APPENDIX D

RESPONSES TO TECHNICAL AND ADMINISTRATIVE COMMENTS ON THE DRAFT AND DRAFT FINAL TECHNICAL REPORTS

Comments pertaining to the Draft Report were provided on December 12, 2002. Additional comments on the Draft Final Report are appended at the end of the list.

DRAFT REPORT

DRAFT REPORT - OVERALL COMMENTS

1. Some characters did not translate when PDF was created. Please ensure a good translation with final report.

[Response]: We have revised and checked our procedure for converting to pdf files to ensure a good translation with final report.

2. Formation and aquifer names should always refer to a noun (i.e. aquifer, formation, etc.).

[Response]: We have added nouns as suggested in most places. In a few places such as table columns where space was limited we have left out the nouns.

3. Mining and SAWS-ALCOA pumping are described in mixed ways in the report. It might be good to explain the history and planned use and then be consistent when describing effects in the report (partly a stakeholder comment).

[Response]: We added text in section 6.3.6 Wells, that describes regional water plan water management strategies.

4. Additional discussion on how the predictive pumping was assigned would be useful and was requested by a stakeholder.

[Response]: We added text in section 6.3.6 Wells that describes how the predictive pumping was assigned.

DRAFT REPORT- TABLE OF CONTENTS

1. 9.2: Please fix margin indent

[Response]: Corrected.

2. Figure 6: Please remove ‘13’ from figure title

[Response]: Corrected.

3. Figures 56 through 61, 99, 100: Please refer to formation and aquifer as the primary descriptor and then the layer. Note that layers are not referred to consistently in the figure captions.

[Response]: Corrected.

4. Figure 62: ‘aquifer’ should be ‘aquifers’
[Response]: Corrected.

5. Figures 65, 66, 68, 84, 85, 86: Please add ‘aquifer’ after ‘Simsboro’ and ‘Carrizo.’ Note that ‘Simsboro,’ ‘Carrizo,’ ‘Wilcox,’ and other formation and aquifer names should be followed by aquifer or appropriate geologic name in the report.
[Response]: Corrected.

6. Figure 70: Please include rest of caption
[Response]: Corrected.

7. Figure 76: Please verify year. Appear that it should be 2000 instead of 1990.
[Response]: Corrected.

DRAFT REPORT- ABSTRACT

1. Page 1, 1st paragraph: “Groundwater withdrawal from the central part of the Carrizo-Wilcox…” Please define what you mean by 'central part.'
[Response]: Sentence added that states “This model covers the central section of the Carrizo-Wilcox aquifer as defined by the surface-water divide between the San Antonio and Guadalupe Rivers to the southwest and the surface-water divide between the Trinity and Neches Rivers to the northeast.” Previous sentence revised to introduce the three models.

2. Page 1, 2nd paragraph: “…water-use survey estimates of historical and future groundwater withdrawals…” Water-use survey estimates apply only to historical withdrawals. Please change sentence to reflect this.
[Response]: “and future” was deleted.

DRAFT REPORT- 1.0 INTRODUCTION

1. Page 4, 1st paragraph: See comment 40 under *DRAFT REPORT - SECTION 4.0: HYDROLOGIC SETTING*
[Response]: Text revised to say “Groundwater production is predominantly for municipal public-water supply, manufacturing, and rural domestic uses.” These make up more than 50 percent of total withdrawal.

2. Page 4, 2nd paragraph: “Groundwater availability is defined as the total amount of groundwater available from an aquifer under a predefined development scenario chosen by the Regional Water Planning Groups.” This statement is not true. Please change.
[Response]: Text revised to “Estimating groundwater availability for the 50-yr planning period in Texas involves information on aquifer management goals, environmental issues, rules and regulations, and scientific understanding of how an aquifer works (Mace and others, 2001).”

3. Page 5, 1st line: “….pumpage increased by from 10,600 ….” Please remove 'by.'
[Response]: Corrected

4. Page 5, 2nd paragraph: Please repair the bad break at end of paragraph between "the" and "Carrizo-Wilcox."

[Response]: Corrected

5. Page 5, 3rd paragraph: Discussion on transient calibration and verification indicates that the quality of calibration and verification was assessed only by comparing simulated water levels to measured water levels at the end of the decades. However, there should have also been a comparison to water-level changes over time during the decades. Please change the sentence to reflect this.

[Response]: Five calibration criteria were checked. Text has been revised to reflect this.

6. Page 5, 3rd paragraph, discussion on projected pumping demands: The RWPGs did not provide projected pumping demands. The RWPGs provided projected demands and supplies with possible water management strategies. The TWDB did an analysis to assign the demands to groundwater and surface water sources. Please change this sentence to reflect this.

[Response]: Text revised to state that Groundwater withdrawal for the 50-yr period was derived from a TWDB analysis of the demands and supplies of surface water and groundwater, along with possible water management strategies, projected by the Regional Water Planning Groups.

7. Page 7, 1st paragraph: Please change "stakeholder meetings" to "stakeholder advisory forums."

[Response]: Corrected

8. Page 7, 2nd paragraph: Please list GCDs first and RWPGs second.

[Response]: Corrected

DRAFT REPORT- 2.0 STUDY AREA

1. Figure 5: Please add a date (as of…) to the figure. Note that several GCDs have been confirmed since the map was prepared.

[Response]: Corrected

2. Section 2.1, Page 14: Note that the predictive model requires the use of an average precipitation from 1960 to most recent data. Please add a description of this time period for precipitation.

[Response]: Text revised to state that since the steady-state model represents a long period of time (at least 100 yr), we assigned recharge for the steady-state calibration using a long-term average (1940 to 1997) precipitation, whereas or the predictive model we assigned a constant recharge rate for normal years using an average precipitation calculated from 1960 to 1997 data. This excludes the effect of the 1950s drought of record from the calculation of the normal year recharge rate.

3. Page 14, paragraph 2: “Average annual precipitation during the period from 1900…” should be “Annual precipitation during the period from 1900…”

[Response]: Corrected

4. Figure 6. Please label drainage basins.

[Response]: Corrected

5. Figure 7. Consider using thicker contours (difficult to resolve with county lines).

[Response]: Corrected

6. Figures 7, 8, and 9: Please add a reference to the data source to the figure.

[Response]: Figure 7 on precipitation is from www.twdb.state.tx.us/mapping/gisdata.htm. Figure 9 on average net lake evaporation rate is from data at http://hyper20.twdb.state.tx.us/Evaporation/evap.html.

7. Figure 11: The same color is used for Pleistocene etc. and Simsboro Fm. Please change color scheme so all the divisions can be clearly identified.

[Response]: Corrected

8. Figure 11: Two boxes in the legend have no name. Please address.

[Response]: Corrected

9. Section 2.2, page 28,4th sentence: Please add "and" to the sentence.

[Response]: Corrected

10. Section 2.2: Please review the width of the outcrop as referenced in the report. The report says less than 2 miles wide, but it appears from the geology map that it is more than 20 miles wide.

[Response]: Additional detail added to expand clarity. Formations are not formally broken out south of the Colorado River and north of the Trinity River. The width of the Wilcox Group is given for those areas.

DRAFT REPORT- 3.0 PREVIOUS WORK

1. Section 2.2, page 29: Please explain what the Newby flow unit is.

[Response]: Added text to identify the Newby Member of the Reklaw Formation.

DRAFT REPORT - 4.0: HYDROLOGIC SETTING

1. Figure 15, page 35: For A'-A", there appears to be a horst in Lee County. It seems more likely that there would be a graben or normal faulting toward the coast. The horst feature shows up in Lee County where no faulting is indicated on Figure 34. Faulting in Bastrop County in Figure 34 does not appear on the cross section. Also note that the Simsboro appears to thicken in the horst. Please review Figures 34 and 35 for accuracy and make any needed changes.

[Response]: Revised. Not all faults were shown on the figure leading to an impression of a geologic structure that is not present. Other revisions made as suggested.

2. Figure 16, page 36: For C-C', '10,000' should be '-10,000.'
[Response]: Corrected.

3. Section 4.1: Hydrostratigraphy section discusses the Quaternary alluvium while ignoring Queen City, Sparta, and Yegua (?) aquifers. Need to either add brief discussion of missing aquifers or explain why Quaternary alluvium important to the modeling effort. Important to discuss Queen City as its hydraulic heads are added to the model.
[Response]: Text added to discuss Queen City and Sparta aquifers.

