Section 2.3 Table of Contents

Section 2.3 List of Tables

List of Tables (Cont.)

List of Tables (Cont.)

Section 2.3 List of Figures

List of Figures (Cont.)

List of Figures (Cont.)

List of Figures (Cont.)

2.3 Water

This section describes the hydrology, water use, and water quality characteristics of the VCS site and surrounding region that could affect or be affected by the construction and operation of nuclear power reactor units. The potential water-related impacts of construction and operations are described in Sections 4.2 and 5.2, respectively.

VCS is located in Victoria County, Texas, near the west bank of the Guadalupe River, at river mile 29.6; approximately 13 miles south of the city of Victoria, Texas; approximately 8 miles west of Bloomington, Texas; and east of U.S. Highway 77 (see Figure 2.3.1-1). The existing ground elevation at the power block site is approximately 80 feet NAVD 88. A cooling basin with approximately 4900 acres of nominal surface area will be constructed south of the power block to function as the normal power heat sink for VCS. The existing ground surface elevations in the area of the cooling basin range from approximately 80 feet NAVD 88 in the northwest corner to approximately 65 feet NAVD 88 along the southern edge.

The minimum finished site grade elevation for the power block area is elevation 95 feet NAVD 88. The top of the cooling basin embankment dam will be at 102.0 feet NAVD 88, with exceptions at the piping penetration areas. These areas have elevated bridges over the piping to allow an uninterrupted roadway on the embankment. The bottom elevation of the cooling basin is designed to be at 69 feet NAVD 88 or lower, hence grading will be necessary primarily in the northern part of the cooling basin where the natural grade is higher than 69 feet NAVD 88. Detailed descriptions of the cooling water systems of VCS and the cooling basin are provided in Section 3.4.

New transmission lines would be constructed to connect VCS with the existing regional electric grid. The final routes of the new transmission corridors have not been selected, but the probable route characteristics have been determined using a macro-corridor study that outlines options for transmission line routes, as described in Subsection 2.2.2. The general hydrological environment of the representative transmission corridors, and potential hydrologic impacts of the transmission lines during construction and operation are described in Sections 4.2 and 5.2, respectively.

2.3.1 Hydrology

This subsection describes the surface water bodies and groundwater aquifers that could affect the plant water supply and effluent disposal or that could be affected by the construction and operation of VCS. The site-specific and regional data on the physical, hydrologic, and hydrogeologic characteristics of these water resources are summarized in the following subsections.

2.3.1.1 Surface Water

The VCS site is located within the Lower Guadalupe River basin. The main hydrologic features near the site include the Guadalupe and San Antonio Rivers, Linn Lake, San Antonio Bay, Kuy Creek, Dry Kuy Creek, the Victoria Barge Canal, and the Guadalupe Blanco River Authority (GBRA) Calhoun County Canal System. Each of these features is described in detail in this subsection.

2.3.1.1.1 The Guadalupe and San Antonio River Basin

The Guadalupe River basin extends from Kerr County in the south central portion of Texas to its mouth in the San Antonio Bay at the Gulf of Mexico. The drainage area for the Guadalupe River basin is 5953 square miles (TWDB 2007). Even though the San Antonio River discharges to the Guadalupe River just upstream from its mouth, the Texas Water Development Board (TWDB 2007) considers the San Antonio River as a separate river basin, and the Guadalupe River basin drainage area listed above does not include the San Antonio River basin drainage area. The San Antonio River basin extends from north of San Antonio, Texas, to its confluence with the Guadalupe River upstream from Tivoli, Texas. The drainage area for the San Antonio River basin is 4180 square miles (TWDB 2007). The San Antonio River basin is adjacent to the Guadalupe River basin and runs in a general northwest to southeast direction as shown in Figure 2.3.1-2. The total drainage area for the combined river basins at the stream gage at Tivoli, Texas, is 10,128 square miles (USGS 2008). Major tributaries to the Guadalupe River include Coleto Creek, Peach Creek, Sandies Creek, and the San Marcos River and its tributaries, the Blanco River, and Plum Creek. The Medina River and Cibolo Creek are principal tributaries of the San Antonio River. All of these rivers and tributaries contribute to the water supply for the raw water makeup (RWMU) system for the VCS cooling basin.

The Guadalupe and San Antonio River basins are located in a climate region classified as humid subtropical. Summers are hot and humid, while winters are often mild and dry. Most of the precipitation from May through September is from occasional thunderstorms, which contribute much of the annual precipitation. The cool season, November through March, is typically the driest season of the year. Mean annual precipitation is 32 inches for the Guadalupe River basin (HDR 2006). There is a general trend of decreasing precipitation from the eastern portions of the basins to the western portions (HDR 2006 and TWDB 2007).

Stream flow gaging data collected in both basins since the 1930s indicate that there have been major droughts in almost every decade since gaging began. During the 30-year time period from 1941 to 1970, there were three major statewide droughts, from 1947 to 1948, from 1950 to 1957, and from 1960 to 1967. The most severe of these droughts occurred from 1950 to 1957. Recent less severe droughts in the south central Texas region have also occurred from 1983 to 1984, 1987 to 1990, and in 1996, 1999, and 2006 (TWDB 2007). The most recent regional drought occurred from 2007 to

2009 (GBRA 2009). Water use information in both river basins is described in Subsection 2.3.2 and the impacts of VCS on the water users in the region are described in Section 5.2.

Flooding is also a frequent event in both basins. Annual peak discharges for the Guadalupe River at Victoria and the San Antonio River at Goliad are shown in Tables 2.3.1-1 and 2.3.1-2, respectively. The largest flood on record on the Guadalupe River at Victoria gaging station (drainage area of 5198 square miles) had a peak flow rate of 466,000 cubic feet per second (cfs) and occurred on October 20, 1998. As shown in Table 2.3.1-1, there are 4 years with flood peak discharges above 100,000 cfs and 16 years with flood peak discharges above 50,000 cfs (for the period of record water years 1935–2007). The annual mean flow rate at the Victoria gaging station is 1978 cfs (USGS 2008A). The largest flood on record on the San Antonio River at Goliad (drainage area 3921 square miles) had a peak flow rate of 138,000 cfs and occurred on September 23, 1967. As shown in Table 2.3.1-2, there are 3 years with flood peak discharges above 50,000 cfs and 12 years with flood peak discharges above 25,000 cfs for the period of record (water years 1914, 1925–1929, 1935, and 1939–2007). The annual mean flow rate of the San Antonio River at Goliad is 781 cfs (USGS 2008B).

