Impacts of Comanche Peak Nuclear Power Plant Units 3 and 4 Operations on Downstream Water Quality

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Issue Statement

Provide a narrative that addresses water quality conditions on the Brazos River downstream of Lake Granbury and impact of Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4.

Response

Brazos River Description

The Brazos River Basin originates in eastern New Mexico and extends about 640 mi southeasterly across Texas to the Gulf of Mexico south of Houston. The upper basin is about 70 mi wide in the northwestern part of Texas, expands to a maximum width of 110 mi near Waco, and constricts to about 10 mi wide near Richmond in the lower basin. The Brazos River and its tributaries drain an area of about 45,700 sq mi. Approximately 9570 sq mi of the upper part of the basin, including all of the area in New Mexico, does not contribute to downstream flows. The Brazos River can be characterized as an incised, meandering, sand-bed channel with unstable banks. Frequent, near-vertical cut banks 20 to 35 ft high are prominent along much of its length (USGS 2007).

Lake Granbury (Segment 1205) Description

Lake Granbury is an 8700-acre reservoir located on the main stem of the Brazos River in Hood and Parker Counties. Water body uses include aquatic life, contact recreation, fish consumption, water supply, and general uses (TCEQ 2009).

Brazos River below Lake Granbury (Segment 1204) Description

The Brazos River below Lake Granbury is a 52-mile freshwater stream segment from a point immediately upstream of the confluence of Camp Creek in Bosque/Johnson County to De Cordova Bend Dam in Hood County. Water body uses include aquatic life, contact recreation, fish consumption, and general uses (TCEQ 2009).

Stream Flow Characteristics

Stream flow in the Brazos River Basin has been altered since the 1940s by the construction of dams either on the Brazos River or on its major tributaries. U.S. Geological Survey (USGS) and Brazos River Authority (BRA) data indicate a mean monthly flow of 975 cfs (USGS 2007a) at the USGS Brazos River Dennis station located upstream of Lake Granbury, a mean monthly discharge at De Cordova Bend Dam on Lake Granbury of 1031 cfs, and a mean monthly flow of 1234 cfs (USGS 2007a) at the USGS Glen Rose station located downstream of Lake Granbury. The increase in observed downstream flows along the Brazos River can be attributed to additional inflow from peripheral tributaries and local run-off.

Water Quality of the Upper Brazos River Basin

In order to evaluate potential impacts of CPNPP Units 3 and 4 blowdown discharges on downstream water quality, it is important to understand the current water quality conditions in the upper basin, particularly the recognition of natural salt pollution as a

serious and widespread water quality problem. No other pollution source, manmade or natural, has had the impact of the natural salt sources located in the upper basin. Due to these water quality issues, some sources of water, particularly from Lake Whitney, Lake Granbury, and Possum Kingdom Reservoir, may be limited in their suitability for some uses and require advanced treatment (desalination). As the Brazos River flows to the Gulf of Mexico, inflows from tributaries decrease the concentration of dissolved minerals, which in turn improves the quality of water (Brazos G 2006). The upper basin region includes the Salt, Double Mountain, and Clear Forks of the Brazos River. Water quality impacts are represented by high conductivity levels, along with high total dissolved solids (TDS) and chloride concentrations. While this region contributes only 14 to 18 percent of the total Brazos River flow, the area contributes 45 to 55 percent of the total dissolved minerals and about 75 to 85 percent of the dissolved salts (Brazos G 2006). The table below (BRA 2007) shows the wide range of water quality standards (particularly chloride, sulfate, and TDS) for classified segments in the upper basin.

