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U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555
ATTN: David B. Matthews, Director
Division of New Reactor Licensing

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT, UNITS 3 AND 4
DOCKET NUMBERS 52-034 AND 52-035
SUPPLEMENTAL INFORMATION IN RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ENVIRONMENTAL REVIEW

Dear Sir:

Luminant Generation Company LLC (Luminant) submits herein supplemental information in response to the Request for Additional Information regarding the Environmental Review of the Combined License Application for Comanche Peak Nuclear Power Plant, Units 3 and 4. The information addresses the blowdown treatment facility and hydrology.

Some of the electronic files included on the CD are "native files" to allow the reviewers to work with the data as requested by the NRC. These files do not meet the "Guidance for Electronic Submission to the NRC," Revision 5.

Should you have any questions regarding these responses, please contact Don Woodlan (254-897-6887, Donald.Woodlan@luminant.com) or me.

There are no commitments in this letter.

I state under penalty of perjury that the foregoing is true and correct.

Executed on December 18, 2009.

Sincerely,

Luminant Generation Company LLC

Donald R. Woodlan for

Rafael Flores

Attachments: 1. Supplemental Information in Response to the Request for Additional Information Regarding the Environmental Review
2. List of Files on the Enclosed CD

Enclosure: CD Containing Electronic Files

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NRO

cc: Michael Willingham w/attachments and CD
Greg Zimmerman (ORNL) w/attachments and CD

Electronic distribution w/attachments only (no CD)

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Attachment 1

Supplemental Information in Response to the Request for Additional Information Regarding the Environmental Review

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI REGARDING THE ENVIRONMENTAL REVIEW

DATE OF RAI ISSUE: 6/26/2009

QUESTION NO.: GEN-03 (3.6.1-1) HYD-23 (9.4.2.2.5-1) and LU-03 (5.5.1.1.2-1)

SUPPLEMENTAL INFORMATION:

This response is provided in two parts: Background and Response.

BACKGROUND:

Each of the above-referenced Environmental Report (ER) RAI responses refer to some aspect of the Blowdown Treatment Facility (BDTF) and require supplemental responses. The supplemental information needed for the responses (and for the NRC to complete their review) is being provided as a combined response herein to facilitate an understanding of the system as a whole and to describe any associated potential impacts to the environment and possible mitigative measures.

Due to the complexity of the system and its relationship with the environment, this combined response is provided using the following outline:

I. BDTF DESIGN CONSIDERAITONS, DESIGN, AND OPERATION:

   a. Design Considerations

   b. BDTF Design

      i. Treatment System: Pre-filters, Ultrafilters, and Reverse /Osmosis (R/O) membranes

      ii. Evaporation Pond and Mister System

      iii. Storage Pond

   c. BDTF Operation

   d. Water Quality Affects

   e. Composition and Amount of Salt/Solids Generation

f. Method and Frequency of Solids Removal

i. Anticipated BDTF Maintenance, Frequency, and Worker Protection

ii. Off-site Disposal Options Considered

II. ER UPDATE

III. ALTERNATIVES

a. Alternatives Considered

b. Primary Alternative Considered (Closed-cycle System)

c. Ecological Impacts of Alternatives

RESPONSE:

As described in ER Subsection 2.3.1.2.4 elevated Total Dissolved Solids (TDS) and chloride concentrations have been detected in the section of the upper drainage basin of the Brazos River including Lake Granbury. The condition is described as fairly widespread in the upper basin as a result of natural salt bearing formation in the Salt and Double Mountain forks of the Brazos River coupled with drought conditions. As a result, Lake Granbury can experience seasonally high TDS and chloride concentrations. During these seasonally high periods, TDS and chloride concentrations when concentrated by a factor of 2.4, may exceed the surface water quality standards of 2500 mg/l and 1000 mg/l, respectively. Therefore, mitigative measures have been considered for the blowdown discharge back to Lake Granbury when the expected concentrations exceed the surface water quality standards. The current proposed system is the Blowdown Treatment Facility (BDTF) described below.

I. BDTF DESIGN CONSIDERATIONS, DESIGN, AND OPERATION:

a. Design Considerations

The following design considerations were used for the conceptual design of the BDTF.

- The chloride concentration in the makeup water to the cooling tower is the limiting chemical constituent in the design of the BDTF. This input was selected by reviewing the following data sets where chloride concentrations were analyzed:

  (1) The 2001 – 2006 Brazos River Authority data summarized in ER Table 2.3-25 (Sheets 1-3).

  (2) The 2007 – 2008 quarterly data (April, July, and October of 2007 and January 2008) for COLA development from various locations and depths within Lake Granbury. This data is summarized in ER Table 2.3-26 (Sheets 1-3).

  (3) The 2001 – 2006 BRA data summarized in ER Table 2.3-25 shows the minimum and maximum chlorides concentrations from Lake Granbury at 95 mg/l at location 11862 and 1783 mg/l at location 11860, respectively.

  (4) The 2007 – 2008 data collected for COLA development and summarized in Table 2.3-26 shows the minimum and maximum chlorides concentrations from Lake Granbury at 207 mg/l and 594 mg/l, respectively. Since the US Geological Survey (USGS) 60 year data suggests that periods of higher chloride concentrations would need to be taken into account

during drought conditions, and considering that chloride concentrations comprise approximately 50 percent of the TDS concentration, a maximum chloride concentration based upon the data identified above was selected.

Chloride concentrations in makeup water to the cooling towers are conservatively assumed to be 1800 mg/l. When designing the BDTF, chloride concentration charge balance dictates the accompanying TDS concentration in the mass balance process water flow through the system. Discharges to Lake Granbury will meet the TCEQ Surface Water Quality Standard for chlorides and TDS concentrations at 1000 mg/l and 2500 mg/l, respectively.

- Based upon the chloride concentration of 1800 mg/l and the charge balance used in the mass balance for the process flow through the system, the associated TDS concentration is 3525 mg/l. This conservative concentration is consistent with higher TDS concentrations for periods of dry or drought conditions purported in the Freese and Nichols Report (*Lake Granbury Dissolved Mineral Study*, Freese and Nicholes, Inc. for Luminant Generation Company, October 8, 2008) where 60 years of USGS gauge data was collected and then monthly averaged for the years 1940 through 2000.
- Metals and other analytes were assumed using the maximum values from Lake Granbury data included in the ER (Table 2.3-26).

b. BDTF Design

The BDTF contains a treatment system for blowdown water and evaporation accelerated by the use of misters. Reject water from the treatment system is directed to the misters for spray over the evaporation pond and to the storage pond. The evaporation pond allows for the collection of solids dropped from the evaporated droplets and the mist that does not evaporate. The storage pond allows for additional reject water storage capacity and acts as a collection point of the rejects and evaporation pond runoff. The basic equipment in the treatment system consists of pre-filters, ultrafilters, and reverse osmosis (R/O) membranes. The discussions below focus on one unit for CPNPP 3 or 4.

The following design parameters are used:

- Makeup water flow rate: approximately 31,000 gpm
- Cooling tower cycles of concentration: 2.4
- Cooling tower evaporation and drift: Approximately 18,000 gpm
- Blowdown water flow rate from cooling tower: approximately 13,000 gpm

i. Treatment System: Pre-filters, Ultrafilters, and R/O membranes

The pre-filters reduce turbidity and the ultrafilters remove colloidal materials from cooling tower blowdown water. The function of the R/O membranes is to concentrate the TDS, chloride, and metals by a factor of five (5). R/O membranes are designed to achieve 80 percent recovery with clean R/O permeate of approximately 8200 gpm. The waste reject concentrate is approximately 2040 gpm from the R/O membranes. The total discharge is approximately 2600 gpm including backwash water (approximately 540 gpm) to the evaporation pond.

ii. Evaporation Pond and Mister System

Evaporation Pond

The concentrated reject waste stream is pumped from the reject sump to the evaporation pond that is 2364 ft X 2364 ft X 4 ft (plus 2 ft of freeboard).

The evaporation pond will be sectionalized to allow proper arrangement of the misters and access for cleanout of the pond and maintenance of the equipment. It will be constructed in accordance with Texas Administrative Code (TAC) 330.17, Municipal Solid Waste and Texas Commission on Environmental Quality (TCEQ) 217.203, Design Criteria for Natural Treatment Facilities. The pond can be lined by either high density polyethylene (HDPE) or compacted clay. Using compacted clay will allow the addition of a concrete layer to allow vehicle entrance to the pond to facilitate cleanup. Cleanup of the pond will need to occur on a rotating basis to maintain salt levels manageable. The pond is protected from inundation from a 10-year, 2-hour rainfall by two feet of freeboard.

Mister System

The mister system is designed to evaporate the backwash water from the treatment system. There will be a total of 182 misters arranged in the evaporation pond to facilitate continuous evaporation of the water from the waste reject flow (rounded up to 5200 gpm for Units 3 and 4). The mister design is as follows:

One mister is comprised of 30 nozzles; the design of each nozzle is 2.67 gpm at 150 psi and results in the average water droplet size of 90 micron.

Design of flow misters is 80.1 gpm.

Efficiency of mister is 35.7 percent based on 10 years average monthly evaporation rate from 1997 to 2007 in Somervell County, Texas.

Total design flow to each mister is 80.1gpm. Factoring in the evaporation efficiency of 0.357 results in an evaporation rate of 28.6 gpm

The number of misters is designed using the following evaluation:

5200 gpm/28.6 gpm = 182 misters

The misters will be spaced at a minimum distance of 51 ft along the interior berms in the evaporation pond.

iii. Storage Pond

The storage pond is designed to store backwash for maintenance and as a contingency has a capacity of three aggregate months of storage. The dimensions of the storage pond are approximately 1436 ft X 1436 ft X 32 ft, with 2 ft of freeboard.

The storage pond will also be constructed in accordance with TCEQ municipal solid waste regulations cited for the evaporation pond above.

c. BDTF Operation

The BDTF is designed to allow for continuous operation (24 hours for 365 days per year), if needed, to meet the surface water quality standards. During periods where the TDS and chloride concentrations in the untreated blowdown do not exceed the surface water quality standards, the BDTF is not operated. The BDTF will be operational when the TDS concentrations in Lake Granbury reach 1000 mg/l and/or when chloride concentrations reach 400 mg/l. Based upon the USGS gauge data for years 1940 through 2000 monthly averages, approximately 15 percent of the time, the TDS concentration will be below 1000 mg/l and treatment after being concentrated 2.4 times through the cooling towers will be unnecessary since discharge limits will still be met.

For the discussions below, refer to Figure 3.6-1. The normal flow path of BDTF at the design conditions will take approximately 83 percent of the blowdown flow and divert it to the facility for treatment. Approximately 95 percent of the diverted water is filtered water and will be sent to the R/O unit. Approximately 80 percent of the filtered water will become treated water and will be reverted back to the main blowdown stream. Approximately 5 percent of the diverted water is reject water from the filters and approximately 20 percent of the filtered water is reject water from the R/O units. The reject water above will become waste water, which will be backwash containing the rejects from pre-filters, ultrafilters, and R/O membranes and will be routed either directly to the misters or the storage pond. If there are insufficient misters available (due to maintenance) to evaporate the total amount of design flow, the excess will be diverted to the storage pond and then be sent to the misters when load demand improves. New Subsection 3.6.1.4 that discusses the BDTF flow process has been added to the ER.

In the event that the blended flow back to Lake Granbury would exceed discharge limits (for example when Lake Granbury TDS and chloride exceed design input parameters), a larger stream will be diverted as necessary to not exceed the discharge limits. To accommodate this additional flow, the spare pre-filters, ultrafilters, and R/O membrane treatment train will be placed into service. There is an equivalent of 50 percent spare capacity available. Excess Pre-filters, Ultrafilters, and R/O membrane reject flow will be diverted to the storage pond until the system demand is lower than the design capacity of the misters and the storage volume can then be evaporated. These flow paths will keep the concentration of solids in the reject water at calculated levels since there is no mechanism to concentrate them further.

Maintenance of a section of the pre-filters, ultrafilters, and R/O membrane equipment can be accomplished while the remaining equipment is running. Spare equipment will be brought into service, as needed. In that case the excess cooling tower blowdown can be directed to the storage pond untreated, temporarily increasing the volume of flow to the pond.

The operation of the BDTF includes intake and discharge monitoring to ensure the BDTF is operated as necessary to meet the discharge limits. The monitoring equipment and the frequency of monitoring will be specified during the detailed design phase.

d. Water Quality Affects

As stated in this response, the BDTF is designed to ensure TDS and chloride discharge concentrations to Lake Granbury will meet the current surface water quality standards of 2500 mg/l and 1000 mg/l. Therefore, when the natural concentrations exceed these standards, the levels of TDS and chlorides in the BDTF discharge to Lake Granbury will essentially improve the water quality of Lake Granbury.

As discussed in ER Subsection 5.2.3.4, water treatment chemicals for the cooling tower are designed to be consumed by the system, with residual concentrations remaining in the effluent at trace to non-detectable concentrations.

For metals and other analytes, ER Subsection 5.2.3.4, conservatively describes the cooling tower blowdown analyte concentrations expected from the 2.4 cooling tower cycles of concentration (blowdown water) and the expected discharge concentrations into Lake Granbury without accounting for the BDTF. This description is based on quarterly monitoring data collected from various sampling locations in Lake Granbury from April 2007 through January 2008; presented in Table 2.3-26. When the BDTF is operational, the blended discharge concentrations were assessed by factoring in the R/O treatment process (Subsection 3.6.1.4) and it was found that the analyte concentrations in the blended discharge will be less than the analyte concentrations in the untreated discharge. This assessment was performed to provide a conservative estimate and used maximum values for a bounding scenario for discharge concentrations at a 2.4 cycle concentration with and without the BDTF. The actual discharge concentrations will be met based on the TPDES limits that will be established by the TCEQ at the time of permit issue.

Screening levels shown in Table 2.3-26 were established based on the *2008 Guidance for Assessing and Reporting Surface Water Quality in Texas* (final issue dated March 19, 2008), prepared by the TCEQ Surface Water Quality Monitoring Program (SWQM-guidance). The SWQM-guidance describes how to report concentrations less than the laboratory reporting limits (non-detects). As stated in the SWQM-guidance, there is no generalized way to determine the true value for an individual result in the range between zero and the reporting limit; however, for criteria that are expressed as averages, half of the reporting limit or half of the criterion, which ever is less, should be used. To maintain conservatism, this guidance was used for the statistical evaluation of the average, mean, maximum concentrations for all analytes reported in Table 2.3-26.

As shown in Table 2.3-26 arsenic, cadmium, chromium, lead, selenium, and nickel, all contained analytical results of non-detect values (none of the sample results were reported above the laboratory detection limits). Following the TCEQ SWQM-guidance, the non-detects were factored as the smallest of the two values (half the non-detect value or half the screening criterion) and then concentrated at a factor of 2.4; an extremely conservative estimation of metal concentrations for discharge to Lake Granbury. Of the metals cited above, the half detection limit was used to estimate concentrations that would result from CPNPP Units 3 and 4 discharges, based on the 2.4 concentration factor for the cooling tower operation. Although the mean and maximum selenium concentrations in the blowdown were estimated to exceed the TCEQ Criteria for Specific Metals in Water for Protection of Aquatic Life, which is an extremely conservative estimation of the expected actual conditions, the blended discharge from the BDTF will reduce the selenium concentrations well below the screening level of 0.005 mg/l.

Copper, barium, magnesium, and zinc contained sampling results above the laboratory detection limits. Therefore, the average, minimum, and maximum concentrations were considered true values and none exceeded their respective screening levels when concentrated by a factor of 2.4 and blended with the BDTF discharge.

e. Composition and Amount of Salt/Solids Generation

The composition of the salt and solids in the evaporation pond are determined based on TDS and chloride concentrations of 3525 mg/l and 1800 mg/l. In addition, metal and other analytes were considered by using the maximum values provided in Table 2.3-26. The concentrated maximum based on operation of the BDTF as described in I.c above, was used to estimate pond solids composition in mg/kg. As discussed in Section I.d of this response, several of the metals were reported as non-detect values, a conservative approach for estimating the final composition of the solids/salts. This conservative approach is considered a bounding scenario and the composition of the metals in the solids was found to be non-hazardous.

The total amount of solids and salts were estimated for two cases. For the maximum case, where the BDTF operates 365 days/yr, the salt generated in pounds per year was calculated:

Maximum case (TDS: 3525 mg/l)

Total of salt/solids of 4.74E+4 lb/hr x 24 hr/day x 365 days/yr x 2 units = 8.31E+8 lb/yr

Based upon the USGS 1940 through 2000 gauge monthly averaged data, the BDTF will be placed into operation 85 percent of the time (when the TDS concentration meets or exceed 1000 mg/l). The expected TDS concentration 70 percent of the rest of the time will range from 2000 to 2500 mg/l. The expected TDS concentration of 2500 mg/l is conservative to use when calculating expected salt deposition inasmuch as the actual salt deposition would be less.

While the BDTF is in operation approximately 85 percent of the year, the intake concentration will fluctuate between 2000 to 2500 mg/l approximately 70 percent of the time. Thus, the expected salt deposition after processing through the BDTF would fluctuate and be less.

Accordingly, the actual amount of salt produced will be less than the calculated value since the calculated value assumes 2500 mg/l for the entire duration when the BDTF operates 85 percent of the year.

Expected case (TDS: 2500 mg/l)

Total of salt/solids of 2.63E+4 lb/hr x 24 hr/day x 310 days/yr x 2 units = 3.91E+8 lb/yr

This is equivalent to 572 tons per operating day.

f. Method and Frequency of Solids Removal

i. Anticipated BTDF Maintenance, Frequency, and Worker Protection

The R/O membranes require occasional cleaning, using a clean-in-place system. This will involve flushing with a dilute solution of R/O permeate and chemical (for example, citric acid or EDTA). The exact chemical would be recommended by the membrane manufacturer, based on the membrane material and type of fouling present. The spent cleaning solution would be discharged to the evaporation pond. The quantity of cleaning solution would be extremely small compared to the UF/RO reject flow quantities and therefore would not be expected to have any effect on the pond solids.

The level of solids in the pond will be monitored on a regular basis, and the solids will be removed as needed. It is expected that the solids will be partially wet in some areas. Removal of solids from the evaporation pond will be accomplished manually by vacuuming the pond. If the solids prevent vacuuming, they will be manually broken up by hand equipment.

Once the solids are removed and ready for transport, the unprotected portions of the pond liner (clay or HDPE) will be inspected. Any perforations or gouges will be repaired.

The solids composition is non-hazardous. Any workers or operators involved in the BDTF operation and maintenance of the evaporation pond will receive the appropriate hazards awareness training in accordance with 29 CFR 1910. This training has been identified in FSAR Subsection 13.2.1.1.3.

ii. Off-site Disposal Options Considered

A potential disposal option is a state-permitted non-hazardous industrial solid waste landfill located in Texas. In Texas, there are three classifications of non-hazardous industrial solid waste, which are Class 1, 2 and 3. It is anticipated that the salt wastes will be classified as a Class 2 industrial waste. Documentation such as analytical data and/or process knowledge would be required in order to properly classify the waste. Classification as a Class 1 would be the worst case scenario. If the waste is a Class 1, there are additional handling and disposal requirements, and the waste is not routinely disposed of at municipal solid waste (MSW) landfills. For conservatism, this assessment assumes the waste is Class 1.

Acceptance of non-hazardous industrial solid waste at MSW landfills requires prior written authorization from the Texas Commission on Environmental Quality (TCEQ). For the acceptance of Class 1 non-hazardous industrial solid waste at MSW landfills, TCEQ requires that the landfill construct a special unit for disposal and have written authorization in their permit. There were 13 Class 1 landfills and 48 landfills for Class 2 and 3 within a 50 mile radius that accepted non-hazardous industrial waste in 2007. There are fewer landfills that handle Class 1 waste because of the special waste designation due to the handling and disposal requirements.

According to the *2007 Municipal Solid Waste in Texas: A Year in Review*, (the latest data currently available) there are 272 permitted landfills in Texas, however only 246 MSW landfills provided data for 2007 and of those only 216 were open. Of those 216 landfills, 188 were active (accepting waste) and 27 were open but inactive (not accepting waste). It is anticipated that the solid will be disposed of in a Type I landfill, which is the standard landfill for the disposal of MSW. Of the 216 landfills open at the end of 2007, 171 were permitted as Type I landfills.

According to the 2007 report, the total remaining landfill capacity in the state at the end of the year was 2.15 billion cubic yards and would have serve for 42 years. Type I landfills disposed of 30,204,900 tons and have a remaining capacity of 44 years. Statewide capacity increased in 2007, with 28 facilities receiving permit amendments to expand. This resulted in a net capacity increase of approximately 27.2 million tons.

Based on CPNPP solid waste generation of approximately 209,000 tons per year, Texas had adequate landfill capacity in 2007. However, this is not evenly distributed across the state. There are 24 councils of governments (COGs) across the state, which are responsible for MSW management planning on a regional basis. There are five COGs partially within the 50 mile radius CPNPP. The North Central Texas Council of Governments (NCTCOG) is where Hood and Somervell counties are located. The remaining four are NorTex Regional Planning Commission (NRPC), West Central Texas Council of Governments (WCTCOG), Heart of Texas Council of Governments (HOTCOG) and Central Texas Council of Governments (CTCOG). As of 2007, NCTCOG reported that there are 23 active MSW landfills with a remaining capacity of 380,108,105 tons or 35 years. NRPC reported two active MSW landfills with a remaining capacity of 55,328,271 tons or 91 years. WCTCOG reported eight active MSW landfills with a remaining capacity of 76,597,458 tons or 86 years. HOTCOG reported four active MSW landfills with a remaining capacity of 38,175,535 tons or 28 years. CTCOG reported two active MSW landfills with a remaining capacity of 7,980,129 tons or 17 years. Therefore, there was adequate landfill capacity within 50 miles of CPNPP for the life of the plant.

It is expected that the solid waste will be transported from the site to the landfills using approved trucks and/or rail in accordance with state and federal regulations. Typically, it is expected to be dry. If the solids are wet they will be transported in water tight containers to be processed at the landfill facility to meet the landfill requirements.

Another disposal option is injection of the salt waste into a Class I or Class V well. In order to consider this option the solid salt waste would need to be mixed with a fluid and additional characterization of the liquid salt waste would be required before disposal. A Class I injection well can be used only if the waste is considered a non-hazardous desalination concentrate or non-hazardous drinking water treatment residuals. This determination would be made by the TCEQ. The disposal of the salt waste as an injection fluid for disposal would be regulated and permitted by the TCEQ. The owner/operator of the commercial disposal/injection well would be responsible for the permitting requirements.

II. ER UPDATE

Subsection 3.6.1.4 has been added to the ER to clarify cooling tower discharge with and without the BDTF operation. This revision also identifies the conceptual design parameters and discusses the operation of the BDTF.

III. ALTERNATIVES

a. Alternatives Considered

Alternative system designs for the BDTF were evaluated as described in ER Subsection 9.4.2.2.5. Table 9.2-6 has been added to the ER to describe alternatives that have been considered. The design of the proposed system is considered the most flexible and robust and the operation of the system can be altered to meet projected future requirements.

b. Primary Alternative Considered (Closed-cycle System)

With respect to alternate designs for the BDTF, one alternative of interest is processing and returning all the water to the cooling tower basins for reuse and not returning the water to Lake Granbury (closed-cycle system). The closed-cycle system design is similar to the proposed system except that it eliminates the need for a full-flow return piping system. For the design of the closed-cycle system, approximately 65 percent of the blowdown flow (8400 gpm) is routed to the BDTF and approximately 80 percent clean flow (6700 gpm) is pumped to blend with the remaining raw blowdown flow to produce a 1800 mg/l chloride return to the cooling tower assuming that the makeup water chloride concentration is 1800 mg/l. Approximately 400 acres are expected to be disturbed for the construction of the Closed-cycle System, which is the same as the proposed system.

The positive and negative points of the Closed-cycle System and the proposed BDTF system are summarized below.

- <u>Facility Dimension</u> - Both the Closed-cycle System and the proposed BDTF system are expected to disturb approximately 400 acres of land in the same proposed on-site location.
- <u>Operation</u> - For the design basis of the proposed system, when the TDS concentrations in Lake Granbury reach 1000 mg/l and/or when chloride concentrations reach 400 mg/l, the BDTF will be in continuous operation. However, when the chloride and TDS concentrations are low, the BDTF will be bypassed. The Closed-cycle System will be continuously operated in order to maintain the TDS and chloride concentration of the cooling tower. Because the Closed-cycle System for the BDTF needs to be in continuous operation, redundancy will need to be considered for the design.

- Water Loss and Waste Generation - For both systems, solid waste (mostly salt) will be generated when the systems are operated. As discussed above, the Closed-cycle System will be in continuous operation, resulting in more water loss and the generation of more solid waste.

- Maintenance - A discharge line is needed for the Closed-cycle System to dispose of water during repair or maintenance on equipment such as the cooling tower basin, pumps, and evaporation pond.

In summary, Luminant has looked at the options (including the financial impacts) and chose the current design. Both options offer environmental impacts of a different nature, but the impacts of both are small and acceptable. However, the current design is considered the most flexible and robust, and the operation of the system can be altered to meet potential future requirements.

c. Ecological Impacts for Alternatives Considered

Cooling towers will be used for heat removal at CPNPP Units 3 and 4. Various options were considered for intake supply to the cooling towers and processing the associated blowdown water from the cooling towers. The various alternatives considered were discussed previously. The focus of this discussion is to address the ecological impacts associated with processing the discharge water.

