL			**368,656**	**368,656**	**368,656**	**368,656**	**368,656**	**368,656**

[1] Two City of Austin ROR Rights and an LCRA back-up add up to 250,000 ac-ft/yr.

[2] The City of Austin ROR Right and the LCRA back-up add up to 21,403 ac-ft/yr.

[3] The City of Austin ROR Right and the LCRA back-up add up to 20,300 ac-ft/yr.

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3.5 REVISED SHORTAGE ANALYSIS

Once the availabilities were determined, the supplies were calculated for the water user groups (WUGs) and were compared to the WUG demands from the 2006 Plan. (Population and demand numbers will not be revised until the next phase of planning.) This provided a second method of viewing what effects the revised WAM had on the Region K numbers. Tables showing the revised shortages for each county can be found in *Appendix D.*

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Figure 3.1 below shows a comparison of the availabilities in ac-ft/yr from just the WAM modeling for 2001, 2006, and the current study. Overall, the 2006 Region K Plan and the 2008 Region K WAM Cutoff model total availability numbers are very similar. *Appendix E* contains a table showing a comparison of the availabilities for the various surface water entities for the 2001 Plan, 2006 Plan, and current study.

Figure 3.1 Region K Water Availability from WAM Modeling

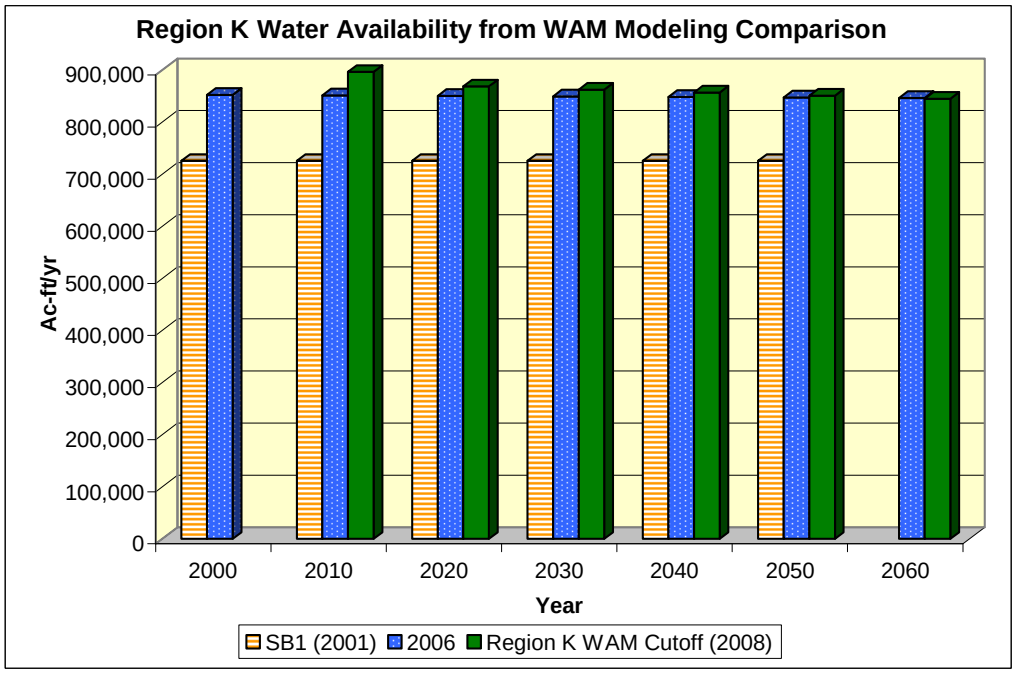

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Table 3.6 below shows how the supply (either surplus or shortage) by water use from the Region K WAM Cutoff model differs from the supply by water use calculated for the 2006 Region K Plan. As the table shows, the supply for livestock, manufacturing, and mining uses did not change at all. The supply for municipal use, irrigation use, and steam-electric use were all less. The supplies decreased even though the overall availability increased as a result of the way the supplies are calculated. The additional availability can be used for future water management strategies.