4. Section 4.2, page 39: It is unclear which data was used where and how for creating the structure maps. Please add more detail on methods (i.e. were maps digitized from reports, how many new data points and where).
[Response]: Information added on sources of information and how data were reconciled.

5. Section 4.2: Later sections indicate that the Reklaw Fm. was included as a layer. Therefore, please include a figure showing the top of the Reklaw Fm.
[Response]: Added figure 22 showing structure of top of Reklaw Formation.

6. Section 4.2: Later sections indicate that the alluvium was included as a layer in the model. Please include a discussion on how the thickness of alluvium was assessed and describe the thicknesses.
[Response]: Additional text added to page 39 of draft report as follows: "Alluvial deposits associated with the Colorado, Brazos, and Trinity Rivers likely have a significant impact on the interaction of surface water and groundwater in the outcrop of the Carrizo-Wilcox aquifer. Areal limits of the alluvium associated with the Colorado, Brazos, and Trinity Rivers were digitized from McGowen and others (1987), Proctor and others (1988), Proctor and others (1993a), Proctor and others (1993b), and Shelby and others (1993). The upper surface of the alluvium was taken as ground surface and assigned by draping USGS DEM data onto model cell centroids in the areas underlain by alluvium. Thickness of alluvium was estimated from data on well depth and well-screen position (Wilson, 1967; http://www.twdb.state.tx.us/data/waterwell/well_info.html). The lower surface of alluvium was mapped by subtracting alluvium thickness from DEM for each model cell."

7. Figures 18 through 21: Not sure what the extended blue areas are near the up-dip limit of the outcrop. Please address.
[Response]: Map information for additional cells between the alluvium in layer 1 and the uppermost active bedrock model layer has been masked in all figures except for figures 55 to 58 which show the active model cells.

8. Figures 22-25: Please remove 'Model' from legends.
[Response]: Corrected.

9. Page 50, paragraph 4: The 3,000 mg/l TDS contour represents the base of 'potentially potable water', not 'freshwater' (1,000 mg/l TDS).

[Response]: Corrected in all maps.

10. Page 51. 3,000 mg/l is limit of slightly saline or potentially potable water.

[Response]: Corrected.

11. Section 4.4.1, page 55: Unclear how reported water levels in the College-Bryan Station well field were adjusted. Please explain in more detail.

[Response]: Text added as follows to page 55 of draft report: Water-level measurements taken when a well is not pumping are considered static water-level measurements. Simulated water levels reflect drawdown caused by groundwater withdrawal assigned to model cells. Adjusting static water levels for the Bryan-College Station well field is appropriate for comparison to simulated results for model cells. The adjustment followed the method of Anderson and Woessner (1992). An initial water-level recovery was estimated using the known transmissivity, average pumping rate, and assumed elapsed recovery time. Initial recovery was projected to an equivalent for a 1-mi grid cell. The correction factor is small relative to measured and simulated changes in water level.

12. Figure 26. Cannot clearly see contours, especially in the freshwater part of the aquifer.

[Response]: Corrected.

13. Section 4.4.2, page 60, 3rd paragraph: "This seems more probable…" Please explain why it seems more probable.

[Response]: Text revised to delete phrase and rewritten for clarity.

14. Section 4.4.2: Figure27 shows a large cone of depression in Gonzales County in the freshwater part of the aquifer, and Figure 27 and 28 show cones of depression in the deep down-dip part of the aquifer. Cones of depression are not consistent with a pre-development potentiometric surface. Please explain why these features are in the map. If appropriate, please update the map.

[Response]: Figure revised to not show data from oil and gas fields at which calculated equivalent hydraulic heads were below local trends and which probably have been affected by gas production.

15. Section 4.4.2, Figure 27: The lower right-hand corner of the map in the fresh-water part of the aquifer shows hydraulic heads going down. There are no data points to support this. Please add a discussion in the text as to why this may be realistic. Also, please check the values of the contours in this area: the two contours have the same value of '200.'

[Response]: Draft report on page 59 (1st paragraph) identified our interpretation that the topographic elevation of <100 ft msl in the lower Angelina River valley must influence the hydraulic head in the Carrizo-Wilcox aquifer and define the 'base level' of the aquifer. This point is repeated as needed in the revised text.

16. Section 4.4.2., Figure 28: The lower right-hand corner of the map in the fresh-water part of the aquifer shows hydraulic heads going down. There are no data points to support this. Please add a discussion in the text as to why this may be realistic.

[Response]: Draft report on page 59 (1st paragraph) identified our interpretation that the topographic elevation of <100 ft msl in the lower Angelina River valley must influence the hydraulic head in the Carrizo-Wilcox aquifer and define the 'base level' of the aquifer. This point is repeated as needed in the revised text.

17. Section 4.4.2, Page 61: "One implication of the reversal in gradient of hydraulic head…" suggests that there is a reversal of hydraulic gradient, but it has not been previously discussed (there is discussion that gradient has changed, but not magnitude and not reversal). Please rewrite to reflect actual analysis. Also please check the logic of the sentence: "One implication…that there may have been…" Even if there wasn't a hydraulic gradient reversal, there still may have been a stagnation zone. This may also be the appropriate place to discuss how a change would affect the aquifer given that the boundary is assumed to remain the same in subsequent modeling.

[Response]: Added text to 3rd paragraph on page 60 to more clearly identify the reversal in gradient. It was beyond scope to discuss how a change would affect the aquifer given that the boundary is assumed to remain the same in subsequent modeling.

18. Figure 30: Please add dashed lines where appropriate to this figure for the water-level elevations as done in figures 29 and 31.

[Response]: Corrected.

19. Figure 34: Well 37-17-902 and others appear to be beyond where Calvert Bluff is defined. Please review the location of these wells.

[Response]: Well locations were reviewed.

20. Figure 36: Note that well 37-17-902 on figure 34 does not have a hydrograph in this figure. Please review well numbers between figure 34 and figures 33, 35, 36, and 37.

[Response]: Only the 40 wells included as hydrographs remain in the revised figure.

21. Section 4.2: Please add a map/discussion of water levels in the Queen City aquifer (referred to earlier as being assigned to the Reklaw).

[Response]: New figure 30 presents the 'predevelopment' map of the Queen City aquifer.

22. Section 4.4.3, page 61, 1st paragraph: Page 61, para. 4. The first two sentences appear to conflict with each other.

[Response]: Corrected and paragraph rewritten.

23. Section 4.4.3, pages 61-62: What were the pre-development hydraulic heads in the Bryan-College Station and Lufkin-Angelina County well fields?
[Response]: Text added to state predevelopment hydraulic heads in the Bryan-College Station and Lufkin-Angelina County well fields.

24. Section 4.5: Please include discussion on how figure 39 was developed.
[Response]: Figure 39 has been moved and renumbered as figure 69. In its place in the section on recharge is a map of soil hydraulic conductivity, the basis for mapping recharge rates. The recharge section was extensively rewritten to spell out the method of calculation.

25. Section 4.5: Please discuss 'rejected recharge.'
[Response]: Paragraph added on rejected recharge. "Rejected recharge is the concept that much of the water that reaches the water table as recharge in the unconfined part of the aquifer does not travel downdip into the confined part of the aquifer. Rejected recharge leaves the unconfined part of the aquifer by discharge to seeps and springs in valleys, discharge to rivers and streams, evapotranspiration in river bottomland areas. Rejected recharge generally does not include withdrawal of groundwater by wells in the unconfined aquifer. The water that cycles through the unconfined aquifer, therefore, is not available for withdrawal by wells in the confined part of the aquifer. Captured recharge is the concept that drawdown of water levels in the confined part of the aquifer increases the gradient in hydraulic head and draws more groundwater from the unconfined to confined parts of the aquifer. In addition, drawdown of water levels in the unconfined aquifer, owing to pumping of wells in either the unconfined or confined parts of the aquifer, results in a decrease in the discharge of groundwater to rivers and streams and may reduce actual evapotranspiration. Groundwater that is "captured" by the confined aquifer reflects a change in the water budget of the aquifer."

26. Section 4.5: Please clarify the assignment of recharge to the Hooper and Calvert Bluff.
[Response]: Recharge to the Hooper and Calvert Bluff was handled the same way as recharge for other layers and this is explained in the revised text.

27. Section 4.5: Later in the report, recharge is reported for the Reklaw as a model result. Please explain how this was assigned (may be more appropriate to discuss in the calibration section).
[Response]: Recharge to the Reklaw was handled the same way as recharge for other layers and this is explained in the revised text. Methodology is given in section 6.0 and deleted out of section 4.0. Results are given in section 8.0.

