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Environmental Impact Statement for Combined Licenses (COLs) for South Texas Project Electric Generating Station Units 3 and 4

Final Report

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

U.S. Army Corps of Engineers
U.S. Army Engineer District, Galveston
Galveston, TX 77553-1229

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by STP Nuclear Operating Company (STPNOC) for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the STPNOC application are (1) NRC issuance of COLs for two new nuclear power reactor units at the South Texas Project Electric Generating Station (STP) site in Matagorda County, Texas, and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit to perform certain construction activities on the site. The Corps is participating in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the STP site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts.

The EIS includes the evaluation of the proposed action's impacts to waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Appropriation Act of 1899. The Corps will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the Corps' permit decision document, will include an alternatives analysis to determine the Least Environmentally Damaging Practicable Alternative.

After considering the environmental aspects of the proposed action, the NRC staff's recommendation to the Commission is that the COLs be issued as proposed. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by STPNOC; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and in this EIS. The Corps will issue its Record of Decision based, in part, on this EIS.

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Executive Summary

By letter dated September 20, 2007, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from STP Nuclear Operating Company (STPNOC) for combined construction permits and operating licenses (combined licenses or COLs) for South Texas Project Electric Generating Station (STP) Units 3 and 4, located in Matagorda County, Texas. The review team's evaluation is based on the October 2010 revision to the application, responses to requests for additional information, and supplemental letters.

The proposed actions related to the STP Units 3 and 4 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the STP site, and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Act to perform certain construction activities on the site. The Corps is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency and participates collaboratively on the review team. The reactor specified in the application is the certified U.S. Advanced Boiling Water Reactor design, as modified by a proposed amendment to the ABWR design certification that is being sought by STPNOC to address the requirements of 10 CFR 50.150 on the ability of the design to withstand the impact of a large commercial aircraft (U.S. ABWR, hereafter referred to as ABWR in this EIS).

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 *et seq.*) directs that an EIS be prepared for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

The purpose of STPNOC's requested NRC action—issuance of the COLs—is to obtain licenses to construct and operate two new nuclear units. These licenses are necessary but not sufficient for construction and operation of the units. A COL applicant must obtain and maintain the necessary permits from other Federal, State, Tribal, and local agencies and permitting authorities. Therefore, the purpose of the NRC's environmental review of the STPNOC application is to determine if two new nuclear units of the proposed design can be constructed and operated at the STP site without unacceptable adverse impacts on the human environment. The purpose of STPNOC's requested Corps action is to obtain a permit to perform regulated activities that would impact waters of the United States.

Upon acceptance of the STPNOC application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent

(72 FR 72774) to prepare an EIS and conduct scoping. On February 5, 2008, the NRC held two scoping meetings in Bay City, Texas, to obtain public input on the scope of the environmental review. The staff reviewed the comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments.

To gather information and to become familiar with the sites and their environs, the NRC and its contractor Pacific Northwest National Laboratory (PNNL) visited the STP site in February 2008 and the Allens Creeks alternative site in March 2008. In August 2009, the NRC and PNNL visited the Red 2 and Trinity 2 alternative sites. During the site visits, the NRC staff and its contractors met with STPNOC staff, public officials, and the public.

Included in this EIS are (1) the results of the review team's analyses, which consider and weigh the environmental effects of the proposed actions; (2) potential mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's recommendation regarding the proposed action.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels – SMALL, MODERATE, and LARGE:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

In preparing this EIS, the review team reviewed the application, including the Environmental Report (ER) submitted by STPNOC; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NUREG-1555, *Environmental Standard Review Plan* and Staff Memorandum on *Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements*. In addition, the NRC staff considered the public comments related to the environmental review received during the scoping process. Comments within the scope of the environmental review are included in Appendix D of this EIS.

A 75-day comment period began on March 26, 2010, when the U.S. Environmental Protection Agency (EPA) published a Notice of Availability of the draft EIS to allow members of the public and agencies to comment on the results of the environmental review. During this period, the NRC and Corps staff conducted two public meetings in Bay City, Texas, to describe the results of the environmental review, respond to questions, and accept public comment. All comments received on the draft EIS are included in Appendix E.

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs be issued as requested. This recommendation is based on (1) the application, including the ER submitted by STPNOC; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of public comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The Corps will issue its Record of Decision based, in part, on this EIS.

The NRC staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the NRC's Safety Evaluation Report, which is still being developed.

Abbreviations/Acronyms

AADT	Average Annual Daily Traffic
ABWR	U.S. Advanced Boiling Water Reactor
ac	acre(s)
ac-ft/yr	acre-feet per year
ACHP	Advisory Council on Historic Preservation
ADAMS	Agencywide Documents Access and Management System
AEC	U.S. Atomic Energy Commission
AEP	American Electric Power
AEP	Archaeology and Ethnography Program
AIA	Aircraft Impact Assessment
APE	area of potential effect
ALARA	as low as is reasonably achievable
ARRA	American Recovery and Reinvestment Act of 2009
ASLB	Atomic Safety and Licensing Board
BACT	best available control technology
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BGCD	Bluebonnet Groundwater Conservation District
BGS	below ground surface
BMP	best management practice
Btu	British thermal unit(s)
Bq	Becquerel(s)
BRA	Brazos River Authority
BWR	boiling water reactor
°C	degree(s) Celsius
CAES	compressed air energy storage
CBC	Christmas Bird Count
CCD	Census County Division
CDC	Centers for Disease Control and Prevention
CDF	core damage frequency
CDR	Capacity, Demand, and Reserves Report
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	curie(s)
cm	centimeter(s)

CMP	Coastal Management Program
CMZ	Coastal Management Zone
CNP	CenterPoint Energy
CO	carbon monoxide
CO_2	carbon dioxide
COL	combined license
CORMIX	Cornell Mixing Zone Expert System
Corps	U.S. Army Corps of Engineers
CPGCD	Coastal Plains Groundwater Conservation District
CPS Energy	City Public Service Board of San Antonio, Texas
CPUE	catch per unit effort
CR	County Road (CR 360, CR 392)
CREZ	Competitive Renewable Energy Zones
CWA	Clean Water Act
CWIS	circulating water intake structure
CWS	circulating water system
CZMA	Coastal Zone Management Act
DBA	Design Basis Accident
dBA	decibel(s) (acoustic)
DC	design certification
DCD	Design Control Document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DSM	demand side management
D/Q	deposition values
DWS	drinking water standards
EA	Environmental Assessment
EAB	Exclusion Area Boundary
ECP	Essential Cooling Pond
EIA	Energy Information Administration
EIS	environmental impact statement
EFH	essential fish habitat
ELF	extremely low frequency
ELCC	effective load carrying capability
EMF	electromagnetic field
EOF	Emergency Operations Facility
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ERCOT	Electric Reliability Council of Texas

ESA	Endangered Species Act of 1973, as amended
ESRP	Environmental Standard Review Plan
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FDA	final design approval
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement
FM	Farm-to-Market
FMP	Fishery Management Plan
fps	feet per second
FR	Federal Register
FSAR	Final Safety Analysis Report
FSC	Federal Species of Concern
FSER	Final Safety Evaluation Report
ft	foot or feet
ft^2	square feet
ft^3	cubic feet
FWS	U.S. Fish and Wildlife Service
GBq	gigabecquerel
GCC	global climate change
GCRP	U.S. Global Change Research Program
GE	General Electric
GEIS	generic environmental impact statement
GHG	greenhouse gases
GIT	Georgia Institute of Technology
GIWW	Gulf Intracoastal Waterway
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWMS	gaseous waste-management system
ha	hectare(s)
HAPC	habitat areas of particular concern
hr	hour(s)
Hg	mercury
HLW	high-level waste
Hz	hertz
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection

IGCC	integrated gasification combined cycle
in.	inch
INEEL	Idaho National Engineering and Environmental Laboratory
IOU	investor owned utility
ISD	Independent School District
ISO	independent system operator
I&S	interest and sinking fund
km	kilometer(s)
km^2	square kilometer(s)
kWh	kilowatt-hour(s)
kV	kilovolt(s)
L	liter(s)
lb	pound(s)
LCRA	Lower Colorado River Authority
LCRWPG	Lower Colorado Regional Water Planning Group
LEDPA	least environmentally damaging practicable alternative
LERF	large early release frequency
LLW	low-level waste
LNG	liquefied natural gas
LOS	level of service
LPZ	Low Population Zone
LRF	large release frequency
LST	local standard time
LSWP	LCRA-SAWS Water Project
LTDEF	long-term demand energy forecast
LTSF	Long-Term Storage Facility
LWA	Limited Work Authorization
LWMS	liquid waste management system
LWR	light water reactor
m	meter(s)
m^3	cubic meter(s)
MACCS2	MELCOR Accident Consequence Code System Version 2
MBq	megabecquerel(s)
MCEDC	Matagorda County Economic Development Corporation
MCEMO	Matagorda County Emergency Management Office
MCPE	market clearing prices of energy
MCR	Main Cooling Reservoir
MDC	Main Drainage Channel

MEI	maximally exposed individual
METGCD	Mid-East Texas Groundwater Conservation District
mg	milligram(s)
MGD	million gallons per day
mg/L	milligram(s) per liter
mi	mile(s)
mi^2	square mile(s)
MIT	Massachusetts Institute of Technology
mL	milliliter(s)
MMS	Minerals Management Service
mo	month
MOU	Memorandum of Understanding
M&O	maintenance and operations
mph	mile(s) per hour
mR	milliroentgen
mrad	millirad(s)
mrem	millirem(s)
μS	microsiemens
MSA	Metropolitan Statistical Area
MSL	mean sea level
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s) of uranium
MUD	municipal utilities district
MW	megawatt(s)
MWd	megawatt-day(s)
MW(e)	megawatt(s) electrical
MW(t)	megawatt(s) thermal
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection & Measurements
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NHPA	National Historic Preservation Act of 1966, as amended
NIEHS	National Institute of Environmental Health Sciences
NINA	Nuclear Innovation North America
NMFS	National Marine Fisheries Services
NMM	navigation mile marker
NOAA	National Oceanic and Atmospheric Administration

NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRG	NRG South Texas LP
NRHP	National Register of Historic Places
NSR	new source review
NTF	Nuclear Training Facility
OCS	outer continental shelf
ODCM	offsite dose calculation manual
OSF	Onsite Staging Facility
OSGSF	Old Steam Generator Storage Facility
OSHA	Occupational Safety and Health Administration
OW	observation well
PAM	primary amoebic meningoencephalitis
pCi	picocuries
pCi/L	picocuries per liter
PGC	Power Generation Company
PIR	Public Interest Review
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
PM_{10}	particulate matter with a diameter of 10 microns or less
PNNL	Pacific Northwest National Laboratory
POSGCD	Post Oak Savannah Groundwater Conservation District
ppt	parts per thousand
PSD	prevention of significant deterioration
PUCT	Public Utility Commission of Texas
PWR	pressurized water reactors
RAI	request for additional information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCRWPG	Region C Regional Water Planning Group
RCW	Reactor Building Cooling Water
RE	refueling
rem	roentgen equivalent man (a special unit of radiation dose)
REMP	radiological environmental monitoring program
RIMS	Regional Input-Output Model System
RMPF	Reservoir Makeup Pumping Facility
RMR	reliability must run
ROD	Record of Decision

ROI	region of interest
ROW	right of way
RRGCD	Red River Groundwater Conservation District
RSICC	Radiation Safety Information Computational Center
RSW	Reactor Service Water
RV	recreational vehicle
Ryr	reactor-year
s	second(s)
SACTI	Seasonal and Annual Cooling Tower Impacts
SAMA	severe accident mitigation alternatives
SAMDA	severe accident mitigation design alternatives
SAWS	San Antonio Water System
SCR	selective catalytic reduction
SECPOP 2000	Sector Population, Land Fraction, and Economic Estimation Program
SER	Safety Evaluation Report
SGIA	signed generation interconnection agreement
SHPO	State Historic Preservation Officer
SO_2	sulphur dioxide
SO_x	sulphur oxide
STP	South Texas Project Electric Generating Station
STPEGS	STP Electric Generating Station
STPNOC	STP Nuclear Operating Company
SUV	sport utility vehicle
Sv	sievert
SWMS	solid waste management system
SWPPP	Stormwater Pollution Prevention Plan
TAC	Texas Administrative Code
TAMUG	Texas A&M University at Galveston
TBEG	Texas Bureau of Economic Geology
TBq	terabecquerel(s)
TCC	Texas Central Company
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Plan
TDCJ	Texas Department of Criminal Justice
TDHCA	Texas Department of Housing and Community Affairs
TDS	total dissolved solids
TDSHS	Texas Department of State Health Services
TEA	Texas Education Agency
TEDE	total effective dose equivalent

Texas RE	Texas Reliability Entity
THC	Texas Historical Commission
TIS	Texas Interconnected System
TLD	thermoluminescent dosimeter
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TPWP	Texas Prairie Wetlands Project
TRAGIS	Transportation Routing Analysis Geographic Information System
TRC	Texas Railroad Commission
TSECO	Texas State Energy Conservation Office
TSHA	Texas State Historical Association
TWC	Texas Water Code
TWDB	Texas Water Development Board
TX	Texas
TxDOT	Texas Department of Transportation
U_3O_8	triuranium octaoxide ("yellowcake")
UF_6	uranium hexafluoride
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
UMTRI	University of Michigan Transportation Research Institute
UO_2	uranium oxide
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
VOC	volatile organic compound
WCS	Waste Control Specialists, LLC
WHO	World Health Organization
WMA	Wildlife Management Area
WSEC	White Stallion Energy Center
WSWTS	West Sanitary Waste Treatment System
WCID	Water Control and Improvement District
χ/Q	atmospheric dispersion values
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

1.0 Introduction

By letter dated September 20, 2007, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from STP Nuclear Operating Company (STPNOC) for combined construction permits and operating licenses (combined licenses or COLs) for South Texas Project Electric Generating Station (STP) Units 3 and 4. The review team's evaluation is based on the October 2010 revision (Revision 4) to the application, responses to requests for additional information, and supplemental information.

The location of the proposed Units 3 and 4 is approximately 2000 ft northwest of the existing STP Units 1 and 2. The STP site and existing facilities are owned by NRG Energy, Inc. (NRG); City Public Service Board of San Antonio, Texas (CPS Energy); and the City of Austin, Texas. It is planned that STP Unit 3 would be owned by Nuclear Innovation North America (NINA) Texas 3 LLC and CPS Energy, and STP Unit 4 would be owned by NINA Texas 4 LLC and CPS Energy (STPNOC 2010a). STPNOC would be the licensed operator for the proposed Units 3 and 4, as it currently is for the existing Units 1 and 2. In its application, STPNOC specified the certified U.S. Advanced Boiling Water Reactor (ABWR), as modified by STPNOC's proposed amendment to the ABWR (STPNOC 2010b), as the proposed reactor design for Units 3 and 4.

By letter dated January 19, 2011 (STPNOC 2011), STPNOC notified the NRC that its organizational arrangement was changing such that the lead applicant for STP Units 3 and 4 would be NINA, with STPNOC remaining as the operator. With the change, NINA would assume responsibility for the design and construction of STP Units 3 and 4 and STPNOC would be the operator and license holder for both new units. Throughout this environmental impact statement (EIS), the acronym "STPNOC" means the lead applicant or lead licensee responsible for design and construction (i.e., NINA) or operations (i.e., STPNOC), depending upon the context of the discussion.

On March 9, 2010, STPNOC submitted a Department of the Army Permit application (STPNOC 2010c) to the U.S. Army Corps of Engineers (Corps) Galveston District for activities associated with constructing and operating STP Units 3 and 4. On March 25, 2010, the Corps published a public notice pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Appropriation Act of 1899. The Corps is participating with the NRC in preparing this EIS as a cooperating agency.

The proposed actions related to the STP Units 3 and 4 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the STP site; and (2) the Corps issuance of a permit pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. The permit application to the Corps requests authorization to expand an existing barge slip on the Colorado River and to culvert and fill waters of the United States for the purpose of constructing a heavy haul road on the site.

1.1 Background

A COL is a Commission approval for the construction and operation of a nuclear power facility. NRC regulations related to COLs are found primarily in Title 10 of the Code of Federal Regulations (CFR) Part 52, Subpart C.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 *et seq*.), requires preparation of an EIS for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

According to 10 CFR 52.80(b), a COL application must contain an Environmental Report (ER). The ER provides the applicant's input to the NRC's EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51. Part 3 of STPNOC's application contains the ER, which provides a description of the proposed actions related to the application and the applicant's analysis of the potential environmental impacts of construction and operation of proposed Units 3 and 4.

The STPNOC license application references the certified U.S. ABWR design (STPNOC 2010a; 10 CFR Part 52, Appendix A), as modified by a proposed amendment to the ABWR design certification (STPNOC 2010b) that is being sought by STPNOC to address the requirements of 10 CFR 50.150 on the ability of the design to withstand the impact of a large commercial aircraft. STPNOC referenced this proposed amendment in Revision 4 of its COL application, dated October 5, 2010. Subpart B of 10 CFR Part 52 contains NRC regulations related to standard design certifications. The referenced certified ABWR Design Control Document was approved by the NRC in March 1997 and the final design certification rule was published in the *Federal Register* (FR) on May 12, 1997 (62 FR 25827). This EIS accounts for the referenced ABWR design, as modified by STPNOC's proposed amendment to 10 CFR Part 52, Appendix A. Where appropriate, this EIS incorporates the results of the ABWR design review.

1.1.1 Application and Review

The purpose of the STPNOC application is to obtain COLs to construct and operate a baseload nuclear power plant comprised of two new reactors. In addition to the COLs, STPNOC must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The purpose of STPNOC's requested Corps action is to obtain a permit to perform regulated activities that would impact waters of the United States.

1.1.1.1 NRC COL Application Review

STPNOC submitted an ER as part of its COL application (STPNOC 2010d). The ER focuses on the environmental effects of construction and operation of two ABWR units. The NRC regulations setting standards for review of a COL application are listed in 10 CFR 52.81. Detailed procedures for conducting the environmental portion of the review are found in guidance set forth in NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000) and recent updates, hereafter referred to as the ESRP. Additional guidance on conducting environmental reviews is provided in the NRC Staff Memorandum *Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2010a).

In this EIS, the review team evaluates the environmental effects at the STP site of two ABWR reactors, each with thermal power ratings of 3926 MW(t). The new units would use a closed-loop cooling water system that would withdraw and discharge water from and to the Main Cooling Reservoir. In addition to considering the environmental effects of the proposed action, the NRC considers alternatives to the proposed action including the no-action alternative and the construction and operation of new reactors at alternative sites. Also, the benefits of the proposed action (e.g., need for power) and measures and controls to limit adverse impacts are evaluated. STPNOC's proposed action to construct and operate two new nuclear units includes requests for exemptions from the ABWR design certification (DC) under 10 CFR 52.93. The environmental impacts of the requested exemptions are addressed in this EIS. The technical analysis for each DC exemption will be included in the NRC's Final Safety Evaluation Report (SER), including a recommendation for approval or denial of each exemption.

Upon acceptance of the STPNOC application, the NRC began the environmental review process by publishing in the *Federal Register* on December 21, 2007, a Notice of Intent to prepare an EIS and conduct scoping (72 FR 72774). On February 5, 2008, the NRC held two public scoping meetings in Bay City, Texas, to obtain public input on the scope of the environmental review and contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A listing of the agencies and organizations contacted is provided in Appendix B. The staff reviewed the comments received during scoping and responses were written for each comment. In-scope scoping comments and responses are included in Appendix D. A complete listing of the scoping comments and responses is documented in the South Texas Project Combined License Scoping Summary Report (NRC 2008).

To gather information and to become familiar with the sites and their environs, the NRC and its contractor Pacific Northwest National Laboratory (PNNL) visited the STP site in February 2008 and the Allens Creeks alternative site in March 2008. In August 2009, the NRC and PNNL visited the Red 2 and Trinity 2 alternative sites. During the site visits, the NRC staff met with

STPNOC staff, public officials, and the public. Documents related to the STP site and alternatives sites were reviewed and are listed as references where appropriate.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels established by the NRC – SMALL, MODERATE, and LARGE:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the STP site, including the environmental impacts associated with constructing and operating reactors at the site, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's recommendation to the Commission regarding the issuance of COLs for proposed Units 3 and 4 at the STP site.

The draft EIS was published on March 19, 2010 (NRC 2010b). A 75-day comment period commenced on March 26, 2010, when the U.S. Environmental Protection Agency's (EPA's) Notice of Availability of the draft EIS appeared in the *Federal Register* (75 FR 14594), to allow members of the public and agencies to comment on the results of the environmental review. Two public meetings were held in Bay City, Texas, on May 6, 2010, to describe the preliminary results of the environmental review, respond to questions, and receive comments on the draft EIS. When the comment period ended on June 9, 2010, the review team considered all of the comments received. All comments received on the draft EIS are included in Appendix E. Changes made in response to public comments and other substantive changes are identified by change bars in the margins of this final EIS.

1.1.1.2 Corps Permit Application Review

The Corps is part of the review team that makes a determination based on the three significance levels established by the NRC; however, the Corps' independent Record of Decision (ROD) regarding the aforementioned permit application will reference the analyses in the EIS and present any additional information required by the Corps to support its permit

decision. The Corps' role as a cooperating agency in the preparation of this EIS is to ensure that the information presented is adequate to fulfill the requirements of Corps regulations applicable to construction of the preferred alternative identified in the EIS. The Clean Water Act Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230), which contains the substantive environmental criteria used by the Corps in evaluating discharges of dredged or fill material into waters of the United States, and the Corps' Public Interest Review (PIR) (33 CFR 320.4), direct the Corps to consider a number of factors as part of a balanced process. A discussion of those factors is provided below. The Corps' PIR will be part of its permit decision document and thus will not be addressed in the EIS.

This EIS includes the Corps' evaluation of construction and maintenance activities that impact waters of the United States. The Corps' permit decision will reflect the national concern for both protection and use of important resources. The benefit, which reasonably may be expected to increase from the proposal, must be balanced against its reasonably foreseeable detriments. Public interest factors that may be relevant to the proposal will be considered. These factors include conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and cumulative impacts thereof. Evaluation of the impact on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act. The Corps will address these issues in its permit decision document.