The 1998 storm in the Guadalupe and San Antonio River basins was one of the largest storms on record for the area. Severe flooding in parts of south central Texas resulted from this storm. Record rainfall amounts were recorded at several locations, with at least 30 inches recorded at Marcos, Texas. Peak discharges were greater than the 100-year flood at many locations along both the San Antonio and Guadalupe Rivers, and the flood of record at Victoria was recorded during this storm.

Coleto Creek is a tributary of the Guadalupe River, with its confluence located downstream of Victoria, Texas and upstream of the VCS site. Annual peak discharges at the USGS gaging station on Coleto Creek near Victoria, Texas, a short distance downstream of the Coleto Creek Dam, are shown in Table 2.3.1-3. Flows after 1981 on Coleto Creek are regulated by Coleto Creek Dam and reservoir. The reservoir is primarily used as a cooling pond for the Coleto Creek Power coal-fired power plant and water releases are based on both inflows to the reservoir and plant water needs. After the reservoir was built, the stream gage data at the Coleto Creek gage near Victoria, Texas, showed several instances of minimum daily flow that were near zero (USGS 2008C). The largest flood on record for Coleto Creek downstream of Coleto Creek Dam (drainage area 514 square miles) had a peak flow rate of 236,000 cfs in 1967. As shown in Table 2.3.1-3, there are 3 years with flood peak discharges above 50,000 cfs and 13 years with flood peak discharges above 25,000 cfs for the period of record (water years 1939–1954 and 1979–2007). The annual mean flow rate at Coleto Creek Dam is 117 cfs. (USGS 2008C). The flood of record at Coleto Creek occurred outside the period of record. However, high water marks measured during the 1967 flood were used with the gage information to estimate the peak flow during this flood (USGS 2008C).

There are 29 storage reservoirs in the Guadalupe River basin and 34 storage reservoirs in the San Antonio River basin with storage capacities of at least 3000 acre-feet. Tables 2.3.1-4 and 2.3.1-5 (TCEQ 2008) provide detailed information on the dams associated with each of these storage reservoirs. The locations of the storage reservoirs are shown in Figure 2.3.1-3 for the Guadalupe River basin and Figure 2.3.1-4 for the San Antonio River basin. Although both basins have many additional storage reservoirs with volumes less than 3000 acre-feet, their impact on the river flows and basin hydrology is negligible due to their small storage capacities, thus they are not reported. The storage reservoirs in both basins provide flood control as well as water storage for municipal and industrial purposes. As can be seen in Tables 2.3.1-4 and 2.3.1-5, most of the storage capacity is provided in Canyon Lake Dam and Medina Lake Dam, which are located in the upper portions of the Guadalupe and San Antonio River basins, respectively. The storage capacities of the dams in the lower reaches of both river basins are relatively small and provide either localized flood protection or local water storage.

The Guadalupe River gradient near the VCS site is relatively steep with a well defined, but wide floodplain. The average river bed slope near the site is approximately 0.00026 feet/foot for the reach between the southern limit of the city of Victoria near the U.S. Highway 59 crossing to the Union Pacific Railroad crossing near the southern boundary of the site. This portion of the river is located on the San Marcos uplift, which is the reason for the steeper gradient (White and Calnan 1990). The stream channel is fairly shallow and flows can frequently extend into the floodplain area, which is wide and flat with many wetland and marsh areas adjacent to the river. The 100-year floodplain as defined by the FEMA for the Guadalupe River as well as its tributaries near the site is presented in Figure 2.3.1-5 (FEMA 1998). The average width of the 100-year Guadalupe River floodplain near the site is approximately 3.2 miles. Although, the floodplain is wide at this location, ground elevations rise steeply from elevation 25 feet NAVD 88 at the edge of the floodplain to elevation 70 to 75 feet NAVD 88 along the eastern edge of the site.

Just downstream of the site, the Guadalupe River crosses over the Vicksburg Fault zone, which passes south of the site. After passing this geologic feature the river gradient becomes shallower and the floodplain wider. At the confluence with the San Antonio River upstream of the USGS gage near Tivoli, Texas, the river bed slope is essentially flat. Near Mission Lake, the floodplain is approximately 4.5miles wide. Also, the Lower Guadalupe Diversion Dam and Saltwater Barrier, commonly referred to as the saltwater barrier, is located at river mile 10.2 near Tivoli, Texas. The purpose of the saltwater barrier is to prevent saltwater intrusion into the freshwater supply and maintain an adequate water level in the river to allow diversion into a GBRA water supply canal, which is described in Subsection 2.3.1.1.7. The saltwater barrier, a fabridam, is designed to maintain upstream water levels at an elevation range between approximately 3.5 feet to 4.0 feet NGVD 29 (GBRA 1994), which is equivalent to elevations 3.06 feet to 3.56 feet NAVD 88 (USNGS 2008). When upstream water levels lower to approximately elevation 3.0 feet NAVD 88, fabric bags are inflated to raise the water level upstream, which also prevents intrusion of saline water further upstream. If the upstream water level rises above approximately elevation 3.6 feet NAVD 88, the bags are deflated to reduce the upstream water level. The elevations at which the fabric bags are inflated and deflated are not fixed and are adjusted depending on river flow conditions (GBRA 1994).

The Victoria Barge Canal is also located in the Guadalupe River floodplain east of the river and runs essentially parallel to the river meander axis. This 35-mile canal connects the Port of Victoria to the Gulf Intracoastal Waterway and provides shipping access to several industrial facilities in the lower Guadalupe River basin from San Antonio Bay to the Port of Victoria turning basin. Although the canal is located in the Guadalupe River floodplain, it is not part of the drainage area for the Guadalupe River. A flood protection levee also runs parallel to the canal and is located between the canal and the river preventing overflows from the Guadalupe River into the Victoria Barge Canal during river flooding events and overflow from the canal to the river during tidal flooding events. Additional short levees also exist in the Guadalupe River floodplain along the west bank of the river, between the river and the site. However, the FEMA Flood Insurance Rate Map (Figure 2.3.1-5) indicates that these levees do not provide protection for the 100-year flood (FEMA 1998).

