5.2 Water-Related Impacts

This section describes the impacts of hydrologic alterations on the availability and quality of water resources and the plant water supply, as well as water-use impacts associated with the operation of STP 3 & 4. The following topics are covered:

- Hydrologic alterations resulting from operations of STP 3 & 4 and impact on offsite locations and the effects of these alterations on other water users
- Adequacy of water supplies to meet plant water needs
- Water quality changes and possible effects on water use
- Practices that would minimize or avoid hydrologic alterations having adverse impacts

The evaluation of impacts from hydrologic alterations and water quality changes caused by the operation of STP 3 & 4 is discussed in the following sections.

5.2.1 Hydrologic Alterations and Plant Water Supply

There are no known future diversions from the Colorado River planned for downstream of the STP site. The operation of STP 3 & 4 would not alter surface water flow patterns at the site, including the flood plain areas, with the possible exception of the Colorado River, which will be discussed further in this section. The impact of hydrologic alterations caused by STP 3 & 4 operational activities on offsite locations would be limited to maintenance activities along the existing transmission rights-of-way, which would be similar in nature to those from the existing operation of STP 1 & 2. The possible alteration impacts would be SMALL and would not warrant additional mitigation.

The STP 3 & 4 closed-cycle cooling system would require makeup water supplied to the ~~main cooling reservoir~~ Main Cooling Reservoir (MCR) from the Colorado River to replace that lost to evaporation, drift (entrained in atmospheric water vapor), and blowdown (water released to purge solids). As discussed in Subsection 2.3.2, the MCR is an industrial reservoir and is not considered to be waters of the state (Reference 5.2-1). Seepage losses from the MCR to groundwater are attributed to STP 1 & 2 operation and the addition of STP 3 & 4 would have insignificant impact on the seepage rates (Section 3.3). As discussed in Section 3.3, groundwater used for potable and sanitary use, power plant makeup and other plant uses, and for makeup water for the ~~ultimate heat sink~~ Ultimate Heat Sink (UHS) (mechanical draft cooling towers) would be pumped from existing groundwater wells up to the limits of the current groundwater permit (3000 acre-feet/year [Reference 5.2-2]). STP 3 & 4 total groundwater requirements under normal use conditions were estimated to be 1077 gpm (normalized). Under maximum use conditions, the normalized rate of use was estimated to be 3935 gpm. The maximum groundwater demands are estimated based on the requirements of one unit during a planned refueling outage and the second unit in a forced outage using worst-case relative humidity. Well water demand for the UHS makeup is an average of 720 gpm under normal use conditions and an average of 3030 gpm under maximum use conditions. If the total demand for groundwater is

greater than the well water system capacity, the required additional UHS makeup water would be provided from the MCR (Section 3.3).

The expected normalized rate of withdrawal of Colorado River water (Section 3.3) to replace water losses from the MCR due to STP 3 & 4 heat loads during normal operating conditions is estimated to be approximately 23,170 gpm and 23,427 gpm during maximum (peak) use operations. As discussed in Subsection 2.3.2, the STP site is currently permitted to withdraw 102,000 acre-feet per year or a normalized rate of 62,234 gpm. This permitted withdrawal rate is sufficient to support operation of all four STP units.

MCR makeup water would be pumped from the existing STP Reservoir Makeup ~~Plant~~ Pumping Facility (RMPF) on the Colorado River to the MCR to replace evaporative losses, and blowdown from the MCR, as required to maintain MCR water quality and level (Figure 3.3-1) would be through the existing discharge system. Water would be withdrawn from the MCR for main condenser and turbine system cooling and returned to the MCR. The MCR also would receive blowdown from the STP 3 & 4 UHS and STP 3 & 4 processed waste flows. There would be no direct discharges of individual waste streams to the Colorado River or to groundwater

The most significant water loss from the STP 3 & 4 cooling water system would be through evaporation of water from the MCR. Blowdown to the Colorado River from the MCR would occur if required to maintain water quality in the MCR. Blowdown would occur in accordance with the existing Texas Pollution Discharge Elimination System (TPDES) permit.