Option 1 was used as the basis for the development of the current design. In the previous design, a percentage of the blowdown stream is treated and mixed with the bypassed stream and then pumped to Lake Granbury. The highly concentrated process water was then diverted to a 400-acre BDTF complex.

Options 2 and 3 suggest a lower percentage of the blowdown stream be treated, which would decrease the amount of concentrated waste to be removed once evaporation is complete. However, TDS concentrations in the discharge stream would exceed the surface water quality standards for Lake Granbury and a variance would be necessary. An increase in Lake Granbury TDS would need to be evaluated before downstream ecological impacts could be assessed. Therefore, this option was not considered plausible.

Option 4 suggests an increase in make-up water from Lake Granbury will be treated directly and blended with the blowdown stream to dilute the discharge TDS to 2500 ppm. Increases in intake and discharge rates, volumes, and velocities would require additional evaluation before ecological impacts could be assessed, and would require additional dialogue and agreements with the Brazos River Authority (BRA). The amount of expected withdrawal from Lake Granbury has already been tentatively agreed upon and additional withdrawals would require a pipeline to Possum Kingdom Lake more than 40 miles away. Therefore, this was not considered a plausible option.

Option 5 illustrates several disposal alternatives to increasing the cycles of concentration from 2.4 to 5. Volumes of both makeup and blowdown water would be decreased.

- Option 5a would transport the blowdown stream to Possum Kingdom Reservoir. Habitat along the right of way between CPNPP and Possum Kingdom would need to be evaluated before ecological effects associated with building a pipeline to the lake could be evaluated. Current aquatic ecology of Possum Kingdom would need to be assessed and CORMIX models performed before ecological effects on the lake could be projected.

- Option 5b suggests deep-well injection, which would have little ecological effect.
- Option 5c suggests blowdown be stored and evaporated from a 25 million gallon evaporation pond by increasing the depth of the current size of the pond.

Increasing the cycles of concentration from 2.4 to 5 will cause higher concentrations of impurities in the cooling tower plume. Prior to evaluating ecological effects, plume calculations will need to be revisited. For reasons stated above, Option 5 is not realistic.

Option 6 requires the installation of hybrid towers, which are not economically feasible at this time.

Option 7 was used as a basis for the development of the alternative presented in Section III.c and describes a closed cycle system where 100 percent of the treated blowdown is returned to the cooling tower to be reused. This option eliminates ecological issues associated with the blowdown discharge to Lake Granbury and ground disturbance associated with discharge pipelines as there is no discharge. However, continuous operation of the BDTF would be necessary, which increases solid waste generated. From an ecology standpoint, this option is less invasive than the current design, but was not the design of choice for reasons not pertaining to ecology.

Lake Granbury has naturally occurring high TDS and chloride concentrations. To use Lake Granbury as a source and sink for cooling and discharge water respectively, actions are necessary to reduce TDS and chloride in the blowdown stream. Options considered include treating various percentages of the blowdown stream before pumping water back to Lake Granbury, increasing the volume of intake water to increase dilution prior to discharge, increasing the cycles of concentration and then treating the blowdown stream and pumping to Possum Kingdom Reservoir, which is upstream of Lake Granbury. Taking into account intake and discharge volumes and constituents, cooling tower plume constituents and salt drift, a design based on Option 1 represents a realistic option from an ecological point of view.

Impact on R-COLA

See attached marked-up ER Revision 1 pages 2.3-43, 2.3-164, 3.4-4, 3.6-2, 3.6-4, 3.6-5, 3.6-6, 3.6-7, 3.6-8, 3.6-9, 3.6-10, 3.6-11, Figure 3.6-1, 4.2-3, 5.2-4, 5.2-12, 5.2-15, 5.5-4, 9.2-57, 9.2-58, 9.4-17, and 9.4-22.

Impact on S-COLA

None.

Impact on DCD

None.

calculated using the generation output of CPNPP Units 1 and 2. Monthly 2006 surface water use data for CPNPP Units 1 and 2 are provided in Table 2.3-37.

Luminant selected the MHI US-APWR plant design for CPNPP Units 3 and 4. The location designated for CPNPP Units 3 and 4 is northwest of the existing reactor containment structures for CPNPP Units 1 and 2 (Figure 1.1-3). The US-APWR is rated at 4451 MWt with an optimum output of 1700 MWe (average summer time output is expected to be 1625 MWe). Four banks of mechanical draft wet cooling towers are planned to be utilized for the service water cooling system with makeup water coming from the Brazos River, Lake Granbury. The grade elevation for both units is set at 822.0 ft msl. A permanent stormwater drainage system replaces the construction stormwater drainage system at the completion of construction.

Plant water consumption and water treatment for CPNPP Units 3 and 4 are determined based on plant characteristics and engineering evaluations in the design control document (DCD). An existing water supply pipeline between Lake Granbury and SCR supplies water to SCR, the makeup water source to SCR for CPNPP Units 1 and 2 operation. A return water pipeline from SCR to Lake Granbury also exists, but has reportedly never been used. Because Lake Granbury is the water source for CPNPP Units 3 and 4, additional pipelines and new intake and discharge structures are planned in the vicinity of the existing SCR makeup water intake and discharge structures (Figure 2.3-20).

The estimated water withdrawal for the operation of CPNPP Units 3 and 4 from Lake Granbury is 65,400 gpm (94,176,000 gpd) during maximum operations (Table 2.3-38). The water discharge rate to Lake Granbury during maximum operations, including loss estimates from the conceptual cooling tower BDTF of ~~1,200~~approximately 5,200 gpm (~~1,728,000~~7,488,000 gpd), is estimated at ~~23,700~~approximately 20,900 gpm (~~34,128,000~~30,096,000 gpd) (Table 2.3-39). Consumptive water use for Units 3 and 4 is estimated at ~~60,048,000~~64,080,000 gpd (~~184~~196 ac-ft/day). At this rate, the expected time to drawdown Lake Granbury from a normal pool elevation of 693.0 ft msl to the minimum operating elevation of 675.0 ft msl is approximately 508 days (Table 2.3-38). This estimate is based on current Lake Granbury elevation-volume data and the CPNPP Units 3 and 4 daily consumptive water use estimate. This estimate does not account for inflow, outflow, evaporation, or other water users that may draw upon Lake Granbury. Figure 3.3-1 presents a water use diagram showing flow rates to and from the various water systems. Points of consumption, and sources and discharge locations are included as part of the discussion in this section. Section 3.3 provides a narrative on the water use diagram, including maximum water consumption, water consumption during periods of minimum water availability, and average operation by month and by plant operating status. A description of the BDTF is provided Subsection 3.6.1.1. Additional information related to the CPNPP Units 3 and 4 water withdrawal and return, including withdrawal and return rates for each diversion by use is presented in Section 3.4.

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2.3.2.3 Groundwater

Portions of six major and nine minor aquifers extend into the Brazos Region G Area (Brazos G 2006). The CPNPP site and Lake Granbury are located on outcrops of the Trinity Group aquifer, which occurs mostly in Callahan, Eastland, Erath, Hood, Somervell, Comanche, Hamilton, Coryell, and Lampasas counties. The confined aquifer area is mostly in Johnson, Hill, Bosque, McLennan, Coryell, Bell, and Williamson counties (Figure 2.3-25).

TABLE 2.3-39
CPNPP UNITS 3 AND 4 COOLING TOWER BLOWDOWN DISCHARGE ESTIMATES

Average Water Discharge to Lake Granbury CPNPP Units 3 and 4

Discharge Rate	**Conversion Calculations**				**Discharge Flow**
gpd	gph	gpm	gps	ft^3/gal	cfs
37,584,000	1,566,000	26,100	435.0	7.48	58.16

Average Water Discharge to Lake Granbury CPNPP Units 3 and 4 with BDTF[(a)]

Discharge Rate	**Conversion Calculations**				**Discharge Flow**	
gpd	gph	gpm	gps	ft^3/gal	cfs	
~~34,128,000~~30,096,000	~~1,422,000~~1,254,000	~~23,700~~20,900	~~395.0~~348.3	7.48	~~52.81~~46.57	RAI GEN-03 RAI HYD-23 RAI LU-03

a) BDTF – Blowdown Treatment Facility for CPNPP Units 3 and 4

Notes:

gpm flow rates provided in Figure 3.3-1 were used as a source of the water discharge calculations
Dischagre rates assume 2 US-APWR Units
gpd = gallons per day
gph = gallons per hour
gpm = gallons per minute
gps = gallons per second

of a 24-month cycle and consuming the most flow. Therefore, all other modes are bounded by the power operation.

Non-Essential and Essential Service Water Systems

As noted in Subsection 3.4.1.1, the NESWS provides heat removal from the TCS during power operation while the ESWS provides cooling water for heat removal from the CCWS during all six modes of normal operation. During refueling, the ESWS also supports a full core offload.

As previously stated, CPNPP Units 3 and 4 are estimated to be in the power operation mode for 97 percent of the operating cycle. The time estimates for the remaining modes are as given above and do not include forced outages as they cannot be predicted. The power operating mode is paramount, operating for over 23 months out of a 24-month cycle and consuming the most flow. Therefore, all other modes are bounded by the power operation.

3.4.1.3 Heat Generated, Dissipated to the Atmosphere, and Released in Liquid Discharges

Circulating Water System

In the power operation and startup modes, heat is generated, dissipated to the atmosphere, and released in liquid discharges from the CWS. The CWS releases heat to the atmosphere via the CWS cooling tower and to Lake Granbury liquid discharges via blowdown. The quantities of heat released are summarized in Table 3.4-1.

Essential Service Water System

The ESWS operates in all six modes of plant operation and releases heat to the atmosphere via the UHS cooling towers, and in liquid discharges to Lake Granbury in the form of blowdown. The amount of heat released during each of these modes of operation in the CWS and the ESWS is shown in Table 3.4-1.

3.4.1.4 Water Source and Quantities of Water Withdrawn, Consumed, and Discharged

Circulating Water System

During power operation, the CWS requires makeup water from Lake Granbury. This water is provided to the CWS by the MWS. To provide for the CWS requirements, the MWS must provide sufficient capacity to make up for cooling tower losses due to evaporation, drift, and blowdown. The CWS operation results in the release of this water back to the environment. Evaporation from the cooling tower to the atmosphere is the major consumptive water use. The blowdown operations provide a discharge path to Lake Granbury. Approximately ~~6000~~10,700 gpm of the total raw blowdown per unit will be treated in the blowdown treatment facility. After treatment, approximately ~~4800~~8,200 gpm will return to the blowdown line and flow back to Lake Granbury. The remaining ~~1200~~2,600 gpm will flow to the evaporation pond. The amount of water supplied by the system from Lake Granbury along with the discharge quantities for each of the six modes is provided in Table 3.4-2.

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3.6.1.1 Circulating Water, Service Water, Potable and Sanitary Water, Demineralized Water, and Fire Protection Systems

Each unit has a CWS, essential service water system (ESWS), non-essential service water system (NESWS), potable and sanitary water system (PSWS), demineralized water system (DWS), and fire protection system (FPS). The description of the chemicals injected into these systems and the effect on the effluent discharged to Lake Granbury and SCR is discussed below.

The operation of the CWS is described in Sections 3.3 and 3.4. The operation cycle for this system for normal modes of operation is described in Section 3.4. The chemicals that are needed to maintain proper operation of the system are injected by the chemical treatment system (CTS) during the power operation, startup, hot standby, and safe shutdown modes of operation. The chemicals injected into the CWS, the amount used per year, the frequency of use, and the concentration in the waste stream are shown in Table 3.6-1. A stream of water (blowdown) is removed from each of the CWS and ultimate heat sink (UHS) cooling tower (CT) basins to control the water chemistry. For each plant unit, 24-in carbon steel blowdown piping from the two CWS CT basins is headered into a 42-in prestressed, reinforced concrete piping. The 42-in concrete piping runs approximately 13 mi to the Lake Granbury blowdown discharge outfall where water is dissipated into the lake through diffusers at a rate of 13,050 gallons per minute (gpm) per plant unit. The concentration factor for this evaporative cooling system is provided in Subsection 3.4.1. Prior to discharge to Lake Granbury, approximately ~~46~~83 percent of the blowdown is routed to a Blowdown Treatment Facility (BDTF). Refer to Subsection 3.6.1.4 for description of the BDTF. Sump pumps feed raw blowdown to the BDTF. The facility equipment produces a clean permeate stream and a concentrated waste reject stream. The clean permeate is sent to a holding sump and then pumped to blend with the remaining raw blowdown flow to produce a total dissolved solids (TDS) of less than 2500 milligrams per liter (mg/l) and chlorides less than 1000 mg/l effluent to Lake Granbury, assuming the inlet TDS concentration is 3525 mg/l and the inlet chloride concentration is 1800 mg/l. ~~The clean permeate is sent to a holding sump and then pumped to blend with the remaining raw blowdown flow to produce a 2500 milligram per liter (mg/l) total dissolved solid (TDS) effluent to Lake Granbury, assuming the inlet TDS concentration is 1680 mg/l.~~ The concentrated reject waste stream is sent to the reject sump and then pumped to the evaporation pond.

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The evaporation pond operates at a depth of approximately ~~2~~4 feet (ft), with 2 ft of freeboard, and is interconnected with a three-month storage pond equipped with pumps to recirculate to water misters for forced evaporation. The evaporation pond is sectionalized to alternate dry portions for salt removal. Waste material generated from the BDTF is planned to be disposed at an off-site non-hazardous landfill.

RAI GEN-03
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RAI LU-03

The operations of the SWS, both ESWS and NESWS, are described in Sections 3.3 and 3.4. The operating cycle for these systems for normal modes of operation is described in Section 3.4. The chemicals that are needed to maintain proper operation of the systems are injected by the CTS during the modes of operation that include power operation, startup, hot standby, safe shutdown, cold shutdown, and refueling. The chemicals injected into the ESWS and NESWS, the amount used per year, the frequency of use, and the concentration in the waste stream are shown in Table 3.6-1. The blowdown effluent, which combines with effluent from CWS, and the backwash strainer effluent are discharged to Lake Granbury through a system of multiport diffusers.

blowdown water is drawn from a location above the tube sheet of each steam generator where impurities are expected to accumulate. The blowdown from each steam generator is depressurized by a throttle valve located downstream of the isolation valves.

The turbine closed cooling water system (TCS) cools blowdown water in the nonregenerative heat exchanger to protect the demineralizer resin prior to purifying the blowdown water. The impurities from the cooled blowdown water are removed by the inlet filters, demineralizers, and outlet strainers. SGBD demineralizers consist of two cation demineralizers and two mixed bed demineralizers. The purified water is returned to the condenser. A local grab sample point is provided downstream of each demineralizer to measure the impurities' concentration, a radiation monitor is provided downstream of the demineralizers outlet strainers, and a radiation monitor is provided in the sample line to measure the radioactivity level in the blowdown water. In case of steam generator tube leakage, and when abnormally high radiation level is detected, the blowdown lines are isolated, and the blowdown water included in the SGBD is transferred to a waste holdup tank in the liquid waste management system (LWMS).

3.6.1.3 Wastewater

For each unit, the WWS collects and processes wastewater from equipment and floor drains from nonradioactive building areas.

The WWS collects:

- System flushing wastes during startup prior to treatment and discharge.
- Fluid drained from equipment or systems during maintenance or inspection activities, and other process fluids.
- Waste from nonradioactive equipment and floor drains from the turbine building and other nonnuclear island buildings that may contain oily waste, makeup water treatment plant effluents, sampling sinks, and nonrecoverable SGBD.

Wastewater from the proposed project is expected to be piped to the CPNPP Units 1 and 2 wastewater retention ponds for treatment and disposal.

3.6.1.4 Blowdown Treatment Facility

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As stated in Subsection 3.4.1.1, the CWS makeup water from Lake Granbury undergoes 2.4 cycle concentration in the cooling towers. Based upon 1940 to 2000 USGS gauge data monthly averages, Total Dissolved Solids (TDS) concentrations in Lake Granbury makeup water could reach as high as 3500 mg/l for several months, especially during drought conditions. In reviewing Brazos River Authority data for years 2001 through 2006 (Table 2.3-25) and surface water sampling and quarterly analysis performed during 2007 to 2008 (Table 2.3-26), it is also recognized that Lake Granbury makeup water will also contain chlorides as high as 1800 mg/l as well as metals and other analytes. Since this makeup water will be concentrated 2.4 cycles through the CWS cooling towers, TDS and chlorides must be removed from this water prior to discharge to Lake Granbury.

Alternatives to this facility are discussed in Subsection 9.4.2.2.5 and Table 9.2-6.

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Design Considerations:

The following design considerations were used for the conceptual design of the BDTF.

- The chloride concentration in the makeup water to the cooling tower is the limiting chemical constituent in the design of the BDTF. This input was selected by reviewing the following data sets where chloride concentrations were analyzed:

    1. The 2001 – 2006 Brazos River Authority data summarized in ER Table 2.3-25 (Sheets 1-3).

    2. The 2007 – 2008 quarterly data (April, July, and October of 2007 and January 2008) for COLA development from various locations and depths within Lake Granbury. This data is summarized in ER Table 2.3-26 (Sheets 1-3).

    3. The 2001 – 2006 BRA data summarized in ER Table 2.3-25 shows the minimum and maximum chlorides concentrations from Lake Granbury at 95 mg/l at location 11862 and 1783 mg/l at location 11860, respectively.

    4. The 2007 – 2008 data collected for COLA development and summarized in Table 2.3-26 shows the minimum and maximum chlorides concentrations from Lake Granbury at 207 mg/l and 594 mg/l, respectively. Since the US Geological Survey (USGS) 60 year data suggests that periods of higher chloride concentrations would need to be taken into account during drought conditions, and considering that chloride concentrations comprise approximately 50 percent of the TDS concentration, a maximum chloride concentration based upon the data identified above was selected.

        Chloride concentrations in makeup water to the cooling towers are conservatively assumed to be 1800 mg/l. When designing the BDTF, chloride concentration charge balance dictates the accompanying TDS concentration in the mass balance process water flow through the system. Discharges to Lake Granbury will meet the TCEQ Surface Water Quality Standard for chlorides and TDS concentrations at 1000 mg/l and 2500 mg/l, respectively.

- Based upon the chloride concentration of 1800 mg/l and the charge balance used in the mass balance for the process flow through the system, the associated TDS concentration is 3525 mg/l. This conservative concentration is consistent with higher TDS concentrations for periods of dry or drought conditions purported in the Freese and Nichols Report (Lake Granbury Dissolved Mineral Study, Freese and Nicholes, Inc. for Luminant Generation Company, October 8, 2008) where 60 years of USGS gauge data was collected and then monthly averaged for the years 1940 through 2000.

- Metals and other analytes were assumed using the maximum values from Lake Granbury data included in the ER (Table 2.3-26).

BDTF Design

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The BDTF contains a treatment system for blowdown water and evaporation accelerated by the use of misters. Reject water from the treatment system is directed to the misters for spray over the evaporation pond and to the storage pond. The evaporation pond allows for the collection of solids dropped from the evaporated droplets and the mist that does not evaporate. The storage pond allows for additional reject water storage capacity and acts as a collection point of the rejects and evaporation pond runoff. The basic equipment in the treatment system consists of pre-filters, ultrafilters, and reverse osmosis (R/O) membranes. The discussions below focuses on one unit for CPNPP 3 or 4.

The following design parameters are used:

- Makeup water flow rate: approximately 31,000 gpm
- Cooling tower cycles of concentration: 2.4
- Cooling tower evaporation and drift: Approximately 18,000 gpm
- Blowdown water flow rate from cooling tower: approximately 13,000 gpm

Treatment System: Pre-filters, Ultrafilters, and R/O membranes

The pre-filters reduce turbidity and the ultrafilters remove colloidal materials from cooling tower blowdown water. The function of the R/O membranes is to concentrate the TDS, chloride, and metals by a factor of five (5). R/O membranes are designed to achieve 80 percent recovery with clean R/O permeate of approximately 8200 gpm. The waste reject concentrate is approximately 2040 gpm from the R/O membranes. The total discharge is approximately 2600 gpm including backwash water (approximately 540 gpm) to the evaporation pond.

Evaporation Pond and Mister System

Evaporation Pond

The concentrated reject waste stream is pumped from the reject sump to the evaporation pond that is 2364 ft X 2364 ft X 4 ft (plus 2 ft of freeboard).

The evaporation pond will be sectionalized to allow proper arrangement of the misters and access for cleanout of the pond and maintenance of the equipment. It will be constructed in accordance with Texas Administrative Code (TAC) 330.17, Municipal Solid Waste and Texas Commission on Environmental Quality (TCEQ) 217.203, Design Criteria for Natural Treatment Facilities. The pond can be lined by either high density polyethylene (HDPE) or compacted clay. Using compacted clay will allow the addition of a concrete layer to allow vehicle entrance to the pond to facilitate cleanup. Cleanup of the pond will need to occur on a rotating basis to maintain salt levels manageable. Pond is protected from inundation by a 10 year 2 hour rainfall by use of 2 ft of freeboard. The evaporation pond will be arranged so that the mister non-evaporatives will drain to the storage pond.

Mister System

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The mister system is designed to evaporate the backwash water from the treatment system. There will be a total of 182 misters arranged in the evaporation pond to facilitate continuous evaporation of the water from the waste reject flow (rounded up to 5200 gpm for Units 3 and 4). The mister design is as follows:

One mister is comprised of 30 nozzles; the design of each nozzle is 2.67 gpm at 150 psi and results in the average water droplet size of 90 micron.

Design of flow misters is 80.1 gpm.

Efficiency of mister is 35.7 percent based on 10 years average monthly evaporation rate from 1997 to 2007 in Somervell County, Texas.

Total design flow to each mister is 80.1gpm. Factoring in the evaporation efficiency of 0.357 results in an evaporation rate of 28.6 gpm.

The numbers of misters are designed using the following evaluation:

5200 gpm/28.6 gpm = 182 misters

The misters will be spaced at a minimum distance of 51 ft along the interior berms in the evaporation pond.

Storage Pond

The storage pond is designed to store backwash for maintenance and as a contingency has a capacity of three aggregate months of storage. The dimensions of the storage pond are approximately 1436 ft X 1436 ft X 32 ft, with 2 ft of freeboard.

The storage pond will also be constructed in accordance with TCEQ municipal solid waste regulations cited for the evaporation pond above.

BDTF Operation

The BDTF is designed to allow for continuous operation (24 hours for 365 days per year), if needed, to meet the surface water quality standards. During periods where the TDS and chloride concentrations in the untreated blowdown do not exceed the surface water quality standards, the BDTF is not operated. The BDTF will be operational when the TDS concentrations in Lake Granbury reach 1000 mg/l and/or when chloride concentrations reach 400 mg/l. Based upon the USGS gauge data for years 1940 through 2000 monthly averages, approximately 15 percent of the time, the TDS concentration will be below 1000 mg/l and treatment after being concentrated 2.4 times through the cooling towers will be unnecessary since discharge limits will still be met.

For the discussions below refer to Figure 3.6-1. The normal flow path of BDTF at the design conditions will take approximately 83 percent of the blowdown flow and divert it to the facility for treatment. Approximately 95 percent of the diverted water is filtered water and will be sent to the

R/O unit. Approximately 80 percent of the filtered water will become treated water and will be reverted back to the main blowdown stream. Approximately 5 percent of the diverted water is reject water from the filters and approximately 20 percent of the filtered water is reject water from the R/O units. The reject water above will become waste water, which will be backwash containing the rejects from pre-filters, ultrafilters, and R/O membranes and will be routed either directly to the misters or the storage pond. If there are insufficient misters available (due to maintenance) to evaporate the total amount of design flow, the excess will be diverted to the storage pond and then be sent to the misters when load demand improves. New Subsection 3.6.1.4 has been added to the ER that discusses the BDTF flow process. RAI GEN-03 RAI HYD-23 RAI LU-03

In the event that the blended flow back to Lake Granbury would exceed discharge limits (for example when Lake Granbury TDS and chloride exceed design input parameters), a larger stream will be diverted as necessary to not exceed the discharge limits. To accommodate this additional flow, the spare pre-filters, ultrafilters, and R/O membrane treatment train will be placed into service. There is an equivalent of 50 percent spare capacity available. Excess Pre-filters, Ultrafilters, and R/O membrane reject flow will be diverted to the storage pond until the system demand is lower than the design capacity of the misters and the storage volume can then be evaporated. These flow paths will keep the concentration of solids in the reject water at calculated levels since there is no mechanism to concentrate them further.

Maintenance of a section of the pre-filters, ultrafilters, and R/O membrane equipment can be accomplished while the remaining equipment is running. Spare equipment will be brought into service, as needed. In that case the excess cooling tower blowdown can be directed to the storage pond untreated, temporarily increasing the volume of flow to the pond.

The operation of the BDTF includes intake and discharge monitoring to ensure the BDTF is operated as necessary to meet the discharge limits. The monitoring equipment and the frequency of monitoring will be specified during the detailed design phase.

Composition and Amount of Salt/Solids Generation

The composition of the salt and solids in the evaporation pond are determined based on TDS and chloride concentrations of 3525 mg/l and 1800 mg/l. In addition, metal and other analytes were considered by using the maximum values provided in Table 2.3-26. The concentrated maximum based on operation of the BDTF as described in I.c above, was used to estimate pond solids composition in mg/kg. As discussed in Section I.d of this response, several of the metals were reported as non-detect values, a conservative approach for estimating the final composition of the solids/salts. This conservative approach is considered a bounding scenario and the composition of the metals in the solids was found to be non-hazardous.