Segment Specific Surface Water Quality Standards

Upper Watershed of the Brazos River		Uses			Surface Water Quality Standards						
Segment	Name	Recreation[1]	Aquatic Life[2]	Water Supply[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L)	pH	Bacteria[4] MPN/100ml	Temperature (°F)
1203	Whitney Lake	CR	H	PS	670	320	1500	3.0	6.5-9.0	126/200	93
1204	Brazos River below Lake Granbury	CR	H		750	380	1600	3.0	6.5-9.0	126/200	91
1205	Lake Granbury	CR	H	PS	1000	600	2500	3.0	6.5-9.0	126/200	93
1206	Brazos River below Possum Kingdom	CR	H		1020	500	2300	3.0	6.5-9.0	126/200	90
1207	Possum Kingdom Lake	CR	H	PS	1200	500	3500	3.0	6.5-9.0	126/200	93
1208	Brazos River above Possum Kingdom	CR	H		5000	2000	12000	3.0	6.5-9.0	126/200	95

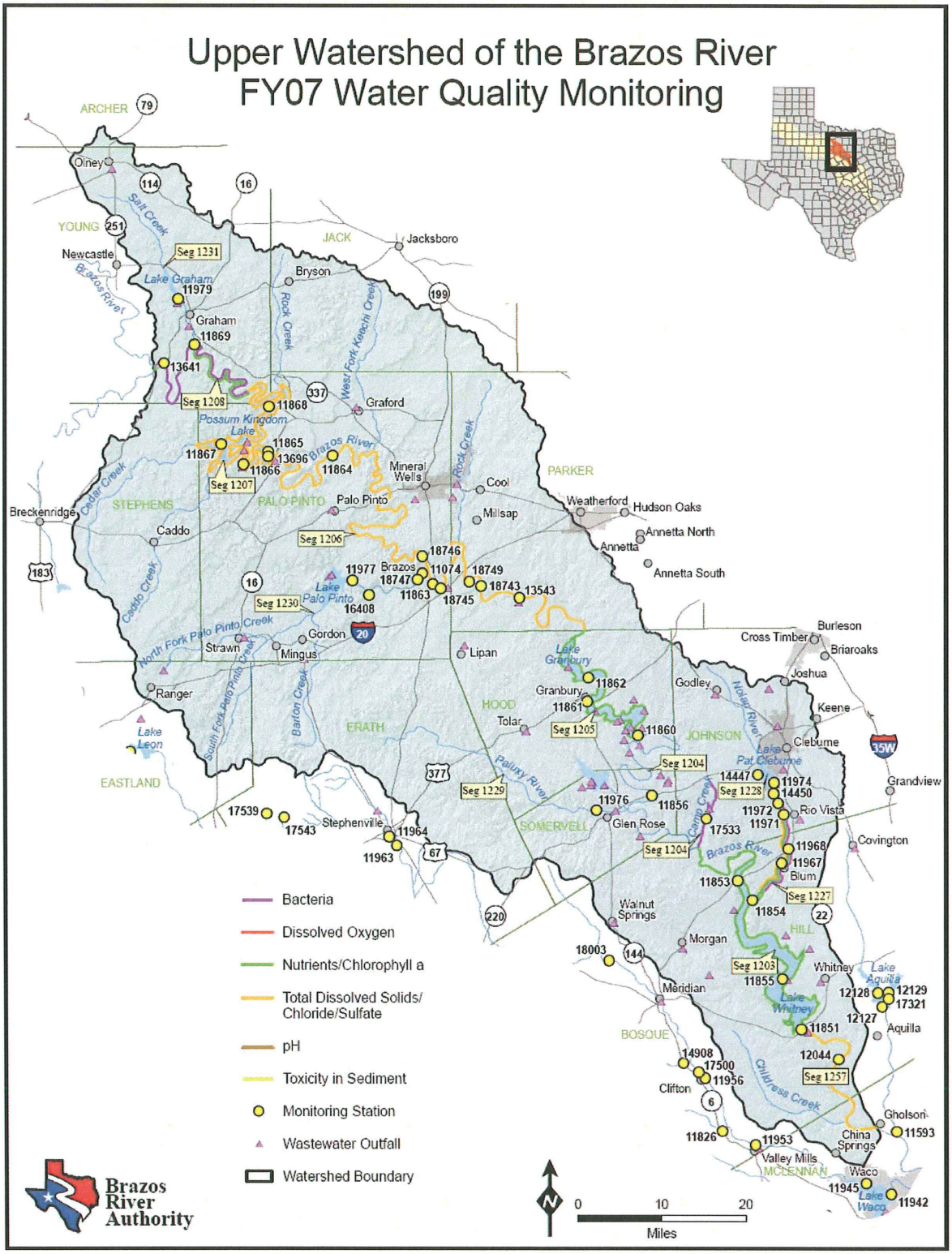
[1]CR- Contact Recreation, NCR-Noncontact Recreation
[2]E-Exceptional, H-High, I-Intermediate, L-Limited
[3]PS-Public Water Supply
[4]The indicator bacteria for freshwater is *E. coli* and Enterococci for saltwater. Fecal coliform is an alternative indicator for both types of water. The criteria numbers represent the geometric mean of E. coli and fecal coliforms, respectively.