Table 3.6 Change in Supply (by Water Use) When Comparing the Region K WAM Cutoff Model Results with the 2006 Region K Plan Results

Water Use	Water Supply Change (ac-ft/yr)					
	2010	2020	2030	2040	2050	2060
Municipal	-322	-313	-305	-296	-287	-280
Irrigation	-15,116	-16,423	-16,410	-16,397	-16,384	-16,368
Livestock	0	0	0	0	0	0
Manufacturing	0	0	0	0	0	0
Mining	0	0	0	0	0	0
Steam-Electric	-8,148	-8,155	-5,134	-5,133	-5,132	-4,769

Looking at the supply shortage changes by county was another method of analysis. Six of the fourteen counties in Region K had supply shortage changes: Colorado County, Fayette County, Llano County, Matagorda County, Mills County, and Wharton County. Eight counties had supply shortages that remained the same as in the 2006 Region K Plan: Bastrop County, Blanco County, Burnet County, Gillespie County, Hays County, San Saba County, Travis County, and Williamson County. *Table 3.7* below shows how the supply by county from the Region K WAM Cutoff model differs from the supply by county calculated for the 2006 Region K Plan. A positive number denotes a decrease in the amount of shortage, while a negative number denotes an increase in the amount of shortage.

Table 3.7 Change in Supply Shortage (by County) When Comparing the Region K WAM Cutoff Model Results with the 2006 Region K Plan Results

County	Water Use	Change in Water Supply Shortage (ac-ft/yr)					
		2010	2020	2030	2040	2050	2060
Colorado	Irrigation	4,602	4,574	4,574	4,574	4,574	4,574
Fayette	Steam-Electric	0	69	183	297	411	526
Llano	Municipal	-178	-169	-160	-151	-142	-135
Matagorda	Irrigation	-29,297	-30,571	-30,558	-30,545	-30,532	-30,516
	Steam-Electric	-240	-248	-8,323	-8,324	-8,325	-7,965
Mills	Municipal	-144	-144	-145	-145	-145	-145
Wharton	Irrigation	8,383	6,532	6,358	6,358	6,358	6,358

The following figures show the supply results for both models.

Figure 3.2 Comparison of Supplies for Colorado County

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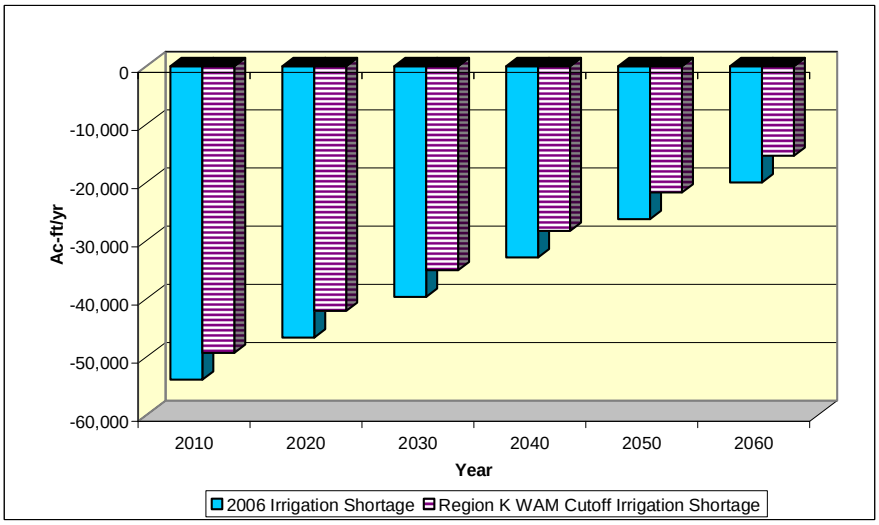

Figure 3.2 shows that although there is still an irrigation shortage in Colorado County, the shortage is a smaller amount as a result of the Region K WAM Cutoff model than it was in the 2006 Region K Plan.

Figure 3.3 Comparison of Supplies for Fayette County

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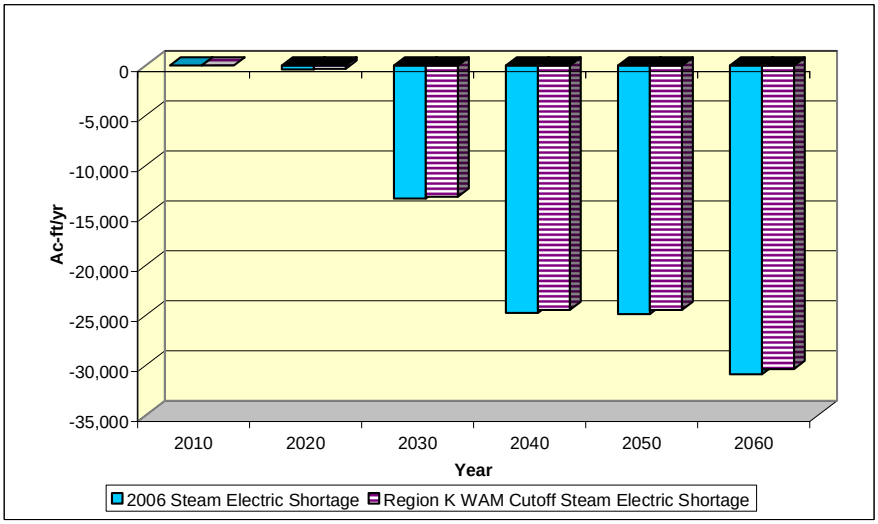