The total amount of solids and salts were estimated for two cases. For the maximum case, where the BDTF operates 365 days/yr, the salt generated in pounds per year was calculated:

Maximum case (TDS: 3525 mg/l)

Total of salt/solids of 4.74E+4 Lb/hr X 24 hr/day X 365 days/yr X 2 units =

8.31E+8 Lb/yr

Based upon the USGS 1940 through 2000 gauge monthly averaged data, the BDTF will be placed into operation 85 percent of the time (when the TDS concentration meets or exceed 1000 mg/l). The expected TDS concentration 70 percent of the rest of the time will range from 2000 to 2500 mg/l. The expected TDS concentration of 2500 mg/l is conservative to use when calculating expected salt deposition inasmuch as the actual salt deposition would be less. RAI GEN-03 RAI HYD-23 RAI LU-03

While the BDTF is in operation approximately 85 percent of the year, the intake concentration will fluctuate between 2000 to 2500 mg/l approximately 70 percent of the time. Thus, the expected salt deposition after processing through the BDTF would fluctuate and be less.

Accordingly, the actual amount of salt produced will be less than the calculated value since the calculated value assumes 2500 mg/l for the entire duration when the BDTF operates 85 percent of the year.

Expected case (TDS: 2500 mg/l)

Total of salt/solids of 2.63E+4 Lb/hr X 24 hr/day X 310 days/yr X 2 units = 3.91E+8 Lb/yr

This is equivalent to 572 tons per operating day.

Method and Frequency of Solids Removal

Anticipated BTDF Maintenance, Frequency, and Worker Protection

The R/O membranes require occasional cleaning, using a clean-in-place system. This will involve flushing with a dilute solution of R/O permeate and chemical (for example, citric acid or EDTA). The exact chemical would be recommended by the membrane manufacturer, based on the membrane material and type of fouling present. The spent cleaning solution would be discharged to the evaporation pond. The quantity of cleaning solution would be extremely small compared to the UF/RO reject flow quantities and therefore would not be expected to have any effect on the pond solids.

The level of solids in the pond will be monitored on a regular basis, and the solids will be removed as needed. It is expected that the solids will be partially wet in some areas. Removal of solids from the evaporation pond will be accomplished manually by vacuuming the pond. If the solids prevent vacuuming, they will be manually broken up by hand equipment.

Once the solids are removed and ready for transport, the unprotected portions of the pond liner (clay or HDPE) will be inspected. Any perforations or gouges will be repaired.

The solids composition is non-hazardous. Any workers or operators involved in the BDTF operation and maintenance of the evaporation pond will receive the appropriate hazards awareness training in accordance with 29 CFR 1910. This training has been identified in FSAR Subsection 13.2.1.1.3.

Off-site Disposal Options Considered

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A potential disposal option is a state-permitted non-hazardous industrial solid waste landfill located in Texas. In Texas, there are three classifications of non-hazardous industrial solid waste, which are Class 1, 2 and 3. It is anticipated that the salt wastes will be classified as a Class 2 industrial waste. Documentation such as analytical data and/or process knowledge would be required in order to properly classify the waste. Classification as a Class 1 would be the worst case scenario. If the waste is a Class 1 there are additional handling and disposal requirements and the waste is not routinely disposed of at municipal solid waste (MSW) landfills. For conservatism, this assessment assumes the waste is Class 1.

Acceptance of non-hazardous industrial solid waste at MSW landfills requires prior written authorization from the Texas Commission on Environmental Quality (TCEQ). For the acceptance of Class 1 non-hazardous industrial solid waste at MSW landfills, TCEQ requires that the landfill construct a special unit for disposal and have written authorization in their permit. There were 13 Class 1 landfills and 48 landfills for Class 2 and 3 within a 50 mile radius that accepted non-hazardous industrial waste in 2007. There are fewer landfills that handle Class 1 waste because of the special waste designation due to the handling and disposal requirements.

According to the 2007 Municipal Solid Waste in Texas: A Year in Review, (the latest data currently available) there are 272 permitted landfills in Texas, however only 246 MSW landfills provided data for 2007 and of those only 216 were open. Of those 216 landfills, 188 were active (accepting waste) and 27 were open but inactive (not accepting waste). It is anticipated that the solid will be disposed of in a Type I landfill, which is the standard landfill for the disposal of MSW. Of the 216 landfills open at the end of 2007, 171 were permitted as Type I landfills.

According to the 2007 report, the total remaining landfill capacity in the state at the end of the year was 2.15 billion cubic yards and would have serve for 42 years. Type I landfills disposed of 30,204,900 tons and have a remaining capacity of 44 years. Statewide capacity increased in 2007, with 28 facilities receiving permit amendments to expand. This resulted in a net capacity increase of approximately 27.2 million tons.

Based on CPNPP solid waste generation of approximately 209,000 tons per year, Texas had adequate landfill capacity in 2007. However, this is not evenly distributed across the state. There are 24 councils of governments (COGs) across the state, which are responsible for MSW management planning on a regional basis. There are five COGs partially within the 50 mile radius CPNPP. The North Central Texas Council of Governments (NCTCOG) is where Hood and Somervell counties are located. The remaining four are NorTex Regional Planning Commission (NRPC), West Central Texas Council of Governments (WCTCOG), Heart of Texas Council of Governments (HOTCOG) and Central Texas Council of Governments (CTCOG). As of 2007, NCTCOG reported that there are 23 active MSW landfills with a remaining capacity of 380,108,105 tons or 35 years. NRPC reported two active MSW landfills with a remaining capacity of 55,328,271 tons or 91 years. WCTCOG reported eight active MSW landfills with a remaining capacity of 76,597,458 tons or 86 years. HOTCOG reported four active MSW landfills with a remaining capacity of 38,175,535 tons or 28 years. CTCOG reported 2 active MSW landfills with a remaining capacity of 7,980,129 tons or 17 years. Therefore, there was adequate landfill capacity within 50 miles of CPNPP for the life of the plant.

It is expected that the solid waste will be transported from the site to the landfills using approved trucks and/or rail in accordance with state and federal regulations. Typically, it is expected to be dry. If the solids are wet they will be transported in water tight containers to be processed at the landfill facility to meet the landfill requirements. RAI GEN-03 RAI HYD-23 RAI LU-03

Another disposal option is injection of the salt waste into a Class I or Class V well. In order to consider this option the solid salt waste would need to be mixed with a fluid, additional characterization of the liquid salt waste would be required before disposal. In order to consider injection into a Class I injection well only if the waste is considered a non-hazardous desalination concentrate or non-hazardous drinking water treatment residuals. This determination would be made by the TCEQ. The disposal of the salt waste as an injection fluid for disposal would be regulated and permitted by the TCEQ. The owner/operator of the commercial disposal/injection well would be responsible for the permitting requirements.

3.6.2 SANITARY SYSTEM EFFLUENTS

This section describes the nature and quantity of the sanitary waste contribution, and the treatment facilities during construction and operation of the plant. The primary purpose of the sanitary wastewater treatment system (SWWTS) is to collect sanitary waste from various plant areas such as restrooms, locker rooms, etc., for processing through the treatment facility, and to produce high-quality effluent that is acceptable for discharge to the environment. The sanitary wastewater facility consists of a SWWTS and a filter press system for sludge dewatering.

The SWWTS is a 100,000-gallon per day (gpd) wastewater treatment plant (WWTP) with a 15-cubic foot (cu ft) filter press system designed to process sanitary waste and sludge dewatering, respectively, generated during construction and normal operations of the proposed project.

The WWTP is comprised of several major components such as an equalization tank, aeration chamber, clarifier, sludge digester tank and post ultraviolet (UV) disinfection treatment, feed and transfer pumps, and air blowers. Sanitary wastewater collected in the sanitary lift stations from construction and operating buildings of the proposed project is lifted by grinder pumps to the equalization chamber where the wastewater is stored with a retention time then pumped forward. The sanitary wastewater is airlifted by two duplex equalization pumps to the aeration chamber that uses the extended aeration technique of using a blower for biological oxygen demand (BOD) reduction. The effluent from the aeration chamber then flows to the clarifier for solids removal. The clarifier effluent is passed through the UV disinfection system via a booster pump, to disinfect water and oxidize chemicals in process streams. The effluent is discharged to SCR directly, without dilution from any other source. The treated effluent meets the following permit discharge limit requirements:

- pH – 6 – 9.
- TSS – 20 parts per million (ppm) monthly average, 45 ppm daily maximum.
- BOD – 20 ppm monthly average, 45 ppm daily maximum.
- Coliform Count – 200 per 100 ml monthly average, 400 daily maximum.

RAI GEN-03
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RAI LU-03

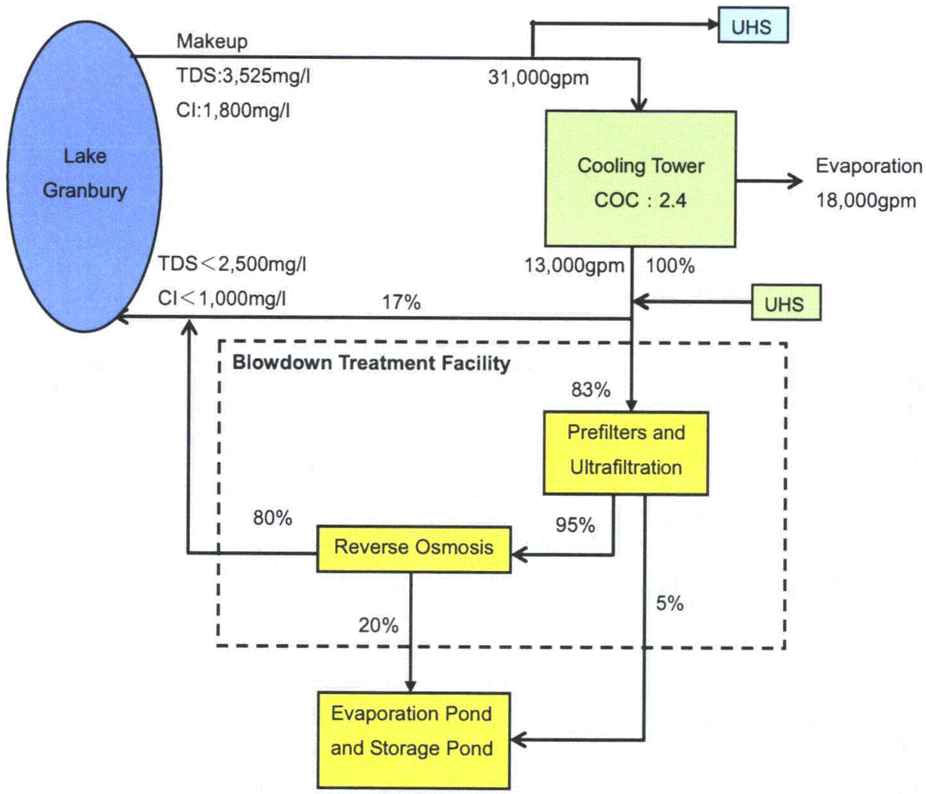

Figure 3.6-1 Sketch of Blowdown Water Treatment Facility Per Unit

4.2.1.1.3 Construction Areas, Temporary Structures, and Parking Areas

Several laydown yards, temporary buildings, parking areas, and other related structures are expected to be created and utilized during construction activities. Potential erosion and sedimentation from the construction, and use of these areas and structures should be controlled using appropriate BMPs, as required by the SWP3. These controls may include material dunnage, vegetative buffer zones, silt fencing, and diversionary channels to sedimentation basins. Any effects that may occur from these activities would be temporary and are expected to be SMALL due to the implementation of appropriate stormwater BMPs.

4.2.1.1.4 Cooling Towers

Placement of cooling towers to support the CPNPP Units 3 and 4 plant operations are planned on a smaller peninsula located northwest of the proposed construction area of Units 3 and 4 (Figure 2.1-1). Approximately 152 ac is expected to be disturbed for construction of the cooling towers. Due to the location of cooling towers in a previously undisturbed area, the potential for increased sediment runoff from heavy earth-moving activities and loss of vegetative cover increases. Additionally, construction of a pipeline from the proposed cooling towers area to the power block area involves some disturbance of the existing area. Any effects that may occur from these activities would be temporary and are expected to be SMALL due to implementation of appropriate stormwater BMPs.

4.2.1.1.5 Blowdown Treatment Facility

Placement of a Blowdown Treatment Facility (BDTF) to support the CPNPP Units 3 and 4 operations is planned for an area southwest of SCR Dam and due south of existing CPNPP Units 1 and 2 (Figure 1.1-4). Approximately 400 ac is expected to be disturbed for construction of the BDTF. Due to the location of the BDTF in a predominantly undisturbed area, the potential for increased sediment runoff from heavy earth-moving activities and loss of vegetative cover increases. Any effects that may occur from these activities would be temporary and are expected to be SMALL due to the implementation of appropriate stormwater BMPs. Additionally, any alteration of natural drainage features that may occur during construction of the BDTF will require appropriate USACE permits. For a description of the BDTF see Subsection ~~3.6.1.1~~3.6.1.4. RAI GEN-03 RAI HYD-23 RAI LU-03

4.2.1.1.6 Currently Undisturbed Areas

A majority of the areas proposed for additional power plant area construction are currently within previously disturbed areas. The cooling tower area and BDTF area are predominantly undisturbed, overgrown, and forested as are smaller areas within the CPNPP Units 3 and 4 power block. Clearing these areas may be required to support construction activities. Construction activities are expected to follow BMPs for soil and erosion control, as required by the site's SWP3 in accordance with the TPDES General Permit. Therefore, impacts to the currently undisturbed areas from construction activities are considered to be SMALL and would not warrant further mitigation.

treated liquid low-level radioactive process water, and treated sanitary outflows are discharged to SCR. Tables 2.3-38 and 2.3-39 present plant makeup water and discharge rates. The water discharge rate to Lake Granbury during normal operations from the CWS, including loss estimates from the conceptual blowdown treatment facility (BDTF) of ~~1200~~5,200 gpm is estimated at ~~23,700~~20,900 gpm. Effluent from other CPNPP Units 3 and 4 systems are expected to be discharged to the wastewater treatment basins (Figure 3.3-1) (Subsection 3.4.2.2). Additional information related to the CPNPP water use and discharge is presented in Sections 3.3 and 3.4. Additional information about water withdrawal, consumption, and returns, including operational and shutdown modes, is presented in Sections 3.3, 3.4, and Table 3.4-2. RAI GEN-03 RAI HYD-23 RAI LU-03

No operational water withdrawals are planned to be associated with the operation and maintenance of the transmission lines.

5.2.1.4 Present and Future Surface Water Use

Each year, the Texas Water Development Board (TWDB) conducts an annual survey of surface water (and groundwater) use by municipal and industrial entities within Texas for water resource planning purposes (TWDB 2007a). The TWDB consumptive water use estimates for municipal, manufacturing, and steam-electric power categories come from an annual survey of public water suppliers and major manufacturing and power entities.

Non-consumptive water uses, such as navigation, hydroelectric generation, environmental flows, and recreation, are not reported by the TWDB. The water use reported by the TWDB annual survey covers consumptive withdrawals only and does not include net use by category or water return information. The TWDB reports water use by category on an annual basis and monthly use rates are not provided in the data.

The TWDB publishes annual water use estimates as described in Subsection 2.3.2.2. The 2006 draft estimated water use for Somervell County is 16,100 acre-feet and 48,931 acre-feet for Hood County (TWDB 2009). TWDB annual water use estimates for year 2004 are not considered draft and contain water use estimates in terms of groundwater and surface water use (TWDB 2007a). The 2004 data estimated total water use in Hood County at 11,857 ac-ft, of which 62 percent was reported as surface water use (and 38 percent groundwater use). Somervell County estimated water use was reported at 46,611 ac-ft in 2004, of which 96 percent was reported as surface water use (and 4 percent groundwater use). Total water use for Hood and Somervell counties represents 1.65 percent of the total reported water use in the Brazos River Basin.

Surface water withdrawals for Hood County were estimated at 7306 ac-ft in 2004 (TWDB 2007a). Approximately 76 percent of this use was for irrigation use, 15 percent for municipal use, five percent for steam electric use, and four percent for livestock use. Surface water withdrawals for Somervell County were estimated at 44,693 ac-ft in 2004. Approximately 99 percent of this withdrawal was for steam electric use with less than one percent for irrigation, mining, and livestock uses. Table 2.3-35 provides annual water use estimates by use category for Hood and Somervell counties.

Some of the water withdrawn from the Brazos River Basin watershed is returned to the Brazos River. Water use information for the Brazos River Basin watershed area for 2004 is presented in Table 2.3-33. Total 2004 water withdrawals from Hood and Somervell counties are presented in is currently being considered by the TCEQ. Extensive third party water availability modeling has been performed for the Brazos River drainage basin and the modeling supports the availability of sufficient unallocated water for CPNPP Units 3 and 4, without impacting other users.

Average annual surface water withdrawal (diversion) from Lake Granbury to SCR for CPNPP Units 1 and 2 operations is estimated at 34,128 ac-ft/yr from 1994 to 2006. Average forced evaporation from Units 1 and 2 operation is 17,391 ac-ft/yr, and average reservoir discharge flow through Squaw Creek Dam is 21,678 ac-ft/yr for the same time period (TCEQ 2006). Considering the average gain from Lake Granbury with the average losses from forced evaporation and releases to Squaw Creek, an average loss of 4941 ac-ft/yr from SCR is realized. As discussed in Subsection 2.3.2.2.4, water use records for 2006 indicate that more water was diverted from Lake Granbury than was lost through forced evaporation and spillage through the SCR dam spillway. This hypothetical water loss or gain is driven by the variability of environmental in-flows and natural evaporation, which are not accounted for in the water use reports submitted to the TCEQ. An existing agreement between Luminant and the BRA provides 48,300 ac-ft/yr of make-up water from Lake Granbury to SCR for Units 1 and 2 operation. Consequently, adequate water is available to compensate for possible net losses and adverse environmental variability.

Projected maximum water use estimates are outlined in the previously mentioned amendment to the 2006 Region G Water Plan. These water use estimates include a maximum annual water withdrawal from Lake Granbury of 103,717 ac-ft/yr for the operation of CPNPP Units 3 and 4, with a maximum return flow of 42,100 ac-ft/yr. Net consumptive water use for the operation of Units 3 and 4 is estimated at 61,617 ac-ft/yr; however, an in-line water treatment system for CPNPP Units 3 and 4 blowdown currently in the design phase would decrease the annual discharge into Lake Granbury. Additional information about this Blowdown Treatment Facility (BDTF) is provided in Subsection ~~3.6.1.1~~3.6.1.4. Figure 2.3-30 provides a simplified water use diagram for CPNPP Units 1 and 2 and Units 3 and 4 showing all inputs and outputs of the system. RAI GEN-03 RAI HYD-23 RAI LU-03

An existing agreement between Luminant and the BRA identifies 27,447 ac-ft/yr of water from Possum Kingdom Lake currently under contract to Luminant. This water is expected to be reallocated to CPNPP for normal use by CPNPP Units 3 and 4, while the remaining 76,270 ac-ft/yr needed for CPNPP Units 3 and 4 is pending approval. Any new contract with the BRA is expected to provide for minimum flow conditions so that downstream water users should not be impacted. The dependable yield of Lake Granbury has been evaluated as at least 64,712 ac-ft/yr, exclusive of the additional yield, which could be made available by releases from Possum Kingdom Lake (Brazos G 2006). Yield analysis for Possum Kingdom Lake indicates a firm yield of 230,750 ac-ft in 2000 and 2060 (Brazos G 2006). Additional information related to future water use in the Brazos River Basin is presented in Subsection 2.3.2.2.4.

As mentioned previously, Luminant plans to reallocate the 27,447 ac-ft/yr from Possum Kingdom Lake provided by current Luminant and BRA agreements in addition to the 76,270 ac-ft/yr that is being negotiated with the BRA for CPNPP Units 3 and 4. The impact to downstream future water availability is considered in determining the amount of water available for use by CPNPP Units 3 and 4, consequently the impact is SMALL.

case to the ambient water temperature prior to simulating the discharge effects. The mixing-zone temperature excess for the discharge was then re-defined by decreasing the maximum allowable 3°F difference by the water temperature increase due to the discharge component; the discharge 93°F isotherm (only applicable for the max-T case) was defined based on the discharge-blowdown temperature and the ambient temperature incremented as described.

The two and a half-cycle (i.e., cycles of concentration) low-reservoir-temperature modeling scenario results in the largest mixing zone. Even for this case, the mixing zone is demonstrably small. Allowing for a maximum cross-stream diffuser extent of approximately 74 ft, less than four percent of the lake width is impacted by the mixing zone and discharge structure. See Subsection 5.3.2 for further details regarding the thermal plume's mixing zone.

5.2.3.4 Wastewater Discharge

Cooling Tower Blowdown

Maximum blowdown from the cooling towers is discharged into Lake Granbury at a rate of approximately 26,076 gpm for the site total (Table 3.4-2) (Subsection 3.4.2.2).

Details related to water quality of Lake Granbury are presented in Subsection 2.3.3. Most of the mean and maximum trace metals concentrations are below the TCEQ Criteria for Specific Metals in Water for Protection of Aquatic Life. Selenium was not detected above the detection limit (0.005 mg/L). When half the detection limit was used to estimate concentrations that would result from CPNPP Units 3 and 4 2.4-cycle cooling tower operation, selenium was estimated to exceed the TCEQ Criteria for Specific Metals in Water for Protection of Aquatic Life and also for both the mean and maximum concentrations when mixed with Lake Granbury at low flow. However, selenium is expected to be reduced to concentrations less than the TCEQ standards for Specific Metals in Water for Protection of Aquatic Life at the edge of the mixing zone in Lake Granbury during the annual mean flow for both mean and maximum concentrations.

When the BDTF is operational, the blended discharge concentrations were assessed by factoring in the R/O treatment process (Subsection 3.6.1.4) and it was found that the analyte concentrations in the blended discharge will be less than the analyte concentrations in the untreated discharge. RAI GEN-03 RAI HYD-23 RAI LU-03

As mentioned in Subsection 2.3.3.1.9, Lake Granbury, the cooling water system (CWS) supply and blowdown discharge reservoir for CPNPP Units 3 and 4 was identified as a candidate on the Draft 2008 303(d) List as being impaired by naturally occurring chloride concentrations (TCEQ 2008). Prior to this, concerns for screening levels were listed on Lake Granbury for naturally occurring chloride, sulfate, and TDS concentrations (BRA 2007). Chlorides are not estimated to exceed the Texas Surface Water Quality Standards (TSWQS) for Lake Granbury as a result of the 2.4-cycle cooling tower operation for the mean concentration but are estimated to exceed the TSWQS for the maximum concentration, and the maximum concentrations when diluted by Lake Granbury at low flow. However, chlorides are expected to be reduced to concentrations less than the TSWQS when mixed with Lake Granbury during the annual mean flow for both mean and maximum concentrations. TDS is estimated to exceed the TSWQS for Lake Granbury for maximum concentrations as a result of the 2.4-cycle cooling tower operation and when mixed with Lake Granbury at low flow for both mean and maximum concentrations and maximum

5.5.1.2.1 Nonradioactive Solid Waste

Solid nonradioactive industrial waste including non-hazardous industrial and office waste streams are not burned or disposed of on-site. Private, municipal, or county solid waste transporters typically collect this waste for recycling or disposal in an appropriately permitted landfill. Therefore, these wastes do not affect the site terrestrial ecology, soil, or groundwater; thus there impact is considered SMALL.

Water treatment and purification waste RO filters are containerized and disposed of at a permitted non-hazardous waste landfill. Solid waste generated from the Blowdown Treatment Facility (BDTF) is planned to be disposed of at an off-site permitted non-hazardous waste landfill. Additional information on waste generated from the BDTF is presented in Subsection ~~3.6.1.1~~3.6.1.4. RAI GEN-03 RAI HYD-23 RAI LU-03

Construction and demolition wastes are transported off-site for disposal at an industrial waste landfill. Some excavated clean soils may be placed at certain areas on-site where some fill is needed for other activities; e. g., leveling for parking lot surfaces. Impacts from nonradioactive solid industrial waste have been reduced because of the CPNPP waste reduction program, which is expected to be implemented for the operations of Units 3 and 4; therefore, additional mitigation is not required.

5.5.1.2.2 Hazardous Wastes

Hazardous waste is managed and disposed of by CPNPP in accordance with federal and state regulations as per RCRA and TCEQ requirements. The CPNPP has an assigned site-specific EPA RCRA (TXD020332078) and TCEQ NOR (33036) identification numbers for waste disposal. The current generation of hazardous waste at CPNPP is less than 220 pounds per month. Based on this volume of waste the facility is classified as a Small Quantity Generator (SQG) under TCEQ criteria. In addition, CPNPP has a waste reduction program in place that has reduced the volume of hazardous waste generated from approximately 90 tons per year in 1994 to less than one in 2006. Waste volumes generated by operating the new CPNPP Units 3 and 4 are projected to be similar or less than the quantities generated from Units 1 and 2. The site is projected to remain a SQG, therefore having a SMALL impact and no additional mitigation would be required.

The majority of the hazardous wastes generated from the operations of Units 1 and 2 is Freon contaminated waste oil. This waste stream would likely be generated from Unit 3 and 4 operations. Hazardous waste streams generated by the operations of Units 1 and 2 are collected and stored in a designated, enclosed hazardous waste storage building. Wastes generated from the operations of Units 3 and 4 are expected to be stored in this building. Periodically (within in 90 days after being generated) these wastes would be manifested then transported and disposed of at an off-site RCRA-permitted Treatment, Storage, and Disposal (TSD) facility. As mentioned above, a limited amount of hazardous waste is generated by the operations of Units 3 and 4. Impacts on the local environment from hazardous waste management are SMALL, and additional mitigation would not be required.