Water diverted to the MCR is currently considered lost to potential downstream surface water users and downstream aquatic communities and is considered a consumptive loss. The groundwater pumped from the existing site wells serving the STP site would also be considered a consumptive loss because the water would be either consumed or discharged to the MCR.

The assessment that follows conservatively assumes that all Colorado River water pumped to the MCR and all groundwater pumped from the wells is consumed. In reality, some water returns to the Colorado River as groundwater flow as the water seeps from the MCR and infiltrates the upper shallow portion of the groundwater system beneath the MCR. The water then flows toward the Colorado River where it discharges. Water from the MCR is also released through the pressure relief wells located in the above-grade dike surrounding the MCR. Water from these relief wells is discharged to a surface water ditch that surrounds the MCR and flows away from the reservoir through the STP site's natural drainage features.

As discussed in Subsection 2.3.2, the projected firm water demands for stored water in the Highland Lakes located upstream of the STP site on the Colorado River is currently still less than the total firm water available. Therefore, it is extremely remote that firm water rights would be reduced, even under extreme drought conditions. If conditions are worse than the drought of record, which occurred from the late 1940s through the 1950s (Subsection 2.3.2), the LCRA must curtail and distribute the

available supply of firm water among all of its firm water supply customers on a pro rata basis (Reference 5.2-3). As discussed in Subsection 2.3.2, the STP site currently has surface water rights for 102,000 acre-feet per year and an additional 20,000 acre-feet/year of backup water for two-unit operation and 40,000 acre-feet/year for four-unit operation during periods when the water necessary to maintain the MCR at or above an elevation of 27 feet mean sea level is not available from the Colorado River. If this situation were to occur, the backup water would be released by the LCRA from firm stored water or any other sources of water originating upstream of the Bay City Dam (Reference 5.2-4).

Operation of STP 3 & 4 would not create any new impacts in the vicinity of the flood plain. The infrastructure constructed in the floodplains is currently used for STP 1 & 2. The current facilities would support STP 3 & 4. There would be no new infrastructure built in support of STP 3 & 4 in the flood plain areas adjacent to the site that would create impacts resulting from alterations to the flood plain flow paths.

5.2.2 Water Use Impacts

5.2.2.1 Surface Water

Long-term (1948–2005) daily Colorado River flow records were used to estimate the annual mean, the lowest annual mean, and the lowest daily mean flows of the Colorado River in the vicinity of the STP site (Reference 5.2-5).

Based on the planned cooling system configuration (Figure 3.3-1), surface water removal from the Colorado River for STP 3 & 4 is estimated to be at a normalized rate of 42,604 gpm under normal operating conditions and 44,779 gpm under maximum operating conditions, which could occur for a period of approximately 48 hours (see Table 3.3-1). Of these surface water removal rates, approximately 23,170 gpm (normal operating conditions) and 23,427 gpm (maximum use operations) are attributable to STP 3 & 4 heat loads. The long-term monthly average Colorado River flow upstream of the STP site at the closest U.S. ~~Geologic~~ Geological Survey (USGS) Gauging Station ~~(USGS, 08162500)~~ 08162500 (Figure 2.3.1-5) near Bay City (Reference 5.2-5) varies from 374,748 gpm to 1,919,518 gpm (Table 5.2-1).

Less than 12% (Table 5.2-1) of the estimated monthly mean Colorado River flow near Bay City would be lost to makeup. Makeup withdrawal for maximum use operations from the Colorado River projected for STP 3 & 4 represents 3.8% of the historical annual mean flow (1,180,344 gpm [2630 cfs]) of the river near Bay City. However, the annual mean flow during 2006 was 303,834 gpm ~~(677 cfs [Reference 5.2-5])~~ (677 cfs) (Reference 5.2-5). The projected normal use withdrawal of 42,604 gpm for STP 3 & 4 during a 303,834 gpm (677 cfs) flow event would represent 14% of flow. As discussed in Subsection 2.3.1.1, the probable minimum flow rate at Bay City is estimated as zero. If there is no downstream flow, the Colorado River near the STP RMPF intake structure would be occupied by tidal water. Because Segment 1401 is considered tidal, there is no established 7Q10 value for the Colorado River for Segment 1401 (Reference 5.2-5). The closest stream gauge to the STP site where 7Q10 data is maintained is the Bay City USGS Gauging Station 08162500 where, from October 1, 1976 through December 31, 2005, the 7Q10 (7 consecutive day low period over a 10-year period)

was determined to be 20 cfs (Reference 5.2-6). Because of the zero probable minimum flow at Bay City and a low 7Q10 value of 20 cfs, the 7Q10 water flow value will not be used to determine potential impacts.