As part of the Corps' permit evaluation process, the Corps issued a public notice on March 25, 2010, to solicit comments from the public about STPNOC's proposal to perform site preparation activities and construct supporting facilities at the STP site. Comments received on the Corps' public notice are provided in Appendix K of this EIS.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations for Nuclear Power Plants" (72 FR 57416), the Commission defined "construction" as those activities within its regulatory purview as defined in 10 CFR 51.4. Many of the activities required to construct a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associate activities. These preconstruction activities may take place before the application for a COL is submitted, during the review of a COL application, or after a COL is granted. Although preconstruction activities are outside the NRC's regulatory authority, nearly all of them are within the regulatory authority of local, State, or other Federal agencies.

Because the preconstruction activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities that propose to construct structures in and under navigable waters and to discharge dredged, excavated, and/or fill material into waters of the United States, including jurisdictional wetlands that require permits from the Corps, are viewed by the Corps as direct effects related to their Federal permitting action. Chapter 4 describes the relative magnitude of impacts related to construction and preconstruction activities.

1.1.3 Cooperating Agencies

NEPA lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may have special expertise regarding an environmental issue or jurisdiction by law. These other agencies are referred to as “cooperating agencies.” Cooperating agencies have the responsibility to assist the lead agency through early participation in the NEPA process, including scoping, by providing technical input to the environmental analysis, and by making staff support available as needed by the lead agency.

Most proposed nuclear power plants require a permit from the Corps, where impacts are proposed to waters of the United States, in addition to a license from the NRC. Therefore, the NRC and the Corps decided that the most effective and efficient use of Federal resources in the review of nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, the NRC and the Corps signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (Corps and NRC 2008). Therefore, the Galveston District of the Corps is participating as a cooperating agency as defined in 10 CFR Part 51.14.

As described in the MOU, the NRC is the lead Federal agency, and the Corps is a cooperating agency in the development of the EIS. Under Federal law, each agency has jurisdiction related to portions of the proposed project as major Federal actions that could significantly affect the quality of the human environment. The goal of this cooperative agreement is the development of one EIS that serves the needs of the NRC license decision process and the Corps permit-decision process. While both agencies must comply with the requirements of NEPA, both agencies also have mission requirements that must be met in addition to the NEPA requirements. The NRC makes license decisions under the Atomic Energy Act of 1954, as amended (42 USC 2011 *et seq.*), and the Corps makes permit decisions under the Rivers and Harbors Appropriation Act of 1899 and the Clean Water Act. The Corps is cooperating with the NRC to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of Corps regulations, the EPA’s Clean Water Act Section 404(b)(1) guidelines, which contain the substantive environmental criteria used by the Corps in evaluating discharges of dredged or fill material into waters of the United States, and the Corps PIR process.

As a cooperating agency, the Corps is part of the NRC review team, involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. For the purposes of assessment of environmental impact under NEPA, the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.1.1 of this EIS; this approach has been vetted by the Council on Environmental Quality when the NRC established its environmental review framework for the renewal of operating licenses. A cooperating agency may adopt the EIS of a lead Federal agency without recirculating it when the cooperating agency concludes, after an independent review of the EIS, that its comments and suggestions have been satisfied and issues a ROD. The goal of the process is that the Corps will have all the information necessary to make a permit decision when the final EIS is issued. However, it is possible that the Corps may still need some information from the applicant to complete the permit documentation, information that the applicant could not make available by the time of final EIS issuance.

1.1.4 Concurrent NRC Reviews

In reviews that are separate from, but parallel to, the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in a SER issued by the NRC. The SER presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two ABWR reactors can be constructed and operated at the STP site without undue risk to the health and safety of the public, (2) whether the emergency preparedness program meets the applicable requirements in 10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73, and 10 CFR Part 100, and (3) whether site characteristics are such that adequate security plans and measures as referenced in the above CFR Parts can be developed. Preparation of the final SER for the STPNOC COL application is ongoing.

STPNOC submitted an application to amend the design certification rule for the ABWR by letter dated June 30, 2009 (STPNOC 2009b). The purpose of the amendment is to demonstrate compliance with the requirements in 10 CFR 50.150, the Commission's new aircraft impact assessment (AIA) rule. The AIA rule requires "…applicants for new nuclear power reactors to perform a design-specific assessment of the effects of the impact of a large, commercial aircraft. The applicant is required to use realistic analyses to identify and incorporate design features and functional capabilities to show, with reduced use of operator actions, that either the reactor core remains cooled or the containment remains intact, and either spent fuel cooling or spent fuel pool integrity is maintained." The staff documented their safety findings in an SER. In addition, the staff prepared an environmental assessment (EA) that was limited to the review of the impact of the proposed amendment on the existing analysis of severe accident mitigation design alternatives for the ABWR design. The results of that EA are incorporated into this EIS. On January 20, 2011, the Commission published a proposed rule (76 FR 3540) to approve the proposed amendment to the ABWR design. If the NRC makes a final determination to approve

the STPNOC amendment, it will do so in a final rule. The COL for Units 3 and 4 would not be issued until the design certification amendment is issued as a final rule.

In addition to the COL review, STPNOC submitted a request to the NRC for a limited work authorization (LWA), in accordance with 10 CFR 50.10(d), for construction of permanent crane foundation retaining walls. In its request dated November 16, 2009, STPNOC explained why it did not believe an LWA was required for this particular activity (STPNOC 2009a). The NRC responded on January 08, 2010, that STPNOC would need an LWA for the retaining walls and therefore must either (1) submit a complete LWA request, (2) submit a request for an exemption, or (3) delay construction of the retaining walls until the COLs have been issued for Units 3 and 4 (NRC 2010c). STPNOC, in a letter dated February 2, 2010, withdrew their LWA request and formally requested an exemption (STPNOC 2010e). On March 23, 2010, STPNOC submitted a revised request for an exemption from 10 CFR 50.10(a)(1), to the extent necessary for the NRC to authorize installation of the retaining walls (STPNOC 2010f), supplemented by additional information on July 21, 2010 (STPNOC 2010g). The NRC conducted a separate safety and environmental review for STPNOC's exemption request. The results of that environmental review were issued in an EA, published in the *Federal Register* on November 3, 2010 (75 FR 67784). On November 5, 2010, the NRC granted STPNOC an exemption from 10 CFR 50.10 to begin construction activities related to the installation of the crane foundation retaining walls (NRC 2010d).

By letter dated October 25, 2010, STPNOC submitted an application to the NRC for renewal of the operating licenses of STP Units 1 and 2 (STPNOC 2010h). As part of that application review process, the NRC will analyze the environmental impacts of renewing the license for an extended period of operation and document its analysis in an EIS. The NRC will also evaluate whether the effects of aging on plant equipment will be managed such that Units 1 and 2 can be operated during the period of extended operation without undue risk to the health and safety of the public and will document its conclusions in an SER.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52, of COLs for authorizing the construction and operation of two new ABWR units at the STP site. This EIS provides the NRC's analyses of the environmental impacts that could result from building and operating two proposed new units at the STP site or at one of the three alternative sites. These impacts are analyzed to determine if the proposed site is suitable for the addition of the new units and whether any of the alternative sites is considered obviously superior to the proposed site.

The Corps' Federal action is the decision whether to issue a permit pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 to authorize certain construction activities potentially affecting waters of the United States based on an evaluation of

the probable impacts, including cumulative impacts, of the proposed construction activities on the public interest. These impacts are analyzed by the Corps to determine whether there is a practicable alternative with less adverse impact on the aquatic ecosystem provided that the alternative does not have other significant adverse consequences.

1.3 The Purpose and Need for the Proposed Actions

The continued growth of residential and commercial development in Texas has created an increased demand for electrical power. The purpose of this proposed action, authorization of the construction and operation of two ABWR units at the STP site, is to provide additional baseload electrical generation capacity for use in the owner's current markets and/or for potential sale on the wholesale market. The need for additional baseload power is discussed in Chapter 8 of this EIS.

Two COLs from the NRC are needed to construct and operate the proposed two new units. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COLs are granted. STPNOC must obtain and maintain permits or authorizations from other Federal, State, and local agencies, and permitting authorities before undertaking certain activities. The ultimate decision whether or not to build the new units and the schedule for building are not within the purview of the NRC or the Corps and would be determined by the license holder if the authorizations are granted.

1.4 Alternatives to the Proposed Actions

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement analyzing alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 9 of this EIS addresses five categories of alternatives to the proposed action: (1) the no-action alternative, (2) energy source alternatives, (3) alternative sites, (4) system design alternatives, and (5) onsite alternatives to reduce impacts to aquatic resources.

In the no-action alternative, the proposed action would not go forward. The NRC could deny STPNOC's request for the COLs. If the request was denied, the construction and operation of the two new units at the STP site would not occur nor would any benefits intended by the approved COLs be realized. Energy source alternatives include alternative energy sources, focusing on those alternatives that could generate baseload power. The alternative site selection process to determine alternate site locations for comparison with the STP site is addressed below. System design alternatives include heat dissipation and circulating water systems, intake and discharge structures, and water-use and treatment systems. Finally, onsite

alternatives evaluated by the Corps to reduce potential impacts to waters of the United States including jurisdictional wetlands and shoreline resources, are described.

In its ER, STPNOC defines a region of interest for use in identifying and evaluating potential sites for power generation. Using this process, the applicant reviewed multiple sites and identified nine primary sites for this project from which the alternative sites were selected. The staff evaluated the region of interest, the process by which alternative sites were selected, and the environmental impacts of construction and operation of a new power reactor at those sites using reconnaissance-level information. The alternative sites selected from the primary sites include two privately owned greenfield sites and a greenfield site that is partially owned by NRG Energy, Inc. and was previously considered for the location of a nuclear power plant. The objective of the comparison of environmental impacts is to determine if any of the alternative sites are obviously superior to the proposed STP site.

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act, the Corps is required by regulation to apply the criteria set forth in the 404(b)(1) guidelines (33 USC 1344; 40 CFR Part 230). These guidelines establish criteria that must be met in order for the proposed activities to be permitted pursuant to Section 404. Specifically, these guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse consequences (40 CFR 230.10(a)).

1.5 Compliance and Consultations

Before building and operating new units, STPNOC is required to obtain certain Federal, State, and local environmental permits, as well as meet applicable statutory and regulatory requirements. STPNOC (2010d) provided a list of environmental approvals and consultations associated with the proposed Units 3 and 4. Potential authorizations, permits, and certifications relevant to the proposed COLs are included in Appendix H. The NRC staff reviewed the list and contacted the appropriate Federal, State, Tribal, and local agencies to identify any consultation, compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the acceptability of the STP site for building and operating the two proposed ABWR units. A chronology of the correspondence is provided as Appendix C. A list of the key consultation correspondence is provided as Appendix F, which also contains a biological assessment and an essential fish habitat assessment.

1.6 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”

10 CFR Part 73. Code of Federal Regulations, Title 10, *Energy*, Part 73, “Physical Protection of Plants and Materials.”

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, “Reactor Site Criteria.”

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Parts 320-330, “General Regulatory Policies to Nationwide Permit Program.

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, “Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material.”

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, “Terminology and Index.”

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South Texas Project Nuclear Operating Company (STPNOC). 2009b. Letter from Mark McBurnett, STPNOC, to NRC, dated June 30, 2009, "Application to Amend the Design Certification Rule for the U.S. Advanced Boiling Water Reactor (ABWR)." Accession No. ML092040048.

South Texas Project Nuclear Operating Company (STPNOC). 2010a. *South Texas Project Units 3 and 4 Combined License Application, Part 1, General and Financial Information*. Revision 4, Bay City, Texas. Accession No. ML102860173.

South Texas Project Nuclear Operating Company (STPNOC). 2010b. *ABWR STP Aircraft Impact Assessment (AIA) Amendment*. Revision 3, Bay City, Texas. Accession No ML102870017.

South Texas Project Nuclear Operating Company (STPNOC). 2010c. Letter from Scott Head, STPNOC, to the U.S. Army Corps of Engineers Galveston District, dated March 9, 2010, "South Texas Project Units 3 and 4 Application for Department of Army Permit." Accession No. ML102700237.

South Texas Project Nuclear Operating Company (STPNOC). 2010d. *South Texas Project Units 3 and 4 Combined License Application, Part 3, Environmental Report*. Revision 4, Bay City, Texas. Accession No. ML102860592.

South Texas Project Nuclear Operating Company (STPNOC). 2010e. Letter from Mark McBurnett, STPNOC, to NRC dated February 02, 2010, "Request for Exemption to Authorize Installation of Crane Foundation Retaining Walls." Accession No. ML100350219.

South Texas Project Nuclear Operating Company (STPNOC). 2010f. Letter from Mark McBurnett, STPNOC, to NRC dated March 23, 2010, "Request for Exemption to Authorize Installation of Crane Foundations Retaining Walls." Accession No. ML100880055.

South Texas Project Nuclear Operating Company (STPNOC). 2010g. Letter from Scott Head, STPNOC, to NRC dated July 21, 2010, "Revised Request for Exemption to Authorize Installation of Crane Foundations Retaining Walls." Accession No. ML102070274.

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U.S. Army Corps of Engineers and U.S. Nuclear Regulatory Commission (Corps and NRC). 2008. *Memorandum of Understanding: Environmental Reviews Related to the Issuance of Authorizations to Construct and Operate Nuclear Power Plants*. September 12, 2008. Accession No. ML082540354.

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U.S. Nuclear Regulatory Commission (NRC). 2008. *South Texas Project Combined License Scoping Summary Report.* Washington, D.C. Accession No. ML082260454.

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U.S. Nuclear Regulatory Commission (NRC). 2010b. *Draft Environmental Impact Statement for Combined Licenses (COLs) for South Texas Project Electric Generating Station Units 3 and 4 – Draft Report for Comment*. NUREG-1937, Volumes 1 and 2. Washington, D.C.

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U.S. Nuclear Regulatory Commission (NRC). 2010d. Letter from Mark Tonacci, NRC, to Mark McBurnett, STPNOC, dated November 5, 2010, "South Texas Project Nuclear Power Plant Units 3 and 4 Exemption from the Requirements of Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.10 (TAC NO. RG1056)." Accession No. ML102770454.

2.0 Affected Environment

The site proposed by STP Nuclear Operating Company (STPNOC) is located in a rural area of Matagorda County, Texas. STPNOC currently operates two nuclear generating units (existing Units 1 and 2) on the South Texas Project (STP) site. The site is located approximately 10 mi north of Matagorda Bay, 70 mi south-southwest of Houston, and 12 mi south-southwest of Bay City, Texas, along the west bank of the Colorado River. The proposed Units 3 and 4 location is described in Section 2.1, followed by descriptions of the land, water, ecology, socioeconomics, environmental justice, historic and cultural resources, air, geology, and radiological and nonradiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects, and references are presented in Section 2.13.

2.1 Site Location

STPNOC's proposed location for Units 3 and 4 is wholly within the STP site, approximately 1500 ft north and 2150 ft west of the center of the existing Units 1 and 2 containment buildings on the north side of the Main Cooling Reservoir (MCR), as shown in Figure 2-1 (STPNOC 2010a). Bay City Census County Division (CCD) is the closest population center (more than 25,000 residents) to the proposed new units (STPNOC 2010a) (Figure 2-2). The STP property is approximately 12,220 ac and directly borders the west side of the Colorado River on the site's east boundary.

2.2 Land Use

This section discusses existing conditions related to land-use issues on and in the vicinity (i.e., the area encompassed within a radius of 6 mi) of the STP site. Section 2.2.1 describes the site and the vicinity around the site. Section 2.2.2 discusses the existing transmission line corridors. Section 2.2.3 discusses the region, defined as the area within 50 mi of the site boundary.

2.2.1 The Site and Vicinity

The STP site comprises approximately 12,220 ac in an unincorporated area of Matagorda County, Texas. Land-use classifications of the STP site are shown in Figure 2-3. Landscape features and habitat types are shown in Figure 2-4. Land-use classifications within a 6-mi radius of the STP site are shown in Figure 2-5.

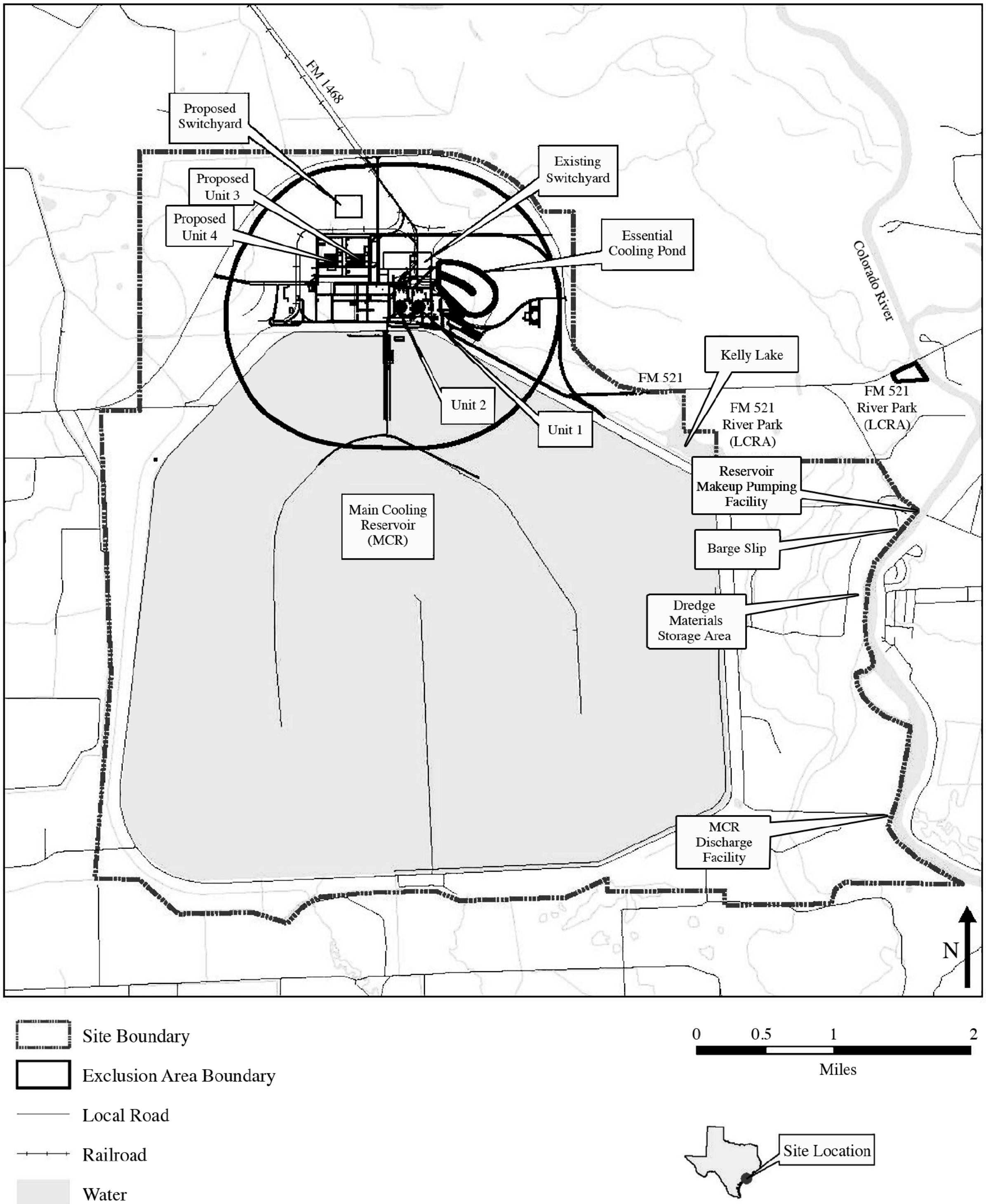

Figure 2-1. STP Site and Proposed Plant Footprint (STPNOC 2010a)

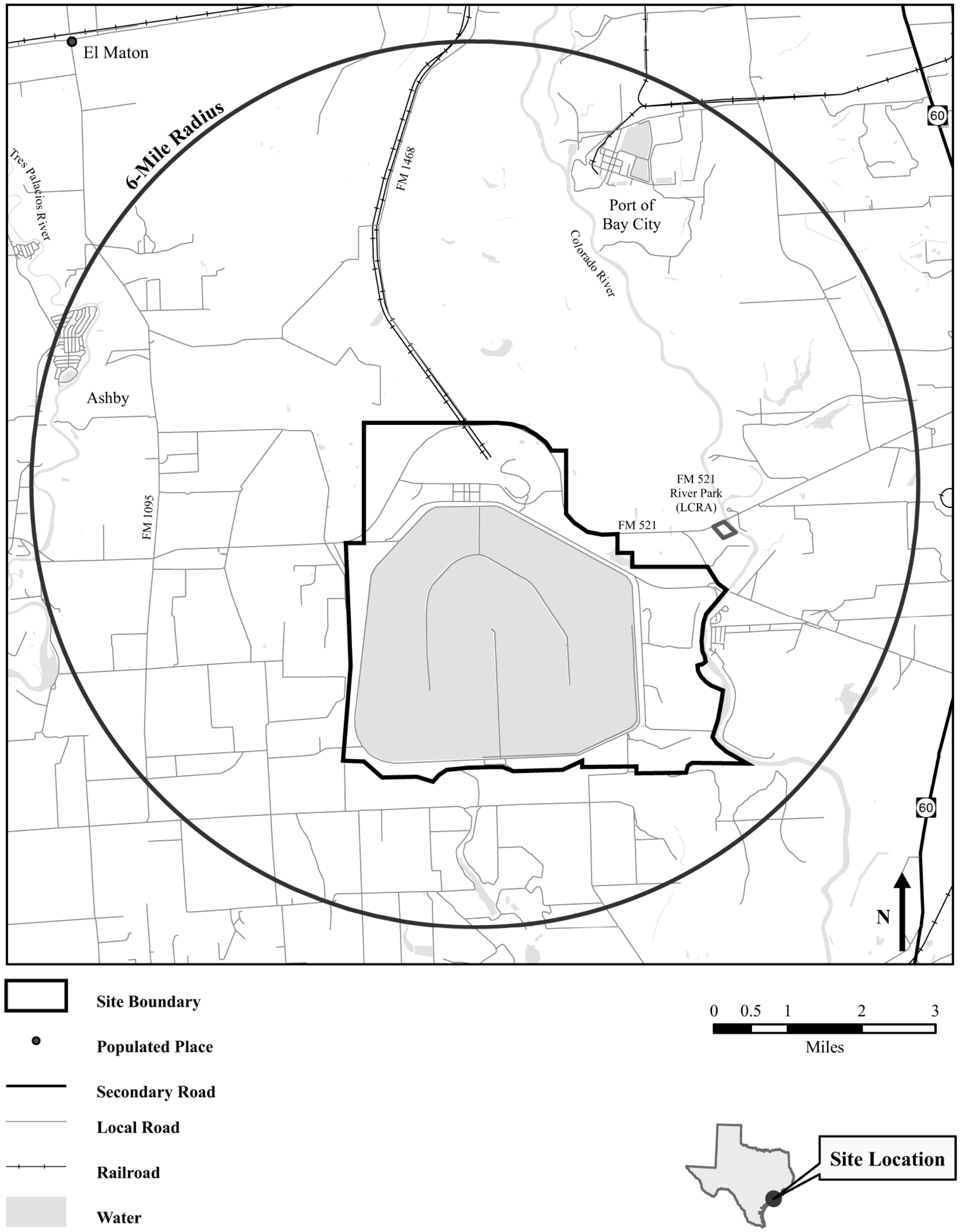

Figure 2-2. STP Site and Vicinity (STPNOC 2010a)