Lake Granbury (Segment 1205) Water Quality

Lake Granbury was identified as a candidate on the 2008 303(d) List as impaired by naturally occurring chloride concentrations (TCEQ 2009). Prior to this, concerns for screening levels were identified on Lake Granbury for naturally occurring chloride, sulfate, and TDS concentrations (BRA 2007).

Brazos River below Lake Granbury (Segment 1204) Water Quality

The 2000, 2002, 2004, 2006, and 2008 Texas Water Quality Inventory Reports show Segment 1204 to fully support established aquatic life, recreation, and general use water quality standards. The fish consumption use was not assessed (TCEQ 2009). Historical data at monitoring station 11856, located on the Brazos River approximately 31 mi downstream of De Cordova Bend Dam, indicate an increasing trend in water temperature and chloride levels; however, these parameters remain below the level that would indicate a concern (BRA 2007). The figure on page 4, from the 2007 BRA Basin Summary Report (BRA 2007), shows water quality concerns within the upper basin.


Upper Watershed of the Brazos River
FY07 Water Quality Monitoring
ARCHER
Olney
YOUNG
Newcastle
JACK
Jacksboro
Bryson
Lake Graham
11979
Graham
11869
13641
Seg 1231
Seg 1208
11868
Graford
Possum Kingdom Lake
11867
11865
13696
11866
11864
Seg 1207
Mineral Wells
PARKER
Cool
Weatherford
Hudson Oaks
Millsap
Annetta North
Annetta
Annetta South
Breckenridge
STEPHENS
PALO PINTO
Palo Pinto
Caddo
Seg 1206
18746
11977
Brazos
11074
18749
18747
18743
13543
11863
18745
Lake Palo Pinto
16408
Seg 1230
Gordon
Strawn
Mingus
Lipan
Ranger
Lake Leon
EASTLAND
Lake Granbury
11862
Granbury
11861
Tolar
HOOD
ERATH
Seg 1205
11860
Godley
Cross Timber
Burleson
Briaroaks
Joshua
Keene
JOHNSON
Cleburne
Lake Pat Cleburne
Grandview
Seg 1204
14447
11974
14450
Seg 1228
11976
11856
Glen Rose
11972
11971
Rio Vista
17533
SOMERVELL
Covington
11968
11967
Blum
11853
Seg 1227
11854
Walnut Springs
HILL
Morgan
18003
Seg 1203
11855
Whitney
Lake Aquilla
12128
12129
17321
Meridian
Lake Whitney
12127
11851
Aquilla
BOSQUE
14908
12044
17500
11956
Seg 1257
Clifton
Childress Creek
Gholson
11593
11826
11953
China Springs
Valley Mills
MCLENNAN
Waco
11945
Lake Waco
11942
17539
17543
Stephenville
11964
11963
Bacteria
Dissolved Oxygen
Nutrients/Chlorophyll a
Total Dissolved Solids/ Chloride/Sulfate
pH
Toxicity in Sediment
Monitoring Station
Wastewater Outfall
Watershed Boundary
Brazos River Authority
N
0
10
20
Miles