As discussed in Subsection 2.3.2 and indicated in Table 2.3.2-9, STP 1 & 2 currently withdraws surface water as needed from the Colorado River after confirming that the flow at the USGS Bay City Gauging Station is capable of supporting the withdrawal of surface water in accordance with the current STP 1 & 2 surface water withdrawal permit. Surface water flow of the Colorado River will continue to be monitored for flow before the withdrawal of surface water for STP 3 & 4 operations to ensure that surface water could be pumped in accordance with the current STPNOC surface water use permit. This practice helps ensure that water withdrawn from the Colorado River is acceptable for supply into the MCR.

Surface water withdrawals would be in accordance with current STPNOC water rights permits and contracts with the Lower Colorado River Authority (LCRA). Therefore, during low-flow days, withdrawal of surface water for the operation of STP 3 & 4 could have a SMALL impact on the availability of fresh water downstream of the site and not warrant additional mitigation. The cumulative impacts of all four operating units are discussed in Section 10.5.

5.2.2.2 Groundwater

As discussed in Subsection 2.3.2, groundwater wells would be used to supply makeup water to STP 3 & 4 for the ~~ultimate heat sink~~ UHS, service water for the power plant makeup and use, and water for the potable and sanitary systems. From 2001 to 2006, STP 1 & 2 groundwater production averaged 798 gpm from five production wells located in the deep confined aquifer (Table 2.3.2-16). The highest production (863 gpm) was in 2001. The lowest production was 745 gpm, in 2002. The existing five production wells at STP (Subsection 2.3.2) are permitted to withdraw a combined total of 3000 acre-feet per year (1860 gpm).

As discussed in Section 3.3, the groundwater needs for STP 3 & 4 would be 1077 gpm during normal operations and 3935 gpm during maximum operations. The primary groundwater production for STP 1 & 2 is through the use of production Wells 5, 6, and 7. As discussed in Subsection 2.3.2, the average use for 2001 through 2006 of groundwater for STP 1 & 2 is 798 gpm. This would allow the use of approximately 1062 gpm for normal operations of STP 3 & 4 which would require an average production rate of approximately 1077 gpm. During normal operations of STP 3 & 4, STPNOC would use groundwater in excess of that used by STP 1 & 2 up to the current permitted limit of 3000 acre-feet/year (an average of 1860 gpm). STPNOC would use the MCR to supply additional water above this value as required for continued operations. STPNOC is currently evaluating the possibility of permitting and installing additional groundwater wells at the STP site. Once the evaluation has been completed, the NRC would be notified if additional wells are proposed. Should additional wells be proposed, STPNOC would submit the necessary well permit applications to the Coastal Plains Groundwater Conservation District (CPGCD) and TCEQ as required for approval.

To meet the proposed maximum or peak groundwater demand (normalized value of 3935 gpm) for STP 3 & 4, STPNOC would supply the water needed for STP 3 & 4 UHS makeup in excess of the normal operations groundwater value (normalized value of 1077 gpm) by using water stored in the MCR to supply the additional water instead of permitting and installing additional wells at the STP site. As discussed in Subsection 2.3.1, any proposed new wells would be required to be at least 4000 feet from STP 1 & 2 and STP 3 & 4 to prevent potential subsidence of the facilities. Depending on the period of maximum operations of up to 30 days, and depending on the level of the MCR, an additional withdrawal rate of 2873 gpm would be required. This additional demand could create a short-term need for increased surface water withdrawal from the Colorado River.