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Figure 3.3 shows that the steam-electric shortage in Fayette County is smaller for most decades as a result of the Region K WAM Cutoff model than it was in the 2006 Region K Plan.

Figure 3.4 Comparison of Supplies for Llano County

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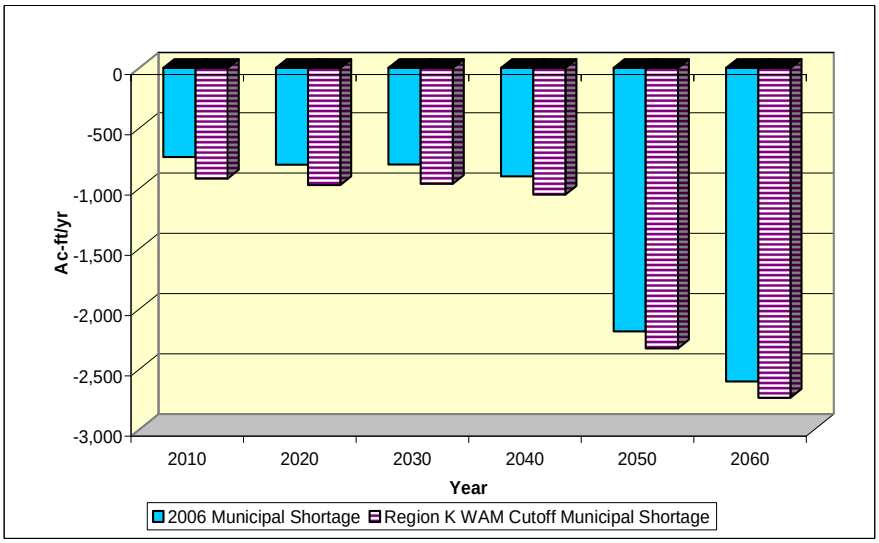

Figure 3.4 shows that the municipal shortage for Llano County is slightly larger as a result of the Region K WAM Cutoff model than it was in the 2006 Region K Plan. This is due specifically to the City of Llano reservoir having a firm yield of 0 ac-ft for most of the years within the drought-of-record period.

Figure 3.5 Comparison of Supplies for Matagorda County

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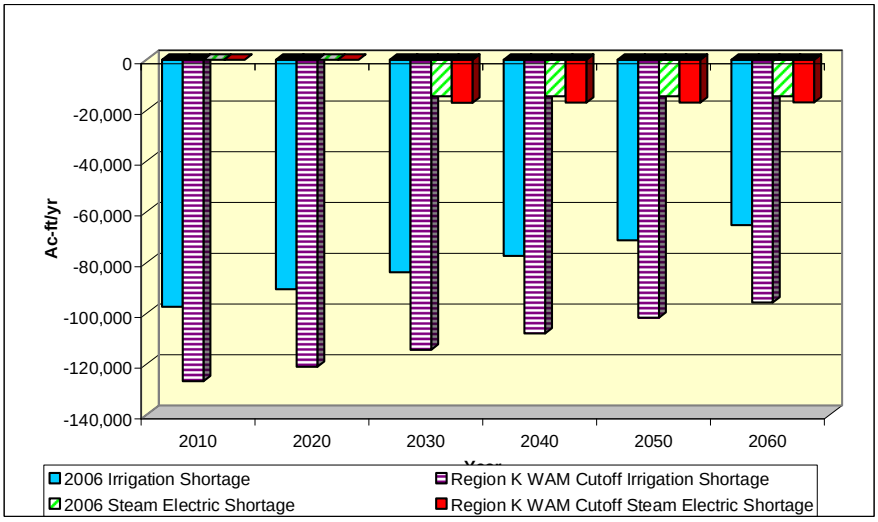

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Figure 3.5 shows that both the irrigation shortage and the steam-electric shortage for Matagorda County are larger as a result of the Region K WAM Cutoff model than they were in the 2006 Region K Plan.