28. Section 4.5: Please outline assumptions used in the chloride recharge estimation.
[Response]: Text added: "The primary assumptions of the chloride mass balance approach are that water movement is downward and there are no subsurface sources or sinks of chloride. The first assumption is valid because in broad areas between surface water bodies the main direction of water movement is vertical and the direction in the hydrogeologic setting of the study area the direction of net flow of water in the

unsaturated zone is downward. The second assumption also is reasonable for these tests in the Simsboro Formation outcrop (Dutton, 1985, 1990)."

29. Figure 43: Please include the outcrop of the Carrizo-Wilcox aquifer (referred to in the text).
[Response]: Added as suggested.

30. Figure 44b: Please change 'csf' to 'cfs' on y-axis of plot.
[Response]: Corrected.

31. Figure 45: Please change 'cfs/m^{-2}' to 'cfs/mi^{2}' on the y-axis.
[Response]: Corrected.

32. Section 4.6: Please discuss streambed conductance.
[Response]: Text added.

33. Section 4.6: Please discuss hydraulic connection of lakes to aquifers.
[Response]: Text added.

34. Table 4: Unclear what "Field data (fig. 46)"means in the Table. Please clarify or remove.
[Response]: Line revised to refer to Mace and others (2000) data in figure 46.

35. Section 4.7, bottom of page: Sentence is cut off. Please include all of the sentence.
[Response]: Corrected.

36. Figures 48, 49, 50: Not sure what the extended blue areas are near the up-dip limit of the outcrop. Please address.
[Response]: Map information for additional cells between the alluvium in layer 1 and the uppermost active bedrock model layer has been masked in all figures except for figures 55 to 58 which show the active model cells.

37. Section 4.7, page 90: "…(for example, figs. 12,~~14~~ 13) ….." should be 'figs. 12 and 13.'
[Response]: Corrected.

38. Section 4.7, last paragraph: Please include more information on how specific storage was assigned to the model. We need to be able to reproduce assigned values.
[Response]: Several paragraphs added to section 6 to discuss how storativity was assigned. Text reorganized between sections 4 and 6.

39. Section 4.7: Please include a discussion on horizontal anisotropy.
[Response]: Text added. "There is appreciable lateral heterogeneity in hydrogeologic properties related to the original depositional systems and subsequent burial diagenesis of the sediments that make up the Carrizo-Wilcox aquifer. Much of the heterogeneity

reflects the variations in thickness of sandstones (figs. 12, 13). The thick major sands may have greater hydraulic conductivity than thinner sands, and also have greater lateral continuity (Fogg and others, 1983). We assume that the aquifer and aquitard materials are isotopic in the horizontal direction. This means that horizontal hydraulic conductivity is the same regardless of direction."

40. Section 4.8, 1st paragraph: Logic: Most pumping is from municipal and manufacturing, but accounts for only one third of total pumping. Please address.
[Response]: Text revised. "Most pumping from the Carrizo-Wilcox aquifer in the study area has been for municipal public-water supply, manufacturing, and rural domestic water uses. These three uses have made up more than 60 percent of total pumping from the aquifer in the period from 1980 through 2000."

41. Section 4.8, 3rd paragraph, 2nd sentence: "Because there are few measurements of historical pumping…" is too broad a statement. Our water-use survey collects reported measured values of pumping for municipal and industrial uses of water.
[Response]: Text revised to say that "because most pumping has not been volumetrically metered, it is generally estimated indirectly…"

42. Figure 51: Please change '200' to '2000.'
[Response]: Corrected.

43. Section 4.8: Please show a map showing the distribution of irrigation pumping.
[Response]: New figure 60 added with 6 maps that show 200 pumping allocation for municipal, manufacturing, irrigation, mining, rural domestic, and stock.

44. Section 4.8, page 115, paragraph 3: Please explain why mining was distributed based on land use rather than using specific well locations.
[Response]: As discussed during the TWDB review of the transient model calibration, we had found few enumerated wells in counties to which mining pumping was to be assigned. The decision was made to use land use for those counties where we lacked adequate information to distribute pumping to wells. For Bastrop, Lee, and Milam County we had specific information available to assign well locations for mining.

45. Table 6a: Please explain why there is a increase in pumping in Lee County (stakeholder comment).
[Response]: Text added in section 6 to relate predictive pumping to the regional water plan water management strategies, and to explain how the pumping was allocated to the model. The Region G regional water plan identified the Carrizo-Wilcox aquifer as a water management strategy to meet Williamson County water needs. Predicted groundwater withdrawal ranges from less than 1,000 acre-ft/yr in 2001 to more than 18,000 acre-ft/yr in 2050. Identified users included the cities of Bartlett, Brushy Creek, Florence, Georgetown, Granger, Hutto, Leander, Round Rock, Taylor, and Thrall and also water-supply corporations supplying rural domestic users. This predicted groundwater withdrawal was split between the Carrizo and Simsboro aquifers and allocated in the model to Lee County using the footprint defined in the Trans-Texas

Water Program (HDR Engineering, 1998) and previously simulated in the Dutton (1999) model. Predicted pumping ranged from less than 1,000 acre-ft/yr in 2001 to more than 18,000 acre-ft/yr in 2050.

46. Please discuss evapotranspiration.
[Response]: Section 4.7 added on Groundwater Evapotranspiration

47. TNP is not a mine but a power plant (whose new name is Twin Oaks Power Plant) (stakeholder comment).
[Response]: Corrected.

DRAFT REPORT - 5.0: CONCEPTUAL MODEL OF GROUNDWATER FLOW

1. Page 124, 3rd bullet: Evapotranspiration is not discussed in Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.
[Response]: Section 4.7 added to discuss Groundwater Evapotranspiration.

2. Page 124, 3rd bullet: Net recharge is not discussed in Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.
[Response]: Net recharge discussed using the term 'rejected recharge' in added text to section 4.0.

3. Page 124, 4th bullet: "Most groundwater contribution to the base flow of rivers and streams crossing the outcrop is from the Simsboro and Carrizo." This concept is not discussed in the Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.
[Response]: The statement that base flow is mainly from the Simsboro and Carrizo aquifers has been added to section 4.6.

4. Page 124, 5th bullet: "The proportion of recharge that reaches the confined aquifer changes with increased pumping." This concept is not discussed in the Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.
[Response]: This has been added to the discussion of rejected recharge added to page 74 of the draft report.

5. Page 124, 6th bullet: Cross-formational flow. This concept is not discussed in the Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.
[Response]: Discussion of Cross-formational flow has been added to page 59 of the draft report in discussion on water levels.

6. Page 124, 7th bullet: "…where there is a tendency for upward discharge into the overlying formation." This concept is not discussed in the Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.

[Response]: Discussion of Cross-formational flow has been added to page 59 of the draft report in discussion on water levels.

7. Page 126, 3rd bullet: Flow rates. This concept is not discussed in the Hydrologic Setting section. Please discuss in the Hydrologic Setting section or remove from conceptual model.

[Response]: The reference to groundwater ages and flow rates has been deleted.

DRAFT REPORT - 6.0: MODEL DESIGN

1. Section 6.2, page 129, bottom of page: Please fix the 'stutter sentence' that begins on this page and continues onto page 136.

[Response]: Corrected.

2. Section 6.2, page 136, end of 1st paragraph: Please discuss in more detail assigning active cells beneath the active cells in layer 1 (i.e. how thick and what hydraulic properties were assigned).

[Response]: Text added to section 6.2 to discuss the additional cells: Some of the active cells assigned in layers 2 through 5 are beneath the alluvium of layer 1 but above the uppermost bedrock layer. It was necessary using MODFLOW to create additional active cells in these layers to allow a connection between the alluvium modeled in layer 1 and the underlying bedrock layer. These additional cells are apparent in figures 55 to 58 as narrow northwestward extensions of the active cells of model layers." Additional text on properties added to section 6.4

3. Section 6.2, page 136: In addition to the grid origin, please discuss/present the projection parameters.

[Response]: Added table 9 with projection information.

4. Section 6.3.1, page 17: Please remove discussion of recharge results to the calibration section. This section should only be discussing procedures.

[Response]: Text reorganized between sections 4, 6, and 8. Revised section 6 text focuses on procedures.