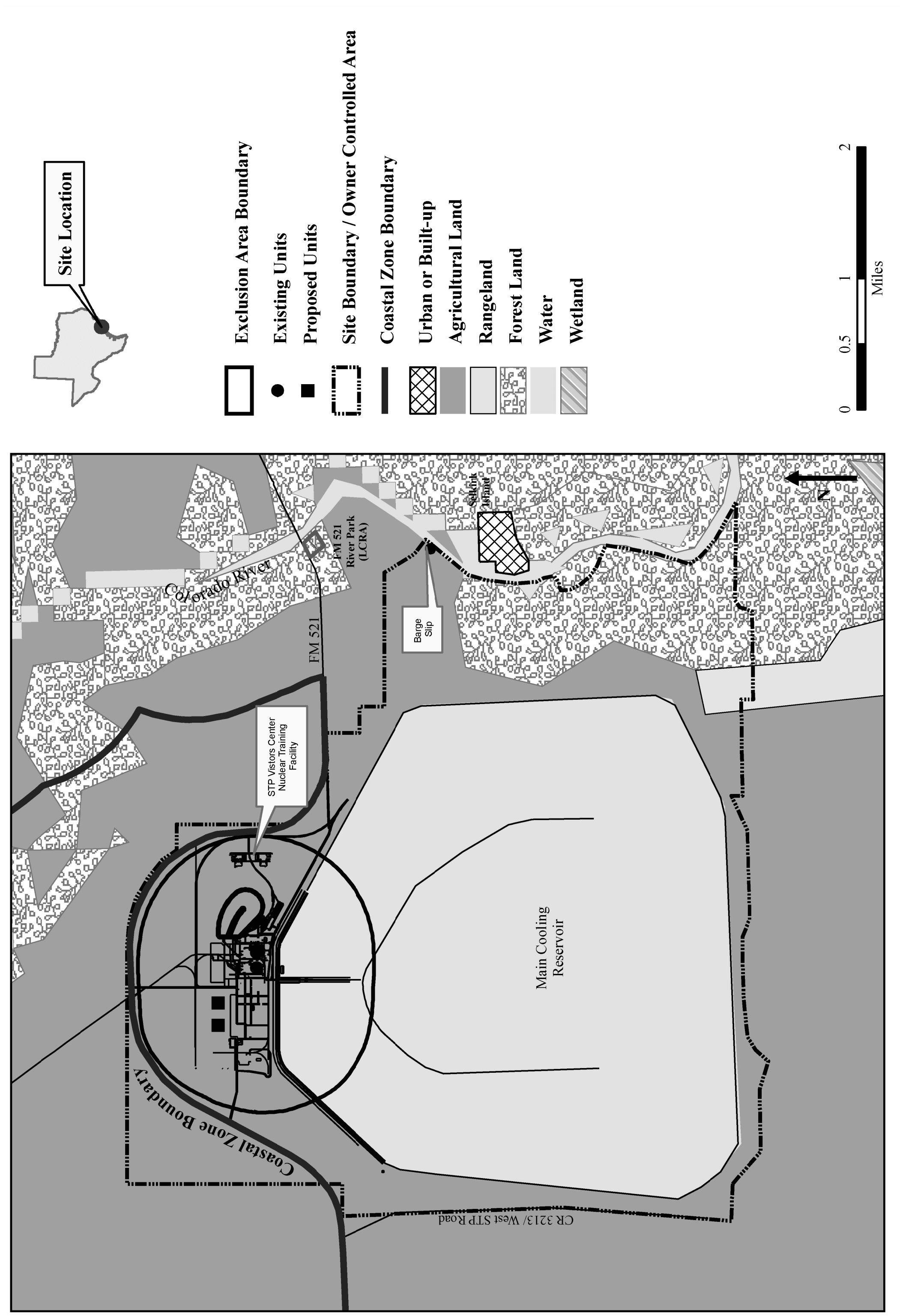

Figure 2-3. Land-Use Classifications at STP Site (STPNOC 2010a)

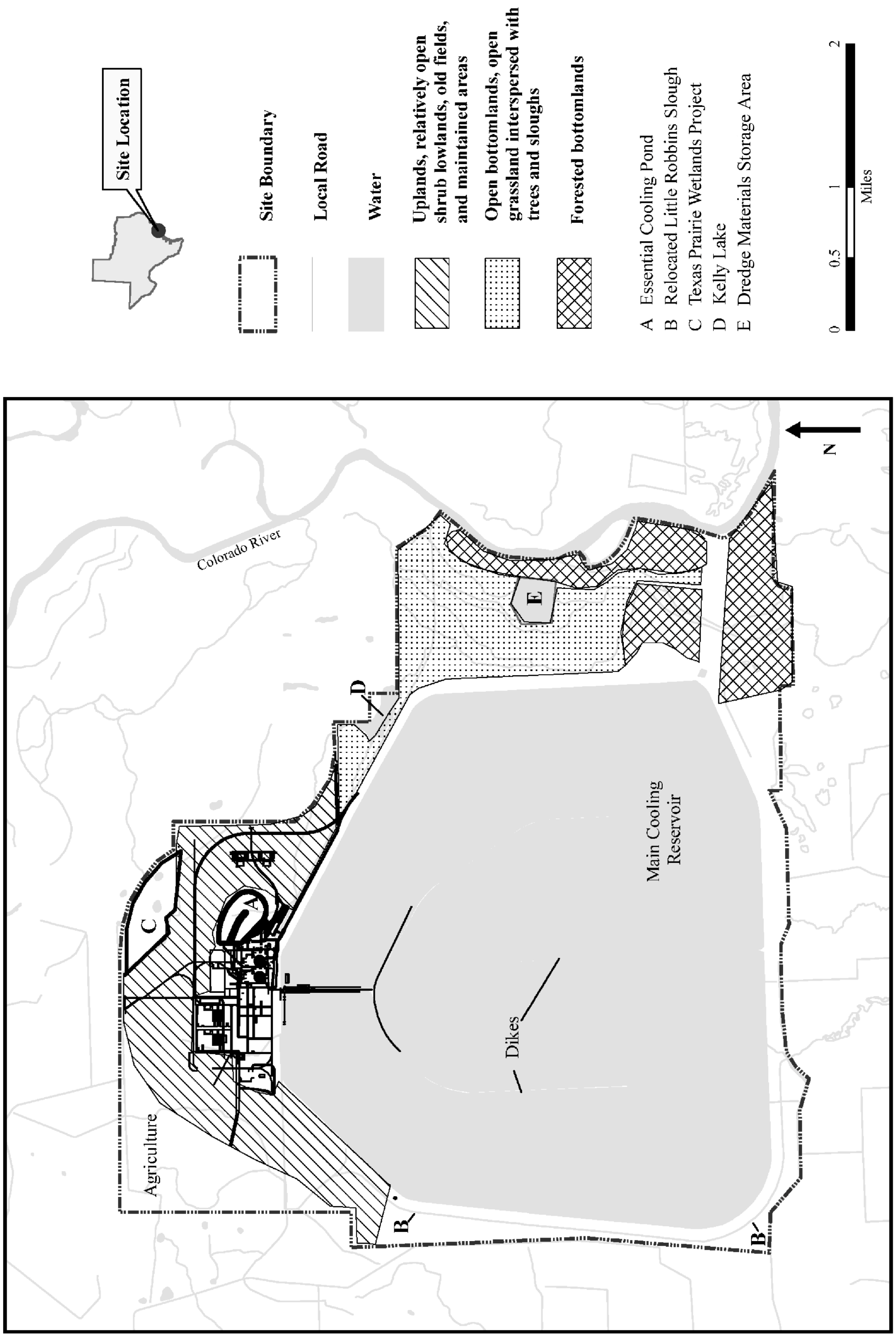

Figure 2-4. Landscape Features and Habitat Types of the STP Site (adapted from STPNOC 2010a)

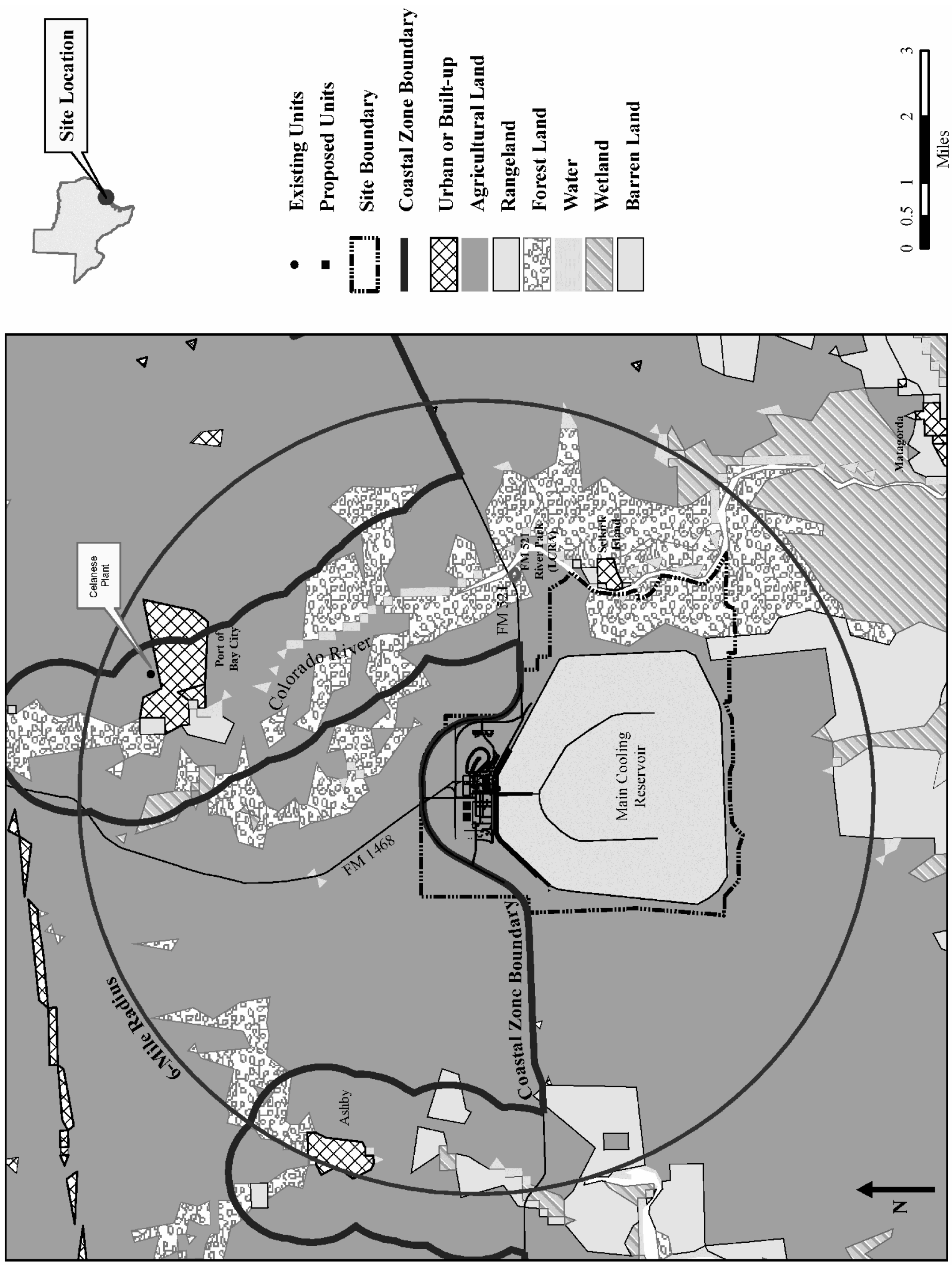

Figure 2-5. Land-Use Classifications in the Vicinity of the STP Site (STPNOC 2010a)

The topography in the vicinity of the STP site is characterized by relatively flat coastal plain with farmland and pasture land predominating. Elevations generally range from 20 to 30 ft above mean sea level (MSL). Approximately 67 percent of the land within the 6-mi vicinity of the STP site is agricultural land; 15 percent is forest land; 11 percent is water; 1 percent is wetlands; 4 percent is rangeland, grassland, or bottomland; 2 percent is urban; and less than 1 percent is barren land (STPNOC 2010a).

The STP site contains two existing nuclear generating units, STP Units 1 and 2, which are licensed by the U.S. Nuclear Regulatory Commission (NRC) and have a combined net electric generating capacity of approximately 2500 MW(e). Unit 1 began commercial operation in March 1988, and Unit 2 began commercial operation in March 1989. Together, the two existing nuclear units, other facilities such as the training facility, and onsite transmission line corridors occupy approximately 300 ac of the STP site (STPNOC 2010a).

The MCR occupies approximately 7000 ac of the STP site, and about 1750 ac are currently occupied by Units 1 and 2 and associated facilities. The remainder of the site is undeveloped land or is used for agriculture and cattle grazing. Some of the undeveloped land located east of the MCR is leased for cattle grazing (STPNOC 2010a). Land use within the STP site is summarized in Table 2-1.

Table 2-1. Land Use at the STP Site

Land Use Category	Acres	Percentage
bottomland	1176	9.6
Units 1 and 2 construction spoils area	41	0.3
Essential Cooling Pond	46	0.4
existing facilities related to Units 1 and 2	300	2.5
forested communities	53	0.4
forested/mixed pastureland	91	0.7
leased agricultural lands	536	4.4
Main Cooling Reservoir	7000	57.3
maintained and disturbed areas	468	3.8
mixed grass communities	485	4.0
scrub shrub communities	970	7.9
wetlands	162	1.3
reservoir levee systems	759	6.2
dredge materials disposal area	133	1.1
Total	12,220	

Source: STPNOC 2010a

No zoning currently applies to the STP site (STPNOC 2010a). STPNOC has maintained its own land management plan for the STP site since 1995. Approximately 90 percent of the STP site, excluding the MCR and existing facilities, constitutes prime farmland (STPNOC 2010a).

The owners of the STP site own or control all of the mineral interests within the STP site boundary. The owners also have the power to acquire any outstanding mineral interests needed for operation of the proposed nuclear units. The owners control the surface minerals and any drilling used to recover minerals. However, the owners have agreed to not exercise their right to use any area within the exclusion area boundary at the STP site for explorations or recovery of minerals, or convey or lease mineral rights to any third party, without obtaining STPNOC's prior approval. There are mineral resources (e.g., sand and gravel, coal, oil, natural gas, ores) within the STP site boundary and within the 6-mi vicinity that are presently being exploited or are of known commercial value. There are two petroleum wells on the STP site that have been plugged and abandoned. There are also 7 petroleum wells, 26 natural gas wells, and 9 oil/gas wells within the 6-mi vicinity (STPNOC 2010a).

The 46-ac Essential Cooling Pond (ECP) serves as the Ultimate Heat Sink (UHS) for existing STP Units 1 and 2 and is east of Units 1 and 2 (STPNOC 2010a). The Texas Prairie Wetlands Project is a managed 110-ac shallow wetland area that was constructed in the northeast portion of the STP site in 1996 to enhance the site for waterbirds (STPNOC 2010a). There are waters of the United States subject to Federal regulatory authority within the proposed building and laydown/spoils sites for proposed Units 3 and 4.

The STP site is located along the west bank of the Colorado River. A barge slip on the Colorado River is located approximately 3.5 mi southeast of existing STP Units 1 and 2. The Colorado River is not a wild and scenic river as that term is defined at in 36 CFR 297.3. Small portions of the STP site near the Colorado River are within the 100-year and 500-year floodplains (STPNOC 2010a).

Several sloughs flow through the STP site. One slough feeds 34-ac Kelly Lake, which is located in the northeast corner of the site (see Figure 2-2) (STPNOC 2010a). Little Robbins Slough is an intermittent stream located in a channel on the west side of the west embankment of the MCR (STPNOC 2010a).

Access to the STP site is from farm-to-market (FM) roads FM 521 and FM 1468. FM 1468 intersects FM 521 approximately 350 ft west of the main plant entrance (STPNOC 2010a). An inactive railroad spur approximately 9 mi long, runs north from the STP site to a commercial railroad line operated by the Union Pacific Railroad. No natural gas pipelines traverse the STP site (STPNOC 2008f).

The Texas Parks and Wildlife Department (TPWD) operates the 7200-ac Mad Island Wildlife Management Area (WMA) located approximately 3 mi south of the STP site. There is a Lower

Colorado River Authority (LCRA) park approximately 3 mi east of the STP site (see Figure 2-1). The 7063-ac Clive Runnells Family Mad Island Marsh Preserve is approximately 4 mi southwest of the STP site and contains both upland prairie and a variety of coastal wetlands (STPNOC 2010a). The preserve is owned and operated by The Nature Conservancy of Texas. There are no schools, hospitals, or prisons within the vicinity of the STP site.

Most of the STP site is located within the coastal management zone established by the Texas Coastal Management Program (TCMP) (STPNOC 2010a). As required by Section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA) (16 USC 1451 *et seq*), STPNOC consulted with the Texas General Land Office to determine whether or not the proposed project would be consistent with the Texas Coastal Management Program. STPNOC submitted a consistency determination to the Texas Coastal Coordination Council in April 2008 for its review. The Council responded in a June 9, 2008, letter that no unavoidable adverse impacts had been found for proposed Units 3 and 4 and that the proposed project would therefore be consistent with the goals and policies of the TCMP (STPNOC 2010a).

2.2.2 Transmission Lines

Four transmission service providers currently serve the STP site: CenterPoint Energy, American Electric Power Texas Central Company, the City of Austin, and the City Public Service Board of San Antonio (STPNOC 2010a). The existing 345-kV switchyard at the STP site currently has nine 345-kV transmission lines that connect it to the utility grid. These nine lines occupy three corridors, identified as the Eastern, Western, and Northwestern (or Middle) corridors. The corridors originate at the STP site (STPNOC 2010a). The power transmission system for proposed Units 3 and 4 would not require new transmission lines or corridors, but would use five of the nine 345-kV transmission lines that currently connect to existing STP Units 1 and 2 (STPNOC 2010a). A portion of the system would be upgraded as discussed in Chapter 3.

2.2.3 The Region

The 50-mi region surrounding the STP site is shown in Figure 2-6. The STP site is approximately 12 mi south-southwest of Bay City, Texas, and 10 mi north of Matagorda Bay on the Gulf of Mexico. Bay City is the county seat of Matagorda County. Palacios is the other incorporated community in Matagorda County. No Tribal lands of Federally recognized Indian Tribal entities are located within the 50-mi region (STPNOC 2010a).

All or portions of nine counties (Brazoria, Fort Bend, Wharton, Jackson, Victoria, Calhoun, Lavaca, Colorado, and Matagorda) are within 50 mi of the STP site (STPNOC 2010a).

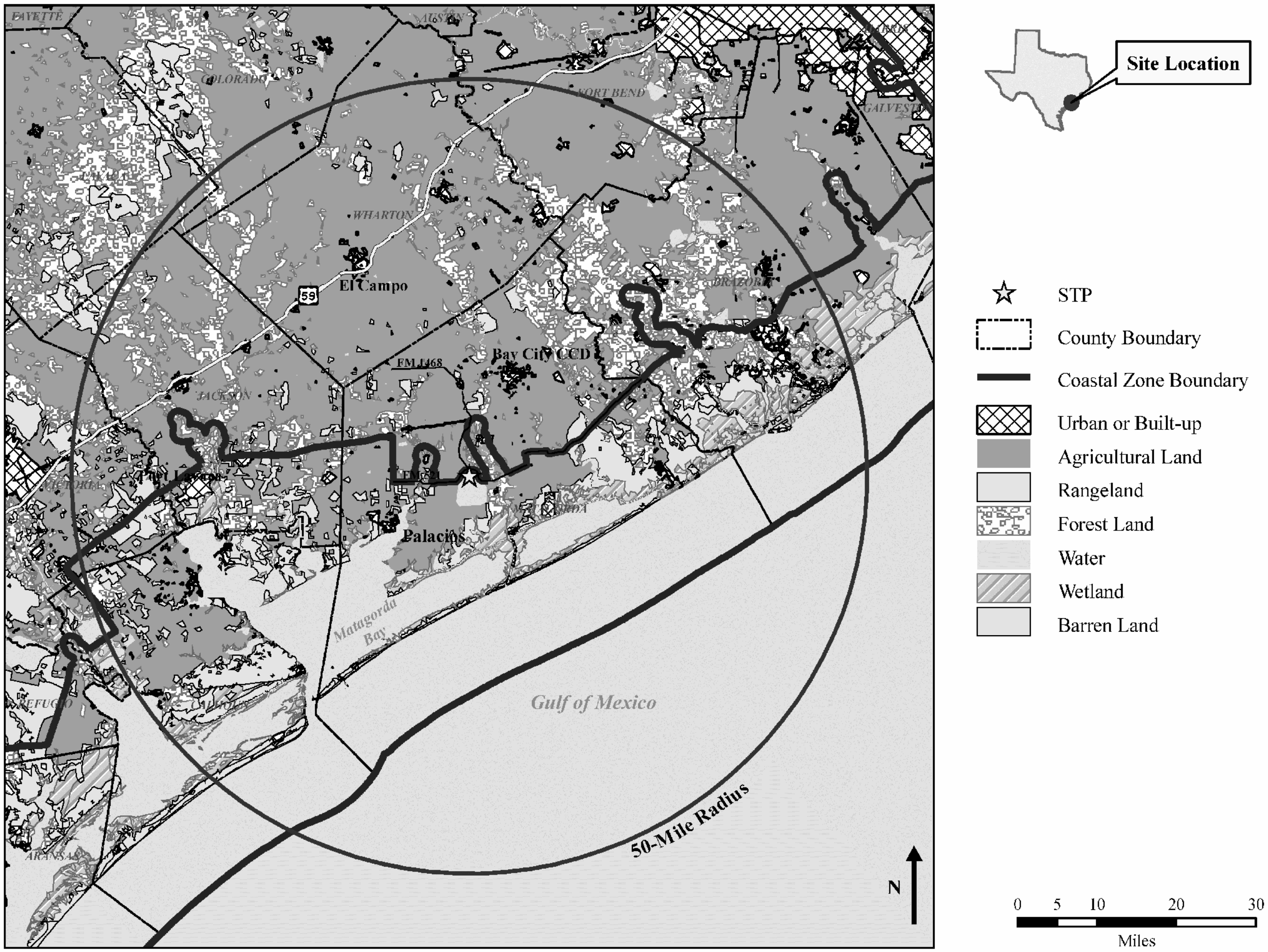

Figure 2-6. Land-Use Classifications in STP 50-mi Region (STPNOC 2010a)

Within the region, approximately 61 percent of the land is agricultural, 18 percent forest, 10 percent rangeland, 5 percent wetland, 2.5 percent urban or built-up, 2 percent freshwater bodies, and less than 1 percent is barren land (STPNOC 2010a).