Figure 3.6 Comparison of Supplies for Mills County

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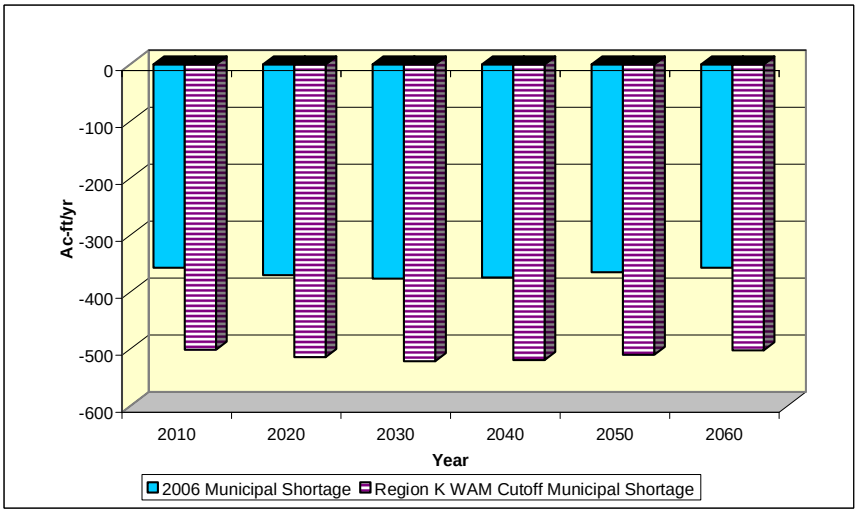

Figure 3.6 shows that the municipal shortage for Mills County is slightly larger as a result of the Region K WAM Cutoff model than it was in the 2006 Region K Plan. This is due specifically to the City of Goldthwaite reservoir having a firm yield of 0 ac-ft for most of the years within the drought-of-record period.

Figure 3.7 Comparison of Supplies for Wharton County

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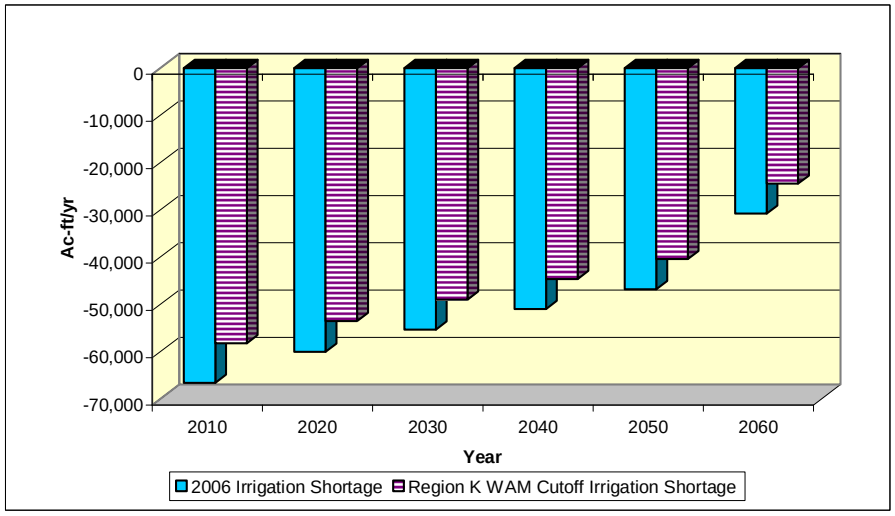

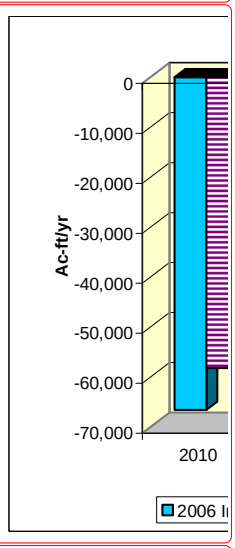

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Figure 3.7 shows that although there is still an irrigation shortage in Wharton County, the shortage is a smaller amount as a result of the Region K WAM Cutoff model than it was in the 2006 Region K Plan.