To determine potential offsite impact during the operation of STP 3 & 4, cumulative projected water usage was used to calculate drawdown at the site boundary as though all water was pumped from a single onsite well. As discussed in Section 3.3, the normal use of groundwater for STP 3 & 4 may require the permitting and installation of additional groundwater wells. If additional wells are proposed, STPNOC would apply to the CPGCD for the necessary groundwater permit(s). The minimum distance allowed by the CPGCD between permitted wells is 2500 feet (Reference 5.2-7). Therefore, the 2500-foot distance will be used for the most conservative model distance from an STP site well to any potential offsite well. As with Section 4.2, a confined nonleaky aquifer scenario was used to determine the drawdown at the offsite groundwater well location closest to the STP 3 & 4 well location. Data used to input to an analytical distance-drawdown model is described in Subsection 2.3.1 and are referenced in Table 5.2-2.

A confined nonleaky scenario would most likely represent actual site conditions. The hydrologic parameters used in support of a confined nonleaky aquifer scenario are included in Table 5.2-2. The Theis nonequilibrium well equations (Reference 5.2-8) for a confined nonleaky scenario are as follows:

$s = [Q/4(3.14)T](W(u))$ $\quad u = r^2S/4Tt$

where:

s = drawdown (ft) $\quad$ T = transmissivity, ft^2/day

Q = pumping rate, ft^3/day $\quad$ t = time since pumping started, days

W(u) = Theis well function $\quad$ S = coefficient of storage

r = distance to pumping well, ft

The assumptions made were that the aquifer is homogeneous, isotropic, of uniform thickness, and of infinite aerial extent. The assumptions also include that the potentiometric surface before pumping is horizontal; the well is pumped at a constant discharge rate; the well is fully penetrating and flow is horizontal; the well diameter is infinitesimal so that storage within the well can be neglected; and water from storage is discharged instantaneously with decline of head.

An assumption was made that all of the water to be pumped was from a fully penetrating single well (any site well). The results of the confined nonleaky scenario model indicated that drawdown from normal operation of STP 3 & 4 of the deeper portion of the Chicot Aquifer potentiometric surface 2500 feet from a single STP site well was 38 to 42 feet based on an average pumping rate of 1062 gpm over a period of 40 years. The pumping rate of 1062 gpm is the remainder of the current STP site permit after the average of 798 gpm STP 1 & 2 groundwater use rate is subtracted (1860 gpm–798 gpm). Drawdown values for the deep portion of the Chicot Aquifer for the above pumping case, pumping at the maximum permit limit of 3000 acre-feet/year (an average of 1860 gpm) and pumping at a well design yield of 500 gpm, are included in Table 5.2-2.

In reality, the actual withdrawal resulting from the pumping of an STP well 2500 feet away would result in less drawdown than assigning all of the total pumping rates to one well. For example, the projected drawdown of (Table 5.2-2) over a 40-year period at a pumping rate of 1062 gpm would result in a drawdown of 38 to 42 feet. Pumping at a rate of no more than 500 gpm over a 40-year period in any single well would result in a drawdown of 18 to 20 feet 2500 feet from that well. These values assume that no two pumping wells adjacent to each other are used at the same time. If this were to occur, the effects of the two wells being pumped simultaneously would result in an overlap of drawdown and would likely lower drawdown in areas between the pumping wells. The additive effect could extend off site. However, most of the additive effect form the onsite pumping of multiple wells would remain on the STP site.

Because of the confining unit between the deep and shallow portions of the Chicot Aquifer, STPNOC concludes that there would be no impact to the shallow portion of the aquifer during operation of STP 3 & 4. However, STPNOC concludes that impacts due to increased pumping during operational activities at STP 3 & 4 to the deeper portion of the Chicot Aquifer would be SMALL and would not warrant mitigation. The cumulative impacts of all four units on groundwater resources are discussed in Section 10.5S.

5.2.3 Water Quality Impacts

5.2.3.1 Chemical Impacts

Mechanical draft cooling towers, such as the ones proposed for the STP 3 & 4 UHS, remove waste heat by allowing water to evaporate to the atmosphere. The water lost to evaporation must be replaced continuously with makeup water to prevent the accumulation of solids and solid scale formation. To prevent buildup of these solids, a small portion of the circulating water with elevated levels of solids is drained or blown down, and cooling tower water chemistry must be maintained with anti-scaling compounds and corrosion inhibitors.