TABLE 9.2-6 (Sheet 1 of 2)
DESIGN ALTERNATES THAT HAVE BEEN CONSIDERED FOR WATER TREATMENT OPTIONS

RAI GEN-03
RAI HYD-23
RAI LU-03

OPTION NO. (Per Unit)	ADVANTAGES	DISADVANTAGES
1. Divert and treat 46% (~5940 gpm) of cooling tower blow down to produce a blended effluent concentration of 2500 mg/l.	• Continue to operate at 2.4 COC, thus maintaining BD and MU rates. • Blended effluent TDS is reduced to 2500 mg/l which is present Lake Granbury water quality standard.	• Diversion of ~46% of BD requires greatest amount of water treatment equipment and largest new evaporation pond (6 million gallons) for waste concentrates. • Additional facility with associated operation / maintenance.
2. Divert and treat ~30.7% % (~3964 gpm) of cooling tower blow down to produce a blended effluent concentration of 3000 mg/l.	• Continue to operate at 2.4 COC, thus maintaining BD and MU rates. • Blended effluent TDS is reduced to 3000 mg/l which is a reduction of 25% from 4000 mg/l	• Diversion of ~30.7% of BD requires large amount of water treatment equipment and large new evaporation pond (4.5 million gallons) for waste concentrates. • Additional facility with associated operation/maintenance. • requires variance in present 2500 mg/l Lake Granbury water quality standard
3. Divert and treat 18% (~2320 gpm) of cooling tower blow down to produce a blended effluent concentration of 3500 mg/l.	• Continue to operate at 2.4 COC, thus maintaining BD and MU rates. • Blended effluent TDS is reduced to 3500 mg/l which is a reduction of 12.5% from 4000 mg/l • 3500 mg/l is the Possum Kingdom present limit.	• Diversion of ~18% of BD requires least amount of water treatment equipment and smaller new evaporation pond (3 million gallons) for waste concentrates. • Additional facility with associated operation/maintenance. • Requires variance in present 2500 mg/l LG water quality std.
4. Divert excess cooling tower makeup (~28%, ~8626 gpm)) from Lake Granbury, treat and blend to produce an effluent concentration of 2500 mg/l	• Continue to operate at 2.4 COC, thus maintaining BD and MU rates. • Blended effluent TDS is reduced to 2500 mg/l which is present to LG water quality std. • MU is a less concentrated TDS ~1680mg/l which utilizes smaller and more efficient WT equipment (92.5% recovery).	• Gross Make-up pumping demand increased. • Gross BD rate increases. • Additional WT facility with associated operation/maintenance is required. • New 3 million gallon evaporation pond required for waste concentrates.

TABLE 9.2-6 (Sheet 2 of 2)
DESIGN ALTERNATES THAT HAVE BEEN CONSIDERED FOR WATER TREATMENT OPTIONS

RAI GEN-03
RAI HYD-23
RAI LU-03

OPTION NO. (Per Unit)	ADVANTAGES	DISADVANTAGES
5a. Increase tower COC to 5.0 with increased chemical feed and treatment. Produces 4540 gpm concentrated effluent @ 8400 mg/l to Possum Kingdom. 5b. Increase tower COC to 5.0 with increased chemical feed and treatment. Produces 4540 gpm concentrated effluent @ 8400 mg/l to deep well injection. 5c. Increase tower COC to 5.0 with increased chemical feed and treatment. Produces 4540 gpm concentrated effluent @ 8400 mg/l to new 25 million gal. Evap. Pond.	• Reduces the LG make-up requirement by over 25%. • Reduces the MU pumping costs and line sizes. • Potential to send softener regenerant flow to existing evaporation pond. • BD rate is significantly reduced, therefore reducing discharge lines.	• Approximately twice the chemical usage cost as 2.4 design. • Additional chemical feed storage and handling equipment. • Additional softening equipment required. • High effluent concentration of ~8400 mg/l. • Long pumping distance to PK. • Large new shallow evaporation pond >25 million gallons.
6. Hybrid Wet/Dry Tower Option. Partial recovery (15% approx) and blend of evaporation from hybrid cooling tower.		Option not considered. Cost is three times higher ($114 million vs. $34 million) when compared to Mechanical Draft Wet Type CT's.
7. Closed-cycle system. Divert and treat 65% (~8,400 gpm) of cooling tower blowdown to produce a blended returning water concentration equalize with MU from Lake Granbury.	• Continue to operate at 2.4 COC, thus maintaining BD and MU rates. • Returning water TDS is reduced to maintain in continuous operation of cooling tower.	• Continuous operation is generate to more solid waste. • BDTF need to be in continuous operation, redundancy will need to be considered for the design. • Discharge line is needed in order to maintenance on equipment such as cooling tower basin, pumps and evaporation pond.

Based on the analysis above and the results presented in Section 5.2, no adverse impacts are identified in the water supply portion of the proposed CWS, and no mitigation is warranted.

9.4.2.1.4 Water Treatment

The water treatment or circulating water chemistry, for the influent water of the proposed projects' CWS is maintained by a chemical feed system (Subsection 3.3.2). Chemical equipment would inject the required chemicals into the circulating water downstream of the CWS pumps. The chemicals used would be divided into six categories based upon function: biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor, and silt dispersant. The pH adjuster, corrosion inhibitor, scale inhibitor, and dispersant would be metered into the system continuously or as required to maintain proper concentrations. The biocide application frequency might vary with seasons. The algaecide would be applied, as necessary, to control algae formation on the cooling tower.

The water treatment of the blowdown water portion of the proposed projects' CWS is performed by a Blowdown Treatment Facility (BDTF) with associated evaporation ponds and misters. The design allows for a diversion of approximately ~~46~~83 percent of the blowdown flow for treatment and returning 80 percent of the diverted (cleaned water) flow back into the main blowdown line back to Lake Granbury (URS 2008). RAI GEN-03 RAI HYD-23 RAI LU-03

The basic equipment in the BDTF consists of parallel trains of course prefilters, ultrafilters, and reverse osmosis membranes. Also included are appropriate chemical dosing/cleaning equipment, interconnecting piping, sump/tanks and transfer pumps. One evaporation pond with multiple sections and misters will be installed along with one retention pond to store up to three months of evaporation pond overflow (URS 2008).

Ponds are expected to be lined with impermeable clay and two high density polyethylene liners to achieve the required permeability ratings. The BDTF will utilize approximately 400 ac (400 ac is a bounding number for the available acreage in the proposed location) of CPNPP site property (URS 2008). This area is a previously undisturbed area. No additional land will be required to be purchased. The BDTF will be constructed in the southeast corner of the site property. This area of the site shares the boundary with a sparsely populated area.

The noise from the BDTF is expected to be of a SMALL impact. There is little fogging and icing in this area normally and there are no public roads of significant population areas in close proximity to the BDTF. There are no crops grown in the immediate area and the impact due to salt drift is SMALL.

The system design provides for 80 percent return of diverted flow back into the main blowdown line and into Lake Granbury. The consumptive water loss impact of this system is SMALL and the impact on the water quality returned to Lake Granbury is beneficial. This system helps ensure the TPDES requirements for release to waterways will be met even with the highly variable TDS and salt concentrations of the influent water withdrawn from Lake Granbury.

Based on the analysis above and the results of Subsection 5.5.1, no adverse impacts are identified in the influent water treatment and blowdown water treatment system portion of the proposed CWS, and no mitigation is warranted.

proposed water supply for the heat dispersion system at CPNPP Units 3 and 4 is Lake Granbury reservoir. No alternate sources of water are available for this purpose; alternate sources would require the development of a new lake and sufficient water supply from the Brazos River System to fill the new lake. The time required obtaining land and mineral rights, ROWs, and permission to build a new lake does not support the scheduled activities of the project. Land and water are not available to provide any viable alternate water sources. The Lake Granbury proposed water supply system is designed so that the intake would be at sufficient depth to insure flow during all anticipated lake low water levels. No shortages are anticipated. Based on the maximum intake flow with both units in operation, Lake Granbury reservoir would supply sufficient water to meet the operational requirements of the cooling water systems.

Withdrawal volumes are regulated by the Brazos River Authority (BRA). The withdrawal would be controlled by allocation agreement with the BRA. The environmental impact of the use of this water supply would be SMALL. No alternative source is identified that would be environmentally equivalent or superior. No adverse impact is identified, and no mitigation is warranted.

9.4.2.2.5 Alternatives to the Proposed Water Treatment System

Water treatment of the influent water is applied to the CWS water for the proposed project (Subsection 3.3.2.1). Treatment typically consists of adjustments to water chemistry using several chemicals: biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor, and silt dispersant. Water quality effects could occur from the concentration and discharge of chemicals added to the re-circulating cooling water. These additives are present in the blowdown.

Concentration of dissolved salts in the makeup water resulting from evaporative water losses would require the discharge of a certain percentage of the mineral-rich stream (blowdown) and its replacement with fresh water (makeup). The concentration of total dissolved solids in the cooling tower blowdown would be monitored to meet the values on the TPDES permit. Dilution of the low-volume blowdown by the receiving water would also reduce water quality effects of contaminants discharged from closed-loop cooling systems. The number of cycles that water is used before the blowdown is removed is changed to meet the limitations of the TPDES contaminant concentrations in the system. The treatment of the blowdown water may be required to remove chemicals, salts and TDS to meet TDPES discharge limits and not adversely impact the water quality in the lower part of Lake Granbury. Any water treatment depends on the TPDES permit requirements that is expected to be modified prior to construction of CPNPP Units 3 and 4.

Based upon expected TPDES permit requirements, design alternatives for the BDTF water treatment included a number of possible designs and variations on the designs. The proposed system consists of a ~~46~~approximately 83% diversion and treatment of the blowdown and then returning 80% of the diverted water to the blowdown returning to Lake Granbury with a blended effluent TDS concentration of 2500 mg/l. The proposed system satisfies the expected effluent TDS ~~concentration limit~~concentration less than 2500 mg/l and chloride concentration less than 1000 mg/l of 2500 mg/l discharge into Lake Granbury. Alternatives of this same design were evaluated using 31% and 18% diversion values and returning blended effluent TDS concentrations of 3000 mg/l and 3500 mg/l respectively. (URS 2008a)

RAI GEN-03
RAI HYD-23
RAI LU-03

RAI GEN-03
RAI HYD-23
RAI LU-03

QUESTION NO.: HYD-10 (5.2) and HYD-16 (5.2)

SUPPLEMENTAL INFORMATION

This response is provided in two parts: Background and Response.

BACKGROUND:

The information needs for HYD-10 and HYD-16 were fundamentally addressed in the white paper entitled "Impacts of Comanche Peak Nuclear Power Plant Units 3 and 4 Operations on Downstream Water Quality" submitted to the NRC via Luminant letter TXNB-09025, dated July 20, 2009 (ML092090653).

Based on a conference call with the NRC conducted on November 5, 2009, Luminant understands that one year of discharge monitoring data from National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Reports (DMRs) and available water quality data for sampling locations downstream of De Cordova Bend Dam are needed for the NRC to complete its review.

RESPONSE:

Data are provided on pollutant point discharges to Lake Granbury, the Brazos River downstream of Lake Granbury, and other discharges in the CPNPP site area in response to the NRC needs identified above.

The 2008 NPDES Discharge Monitoring Reports (DMRs) for discharges to Lake Granbury and Brazos River below Lake Granbury are included as an attachment to this response. This monthly discharge monitoring data shows the magnitude and character of permitted discharges into Lake Granbury and the Brazos River below Lake Granbury. The DMRs and additional discharge data were obtained from the US EPA Enforcement and Compliance History Online (ECHO) service (http://www.epa-echo.gov/echo/compliance_report_water_icp.html) including the discharge location, the effluent flow rate, the allowable and average contaminant concentrations, and the temperature for each discharge where applicable.

The above referenced data have been combined in the attached "2008 NPDES-DMR Data for Discharges to Lake Granbury and Brazos River below Lake Granbury" to show the discharge location and the associated discharge parameters for 2008, as available. The data are also depicted graphically to show the magnitude and character of permitted discharges into Lake Granbury and the Brazos River below Lake Granbury.

A review of TCEQ surface water quality data revealed data for two water quality monitoring locations on the Brazos River between Lake Granbury and Lake Whitney. The first location (Station 11856) is on the Brazos River at US 67, approximately 31 miles downstream of De Cordova Bend Dam. Data for this station dates back to the late 1960s and continues through 2006; however, the frequency of sampling is often sporadic and unreliable for determining trends. Data for this location are summarized in the attached data table from the BRA's 2007 Basin Summary Report. According to the BRA, this segment of the Brazos River is currently not listed as impaired, and historical trending data collected from January 2000 to August 2004 indicate an increasing trend in water temperature and chloride levels at Station 11856. However, these parameters remain below the level that would indicate a concern. The second location (Station 20213) is located on the Brazos River at FM 200, approximately 2.75 miles downstream of Station 11856. This station was established as a result of construction on US 67 near Station 11856. Routine monthly sampling at Station 20213 began in January of 2007. The most recent monthly data available for Monitoring Station 20213 (January 2007 to August 2009) show summer peak temperatures below the surface water quality standard of 91°F. Additionally, chloride and TDS concentrations appear to have decreased when compared to the earlier data from Monitoring Station 11856. The new data for Monitoring Station 20213 is provided as an attachment and does not indicate a water quality concern for the Brazos River below Lake Granbury. According to the BRA, there are no other water quality monitoring stations between Lake Granbury and Lake Whitney.

Impact on R-COLA

None.

Impact on S-COLA

None.

Impact on DCD

None.

Attachments (on CD)

EPA ECHO output files for 2008 Discharge Monitoring Reports (DMRs)

- TX0027685 – City of Tolar
- TX0046400 – DeCordova SES 2008
- TX0065854 – CPNPP
- TX0094412 – Oak Trail Shores WWTP
- TX0102598 - SWATS
- TX0105155 - Pecan Plantation WWTP
- TX0120243 - Treaty Oaks WWTF
- TX0127426 - Fall Creek Utility Co
- TX0033316 - City of Glen Rose WWTP
- TX0046400 - DeCordova SES ALL
- TX0066702 - Riverbend Retreat
- TX0098264 - Blue Water Shores
- TX0104833 - Ridge Utilities WWTF
- TX0105163 - DeCordova Bend Estate WWTP
- TX0123820 - Wolf Hollow
- TX1015210 - Granbury

2008 NPDES-DMR Data for Discharges to Lake Granbury and Brazos River below Lake Granbury

2000 to 2004 Summary Table of Surface Water Quality Data for Monitoring Station 11856

2007 to 2009 Surface Water Quality Data for Monitoring Station 20213

QUESTION NO.: HYD-13 (3.6.3.2-1)

Provide for reference details of how storm water will be routed, collected, treated and disposed for the Unit 3 and 4 facilities.

SUPPLEMENTAL INFORMATION

DRN 12-05-500-001, was submitted via Luminant letter TXNB-09029 dated August 10, 2009 (ML092360142). The drawings associated with this submittal were inadvertently omitted from the package and are attached herewith. There are a total of eight drawings as listed below.

Impact on R-COLA

None.

Impact on S-COLA

None.

Impact on DCD

None.

Attachments (on CD)

Drawings (all Revision F)

CVL-12-11-100-001
CVL-12-11-101-001
CVL-12-11-102-001
CVL-12-11-103-001
CVL-12-11-104-001
CVL-12-11-105-001
CVL-12-11-106-001
CVL-12-11-107-001

QUESTION NO.: HYD-15 (5.2.1)

Provide estimates of the water availability, physical, and water quality impacts on Brazos River system of Brazos River system water management changes that would be induced by the implementation water rights adequate for operation of CPNPP Units 3 and 4, including water quality impacts to Possum Kingdom Lake, Lake Granbury, and the Brazos River downstream of Lake Granbury. Include quantitative multi-year time series simulation data on the elevation, inflows, releases, and water quality of reservoirs in the Brazos River system.

SUPPLEMENTAL INFORMATION

This response is provided in two parts: Background and Response.

BACKGROUND:

The information need for HYD-15 was fundamentally addressed in an attachment submitted to the NRC via Luminant letter TXNB-09029, dated August 10, 2009 (ML092360142). The attachment contained the results for the modified WAM simulations, the executable WAM code, and a description of the modifications that were made to the TCEQ WAM.

Based on a conference call with the NRC conducted November 5, 2009, Luminant understands that the following information is needed for the NRC to complete its review:

- Description of the baseline hydrologic conditions including historical streamflows, dam releases, and reservoir elevations
- Flow and elevation duration analyses including tabular streamflow, reservoir elevation, and reservoir release data
- Description of how the water system would behave with CPNPP Units 3 and 4 diversion and discharge
- Overall assessment of the hydrological alterations represented by water level elevation changes resultant from CPNPP Units 3 and 4 operations in Possum Kingdom Lake, Lake Granbury and the Brazos River downstream of Lake Granbury

RESPONSE:

The attached Freese and Nichols Memorandum, dated December 15, 2009, provides an explanation of the baseline hydrologic conditions, including flow and elevation analyses, and the modeled alterations resultant from CPNPP Units 3 and 4 water use for Possum Kingdom Lake, Lake Granbury, and the Brazos River.

Impact on R-COLA

See attached marked-up ER Revision 1 pages 5.2-6, 5.2-7, 5.2-9, 5.2-10, 5.2-11, and 5.2-19.

Impact on S-COLA

None.

Impact on DCD

None.

Attachments

Memorandum from Jon Albright, Freese & Nichols, to Bruce Turner, Luminant, Supplemental Information for NRC Request, December 15, 2009 (hard copy)

CD-ROM containing tabulated results of the RiverWare modeling and executable files for the Water Rights Analysis Package, the model used for the Brazos Water Availability Model (WAM)

MEMORANDUM

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

4055 International Plaza, Suite 200 • Fort Worth, Texas 76109 • 817-735-7300 • fax 817-735-7491 www.freese.com

TO: Bruce Turner, Luminant

FROM: Jon S. Albright

SUBJECT: Supplemental Information for NRC Request

DATE: December 15, 2009

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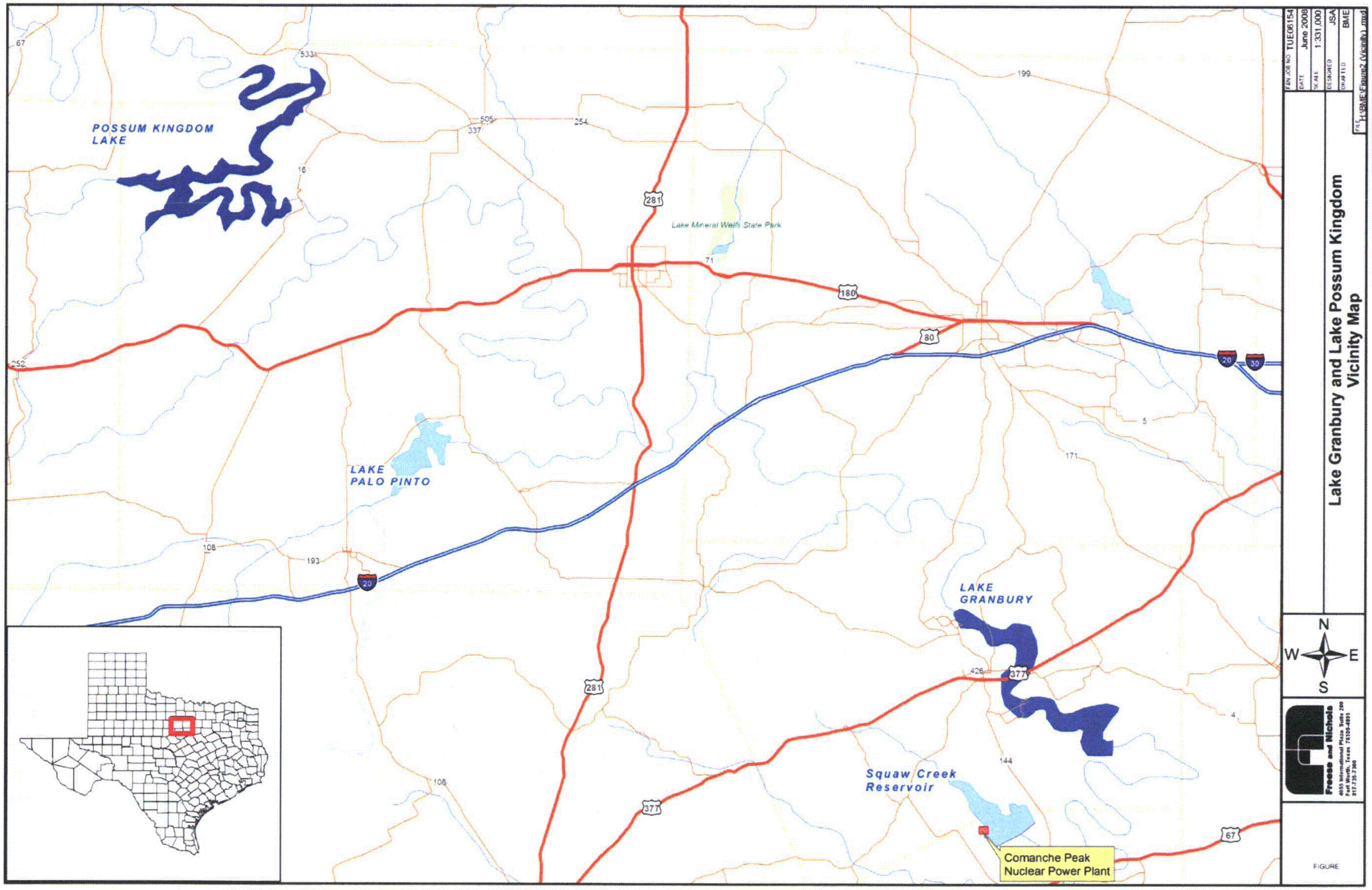
1. Freese and Nichols, Inc. (FNI) believes that Scenarios A and C from the October 10, 2008 *Lake Granbury Dissolved Minerals Study* using 2020 conditions can be used to compare conditions with and without the proposed Units 3 and 4 at the Comanche Peak Nuclear Power Plant (Comanche Peak). Even though the Dissolved Minerals Study focused on water quality impacts, the year 2020 hydrologic modeling should give a reasonable assessment of the operation of Lakes Possum Kingdom and Granbury around the time that Units 3 and 4 come on-line. Scenario A only has the demands for the existing Units 1 and 2 at Comanche Peak. Scenario C is identical to Scenario A but adds the demands for the proposed Units 3 and 4 with treatment of the blowdown to stream standards. (Scenario B is the same as Scenario C except without treatment of the blowdown to reduce TDS loading.) Figure 1 is a location map showing the area of interest.

Demands for Units 3 and 4

2. The demands for Units 3 and 4 in the *Lake Granbury Dissolved Minerals Study* was 90,152 acre-feet per year with a consumptive demand of 53,827 acre-feet per year, with 36,325 acre-feet per year returned to Lake Granbury as blowdown. (In Scenario C, the total consumptive demand and blowdown volume varies somewhat from month to month with different levels of treatment to remove dissolved solids from the blowdown.) The demand and consumptive amounts were provided by Luminant. According to Luminant, the demand of 90,152 acre-feet per year is based on a statistical analysis of historical air temperature conditions at the site. These historical temperatures were divided into 13 bins and an estimate of water needs for each bin was extrapolated using turbine performance curves. The 90,152 acre-feet per year demand level is indicative of typical annual demands expected for the new units. Other studies



POSSUM KINGDOM LAKE
Lake Mineral Wells State Park
LAKE PALO PINTO
LAKE GRANBURY
Squaw Creek Reservoir
Comanche Peak Nuclear Power Plant
67
533
505
337
254
16
281
71
180
80
199
20
30
252
5
171
108
193
426
377
144
4
67
N
W
E
S
Lake Granbury and Lake Possum Kingdom
Vicinity Map
TUE06154
June 2008
1:331,000
JSA
BME
Freese and Nichols
FIGURE

have used different demand levels as the design for the new units has been refined over time. For example, the amendment to the Brazos G Regional Water Plan used a demand of 103,717 acre-feet per year with a consumptive demand of 61,617 acre-feet per year, with 42,100 acre-feet per year returned as blowdown. This demand level is based on operation during high summer ambient temperatures, applied year around. For this memorandum, Scenario C was rerun with the 103,717 acre-feet of demand to examine the sensitivity of lake levels and flows to demand under 2020 conditions.

Modeling Assumptions

3. Table 1 is a summary of the assumptions used in the modeling of Scenarios A and C. Additional description of the modeling scenarios can be found in the *Lake Granbury Dissolved Minerals Study*. The modeling assumptions are based on historical operation of Lakes Possum Kingdom and Granbury. In our opinion these policies are a reasonable way to operate the reservoir system. The Brazos River Authority is currently re-evaluating its operating policies, and future operating policies may be different than those presented in this study.

4. The Lake Granbury Dissolved Minerals Study used a RiverWare model of the Brazos River from Lake Possum Kingdom to the Brazos River near Glen Rose stream gage (USGS 08091000), including Lake Granbury. Figure 2 shows the objects in the RiverWare model. The Glen Rose gage is located 4.1 stream miles upstream of the confluence of the Brazos and Paluxy Rivers[1]. The modeling to date does not extend to the Paluxy confluence. The RiverWare model uses monthly hydrology covering the historical period from 1940 to 2007. Attachment 1 contains more information regarding the model.