5. Section 6.3.2, 3rd paragraph: "Hydraulic conductance is the product of the width, length, and thickness of the alluvium." This is incorrect. Please include the correct definition of hydraulic conductance.

[Response]: Revised to state that "Hydraulic conductance is the function of the width, length, and thickness" and additional explanation added.

6. Section 6.3.3, page 140: "It is applied over a broad area…" Please be more specific.
[Response]: Changed statement and revised two paragraphs to discuss how ET was assigned.

7. Section 6.3.3, page 140: "The two parameters of the ET package in MODFLOW are the maximum ET rate applied at ground surface…" This is incorrect. The ET package assigns an "ET surface," which is not necessarily the ground surface. Please address.
[Response]: Text revised to state that "The parameters of the ET package in MODFLOW are the maximum ET rate, the elevation at which the maximum rate is applied (the ET surface), and the depth below the top of a cell at which the ET is assumed to be zero (extinction depth). While the ET package is turned on for each cell representing the outcrop of a layer, groundwater discharge is indicated only if the elevation of the simulated water level is higher than the elevation of the extinction depth."

8. Section 6.3.5, page 141: "…water levels in the Queen City have remained fairly constant during the past 50 yr." This was not shown in the Hydrologic Setting sections. Please include an analysis of water levels in the Queen City in the Hydrologic Setting section to substantiate this claim.
[Response]: Text added to section 4.4.2 describing the water levels of the Queen City aquifer.

9. Section 6.3.5, page 142: "We accordingly adjusted the GHB boundary to represent a decrease in fluid pressure." In Section 4.4.2, you say that it was beyond the scope of the project to map transient changes in fluid pressure in this zone. If an analysis was done, please include it in Section 4.4.2. If an analysis was not done and heads were adjusted on this boundary, then please discuss how this was done and why.
[Response]: It was incorrectly stated that the GHB boundary was changed. The boundary was kept constant. This has been restated in the revised report.

10. Section 6.3.5, page 142: "The GHB boundary along the southwestern side of the model was kept unchanged for the calibration and verification period…" The parameters assigned to this boundary have not been previously discussed. Please discuss.
[Response]: The parameters assigned to the GHB boundary have been added to section 6.3.4.

11. Section 6.3.5, page 142: "GHB conductance was set to the value of aquifer transmissivity." Hydraulic conductance is not equivalent to transmissivity. Please review how conductance was assigned to the model.
[Response]: GHB conductance has units of length-squared/time (L^2/t), the same as transmissivity. Transmissivity of model cells was used the initial estimate of GHB conductance in model calibration for the northeast and southwest boundaries. Trial-and-error adjustment determined how far the boundary effect would extend into the model area and what value gave the best match to estimated water level.

12. Section 6.3.5, page 142: Please explain why gaps were left in the GHB in the northeastern and southeastern corners of the model.

[Response]: In the draft model we left the interval between the hydropressured and geopressured domains and lateral no flow boundaries. To close up the gaps in the GHB package we used linear interpolation to assign GHB heads in the convergence zone between the hydropressured and geopressured domains. This is stated in the revised text.

13. Section 6.3: Please explain what boundary condition was used for the bottom of the model.

[Response]: Text added to state that a no flow boundary was used for the base of the model between the Hooper and Midway.

14. Section 6.3: Please explain what boundary condition was used for the outcrop of the Reklaw Fm.

[Response]: Text added to start of section 6.0 to state that "Boundary values were applied to all six faces of the model (top, bottom, and sides). Boundary conditions for the top or upper surface of model layers variously included MODFLOW's recharge, stream-flow routing, evapotranspiration (ET), and general-head boundary (GHB) packages. The bottom of the model was set as a no-flow boundary; we assumed there is no appreciable exchange of groundwater between the Hooper and the underlying Midway Formations (fig. 10), both of which have a large proportion of low-permeability claystone. The updip (northwestern) boundary of each layer was also defined as a no-flow boundary. The GHB boundary package was applied to the downdip (southeastern), northeastern, and southwestern sides of the model. The horizontal flow barrier and wells packages of MODFLOW were applied internal to the model."

15. Section 6.3: Please show a map of active cells in Layer 1.

[Response]: Figure 59 shows the active cells in the revised draft report; we changed the map to better distinguish which cells are active.

16. Section 6.3: Wells are mentioned as a boundary condition in the introduction, but not mentioned in discussion. Please include of wells as boundary conditions.

[Response]: A new section 6.3.6 on wells is included that incorporates some text previously given in section 4.

17. Section 6.3: Please include a discussion of reservoirs and how assigned in model.

[Response]: A new section 6.3.2.2 on Surface-Water Reservoirs has been added.

18. Section 6.3.2: Please discuss whether or not Manning's roughness coefficient was used in stream-flow routing and what the source of the data was.

[Response]: We used data on surface-water stage heights from USGS gauging stations to define stream stage in the model, rather than selecting the option in the stream-flow routing package of calculating stream stage in reaches from Manning's equation. Statement added to text.

19. Section 6.4: "Specific yield was assigned as a function of depth and sandstone in the aquifers." Either here or in the Hydrologic Setting section, please discuss this approach in more detail.

[Response]: Section 6.4 includes discussion of how storativity was assigned.

20. Please include a map showing where horizontal flow barriers were used.

[Response]: Figures 54 to 58 now include the HFB package cells.

DRAFT REPORT - 7.0: MODELING APPROACH

1. Page 147: "The increase in range of measured values and the increase in number of measurements mean that apparent model performance improves with time…" This is not a universal occurrence. Please adjust text to reflect this.

[Response]: This was revised to read more clearly as a model-specific rather than general result, and the exceptions were pointed out.

2. Page 147: Please discuss calibration criteria for the steady-state model.

[Response]: Five model criteria are presented in the revised text.

3. Page 147: "The third calibration measure is mapping the residual differences…" "third" should be "second."

[Response]: Corrected.

4. Page 147: There are other required calibration measures: (1) Water balance is less than 1 percent and (2) RMS error for fitting hydrographs. Please include these in the discussion and, in the case of RMS error for hydrographs, in the report.

[Response]: Corrected and added.

DRAFT REPORT - 8.0: STEADY-STATE MODEL

1. Section 8.0, page 149: "…one long time step." Please consider changing this to "…one long stress period."

[Response]: Text changed to “one long (100-yr) stress period.”

2. Section 8.1, page 149: Please change "…applied allows enough…" to "…applied allowed enough…"

[Response]: Text changed to “…as initially applied, allowed so much…”

3. Table 7: Please fix formatting for RMSE/h for layer 3, steady-state.

[Response]: Corrected.

4. Table 8: Unclear why Big Creek and Duck Creek are not included in the calibration data set but, in the case of Big Creek, model results are compared to the sum. Please explain.

[Response]: Table 8 renumbered as table 12 and revised. Big Creek had always been included in the calibration data set, the “*” in table 8 of the draft report was a typo. Duck Creek was not in the initial steady state calibration data set but it has been added.

5. Table 8: Please include the percent of estimated base flow for the total base flow.
[Response]: Table 8 (renumbered to 12) revised to include percent of estimated base flow.

6. Tables 8, 9, 10, and 11: Please add "Values rounded to…" to the caption.
[Response]: Corrected.

7. Section 8.2, 1st sentence: Please remove "specific yield" from the list of sensitivity parameters.
[Response]: Corrected.

8. Table 9: Please include a reminder of which layers correspond to which aquifers/formations.
[Response]: All tables and figures that list a number for a layer also include a layer name, although for space reasons we did not include a noun, e.g., Simsboro (5).

9. Section 8.0: Please include a map comparing measured and simulated water levels.
[Response]: The simulated water levels for the Simsboro and Carrizo in the revised report include superposed trace of contours from the estimated water-level maps.

10. Section 8.0: Please include a map showing the residuals between measured and simulated water levels.
[Response]: Residuals (simulated minus observed water levels) have been added for the Simsboro and Carrizo aquifers.

11. Section 8.1, page 150: "Improved model results came from varying the maximum ET rate according to regional trends in net lake-surface evaporation." Unclear if figure 9 was used or a generalization of figure 9. Please clarify. If a generalization was used, please include a map to show final calibrated values.
[Response]: Maximum ET rates are set to the net lake-surface evaporation or 14 in/yr, whichever is greater as described in Section 4 of the report. The same data set was used to build figure 9.

12. Please report the water balance error.
[Response]: The water balance error is included in each budget table and summarized in the text as less than 0.01 percent.