Water Treatment Facilities

To mitigate surface water quality issues from natural salt pollution, existing and planned municipal surface water projects in the upper basin utilize or plan to utilize advanced water treatment systems. The BRA currently operates an advanced surface water treatment facility on Lake Granbury, known as the Lake Granbury Surface Water and Treatment System (SWATS). SWATS provides water to the City of Granbury, the Acton Municipal Utility District, the Johnson County Fresh Water Supply District No. 1, the Johnson County Special Utilities District, and in the near future, the City of Keene. The system uses an advanced membrane treatment process to remove naturally occurring salt from the water withdrawn from Lake Granbury, making it suitable for potable purposes (BRA 2009).

The Lake Whitney Water Supply Project is planned for the City of Cleburne water supply. The project will develop 9700 ac-ft per year of undeveloped water supply from Lake Whitney contracted to the City of Cleburne through the BRA. Information from the Brazos Region G Planning Group indicates that planned municipal water use from Lake Whitney will require advanced treatment for TDS and chlorides (F&N 2008).

CPNPP Units 3 and 4 Blowdown

If untreated, cooling tower blowdown water returned to Lake Granbury will contain essentially the same mass load of TDS as the water originally diverted, but in greater concentrations due to the forced water loss during the cooling process (HDR 2008). Water chemistry analysis of estimated CPNPP Units 3 and 4 untreated blowdown constituent concentrations indicates that maximum concentrations of chlorides and sulfates are expected to exceed the Texas Surface Water Quality Standards (TSWQS) for Lake Granbury during low flow conditions. Mean and maximum concentrations of TDS are expected to exceed the TSWQS during low flow and maximum TDS concentrations are expected to exceed during mean flow conditions. Based on these estimations and the known impact of the natural salt sources located in the upper basin of the Brazos River, a blowdown treatment facility for CPNPP Units 3 and 4 discharges is planned to treat cooling tower blowdown water to meet the requirements of the Texas Pollution Discharge Elimination System (TPDES) permit.

Current Permitted Discharges

TPDES information was obtained from the U.S. Environmental Protection Agency (EPA) Envirofacts website (EPA 2009). The table below provides a summary of TPDES-permitted discharges to Lake Granbury and the Brazos River below Lake Granbury. The following figure shows the location of each permitted outfall in relation to the planned CPNPP Units 3 and 4 outfall.

TPDES-PERMITTED DISCHARGES

PERMITTED DISCHARGE FACILITY	DISCHARGE TYPE	DISTANCE UPSTREAM / DOWNSTREAM FROM CPNPP DISCHARGE (MI)	AVG DAILY FLOW LIMIT (Mgd)	MONITORED DISCHARGE CONSTITUENTS
MONARCH (OAK TRAIL SHORES)	SEWERAGE SYSTEM	22.45 UPSTREAM	0.16	PH, FLOW, ALUMINUM, TDS