Information on five USGS-maintained stream flow gage stations on the Guadalupe and San Antonio Rivers near the VCS site are shown in Table 2.3.1-6. The information presented includes the location, drainage area, period of record, and the mean, minimum, and maximum average annual flow for the period of record. The gages cover the major streams near the site, with the exception of Kuy Creek, a tributary to the Guadalupe River that passes south of the site with a drainage area of approximately 62 square miles. More information on Kuy Creek is presented in Subsection 2.3.1.1.3. The locations of these gages as well as other selected gages in the two river basins are shown in Figure 2.3.1-6. A stream gage on the Guadalupe River also exists at Bloomington, Texas, and its location is shown in Figure 2.3.1-6. However, this gage only records water level data and has a sporadic period of record. Thus, this gage was not included in Table 2.3.1-6. The stream gage at Tivoli does not provide accurate stream flow information for high flow data due to the flatness and width of the floodplain at that location, and only sporadic data is available. Additionally, the drainage area at Victoria (5198 square miles) plus the drainage area for Coleto Creek (514 square miles) represent approximately 96 percent of the Guadalupe River watershed. Thus, for the purposes of assessing water availability from the Guadalupe River for VCS, flow data from the gage at Victoria and the gage at Coleto Creek are used.

The raw water makeup (RWMU) system intake for VCS will be located downstream of the confluence of the San Antonio and Guadalupe Rivers, as described in Subsection 2.3.1.1.7, where flows from the San Antonio River are also available for plant use. The RWMU system is described in Sections 3.1and 3.4. The downstream most gaging station on the San Antonio River is located at McFaddin. However, this gage has less than 2 years of data, which is not sufficient to provide a long-term analysis of water supply. The gaging station at Goliad, with a drainage area of 3921 square miles, represents approximately 94 percent of the San Antonio River watershed and is used in combination with the flow data at Victoria and Coleto Creek to assess the flow available for use by the plant.

In order to facilitate the evaluation of water supply characteristics at the VCS site, flow statistics are presented for the Victoria, Goliad, and Coleto Creek gaging stations. The flows at these three stations can be used to establish a reasonable estimate of the flow available in the river near the VCS intake area. Daily and monthly discharge data are available for a period of record from water years 1925 to 1928 and 1939 to 2007 for Goliad on the San Antonio River, from water years 1935 to 2007 for Victoria on the Guadalupe River, and from water years 1981 to 2007 for Coleto Creek. Tables 2.3.1-7, 2.3.1-8, and 2.3.1-9 provide the monthly mean flow rates for each station's period of record. The mean daily flow rates for each station are presented in Tables 2.3.1-10, 2.3.1-11 and 2.3.1-12. The maximum daily-mean flow rates are presented in Tables 2.3.1-13, 2.3.1-14 and 2.3.1-15, while the minimum daily mean flow rates are presented in Tables 2.3.1-16, 2.3.1-17 and 2.3.1-18 (USGS 2008A, USGS 2008B, and USGS 2008C).

Monthly flow data from the Victoria and Goliad stream gages during the three major statewide droughts before September 2007 (1947 to 1948, 1950 to 1957, and 1960 to 1967) are highlighted in Tables 2.3.1-7 and 2.3.1-8 (USGS 2008A and USGS 2008B). Data is not available at Coleto Creek during these drought periods. Because the RWMU system intake is located downstream of the confluence of the San Antonio River, low flow data from the Victoria stream gage on the Guadalupe River and the Goliad stream gage on the San Antonio River are combined to estimate water availability during periods of drought. The minimum combined Victoria and Goliad stream gages 7-day low flow for the period of record is approximately 46 cfs, occurring in August of 1956. Using the combined Victoria and Goliad daily flow data, a frequency analysis was performed using a Log-Pearson Type 3 distribution. The results of this analysis indicate that the 10-year, 7-day low flow (7Q10) on the Guadalupe River downstream of the confluence with the San Antonio River would be approximately 222 cfs.

Blowdown from the cooling basin to the Guadalupe River will be performed as needed to maintain water chemistry control in the cooling basin. The blowdown discharge system will consist of a single 48-inch diameter pipe with multiple diffuser ports at the outfall in the Guadalupe River at the location shown in Figure 2.3.1-7. A bathymetric survey on the Guadalupe River at the proposed discharge location was conducted near the end of March 2009. Three river cross sections at and near the discharge location that depict the river bathymetry are shown in Figures 2.3.1-8 through 2.3.1-10, with the location depicted in Figure 2.3.1-8 being 200 feet upstream of the discharge location, the location in Figure 2.3.1-9 being near the proposed discharge location, and the location in Figure 2.3.1-10 being 500 feet downstream of the discharge location. The cross sections indicate a fairly uniform width and depth for the river channel, with a top width of approximately 80 feet and a depth of approximately 5 feet on the day of the survey. The 7Q10 for the Guadalupe River at the Victoria gage, which is upstream of the proposed discharge location, is estimated to be 110 cfs.

The *Flood Insurance Study for the Unincorporated Areas of Victoria County, Texas* reports the peak discharges for various flood frequencies on the Guadalupe River on the confluence of Coleto Creek just downstream of Victoria, Texas (FEMA 1998). These values are presented in Table 2.3.1-19.

2.3.1.1.2 Linn Lake

Linn Lake is a perennial natural shallow retention area located on the western edge of the Guadalupe River floodplain at the base of the slopes leading to the floodplain along the eastern edge of the proposed VCS cooling basin, as shown in Figure 2.3.1-1. Originally, it was an oxbow bend on the Guadalupe River but has been cut off from the main river channel over time. The lake has an estimated surface area of approximately 470 acres and is principally fed by the Guadalupe River and surface runoff from floodplain areas north of the lake. The lake is at approximately the same elevation as the river and receives overflows even during normal river flows. The lake also receives surface runoff from the eastern portion of the proposed VCS site through small surface tributaries along the western edge of the lake. In addition to receiving flow from the Guadalupe River, flow from the lake also returns to the river, depending on water levels in the lake and river.

2.3.1.1.3 San Antonio Bay System

The Guadalupe River discharges to the San Antonio Bay system approximately 8 miles, or 10 river miles, downstream of the confluence of the San Antonio River. The bay system consists of several smaller bays linked together to form one large bay. These smaller bays include Espiritu Santo, San Antonio Guadalupe, Hynes, Ayres, and Mesquite bays, and Mission Lake. The total surface area of the bay system is approximately 136,240 acres at mean low water and 141,200 acres at mean high water. The average depth of the bays, excluding the shipping channels at mean low water, ranges from 2.4 to 5.9 feet with an average tidal range of 0.2 to 0.3 feet. Salinity concentrations in the upper bay system range from approximately 0.5 to 9.0 parts per thousand (ppt) and in the lower bay from approximately 6.0 to 26.0 ppt (White and Calnan 1990).