2.3 Water

This section describes the hydrologic processes and water bodies in and around the STP site, the existing water use, and the quality of water in the vicinity of the proposed Units 3 and 4 site. This description is limited to those parts of the hydrosphere that may affect or be affected by building and operation of the proposed Units 3 and 4. Building activities will affect the Shallow Aquifer at the site. Building and operation activities would make use of groundwater from the Deep Aquifer. During operation of the proposed Units 3 and 4, the Colorado River would be the source of makeup water for normal plant operations, and groundwater would be used as the source for makeup water for the UHS of the proposed units, service water for Units 3 and 4, and water for sanitary and potable water systems. The Colorado River would receive water discharged from the MCR. The environment described in this section, therefore, includes (1) the Colorado River system upstream of the site, because (a) it is the source of runoff that sustains the flow in the river and would provide makeup water for normal plant operations and (b) future availability of water in the river may be affected by the amount of water allocated to Units 3 and 4; (2) the Colorado River System downstream of the site because downstream water availability and quality may be affected by water used by Units 3 and 4 and the water discharged from the MCR; (3) local water features at and adjacent to the site, and (4) the local and regional groundwater systems, because they are the source of water during the building and operation of Units 3 and 4.

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could affect, or be affected by, building and operation of proposed Units 3 and 4. The hydrologic conditions at the proposed Units 3 and 4 site are described in Section 2.4 of the Final Safety Analysis Report (FSAR) (STPNOC 2010b). A summary of the hydrologic conditions of the proposed site is provided in Section 2.3 of the Environmental Report (ER) (STPNOC 2010a). The following descriptions are based on information from these sources and other publicly available sources of hydrological data (LCRWPG 2006; LCRA 2009a, b; USGS 2009a, b; TCEQ 2007, 2008a; Corps 2009b; TxDOT 2007).

2.3.1.1 Surface-Water Hydrology

Figure 2-7 shows the location of the STP site with respect to the Lower Colorado River Basin and the Colorado-Lavaca Basin. The Colorado River Basin (Figure 2-8) is approximately

42,318 mi^2 in size (LCRWPG 2006). The Lower Colorado River Basin is the portion downstream of Lake O.H. Ivie (Figure 2-8). Approximately 90 percent of the contributing area of the basin lies upstream of the Mansfield Dam located near Austin, Texas (LCRWPG 2006). The STP site is located on the west bank of the Colorado River at River Mile 14.6. The location of the site with respect to nearby cities, the Matagorda Bay, and the Gulf of Mexico is shown in Figure 2-9. The Matagorda Bay and the Gulf of Mexico are located approximately 12 and 15 mi to the south, respectively (Figure 2-10). The water surface elevations in the Colorado River near the site are subject to upstream release and tidal fluctuations.

The mouth of the Colorado River where it flows into the Gulf of Mexico is located approximately 28 mi east-northeast of Port O'Connor and approximately 48 mi west-southwest of Freeport (Figure 2-7). At both of these gulf coast cities, the National Oceanic and Atmospheric Administration (NOAA) maintains tide gauges. The mean tidal range, the difference between the mean high water and mean low water, at Freeport is 1.4 ft and the diurnal range, the difference between mean higher high water and mean lower low water, is 1.8 ft (NOAA 2009a). The corresponding values at the Port O'Connor tide gauge are 0.7 ft and 0.8 ft (NOAA 2009b). NOAA (2009c) estimated the long term sea-level rise to range from 1.1 to 1.8 ft/century at the Freeport tide gauge using data from 1954 to 2006. NOAA did not perform the corresponding estimate at the Port O'Connor tide gauge.

On a longer-term scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge by the U.S. Global Change Research Program (GCRP), a Federal Advisory Committee, has been considered in preparation of this environmental impact statement (EIS). According to the GCRP, it is reasonably foreseeable that sea level rise may exceed 3 ft by the end of the century (GCRP 2009). Actual changes in shorelines would also be influenced by geological changes in shoreline regions (e.g., subsidence). The increase in sea level relative to the Colorado River bed, coupled with reduced streamflow (also due to climate change), would result in the salt water front in the Colorado River moving up towards the Reservoir Makeup Pumping Facility (RMPF).

The discharge and water temperature in the Colorado River near the site are characterized by measurements made at the U.S. Geological Survey (USGS) gauge 08162500, Colorado River near Bay City, Texas. Streamflow discharge data at this gauge has been available since May 1, 1948. The period of record for water quality sampling at this gauge spans October 16, 1974, through June 26, 2001.

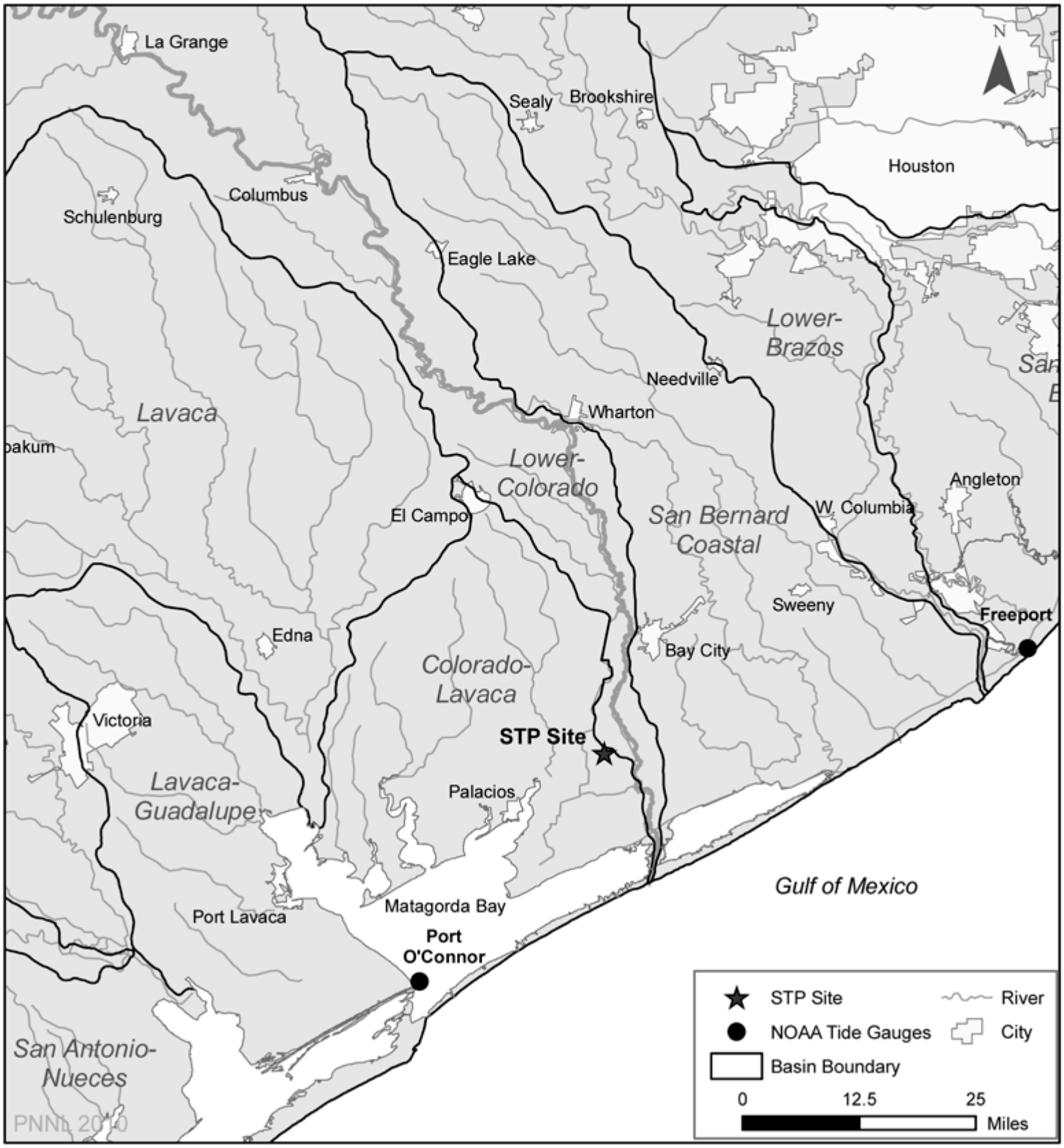

Figure 2-7. Location of the STP Site and the Adjacent Watersheds

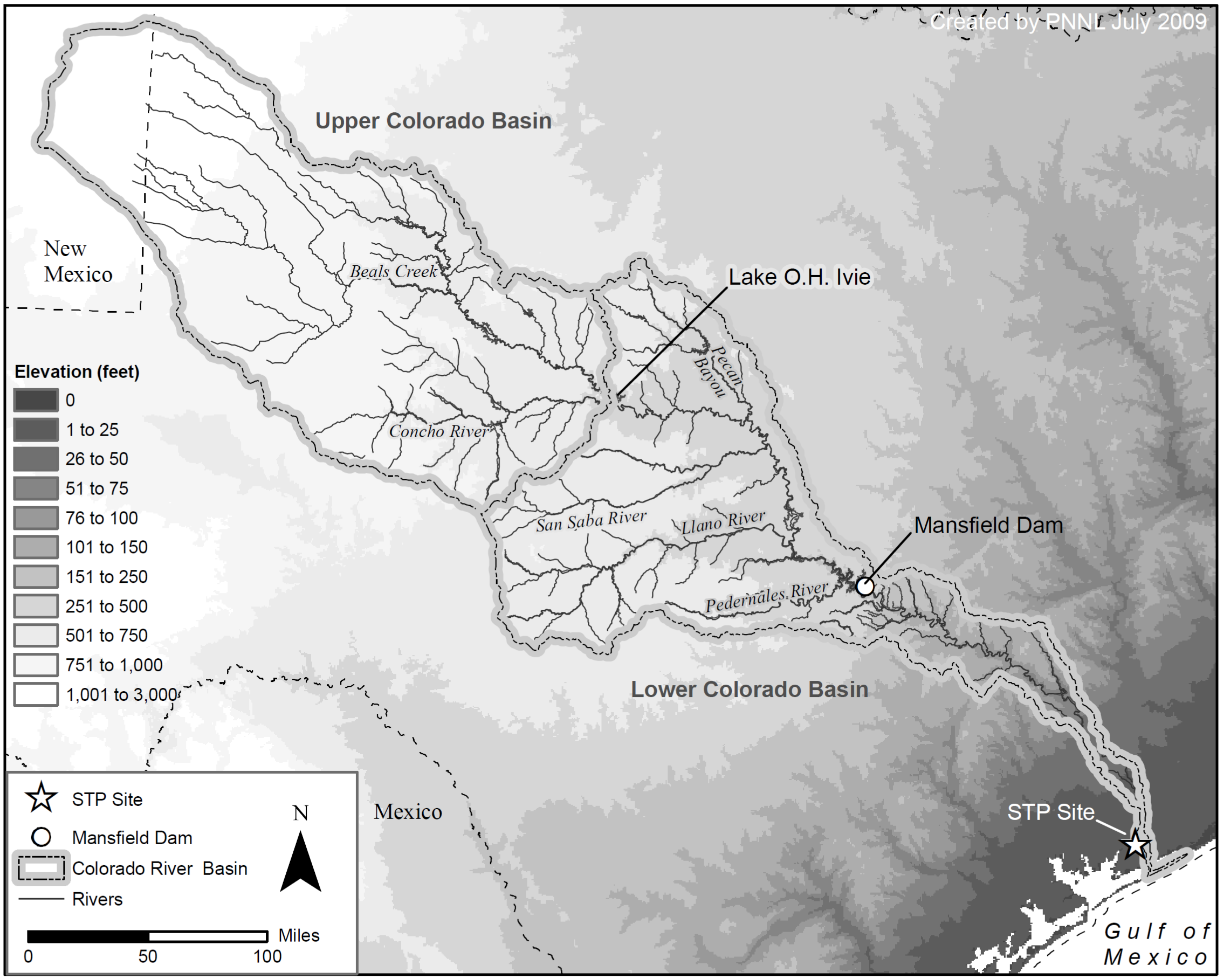

Figure 2-8. The Colorado River Basin

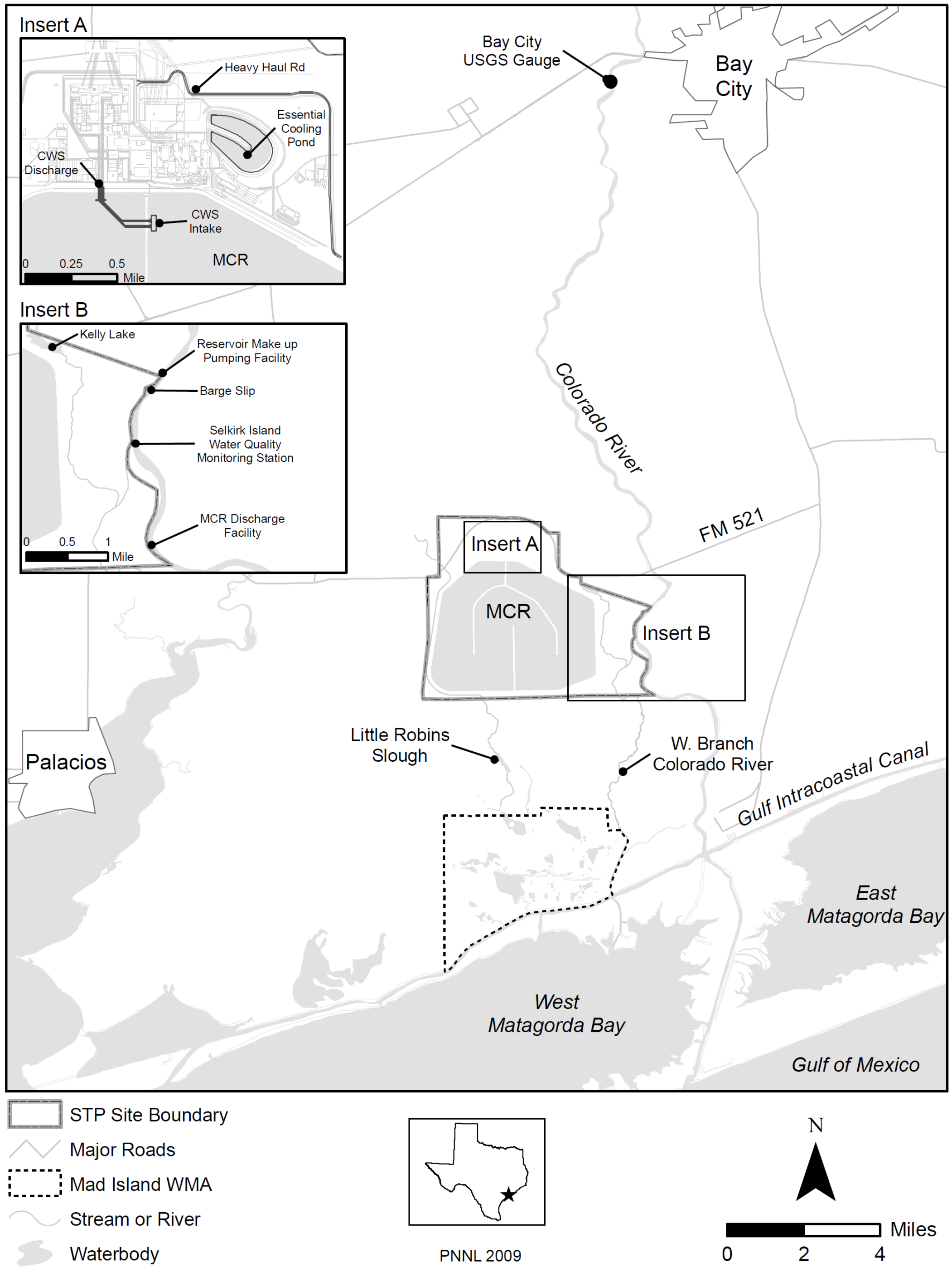

Figure 2-9. Location of the STP Site with Respect to Nearby Cities, the Matagorda Bay, and the Gulf of Mexico

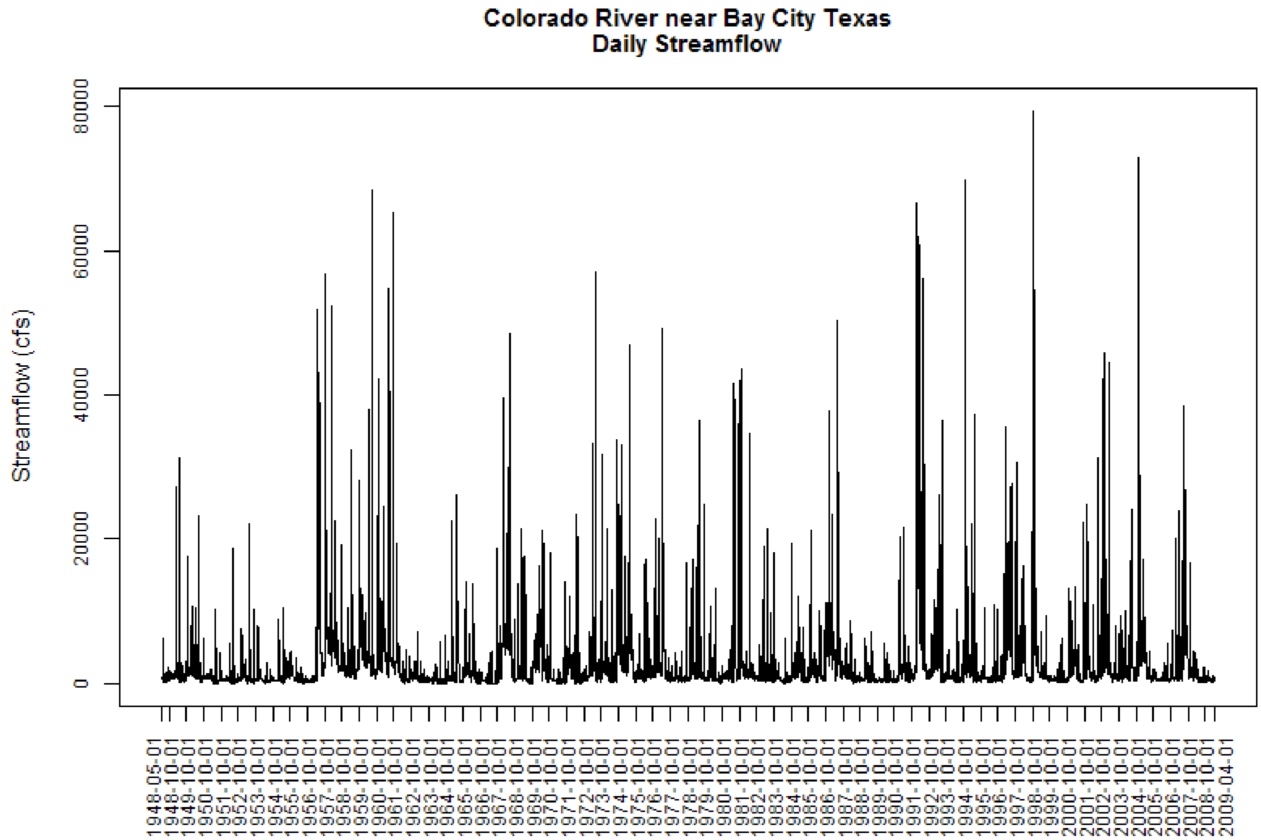

Figure 2-10. Daily Mean Colorado River Discharge near Bay City, Texas (USGS 2009c)

The mean annual discharge at the USGS gauge near Bay City, based on data for water years 1949 through 2008, is estimated to be approximately 2629 cfs (USGS 2009a). Mean monthly discharges at the same location reveal that August is the driest month with approximately 932 cfs of mean discharge, and June is the wettest month with approximately 4240 cfs of mean discharge (USGS 2009b). The daily discharge for the period of record for the USGS gauge near Bay City (USGS 2009c) is shown in Figure 2-10. The mean daily discharge for the period of record is 2613 cfs.