TPDES-PERMITTED DISCHARGES				
PERMITTED DISCHARGE FACILITY	DISCHARGE TYPE	DISTANCE UPSTREAM / DOWNSTREAM FROM CPNPP DISCHARGE (MI)	AVG DAILY FLOW LIMIT (Mgd)	MONITORED DISCHARGE CONSTITUENTS
CITY OF GRANBURY	SEWERAGE SYSTEM	11.75 UPSTREAM	2.00	PH, FLOW, TSS, AN, FC, CBOD
ACTON MUD 1 (DE CORDOVA BEND ESTATES)	SEWERAGE SYSTEM	6.25 UPSTREAM	0.60	PH, FLOW, TSS, AN, CBOD
TXU (DE CORDOVA STEAM ELECTRIC STATION)	UTILITY WASTEWATER	7.30 UPSTREAM	1041.48	PH, FLOW, TEMP, TRC
TEXAS H2O (CANYON CREEK)	SEWERAGE SYSTEM	7.65 UPSTREAM	0.042	PH, FLOW, BOD, TSS
LAKE GRANBURY SWATS	WATER TREATMENT WASTE	4.50 UPSTREAM	2.5	PH, FLOW, CHLORIDES, SULFATES
HOOD COUNTY (AQUA UTILITIES, INC)	SEWERAGE SYSTEM	1.70 UPSTREAM	0.088	PH, FLOW, BOD, TSS
RIDGE UTILITIES	SEWERAGE SYSTEM	1.45 UPSTREAM	0.06	PH, FLOW, BOD, TSS
FALL CREEK (MANMADE DITCH; UNNAMED TRIBUTARY)	SEWERAGE SYSTEM	UNKNOWN UPSTREAM	0.012	PH, FLOW, BOD, TSS, DO
AQUASOURCE - TREATY OAKS (UNNAMED TRIBUTARY)	SEWERAGE SYSTEM	UNKNOWN DOWNSTREAM	0.055	PH, FLOW, CBOD, AN, TSS
ACTON MUD 2 (PECAN PLANTATION)	SEWERAGE SYSTEM	13.00 DOWNSTREAM	0.487	PH, FLOW, BOD, TSS
WOLF HOLLOW	UTILITY WASTEWATER	16.00 DOWNSTREAM	1.10	PH, FLOW, TEMP, TRC, CBOD, TDS, SULFATES, CHLORIDES
UNIMIN CORPORATION (3 OUTFALLS ON GEORGES CR)	GROUNDWATER	UNKNOWN DOWNSTREAM	1.50	PH, FLOW, TSS
TOLAR VIA SQUAW CR	SEWERAGE SYSTEM	35.00 DOWNSTREAM	0.10	PH, FLOW, BOD, TSS
CPNPP 1 & 2 VIA SQUAW CR	POWER GENERATION	35.00 DOWNSTREAM	3168	PH, FLOW, TEMP, FAC, TRC, TSS, O&G, FC, TDS, FE, CU
BILL BRILEY INACTIVE	SEWERAGE SYSTEM	UNKNOWN	UNKNOWN	UNKNOWN
GLEN ROSE (VIA PALUXY RIVER)	SEWERAGE SYSTEM	35.00 DOWNSTREAM	0.60	PH, FLOW, DO, TSS, CBOD, TRC, AN
TARRANT BAPTIST	SEWERAGE SYSTEM	41.00 DOWNSTREAM	0.06	PH, FLOW, DO, TSS, BOD, TRC

Notes:
TEMP – Temperature
DO – Dissolved Oxygen
FAC - Free Available Chlorine
TRC – Total Residual Chlorine
TSS – Total Suspended Solids
O&G – Oil & Grease
BOD- Biochemical Oxygen Demand (5-day)
CBOD – Carbonaceous Biochemical Oxygen Demand
FC- Fecal Coliform
AN – Ammonia Nitrogen
FE - Iron
CU- Copper

Seven (7) sewerage systems discharge to Lake Granbury with a combined average daily flow limit of 2.962 million gallons per day (Mgd). Other discharges include the De Cordova Steam Electric Station (SES) power plant with a permitted daily discharge of 1041.48 Mgd (once-through cooling) and the Lake Granbury SWATS facility with an average daily discharge limit of 2.5 Mgd (water treatment waste).

Six (6) sewerage systems ultimately discharge to the Brazos River below Lake Granbury (Segment 1204) either directly or by way of a reservoir or stream. These discharges have a combined average daily flow limit of 1.302 Mgd. Three (3) permitted outfalls for groundwater discharge from a mining operation are located on George's Creek, a tributary to the Brazos River. Average daily flow limits for the three outfalls is 1.5 Mgd. Other discharges include the Wolf Hollow power plant with a permitted daily discharge of 1.10 Mgd to the Brazos River and CPNPP Units 1 and 2, which discharge up to 3168 Mgd of once-through cooling water to Squaw Creek Reservoir (SCR). USGS stream gauge data for Squaw Creek show the average flow contribution to the Brazos River from SCR dam releases is 13.57 Mgd (21 cfs) (USGS 2007a). Based on the downstream distances of these discharges from De Cordova Bend Dam and additional dilution from peripheral tributaries and local run-off, no cumulative effects from mixed discharge plumes are expected.