The Guadalupe River delta in the upper portions of the bay system is characterized by extensive brackish to fresh-water marshes. The delta has had a history of delta lobe growth, abandonment, and deterioration. Sedimentation in the delta is characterized by stream deposition in a shallow, relatively quiescent body of water. Average annual sediment loads from the Guadalupe and San Antonio Rivers have remained relatively unchanged since the 1940s when measurements began. The average annual suspended sediment load to the bay system has been estimated to be approximately 647 acre-feet (White and Calnan 1990).

2.3.1.1.4 Local Hydrologic Features

There are several intermittent or ephemeral streams traversing the existing site. The locations of these streams are shown in Figure 2.3.1-11. Kuy Creek, which passes by the southwest corner of the site and discharges to the Guadalupe River, has a drainage area of approximately 62 square miles. Dry Kuy Creek, which passes by the northwest corner of the site, flows southeast and discharges to Kuy Creek south of the site. There are a few other unnamed short intermittent and ephemeral streams on the site. Most are tributaries to Dry Kuy Creek; the others flow to Linn Lake or Kuy Creek. All of these streams are hydrologically connected by surface flow to the Guadalupe River.

The external design basis flood, (i.e., excluding the local probable maximum precipitation [PMP] event), for the safety-related structures of VCS is a result of the flooding due to a postulated breaching of the embankment of the proposed VCS cooling basin. The external design basis flood elevation as a result of the postulated embankment breach is 91.0 feet NAVD 88.

2.3.1.1.5 Wetlands

A wetland survey conducted for the VCS site between March and April 2009, indicated that before construction, 62 areas, totaling 1843.42 acres, meet the criteria for designation as wetland in accordance with the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (USACE 2008). The designated wetland areas are shown in Figure 2.3.1-11. Wetland Wb13/14 has a surface area of 245.42 acres and represents the largest wetland outside of the Wp1 wetland complex (769.75 acres) associated with Linn Lake. Other sizeable wetlands include Wa6 (38.51 acres), Wa7(10.64 acres), Wa8 (18.95 acres), Wa9 (10.92 acres), Wa16 (41.88 acres), Wa17 (10.68 acres), Wa44 (11.63 acres), Wb1 (207.16 acres), Wb5 (25.68 acres), Wb7 (12.97 acres), Wb12 (50.01 acres), Wb15 (222.21 acres), and Wb16 (88.92 acres). The remaining delineated wetlands each occupy less than 10 acres.

Of the 62 wetlands, 42 were determined to be isolated wetlands with no noticeable surface water connection. The extent to which the surveyed wetlands fall within federal jurisdiction will be determined during completion of the permitting activities discussed in Section 1.2, at the COL stage. Two major classes of wetland systems occur on the VCS site; palustrine (freshwater), and lacustrine. A primarily lacustrine wetland (Wp1), with a palustrine forested component, associated with Linn Lake accounts for 769.75 acres (41.8 percent) of the total designated wetlands, and palustrine unconsolidated bottom and palustrine unconsolidated shore wetland systems account for 4.01 acres (0.2 percent) of total designated wetlands. The remaining 1069.66 acres (58.0 percent) of the designated wetlands are palustrine emergent wetland systems.

2.3.1.1.6 Guadalupe and San Antonio River Sediment Transport and Loading

Sediment data has been collected on the Guadalupe and San Antonio Rivers at the Victoria and Goliad gaging stations, respectively. These are the closest upstream stations from the intake location and are used to characterize the suspended sediment concentration for river water available for the VCS RWMU system intake.

The Victoria gaging station has data collected from 1973 through August 1994, with 158 total samples taken. Table 2.3.1-20 presents the suspended sediment concentration measurements for the Guadalupe River at Victoria. The average suspended sediment concentration for the data collected is 128 mg/l. However, this value is heavily influenced by a few high concentration measurements, as evidenced by the median value of 74.5 mg/l for the period of record. The maximum and minimum concentrations during the period of record were 1210 mg/l and 9 mg/l, respectively. (USGS 2008D)

The Goliad station has a period of record from October 1974 through August 1994 with 163 total samples taken. Table 2.3.1-21 presents the suspended sediment concentration measurements for the San Antonio River at Goliad. In general, the suspended sediment concentrations in the San Antonio River are higher than those of the Guadalupe River. The average suspended sediment concentration for the data collected is 260 mg/l. This value is also heavily influenced by a few high concentration measurements, as evidenced by the median value of 122 mg/l for the period of record. The maximum and minimum concentrations during the period of record were 2450 mg/l and 5 mg/l, respectively. (USGS 2008E)

The average annual suspended sediment load from the Guadalupe and San Antonio Rivers combined to the San Antonio Bay systems has been estimated to be approximately 647 acre-feet per year (White and Calnan 1990).

2.3.1.1.7 GBRA Calhoun Canal System

The entrance to the GBRA Calhoun Canal system is located on the Guadalupe River just upstream of the Lower Guadalupe Diversion Dam and Saltwater Barrier as shown in Figure 2.3.1-12. The system diverts water from the Guadalupe River downstream of the confluence of the San Antonio River. The system consists of man-made and natural canals along with siphons and pumping stations to supply fresh water to various GBRA customers. The GBRA Calhoun Canal is evaluated as an alternate raw water makeup system intake location in Section 9.4.

2.3.1.1.8 RWMU System

The water source for the RWMU system is the Guadalupe River, as shown in Figure 2.3.1-12. The RWMU intake structure and pumphouse will be located on ground that is located above the

Guadalupe River floodplain 0.6 mile south of the river, approximately 11.8 miles southeast of the VCS power block. Water would be withdrawn from the Guadalupe River and conveyed to the pumphouse via a 3150-foot-long intake canal. The entrance to the intake canal would also be located upstream of the Lower Guadalupe Diversion Dam and Saltwater Barrier, across the river from the diversion of the GBRA Calhoun Canal system, as shown in Figure 2.3.1-12. A cross section of the Guadalupe River at the intake canal location is shown in Figure 2.3.1-13. Makeup water demands are described in Section 3.3 and the RWMU system intake and pumphouse are described in Section 3.4.

2.3.1.1.9 References

FEMA 1998. Federal Emergency Management Agency, *Flood Insurance Study, Unincorporated Areas of Victoria County, Texas*, 1998.