Texas experiences frequent droughts (LCRWPG 2006). Droughts in Texas are primarily caused by formation of a stationary, high-pressure system called the Bermuda High that prevents passage of low-pressure fronts (LCRWPG 2006). Based on streamflow data at the USGS gauge near Bay City, the annual discharge during water years 1951 to 1956 ranged from 23 to 48 percent of the mean annual discharge. During 1962 to 1967, the annual discharge ranged from 21 to 79 percent of the mean annual discharge. During 1983 to 1986, the annual discharge ranged from 25 to 72 percent of the mean annual discharge. During 1988 to 1991, the annual discharge ranged from 21 to 78 percent of the mean annual discharge. These episodes are

examples of multi-year drought in the Colorado River Basin. Out of 55 years during 1948 through 2008 for which annual discharges were measured by the USGS at the Bay City gauge, the annual discharge was less than 75 percent of mean annual discharge during 26 years.

The streamflow in the Colorado River downstream of Austin, Texas, is influenced by releases from the Mansfield Dam. The LCRA operates six dams: Buchanan, Inks, Wirtz, Starcke, Mansfield, and Tom Miller (LCRA 2009b) that inundate the six highland lakes: Buchanan, Inks, Lyndon B. Johnson, Marble Falls, Travis, and Austin, respectively (Figure 2-11). Lake Buchanan has a storage capacity of 875,566 ac-ft at its normal operating level and is used for water supply and hydroelectric power generation. Lake Travis has a storage capacity of 1,131,650 ac-ft at its normal operating level and is used for water supply, flood management, and hydroelectric power generation. The combined water storage capacity of the six highland lakes is 2,184,777 ac-ft (LCRA 2009b).

The LCRA manages the Colorado River and Lakes Buchanan and Travis as a single system for water supply in the Lower Colorado River Basin (LCRA 2010). The two lakes are used to conserve water and inflows into the river below the highland lakes are used to meet downstream demand to the extent possible. Waters stored in the lakes are released only when downstream water rights cannot be met. Generally, LCRA does not release waters from any of the lakes exclusively for hydroelectric power generation. However, during emergency shortage of electricity or during times when such releases would provide other benefits, LCRA may release waters from the lakes (LCRA 2010).

The floodplain in the Lower Colorado River Basin has a relatively flat gradient and is characterized by broad floodplains. Streamflow in the Colorado River is controlled by releases from the Mansfield Dam and remains relatively unaffected downstream. A description of existing water diversions downstream of the Mansfield Dam is provided in Section 2.3.2.1.

The predominant surface water feature near the STP site is the MCR (Figure 2-9), an engineered cooling pond impounded by earthen embankments constructed on the natural ground surface immediately south of the existing facility. The MCR is part of the closed-cycle cooling system for STP Units 1 and 2 and acts as the normal heat sink for waste heat generated during operations of these units. The MCR is currently operated to dissipate waste heat from the operations of existing Units 1 and 2, primarily via evaporation and radiation to the atmosphere.

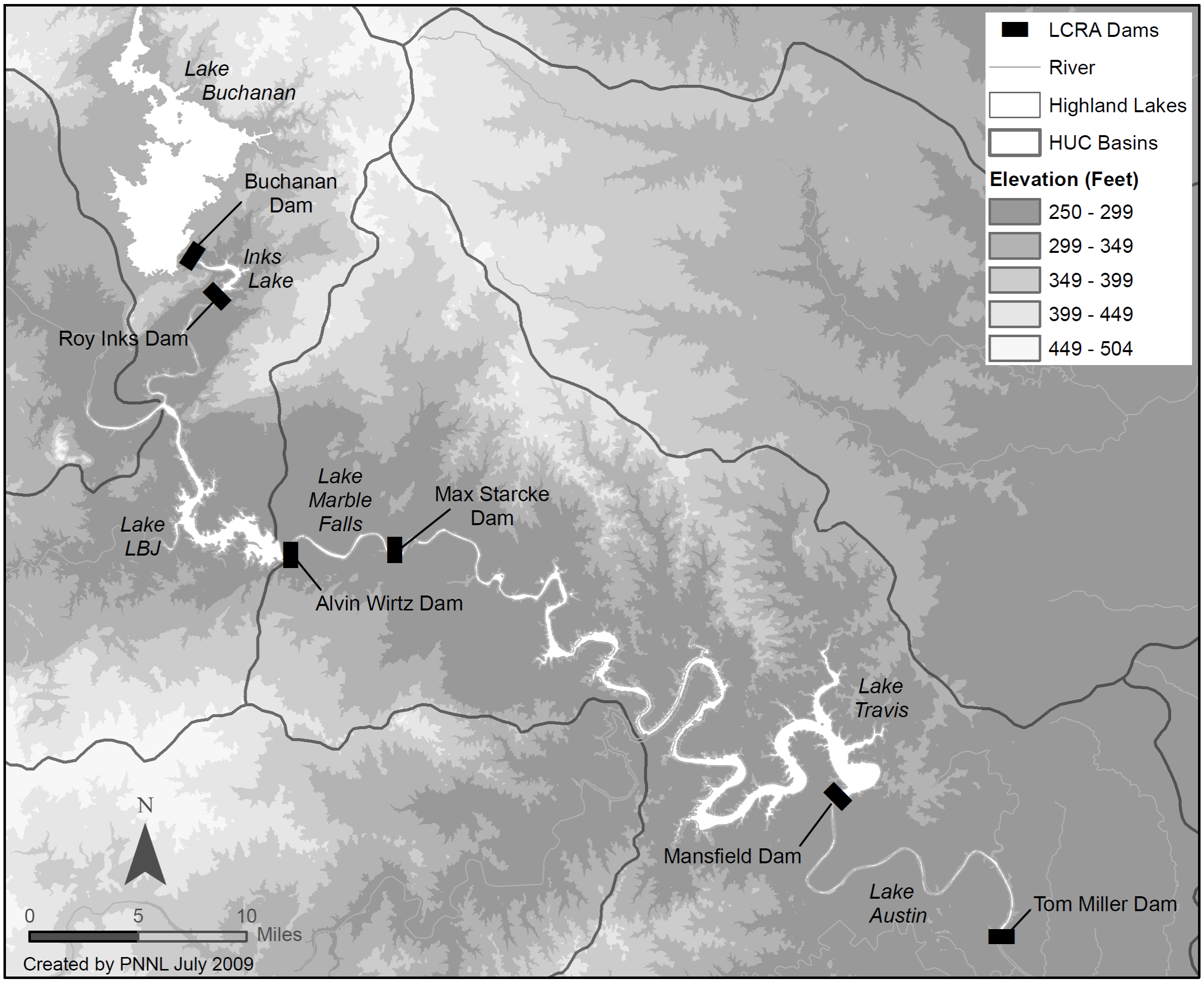

Figure 2-11. The Six LCRA Dams and the Corresponding Highland Lakes They Impound

Water is lost from the MCR due to evaporation and seepage. A network of relief wells exists along the MCR embankment. These relief wells drain some water away from the Shallow Aquifer that receives seepage from the MCR and discharges it into site drainage ditches. The site drainage ditches discharge to the Little Robbins Slough located towards the west of the STP site and to the Colorado River just upstream of the RMPF located towards the east. Water loss from the MCR due to evaporation results in a build-up of total dissolved solids (TDS) within the reservoir. Make-up water from the Colorado River is withdrawn from the RMPF, which is located on the west bank of the river, to maintain the MCR volume and to control the concentration of TDS in its waters. The MCR has a buried discharge pipe approximately 1.1 mi in length that allows the periodic discharge of water from the reservoir to the Colorado River. The outfall of this discharge line is equipped with seven ports located along the west bank of the Colorado River approximately 2 miles downstream of the RMPF. The U.S. Army Corps of

Engineers (Corps) has determined that the MCR is not waters of the United States (Corps 2009a). The Texas Commission on Environmental Quality (TCEQ) has also stated that the MCR is not waters of the State (TCEQ 2007). However, the MCR supports active aquatic and avian habitats (see Sections 2.4.1 and 2.4.2). The MCR also has a spillway near its southeast corner that allows release of excess water from the MCR to the Colorado River during heavy precipitation events. The spillway contains gates that can be manually opened to allow for the release of water.

The Colorado River provides makeup water to replace evaporation loss from the MCR due to the normal operation of existing STP Units 1 and 2. The water evaporated from the MCR includes that due to natural evaporation and due to induced evaporation from the heat load of Units 1 and 2. Water is pumped into the MCR from the Colorado River. The MCR was also designed to discharge periodically into the Colorado River to maintain the water quality below 3000 μS/cm for specific conductivity (STPNOC 2010a). The Colorado River is not the heat sink for the existing units.

As stated below in Section 2.9.1, the topography near the STP site is flat and there is no significant difference between local and regional climate. Based on climatological data from Victoria and Corpus Christi, mean precipitation varies from 2 to 3 in. per month with maximum precipitation of approximately 4 to 5 in. per month in May and June and in September and October. Snowfall is not uncommon, occurring over half of the winters; however, snowfall is generally limited to trace amounts. Annual potential evapotranspiration[(a)] in Texas varies from approximately 53 in. at Port Arthur to over 79 in. at El Paso (Irrigation Technology Center 2009). The annual potential evapotranspiration at Victoria is approximately 57 in. with monthly variations from 2.3 in. in December to nearly 7 in. in July (Irrigation Technology Center 2009).

The power block area of the existing Units 1 and 2 is drained by gravity to the east via the Plant Area Drainage Ditch or via drainage around the Essential Cooling Pond. The Main Drainage Channel (MDC) is an unlined channel located north of the power block of the proposed Units 3 and 4 and runs west before turning southwest after crossing the existing railroad track (Figure 2-12). The MDC continues southwest across the west access road and eventually joins the Little Robbins Slough west of the MCR.

Little Robbins Slough is an intermittent stream that originates approximately 2 mi northwest of the STP site and has a drainage area of approximately 4 mi^2. During the building of Units 1 and 2, the original course of the stream was relocated to the west of the MCR. The relocated channel runs along the western edge of the MCR embankment, turns east at the southwest corner of the MCR embankment and rejoins its natural course approximately 1 mi east of the southwest corner of the MCR embankment. The Little Robbins Slough flows into Robbins

(a) Potential evapotranspiration is the evaporation from the soil and transpiration from crops or vegetation under unlimited water supply conditions.

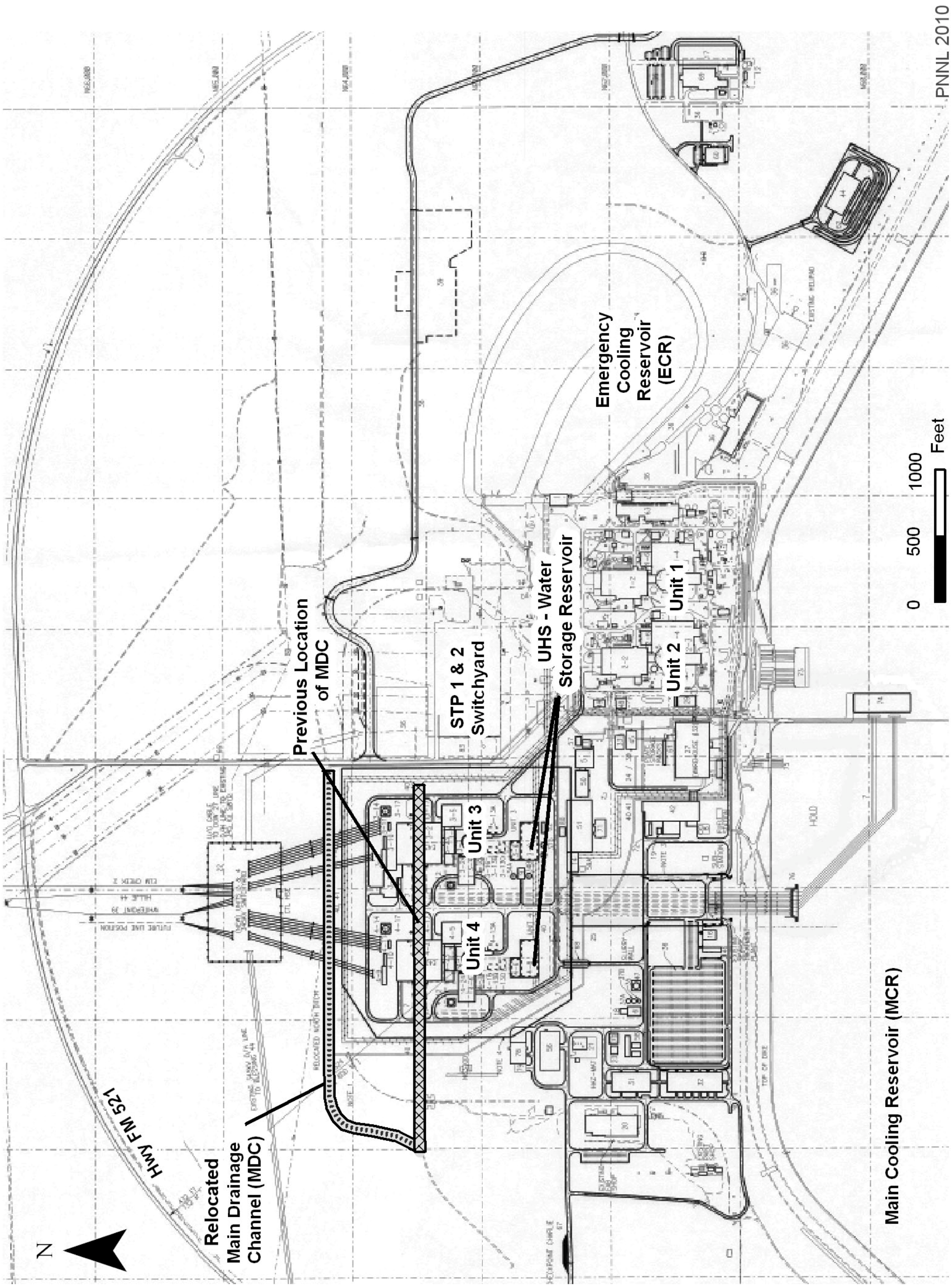

Figure 2-12. Current and Previous Locations of the Main Drainage Channel (STPNOC 2010d)

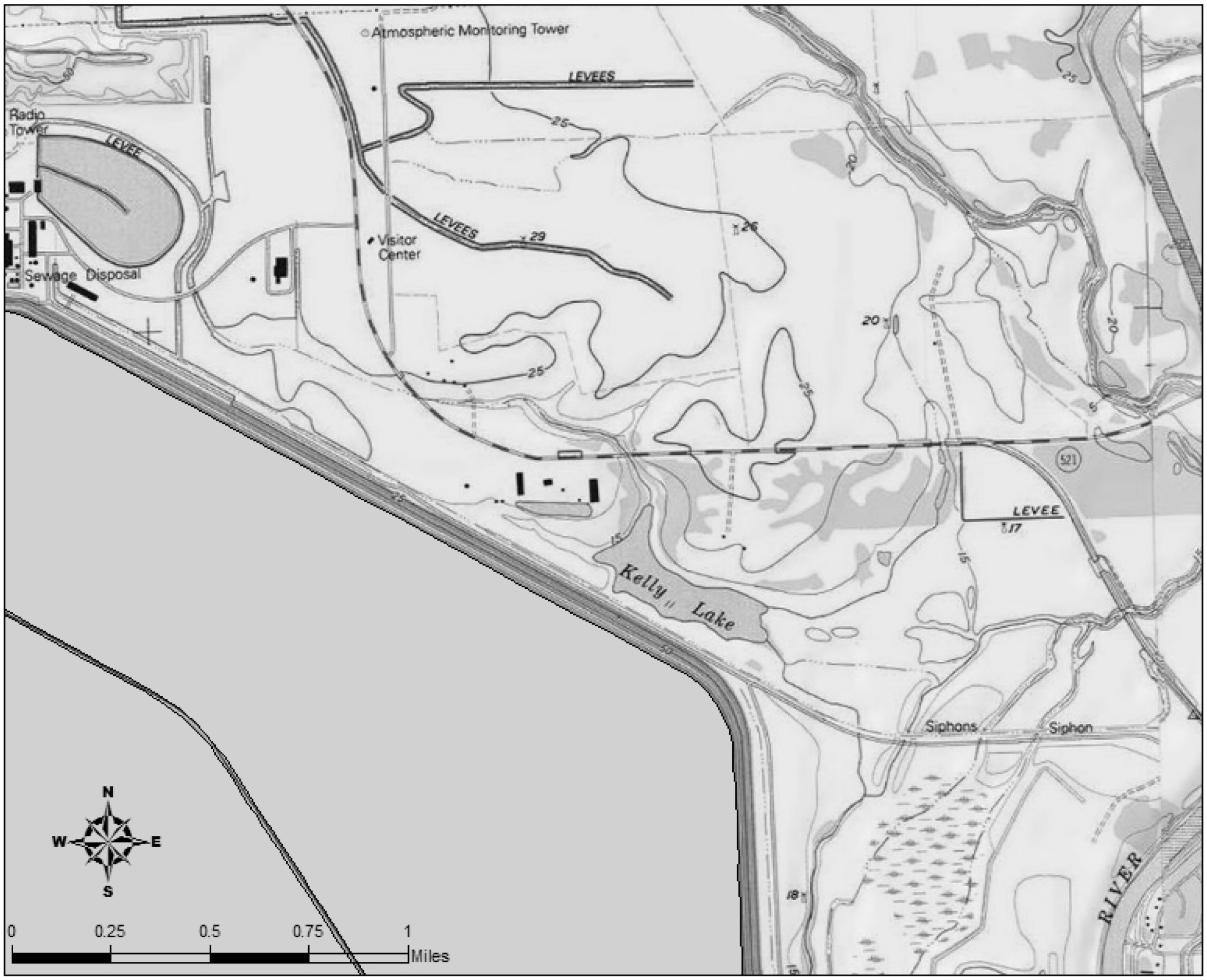

Figure 2-13. Kelly Lake and Local Drainages Flowing Into and Out of the Lake

Slough, which is a brackish marsh that joins the Gulf Intracoastal Waterway (GIWW) approximately 4 mi to the south (Figure 2-9). There is no known streamflow or water quality monitoring of the Little Robbins Slough.

The GIWW is a 1300-mi-long man-made canal that runs along the Gulf of Mexico coast from Brownsville, Texas, to St. Marks, Florida (TxDOT 2007). The GIWW is connected to the Colorado River and the Matagorda Bay.

Kelly Lake is a small lake located north of the northeast edge of the MCR embankment (Figure 2-13). It is fed by a small catchment area north of the lake. The USGS topographical map shows at least two drainages that flow into the lake and one that exits the lake. The drainage that exits the lake flows generally south along the east side of the MCR embankment

and eventually joins West Branch of the Colorado River near the southeast edge of the MCR embankment.

The RMPF is located on the west bank of the Colorado River approximately 2 mi upstream of the MCR discharge outfall. The RMPF currently houses two pumps of 240 cfs capacity and two pumps of 60 cfs capacity for a total intake capacity of 600 cfs. The intake structure consists of a set of traveling screens, a siltation basin, a sharp-crested weir, and the pumping station. A buried pipeline conveys water from the RMPF to the MCR.

The RMPF contains 24 traveling screens, each 10 ft in width (STPNOC 2010c). The bottom of the screens in the embayment is located at an elevation of 10 ft below MSL. Currently, only half of the installed traveling screens are used to support the operation of the existing STP Units 1 and 2.

2.3.1.2 Groundwater Hydrology

This section describes the aquifer system at the regional, local, and site-specific scales, and summarizes the hydrogeologic properties (including piezometric heads).

Regional Geology and Aquifer System

The groundwater aquifers in the region and in the vicinity of the site are described in Section 2.3.1.2 of the ER (STPNOC 2010a). The STP site lies in Coastal Prairies sub-province of the Gulf Coastal Plains physiographic province. The Coastal Prairies sub-province is a broad band paralleling the Texas Gulf Coast (STPNOC 2010a). The sub-province is characterized by relatively flat topography ranging from sea level at the coast to 300 ft above MSL along the northern and western inland boundaries of the sub-province. Underlying the STP site is a wedge of southeasterly dipping sedimentary deposits. Numerous local aquifers are found in the thick sequence of alternating and interfingering beds of clay, silt, sand, and gravel. Groundwater ranging in quality from fresh to saline is found in these sediments. Three depositional environments are evident: continental (alluvial plain), transitional (delta, lagoon, beach), and marine (continental shelf). Oscillations of the ancient shoreline have resulted in overlapping mixtures of sediments (STPNOC 2010a; Ryder 1996).

The USGS describes the aquifers underlying the STP site as the Texas coastal lowlands aquifer system, and divides the aquifer system into hydrogeologic units or permeable zones A through E (Ryder and Ardis 2002). Within the State of Texas, both the Texas Water Development Board (TWDB) and the LCRA refer to the aquifer system as both the Gulf Coast Aquifer system and the Coastal Lowlands Aquifer System, and they use hydrogeologic unit names rather than letters to describe the aquifer system (TWDB 2007, 2006b; Young et al. 2007). Common hydrogeologic unit names, from shallow to deep, are as follows (STPNOC 2010a):

- Chicot Aquifer
- Evangeline Aquifer
- Burkeville Confining Unit
- Jasper Aquifer
- Catahoula Confining Unit
- Vicksburg-Jackson Confining Unit.

The naming convention used in Texas, which is different than that used by the USGS, is employed in the hydrology sections of this EIS (Figure 2-14).

In the vicinity of the STP site, the Gulf Coast Aquifer system (i.e., the Coastal Lowlands Aquifer system) extends from the coast to approximately 100 mi inland (STPNOC 2010a) (Figure 2-15). The Gulf Coast Aquifer thickens from inland toward the Gulf of Mexico. Inland, its base is the contact of the aquifer with the top of the Vicksburg-Jackson confining unit. Approaching the coast, the base of the aquifer is defined by the approximate depth where groundwater has a TDS concentration of more than 10,000 mg/L. The thickness of the aquifer ranges from 0 ft at the up-dip limit of the aquifer system in the northwest to approximately 1000 to 2000 ft in Matagorda County at the down-dip limit of the system in the southeast (STPNOC 2010a; Ryder 1996).

The U.S. Environmental Protection Agency (EPA) has identified the Edwards Aquifer I and Edwards Aquifer II as sole source aquifers in Texas (EPA 2009a, b, c). The Edwards Aquifer extends west of Austin, Texas. Based on the location of the Edwards Aquifer, the review team has determined that neither surface water nor groundwater use would impact the Edwards Aquifer.