13. Need a discussion on how horizontal flow barriers were calibrated.
[Response]: We state that “Trial-and-error adjustment showed that the steady-state model was not very sensitive to changes in the HFB hydraulic characteristic term. Further tests during the transient model calibration showed no reason to change the initial estimates of the HFB hydraulic characteristic.”

DRAFT REPORT - 9.0: TRANSIENT MODEL

1. Section 9.1: Please include a map of measured water levels vs. simulated water levels.

[Response]: The 1990 and 2000 simulated water levels for the Simsboro and Carrizo in the revised report include superposed trace of contours from the estimated water-level maps. Residuals maps also are included.

2. Figure 72: The model does not do well in matching water levels in the northeastern part of the model although it is stated that the model 'generally' matches the observed water levels. Please add more discussion as to why this area is error.

[Response]: Revised text adds statement to page 165 of the draft report that "other factors could include errors in pumping rate, storativity, and vertical permeability between the Carrizo and Reklaw layers.

3. Section 9.1: Please include the RMSE for the hydrographs.

[Response]: RMSE and Shift are given in each of the 40 hydrographs shown through 2000.

4. Figure 83: The last three years show the same value for precipitation. Please review and address as appropriate.

[Response]: The latest mappable precipitation data we had available at the start of the project was 1997 and so we use that year's value for 1998 through 2000. This is mentioned in the text.

5. Please report the water balance error.

[Response]: The water balance error is included in each budget table and summarized in the text as less than 0.01 percent.

6. Table 10: Please include a note on the time period the change in storage represents.

[Response]: Comments have been added to the three water budget tables (steady state, transient, and predictive). In general the annual rates are totals or averages for a year and not extrapolated from part of a year, e.g., a 12-month time step or 12 1-month stress periods. For 1990 we did end up having to extrapolate from a 2.4 month time step to the rest of the year.

7. Section 9.3: Please include several hydrographs showing sensitivity to hydrologic parameters.

[Response]: New figure 104 shows several hydrographs showing sensitivity to hydrologic parameters for the Carrizo and Simsboro. We made other hydrographs; hydrographs are only visibly sensitive if they show large amounts of drawdown.

8. Please include a budget for 1990 and the drought of the 1990s.

[Response]: Table 14b includes a budget for the maximum drought years of 1988 and 1996.

9. Please provide a map of the final calibrated specific storage.

[Response]: Figures 64 to 68 show the final calibrated storativity.

DRAFT REPORT - 10.0: PREDICTIONS

1. Section 10, 1st paragraph: "…pumping rates projected by the Regional Water Planning Groups…" See comment 6 in the DRAFT REPORT- 1.0 INTRODUCTION.

[Response]: [Response]: Text revised to state that the projected pumping rates for 2000 to 2050 were derived from a TWDB analysis of the demands and supplies of surface water and groundwater, along with possible water management strategies, included in the Regional Water Plans prepared by Regional Water Planning Groups.

2. Section 10.1, page 199, 1st paragraph: "… water strategy…" should be "…water management strategy…"

[Response]: Corrected.

3. Section 10.1, page 199, 2nd paragraph: "The model predicts that combining too much pumping in a few closely spaced cells yields simulation results that can include dewatering of cells." Does this mean that the predictive runs include dewatered cells in the large well field areas? If this is the case, then please discuss the implications of this on model results (i.e. underestimated drawdowns).

[Response]: Text rewritten and quoted phrase deleted. In the revised model, about 30 models cells at the updip limit of the outcrop of the Hooper aquitard (layer 6) are simulated as going dry by 2050. These are the only model cells that go dry during the historical and predictive simulations (no cells go dry as of 2000). That these cells go dry in the model reflects the interaction of pumping and recharge rates, cell thickness, specific yield, and hydraulic conductivity assigned to that part of the model. Groundwater withdrawal assigned to these model cells represents mainly rural domestic water use, estimated on the basis of census information. Finding good yields of potable groundwater near the updip limit of the Hooper aquitard can be problematic. Future pumping rates from the updip Hooper most likely will be limited by well yield and water quality.

These cells going dry does have an effect on the water budget, we lose as much as 3,000 acre-ft/yr from the simulation in 2050, mainly from stock and rural domestic pumping, that had been assigned to these edge cells of the outcrop.

4. Section 10: Please include a discussion of how the drought of record was defined and how it compares to normal precipitation.

[Response]: Draft report section 2.1 on physiography and climate stated that the period from 1954 through 1956 included 3 of the 10 driest years since 1940 and can be defined as the drought of record for the area (fig. 8). The driest years during the decades of the 1980s and 1990s were 1988 (average of 29.4 inches/yr) and 1996 (average of 38.1 inches/yr).

We also point out in section 6.1 that recharge rate was assigned to future drought years using according to the difference between precipitation in those drought years and the average (1960 to 1997) precipitation rate, the same methodology for assigning recharge as a function of precipitation and soil characteristic for any year. Monthly recharge during the drought years was kept uniform because we assume that drainage from the unsaturated zone to the water table does not cease during a drought year.

5. Please change "Simsboro" in the captions of figures 94 through 98 to "Carrizo."
[Response]: Corrected.

6. Table 11: Pumping rates do not agree with those shown in Table 5. Please address.
[Response]: Some of the difference was rounding error, some was more dry cells in the draft version of the model. There remains a slight difference (<1 percent) between revised tables 5 and 16, which replace tables 5 and 11, which probably relate to the 30 Hooper cells going dry.

7. Table 11: Parts of Table 11 do not agree with model output.
[Response]: Some difference may be from draft version of the flow model saved for the data model that incorporated corrections and improvements after the draft report had already been committed to production.

8. Table 11: Please specify which stress period the budgets apply to (i.e. the last monthly stress period or the sum of the 12 stress periods for a year).
[Response]: Comment added to table stating that the budget is calculated from sum of the 12 1-month stress periods that make up each decadal-year simulation.

9. Figure 101: Please label what (a) and (b) are.
[Response]: Parts (a) and (b) are identified in the caption.

DRAFT REPORT - 11.0: LIMITATIONS OF THE MODEL

1. Section 11.2, page 215, 1st bullet: Extraneous period occurs after Wilcox in three places.
[Response]: Corrected.

DRAFT REPORT - 12.0: FUTURE IMPROVEMENTS

1. 2nd paragraph: "In some cases there are significant discrepancies between the estimates for future pumping developed by the regional water planning groups and the TWDB that need to be resolved." The RWPGs did not develop datasets for future pumping. Please revise this statement.
[Response]: Sentence was deleted.

2. Page 219, 1st bullet: Please specify who in the Federal government.
[Response]: Reference is revised to cite publication by Neuzil (1994) on assessment of low-permeability materials.

3. Page 220, 1st bullet: "Additional research is needed for water quality ….." Please add 'for.'

[Response]: Corrected.

DRAFT REPORT - 13.0: CONCLUSIONS

No comments

DRAFT REPORT - APPENDIX A

1. Section A-3.1: All of the superscripts in this section are not "super," they need to be raised. Specifically degree symbols and mass numbers.

[Response]: Corrected.

DRAFT REPORT - APPENDIX B

1. Page B-4, equation 1: Please define 'dh.'

[Response]: The term 'dh,' with units of length (L) was defined in the draft report in the line immediately following equation (1).

2. Page B-4, equation 2: Is it 'm' as shown in the equation or 'M' as in the definition?

[Response]: Corrected; lower case changed to upper case.

DRAFT REPORT - FIGURES

The following figures are not readable when photocopied in black and white (see RFP Attachment 1 page 25/40, "figures shall be designed such that a black and white photocopy is readable"). If possible please use different line types, symbols, or shades of gray rather than different colors:

Figures 11, 12, 13, 34, 44, 48, 50, 52, 53, 54, 64, 70, 76

[Response]: Per discussion with the Project Manager, it is our understanding that the original TWDB intent was that color figures be readable when printed as an original to a standard office-quality black and white printer, as has been set for the reporting standard in the 2002 GAM technical specifications. We believe these figures meet this requirement.

DRAFT REPORT - MODEL

No comment. Model runs, although there are some differences between the water budget in the model and the budget presented in the report.