GBRA 1994. Guadalupe Blanco River Authority, Calhoun Canal Division, *Operating Manual for Diversion System Operator*, September 1981, revised October 1994.

GBRA 2009. Guadalupe Blanco River Authority, Basin Briefing, November 2009, available at http://www.gbra.org/Library/BasinBriefingNov209.aspx, accessed February 22, 2010.

HDR 2006. HDR, *South Central Texas Regional Water Plan, Volume I*, June 2006.

TCEQ 2008. Texas Commission on Environmental Quality, Dam Safety Division, Guadalupe and San Antonio River Dam Data, Extracted 2008.

TWDB 2007. Texas Water Development Board, *Water for Texas 2007, Volume II*, Document No. GP-8-1, January 2007.

USGS 1999. U. S. Geological Survey, Fact Sheet FS-147-99, *Floods in the Guadalupe and San Antonio River Basins in Texas, October 1998*, September 1999.

USGS 2008. U.S. Geological Survey, Stream Gage Data, *Stream Flow Records, Gage 08188800, Guadalupe River at Tivoli, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08188800&agency_cd=USGS, accessed March 25, 2008.

USGS 2008A. U.S. Geological Survey, *Stream Gage Data, Stream Flow Records, Gage 08176500, Guadalupe River at Victoria, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08176500&agency_cd=USGS, accessed April 3, 2008.

USGS 2008B. U.S. Geological Survey, *Stream Gage Data, Stream Flow Records, Gage 08188500, San Antonio River at Goliad, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08188500&agency_cd=USGS, accessed April 3, 2008.

USGS 2008C. U.S. Geological Survey, *Stream Gage Data, Stream Flow Records, Gage 08177500, Coleto Creek near Victoria, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08177500&agency_cd=USGS, accessed April 3, 2008.

USGS 2008D. U.S. Geological Survey, *Stream Gage Data, Water Quality Records, Gage 08176500, Guadalupe River at Victoria, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08176500&agency_cd=USGS, accessed April 3, 2008.

USGS 2008E. U.S. Geological Survey, Stream Gage Data, *Water Quality Records, Gage 08188500, San Antonio River at Goliad, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08188500&agency_cd=USGS, accessed April 3, 2008.

USGS 2008F. U.S. Geological Survey, Stream Gage Data, *Stream Flow Records, Gage 08188570, San Antonio River near McFaddin, Texas*, available at http://nwis.waterdata.usgs.gov/tx/nwis/nwisman/?site_no=08188570&agency_cd=USGS, accessed April 3, 2008.

USACE 2008. U.S. Army Corps of Engineers, Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Costal Plain Region, Vicksburg, MS, 2008.

USNGS 2008. U.S. National Geodetic Survey, *National Vertical Datum Conversion Utility*, available at http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html, accessed May, June and July 2008.

White and Calnan 1990. White, William A, and Calnan, Thomas R., *Sedimentation in Fluvial-Deltaic Wetland and Estuarine Areas, Texas Gulf Coast*, Prepared for Texas Parks and Wildlife Department, 1990.

Table 2.3.1-1
Annual Peak Discharges for the Guadalupe River at Victoria, Texas USGS 08176500

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)	Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1935	Jun. 20, 1935	29.72	38,500	1971	Sep. 12, 1971	22.48	9,740
1936	Jul. 03, 1936	31.22	179,000	1972	May 16, 1972	30.37	58,500
1937	Oct. 04, 1936	26.77	17,200	1973	Jun. 17, 1973	29.33	33,100
1938	Apr. 30, 1938	28.75	25,400	1974	Oct. 16, 1973	28.98	25,200
1939	Jun. 06, 1939	14.52	4,940	1975	May 29, 1975	29.24	30,200
1940	Jul. 03, 1940	29.67	55,900	1976	Apr. 19, 1976	26.54	14,100
1941	May 03, 1941	29.73	58,000	1977	Apr. 24, 1977	30.09	54,500
1942	Jul. 09, 1942	29.8	56,000	1978	Sep. 14, 1978	25.64	12,700
1943	Oct. 21, 1942	18.8	7,710	1979	May 12, 1979	28.36	19,300
1944	Jun. 01, 1944	23.94	12,300	1980	May 19, 1980	24.68	11,600
1945	Apr. 06, 1945	28.57	22,000	1981	Sep. 02, 1981	31.1	105,000
1946	Sep. 03, 1946	27.7	17,900	1982	May 19, 1982	28.2	18,500
1947	Oct. 17, 1946	29.55	46,000	1983	Nov. 20, 1982	23.95	10,900
1948	May 28, 1948	17.5	6,970	1984	Oct. 21, 1983	11.7	3,280
1949	Apr. 30, 1949	28.53	20,600	1985	Apr. 21, 1985	23.85	10,600
1950	Oct. 28, 1949	24.95	13,300	1986	Nov. 29, 1985	26.29	13,700
1951	Jun. 08, 1951	23.96	12,300	1987	Jun. 07, 1987	30.45	83,400
1952	Sep. 16, 1952	29.46	28,400	1988	Nov. 28, 1987	13.24	3,900
1953	May 04, 1951	23.19	11,600	1989	May 21, 1989	13.89	4,280
1954	Oct. 26, 1953	19.68	8,560	1990	Sep. 12, 1990	15.61	5,230
1955	May 22, 1955	14.83	4,950	1991	Apr. 05, 1991	27.83	17,000
1956	May 18, 1956	7.46	1,730	1992	Dec. 25, 1991	30.13	61,500
1957	May 02, 1957	29.92	35,300	1993	Jun. 30, 1993	27.87	17,700
1958	Feb. 26, 1958	30.28	58,300	1994	May 19, 1994	26.04	13,300
1959	Apr. 15, 1959	22.33	10,100	1995	Oct. 19, 1994	29.37	39,600
1960	Jul. 01, 1960	29.06	23,700	1996	Sep. 22, 1996	22.71	9,760
1961	Jun. 22, 1961	30.35	55,800	1997	Apr. 04, 1997	29.07	32,700
1962	Nov. 17, 1961	23.11	10,800	1998	Oct. 13, 1997	28.3	20,600
1963	Feb. 21, 1963	13.22	4,100	1999	Oct. 20, 1998	34.04	466,000
1964	Nov. 11, 1963	16.19	5,720	2000	Jun. 12, 2000	17.54	6,220
1965	Feb. 21, 1965	27.3	15,000	2001	Sep. 03, 2001	29.36	39,300
1966	Dec. 08, 1965	21.99	9,790	2002	Jul. 10, 2002	30.32	71,700
1967	Sep. 21, 1967	30.67	70,000	2003	Nov. 08, 2002	29.99	58,500
1968	Jan. 25, 1968	29.72	44,300	2004	Jun. 15, 2004	27.48	16,100
1969	Apr. 13, 1969	27.13	15,200	2005	Nov. 26, 2004	30.9	102,000
1970	May 20, 1969	21.7	9,190	2006	Jul. 06, 2006	13.73	4,290
				2007	Jul. 03, 2007	29.33	38,600