Similarly, because conditions in cooling towers are conducive to the growth of fouling bacteria and algae, a biocide must be added to the system. This is normally a chlorine or bromine-based compound, but occasionally, hydrogen peroxide or ozone is used. Table 3.6-1 lists water treatment chemicals currently used for STP 1 & 2 and that would likely be used in STP 3 & 4.

Water drawn from the Colorado River is expected to require limited treatment to prevent biofouling in the makeup intake structure and makeup water piping. Additional water treatment would take place in the cooling tower basins, and would include the addition of biocides, anti-scaling compounds, and dispersants. Sodium hypochlorite and sodium bromide are used to control biological growth in the existing circulating water system and would likely be used in the new system as well. TPDES Permit No. WQ0001908000, issued in 2005 (Reference 5.2-9), limits total residual chlorine (0.05 milligrams per liter daily maximum) from any single generating unit for more than two hours per day unless longer periods are required for macroinvertebrate control. Discharge from the MCR may not exceed 12.5% of the flow of the Colorado River at the discharge point. Processed wastewater discharged from STP 3 & 4 facilities to the MCR would be similar to that currently discharged under the STP 1 & 2 TPDES permit. STPNOC would submit the necessary applications to TCEQ for permitting the proposed STP 3 & 4 discharges to the MCR.

Discharge from the MCR cannot occur when the Colorado River is less than 800 cfs (Reference 5.2-9). As discussed in Subsection 2.3.2, there is currently no routine discharge from the MCR to the Colorado River. STP 1 & 2 has discharged water from the MCR to the Colorado River once, in 1997. Projections of the MCR water quality and additional demands upriver could necessitate the use of the STP permitted reservoir blowdown system to maintain water quality by 2010. MCR water quality is currently maintained by selective pumping during high river flow conditions (>1200 cfs) (Reference 5.2-10). If upstream demands increase, the availability of water at a flow greater than 1200 cfs could be reduced.

Blowdown from the MCR to the Colorado River would occur as necessary to maintain the MCR water quality at an average of 3000 micro-Siemens per centimeter (µS/cm) (Reference 5.2-4). The current TPDES permit (Reference 5.2-10) allows an average MCR discharge rate of 144 mgd with a daily maximum of 200 MGD. The permit pH range for water discharged from the MCR is between 6.0 and 9.0 standard units. The water temperature daily average limit is 95°F with a daily maximum of 97°F. The total residual chlorine daily maximum is 0.05 milligrams per liter (mg/L) (Reference 5.2-10). Limits on outfall concentrations, rates, and schedules for STP 3 & 4 operational discharges to the MCR would be determined through the TPDES permitting process. STPNOC would submit the new or modified permit provisions to the NRC when they become available.

As discussed in Subsection 2.3.3, during 2004 Segment 1401 of the Colorado River (the reach of the river associated with STP) was listed as fully supporting aquatic life, contact recreation, and general use (Reference 5.2-11). As indicated in Reference 5.2-12, Segment 1401 was added to the list of impaired waters due to the presence of bacteria. The STP 1 & 2 wastewater treatment facility currently discharges treated water to the MCR where it is diluted by water of the MCR and reused. The waste water from current STP 1 & 2 facilities does not discharge directly to the Colorado River.

Impacts of chemicals in the proposed MCR blowdown on the Colorado River water quality would be SMALL and would not warrant mitigation. STPNOC would submit the necessary permit applications to TCEQ for review for a modified or new TPDES permit

for STP 3 & 4 facility discharges to the MCR and from the MCR to the Colorado River. TCEQ would evaluate potential effects of STP 3 & 4 on the MCR water quality and the Colorado River water quality and determine if adjustments are necessary to the current TPDES permitted 001 outfall limits. STPNOC would monitor the MCR water quality on a regular basis in conjunction with the MCR water level to determine if and when blowdown is necessary. STPNOC would continue to monitor flow of the Colorado River prior to withdrawing surface water and discharging water to the Colorado River.

5.2.3.2 References

5.2-1 TCEQ (Texas Commission on Environmental Quality) 2007. Letter from Kelly Holligan (TCEQ) to R. A. Gangluff (STP Nuclear Operating Company) Re: Cooling Water Intake Structures Phase II Rules; South Texas Project Electric Generating Station; TPDES Permit No. WQ0001908000, June 27, 2007.