CZWX_c GAM Review – Part B: Project Data

Did we get all of the data files we requested? No

Is the data organized in the way we requested? No

Introduction:

It is imperative that we receive enough source data to completely rebuild the groundwater model from scratch and reproduce all report figures and tables should it be necessary. In other words, if a new model grid resolution and/or orientation was needed, there should be sufficient data to create a new model for the study area. Moreover, there should be enough data to regenerate any or all of the intermediate derivative data with updated information. This source and intermediate derivative data should be organized under the SRCDATA folder/directory according to the guidelines set forth in Attachments 1 & 2 of the RFP. An empty directory tree structure was provided to facilitate the organization of the project data. The empty directory tree structure is available for download in zip format at http://www.twdb.state.tx.us/gam/resources/gam_tree.zip.

It is also required that all final model parameter and variable/stress data be delivered in a database format that can easily be referenced to each and every model grid cell. In other words, there should be enough cell-referenced data to regenerate all or update any individual cell value of the required MODFLOW or PMWIN input files. The file format of these databases may be in Excel 97, Access 97, or in an ESRI GIS format compatible with ArcView 3.2 or ArcInfo 7.21. Each sheet, table, or coverage should be attributed with the appropriate model grid cell-reference information as set forth in Attachments 1 & 2 of the RFP. These data sets should be organized under the GRDDATA folder directory and with in the appropriate sub-folders/directories. The GRDDATA OUTPUT folder and its sub-folders/directories may be omitted or left empty.

Finally, the actual MODFLOW 96 and PMWIN 5.0 formatted files for both INPUT and OUTPUT must be organized as set forth in Attachments 1 & 2 of the RFP. Separate folders/directories must be used for 1) the calibrated steady-state model files; 2) the calibrated transient model files; 3) the verification transient model files; 4) and each of the decadal transient predictive model simulation run files.

Review Summary:

The data provided by the CZWX_c contractor are missing some required data sets as listed in sections below. Listing files are needed within each folder/directory listing all file names or groups of file names and their contents. Contractor did not follow data model organization as requested in RFP.
[Response]: It is our understanding that we need to provide files and documentation in the format and software used for their construction. Data sets worked up in Excel or Surfer will be reported in Excel or Surfer. It is not required to construct ArcView coverages solely for the purpose of providing a GIS coverage if that data was otherwise developed. Access was not much used during this project.

Hard copy listing files were provided with the data model; digital versions of the file listings will be included in the final data model.

Some metadata files had incorrect spatial reference information or missing altogether. Metadata files should include enough information to determine data source, data processing methods, data units, and correct spatial parameters (for GIS coverages) for each data set, table, worksheet, and/or coverage. Moreover, the GIS coverages may have been projected with incorrect NAD 27 datum instead of correct NAD 83 datum since state and county coverages do not match exactly with TWDB state and county GAM coverages. The datum error results in various horizontal shifts from less than 100 ft. to more than 3,000 ft in various directions in various places.
[Response]: It is our understanding the 100 to 3,000 ft error originated from our using TWDB data early in the project that had been posted on the TWDB website with truncated projection reference information. BEG had discovered this error in related work for the SHP Ogallala GAM project and passed this information along through that contractor to the TWDB, after which the web site information was changed. Unfortunately, this error was not brought to the attention of the CW-c GAM project team and it was not previously corrected. The cited spatial shift is the same as that observed resulting from the truncation errors.

Our corrective action has been to redownload and save to the data model as many coverages as possible to recreate. Not all of the sequence of calculations could be followed through late in the project for all coverages. Few of the coverages using TWDB data with this error had a significant effect on model design or results. The shift is small compared to model grid-cell size and especially with respect to the large distances between control data.

The NAD27 versus NAD83 issue we believe is a different problem. The NAD27 labels in the metafiles are incorrect in most if not all cases and are being corrected in the revised data model. We had used a software package to automatically generate the metadata files; it defaulted the NAD27 statement for all files. This is corrected in the revised data model.

File nomenclature is inconsistent such that it is extremely difficult to associate data files with metadata files. Consistency should be kept throughout with regard to file suffix (ie. .TXT or .MET). Furthermore, file prefix should be same for metadata file as for its associated data file(s). Additional comments below listed under expected data model organization.
[Response]: The revised data model includes more consistency in file naming.

Pumpage data sets are unacceptable due to missing data fields and poor or missing documentation.
[Response]: Additional data and documentation are being included in the several file sets used to generate the pumping input files for the model.

DRIVE:\CZWX_c\grddata\input\hydraul

NO DATA OR FOLDER FOUND – model cell-referenced hydraulic parameters should go here.

[Response]: The input, output, and documentation of ArcView, Surfer®, Excel, and Fortran-based calculations that generated the values of horizontal and vertical permeability will be loaded into this directory.

DRIVE:\CZWX_c\grddata\input\ibnd

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory.

Access97 database is acceptable except for needed metadata file describing fields and field units.

[Response]: ASCII files will be used to present metadata information on data fields and field units

DRIVE:\CZWX_c\grddata\input\stress\ststate\drns

NO DATA OR FOLDER FOUND – model cell-referenced hydraulic parameters should go here along with required documentation.

[Response]: No drain package was used in the model.

DRIVE:\CZWX_c\grddata\input\stress\ststate\evt

NO DATA OR FOLDER FOUND – model cell-referenced hydraulic parameters should go here along with required documentation.

[Response]: The TWDB data on net lake evaporation was used to estimate maximum ET rate. Gridded data based on this information are included in this directory.

ET input parameters were constant through time; they did not vary with stress period and are the same for steady state, transient, and predictive models. The same files and documentation will be placed in the respective folders to make them available for each model.

DRIVE:\CZWX_c\grddata\input\stress\ststate\rech

Difficult to ascertain whether this data is actually in grid format due to lack of documentation. More detailed documentation is needed to explain each of the Excel files and final recharge values. For example, what are the files ppte_avr_1951-1997_3avr.xls and Set-Rech-File2.1.xls used for? What values are used for drought of record periods of the predictive simulations? The recharge files need much more organization as detailed under by Attachment 2 of RFP.

[Response]: The same methodology was used for estimating recharge for the steady state, transient, and predictive models. The key information for generating recharge input for the model include (1) maps of precipitation through time by model cell, derived from NWS station measurements, and (2) soil permeability, derived from STATSGO coverage. Calculations from the derived gridded data were done in Excel. These files and

documentation will be placed in the respective folders to make them available for each model.

File names will be simplified and tied to metafile information more clearly with consistent naming.

DRIVE:\CZWX_c\grddata\input\stress\ststate\res

NO DATA OR FOLDER FOUND – model cell-referenced reservoir package parameters should go here.

[Response]: There were no reservoirs in the steady state (1850-1950) model.

DRIVE:\CZWX_c\grddata\input\stress\ststate\strm

NO DATA OR FOLDER FOUND – model cell-referenced stream package parameters should go here along with required documentation.

[Response]: Streamflow routing input parameters were constant through time; they did not vary with stress period and are the same for steady state, transient, and predictive models. The same files and documentation will be placed in the respective folders to make them available for each model.

We will provide an Excel file listing model cell-referenced stream package parameters with required documentation.

DRIVE:\CZWX_c\grddata\input\storage

NO DATA OR FOLDER FOUND – model cell-referenced hydraulic parameters should go here along with required documentation.

[Response]: We generated storativity values for the model grid in Excel. These files will be placed here with documentation.

DRIVE:\CZWX_c\grddata\input\stress\ststate\well

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: There was no pumping in the steady-state (1850-1950) model.

The Excel spreadsheets for calibration and predictive pumpage are acceptable but each need a metadata file describing fields and field units. Pumpage data sets must contain WUG_ID and WUG_Name relationship as specified by RFP.

The predevelopment municipal pumpage Excel file has no reference to model cell_id, row, or column as required by Attachment 2 of RFP. Other ASCII pumpage data also have no reference to model cell_id, row, or column as required by Attachment 2 of RFP. None of the predevelopment data sets have metadata files associated with them.

DRIVE:\CZWX_c\grddata\input\stress\trans\drns

NO DATA OR FOLDER FOUND – model cell-referenced hydraulic parameters should go here along with required documentation.

[Response]: No drain package was used in the model.

DRIVE:\CZWX_c\grddata\input\stress\trans\evt

NO DATA OR FOLDER FOUND – model cell-referenced hydraulic parameters should go here along with required documentation.

[Response]: The TWDB data on net lake evaporation was used to estimate maximum ET rate. Gridded data based on this information are included in this directory.

ET input parameters were constant through time; they did not vary with stress period and are the same for steady state, transient, and predictive models. The same files and documentation will be placed in the respective folders to make them available for each model.