Note: Flows for 1962 and later affected by regulation or diversion
Source: USGS 2008A

Table 2.3.1-2
Annual Peak Discharges for the San Antonio River at Goliad, Texas USGS 08188500

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)	Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1914	Oct. 02, 1913	44.9	33,800	1970	Jun. 02, 1970	25.28	6,100
1925	Jul. 13, 1925	11.9	1,830	1971	Aug. 09, 1971	22.01	4,970
1926	Apr. 25, 1926	31	11,900	1972	May 15, 1972	34.16	12,800
1927	Apr. 16, 1927	22.5	5,410	1973	Jul. 24, 1973	34.53	14,900
1928	May 16, 1928	19	3,880	1974	Oct. 02, 1973	40.09	21,800
1929	Jan. 11, 1929	31.79	13,100	1975	May 28, 1975	27.48	8,660
1935	Jun. 15, 1935	44.9	33,800	1976	Apr. 18, 1976	29	9,780
1939	Jul. 12, 1939	11.22	1,900	1977	Apr. 25, 1977	36.07	15,900
1940	Jul. 02, 1940	31.37	11,600	1978	Nov. 05, 1977	23.99	6,770
1941	May 01, 1941	34.55	15,700	1979	Apr. 23, 1979	28.34	9,310
1942	Jul. 09, 1942	44.9	33,800	1980	Sep. 09, 1980	25.68	8,240
1943	Oct. 08, 1942	25.51	7,330	1981	Jun. 21, 1981	31.96	12,800
1944	May 30, 1944	29.01	9,880	1982	Oct. 31, 1981	24.49	7,460
1945	Apr. 03, 1945	21.84	5,170	1983	Sep. 21, 1983	23.43	6,960
1946	Sep. 01, 1946	41.66	25,500	1984	Nov. 08, 1983	14.94	3,120
1947	Oct. 02, 1946	42.67	29,400	1985	Jul. 07, 1985	21.44	5,990
1948	Aug. 28, 1948	29.41	10,200	1986	Jun. 10, 1986	29.45	10,700
1949	Apr. 28, 1949	33.76	14,100	1987	Jun. 07, 1987	43.08	33,200
1950	Oct. 27, 1949	24.04	6,420	1988	Jul. 24, 1988	11.08	1,850
1951	Sep. 14, 1951	26.9	8,370	1989	Jun. 17, 1989	11.3	1,920
1952	Sep. 14, 1952	39.82	23,900	1990	Jul. 21, 1990	27.66	9,480
1953	May 20, 1953	28.76	8,560	1991	Apr. 06, 1991	25.92	8,330
1954	May 27, 1954	12.77	2,050	1992	Dec. 25, 1991	41.58	27,500
1955	Sep. 02, 1955	13.83	2,320	1993	Jun. 30, 1993	35.37	16,200
1956	May 16, 1956	14.33	2,420	1994	May 18, 1994	28.71	10,200
1957	May 02, 1957	31.56	10,300	1995	Oct. 18, 1994	28.5	10,100
1958	Feb. 25, 1958	36.21	16,000	1996	Sep. 26, 1996	13.09	2,460
1959	Nov. 01, 1958	22.82	5,220	1997	Jun. 28, 1997	31.78	12,600
1960	Jun. 29, 1960	23.28	5,440	1998	Mar. 19, 1998	18.78	4,610
1961	Oct. 29, 1960	31.62	11,300	1999	Oct. 22, 1998	51.78	59,200
1962	Jun. 03, 1962	23.16	5,660	2000	Jun. 14, 2000	16.82	4,070
1963	Apr. 30, 1963	10.36	1,680	2001	Sep. 02, 2001	41.97	27,200
1964	Aug. 10, 1964	20.03	4,360	2002	Jul. 09, 2002	52.81	70,600
1965	May 24, 1965	30.79	10,600	2003	Oct. 28, 2002	36.13	18,000
1966	Dec. 06, 1965	18.52	3,880	2004	Jun. 14, 2004	31.43	13,000
1967	Sep. 23, 1967	53.7	138,000	2005	Nov. 27, 2004	40.42	23,400
1968	Jan. 24, 1968	41.98	25,900	2006	May 08, 2006	12.04	2,280
1969	Feb. 17, 1969	24.93	6,380	2007	Aug. 23, 2007	38.52	20,800

Note: All discharges affected by regulation or diversion
Source: USGS 2008B

Table 2.3.1-3
Annual Peak Discharges for the Coleto Creek near Victoria, Texas USGS 08177500

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)	Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1939	Jul. 12, 1939	11.4	8,820	1985	Jul. 04, 1985	16.35	9,590
1940	Jun. 30, 1940	22.05	39,200	1986	Jun. 13, 1986	8.17	1,090
1941	Nov. 25, 1940	24.25	48,200	1987	Jun. 11, 1987	19.15	15,100
1942	Jul. 06, 1942	20.75	34,300	1988	Nov. 25, 1987	5.32	231
1943	May 31, 1943	6.76	2,530	1989	Apr. 30, 1989	4.23	37
1944	Mar. 18, 1944	13.08	12,200	1990	Jul. 17, 1990	20.86	19,200
1945	Apr. 20, 1945	7.09	2,700	1991	Apr. 05, 1991	28	37,000
1946	May 23, 1946	12.02	10,000	1992	Apr. 17, 1992	27.68	41,700
1947	Oct. 16, 1946	31.64	89,000	1993	May 05, 1993	23.27	25,900
1948	May 24, 1948	8.78	4,260	1994	May 14, 1994	14	6,020
1949	Apr. 26, 1949	6.89	2,700	1995	Oct. 18, 1994	28.41	44,700
1950	Oct. 26, 1949	6.43	2,290	1996	Aug. 30, 1996	4.95	23
1951	Sep. 13, 1951	11.6	9,440	1997	Apr. 04, 1997	32.05	50,100
1952	May 28, 1952	15.18	17,300	1998	Oct. 13, 1997	26.03	28,500
1953	Aug. 30, 1953	13.73	14,400	1999	Oct. 18, 1998	23.25	22,400
1954	May 25, 1954	3.33	731	2000	Jun. 12, 2000	6.75	504
1967	1967[(a)]	42	236,000	2001	Sep. 01, 2001	22.39	20,200
1979	May 11, 1979	N/A	15,500	2002	Dec. 02, 2001	17.97	11,500
1980	Jan. 20, 1980	15.72	8,550	2003	Oct. 25, 2002	19.97	15,800
1981	Sep. 01, 1981	19.73	16,500	2004	May 14, 2004	18.52	13,200
1982	Oct. 31, 1981	27.02	39,100	2005	Nov. 21, 2004	28.93	41,700
1983	Nov. 19, 1982	19.5	15,900	2006	Jun. 01, 2006	4.94	117
1984	Mar. 12, 1984	18.82	14,400	2007	Jul. 02, 2007	21.67	19,300