CPNPP Units 3 and 4 TPDES Permit

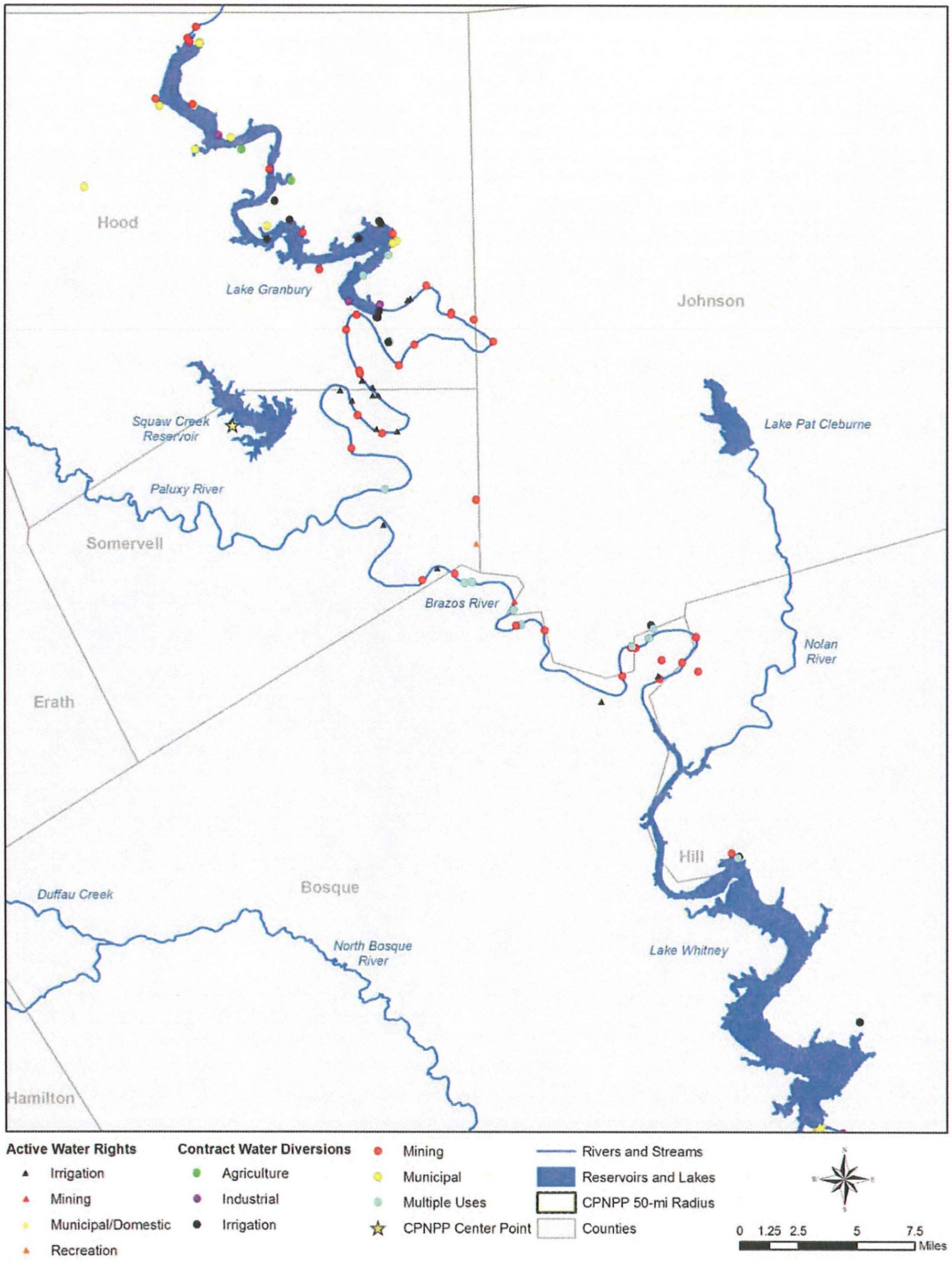
The CPNPP Units 1 and 2 TPDES permit is expected to be amended to include Units 3 and 4 discharges to Lake Granbury. Monitoring requirements are expected to be similar to those currently required for the discharge of SCR blowdown to Lake Granbury (Outfall 005) where monitoring of temperature, TDS, and flow are required. The planned treatment of blowdown for CPNPP Units 3 and 4 ensures permit compliance and minimizes Lake Granbury and downstream water quality impacts.