DRIVE:\CZWX_c\grddata\input\stress\trans\rech

Difficult to ascertain whether this data is actually in grid format due to lack of documentation. More detailed documentation is needed to explain each of the excel files and final recharge values. For example, what are the files ppte_avr_1951-1997_3avr.xls and Set-Rech-File2.1.xls used for? What values are used for drought of record periods of the predictive simulations? The recharge files need much more organization as detailed under by Attachment 2 of RFP.

[Response]: The same methodology was used for estimating recharge for the steady state, transient, and predictive models. The key information for generating recharge input for the model include (1) maps of precipitation through time by model cell, derived from NWS station measurements, and (2) soil permeability, derived from STATSGO coverage. Calculations from the derived gridded data were done in Excel. These files and documentation will be placed in the respective folders to make them available for each model.

File names will be simplified and tied to metafile information more clearly with consistent naming.

DRIVE:\CZWX_c\grddata\input\stress\trans\res

NO DATA OR FOLDER FOUND – model cell-referenced reservoir package parameters should go here along with required documentation.

[Response]: Information on reservoirs used to select the model cells to which reservoirs were assigned will be listed in this directory. The limited coverage on reservoirs, consisting of where reservoirs are in order to assign those reservoirs > 1 cell, will be added.

DRIVE:\CZWX_c\grddata\input\stress\trans\strm

NO DATA OR FOLDER FOUND – model cell-referenced stream package parameters should go here along with required documentation.

Streamflow routing input parameters were constant through time; they did not vary with stress period and are the same for steady state, transient, and predictive models. The same files and documentation will be placed in the respective folders to make them available for each model.

DRIVE:\CZWX_c\grddata\input\stress\trans\well

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: We created master input files of pumping rates for the transient model and the predictive model. These revised files will be placed here with documentation.

The Excel spreadsheets for calibration and predictive pumpage are acceptable but each need a metadata file describing fields and field units. Pumpage data sets must contain WUG_ID and WUG_Name relationship as specified by RFP.

[Response]: Documentation and metadata files on pumping rates will be provided with WUG_ID and WUG_Name relationship.

The predevelopment municipal pumpage Excel file has no reference to model cell_id, row, or column as required by Attachment 2 of RFP. Other ASCII pumpage data also have no reference to model cell_id, row, or column as required by Attachment 2 of RFP. None of the predevelopment data sets have metadata files associated with them.

[Response]: The Excel file will have an added key column with the required model cell_id information.

DRIVE:\CZWX_c\grddata\input\struct

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: We will provide a file with grid cell bottom and top listed with respect to model cell_id and associated metadata files.

Access97 database is acceptable except for needed metadata file describing fields and field units.

DRIVE:\CZWX_c\modflow\modfl_96\input\ststate

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

There is only one set of MODFLOW formatted files and cannot easily determine whether they are for steady-state, transient, or predictive run(s). Steady-state is assumed. Need more documentation for these files.

[Response]: It is our understanding that the requirement is that the steady state model be incorporated as the first long stress period of the transient model so that any future

changes will be readily incorporated. Therefore, the steady state model is the first stress period of the transient model. We have not separated these models for the purpose of the data model. The same MODFLOW files will be saved here as in the DRIVE:\CZWX_c\modflow\modfl_96\input\trans directory.

DRIVE:\CZWX_c\modflow\modfl_96\input\trans

NO DATA OR FOLDER FOUND – MODFLOW formatted ASCII files for transient runs should go here along with required documentation.

[Response]: It is our understanding that the requirement is that the steady state model be incorporated as the first long stress period of the transient model so that any future changes will be readily incorporated. Therefore, the first stress period of the transient model is the steady state run (100-yr long). We have not separated these models for the purpose of the data model. The same MODFLOW files will be saved here as in the DRIVE:\CZWX_c\modflow\modfl_96\ input\ststate directory.

DRIVE:\CZWX_c\modflow\modfl_96\input\pred

NO DATA OR FOLDER FOUND – MODFLOW formatted ASCII files for predictive runs should go here along with required documentation.

[Response]: The multiple predictive (2010, 2020, 2030, 2040, and 2050) MODFLOW model files will be saved here.

DRIVE:\CZWX_c\modflow\pmwin_50\input\ststate

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

There is only one set of PMWIN5.0 formatted files and cannot easily determine whether they are for steady-state, transient, or predictive run(s). Steady-state is assumed. Need more documentation for these files.

[Response]: It is our understanding that the requirement is that the steady state model be incorporated as the first long stress period of the transient model so that any future changes will be readily incorporated. Therefore, the steady state model is the first stress period of the transient model. We have not separated these models for the purpose of the data model. The same PMWIN-5.3 files will be saved here as in the DRIVE:\CZWX_c\modflow\modfl_96\input\trans directory.

DRIVE:\CZWX_c\modflow\pmwin_50\input\trans

NO DATA OR FOLDER FOUND – PMWIN5.0 formatted files for transient runs should go here along with required documentation.

[Response]: It is our understanding that the requirement is that the steady state model be incorporated as the first long stress period of the transient model so that any future changes will be readily incorporated. Therefore, the first stress period of the transient model is the steady state run (100-yr long). We have not separated these models for the

purpose of the data model. The same PMWIN-5.3 files will be saved here as in the DRIVE:\CZWX_c\modflow\modfl_96\ input\ststate directory.

DRIVE:\CZWX_c\modflow\pmwin_50\input\pred

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

PMWIN5.0 formatted files for predictive runs should go here along with required documentation.

[Response]: The multiple predictive (2010, 2020, 2030, 2040, and 2050) PMWIN-5.3 model files will be saved here.

DRIVE:\CZWX_c\modflow\pmwin_50\refdxf

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

DRIVE:\CZWX_c\scrdata\bndy

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

Missing coverages for counties, census, and any other boundary(s) used in study or report.

[Response]: Coverage for counties, census, and any other boundaries will be moved or copied into this directory.

DRIVE:\CZWX_c\scrdata\clim

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

If modelcells_Netevaporation.xls was used for ET package, it should be located under DRIVE:\CZWX_c\grddata\input\stress\trans\evt folder.

[Response]: The files will be moved to the appropriate location.

The NOAA_annualppt_bystation_allmodelboxes.xls file needs further explanation for each of the worksheets as well as purpose of this data set.

[Response]: Additional information will be provided for this and related files.

Unsure what purpose of modelgrid_mergedwith_soil&k&ppt.xls data is for (recharge or soils analysis?). This data set needs more detailed documentation with regard to purpose and processing method(s) for each worksheet. This data set also appears to be a copy of same named file under SOILS folder.

[Response]: This is a master file that brought together key information on precipitation and soils that was used to calculate recharge. Thus it has potential cross-listing value and was included in more than one directory. Additional information on the file and its purpose will be included.

DRIVE:\CZWX_c\scrdata\cnsv

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

Missing landuse coverage and associated documentation.

[Response]: Land use is one of the main conservation-file coverage. Its information will be relocated to this directory.

DRIVE:\CZWX_c\scrdata\geol

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

Data sets under NET_SANDS folder should be located under the DRIVE:\CZWX_c\scrdata\subhyd folder.

[Response]: The files will be moved to the appropriate location.

Need structural surfaces interpreted from source point data sets.
[Response]: Several disparate data sets used to map structure surface are spatially dissimilar, so merging them required both GIS and geostatistical software packages. Layer elevations were checked for vertical consistency by mapping layer thickness calculated with a triangulated irregular network method in AutoCAD. False points inserted at appropriate locations corrected areas with a vertical discrepancy. Layer elevations were extended to areas lacking geophysical control data by kriging layer thickness, recalculating layer elevations from the kriged surface, and merging the recalculated elevation surface into data-poor areas. The interpreted surface, therefore, was actually a back-calculation directly into the model grid cells.

No cross-sections used in study? If yes, cross-sections must be provided under this folder.
[Response]: Cross sections were prepared using paper photocopies of geophysical logs hung together on room-sized poster sections. Visual information from the sections was used to guide the contouring of structure data in map view. These cross sections were scanned and traced for the purpose of generating figures 15 and 16 in the report.

DRIVE:\CZWX_c\scrdata\geom

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.
[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).
[Response]: Please see comment in review summary.

A physiography coverage is required by RFP.
[Response]: Please see comment in review summary. The study area lies entirely within the Interior Coastal Plains, part of the Gulf Coastal Plain, as stated in the draft report. A digitized version of a physiographic map was not required for development of the conceptual model or flow model.