(a) Data not based on specific date. High water marks measured during the flood were used with gage information to estimate the peak flow during this flood.

N/A: Data not available
Note: Discharges for 1981 and after are affected by regulation or diversion
Source: USGS 2008C

Table 2.3.1-4 (Sheet 1 of 2)
Guadalupe River Basin Dams (storage greater than 3000 acre-feet)

No.	NAT ID	Dam Name	County	Lat (deg)	Long (deg)	Year	Dam Height (ft)	Dam Length (ft)	Max Storage (ac-ft)	Effective Top of Dam (ft NGVD 29)
1	TX00004	CANYON DAM	COMAL	29.8667	-98.2000	1964	219	6,830	1,129,300	974.0
2	TX01546	COMAL RIVER WS SCS SITE 4 DAM	COMAL	29.6500	-98.2767	1965	73	2,000	5,293	806.3
3	TX01548	YORK CREEK WS SCS SITE 1 DAM	COMAL	29.8133	-98.0483	1967	81	1,157	4,570	742.8
4	TX01550	COMAL RIVER WS SCS SITE 3 DAM	COMAL	29.7383	-98.1583	1974	58	1,850	6,911	783.3
5	TX01575	PLUM CREEK WS SCS SITE 5 DAM	HAYS	30.0017	-97.8383	1963	38	2,510	3,368	668.0
6	TX01576	PLUM CREEK WS SCS SITE 6 DAM	HAYS	30.0017	-97.8217	1967	36	3,340	5,663	643.1
7	TX01584	YORK CREEK WS SCS SITE 5 DAM	HAYS	29.7767	-97.9833	1963	41	1,897	3,426	589.0
8	TX01599	LAKE MEADOW DAM	GUADALUPE	29.5283	-97.9383	1930	27	2,525	3,100	475.6
9	TX01600	LAKE PLACID DAM	GUADALUPE	29.5467	-98.0000	1964	25	2,057	5,400	N/A
10	TX01601	LAKE MCQUEENEY DAM	GUADALUPE	29.5933	-98.0400	1928	40	1,555	5,050	540.0
11	TX01602	LAKE DUNLAP DAM	GUADALUPE	29.6533	-98.0667	1928	41	1,626	5,900	589.4
12	TX01611	YORK CREEK WS SCS SITE 13 DAM	GUADALUPE	29.8200	-97.9250	1964	33	2,782	5,045	595.3
13	TX01912	LAKE GONZALES DAM	GONZALES	29.4950	-97.6250	1931	42	2,170	23,520	346.5
14	TX01913	LAKE WOOD DAM	GONZALES	29.4683	-97.4917	1931	42	6,450	8,120	304.0
15	TX03418	LOWER PLUM CREEK WS SCS SITE 34 DAM	CALDWELL	29.8650	-97.7550	1965	41	3,106	4,741	573.6
16	TX03420	LOWER PLUM CREEK WS SCS SITE 28 DAM	CALDWELL	29.8567	-97.5117	1963	34	4,300	5,404	479.5
17	TX03423	PLUM CREEK WS SCS SITE 14 DAM	CALDWELL	29.9533	-97.7433	1967	46	3,640	8,715	542.3
18	TX03425	PLUM CREEK WS SCS SITE 17 DAM	CALDWELL	30.0000	-97.7100	1969	35	1,860	5,312	N/A
19	TX03428	PLUM CREEK WS SCS SITE 21 DAM	CALDWELL	29.9567	-97.6533	1962	41	3,400	5,318	522.3
20	TX04547	COMAL RIVER WS SCS SITE 1 DAM	COMAL	29.6867	-98.2883	1978	70	2,530	6,763	919.3
21	TX04657	PLUM CREEK WS SCS SITE 16 DAM	HAYS	30.0033	-97.7400	1975	41	2,800	3,642	559.9
22	TX04693	LOWER PLUM CREEK WS SCS SITE 27 DAM	CALDWELL	29.8333	-97.5617	1974	28	3,830	3,170	N/A
23	TX04744	COLETO CREEK DAM	VICTORIA	28.7233	-97.1667	1980	65	21,000	169,000	120.0
24	TX04788	COMAL RIVER WS SCS SITE 2 DAM	COMAL	29.6750	-98.2517	1981	75	3,100	19,024	866.8

Table 2.3.1-4 (Sheet 2 of 2)
Guadalupe River Basin Dams (storage greater than 3000 acre-feet)

No.	NAT ID	Dam Name	County	Lat (deg)	Long (deg)	Year	Dam Height (ft)	Dam Length (ft)	Max Storage (ac-ft)	Effective Top of Dam (ft NGVD 29)
25	TX05945	UPPER SAN MARCOS RIVER WS SCS SITE 1	HAYS	29.9183	-97.9733	1983	80	2,905	18,399	N/A
26	TX06328	UPPER SAN MARCOS RIVER WS SCS SITE 2	HAYS	29.9333	-97.9617	1985	51	1,465	3,034	726.7
27	TX06329	UPPER SAN MARCOS RIVER WS SCS SITE 4	HAYS	29.8850	-98.0317	1985	100	1,365	5,972	889.8
28	TX06432	UPPER SAN MARCOS RIVER WS SCS SITE 3	HAYS	29.9067	-97.9450	1991	60	1,630	4,323	N/A
29	TX07247	UPPER SAN MARCOS RIVER WS NRCS SITE 5	HAYS	29.8683	-97.9681	1989	71	2,950	7,329	667.2