RiverWare Modeling Results

5. Figure 3 compares the simulated elevations in Lake Granbury for Scenarios A and C under 2020 conditions. Scenario A is shown in blue. Scenario C includes demands at both 90,152 (shown in green) and 103,717 acre-feet per year (shown in red). Figure 4 shows the exceedence frequency of the elevations in the same reservoir. Attachment 2 contains tables with the data used to create these graphs. Without the demands for the new units (Scenario A), the reservoir is full about 57 percent of the time. With the new units (Scenario C), Lake Granbury is full about 48 percent of the time at the 90,152 acre-feet per year demand level and about 46 percent of the

[1] U.S. Geological Survey: Water Resources Data Texas Volume 1, Water Year 1996.

Table 1
Summary of 2020 Modeling Assumptions

Item	Description
Water Supply for Units 1 and 2	48,300 acre-feet per year from Lake Granbury. Luminant is assumed to take the full amount each year and none of this water is returned to Lake Granbury. The actual operation of Squaw Creek Reservoir and Units 1 and 2 are not explicitly modeled.
Demands for Units 3 and 4 **(Scenario C only)**	90,152 acre-feet per year typical demand and 103,717 acre-feet per year high temperature demand. Water comes from Lake Granbury, with approximately 40 percent returned to Lake Granbury as blowdown. The actual amount of blowdown varies somewhat from month to month depending on level of treatment.
Possum Kingdom local demands	12,867 acre-feet per year directly from the reservoir
Other Lake Granbury local demands	36,828 acre-feet per year directly from the reservoir.
Downstream demands from Possum Kingdom/Granbury system	Brazos River Authority demands - 10,000 acre-feet per year released downstream during normal conditions, 50,000 acre-feet per year released downstream during drought. Releases for downstream rights were extracted from the Brazos River Basin Water Availability Model. Attachment 1 contains more information on this model.
Reservoir storage	Adjusted for expected sediment accumulation in 2020. Lake Granbury at conservation - 117,109 acre-feet with 7,737 surface acres. Lake Possum Kingdom at conservation – 495,052 acre-feet with 16,314 surface acres.
Possum Kingdom release rules*	If the reservoir is full, set to the amount needed to reach conservation storage at the end of the timestep. Hydropower releases above elevation 990 feet based on historical operation of the reservoir. Below elevation 990 feet FERC minimum flow releases. If Possum Kingdom has more than 250,000 acre-feet in storage, sufficient water is released downstream to keep Lake Granbury with 80,000 acre-feet in storage. Includes hydropower and FERC releases. If Lake Granbury is more than 2.5 feet down, a portion of the local and downstream demand from Lake Granbury is released from Possum Kingdom based on the percentage of total storage in each reservoir. Includes hydropower and FERC releases.
Lake Granbury release rules*	If the reservoir is full, set to the amount needed to reach conservation storage at the end of the timestep. Set to expected downstream demands for the Brazos River Authority and senior water rights. 28 cfs minimum release at all times.

* Additional information on release rules can be found in the April 17, 2009 Memorandum to Bruce Turner, Luminant, *Description of RiverWare Files*

Figure 2
Objects in RiverWare Model

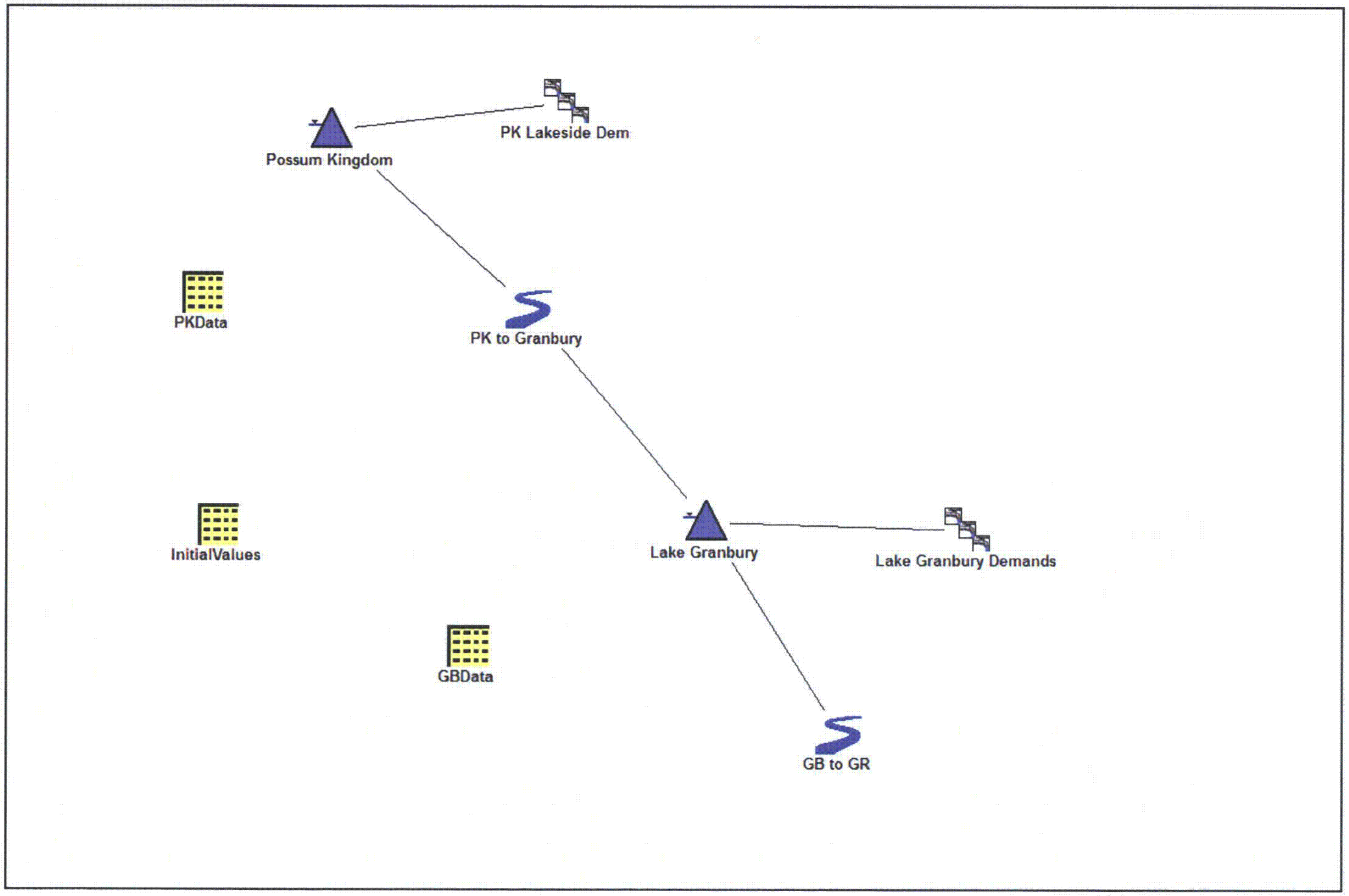


Figure 3
Simulated Lake Granbury Elevations
Scenarios A and C – 2020 Conditions

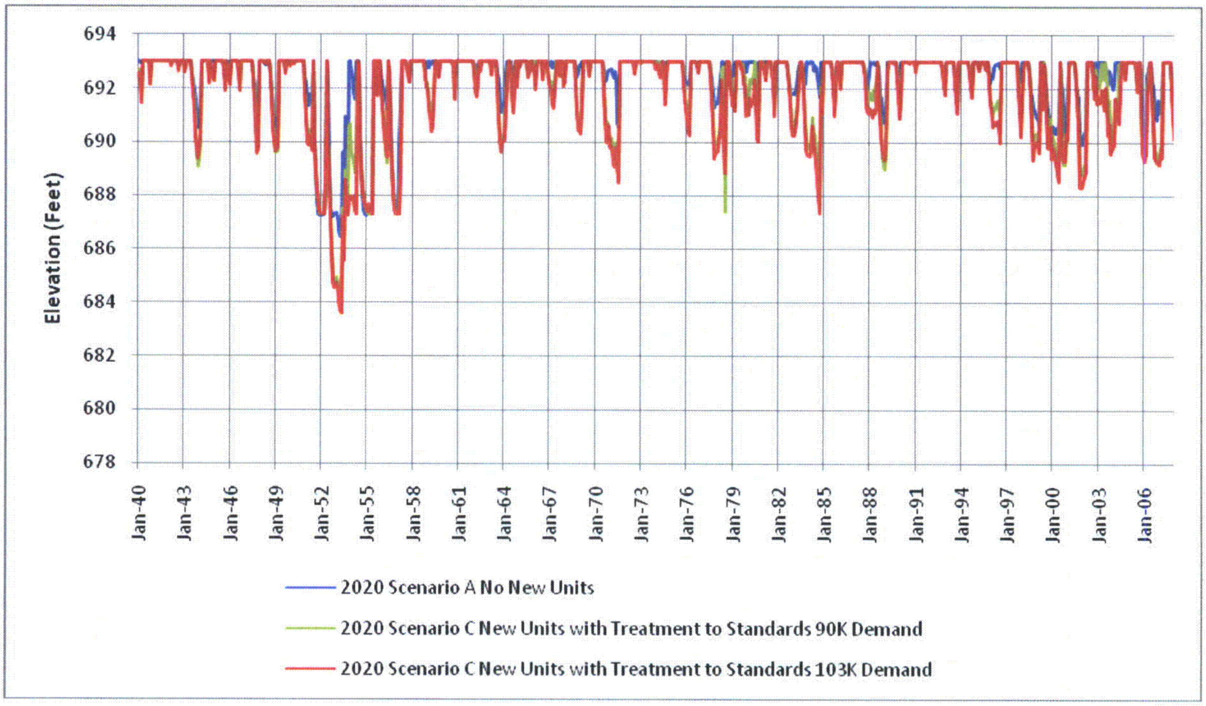
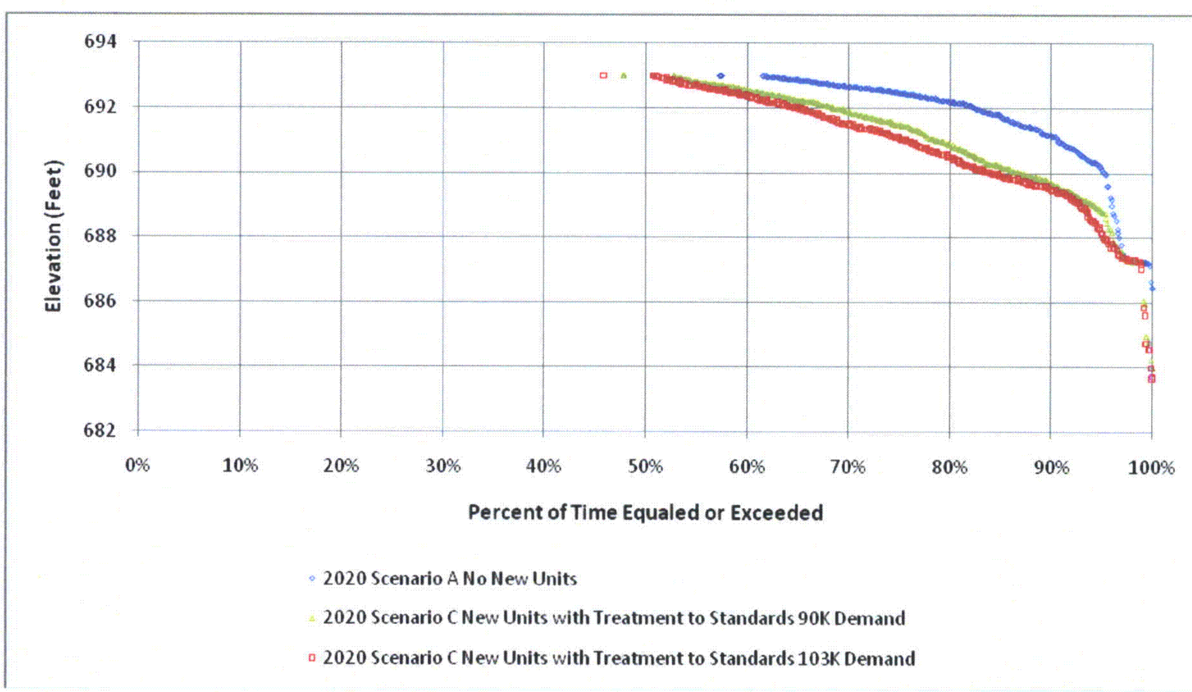


Figure 4
Exceedence Frequencies of Simulated Lake Granbury Elevations
Scenarios A and C – 2020 Conditions



time at the 103,717 acre-feet per year demand level. With the new units the reservoir is somewhat lower during dry periods. The reservoir is about 2.5 feet lower at its lowest point in March 1953 at the 90,152 acre-feet per year demand level and about 2.9 feet lower at the 103,717 acre-feet per year demand level. On average, with Units 3 and 4 (Scenario C) the reservoir is 0.4 feet lower at the 90,152 acre-feet per year demand level and 0.6 feet lower at the 103,717 acre-feet per year demand level.

6. Figures 5 and 6 show the simulated elevations and exceedence frequency for Lake Possum Kingdom, respectively. Attachment 2 contains tables with the data used to create these graphs. Without the new units (Scenario A), Possum Kingdom is expected to be full about 34 percent of the time. With the new units, the reservoir is full about 27 percent of the time at the 90,152 demand level and 26 percent of the time at the 103,717 acre-feet per year demand level. At the reservoir's lowest point in April 1953, with units 3 and 4 the reservoir is 12.6 feet lower at the 90,152 acre-feet per year demand level and 14.8 feet lower at the 103,717 acre-feet per year demand level. On average, in Scenario C the reservoir is 1.3 feet lower at the 90,152 acre-feet per year demand level and 1.5 feet lower at the 103,717 acre-feet per year demand level.

7. Figure 7 shows the modeled annual outflow from Lake Possum Kingdom. Figure 8 shows the exceedence frequency of the monthly outflows from the same reservoir. These values are plotted on a logarithmic scale because of the wide range of values. Figure 9 shows the monthly median outflow from the reservoir. Figures 10, 11 and 12 show the same data for the inflows to Lake Granbury. Attachment 2 contains tables with the data used to create these graphs. These graphs do not show as much difference in flows in this reach as would be expected from the changes in elevation shown in Figures 5 and 6. There are two explanations for this. First, releases from Possum Kingdom when the reservoir is relatively full are similar in both scenarios. Second, the larger spills from Lake Possum Kingdom in Scenario A sometimes mask the increased outflow during dry periods in Scenario C. For example, during the period from July 1951 to April 1953 about 246,000 acre-feet was passed downstream in Scenario A. In Scenario C at the 90,152 acre-feet per year demand level, 338,000 acre-feet was passed downstream during the same period, an increase of 92,000 acre-feet. However, when the reservoir refills in October 1953, in Scenario A 145,000 acre-feet of water spills from Possum Kingdom. In the same month in Scenario C at the 90,152 acre-feet per year demand level, only 37,000 acre-feet spills from the reservoir, a change of 108,000 acre-feet. Even though the outflows are

distributed differently in the two scenarios, over a long period of time the volume of the outflows is similar.

8. Figure 13 shows the annual outflow from Lake Granbury. Figure 14 shows the exceedence frequency of the monthly outflows and Figure 15 shows the monthly medians of the outflows. Figures 16, 17 and 18 show the same data at the Glen Rose gage. Attachment 2 contains tables with the data used to create these graphs. The outflows from Lake Granbury are similar for larger and smaller outflows. As the volume of the outflows decreases, the difference between Scenarios A and C becomes more pronounced, with generally lower outflows in Scenario C (with Units 3 and 4). At the lowest end of the flow range flows are governed by the constant minimum release of 28 cfs. The outflows from the reservoir are similar at both the 90,152 and 103,177 acre-feet per year demands.

9. The modeling shows that the increased demands for Units 3 and 4 will cause both Lake Granbury and Lake Possum Kingdom to be lower during drier periods. At the 90,152 acre-feet per year demand level, which is the typical demand expected from the new units, the maximum change is 12.6 feet in Possum Kingdom and 2.5 feet in Lake Granbury during the period of most severe drawdown. On average, elevations in Possum Kingdom will be 1.3 feet lower and elevations in Lake Granbury will be 0.4 feet lower with Units 3 and 4. All but the highest and lowest outflows from Lake Granbury will be reduced as well. With Units 3 and 4, the outflows from Possum Kingdom would increase during dry periods, and spills from Possum Kingdom at the end of these periods would be smaller. However, over time the outflows from Possum Kingdom would be the similar with and without Units 3 and 4.

10. Previous studies have used other slightly higher demand rates. Using a conservatively high demand of 103,717 acre-feet per year, elevations in Lake Granbury could be somewhat lower. Possum Kingdom elevations, flows from Possum Kingdom to Lake Granbury, and outflows from Lake Granbury would be minimally impacted.

Figure 5
Simulated Lake Possum Kingdom Elevations
Scenarios A and C – 2020 Conditions

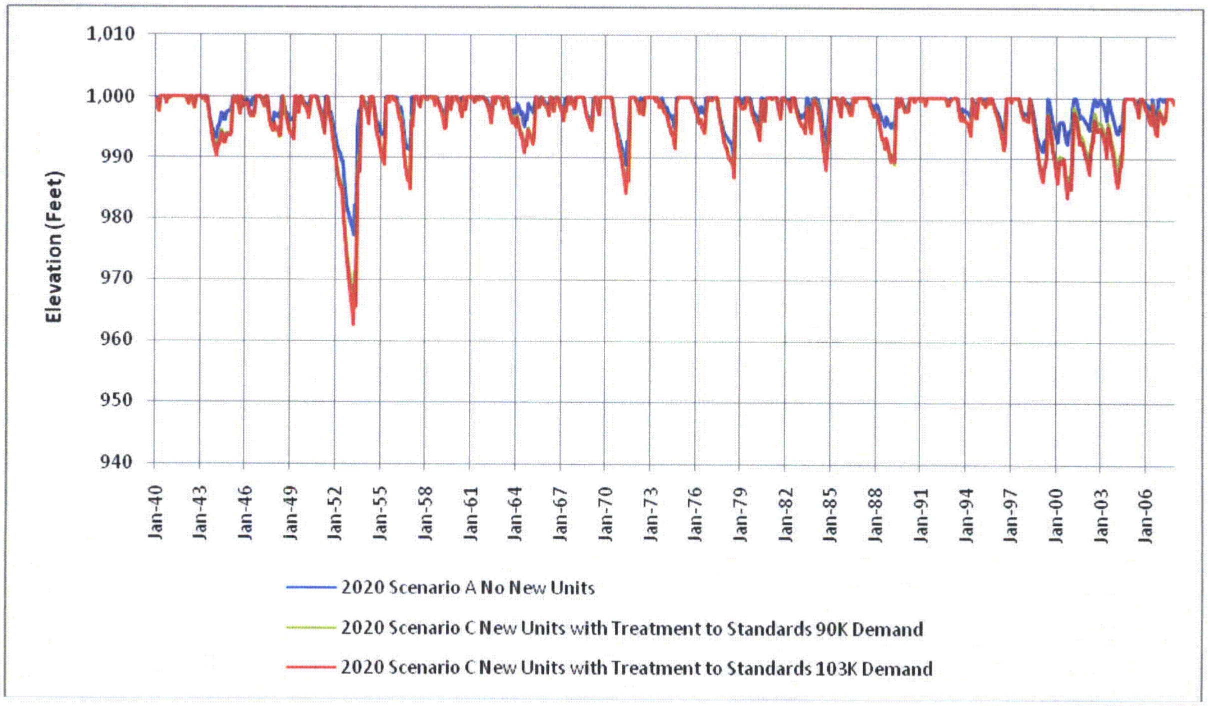


Figure 6
Exceedence Frequencies of Simulated Lake Possum Kingdom Elevations
Scenarios A and C – 2020 Conditions

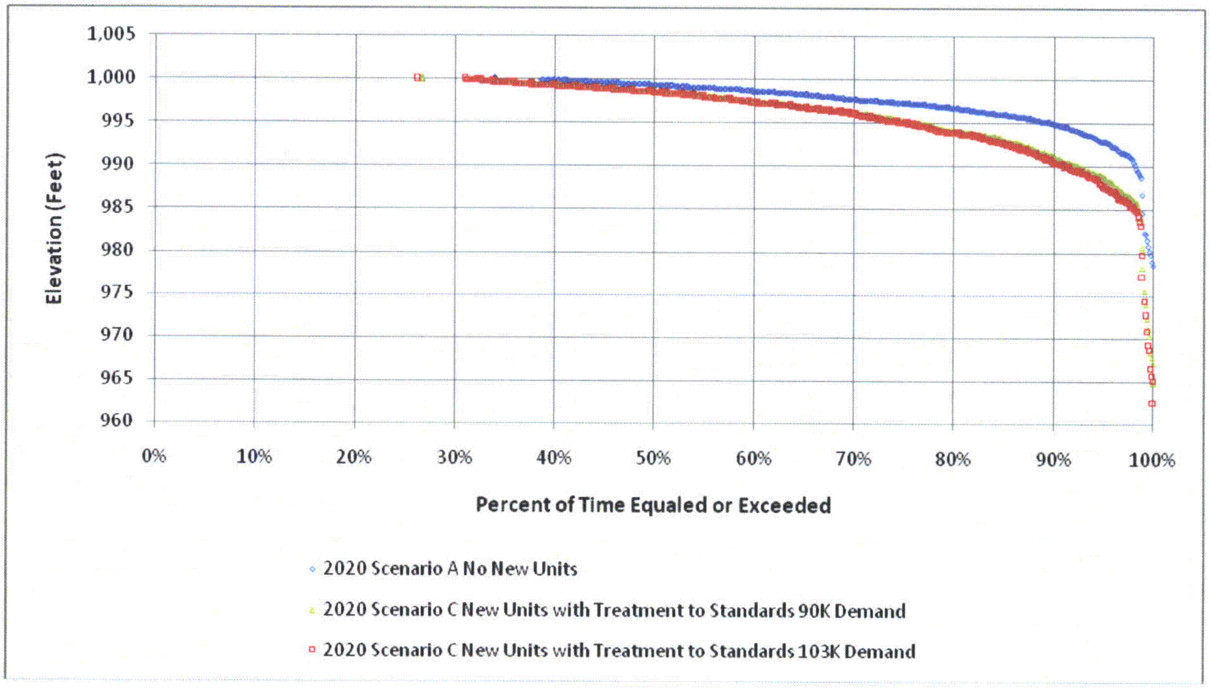


Figure 7
Simulated Annual Outflow from Lake Possum Kingdom
Scenarios A and C – 2020 Conditions

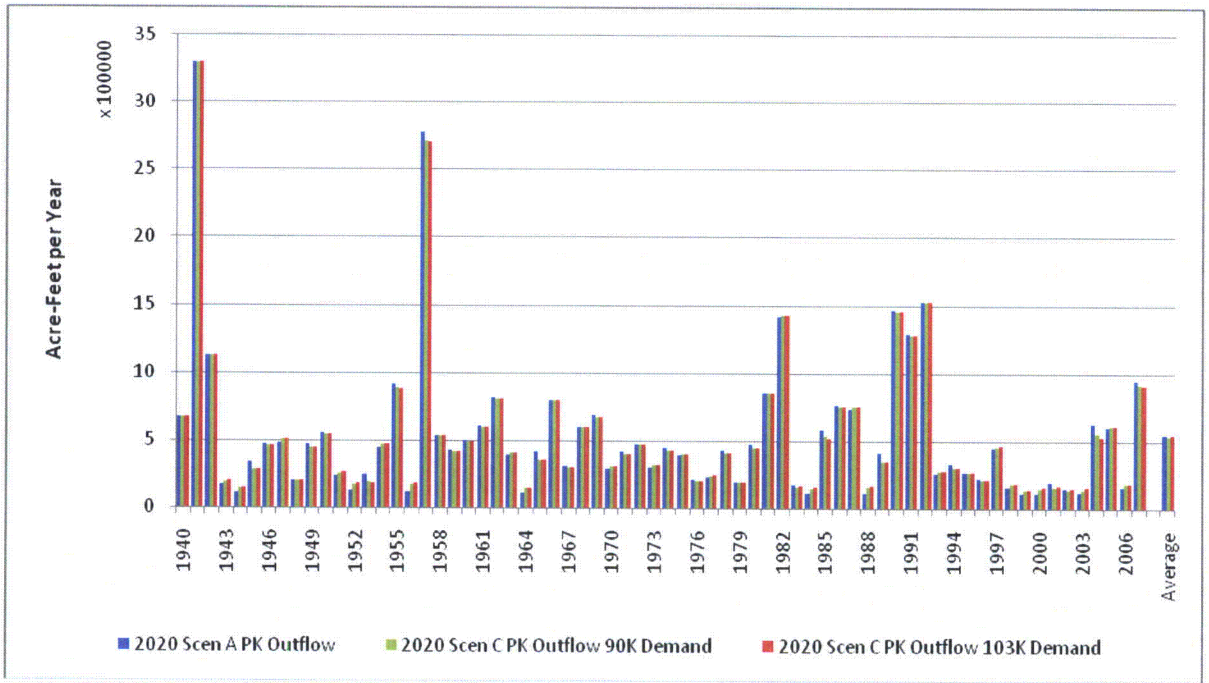


Figure 8
Exceedence Frequencies of Monthly Simulated Outflow from Lake Possum Kingdom
Scenarios A and C – 2020 Conditions