Local and Site-Specific Aquifer System

Within Matagorda County, the Chicot Aquifer is the aquifer used for groundwater production (Figure 2-15). In the vicinity of the STP site the aquifer thickness is somewhat greater than 1000 ft (STPNOC 2010a). Groundwater flow in Matagorda County is generally to the south and southeast toward the Gulf of Mexico; however, rivers and creeks incised into the surface deposits can alter the direction of groundwater flow locally. Pumping of the aquifer system has also resulted in local alterations in groundwater flow direction (STPNOC 2010a; Hammond 1969).

In the vicinity of the STP site, the Chicot Aquifer is composed of a Shallow Aquifer and a Deep Aquifer, and the Shallow Aquifer is further subdivided into Upper and Lower zones (STPNOC 2010a). The Shallow Aquifer's base is between 90 and 150 ft below ground surface (BGS), and the Shallow Aquifer is separated from the Deep Aquifer by a zone of predominantly clay

Era	System	Series	Stratigraphic unit Modified from Baker, 1979		Lithology	Hydrogeologic unit commonly used in Texas Modified from Baker, 1979		Hydrogeologic nomenclature used in USGS reports Modified from Weiss, 1992	
Cenozoic	Quaternary	Holocene	Alluvium		Sand, silt, and clay	Chicot aquifer		Permeable zone A	Coastal lowlands aquifer system
		Pleistocene	Beaumont Formation Montgomery Formation Bentley Formation Willis Sand		Sand, silt, and clay			Permeable zone B	
	Tertiary	Pliocene	Goliad Sand		Sand, silt, and clay	Evangeline aquifer		Permeable zone C	
		Miocene	Fleming Formation Oakville Sandstone		Clay, silt and sand	Burkeville confining unit		Zone D confining unit [1]	
			Catahoula Sandstone or Tuff [2]		Sand, silt, and clay	Catahoula confining unit (restricted)	Jasper aquifer	Permeable zone D	
				Anahuac Formation [1]	Clay, silt and sand			Zone E confining unit [1]	
		Oligocene		Frio Formation [1]	Sand, silt, and clay			Permeable zone E	
			Frio Clay [3]	Vicksburg Formation [1]	Clay and silt	Vicksburg-Jackson confining unit		Vicksburg-Jackson confining unit	
		Eocene	Jackson Group	Whitsett Formation Manning Clay Wellborn Sandstone Caddell Formation					

[1] Present only in the subsurface
[2] Called Catahoula Tuff west of Lavaca County
[3] Not recognized at surface east of Live Oak County

Figure 2-14. Correlation of USGS and Texas Nomenclature (STPNOC 2010a)

material approximately 150-ft thick. Thus, the upper surface of the Deep Aquifer is between 250 and 300 ft BGS. The top of the Upper Shallow Aquifer is found approximately 15 to 30 ft BGS, and its base is at approximately 50 ft BGS. The Lower Shallow Aquifer is found between the depths of 50 ft and 150 ft BGS.

In order of their depth, the Upper Shallow Aquifer exhibits a potentiometric head of approximately 5 to 10 ft BGS (STPNOC 2010a). The Lower Shallow Aquifer exhibits a potentiometric head of approximately 10 to 15 ft BGS. In 1967, the Deep Aquifer exhibited a potentiometric head of approximately 0 ft MSL (STPNOC 2010a; Hammond 1969). However, in May 2006, the Deep Aquifer exhibited a potentiometric head of approximately 55 ft below MSL

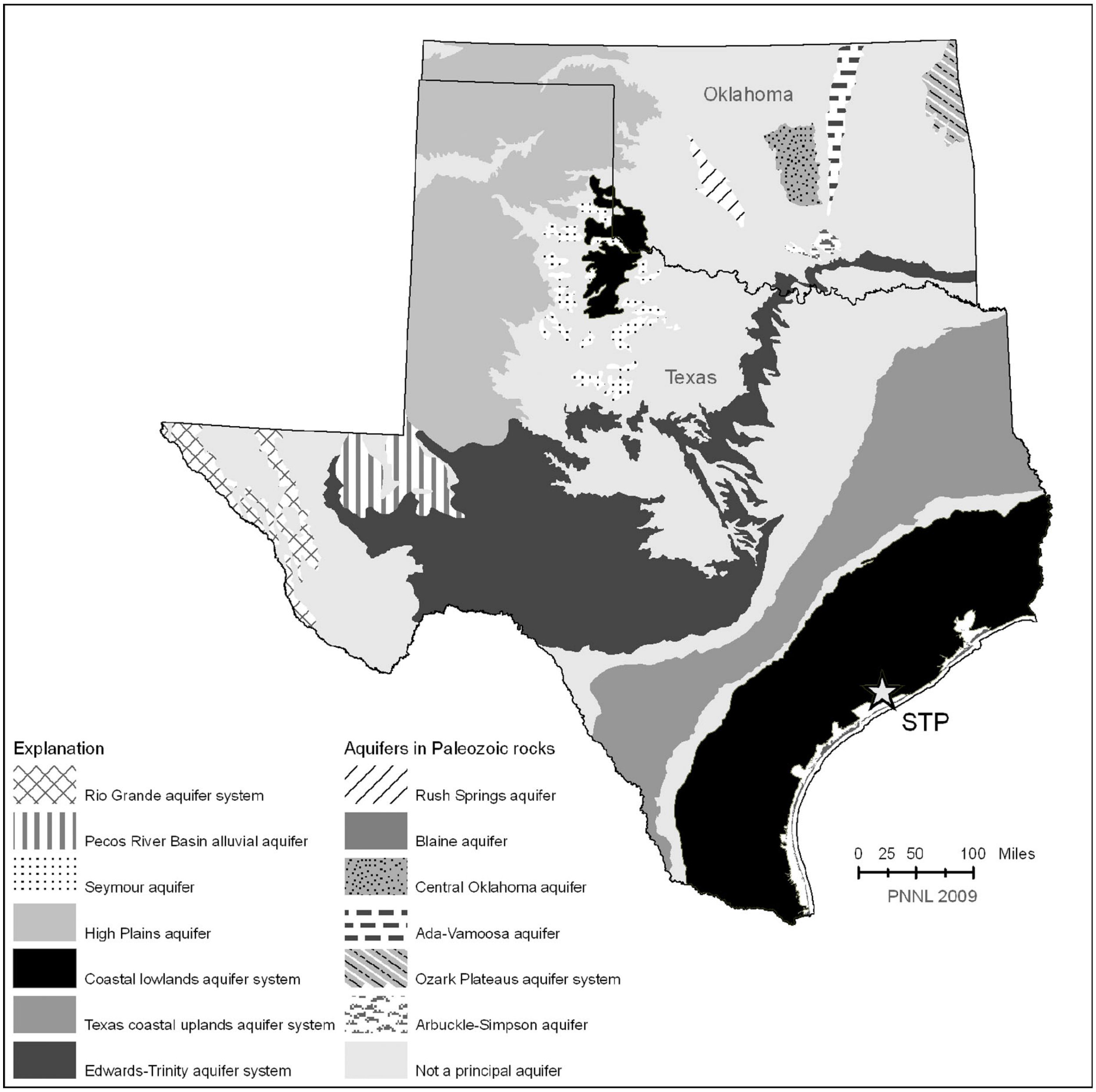

Figure 2-15. Aquifers of Texas

beneath the STP site (STPNOC 2010a). This is equivalent to approximately 85 ft BGS where the existing ground surface at the locations for the proposed units is 30 ft above MSL (STPNOC 2010b). The Upper Shallow Aquifer and Lower Shallow Aquifer exhibit semi-confined behavior with some movement of groundwater between them. The existing STP Units 1 and 2 reactor buildings penetrate the confining strata separating these two aquifers and allow vertical

groundwater movement. The proposed Units 3 and 4 reactor buildings would also penetrate the confining strata. Other locations on the STP site also exhibit movement of groundwater between the Upper and Lower Shallow Aquifers (e.g., in the vicinity of Kelly Lake and at observation well [OW] locations OW-332 and OW-930). The Shallow and Deep aquifers are separated by a thicker confining zone.

Recharge to the Gulf Coast Aquifer occurs in upland areas where strata associated with specific aquifers outcrop at the surface and are exposed to infiltration resulting from precipitation or irrigation. Aquifers can also be recharged by losing streams and rivers. Outcrop areas are in the northern and western portions of the system. Natural discharge from an aquifer occurs through springs and seeps, gaining streams, cross-formational flow out of an aquifer, and evapotranspiration. In addition, groundwater wells constructed and pumped also result in discharge from the aquifer. The Lower Colorado River is described as a gaining stream that receives groundwater from aquifers (TWDB 2006b).

Recharge to aquifers within the Chicot Aquifer underlying the STP site occurs to the northwest of the site, and discharge occurs generally to the east, south and southeast of the site (STPNOC 2010a). The Shallow Aquifer outcrops at the land surface and is recharged a few miles northwest of the STP site in Matagorda County, and it discharges to the Colorado River alluvium near the site. The Deep Aquifer outcrops and is recharged farther north and northwest in Wharton County and discharges into Matagorda Bay and the Colorado River estuary approximately 5 mi southeast of the STP site.

The mean annual precipitation over Matagorda County ranges from 42 to 46 in. (Ryder and Ardis 2002). Based on model simulations, the average recharge in the Texas Gulf Coast Aquifer was 0.52 in./yr in 1982 (Ryder and Ardis 2002). During the period from predevelopment (the early to mid-1930s) until 1982, there are outcrop areas of the aquifer where irrigation water reentered the aquifer by downward percolation. These areas include Matagorda County where the change in recharge since predevelopment ranges from less than 0.5 to 2 in./yr (Ryder and Ardis 2002). In Wharton County, which is upgradient of Matagorda County, the change in recharge since predevelopment is estimated to range from 1 to 6 in./yr. The TWDB in its report on aquifers of the Gulf Coast of Texas (TWDB 2006b) stated that during calibration of its model the recharge rate was estimated as four percent of precipitation which corresponds to nearly 2 in./yr in Matagorda County. In a model produced for the LCRA, Young et al. (2007) described recharge to the Shallow Aquifer system as ranging from 1.5 to 3.0 in./yr, and to the Deep Aquifer system as ranging from 0.25 to 1.0 in./yr.

A feature at the STP site that influences the Shallow Aquifer is the MCR, which is an engineered cooling pond used to dissipate heat from the existing STP units (STPNOC 2010a). The MCR was originally sized for four units similar to existing STP Units 1 and 2, and was created above the original site grade by constructing a 12.4-mi-long earth-fill embankment. The MCR was originally designed to have a normal maximum operating level of 49 ft above MSL and exhibit

approximately 20 ft of hydraulic head above the original ground surface. The MCR has a surface area of 7000 ac, and it is a major feature of the 12,220-ac STP site. The existing STP Units 1 and 2 are located north of the northern MCR embankment.

The bottom of the MCR is unlined and acts as a local recharge source for the Upper Shallow Aquifer, and it appears to cause some mounding in the Upper Shallow Aquifer and possibly the Lower Shallow Aquifer (STPNOC 2010a, b). Descriptions of the Shallow Aquifer are presented in Figures 2.4.13-17 and 2.4.13-17A in the Updated Final Safety Analysis Report (UFSAR) for STP Units 1 and 2 (STPNOC 2008i). A series of 770 relief wells surround the MCR embankment and is designed to collect and discharge some of the seepage from the MCR and relieve hydrostatic pressure on the outer slope and toe of the embankment (STPNOC 2010a). The UFSAR (STPNOC 2008i) for STP Units 1 and 2 estimated that 68 percent of the seepage from the MCR would be captured by the relief well system for an MCR maximum pool elevation of 49 ft above MSL. Subsequent to publication of the draft EIS, simulations conducted by the applicant have shown approximately 50 percent capture by the relief wells and sand drains (STPNOC 2010c). Seepage not intercepted by the relief wells remains in the Upper Shallow Aquifer. Potentiometric data on the Upper Shallow Aquifer obtained from observation wells completed in 2006 through 2008 reveal that groundwater flow from north-northwest of the STP site moves south-southeast toward the Units 3 and 4 power block (STPNOC 2010a, b). This groundwater flow from the north-northwest converges with the flow outward from the MCR, and the flow within the Upper Shallow Aquifer is then diverted to the southeast and southwest around the MCR.

Initial site characterization efforts completed in 2006 and 2007 were inconclusive with regard to mounding in the Lower Shallow Aquifer caused by the MCR. However, additional wells were installed in 2008, and quarterly monitoring completed in 2008 yielded more comprehensive potentiometric surfaces that show no obvious effect to the Lower Shallow Aquifer from MCR seepage into the Upper Shallow Aquifer (STPNOC 2009a, b).

To the east-southeast of the STP site the Upper Shallow Aquifer discharges to either the unnamed tributary flowing into Kelly Lake, groundwater wells, Kelly Lake, or the Colorado River (STPNOC 2010a). It is also plausible that groundwater flow to the southwest in the Upper Shallow Aquifer could discharge to groundwater wells (STPNOC 2010a).

In the vicinity of the existing STP units, where the confining unit has been removed, the hydraulic gradient between Upper and Lower Shallow aquifers is downward, and groundwater movement is interpreted to occur between them (STPNOC 2010a). This interpretation is supported by field measurements of water table elevation taken on May 1, 2006 (STPNOC 2010c) and tritium concentration measurements from 2005 through 2009 (STPNOC 2009a). Potentiometric measurements completed in September 2008 (STPNOC 2010b) in the vicinity of Kelly Lake indicate an upward groundwater gradient between Lower and Upper Shallow aquifers, and suggest groundwater from the Shallow Aquifer discharges to Kelly Lake (STPNOC

2010a). However, measurements completed since September 2008 indicate a downward gradient and suggest seasonal variation (STPNOC 2010a). Other plausible groundwater discharge locations in the Lower Shallow Aquifer to the southeast include groundwater wells and the Colorado River.

The regional groundwater flow in the Lower Shallow Aquifer approaches the STP site from the north-northwest, and, based on recent site characterization data (STPNOC 2010a, b), it would be diverted to the southeast. STPNOC (2010b) states that the hydraulic conductivity of the Lower Shallow Aquifer southwest of proposed Unit 4 is an order of magnitude lower than the region to the southeast, and the potentiometric measurement to the southwest indicate a very small and seasonally variable hydraulic gradient. Accordingly, STPNOC does not consider a southwest directed pathway in the Lower Shallow Aquifer to be a preferential pathway from proposed Unit 4. Thus, in addition to exposure locations to the southeast, there is a plausible exposure via groundwater wells to the southwest of proposed Unit 4 from the Upper Shallow Aquifer but not the Lower Shallow Aquifer.

Groundwater flow in the Deep Aquifer is from the northwest (e.g., Wharton County), toward the southeast and the Gulf of Mexico. Groundwater production wells located at the STP site withdraw an average 798 gallons per minute (gpm) for STP 1 and 2 operations (STPNOC 2010a).

The Deep Aquifer potentiometric surface in the vicinity of Units 1 and 2 in 1967 was estimated to be near 0 ft MSL (STPNOC 2010a; Hammond 1969). The surface was approximately 60 ft BGS in 1975 (approximately 37 ft below MSL; local elevation 23 ft above MSL) (NRC 1975; STPNOC 2008i). In 1986, prior to operation of existing Units 1 and 2, hydraulic head was approximately 75 ft BGS, or approximately 48 ft below MSL where Units 1 and 2 site grade was 27 ft above MSL (STPNOC 2008i). The potentiometric surface in 2006 following more than 20 years of Units 1 and 2 operation and associated groundwater withdrawal was approximately 55 ft below MSL (STPNOC 2010a). Thus, there has been a steady decline in the potentiometric surface from 1967 to present. Groundwater reversal is occurring locally to the STP production wells with groundwater being drawn to the wells in a radial pattern from the surrounding aquifer. Based on the potentiometric surfaces of the Lower Shallow Aquifer (i.e., 10 to 20 ft above MSL (STPNOC 2010a, b) and the Deep Aquifer (i.e., 45 to 55 ft below MSL (STPNOC 2010a), there is a downward hydraulic gradient. However, there is between 100 and 150 ft of a low hydraulic conductivity, predominantly clay, confining zone separating these two aquifers (STPNOC 2008i; STPNOC 2010a). The UFSAR for existing Units 1 and 2 (STPNOC 2008i) reports historic piezometric levels of the Deep Aquifer, and STP water withdrawals have shown a consistent pattern of managed drawdown in the vicinity of production wells with a resulting water table elevation of 50 to 55 ft below MSL since 1986.

Hydrogeologic Properties

The hydrogeologic properties of the groundwater aquifers in the region and in the vicinity of the site are described in Section 2.3.1.2.3.6 of the ER (STPNOC 2010a) and Section 2.4S.12 of the FSAR (STPNOC 2010b). They are presented here to support later calculation of potential impacts on the groundwater resource. Figure 2-16 shows a generalized hydrostratigraphic section at the STP site. Table 2-2 and Table 2-3 summarize the hydrogeologic and physical data of the strata underlying the STP site. Data for the physical properties of bulk density, total porosity and effective porosity shown in Table 2-2 and Table 2-3 were taken from ER Table 2.3.1-17 (STPNOC 2010a) where the number of samples is also reported. Hydraulic properties of the aquifers are from a variety of sources and methods.

Aquifer data from the TWDB for the region (STPNOC 2010a), STP aquifer pumping tests (STPNOC 2010b), STP slug tests (STPNOC 2010b), STP laboratory-derived values (STPNOC 2010a), and existing STP Units 1 and 2 FSAR results were all compiled and reviewed by STPNOC in making its site-specific property value selections. The property values (e.g., hydraulic conductivity, yield) presented by the applicant have been compared to property values presented in various hydrogeology reports issued by the TWDB (Hammond 1969; TWDB 2006b), the LCRA (Young et al. 2007; LCRA 2007b), and the USGS (Ryder 1996; Ryder and Ardis 2002). These literature values for hydraulic properties of the Gulf Coast Aquifer, and especially the Chicot Aquifer, are the result of aquifer tests and model calibration at a larger scale than the STP site. Accordingly, a broader range is seen in the literature data, and higher values for transmissivity are evident because of the deeper aquifer profiles being characterized by wells and model cross sections. Values of total porosity and effective porosity determined from STP site samples are higher than those presented by Ryder (1996), but within the range for sands, silts, and clays.

Unit	Hydrogeologic Zone	Ground Surface	Thickness	Geologic Materials
Shallow Aquifer	Upper Shallow Aquifer Confining Layer		10 - 30 ft	Clay and Silt
	Upper Shallow Aquifer		20 -30 ft	Silty Sand and Poorly Graded Sand
	Lower Shallow Aquifer Confining Layer		15 - 25 ft	Clay and Silt
	Lower Shallow Aquifer		25 - 50 ft	Silty Sand and Poorly Graded Sand with thin Clay and Silt Layers
Deep Aquifer Confining Layer			100 - 150 ft	Silty Clay and Silt with thin Sand Layers
Deep Aquifer			>500 ft	Sand with thin Clay and Silt Layers

Figure 2-16. Generalized Hydrostratigraphic Section Underlying the STP Site (STPNOC 2010a)

Table 2-2. Representative Hydrogeologic Properties of Confining Layers in the STP Hydrogeologic Strata

Hydrogeologic Unit	Property	Units	Representative Value	Range
Vadose Zone, uppermost confining layer	Thickness	ft	20	10–30
	Vertical hydraulic conductivity	gpd/ft^2	0.0036 (gm)	0.051–0.00051
	Bulk (dry) density	pcf	101 (am)	96.4–114.9
	Total porosity	%	40 (am)	31.8–42.8
Lower Shallow Aquifer Confining Layer	Thickness	ft	20	15–25
	Vertical hydraulic gradient	-	0.29	0.02–0.294
	Vertical hydraulic conductivity	gpd/ft^2	0.0036 (gm)	0.051–0.00051
	Bulk (dry) density	pcf	99 (am)	87.3–107.7
	Total porosity	%	42 (am)	36.1–47.2
Deep Aquifer Confining Layer	Thickness	ft	100	100–150
	Vertical hydraulic conductivity	gpd/ft^2	0.0036 (gm)	0.051–0.00051
	Bulk (dry) density	pcf	101 (am)	82.1–111.4
	Total porosity	%	41.0 (am)	33.4–51.8

Source: STPNOC 2010b
gpd = gallons per day; gm = geometric mean, am = arithmetic mean; pcf = pounds per cubic foot

For the Upper Shallow Aquifer, the representative hydraulic conductivity value is the greater of the geometric means of the values determined by slug tests and by aquifer tests. In this case, the aquifer test value of 165 gpd/ft^2 was higher than the slug test value of 107 gpd/ft^2. Use of the higher value is a conservative approach because it results in shorter travel time estimates. For the Lower Shallow Aquifer, the representative hydraulic conductivity value is the higher value of the two data sets (i.e., aquifer test, slug test), which is again based on the aquifer test data set. In this case the aquifer test value of 543 gpd/ft^2 was higher than the slug test value of 152 gpd/ft^2. STP site parameters for the Deep Aquifer are within the range shown by others (Hammond 1969; Ryder 1996; Young et al. 2007). Use of the STP site-specific data sets and representative values are preferred over regionally developed parameters since they are likely to better represent site conditions.

The vertical hydraulic gradient shown in Table 2-2 for the Lower Shallow Aquifer confining strata is a downward directed gradient and its value is based on numerous measurements made at well pairs in the Upper Shallow Aquifer and the Lower Shallow Aquifer. The basis and data supporting this estimate of vertical gradient are provided in the FSAR Rev 4 Table 2.4S.12-8 (STPNOC 2010b). Estimates of horizontal hydraulic gradient in the Upper and Lower Shallow aquifers are also based on field observations of the piezometric surface in each aquifer, respectively. To be conservative, hydraulic gradient values from the high end of measured ranges are assigned as representative values.