The three counties that showed an increased shortage as compared to the 2006 Region K Plan were Llano County, Matagorda County, and Mills County. Llano County had an increased municipal shortage from a reduced firm yield for the City of Llano reservoir. Mills County also had an increased municipal shortage from a reduced firm yield for the City of Goldthwaite reservoir. In the 2006 Plan, the firm yields that were reported for those two reservoirs were based on an average over the Drought-of-Record period, instead of the minimum amount of water available in any given year, which is a more appropriate definition. The Region K Cutoff Model assumed the true definition of reservoir firm yield to determine the amount of water available. Matagorda County had an increased irrigation shortage from the June 29, 1913 priority date for the Gulf Coast run-of-river irrigation water right.

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4.0 RECOMMENDATIONS

The purpose of this study was to evaluate other alternative surface water availability models for the Colorado River, choose the model that most appropriately reflects the actual and historical operating conditions and existing contractual agreements between LCRA and certain upper basin water right holders, use the model to determine the revised availabilities, and compare those availabilities to the ones determined in the 2006 Region K Plan.

The model chosen is the Region K WAM Cutoff Model, and does more accurately reflect the conditions of the Colorado River than either the TCEQ WAM or the "No Call" WAM developed for the 2006 Region K Plan. The model's use was approved by TWDB on March 11, 2008. With continued updates, it is currently recommended that this model be used to determine surface water availabilities of the Colorado River now and in future planning cycles.

Overall, the 2006 Region K Plan and the 2008 Region K WAM Cutoff model total availability numbers are very similar. The planning group feels the effort put forth to create the Region K WAM Cutoff model has been extremely valuable in providing advanced understanding of the surface water availability for the Colorado River Basin. The acceptance of the Cutoff modeling assumption allows the TCEQ WAM to be modified in a manner that alleviates the problems which were created by the modeling assumptions used in the 2006 round of planning. The information provided from the revised model can be a new starting point for surface water availability estimation as part of the 2011 Plan.

Overall, the 2006 Region K Plan and the 2008 Region K WAM Cutoff model total availability numbers are very similar. Through its review, input, and recommendations related to this Task 1 process, the planning group has indicated the effort put forth to create the Region K WAM Cutoff model has been valuable in advancing the group's understanding of the surface water availability for the Colorado River Basin. The acceptance of the Cutoff modeling assumption allows the TCEQ WAM to be modified in a manner that alleviates the problems which were created by the modeling assumptions used in the 2006 round of planning. The information provided from the revised model can be a new starting point for surface water availability estimation as part of the 2011 Plan. Despite the overall similarities in total water availability with the 2006 Region K Plan, the preliminary supply estimates presented in this study indicate both increases and decreases in run-of-river water availability at the level of individual water rights as compared to the supply estimates in the 2006 Plan. The largest shortage increase created by the revised model was located in irrigation in Matagorda County, specifically for the Gulf Coast run-of-river water right. Percentage-wise, all of the irrigation run-of-river water rights with the June 29, 1913 priority date were reduced in the revised model as compared to the 2006 "No-Call" model. The Garwood irrigation water right, with the most senior priority date of November 1, 1900, showed an increase in availability from the results of the 2006 "No-Call" model, with that water most likely coming from the availability decrease in the less senior irrigation water rights. Although there are supply differences on an individual water right basis between the two models, the similarity in water availability on an aggregate regional basis gives confidence in the performance of the Cutoff modeling assumption. The individual differences in water right supplies are likely attributable to the manner in which the two models achieve a redistribution of inflows between the upper and lower Colorado basins, with 2008 Region K WAM Cutoff model offering an improvement in model representation of real-world operations. Efforts to expand current strategies or create new strategies to address these new shortages will occur during the next phase of planning.

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APPENDIX A

TECHNICAL MEMORANDUM BY TCB.....A-1
TECHNICAL MEMORANDUM BY HOFFPAUIR CONSULTING.....A-3
TECHNICAL MEMORANDUM BY TRC/BRANDES.....A-20

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APPENDIX B

DESCRIPTION OF REVISED WAM……...B-1
MODEL APPROVAL REQUEST LETTER SENT TO TWDB……...B-5
MODEL APPROVAL LETTER RECEIVED FROM TWDB……...B-8

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APPENDIX C

EXPANDED TABLE 3.3……C-1
REVISED AVAILABILITY BY WATER SOURCE……C-2
REVISED SUPPLY BY WATER USER GROUP (WUG) ……C-5

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APPENDIX D

REVISED SHORTAGE ANALYSIS TABLES

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APPENDIX E

WATER AVAILABILITY COMPARISON

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