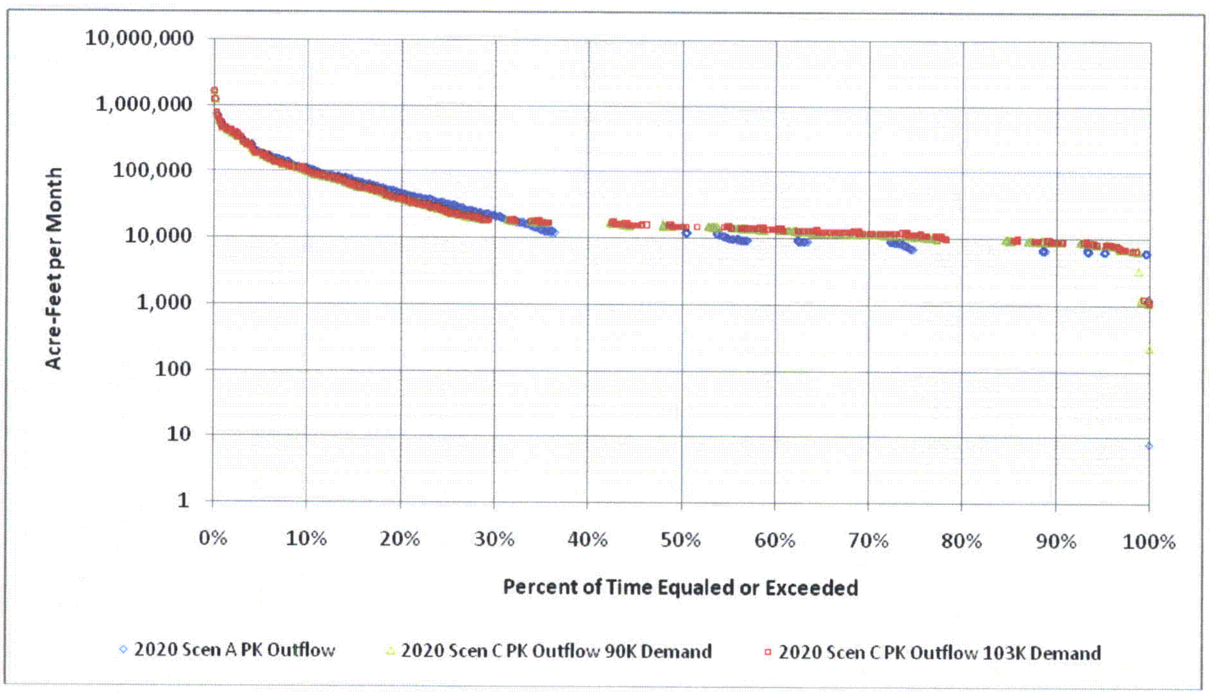


Figure 9
Monthly Median Simulated Outflow from Possum Kingdom
Scenarios A and C – 2020 Conditions

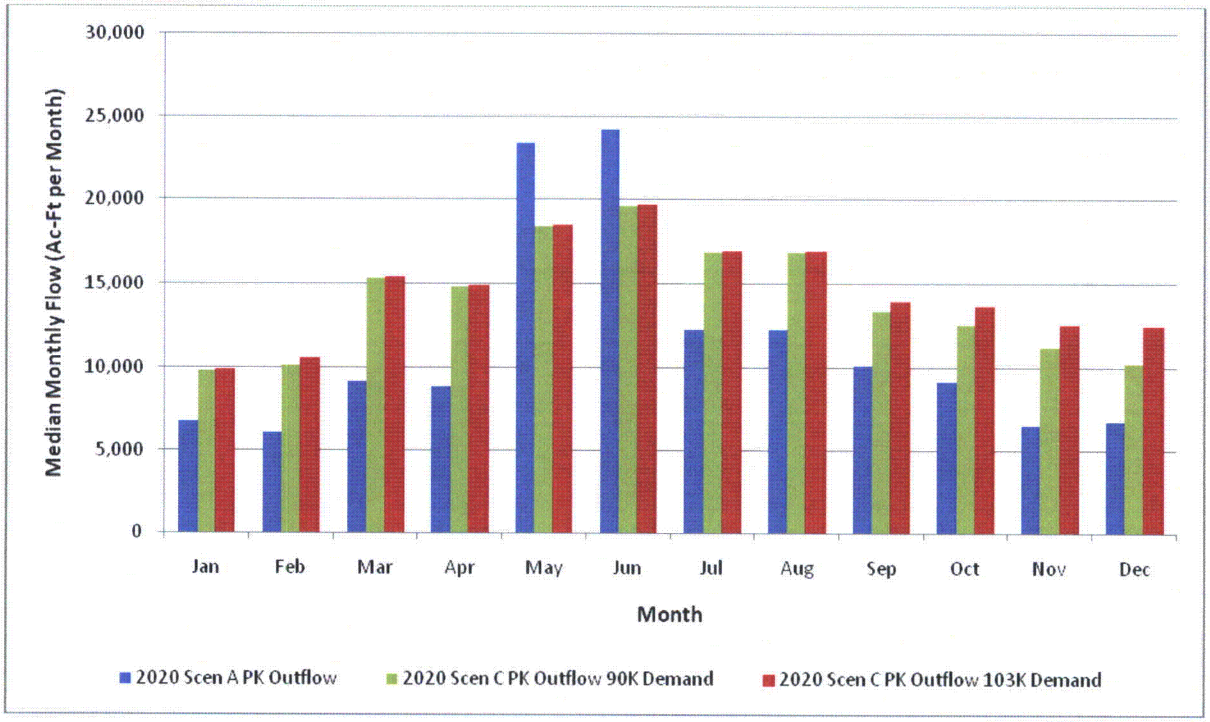


Figure 10
Simulated Annual Inflow to Lake Granbury
Scenarios A and C – 2020 Conditions

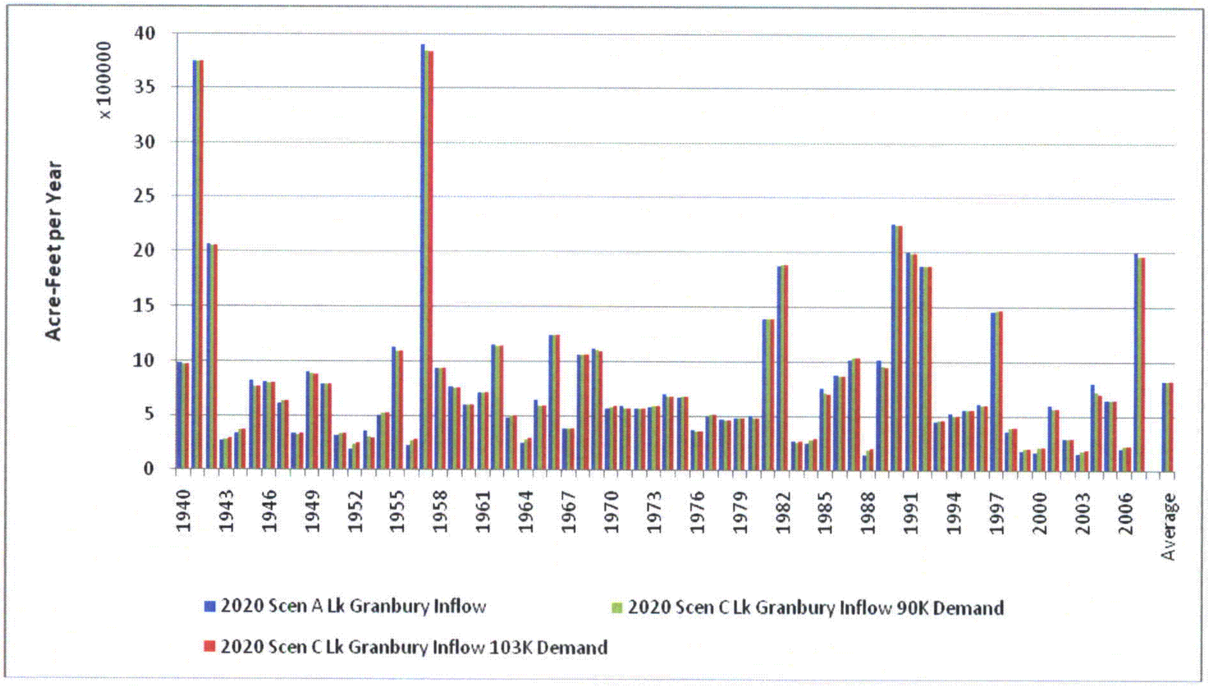


Figure 11
Exceedence Frequencies of Monthly Simulated Inflow to Lake Granbury
Scenarios A and C – 2020 Conditions

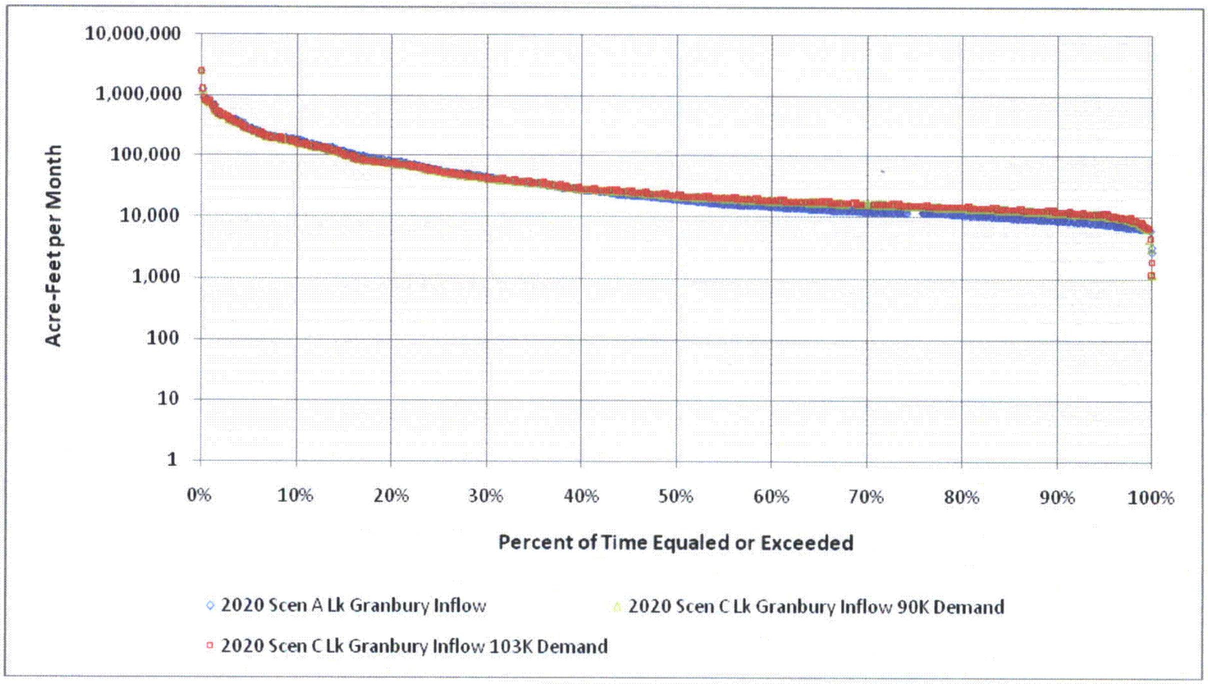


Figure 12
Monthly Median Simulated Inflow to Lake Granbury
Scenarios A and C – 2020 Conditions

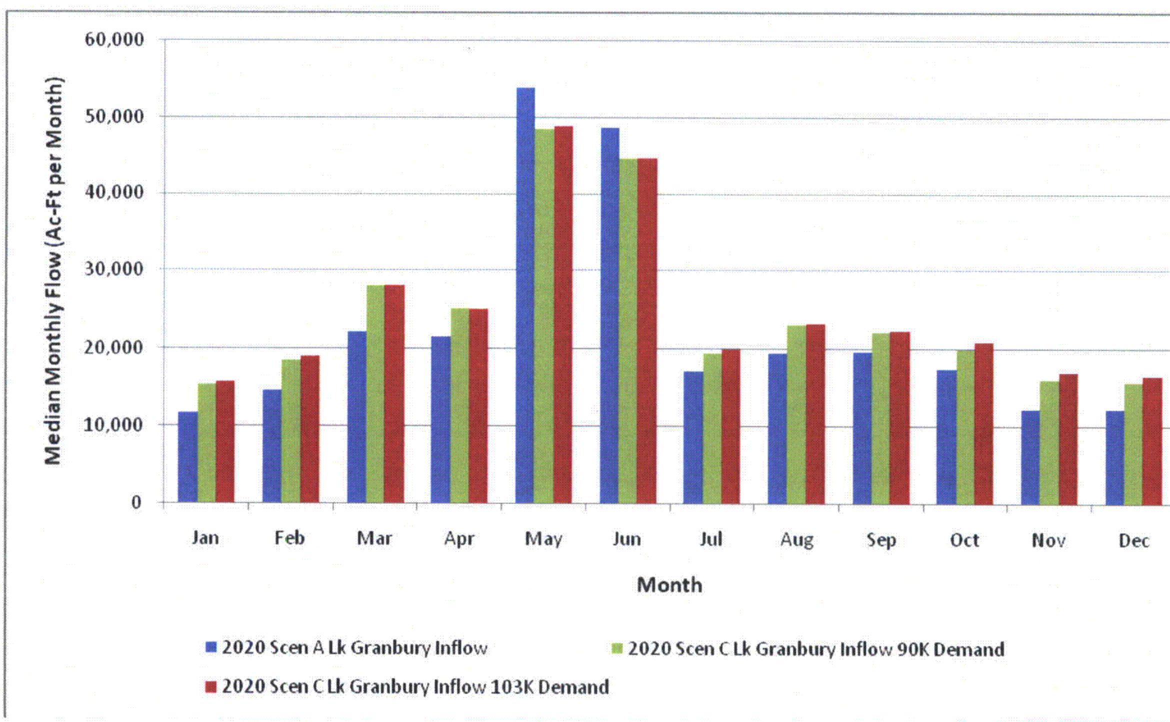


Figure 13
Simulated Annual Outflow from Lake Granbury
Scenarios A and C – 2020 Conditions

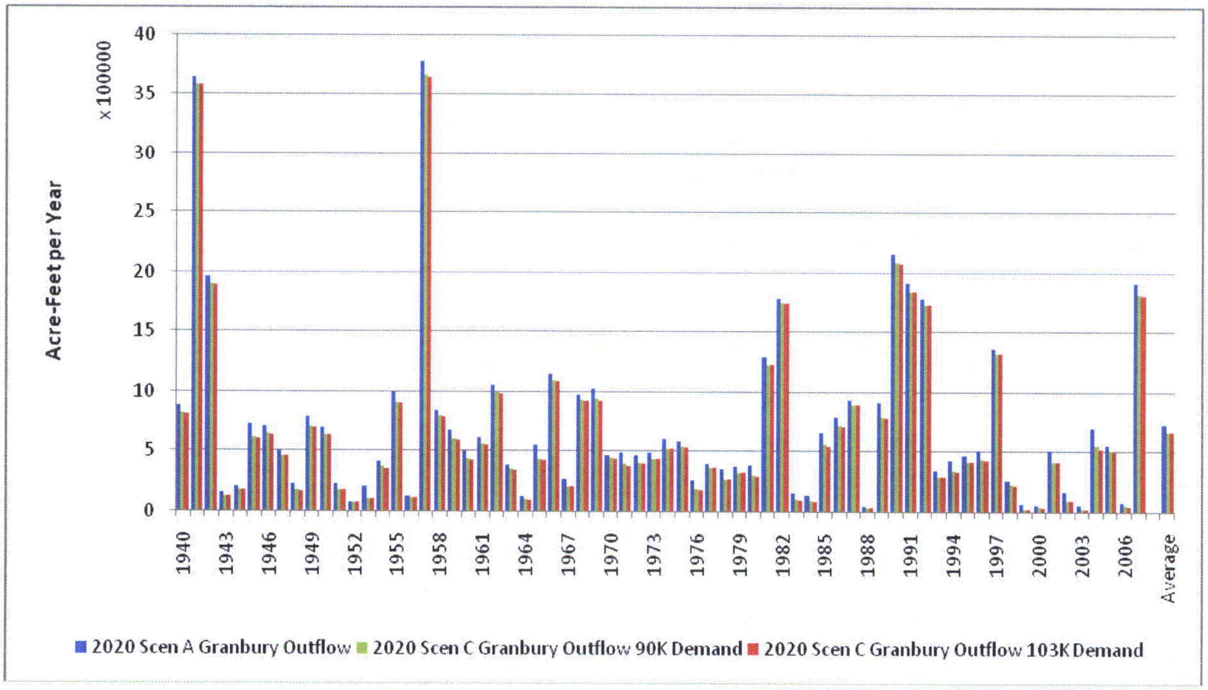


Figure 14
Exceedence Frequencies of Monthly Simulated Outflow from Lake Granbury
Scenarios A and C – 2020 Conditions

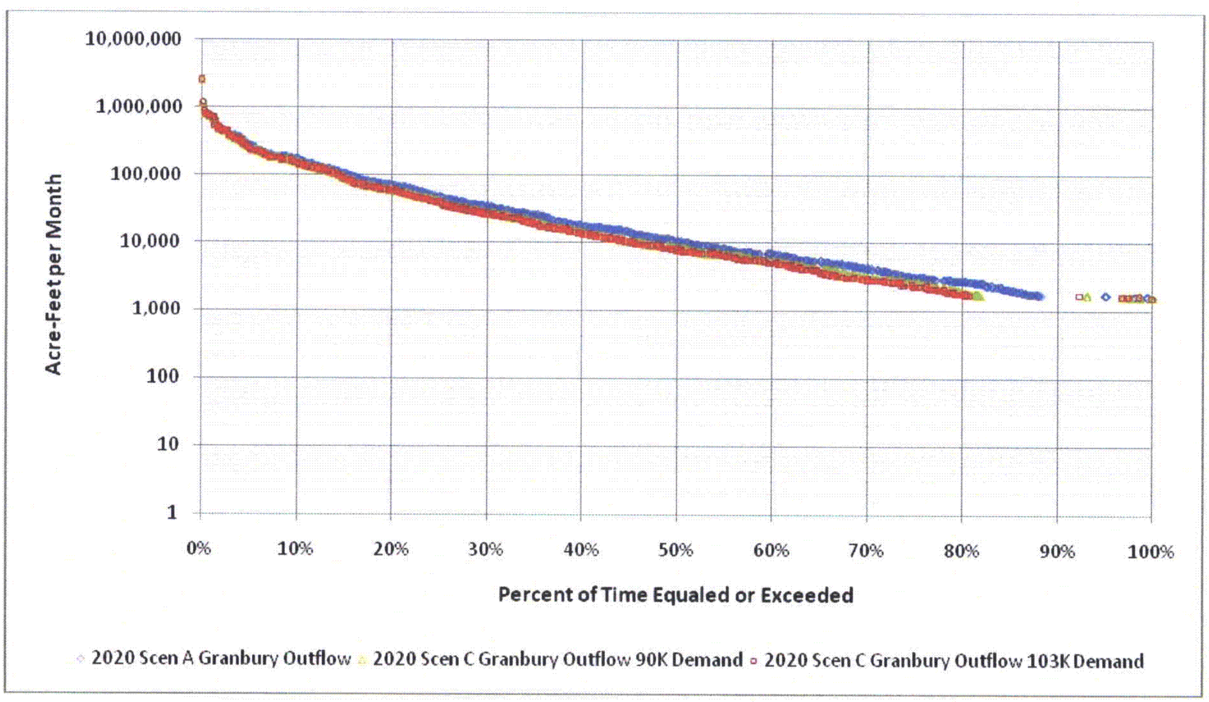


Figure 15
Monthly Median Simulated Lake Granbury Outflows
Scenarios A and C – 2020 Conditions

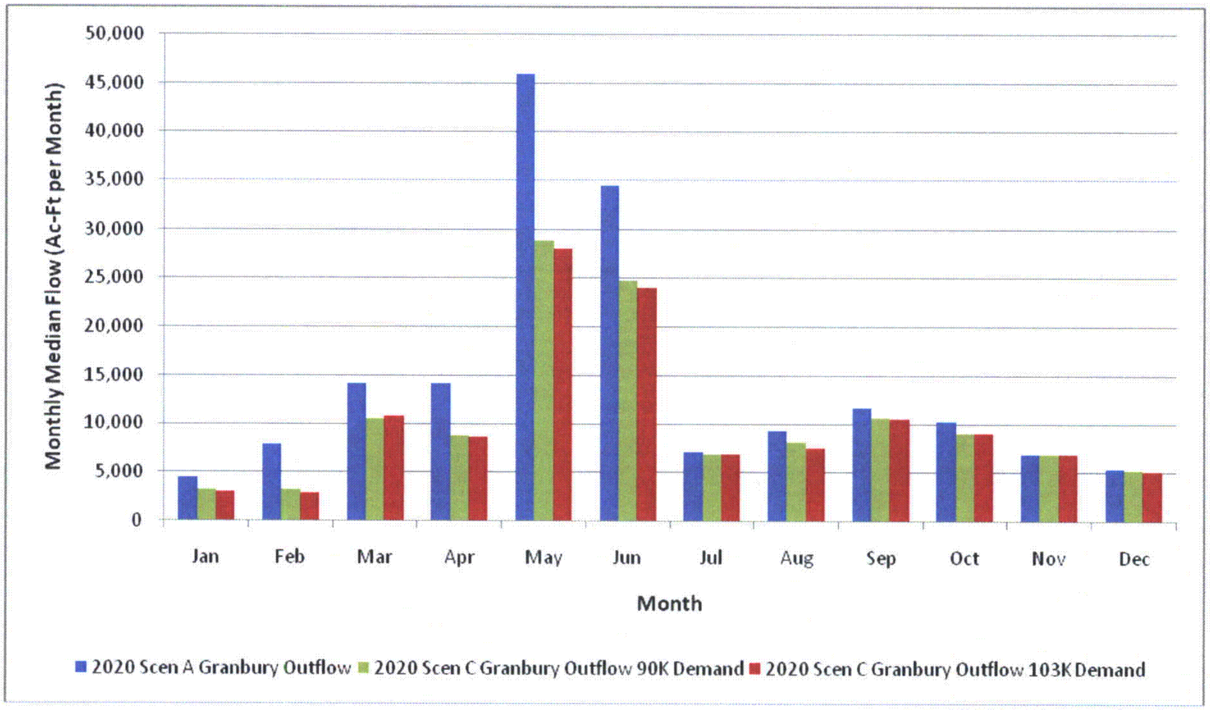


Figure 16
Simulated Annual Flow at Brazos River near Glen Rose Gage
Scenarios A and C – 2020 Conditions

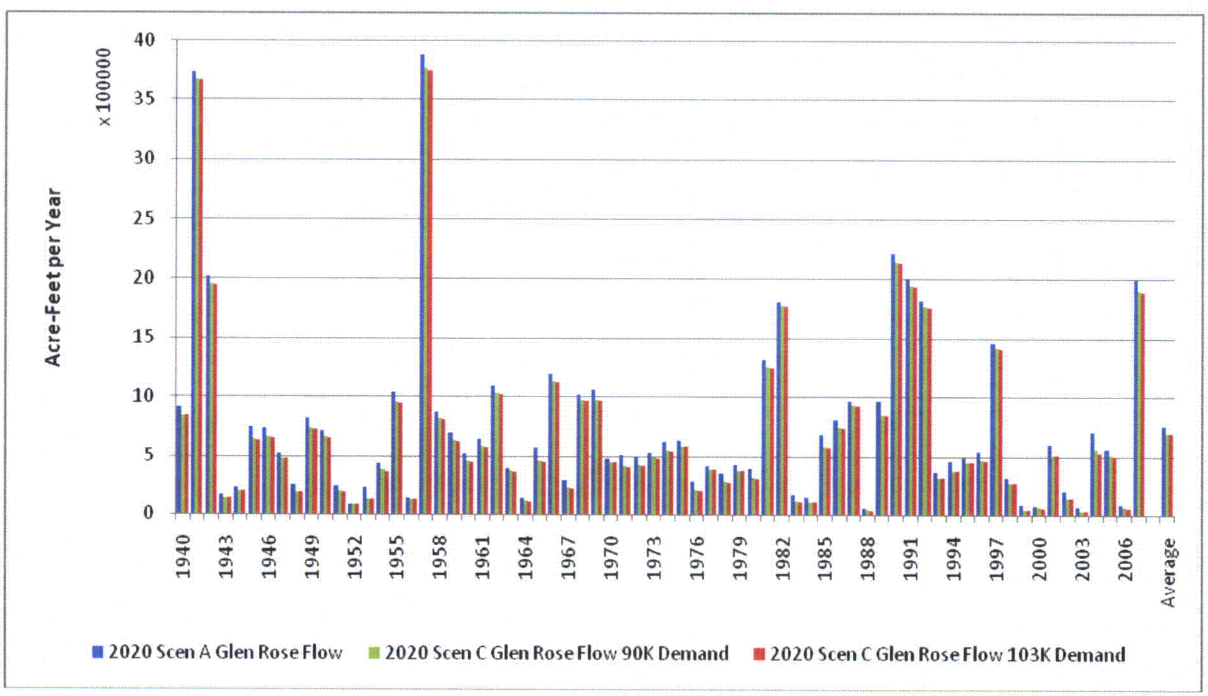


Figure 17
Exceedence Frequencies of Monthly Simulated Flow at Brazos River near Glen Rose Gage
Scenarios A and C – 2020 Conditions