Table 2-3. Representative Hydrogeologic Properties of Aquifers in the STP Hydrogeologic Strata

Hydrogeologic Unit	Property	Units	Representative Value	Range
Upper Shallow Aquifer; piezometric surface 5 to 10 ft BGS	Thickness	ft	25	20–30
	Transmissivity	gpd/ft	3708 (gm) 6800 (am)	1100–12,500
	Storage coefficient	-	1.20E-03 (am)	1.7E-03–7E-04
	Horizontal hydraulic conductivity	gpd/ft^2	165 (gm)	65–420
	Horizontal hydraulic gradient	-	0.002 (southeast) 0.0008 (southwest)	0.0007–0.002; 0.0005–0.0008
	Bulk (dry) density	pcf	99 (am)	97.2–100.2
	Total porosity	%	41 (am)	39.5–41.7
	Effective porosity	%	33 (am)	31.6–33.4
Lower Shallow Aquifer; piezometric surface 10 to 15 ft BGS	Thickness	ft	40	25–50
	Transmissivity	gpd/ft	18,209 (gm) 20,050 (am)	13,000–33,150
	Storage coefficient	-	5.8E-4 (am)	4.5E-4–7.1E-4
	Horizontal hydraulic conductivity	gpd/ft^2	543 (gm) 554 (am)	410–651
	Hydraulic gradient	-	0.0007 (southeast)	0.0004–0.0007
	Bulk (dry) density	pcf	102 (am)	94.5–120.0
	Total porosity	%	39 (am)	28.8–43.9
	Effective porosity	%	31 (am)	23.0–35.1
Deep Aquifer	Thickness	ft	800–>1000	
	Transmissivity	gpd/ft	31,379 (gm) 33,245 (am)	24,201–50,000
	Storage coefficient	-	4.9E-4 (am)	2.2E-4–7.6E-4
	Horizontal hydraulic conductivity	gpd/ft^2	420 (gm)	103–3950
	Hydraulic gradient	-	Directed toward STP wells	
	Bulk (dry) density	pcf	103.1	NA
	Total porosity	%	38.8	NA
	Effective porosity	%	31.0	NA

Sources: STPNOC 2010b; Ryder 1996; LCRA 2007b
gpd = gallons per day; gm = geometric mean, am = arithmetic mean; pcf = pounds per cubic foot.

Groundwater Pathways

If spills were to occur at the STP site and were to reach saturated groundwater, the most likely aquifers to be affected would be the Upper and Lower Shallow aquifers. Seepage from the MCR would recharge the Upper Shallow Aquifer.

2.3.2 Water Use

This section describes the current water use in the Colorado River Basin including that needed for operation of existing STP Units 1 and 2.

In Texas, water use is regulated by the Texas Water Code. As established by Texas Water Code, surface water belongs to the State of Texas (Texas Water Code, Chapter 11, Section 11.021). The right to use surface waters of the State of Texas can be acquired in accordance with the provisions of the Texas Water Code, Chapter 11. In Texas, surface water is a commodity. Since the Colorado River Basin is currently heavily appropriated, future water users in this basin would likely obtain surface water by purchasing or leasing existing appropriations. Regarding groundwater, Texas law has allowed landowners to pump the water beneath their property without consideration of impacts to adjacent property owners (NRC 2009c). However, Chapter 36 of Texas Water Code authorized groundwater conservation districts to help conserve groundwater supplies. Chapter 36, Section 36.002, Ownership of Groundwater, states that ownership rights are recognized and that nothing in the code shall deprive or divest the landowners of their groundwater ownership rights, except as those rights may be limited or altered by rules promulgated by a district. Thus, groundwater conservation districts with their local constituency offer groundwater management options (NRC 2009c). The existing STP Units 1 and 2 use current STPNOC water rights granted by the TCEQ and the conditions of the existing STPNOC-LCRA water contract to withdraw surface water from the Colorado River. Groundwater used by STP Units 1 and 2 is withdrawn from the Deep Aquifer under STPNOC's existing Coastal Plains Groundwater Conservation District (CPGCD) permit. STPNOC has stated that the proposed Units 3 and 4 would operate within the limits of these existing surface water and groundwater appropriations (STPNOC 2010a).

Following the drought of record during 1950 to 1957, the TWDB was established to plan and finance water supply projects. In 1997, Texas Senate Bill 1 created a new water planning process that uses sixteen planning regions, called Regional Water Planning Areas (or Regions), within the State. The Bill designated TWDB as the lead agency with the responsibility to coordinate the regional water planning process and to develop the statewide water plan. The most recent Water Plan, the 2007 plan, was adopted on November 14, 2006 (TWDB 2007). The STP site is located in the Lower Colorado Regional Water Planning Group (LCRWPG), or Region K. The area of Region K follows the Colorado River from mid-state to the Gulf of Mexico.

The State of Texas is also divided into a number of River Authorities that were created by the State legislature to manage surface water resources in river basins within the State. The STP site is located in the LCRA, which was created by the Texas legislature in 1934.

As of November 2009, the State of Texas had 96 groundwater or underground water conservation districts that were created either by the Texas legislature or by TCEQ using a local petition process. The conservation districts have the authority to regulate the spacing between water wells, the production of water from wells, or both.

While the River Authorities act as managers and suppliers of surface water and Groundwater Conservation Districts act as managers and permitting authorities for groundwater within their respective areas, water planning at the regional level is performed by the Regions and the TWDB brings the Regional Water Plans together to adopt the State Water Plan. Regional and State-level water planning consider demands, supplies, and future development of both surface and groundwater resources.

2.3.2.1 Surface-Water Use

The existing STP Units 1 and 2 use surface water provided under contract by the LCRA for make-up water requirements of the MCR. Of the six highland lakes that are formed by the six highland dams that LCRA operates, Lakes Travis and Buchanan provide water supply for communities, industries, agriculture, and aquatic life. Water rights are issued by TCEQ for stored water or for run-of-the-river water and senior water rights holders have priority over the diversions if the water supply is limited during dry years. Water can be directly diverted from the Colorado River by run-of-the-river water rights holders (LCRWPG 2006).

The LCRWPG produced the Region K Water Plan in 2006 (LCRWPG 2006). The LCRWPG estimated the surface water supply in Matagorda County to be 184,857 ac-ft/yr in 2010 and decreasing to 132,193 ac-ft/yr in 2060. The LCRWPG has proposed water management strategies including new water supplies (i.e., surface water and groundwater) and water conservation to meet the level of water demand anticipated between 2010 and 2060. Total water demand for Matagorda County during this period ranges from 302,570 ac-ft/yr in the 2040 decade to 286,093 ac-ft/yr in the 2060 decade, and averages 292,038 ac-ft/yr between 2000 and 2060. The total water demand for Matagorda County includes the STPNOC water rights of 102,000 ac-ft/yr (LCRWPG 2006).

In the report “Water for Texas 2007” produced by the TWDB in 2006 (TWDB 2007), the total water demand in Region K is projected to increase from 1,078,041 ac-ft/yr in 2010 to 1,302,682 ac-ft/yr in 2060. During this same period, existing water supplies are projected to decline from 1,182,078 ac-ft/yr to 887,972 ac-ft/yr. The decline in water supply is attributed to reservoir sedimentation and expired water contracts (TWDB 2007). However, TWDB (2007) stated that

water management strategies are estimated to offset this through a combination of conservation, reuse, new supplies, and desalination measures. Accordingly, the total water demand is expected to be met.

The current surface water resource of the Colorado River near the STP site, represented by the average of mean annual discharges during water years 1949 to 2008 at the Bay City USGS streamflow gauge, is 2629 cfs (1,903,000 ac-ft/yr). Some of this flow is reserved for instream flow needs.

STPNOC currently holds a water right for 102,000 ac-ft of water per year from the Colorado River and is authorized to divert water up to a maximum rate of 1200 cfs (LCRA-STPNOC 2006). The diversion is limited to 55 percent of flows in excess of 300 cfs measured at the USGS streamflow gauge at Bay City Dam (USGS gauge 08162500). In addition, STPNOC also has access to a maximum of 20,000 ac-ft of water per year for operation of existing Units 1 and 2 on a rolling five-year average basis, of firm water[(a)] to help maintain the MCR water surface elevation at or above 27 ft MSL. During delivery of firm water, diversion of the river flow is restricted only by the LCRA estuary requirement. According to its Water Management Plan (LCRA 2010), the LCRA releases water into the Lower Colorado River from Lakes Buchanan and Travis to meet bay and estuary needs. The LCRA releases the critical bay and estuary inflow need of 171,120 ac-ft/yr (236 cfs) every year. In years when the lakes are between 55 and 86 percent full on January 1, LCRA releases 250,680 ac-ft/yr (346 cfs) and the release increases to 1.03 million ac-ft/yr (1423 cfs) if the lakes are more than 86 percent full on January 1.

Using TCEQ's water rights database (TCEQ 2009a), the review team determined that there are 29 active water rights holders in the Colorado River Basin between the Mansfield Dam and the STP site. The combined withdrawal rights for these holders are 327,376 ac-ft/yr. The average annual discharge of the Colorado River, based on streamflow measured during 1899 through 2009 at the Colorado River at Austin, Texas gauge (USGS gauge 08158000) approximately 5 mi downstream of Austin, Texas is 2193 cfs (1,587,653 ac-ft/yr). Therefore, the review team determined that approximately 21 percent of the surface water resource near Austin, Texas, is currently allocated for use between Mansfield Dam and the STP site.

As reported by TCEQ in April 2009, there are 52 active withdrawals in Matagorda County on the Colorado River, various streams, creeks, and sloughs (TCEQ 2009a). The Colorado River water rights belonging to the LCRA (4,168,930 ac-ft/yr), the City of Austin (520,403 ac-ft/yr), and the Colorado River Municipal Water District (103,000 ac-ft/yr) are greater in quantity than those of STPNOC (102,000 ac-ft/yr). In Matagorda County, LCRA is the only entity with water rights greater in quantity than STPNOC (TCEQ 2009a). There are several water rights holders with a

(a) Firm water is that which is diverted from storage under a contact or resolution issued by the LCRA to high-priority users (Watkins et al. 1999).

priority date earlier than that of STPNOC's, however, the combined quantity of these water rights, excluding those belonging to LCRA, is 28,867 ac-ft/yr. The City of Corpus Christi has total water rights amounting to 533,305 ac-ft/yr (TCEQ 2009a), out of which 35,000 ac-ft/yr are from the Colorado River. The 35,000 ac-ft/yr water right was acquired by the City in 1999. All of the City's water rights from the Colorado River have a priority date of November 2, 1900 and are designated for industrial use according to the TCEQ water rights database (TCEQ 2009a).

Water lost from the MCR to consumptive use at the STP site is replaced by pumping from the Colorado River. Under normal river flow conditions, STPNOC currently diverts water from the Colorado River for the existing Units 1 and 2 using the rules stated above. From 2001 to 2006, STPNOC diverted an average of 37,084 ac-ft of water per year for operation of Units 1 and 2 (STPNOC 2010a). The applicant also reported that the existing consumptive water use from the Colorado River is approximately 34,821 ac-ft/yr (STPNOC 2010a). The existing consumptive use is estimated to be 2 percent (34,821 ac-ft/yr of use compared to 1,903,000 ac-ft/yr of current surface water resource (i.e., streamflow of the Colorado River as measured at the Bay City USGS gauge). When compared to the TWDB estimates of water supplies in Region K (TWDB 2007), the current STP water use for Units 1 and 2 during normal operations would be 3 percent in 2010 (34,821 ac-ft/yr of use compared to 1,182,078 ac-ft/yr of estimated supplies).

Water evaporated from the MCR has two components: (1) natural evaporation that occurs at the free water surface without addition of any heat load from the STP units and (2) induced evaporation that occurs because of the additional heat loads discharged with the circulating water into the MCR. The normal and maximum natural evaporation from the MCR are 19,912 gpm (32,118 ac-ft/yr) and 23,109 gpm (37,275 ac-ft/yr), respectively (STPNOC 2008i). The normal and maximum induced evaporations from STP Units 1 and 2 heat loads were reported by the applicant to be 33,200 and 37,200 ac-ft/yr, respectively (STPNOC 2009b). The normal and maximum conditions refer to 93 and 100 percent load factors, respectively (STPNOC 2009b).

2.3.2.2 Groundwater Use

Groundwater use from the Gulf Coast Aquifer system increased between 1940 and the mid-1980s. One cause was the increase in rice irrigation, and Matagorda County was among the counties where this occurred. The largest pumpage from the aquifer was reported in the Houston area where notable subsidence and substantial increases in pumping lift occurred. Issues with overpumping the groundwater resource included land subsidence, saltwater intrusion, stream base-flow depletion, and increased pumping lift. Groundwater use from the Gulf Coast Aquifer system has declined because of these issues and in the mid-1980s the TWDB forecast a decline in groundwater use in the Gulf Coast Aquifer through 2030. Matagorda County was projected to see a net decrease of 48 percent with pumping decreasing from 21,528 gpm (31 MGD) in 1985 to 11,111 gpm (16 MGD) in 2030 (Ryder and Ardis 2002).

Under Texas State law (Water Code, Title 2, Subtitle E, Chapter 36) groundwater conservation districts have the authority and responsibility to define the managed available groundwater in the district (Sec 36.1071 (e)(3)(A)), and the amount of groundwater being used in the district (Sec 36.1071 (e)(3)(B)), and to issue permits based on the managed available groundwater resource. The CPGCD, which is responsible for the groundwater underlying Matagorda County, Texas, has adopted a groundwater availability value of 30,520 gpm (49,221 ac-ft/yr) (Turner Collie & Braden Inc. 2004). This value is consistent with the groundwater availability value appearing in the regional water plans produced in 2002 and 2006 for the TWDB by the Lower Colorado Regional Water Planning Group (Turner Collie & Braden Inc. 2004; LCRWPG 2006). The 49,221 ac-ft/yr value is based on an estimate of maximum usage in 2050 (LCRWPG 2006).

Groundwater management by the CPGCD is an ongoing process. While the current managed available groundwater[(a)] value is 30,520 gpm (49,221 ac-ft/yr), under Texas State law the district is engaged in a process of defining and adopting the desired future condition[(b)] and an updated managed available groundwater value. The district expects to update the "managed available groundwater" value after receipt of information from the TWDB, which is responsible for simulating the groundwater resource using a groundwater availability model (CPGCD 2009a).

An estimate of groundwater supplies representative of the ability of water supply systems to provide groundwater is provided in Table 4 of the CPGCD Management Plan (Turner Collie & Braden Inc. 2004). The estimated groundwater supply level is a constant 22,189 gpm (35,785 ac-ft/yr) through 2050. A similar value appears in Table 3.30 of the LCRWPG report (LCRWPG 2006); it ranges from 22,225 to 22,221 gpm (35,844 to 35,838 ac-ft/yr) over the period 2000 through 2060.

The CPGCD provides a summary of the history of groundwater withdrawal from the Gulf Coast Aquifer in the district. Table 2 (Turner Collie & Braden 2004) of the management plan on groundwater use presents available data from 1980 through 2000. Groundwater pumpage peaked in Matagorda County in 1988 at 27,055 gpm (43,634 ac-ft/yr), and has declined since but not continuously. A low pumpage rate of 8783 gpm (14,165 ac-ft/yr) occurred in 1998. The CPGCD reports an average total groundwater usage rate of 18,746 gpm (30,233 ac-ft/yr) through the year 2000.

(a) "Managed available groundwater" means the amount of water that may be permitted by a groundwater conservation district for beneficial use in accordance with the desired future condition of the aquifer as determined under Section 36.108 of Texas water code, i.e., consideration given to the joint planning of multiple districts within a groundwater management area.

(b) "Desired future condition" is one or more metric that specifies the future value of the related aquifer characteristic such as groundwater elevation, groundwater quality, spring flow, land subsidence and other aquifer characteristics that may be deemed suitable by a groundwater conservation district and groundwater management area.

Strategies by the LCRWPG and the CPGCD to provide for the future demand are divided into surface water and groundwater strategies (LCRWPG 2006; Turner Collie & Braden 2004). These strategies provide a decadal estimate of groundwater specific management that would augment the 22,189 gpm (35,785 ac-ft/yr) existing groundwater supply in Matagorda County. These two projections of supplemental groundwater resource availability from the Region K Water Plans issued in 2002 and 2006 were 14,049 gpm (22,658 ac-ft/yr) through the year 2050 and 18,320 gpm (29,546 ac-ft/yr) through the year 2060, respectively. Thus, based on the more recent 2006 Water Plan, the projected use of groundwater through 2060 is approximately 40,509 gpm (65,331 ac-ft/yr). However, the strategies to augment existing groundwater supplies require financial resources to build infrastructure before the total projected groundwater resource would be available in 2060.

In addition to the above groundwater resource estimates, there is the total permitted amount of groundwater within the CPGCD. The three-year permitted total for the period 2005 through 2007 was 259,840 ac-ft. For the period 2008 through 2010 the permitted total is down to 153,854 ac-ft (CPGCD 2009b). This reduction in total permitted amount was a result of efforts by the CPGCD to convince owners of groundwater use permits to request groundwater quantities consistent with their realistic needs. The CPGCD estimates that the annual permitted amount for each of these three-year permit periods is 86,600 ac-ft/yr and 51,285 ac-ft/yr (CPGCD 2009b).

The quantity of groundwater permitted and the various groundwater resource estimates described above are summarized below in Table 2-4. The annual quantity of groundwater permitted by the CPGCD exceeds the current estimates of managed available groundwater and the estimated groundwater supply. It also exceeds recorded usage within the county. The infrastructure is in place at the STP site to fully utilize its permit limit (described below), and, therefore, while it has not been fully used to date, the full permit limit is included in the estimated groundwater supply value of 22,189 gpm (35,785 ac-ft/yr). The full STP permit limit is also included in the annual permitted value of 31,800 gpm (51,285 ac-ft/yr). It is apparent from the CPGCD data (see Table 2-4) that the existing groundwater supply infrastructure (e.g., groundwater wells and supply infrastructure) does not yet exceed the managed available groundwater resource, despite the fact that the CPGCD may have over-allocated the groundwater resource in aquifers underlying Matagorda County (i.e., “managed available groundwater” is less than “annual permitted (2008-2010)” in Table 2-4) (TC&B 2004, CPGCD 2009b). In addition, the CPGCD is involved in the review and approval process for development of the groundwater supply infrastructure, (e.g., the review and approval of well drilling and groundwater transportation permits).

Aside from the STP production wells which are located on the STP site, there are three public water supply wells approximately 3.75 mi (6 km) southeast of the site (STPNOC 2010a). They serve the Exotic Isle Subdivision, the Selkirk water system, and the Selkirk Island Utilities, and

all are completed in the Deep Aquifer. The closest non-public water supply wells are two wells located approximately 1.25 mi northeast of the site. They are livestock water supply wells.

Table 2-4. Groundwater Resource Estimates for Matagorda County

Resource Description	gpm	ac-ft/yr	References
Managed Available Groundwater	30,520	49,221	TC&B 2004, Table 1
Estimated Groundwater Supply	22,189	35,785	TC&B 2004, Table 4
Average GW Use 1980-2000	18,746	30,233	TC&B 2004, Table 2
High Groundwater Use – 1988	27,055	43,634	TC&B 2004, Table 2
Low Groundwater Use – 1998	8783	14,165	TC&B 2004, Table 2
Future Demand – total in – 2060	40,509	65,331	LCRWPG 2006
Annual Permitted (2008 – 2010)	31,800	51,285	CPGCD 2009b

Current usage by STP for existing Units 1 and 2 was estimated as an average value of 683 gpm (1101 ac-ft/yr) between 1980 and 2000 (Turner Collie & Braden 2004). However, using more recent values from 2001 through 2006, average groundwater use is estimated at 798 gpm (1287 ac-ft/yr) (STPNOC 2010a). The permitted limit of groundwater usage by STP is approximately 1860 gpm (3000 ac-ft/yr) or an absolute usage of 2.93E+09 gallons (9000 ac-ft) during the approximately 3-year permit period[a] (CPGCD 2008). STP has five groundwater production wells completed in the Deep Aquifer that are used to supply groundwater for the operation of STP Units 1 and 2.

A consideration with regard to groundwater use in the region is subsidence caused by substantial declines in groundwater piezometric levels and the consolidation of clays. Recent studies by the USGS (Ryder and Ardis 2002; Kasmarek and Robinson 2004) and the LCRA (2007a) address subsidence in the Gulf Coast Aquifer region. Ryder and Ardis (2002) described the large withdrawal of groundwater in the rice-irrigation region (1900–1975) including most of Jackson and Wharton Counties, and portions of others including Matagorda County, as causing the compaction of clays and a subsidence of less than 1 ft over most of the region with somewhat higher subsidence of 1.5 ft noted in western Matagorda County. However, Ryder and Ardis (2002) concluded that the subsidence was fairly evenly distributed in this mostly rural region, and undesirable impacts were minimized. Hammond (1969) also concluded that subsidence in Matagorda County was not excessive. Hammond noted that excessive subsidence can result in impacts such as cracking highways, breaking pipelines, and sinking of building foundations.

(a) For the current groundwater operating permit, the issue date is February 7, 2008, and the expiration date is February 28, 2011. For future groundwater permits, the permit term may vary slightly, but would be approximately 3 years.

A report completed by the Lower Colorado River Authority and San Antonio Water System (LCRA-SAWS) Water Project also estimated land-surface subsidence since 1900 over most of Matagorda County to be less than 1 ft (LCRA 2007a). Where land-surface subsidence exceeds 1 ft in northwest Matagorda County, it is attributed to groundwater withdrawals associated with gas/petroleum exploration and sulfur mining.

The USGS completed a model of groundwater flow and land-surface subsidence applicable to the northern part of the Gulf Coast Aquifer system (Kasmarek and Robinson 2004). This modeling effort focused on the Harris-Galveston-Fort Bend County area where as much as 10 ft of subsidence has occurred; however, the model extended to include Wharton and Matagorda counties to the southwest. The model match was close to measured values in the focus area, and predicted no subsidence in the coastal irrigation area including Wharton and Matagorda counties.

During construction and through operation in 1993 of STP Units 1 and 2, a subsidence rate of less than 0.1 in. to about 0.2 in. per year was observed (STPNOC 2008a).

2.3.3 Water Quality

The following sections describe the water quality of surface-water and groundwater resources in the vicinity of the STP site. Monitoring programs for thermal and chemical water quality are also described.

2.3.3.1 Surface-Water Quality

This section describes the water quality of surface water bodies near the STP site that may be affected by the construction and operation of proposed Units 3 and 4. STPNOC presented a discussion of the water quality conditions in Section 2.3.3.1 of the ER (STPNOC 2010a).