5.2-2 Operating Permit, STP Nuclear Operating Company, Historical User Permit No. OP-04122805, Coastal Plains Groundwater Conservation District, March 2005.

5.2-3 LCRA (Lower Colorado River Authority), Water Management Plan for the Lower Colorado River Basin, May 2003.

5.2-4 STPNOC (South Texas Project Nuclear Operating Company), 2006. Amended and Restated Contract by and between the Lower Colorado River Authority and STPNOC. Effective as of January 1, 2006.

5.2-5 USGS (U.S. Geological Survey) Water Year 2006 Report, Colorado River, USGS Station 08162500 near Bay City, Texas, April 24, 2007.

5.2-6 Holligan (Karen Visnovsky Holligan), 7Q10 Flows. E-mail from Karen Visnovsky Holligan (TCEQ) to Bridget Twigg (TtNUS) June 13, 2007.

5.2-7 CPGCD (Coastal Plains Groundwater Conservation District), Rules of the Coastal Plains Groundwater Conservation District, adopted May 25, 2004.

5.2-8 “Groundwater and Wells,” Fletcher G. Driscoll, 2nd Edition, Johnson Filtration Systems Inc., St. Paul, Minnesota, 1989.

5.2-9 TCEQ, STP Nuclear Operating Company, TPDES Permit No. 001908000 Renewal. July 21, 2005.

5.2-10 STPNOC (South Texas Project Nuclear Operating Company), South Texas Project Electric Generating Station Certificate of Adjudication 14-5437, May 1, 2005, Rev. 1.

5.2-11 TCEQ 2004 Texas Water Quality Inventory and 303(d), April 14, 2007.

5.2-12 TCEQ 2006 Texas Water Quality Inventory and 303(d), April 27, 2007.

Table 5.2-1 Comparison of Colorado River Flows and STP 3 & 4 Cooling Water Flows

	Mean Monthly River Flow [1], [2]	Maximum [3] River Withdrawal for Makeup (2 units)	Percent of Mean Monthly River Flow Lost to Maximum Makeup (2 units)	Maximum Total Evaporation Rate (2 units) [1]	Percent of Average Flow Lost to Evaporation
January	1,150,274	44,779	3.9	48,556	4.2
February	1,455,907	44,779	3.1	48,556	3.3
March	1,281,324	44,779	3.5	48,556	3.8
April	1,225,224	44,779	3.7	48,556	4.0
May	1,642,608	44,779	2.7	48,556	3.0
June	1,919,518	44,779	2.3	48,556	2.5
July	844,642	44,779	5.3	48,556	5.7
August	374,748	44,779	11.9	48,556	13.0
September	787,195	44,779	5.7	48,556	6.2
October	1,103,150	44,779	4.1	48,556	4.4
November	1,248,562	44,779	3.6	48,556	3.9
December	1,100,906	44,779	4.1	48,556	4.4

[1] All flows in gallons per minute

[2] Reference 5.2-4

[3] Maximum water withdrawal occurs during normal operations

Table 5.2-2 Drawdown Inputs for Confined Nonleaky Aquifer Scenario/Operations

Case	1	2	3	4	5
Distance (feet) [1]	2,500	2,500	2,500	2,500	2,500
Storage Coefficient [2]	0.00076 to 0.00022	0.00076 to 0.00022	0.00076 to 0.00022	0.00076 to 0.00022	0.00076 to 0.00022
Transmissivity [2] ($feet^2$/day)	4,444	4,444	4,444	4,444	4,444
Time (Days)	3,650	7,300	10,950	14,600	14,600
Flow, Q (gpm)	1,062	1,062	1,062	1,062	500
Drawdown at any potential off-site well location 2500-foot distance	33 to 37	35 to 40	37 to 41	38 to 42	18 to 20

Case 1 to 4 - STP 3 & 4 pumping at remaining permit rate (1860 gpm – 798 gpm).
Case 5 STP 1 & 2 pumping at current maximum design yield of 500 gpm for the production wells.
[1] Section 2.3.2
[2] Section 2.3.1