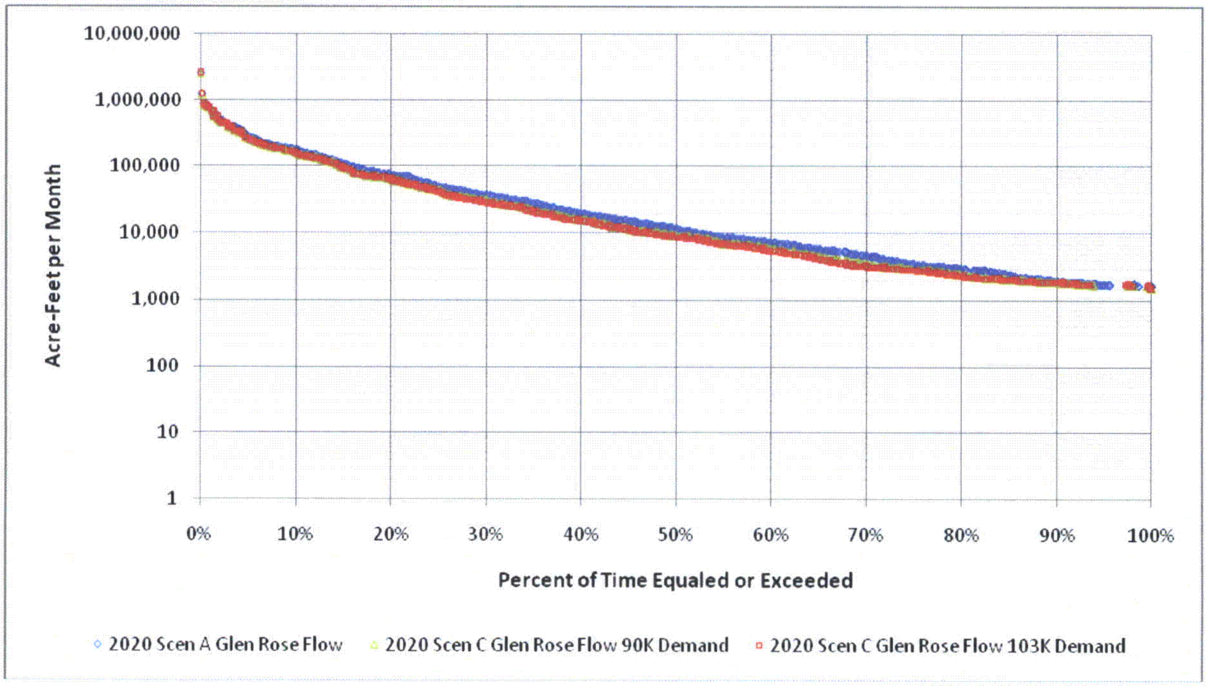
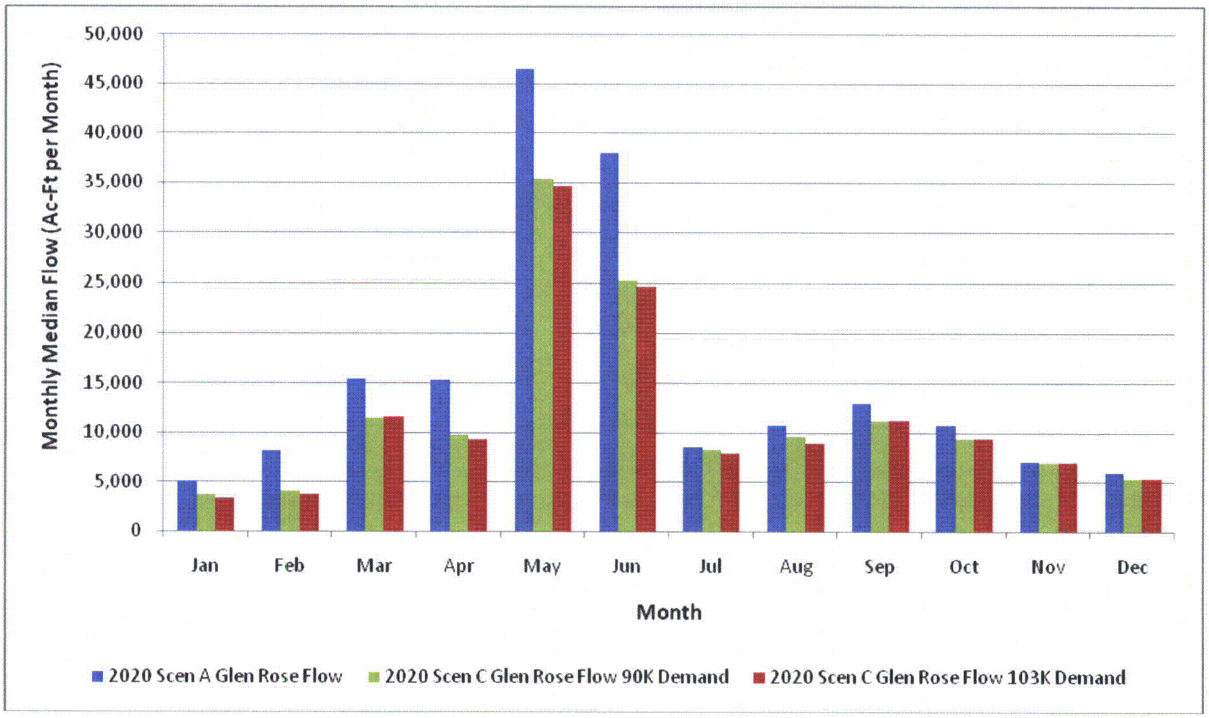


Figure 18
Monthly Median Simulated Flow at Brazos River near Glen Rose Gage
Scenarios A and C – 2020 Conditions



Comparison of WRAP and RiverWare Models

11. Attachment 2 is a CD-ROM containing executable files for the Water Rights Analysis Package, the model used for the Brazos Water Availability Model (WAM). The WAM was included in the original submission to the NRC because it is the basis for Dr. Ward's January 2008 report *Potential Impacts of Comanche Peak Cooling Tower Operation on Total Dissolved Solids in the Lower Reach of Lake Granbury*. The hydrology in the RiverWare model used for the Lake Granbury Dissolved Minerals Study is derived from the WAM as well. However, FNI does not recommend that the WAM be used for comparison of the impacts of Units 3 and 4. The WAM was initially used for water availability analysis to determine if there was sufficient water for the Units 3 and 4. This model looked at 2060 conditions, a period when existing water supplies in the Brazos River Basin are expected to be fully utilized. The scenarios developed using the WAM compared use of the water at Comanche Peak to use of water downstream, not conditions with and without Units 3 and 4. The WAM also has limited capabilities for modeling reservoir systems so it does not include realistic operating policies. The WAM also does not include hydropower operations. FNI chose RiverWare for its modeling of Lakes Possum Kingdom and Granbury because of its flexibility and water quality modeling capabilities. FNI recommends that the RiverWare models be used for comparison of the impacts of Units 3 and 4.
12. Attachment 2 also contains Excel spreadsheets with tabulated results of the RiverWare modeling of Scenarios A and C. These spreadsheets also contain the data used to make Figures 3 through 18.

Attachment 1 – Supplemental Description of Modeling Data

1. The hydrology from 1940 to 1998 used in the Riverware model is derived from the Texas Commission on Environmental Quality's Brazos River Basin Water Availability Model (TCEQ WAM). The TCEQ WAM uses monthly naturalized hydrologic data derived from historical USGS gage records. The TCEQ WAM includes maximum use authorized in every permanent water right in the Brazos River Basin. The WAM is designed to evaluate water availability based on a prior rights system where each water right is assigned a priority date based on the time period when the water supply was first developed. The model allocates water to rights with more senior priorities before water rights with more junior priorities, regardless of the geographic location of the water right in the basin.

2. The Brazos G Regional Water Planning Group modified the TCEQ WAM for use in developing the state-sponsored 2006 Brazos G Regional Water Plan. Brazos G made two significant changes to the TCEQ WAM. First, reservoir storage was adjusted to account for sediment accumulated by the year 2060, the last year of the planning cycle. The TCEQ WAM assumes the full storage authorized in each water right. Second, the Brazos G WAM has explicit modeling of Brazos River Authority contracts at the geographic location of the diversion. The TCEQ WAM aggregates Brazos River Authority water rights at one diversion location rather than at the actual diversion locations of Authority contracts. The Brazos G WAM gives a more realistic assessment of water availability for each Brazos River Authority contract.

3. FNI adopted the 2006 Brazos G WAM for use in our initial assessment of water availability for Units 3 and 4, with a few modifications. The most significant change was the modeling of Units 3 and 4, which was not included in the 2006 Brazos G Water Plan. (A subsequent amendment to the 2006 Plan added the demands for Units 3 and 4.) Other modifications are described in detail in the July 17, 2009 Memorandum to Bruce Turner *Modifications to the Brazos G WAM*.

4. The output of the FNI-modified Brazos G WAM was used for the Riverware hydrology, including inflows into Lake Possum Kingdom, intervening flows between Possum Kingdom and Lake Granbury, the intervening flows between Lake Granbury and the Glen Rose gage, and net evaporation-precipitation rates. Water passed to downstream senior water rights (excluding Brazos River Authority rights) was extracted from the FNI-modified Brazos G WAM as well. These releases assume that all downstream senior water rights are being operated at their maximum authorized diversion, a conservative assumption. These demands were used in the Riverware model when calculating releases from the Lake Granbury/Possum Kingdom system.

5. Riverware hydrology from 1999 to 2007 is based on the historical operation of the reservoirs and historical USGS stream gage records. Releases for downstream water rights were assumed to be the average release for each month for the 1940 to 1998 period simulated in the FNI-modified Brazos G WAM.

6. Both the Riverware model and the WAM model use a monthly time step. FNI believes that a monthly timestep is adequate to assess the impacts of Units 3 and 4. Neither Lake Granbury nor Lake Possum Kingdom fluctuates significantly on a day-to-day basis due to normal reservoir operations. (An influx of flood water can cause a significant daily change in reservoir elevation. However, the presence of additional demands for Units 3 and 4 are unlikely to impact flood operations of the reservoirs.) Daily fluctuations due to hydropower are attenuated in the 145 river miles between Lakes Possum Kingdom and Granbury. Daily diversions from the reservoirs are relatively small compared to the storage in the reservoir and do not cause significant daily fluctuations in reservoir storage.

7. Under Texas law, a "priority call" occurs when a senior water right holder notifies owners of upstream junior water rights to cease diversion and impoundment of inflow that would impact the reliability of the senior water right holder's diversions. Although the WAM models assume constant priority calls by senior water rights, at this time priority calls are very rare in Texas. It is possible that the Brazos River Authority could make a priority call on upstream junior water rights any time it feels that their supplies in Possum Kingdom or Lake Granbury would be compromised. It is also possible that the increased demands for the Units 3 and 4 could increase the possibility that the Authority may elect to exercise its right to make a priority call. However, there are three reasons why the demand for Units 3 and 4 are not a significant impact on upstream water rights. First, if water for Units 3 and 4 is not sold to Luminant for use at Comanche Peak, the Brazos River Authority will eventually sell this water at other locations in the Brazos Basin. Although these demands may not materialize in the 2020 time frame considered in these analyses, regional water plans show that the additional demands will materialize over the next 50 years. Therefore the possibility of a priority call on upstream water rights would be the same in 2060 regardless of the presence of Units 3 and 4. Second, stream losses in the reaches above Possum Kingdom and much of the water passed by upstream water right holders would be lost by the time it reaches Possum Kingdom. Therefore calls on smaller flows could be considered "futile calls", or calls on water that would not reach the downstream user. Finally, the Brazos River Authority already has agreements in place with many of the major

water rights holders above Possum Kingdom to not make a priority call on those rights. Most of the other water rights do not represent a significant impact on the Authority system.

8. The FNI-modified Brazos G WAM assumes that there are no priority calls on water rights above Possum Kingdom. This assumption gives a conservative assessment of available water for Possum Kingdom.

5.2.1.6 Operational Activities Causing Hydrologic Alterations

Maintenance de-silting is not expected to be required for sediment removal near the CPNPP Units 3 and 4 intake structure. The need for installation of rip rap, stemwalls, or other appropriate means to stabilize the banks of the lake during and following construction is not anticipated. Because the need for maintenance de-silting and stabilization of the bank are not expected, hydrological impacts from de-silting are SMALL.

The CPNPP Units 3 and 4 makeup water intake structure from which withdrawal is planned to occur is located northeast of CPNPP on Lake Granbury and is situated next to the western upstream side of the existing makeup water intake structure for SCR. The SCR makeup water intake structure is located on the southwest bank of Lake Granbury, 1.31 mi upstream from the DeCordova Bend Dam. The CPNPP Units 3 and 4 intake structure is designed as a concrete slab with concrete piers to rock and an access bridge similar to the existing access bridge with concrete valve vaults provided on the shore. The screens on the intake structure are expected to have a through screen velocity of 0.5 fps or less. The CPNPP Units 3 and 4 intake structure would be located immediately adjacent to the existing makeup water intake structure for SCR; local flow patterns in the vicinity of the intake structure would be preserved to the maximum extent practical without interference with the operation of the intake structure. Local flow patterns in the vicinity of the intake structure are also expected to prevent significant aggradation of sediment near the intake structure because dredging has not been required for the existing intake for CPNPP Units 1 and 2. Based on the above, hydrological impacts near the intake structure would be SMALL.

The discharge structure is located 0.17 mi upstream of the DeCordova Bend Dam. To minimize hydrologic alterations from the discharge, a multi-port diffuser is expected to be used. The CPNPP Units 3 and 4 CWS and UHS cooling tower blowdown combined discharges would flow through two 42-in diameter pipes (one pipe per unit). The final 82 ft 4 in of each discharge pipe would be a multi-port diffuser with eighteen 4-in diameter nozzles (Figure 5.3-1). The diffuser maximizes thermal and chemical dissolution. The diffuser pipes would be located approximately 1.14 mi downstream from the intake to prevent heated discharge water from recirculating back to the intake. Based on the location of the diffuser upstream of the dam, hydrological impacts near the discharge structure would be SMALL. Additional information related to the CPNPP Units 3 and 4 discharge characteristics is presented in Subsections 5.2.3.1 and 5.2.3.4 as well as Section 3.4.

Dewatering activities that could affect groundwater flow and quality are not required during the operation of CPNPP. Minimal dewatering may be needed during construction of CPNPP Units 3 and 4 as addressed in Subsections 4.2.1.1.1 and 4.2.1.1.6.

Based upon minimal impact from the discharge design, and no maintenance de-silting or dewatering during operation, operational activities at CPNPP are considered to be of SMALL impact and mitigation is not warranted.

5.2.1.7 Surface Water and Groundwater Users Affected by Hydrologic Alterations

~~No effects on other water users, including surface water and groundwater resources used by municipalities, industrial facilities, or local businesses and residents, in the region of CPNPP are~~ RAI HYD-15

~~anticipated from hydrologic alterations. All diversions and returns are expected to be in accordance with approved state and regional water plans.~~All surface water diversions and returns associated with CPNPP Units 3 and 4 operations are expected to be in accordance with approved state and regional water plans. Surface water alterations resultant from CPNPP Units 3 and 4 water use include lower lake levels at Possum Kingdom Lake and Lake Granbury and decreased flows in the reach of the Brazos River between Lake Granbury and Lake Whitney. No hydrologic alterations or effects on groundwater water users from CPNPP Units 3 and 4 operations are anticipated. RAI HYD-15

~~The most extreme low reservoir conditions would be no lower with the operation of the CPNPP Units 3 and 4 because Luminant is negotiating a contract with the BRA that takes into account downstream water rights for the Brazos River.~~ Extensive third party water availability modeling has been performed for the Brazos River drainage basin and ~~activities are underway to amend~~ the Brazos Region G water plan, as well as the State Water Plan have been amended, to provide adequate net diversions to CPNPP Units 3 and 4, plus requirements of other facilities and down stream water rights which might also draw on Lake Granbury. In addition, the BRA's current agreement with Luminant is based upon the BRA's operation of Lake Granbury so that the water level ~~in it will be maintained above~~will not fall below 675 ft msl during low flow conditions (18 ft below the normal pool elevation) (Subsection 5.2.1.5). RAI HYD-15

Third party modeling performed to determine hydrologic alterations resultant from CPNPP Units 3 and 4 water use utilized monthly hydrology data from 1940 to 2007 and year 2020 water use projections and sedimentation conditions (F&N 2009). The resulting model shows the hydrologic alterations to Possum Kingdom Lake, Lake Granbury, and the Brazos River had CPNPP Units 3 and 4 been operating during this period. The model shows baseline conditions and conditions expected with CPNPP Units 3 and 4 typical year demand (90,152 ac-ft/year) and high temperature year demand (103,717 ac-ft/year). RAI HYD-15

The modeling shows that the increased demands for Units 3 and 4 will cause both Lake Granbury and Possum Kingdom Lake to be lower during drier periods. At the 90,152 ac-ft/year demand level, which is the typical demand expected from the new units, the maximum change is 12.6 feet in Possum Kingdom Lake and 2.5 feet in Lake Granbury during the period of most severe drawdown. On average, elevations in Possum Kingdom under typical demand will be 1.3 feet lower and elevations in Lake Granbury will be 0.4 feet lower with Units 3 and 4 water use. At the 103,717 ac-ft/year demand level, which is the high temperature demand expected from the new units, the maximum change is 14.8 feet in Possum Kingdom Lake and 2.9 feet in Lake Granbury during the period of most severe drawdown. On average, elevations in Possum Kingdom under high temperature demand will be 1.5 feet lower and elevations in Lake Granbury will be 0.6 feet lower with Units 3 and 4 water use (F&N 2009). All but the highest outflows from Lake Granbury will be reduced as well, thus lowering flows in the Brazos downstream of Lake Granbury. With Units 3 and 4, the outflows from Possum Kingdom would increase during dry periods, and spills from Possum Kingdom at the end of these periods would be smaller. However, over time the outflows from Possum Kingdom, and thus stream flow between Possum Kingdom and Lake Granbury would be similar with and without Units 3 and 4.

As discussed in the previous Subsection 5.2.1.6, maintenance dredging (de-silting) of Lake Granbury is not expected to be conducted. Stormwater discharged from the site to the SCR is with some minimum surface area free of rooted vegetation and with an average hydraulic retention time of more than seven days. Lakes or reservoirs might be natural water bodies or impounded streams, usually fresh, surrounded by land or by land and a man-made retainer (e.g., a dam). Lakes or reservoirs might be fed by rivers, streams, springs, or local precipitation. Flow-through reservoirs with an average hydraulic retention time of seven days or less should be considered a freshwater river or stream. By EPA definition, Lake Granbury is classified as a lake or reservoir as retention time has been estimated at 260 days (TPWD 2005) by the Texas Parks and Wildlife Department. Additional information is provided in Subsection 5.3.1.1.1 about how CPNPP meets the performance standards specified in the EPA regulations implementing Section 316(b). CPNPP Units 3 and 4 is designed with a closed cycle wet cooling tower with the design features expected by the Phase I rule incorporated into the intake design.

Any facility that discharges into waters of the United States is required to obtain a valid National Pollution Discharge Elimination System (NPDES) permit. In Texas, the TCEQ has been delegated authority to issue a TPDES permit and renew the permit every five years of operation of CPNPP. Subsection 5.2.3.1 provides additional information on the site TPDES permit requirements. No Native American lands are present within 50 mi of CPNPP as discussed in Subsection 2.2.3.

5.2.2 WATER-USE IMPACTS

This subsection describes the results of the (1) analysis of operations that could have impacts on water use, including water availability, (2) analysis of water quality changes that could affect water use, (3) analysis and evaluation of impacts resulting from these alterations and changes, (4) analysis and evaluation of proposed practices to minimize or avoid potential impacts, and (5) evaluation of compliance with federal, state, regional, local, and affected Native American tribal regulations applicable to water use and water quality.

5.2.2.1 Plant Operational Activities Potentially Impacting Water Use

Possum Kingdom Lake, Lake Granbury, and the Brazos River could potentially be affected by operational activities for Units 3 and 4. These activities include (1) makeup water withdrawals from Lake Granbury (Brazos River) and consumptive use, (2) cooling tower blowdown discharges to Lake Granbury (Brazos River), and (3) radioactive and nonradioactive process water discharges to SCR. Preoperational baseline monitoring programs for surface water and groundwater are described in Subsection 6.3.3. RAI HYD-15

5.2.2.2 Surface Water - Makeup Water Withdrawal and Consumptive Use

A description of the Brazos River, hydrologic alterations and their related operational activities, and physical effects of hydrologic alterations are presented in ~~Subsection 5.2.1.1~~Subsection 5.2.1. Discharge records collected by the BRA for the Brazos River were used to estimate the monthly, annual average, and low flows of Lake Granbury. Detailed reservoir flow and hydrology data are presented in Subsection 2.3.1. RAI HYD-15

The proposed CPNPP water intake structure is located north-northeast of the CPNPP site on Lake Granbury. An intake-hydrodynamic description is presented in Subsection 5.3.1.1.1.

~~Lake level reduction associated with consumptive water losses resulting from two-unit operations is not expected to affect recreational boating and fishing in summer, when lake use is at its highest, even during low flow conditions. This expectation is because water extracted for the consumptive use of Units 3 and 4 is taken at a point that is at the upstream side of the DeCordova Bend Dam.~~Recreational boating and fishing in the summer, when lake use is at highest, is not expected to be significantly affected by lake level reduction associated with CPNPP Units 3 and 4 water use except in times of severe drought. Hydrologic modeling performed has shown average decreases in Possum Kingdom Lake of 1.3 to 1.5 ft and maximum decreases of 12.6 to 14.8 ft below the level expected without the Units 3 and 4 water demand. Similarly, average decreases in Lake Granbury of 0.4 to 0.6 ft and maximum decreases of 2.5 to 2.9 ft below the level expected without the Units 3 and 4 water demand were determined (F&N 2009). Consumptive water use for Units 3 and 4 is estimated at 55,690,560 gpd (171 ac-ft/day). At this rate, the expected time to drawdown Lake Granbury from a normal pool elevation of 693 ft msl to the minimum operating elevation of 675 ft msl is approximately 508 days (Table 2.3-38). At the conservation pool elevation of 693 ft above msl, Lake Granbury has a storage volume of 129,011 ac-ft. Based on published elevation storage relationships (TWDB 2005), the 171 ac-ft/day consumptive water use for CPNPP Units 3 and 4 would result in a negligible (less than 0.1 ft) decrease in water level elevation on Lake Granbury. These withdrawals would not reduce the depth of water for boat or fishing upstream of the dam~~ as the impoundment elevation is controlled by the BRA~~. ~~The~~Although flows in the Brazos River downstream of Lake Granbury will be reduced with Units 3 and 4 water use, the withdrawal of water for use by CPNPP Units 3 and 4 should have minimal impact on boating and fishing downstream of the dam. Luminant is negotiating a contract with the BRA that provides for minimum flow conditions so that downstream water users should not be impacted. The 27,447 ac-ft/yr from Possum Kingdom Lake already under contract to Luminant is expected to be reallocated to CPNPP for normal use by CPNPP Units 3 and 4, while the remaining 76,270 ac-ft/yr needed for CPNPP Units 3 and 4 is being negotiated. ~~The BRA is responsible for maintaining Lake Granbury's water level by releases from Possum Kingdom as needed. Therefore, potential impacts from consumptive water uses are expected to be SMALL.~~Based on the results of the third party modeling performed to determine hydrological alterations resultant from CPNPP Units 3 and 4 water demands, potential impacts from consumptive water use are expected to be SMALL, except during extreme drought conditions when the impact is expected to be MODERATE. Lake water level and stream flow changes resultant from CPNPP Units 3 and 4 water demand are not expected to be destabilizing to important attributes of the river and reservoirs resources.

RAI HYD-15

RAI HYD-15

RAI HYD-15

5.2.2.3 Potential Impacts on Water Use

The following subsections discuss impacts on water use from the operation of Units 3 and 4.

5.2.2.3.1 Downstream Water Availability Impacts

Current Surface Water Use

Information about existing water users, including locations of diversions and maximum use rate, is presented in Subsection 2.3.2. Table 2.3-35 provides information about water consumption for Hood and Somervell counties, and Table 2.3-36 provides information about surface water use for Lake Granbury including information about CPNPP Units 1 and 2, Wolf Hollow electric power plant, and DeCordova Bend electric power plant. Upstream users have minimal impact on the water availability for Units 3 and 4 or downstream water users. However, as mentioned in Subsection 5.2.2.2, the BRA maintains Lake Granbury's water level by releases from Possum Kingdom located upstream from CPNPP. As part of this process, hydrologic modeling has been conducted to demonstrate that CPNPP does not have an impact on downstream users including recreational, navigational, and water consumers. The consumptive use of water for CPNPP is described in Subsection 5.2.2.2. The minimum flow released voluntarily by the BRA is expected to be maintained (Subsection 5.2.1.2). The pending ~~Standard~~System Operations Permit (SOP) should address impacts to water availability for users downstream from the CPNPP intake structures on Lake Granbury. Therefore, the impacts are considered SMALL. | RAI HYD-15

Groundwater is not planned for use for operation of Units 3 and 4. Past and current hydrogeologic information for the CPNPP site is presented in Subsection 2.3.1 and FSAR Subsection 2.4.12.