The State of Texas divides river reaches into segments for water quality determination. The segment of the Colorado River adjacent to the STP site, Segment 1401, is classified as a Tidal Stream (TCEQ 2008a). The TCEQ lists aquatic life, contact recreation, and fish consumption as some of the uses of this segment. The TCEQ, under the Federal Water Pollution Control Act (Clean Water Act) Section 305(b), prepares a statewide Water Quality Inventory. The TCEQ also identifies impaired water bodies during this process and lists them on the 303(d) List. Segment 1401 is listed on the 2008 Texas 303(d) List as impaired by presence of bacteria (TCEQ 2008a).

The MCR is part of the closed-cycle cooling system for the existing units. The MCR is permitted to occasionally discharge to the Colorado River through a buried pipeline under a Texas Pollutant Discharge Elimination System (TPDES) permit (TCEQ 2005). Since filling of the MCR, there has been one test of the MCR discharge system (STPNOC 2010a). The current TPDES permit allows an average daily MCR discharge of 144 MGD with a daily maximum of 200 MGD.

The average daily MCR discharge temperature is limited to 95°F with a daily maximum of 97°F. Total residual chlorine in the MCR discharge is limited to a daily maximum of 0.05 mg/L. The pH of the MCR discharge is limited between 6.0 and 9.0 standard units. The TPDES permit specifies that MCR discharge must not exceed 12.5 percent of the flow of the Colorado River at the discharge point. The permit also restricts the MCR discharges to periods when the flow of the Colorado River adjacent to the site is 800 cfs or greater. The MCR discharge facility consists of seven submerged ports located on the west bank of the Colorado River approximately 2 mi downstream of the RMPF. Each port can discharge at a maximum rate of 44 cfs, for a total maximum MCR discharge of 308 cfs.

The segment of the Colorado River adjacent to the STP site, Segment 1401, is classified by the TCEQ as tidal (TCEQ 2009b). The water body uses for the segment include aquatic life use, contact recreation use, general use, and fish consumption use. Title 30 of Texas Administrative Code (30 TAC), Part 1, Chapter 307, §307.10, Appendix A lists site specific uses and criteria for classified segments. The criteria specified for Segment 1401 are a minimum 24-hour mean dissolved oxygen at any point within the segment of 4.0 mg/L, a pH range of 6.5 and 9.0 standard units, an indicator bacteria count of 126 colonies per 100 mL or alternatively, fecal coliform criteria of 200 colonies per 100 mL, and a maximum temperature of 95°F at any point within the segment. The 2008 Texas 303(d) list (TCEQ 2009c) lists Segment 1401 impaired by bacteria since 2006. A total maximum daily load (TMDL) is currently being developed by TCEQ for this segment. The other surface water bodies near the STP site, Little Robbins Slough, West Branch of the Colorado River, and Kelly Lake are not listed in the 303(d) list. East Matagorda Bay and Matagorda Bay are listed since 1996 in the Texas 303(d) list as impaired by bacteria. TMDLs are also currently being developed by TCEQ for these waters.

At the USGS gauge 08162500, Colorado River near Bay City, Texas, monthly water quality sampling data exist only for the months October 1974, through October 1976, February and June of 2000, and March and June of 2001. The LCRA monitors water-quality data in the Colorado River Basin to evaluate overall water quality, ecological conditions, and compliance with State water quality standards (LCRA 2009a).

The LCRA monitors Colorado River water quality at a station named Colorado River Tidal at Selkirk Island, located approximately 2 mi downstream from the FM 521 and approximately 0.7 mi downstream from the RMPF. The water quality data is available for this station from LCRA (2009c).

Water quality data at the Selkirk Island station show a dissolved oxygen range from 0 to 13.5 mg/L with an average of 6.5 mg/L for the period October 1982 through November 2008. For the same period, pH measurements ranged from 6.6 and 9.8 standard units with an average of 7.9 standard units and water temperature measurements ranged from 43.5 to 92.1°F (6.4 to 33.4°C) with an average of 72.5°F (22.5°C). During the period June 1994 through September 2001, *Escherichia coli* bacteria ranged from 1 to 1280 colonies per 100 mL with an

average of 129 colonies per 100 mL. During the period October 1982 through July 2001, fecal coliform ranged from 0 to 13,000 colonies per 100 mL with an average of 391 colonies per 100 mL. The Texas Surface Water Quality Standards (30 TAC Section 307.10, Appendix A) list the following criteria for Segment 1401: (1) dissolved oxygen of 4.0 mg/L, (2) pH range of 6.5 to 9.0 standard units, (3) indicator bacteria count of 35 E. coli for freshwater and *Enterococci* spp. for saltwater per 100 mL or 200 fecal coliform per 100 mL, and (4) water temperature of 95°F. Based on this data, the Colorado River near the STP site occasionally does not meet the criteria set for dissolved oxygen (12 percent of the times measurements were made) and bacteria (24 percent of the times measurements were made). These measurements are consistent with the listing of Segment 1401 on the Texas 303(d) List.

In addition to the water quality monitoring station in the Colorado River, LCRA also maintains three stations in the Matagorda Bay. Two of these stations are located in West Matagorda Bay and one in East Matagorda Bay.

2.3.3.2 Groundwater Quality

This section describes the water quality of groundwater near the STP site that may be affected by the building and operation of proposed Units 3 and 4. STPNOC presented a discussion of the water quality of groundwater in Section 2.3.3.2 of the ER (STPNOC 2010a). Discussions of the present day setting of the underlying groundwater, and of regional salt water intrusion rely on the STPNOC ER, STPNOC annual environmental operating reports, and studies performed by the USGS and the LCRA.

Regional water quality data from the mid-1960s show all wells above or just below the EPA secondary drinking water standard for TDS (STPNOC 2010a; Hammond 1969). More current data for STP production and observation wells indicate that all but a single well are above the TDS standard of 500 mg/L (STPNOC 2010a). Locally, groundwater from the Shallow Aquifer is described as slightly saline because of TDS concentrations above 1000 mg/L (i.e., slightly saline waters have TDS between 1000 and 3000 mg/L). Onsite wells completed in the Shallow Aquifer have an average TDS concentration of approximately 1200 mg/L (STPNOC 2010a). Several regional wells and a majority of the shallow wells in the more current STP data set also exhibited chloride concentrations higher than its EPA secondary drinking water standard value of 250 mg/L. Fluoride was higher than the EPA secondary drinking water standard of 2 mg/L in a single well in each data set; the regional data set and the STP data set. The site-specific data are consistent with the regional water quality information that identify the Deep Aquifer as the preferred drinking water source, and identify the Shallow Aquifer as a lower quality water source. The water quality signatures of the Upper and Lower Shallow aquifers (i.e., sodium chloride and sodium bicarbonate respectively) suggest natural communication is occurring between these aquifers in the vicinity of two observation wells; OW-332 (near the northeast corner of proposed Unit 3) and OW-930 (approximately 4000 ft east of existing Units 1 and 2).

The MCR is connected hydraulically to the underlying Upper Shallow Aquifer and seepage from the MCR recharges the aquifer. A relief well system (i.e., the 770 wells that surround the MCR) is designed in part to intercept the majority of the seepage from the MCR into the Upper Shallow Aquifer. STPNOC (2010a) has estimated that for the MCR at a maximum pool elevation of 49 ft above MSL total seepage from the MCR is 3530 gpm (5700 ac-ft/yr), and that approximately 68 percent of this or 2390 gpm (3850 ac-ft/yr) is intercepted by the relief wells. Recent simulation of the Shallow Aquifer underlying the STP site has indicated that the relief wells and sand drains intercept approximately 50 percent of the total seepage from the MCR (STPNOC 2010c). Regarding radioactive contaminants in the MCR and in seepage from the MCR that recharges the Upper Shallow Aquifer, see Section 5.9.6.

A potential impact on the quality of the Deep Aquifer groundwater resource in the vicinity of the STP site is saltwater intrusion or encroachment resulting from pumping of groundwater in the region. Ryder and Ardis (2002) described saltwater intrusion or encroachment as a potential threat to the rice-irrigation region that includes Matagorda County because of saltwater-bearing deposits downdip, above and below the freshwater deposits. Because of the reduction of hydraulic head from long-term pumping of the aquifer system for rice irrigation, saltwater encroachment could occur by either lateral migration in coastal areas or vertical migration where freshwater sands overlie saline groundwater. However, because the groundwater system exhibits a balance between net recharge and total pumping, Ryder and Ardis (2002) conclude that "(s)altwater encroachment is not currently a serious threat to the quality of groundwater used in the coastal rice-irrigation area" that includes portions of Wharton and Matagorda Counties.

In their study of variable density groundwater flow and groundwater well design, the LCRA (2007b) provided a cross sectional analysis of Colorado, Wharton and Matagorda Counties with added pumping equivalent to 24,800 gpm (40,000 ac-ft/yr, the historical maximum) in Matagorda County over an 80-year period. Wells were placed in the model beginning about 1 mi from the coast, and screened over 400 to 500 ft to a depth of about 1000 ft BGS. Maximum drawdown was about 80 ft over the 80-year period, and the overall water quality did not change significantly. The study also evaluated well design parameters. For wells with 400 to 500 ft screens completed to approximately 700 ft BGS, the LCRA (2007b) study assumed the fresh/saline interface occurred at 1200 ft BGS and found for a hydraulic conductivity of 18 ft/day and anisotropy ratio of 1000 (K_r/K_v) that the critical pumping rate was 527 gpm. For a more realistic anisotropy ratio of 10,000, the LCRA study found that the critical pumping rate was 14,165 gpm. The LCRA (2007b) study provides guidance to others in the region so that groundwater withdrawals should not result in significant degradation of the groundwater quality in the regional groundwater system because of saltwater intrusion.

In the Regional Geology and Aquifer System section, the base of the aquifer is defined as the depth where the groundwater has a TDS concentration of more than 10,000 milligrams per liter (mg/L). Using this metric, Ryder (1996) noted that the thickness of the aquifer system in

Matagorda County ranged from 1000 to 2000 ft. A measure of impact on the quality of the groundwater resource in the Deep Aquifer is the change in depth where the TDS concentration is 10,000 mg/L, or the change in depth to thresholds of TDS level associated with higher quality water. LCRA (2007b) described the groundwater of the Deep Aquifer according to TDS level as either fresh (less than 1000 mg/L), slightly saline (1000 to 3000 mg/L), or moderately saline (greater than 3000 mg/L). In the vicinity of the STP site, the LCRA (2007b) study mapped the 3000 mg/L TDS surface at a depth of between 1000 and 1200 ft BGS.

2.3.4 Water Monitoring

2.3.4.1 Surface-Water Monitoring

The closest USGS streamflow gauge upstream of the STP site is the USGS gauge 08162500, Colorado River near Bay City, Texas. Daily discharge in the Colorado River at this gauge is available since May 1, 1948. NOAA maintains tide gauges at Freeport and at Port O'Connor. Water diverted from the Colorado River to make up the loss of water from the MCR and water consumed are monitored monthly and reported to TCEQ annually according to the TCEQ water rights permit. The volume of water diverted from the Colorado River is also reported to the TWDB annually.

Monthly water quality data is available for a limited period (see Section 2.3.1.1). Lower Colorado River Authority monitors Colorado River water quality at Selkirk Island approximately 1 mi downstream from the STP intake structure (see Section 2.3.3.1). Data monitored at this location includes various flow parameters (such as dissolved oxygen, pH, water temperature, and turbidity), bacteria (*Escherichia coli*, *Enterococci* spp., and fecal coliform), chemistry (biological and chemical oxygen demand, alkalinity, hardness, dissolved calcium and magnesium, nitrate, nitrite, phosphorus, sulfate, and total organic carbon), metals in water and sediment (including Aluminum, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, and Zinc), and organic material in sediment.

STPNOC monitors discharges and effluents as required by the TPDES permit for existing STP Units 1 and 2 at six locations (Figure 2-17). The effluent flows are compiled as daily totals and are reported to TCEQ monthly. When discharge from the MCR to the Colorado River occurs at Outfall 001, the rate of discharge is continuously monitored. The other five outfalls are all internal to the MCR and are monitored on a daily basis.

As part of the Radiological Environmental Monitoring Program, STPNOC analyzed water samples for radionuclides (including Tritium, Iodine, Cesium, Manganese, Iron, Cobalt, Zinc, Zirconium, Niobium, Lanthanum, and Barium) from several locations at the STP site (STPNOC 2010a). Only the levels of Tritium were found to be detectable in four of 12 samples. The maximum concentration of Tritium was reported in south-southeast part the MCR near the discharge facility.

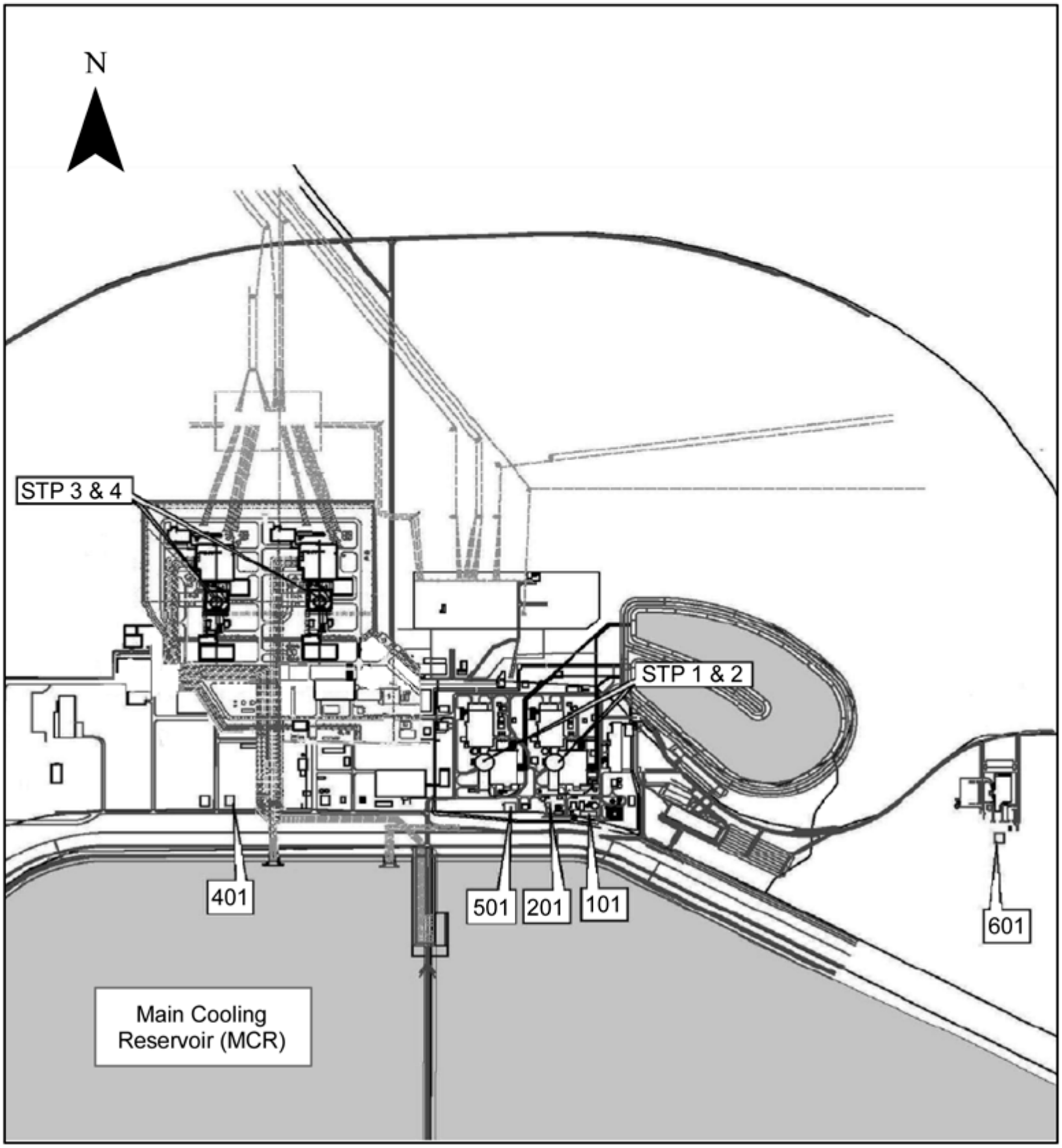

Figure 2-17. Hydrological Monitoring Locations for Existing STP Units 1 and 2 (based on STPNOC 2010a, Figure 6.3-1)

Since 1995, STPNOC has also sampled the west branch of the Colorado River, Little Robbins Slough, east branch of the Little Robbins Slough, an onsite drainage ditch located northeast of the MCR, and the MCR (STPNOC 2010a). Tritium was detected at all six sampled locations within these waterbodies. The maximum concentrations found in these waterbodies are reported in Table 2-5. The EPA primary drinking water standard for Tritium is 20,000 pCi/L. The waters of the MCR are not used for drinking.

Table 2-5. Maximum Tritium Concentration in Water Bodies Near the STP Site (1995-2005)

Location	Maximum Measured Tritium Concentration (pCi/L)	Year the Measurement was Made
West branch of Colorado River	6093	1999
Little Robbins Slough	7725	1995
East branch of Little Robbins Slough	6352	1999
Onsite Drainage Ditch northeast of the MCR	6944	1999
MCR	17,410	1996

Source: STPNOC 2010a

Stormwater runoff discharge from the STP site is monitored at four outfalls (Figure 2-18) during precipitation events. One of these outfalls is located on the Colorado River and three on the Little Robbins Slough.

2.3.4.2 Groundwater Monitoring

Prior to the application for proposed Units 3 and 4, the applicant has conducted annual environment surveys including groundwater and published annual reports (STPNOC 2007, 2008h). The 2006 report presents information generated from sampling 16 Shallow Aquifer wells within the existing Units 1 and 2 Protected Area and a comparable number of Shallow Aquifer STP controlled wells outside the Protected Area (STPNOC 2007, 2009a). Data from wells within the Protected Area are used to monitor past leaks and track contaminant migration while data from outside the Protected Area are used to track the migration of water leaving the MCR and entering the Shallow Aquifer. During site characterization for STPNOC's application, 28 groundwater observation wells were installed in 2006, and an additional 26 observation wells were installed in 2008 (STPNOC 2010a). As discussed in Section 2.3.1.2 above, hydraulic head in the Upper and Lower Shallow aquifers was reported in the application (STPNOC 2010a, b).

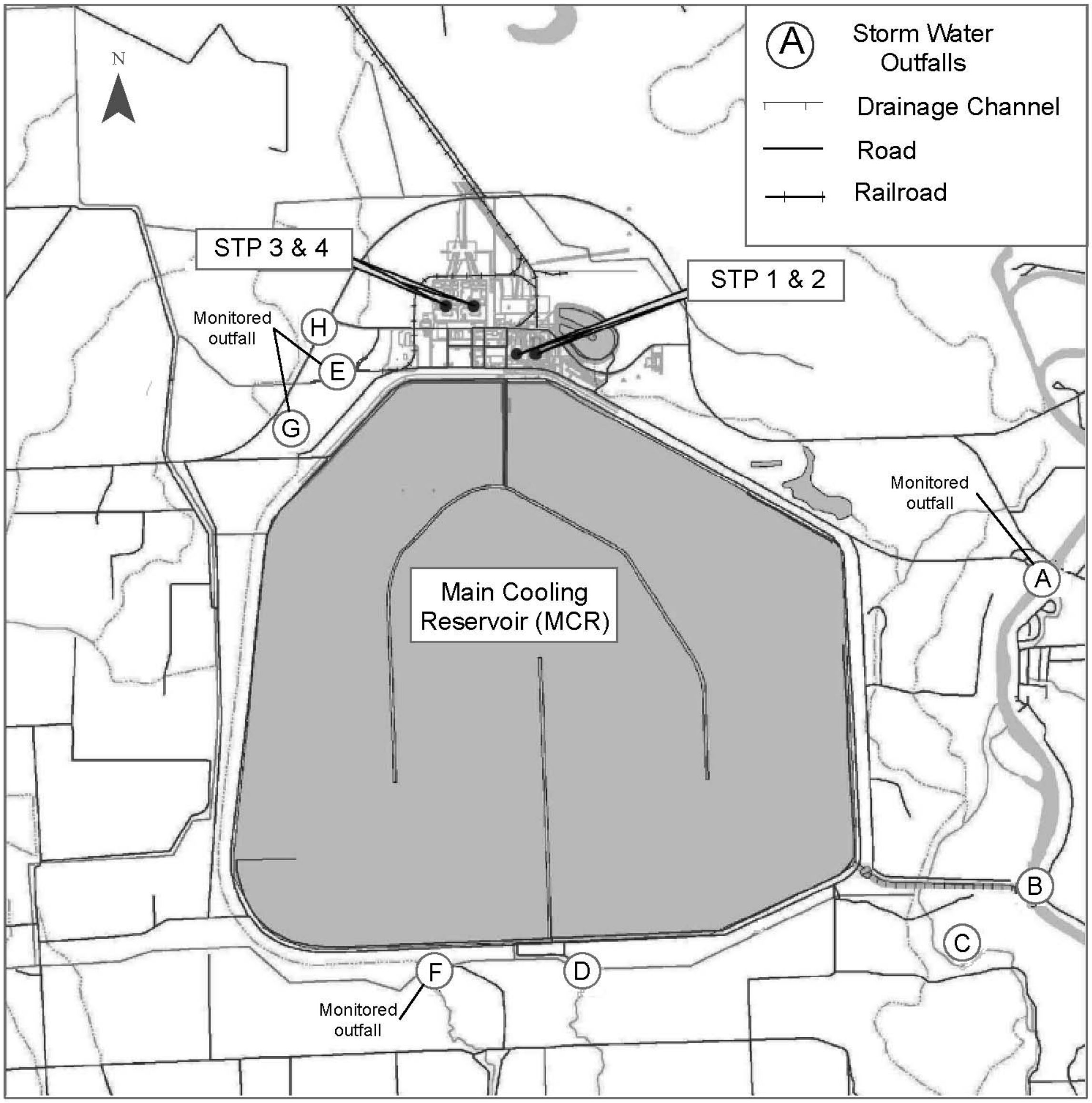

Figure 2-18. Stormwater Monitoring Locations for Existing STP Units 1 and 2 (based on STPNOC 2010a, Figure 6.3-3)