DRIVE:\CZWX_c\scrdata\geop

NO DATA FOUND – geophysical data should go here if used in study.
[Response]: No digitized geophysical data were obtained for this study.

DRIVE:\CZWX_c\scrdata\soil

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

The data set modelgrid_mergedwith_soil&k&ppt.xls needs more detailed documentation with regard to purpose and processing method(s) for each worksheet.

[Response]: This is a master file that brought together key information on precipitation and soils that was used to calculate recharge. Thus it has potential cross-listing value and was included in more than one directory. Additional information on the file and its purpose will be included.

DRIVE:\CZWX_c\scrdata\subhyd

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

The various "county".xls files all need a column header in addition to correct metadata documentation for each file. They appear to be data dumps from the TWDB groundwater database.

[Response]: The "county".xls files were much used as a reference during this study. For example, to check whether reported formation of observation water wells were in the correct layer when they seemed to be out of calibration. Each county file has the basic information on well data, water levels, and water quality. The files are as downloaded from the TWDB web site, where they are posted without header information. We will add information from the TWDB Groundwater Data Dictionary defining the respective column headings.

Some of the header information is also missing from the calvertblufftds228_gam.shp point coverage.

[Response]: This will be corrected.

Need source and intermediate derivative coverages used to spatially distribute stock, irrigation, and domestic other pumpage data. Pumpage data sets must contain WUG_ID and WUG_Name relationship as specified by RFP. Pumpage data must also be related to model layer(s).

[Response]: The various intermediate files in constructing the master pumping input files will be included and described and will include WUG_ID and WUG_Name information.

Layer information is saved in the final pumping master file. Layer assignments for specific wells were checked by comparing aquifer code, if present, to position of the bottom of the well and layer elevation surfaces. Non-point source pumping was assigned on the basis of layer elevation and other assumptions.

Need spatially distributed water levels interpreted from point data as used in report.
[Response]: We will provide the data files used in making maps and the derived Surfer files.

Need spatially distributed conductivity fields interpreted from point data as used in report.
[Response]: Hydraulic conductivity maps were composed from Mace and others (2000) point data, Ayers and Lewis (1985) maps of sandstone thickness, and digitized tracing of hand-drawn contours. These information were gridded in Surfer and back interpolated to the model grid. Further subjective adjustments were made during model calibration in the PMWIN and Excel environments.

Need spatially distributed specific yield and porosity fields if available and/or used in report.
[Response]: We will include the data from Mace and others (2000) in this directory.

Need to specify point coverage used for target water levels and hydrographs used for calibration and verification.
[Response]: We will include the ArcView shape files that listed the ~97 wells for which hydrographs were constructed. Hydrographs were built in Excel using a macro, which will be provided. Of these hydrographs we chose 40 that were representative for inclusion in the report.

DRIVE:\CZWX_c\scrdata\surhyd

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder.
[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

The GAM Reservoir Package Data_0729.xls and GAM Reservoir Package Data_0729.xls model grid referenced data sets and their associated metadata files belong in their appropriate folders under the folder DRIVE:\CZWX_c\grddata\input\stress\ as required by Attachment 2 of RFP.
[Response]: The files will be moved to the appropriate location.

The Base Flow Index (BFI) computer program used to generate baseflow estimates must be included along with documentation.
[Response]: BFI is a public domain program and will be provided in a zipped format.

The watershed_clipped_streams shape file does not appear to have complete coverage of study area nor is its purpose understood. Need better documentation and possibly complete coverage.

[Response]: We will download a new coverage of streams and provide in the data model to replace this.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

Metadata files needed for each ArcView coverage rather than one metadata file for all coverages in addition to needing full spatial data parameter information (ie. NOT just "GAM coordinate system").

[Response]: Metadata files needed for each ArcView coverage will be provided.

Some of the coverages belong under the DRIVE:\CZWX_c\scrdata\bndy\ folder such as the tx_cntys_2m_albers, tx_state_2m_albers, grid_gam, and carizo_gam shape files.

[Response]: The files will be moved to the appropriate location.

Finally, it appears that the coverages may not have been projected correctly since the state and county coverages do not match up exactly with GAM coordinate system.

[Response]: Please see comment in review summary.

DRIVE:\CZWX_c\scrdata\tran

Need a listing file listing name of each file or grouped set of files and their contents or purpose within each folder otherwise, these files are acceptable.

[Response]: Digital versions of the file listings will be included in the final data model for this directory and information the contents or purpose of each file will be included.

Coverages may have incorrect spatial projection parameter (Datum should be NAD 83 instead of NAD 27).

[Response]: Please see comment in review summary.

DRAFT FINAL REPORT

Comments pertaining to the Draft Final Report were provided on February 6, 2003. Comments in quotes (“ ”) paraphrase comments previously made on the Draft Report as cited above in this appendix. Numbering refers to original numbering of comments on the Draft Report. Page numbers refer to pages in the Draft Final Report.

DRAFT REPORT - OVERALL COMMENTS

4. "Additional discussion on how the predictive pumping was assigned would be useful and was requested by a stakeholder." Please change "…water user groups listed in the WUG's listed in the SWP…" on p. 157 to "…water user groups listed in the SWP…" or something appropriate.

[Response]:Redundancy eliminated and text revised to state “ water user groups listed in the SWP…”

DRAFT REPORT- 2.0 STUDY AREA

5. "Figures 7, 8, and 9: Please add a reference to the data source to the figure." This comment was not addressed. Reference cited in comment, but the figures still require a reference.

[Response]:References given in responses to comments have been added to the figure captions.

DRAFT REPORT - 4.0: HYDROLOGIC SETTING

11. "Section 4.4.1, page 55: Unclear how reported water levels in the College-Bryan Station well field were adjusted. Please explain in more detail." Please also include a page number for the Anderson and Woessner reference.

[Response]:The citation to Anderson and Woessner (1992, p. 147-149) has been added to the text.

DRAFT REPORT - 6.0: MODEL DESIGN

5. "Section 6.3.2, 3rd paragraph: 'Hydraulic conductance is the product of the width, length, and thickness of the alluvium.' This is incorrect. Please include the correct definition of hydraulic conductance." Hydraulic conductance is also a function of hydraulic conductivity.

[Response]:The text has been revised to state that “ hydraulic conductance is a function of the length, width, thickness, and hydraulic conductivity of the alluvium…(Harbaugh and McDonald (1996).”

11. "Section 6.3.5, page 142: 'GHB conductance was set to the value of aquifer transmissivity.' Hydraulic conductance is not equivalent to transmissivity. Please review how conductance was assigned to the model." Although the dimensions of

hydraulic conductance and transmissivity are the same, they are very different parameters with potentially different magnitudes. Conductance is the product of hydraulic conductivity and cross-sectional area of flow divided by the length of the flow path. Transmissivity is the product of hydraulic conductivity and the thickness of the aquifer. We do not find discussion on how GHB conductance was adjusted in the discussion of the steady-state calibration although the text here suggests some assigned values with initial values.

[Response]: This comment involves several points that are clarified in the revised text (see page 148 in Final Report):

(1) The use of transmissivity as an initial estimate of GHB conductance applies only to the NE and SW lateral boundaries of the model. The downdip and layer 2 GHB boundaries are handled differently, as discussed in several following paragraphs. This accounts for the 'potentially different magnitudes' perceived in the comment. GHB conductance on the NE and SW lateral boundaries is much greater than on the downdip boundary.

2) The approximation of GHB conductance by transmissivity is by analogy to Darcy's Law. The GHB conductance for the northeast and southwest boundaries may be envisioned as the product of hydraulic conductivity, cell thickness, and row width, divided by column width.

3) Calibration of GHB conductance is mentioned in chapters 8 and 9. Since the GHB boundary on the north side is mainly used to represent the drawdown of water levels outside of the model, for example in a well field near Tyler, Smith County, Texas, adjustment of the GHB boundary was done in the transient model rather than the steady state model. The model was not very sensitive to change of the GHB conductance by ±10 percent, so we marked how far into the model water levels would appreciably change with change in GHB conductance and left the GHB conductance the same as transmissivity.

DRAFT REPORT - 9.0: TRANSIENT MODEL

3. "Section 9.1: Please include the RMSE for the hydrographs." The correction caused Figure 93 to lose the lines of simulated results.

[Response]: The RMSE and shift hydrograph information have been restored:

CZWX_c GAM Review – Part B: Project Data

Our review of the contractor's response to our comments project data will occur when the files are delivered.