Future Surface Water Use

Future consumptive water use information was obtained from the 2006 Brazos Region G Water Plan, which forecasts water demands by category for the years 2010 to 2060 (Brazos G 2006). The water demand estimates compiled for each type of water use do not specify future ground or surface water demand. Estimated demand surpluses or shortages are based on projected surface and groundwater supplies. Projections for non-consumptive water uses, such as navigation, hydroelectric generation, environmental flows, and recreation are not presented. As shown in Table 2.3-43, total water use for the region is projected to increase from 835,691 ac-ft in 2010 to 1,150,973 ac-ft in 2060, a 38 percent increase. The projections indicate that municipal, manufacturing, and steam-electric water use as percentages of the total water use increase from 2000 to 2060, while mining, irrigation, and livestock water use are projected to decrease or remain constant as percentages of the total.

As shown in Table 2.3-44, water demands in Hood and Somervell counties are projected to increase from 44,939 ac-ft in 2010 to 62,600 ac-ft in 2060, a 39 percent increase (Brazos G 2006). It should be noted that the Somervell County steam-electric water user group demands identified in the 2006 Brazos Region G Water Plan do not account for CPNPP Units 3 and 4 water demands, subsequently the additional demands for CPNPP Units 3 and 4 are not included in the regional water demand projections provided in Table 2.3-43 nor the county water demands provided in Table 2.3-44. The revised projected regional and county water demands are to be included in the 2011 Brazos G Water Plan.

The 2006 Brazos Region G Water Plan identifies 10 water user groups within Hood County and seven water user groups within Somervell County (Brazos G 2006). Table 2.3-45 identifies each water user group and their corresponding water surplus or shortage in the years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed to mitigate the shortage. Projected shortages for the Somervell County steam-electric water user group were identified for the years 2030 and 2060 in a July 2008 amendment to the 2006 Brazos Region G Water Plan. The Somervell County steam-electric water user group obtains its water supply from SCR and from the BRA from Lake Granbury. The July 2008 amendment, which has been approved by the Brazos Region G Board and is awaiting approval by the TWDB, identifies the purchase of surface water from the BRA as a planning strategy to overcome the identified shortages and provide adequate net diversions to CPNPP Units 3 and 4. The additional supply is

(CORMIX 2008c) CORMIX Mixing Zone Glossary. http://www.cormix.info/picgal/mixingz.php. Accessed February 10, 2008.

(CPSES 2007) Comanche Peak Steam Electric Station. Final Safety Analysis Report (FSAR), Amendment 101.

(F&N 2009) Memorandum from Jon Albright, Freese & Nichols, to Bruce Turner, Luminant, Supplemental Information for NRC Request. December 15, 2009. RAI HYD-15

(Jirka, Doneker, and Hinton 1996) User's Manual for Cormix: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters. September 1996.

(TCEQ 2006) Texas Commission on Environmental Quality. Annual Water Use Report for Comanche Peak Steam Electric Station, December 2006.

(TCEQ 2008) Texas Surface Water Quality Standards. Texas Administrative Code (TAC), Title 30 (Environmental Quality), Part 1 (Texas Commission on Environmental Quality), Chapter 307, Rule §307.10 (Appendix A).

(TPWD 2005) Texas Parks and Wildlife. Granbury Reservoir 2005 Survey Report. http://www.tpwd.state.tx.us/publications/pwdpubs/lake_survey/pwd_rp_t3200_1300/. Accessed December 2007.

(TWDB 2005) Texas Water Development Board. Volumetric Survey Report of Lake Granbury, July 2003. http://www.twdb.state.tx.us/home/index.asp. Accessed November 2007.

(TWDB 2007a) Texas Water Development Board. Historical Water Use Information, Brazos Basin. http://www.twdb.state.tx.us/home/index.asp. Accessed December 2007.

(TWDB 2009) 2006 Water Use Survey Summary Estimates by County in Acre-Feet, Draft. www.twdb.state.tx.us/wrpi/wus/2006est/2006wus.htm. Accessed May 22, 2009.

(USGS 2007) U.S. Geological Survey. Hydrologic Unit Codes for Region 12 Brazos River Basin. Water Resources of the United States. http://water.usgs.gov/GIS/huc_name.html#Region12. Accessed June 15, 2007.

QUESTION NO.: HYD-20 (6.3-1)

Provide justification and rational for the construction, preoperational, and operational radiological monitoring proposed for groundwater

SUPPLEMENTAL INFORMATION

Groundwater Monitoring Plan - Provide the rationale involved in amending the current CPNPP Units 1 and 2 Groundwater Monitoring Plan to include CPNPP Units 3 and 4, including the expected date of implementation. Additionally, discuss the rationale involved in locating the new groundwater monitoring wells with consideration given as to what wells could potentially be removed during construction. Detail the basis for well locations, identifying how many wells will be placed up-gradient, down-gradient and cross-gradient with aquifer completion elevation.

BACKGROUND:

This is similar to the RAI HYD-21 (6.4-1) in which the NRC requested that the applicant provide justification and rational for the construction, preoperational, and operational hydrological monitoring proposed for groundwater.

The response to this RAI was submitted via Luminant letter TXNB-09025 dated July 20, 2009 (ML092520139). FSAR Subsection 2.4.12.4, Revision 1, reflects that a groundwater monitoring plan would be developed prior to fuel load, and is consistent with what has been used with other COL applications.

RESPONSE:

Sentinel groundwater monitoring wells will be located in down-gradient hydrologic positions from each reactor building in proximity to systems, structures, and components where the highest potential exists to detect inadvertent radiological releases. A minimum of two sentinel wells will be placed down-gradient from each reactor building. To provide positive detection should an inadvertent release from containment occur, these sentinel wells will be located between the Unit 3 and 4 reactor buildings and Squaw Creek Reservoir. Excavation of soil regolith is planned to achieve the final plant grade elevation, exposing the Glen Rose Formation. Therefore, the sentinel wells will be completed in the upper Glen Rose Formation. Each well will be installed in such a manner as to intercept radionuclides prior to reaching sensitive receptors. Please refer to FSAR Figures 2.4.12-213 and 2.4.12-214 for post-construction flow paths. The sentinel wells will be installed at depths sufficient to intercept releases from areas with the highest potential for inadvertent radiological releases. To insure proper placement of the sentinel wells, resources such as post-construction drawings, as-built drawings, photographs, and videos of site construction will be used as well as any other information that would assist well placement to allow early detection of any inadvertent release of radionuclides to the environment.

To assess potential groundwater movement and quality, groundwater monitoring wells will be located in up-gradient and cross-gradient positions to each reactor building. One up-gradient and one cross-gradient monitoring well will be associated with each nuclear island.

Sentinel groundwater monitoring wells, in addition to groundwater monitoring wells located up-gradient and cross-gradient from the reactor buildings will be incorporated into the station's existing groundwater monitoring program. These wells will be sampled on a quarterly basis in accordance with the existing groundwater monitoring program.

At this time, it is not possible to assess which existing groundwater monitoring wells will remain in place after construction of CPNPP Units 3 and 4. Consequently, if existing groundwater monitoring wells will not remain in positions to act as sentinel, up-gradient, and cross-gradient monitoring points, new wells will be installed in the appropriate positions.

Due to the impermeable nature and thickness of the Glen Rose Formation in the immediate vicinity of CPNPP Units 3 and 4, the underlying Twin Mountains Formation will not be monitored in this area. Currently and in the future, the Twin Mountains Formation is and will be sampled as part of the existing CPNPP Radiological Environmental Monitoring Program.

Impact on R-COLA

See attached marked-up ER Revision 1 pages 6.3-8 and 6.3-9

Impact on S-COLA

None.

Impact on DCD

None.

program requirements. Operational monitoring for groundwater and surfacewater satisfies the applicable requirements of other state and federal agencies, as appropriate.

Groundwater contours are mapped prior to operation. Continued monitoring of groundwater levels, along with the radiological monitoring of groundwater, are used to evaluate the groundwater pathway for potential movement of radionuclides into the environment.

6.3.5 SUPPLEMENTAL INFORMATION

RAI HYD-20

Sentinel groundwater monitoring wells will be located in down-gradient hydrologic positions from each reactor building in proximity to systems, structures, and components where the highest potential exists to detect inadvertent radiological releases. A minimum of two sentinel wells will be placed down-gradient from each reactor building. To provide positive detection should an inadvertent release from containment occur, these sentinel wells will be located between the Unit 3 and 4 reactor buildings and Squaw Creek Reservoir. Excavation of soil regolith is planned to achieve the final plant grade elevation, exposing the Glen Rose Formation. Therefore, the sentinel wells will be completed in the upper Glen Rose Formation. Each well will be installed in such a manner as to intercept radionuclides prior to reaching sensitive receptors. Please refer to FSAR Figures 2.4.12-213 and 2.4.12-214 for post construction flow paths. The sentinel wells will be installed at depths sufficient to intercept releases from areas with the highest potential for inadvertent radiological releases. To insure proper placement of the sentinel wells, resources such as post-construction drawings, as-built drawings, photographs, and videos of site construction will be used as well as any other information that would assist well placement to allow early detection of any inadvertent release of radionuclides to the environment.

To assess potential groundwater movement and quality, groundwater monitoring wells will be located in up-gradient and cross-gradient positions to each reactor building. One up-gradient and one cross-gradient monitoring well will be associated with each nuclear island.

Sentinel groundwater monitoring wells, in addition to groundwater monitoring wells located up-gradient and cross-gradient from the reactor buildings will be incorporated into the station's existing groundwater monitoring program. These wells will be sampled on a quarterly basis in accordance with the existing groundwater monitoring program.

At this time, it is not possible to assess which existing groundwater monitoring wells will remain in place after construction of CPNPP Units 3 and 4. Consequently, if existing groundwater monitoring wells will not remain in positions to act as sentinel, up-gradient, and cross-gradient monitoring points, new wells will be installed in the appropriate positions.

Due to the impermeable nature and thickness of the Glen Rose Formation in the immediate vicinity of CPNPP Units 3 and 4, the underlying Twin Mountains Formation will not be monitored in this area. Currently and in the future, the Twin Mountains Formation is and will be sampled as part of the existing CPNPP Radiological Environmental Monitoring Program.

6.3.6 REFERENCES

RAI HYD-20

(Boss 2007) Boss, Stephen, PhD, P.G., Bathymetry and Volume Storage of a Portion of Lake Granbury, Hood County, Texas. Department of Geosciences University of Arkansas. Fayetteville, AR. July 11, 2007.

(Boss 2007a) Boss, Stephen, PhD, P.G., Bathymetry and Volume Storage of a Portion of Squaw Creek Reservoir, Hood County, Texas. Boss, Stephen, PhD, P.G. Department of Geosciences University of Arkansas. Fayetteville, AR. July 11, 2007.

(EPA 2007) U.S. Environmental Protection Agency. Water Discharge Permits. http://www.epa.gov/enviro/html/qmr.html Accessed November 16, 2007.

(TCEQ 2004) Texas Commission on Environmental Quality. Texas Pollutant Discharge Elimination System Permit, TXU Energy Company, L.L.C., Comanche Peak Nuclear Power Plant, Permit No.WQ0001854000. April 23, 2004.

(USDA 1978) United States Department of Agriculture – Soil Conservation Service. Soil Survey of Hood and Somervell Counties, Texas. December 1978.

QUESTION NO.: TE-11 (9.4.2.2.5-1)

SUPPLEMENTAL INFORMATION:

The mister system is designed to evaporate the waste reject water from treatment system and the design is provided in the response to GEN-03/HYD-23/LU-03.

Misting units are anticipated to be used to increase evaporation at the BDTF ponds and 182 misters used simultaneously have the ability to evaporate 5200 gpm. Each unit discharges approximately 80 gpm and 28.6 gpm will evaporate, based on an average evaporation efficiency of 0.357. Salt drift from the misters is a consideration for terrestrial ecology. When a 90-micron droplet of process water is sprayed into the air, a portion of the water droplet evaporates. Some droplets will completely evaporate leaving the solid portion suspended in the air. Meteorological conditions will determine the distance suspended solids are carried by wind currents.

According to a 2004 study performed by the Department of the Interior, it was found that salt drift from misting units was deposited up to 1300 ft from the source with a wind speed of 10 mph. The ER indicates the average wind speed is 10 mph with the predominant wind direction being from the south or southeast. No sensitive areas exist within 1300 ft of the BDTF. Salt drift could be maintained within the 128 ac evaporation pond with judicious placement of the misting units. NUREG 1555 indicates maintaining a deposition rate below 1 – 2 kg/ha/month is expected to prevent damage to vegetation. Salt concentrations leaving the misters are approximately 576 kg/minute. Mitigative measures such as salt fences or wind velocity sensors that halt misting could be employed to contain salt drift when wind speeds exceed 10 mph. If mitigative measures are employed to maintain salt concentrations within the 400 ac. BDTF, ecological impacts due to salt drift will be SMALL.

Additional considerations when developing the BDTF are the location of power lines over the evaporation pond, localized fogging associated with the misting units, and salt concentrations of the pond water. Wings of birds swimming on brine ponds collect salt crystals, which eventually prevent birds from flying. Noise and violent spray action from the misting units will act as a deterrent, discouraging birds from flying near the lines or lighting on the pond. Potential impacts on birds will be monitored and bird deterrent procedures and equipment will be utilized as needed (e.g., noise cannons, netting, artificial predators, periodic patrols, and minimizing periods of time in which standing water is present). Possible localized fogging associated with the misting units will not affect transient birds as they will likely avoid the noise and violent spray. As described in Luminant letter TXNB-09046 dated September 16, 2009 (ML092640643) any localized fogging due to the BDTF ponds is expected to be less than what has historically occurred at and around the site, and would probably be temporary. Therefore, impacts to birds due to fogging are expected to be SMALL.

Impact on R-COLA

See attached marked-up ER Revision 1 pages 5.3-10 and 5.3-11.

Impact on S-COLA

None.

Impact on DCD

None.

Impacts associated with discharge to Lake Granbury are negligible. Chemicals are below NOAEC, the plume is localized at one end of the reservoir, and only a small pelagic area is calculated to be warmer than ambient. In some situations many small impacts could have an additive or synergistic effect on aquatic habitat and impact the environment to uninhabitable levels. Proposed reactors and support systems have been designed to minimally impact the environment. CORMIX was used to ensure the thermal plume would not affect aquatic organisms in the reservoir. An evaporation pond was designed to treat effluent prior to discharge and ensure total dissolved solid levels would not degrade water quality. Because impacts to Lake Granbury are negligible, cumulative impacts associated with CPNPP would not affect aquatic organism populations within the reservoir.

5.3.2.3 Terrestial Ecosystems RAI TE-11

The mister system is designed to evaporate the waste reject water from treatment system and the design is provided in the response to GEN-03/HYD-23/LU-03.

Misting units are anticipated to be used to increase evaporation at the BDTF ponds. One hundred eighty two misters used simultaneously have the ability to evaporate 5200 gpm. Each unit discharges approximately 80 gpm and, based on an average evaporation efficiency of 0.357, 28.6 gpm will evaporate. Salt drift from the misters is a consideration for terrestrial ecology. When a 90 micron droplet of process water is sprayed into the air, a portion of the water droplet evaporates. Some droplets will completely evaporate leaving the solid portion suspended in the air. Meteorological conditions will determine the distance suspended solids are carried by wind currents.

According to a 2004 study performed by the Department of the Interior, it was found that salt drift from misting units was deposited up to 1300 ft from the source with a wind speed of 10 mph. The ER indicates the average wind speed is 10 mph with the predominant wind direction being from the south or southeast. No sensitive areas exist within 1300 ft of the BDTF. Salt drift could be maintained within the 128 ac evaporation pond with judicious placement of the misting units. NUREG 1555 indicates maintaining a deposition rate below 1 – 2 kg/ha/month is expected to prevent damage to vegetation. Salt concentrations leaving the misters are approximately 576 kg/minute. Mitigative measures such as salt fences or wind velocity sensors that halt misting could be employed to contain salt drift when wind speeds exceed 10 mph. If mitigative measures are employed to maintain salt concentrations within the 400 acres BDTF, ecological impacts due to salt drift will be SMALL.

Additional considerations when developing the BDTF are the location of power lines over the evaporation pond, localized fogging associated with the misting units, and salt concentrations of the pond water. Wings of birds swimming on brine ponds collect salt crystals, which eventually prevent birds from flying. Noise and violent spray action from the misting units will act as a deterrent, discouraging birds from flying near the lines or lighting on the pond. Potential impacts on birds will be monitored and bird deterrent procedures and equipment will be utilized as needed (e.g., noise cannons, netting, artificial predators, periodic patrols, and minimizing periods of time in which standing water is present). Possible localized fogging associated with the misting units will not affect transient birds as they will likely avoid the noise and violent spray. Any localized affect is expected to be less than what has historically occurred at and around the site.

and would probably be temporary. Therefore, impacts to birds due to fogging are expected to be SMALL. RAI TE-11

5.3.3 HEAT-DISCHARGE SYSTEM

This subsection describes the impact of the heat-discharge system on the aquatic ecology and the physical impacts such as scouring, silt build up and shore line erosion caused by the flow field induced by the discharge system during station operation. The CWS, ESW, and NESW systems (Section 3.4), use cooling towers to dissipate heat to the atmosphere.

Subsection 5.3.3.1 describes the impacts associated with heat dissipation to the atmosphere. Subsection 5.3.3.2 describes the impacts of the operation of heat dissipation systems on terrestrial ecosystems. Overall, as discussed in the following subsections, the impacts associated with the heat dissipation system on the atmosphere and terrestrial ecosystems are SMALL.

5.3.3.1 Heat Dissipation to the Atmosphere

Cooling systems that depend on evaporation of water for a major portion of the heat dissipation can be expected to create visible vapor plumes. These vapor plumes cause shadowing of nearby lands, salt deposition, and can increase the potential for fogging or icing. Physical and expected performance characteristics of the cooling system are provided in the FSAR Subsection 10.4.5.

Topography of the CPNPP site is virtually flat and has been graded to support four back-to-back mechanical draft cooling towers (MDCT) oriented in a staggered parallel arrangement. Two back to back MDCT arrangements per unit are selected for the proposed project in order to utilize the available areas. Cooling tower dimensions, layout, and airflow rates, are provided in Table 5.3-3. Physical characteristics of the heat discharge system are provided in Subsection 3.4.2.3. Typical drift rates for cooling towers of these types, and average Lake Granbury water dissolved solids and salt concentrations were used to support deposition calculations.

In addition to the CWS, an ultimate heat sink (UHS) is included in the design for CPNPP Units 3 and 4, and each has an associated cooling tower. The UHS heat load dissipated during normal plant operation is included in the CWS heat load utilized in the analysis. The heat dissipated by the UHS cooling tower during plant shutdown/cooldown would be orders of magnitude less than the heat dissipated by the CWS cooling towers. The heat dissipated by the CWS cooling towers would decrease as the plant shuts down and would be zero when the plant is shutdown. The environmental impact that would be associated with UHS system cooling tower operating in conjunction with the CWS cooling tower, or alone, is bounded by the CWS cooling tower analysis.

The NRC has identified several plume-related codes as acceptable methodologies. A model endorsed by NUREG-1555 was Carhart and Policastro. In NUREG-1555, the NRC accepted Carhart and Policastro's conclusion that their code predicts the plume rise within a factor of 2 about 75 percent of the time and visible plume length within a factor of 2.5 about 70 percent of the time. This model was embedded into the Electric Power Research Institute (EPRI) Seasonal/Annual Cooling Tower Impact Prediction Code (SACTI) in 1991.

Attachment 2

List of Files on the Enclosed CD

Attachment Index for ER Supplemental RAI Resposnes

Supplement RAI Number	Folder/Subfolder Names	File Name	Name of Document	Type of Document
HYD-10 and HYD-16	2008 DMRs	TX0027685 - City of Tolar.xlsx	TX0027685 - City of Tolar	DMR Data from EPA ECHO web site
		TX0046400 - DeCordova SES 2008.xlsx	TX0046400 - DeCordova SES 2008	DMR Data from EPA ECHO web site
		TX0065854 - CPNPP.xlsx	TX0065854 - CPNPP	DMR Data from EPA ECHO web site
		TX0094412 - Oak Trail Shores WWTP.xlsx	TX0094412 - Oak Trail Shores WWTP	DMR Data from EPA ECHO web site
		TX0102598 - SWATS.xlsx	TX0102598 - SWATS	DMR Data from EPA ECHO web site
		TX0105155 - Pecan Plantation WWTP.xlsx	TX0105155 - Pecan Plantation WWTP	DMR Data from EPA ECHO web site
		TX0120243 - Treaty Oaks WWTF.xlsx	TX0120243 - Treaty Oaks WWTF	DMR Data from EPA ECHO web site
		TX0127426 - Fall Creek Utility Co.xlsx	TX0127426 - Fall Creek Utility Co	DMR Data from EPA ECHO web site
		TX0033316 - City of Glen Rose WWTP.xlsx	TX0033316 - City of Glen Rose WWTP	DMR Data from EPA ECHO web site
		TX0046400- DeCordova SES ALL.xlsx	TX0046400- DeCordova SES ALL	DMR Data from EPA ECHO web site
		TX0066702 - Riverbend Retreat.xlsx	TX0066702 - Riverbend Retreat	DMR Data from EPA ECHO web site
		TX0098264 - Blue Water Shores.xlsx	TX0098264 - Blue Water Shores	DMR Data from EPA ECHO web site
		TX0104833 - Ridge Utilities WWTF.xlsx	TX0104833 - Ridge Utilities WWTF	DMR Data from EPA ECHO web site
		TX0105163 - DeCordova Bend Estate WWTP.xlsx	TX0105163 - DeCordova Bend Estate WWTP.xlsx	DMR Data from EPA ECHO web site
		TX0123820 - Wolf Hollow.xlsx	TX0123820 - Wolf Hollow	DMR Data from EPA ECHO web site
		TX01015210 - Granbury SE Plant.xlsx	TX01015210 - Granbury SE Plant	DMR Data from EPA ECHO web site
	Hard Copies	2008 NPDES-DMR Data.pdf	2008 NPDES-DMR Data for Discharges to Lake Granbury and Brazos River below Lake Granbury	Figures and charts for response
		2000 to 2004 Summary Table Station 11856.pdf	2000 to 2004 Summary Tables of Surface Water Quality Data for Monitoring Station 11856	Summary Table for response
		2007 to 2009 Station 2013.pdf	2007 to 2009 Surface Water Quality Data for Monitoring Station 2013	Table and Chart for response
HYD-13	NA	CVL-12-11-100-001_Revision F.pdf	CVL-12-11-100-001, Revision F	Drawing
		CVL-12-11-101-001_Revision F.pdf	CVL-12-11-101-001, Revision F	Drawing
		CVL-12-11-102-001_Revision F.pdf	CVL-12-11-102-001, Revision F	Drawing
		CVL-12-11-103-001_Revision F.pdf	CVL-12-11-103-001, Revision F	Drawing
		CVL-12-11-104-001_Revision F.pdf	CVL-12-11-104-001, Revision F	Drawing
		CVL-12-11-105-001_Revision F.pdf	CVL-12-11-105-001, Revision F	Drawing
		CVL-12-11-106-001_Revision F.pdf	CVL-12-11-106-001, Revision F	Drawing
		CVL-12-11-107-001_Revision F.pdf	CVL-12-11-107-001,Revision F	Drawing

Attachment Index for ER Supplemental RAI Resposnes

Supplement RAI Number	Folder/Subfolder Names			File Name	Name of Document	Type of Document
HYD-15	Att 2 (Attachment 2)	RW (Riverware)		2020 Scenario A - No New Units.xlsx	2020 Scenario A - No New Units	Data
				2020 Scenario C - New Units with Treatment 90152 demand.xlsx	2020 Scenario C - New Units with Treatment 90152 demand	Data
				2020CompareBelowPKScenAandC.xlsx	2020CompareBelowPKScenAandC	Data
				2020 Scenario C - New Units with Treatment 103717 demand.xlsx	2020 Scenario C - New Units with Treatment 103717 demand	Data
				2020CompareBelowGranburyScenAandC.xlsx	2020CompareBelowGranburyScenAandC	Data
				CompareElevDataScenAandC.xlsx	CompareElevDataScenAandC	Data
		WAM	WRAPprograms	Display.dll	Display.dll	Executable files for the Water Rights Analysis Package
				Hyd.exe	Hyd.exe	Executable files for the Water Rights Analysis Package
				Sim.exe	Sim.exe	Executable files for the Water Rights Analysis Package
				Tab.exe	Tab.exe	Executable files for the Water Rights Analysis Package
				Salt.exe	Salt.exe	Executable files for the Water Rights Analysis Package
				SimD.exe	SimD.exe	Executable files for the Water Rights Analysis Package
				WinWRAP.exe	WinWRAP.exe	Executable files for the Water Rights Analysis Package
				MSCHRT20.DEP	MSCHRT20.DEP	Executable files for the Water Rights Analysis Package
				MSCHRT20.oca	MSCHRT20.oca	Executable files for the Water Rights Analysis Package
				MSCHRT20.OCX	MSCHRT20.OCX	Executable files for the Water Rights Analysis Package
				MSCHRT20.SRG	MSCHRT20.SRG	Executable files for the Water Rights Analysis Package
			UserManual	User1WRAP.pdf	User1WRAP	manual
				User3SIM.pdf	User3SIM	manual
				User5HYD.pdf	User5HYD	manual
				UserFront.pdf	UserFront	manual
				User2Files.pdf	User2Files	manual
				User4TAB.pdf	User4TAB	manual
				UserCover.pdf	UserCover	manual
				UserINDEX.pdf	UserINDEX	manual