CPNPP Water Quality Impacts on Other Water Users

With respect to CPNPP Units 3 and 4 water use projections, the potential impacts of the Brazos Region G water management strategy were evaluated at two gauge locations on the Brazos River: (1) near Glen Rose downstream of the proposed intake and discharge locations on Lake Granbury and (2) near Richmond in the lower portion of the watershed. The anticipated impact of this water management strategy on overall flows would be minor when addressed from the perspective of the existing 2006 Brazos G Water Plan. Flows downstream of Lake Granbury, as measured by the Glen Rose gauge, would generally be somewhat less than those without the new diversion for CPNPP Units 3 and 4; however, flows would increase in some months. These differences are due to how the BRA system of reservoirs responds in the modeling of the BRA System Operations Plan to meet shifting water needs. There would be little difference in flows at the Richmond gauge. It is not likely that this project, alone, would have a substantial influence on total discharge in the Brazos River or to freshwater inflows to the Brazos River estuary where additional flow inputs would moderate the effects (HDR 2008).

Water use information for Lake Granbury and the Brazos River below Lake Granbury was obtained from the BRA and Texas Commission on Environmental Quality (TCEQ). The majority of the water use along Segment 1204 is for irrigation and mining use and is not used for public water supply. A diversion from Lake Whitney (Segment 1203) for City of Cleburne municipal water supply is planned; however, it is expected to require advanced treatment for chlorides and TDS. Based on the identified downstream water uses and need for advanced water treatment at Lake Whitney, water quality impacts with regard to TDS and chlorides from the operation of CPNPP Units 3 and 4 on other water users are expected to be minimal. The figure below shows current surface water

diversions and designated uses for Lake Granbury and the Brazos River below Lake Granbury.



Aquatic Ecology

During a 2007-2008 seasonal survey of the Brazos River below De Cordova Bend Dam, 19 fish species were encountered. The most abundant fish reported were inland silverside, red shiners, blacktail shiners, and juvenile channel catfish. All fish represented in the survey are ubiquitous to riverine habitat across the state of Texas. Benthic invertebrate samples throughout the survey contained more than 25 families. Most of the invertebrates collected were of the order Diptera, which are quite hardy to a variety of habitat conditions. The upper Brazos River system is dynamic in that water quality is driven by basin flow conditions and the build-up of naturally occurring salt in Possum Kingdom Lake. The organisms residing within the system are acclimated to variations in flow and water quality, and would therefore not be affected by operation of CPNPP Units 3 and 4.

Conclusion

No other pollution source, manmade or natural, has had the impact of the natural salt sources located in the upper basin of the Brazos River. Given the known water quality impact of the natural salt sources located in the upper basin of the Brazos River and expected blowdown return water concentrations, a blowdown treatment facility for CPNPP Units 3 and 4 discharges is planned.No water quality impacts with regard to established water uses or aquatic ecology are expected from the operation of CPNPP Units 3 and 4.

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