Source: TCEQ 2008
N/A: Data not available

Table 2.3.1-5 (Sheet 1 of 2)
San Antonio River Basin Dams (storage greater than 3000 acre-feet)

No.	NAT ID	Dam Name	County	Lat (deg)	Long (deg)	Year	Dam Height (ft)	Dam Length (ft)	Max Storage (ac-ft)	Effective Top of Dam (ft NGVD 29)
1	TX01432	VICTOR BRAUNIG DAM	BEXAR	29.2400	-98.3717	1963	76	9,638	32,324	515
2	TX01448	CALAVERAS CREEK DAM	BEXAR	29.2783	-98.3050	1969	79	5,920	97,441	498
3	TX01450	CALAVERAS CREEK WS SCS SITE 3 DAM	BEXAR	29.3700	-98.3317	1954	37	3,100	3,400	595
4	TX01453	MITCHELL LAKE DAM	BEXAR	29.2700	-98.4733	1967	10	3,500	5,000	530
5	TX01459	CALAVERAS CREEK WS SCS SITE 6 DAM	BEXAR	29.3800	-98.2917	1957	43	2,463	4,801	556
6	TX01461	MARTINEZ CREEK WS SCS SITE 1 DAM	BEXAR	29.4717	-98.3283	1964	38	2,172	3,509	681
7	TX01464	MARTINEZ CREEK WS SCS SITE 6A DAM	BEXAR	29.4783	-98.2900	1966	34	2,420	5,200	631
8	TX01467	SALADO CREEK WS SCS SITE 8 DAM	BEXAR	29.6450	-98.4767	1973	61	1,675	7,100	1,077
9	TX01468	SALADO CREEK WS SCS SITE 4 DAM	BEXAR	29.6233	-98.5200	1972	57	1,760	30,798	1,053
10	TX01469	SALADO CREEK WS SCS SITE 2 DAM	BEXAR	29.6634	-98.5792	1971	65	2,200	4,317	1,162
11	TX01787	MEDINA LAKE DAM	MEDINA	29.5400	-98.9333	1913	165	1,550	327,250	1,076
12	TX01788	MEDINA DIVERSION LAKE DAM	MEDINA	29.5100	-98.9000	1913	51	450	4,500	928
13	TX02028	HONDO CREEK WS SCS SITE 1 DAM	KARNES	28.7483	-97.8033	1968	41	3,250	6,288	N/A
14	TX02031	ESCONDIDO CREEK WS SCS SITE 11 DAM	KARNES	28.8600	-97.8450	1958	37	2,823	7,523	325
15	TX02034	ESCONDIDO CREEK WS SCS SITE 3 DAM	KARNES	28.7717	-97.9283	1956	41	2,310	3,180	425
16	TX02035	ESCONDIDO CREEK WS SCS SITE 4 DAM	KARNES	28.8150	-97.9017	1956	32	2,900	3,743	334
17	TX02040	ESCONDIDO CREEK WS SCS SITE 9 DAM	KARNES	28.8667	-97.9983	1957	30	2,674	4,330	419
18	TX02042	ESCONDIDO CREEK WS SCS SITE 13 DAM	KARNES	28.8133	-97.8767	1973	36	4,000	4,060	319
19	TX04208	SALADO CREEK WS SCS SITE 12 DAM	BEXAR	29.6267	-98.3917	1974	70	3,250	7,425	946
20	TX04313	OLMOS DAM	BEXAR	29.4733	-98.4733	1926	68	1,941	14,240	N/A
21	TX04315	ESCONDIDO CREEK WS SCS SITE 12 DAM	KARNES	28.8300	-97.9217	1974	28	2,667	3,388	342
22	TX04364	SALADO CREEK WS SCS SITE 13A DAM	BEXAR	29.6050	-98.3950	1976	43	1,690	3,026	N/A
23	TX04481	BOERING CITY LAKE DAM	KENDALL	29.8217	-98.7667	1978	87	6,130	15,668	1,546
24	TX04655	UPPER CIBOLO CREEK WS SCS SITE 3 DAM	KENDALL	29.7783	-98.7833	1980	76	2,436	4,732	1,584
25	TX04716	SALADO CREEK WS SCS SITE 1 DAM	BEXAR	29.6633	-98.6000	1975	80	2,640	8,680	1,162
26	TX04717	SALADO CREEK WS SCS SITE 5 DAM	BEXAR	29.6383	-98.5117	1976	64	3,200	5,807	1,099
27	TX04760	SALADO CREEK WS SCS SITE 11 DAM	BEXAR	29.6017	-98.4317	1979	65	1,775	6,318	893
28	TX05798	PANNA MARIA TAILINGS POND DAM	KARNES	28.9600	-97.9367	1978	60	9,810	4,598	375
29	TX06398	SALADO CREEK WS SCS SITE 7 DAM	BEXAR	29.5583	-98.5033	1987	47	22,640	7,016	N/A
30	TX06600	SALADO CREEK WS SCS SITE 10 DAM	BEXAR	29.5958	-98.4375	1994	66	1,264	4,054	N/A

Table 2.3.1-5 (Sheet 2 of 2)
San Antonio River Basin Dams (storage greater than 3000 acre-feet)

No.	NAT ID	Dam Name	County	Lat (deg)	Long (deg)	Year	Dam Height (ft)	Dam Length (ft)	Max Storage (ac-ft)	Effective Top of Dam (ft NGVD 29)
31	TX06646	ECLETO CREEK WS NRCS SITE 9A DAM	DE WITT	29.0008	-97.7083	1993	30	3,183	4,100	373
32	TX06912	ECLETO CREEK WS SCS SITE 4 DAM	KARNES	29.0778	-97.8492	1994	28	2,886	3,910	341
33	TX07211	SALADO CREEK WS NRCS SITE 15R DAM	BEXAR	29.5504	-98.4500	2004	49	6,536	8,704	773
34	TX07263	ECLETO CREEK WS NRCS SITE 3 DAM	WILSON	29.1767	-97.8632	2000	31	2,700	3,340	404

N/A: Data not available
Source: TCEQ 2008

Table 2.3.1-6
USGS Stream Gages near VCS

Gage No.	Name	River	Lat (deg)	Long (deg)	County	Drainage Area (square mile)	Period of Record From Year	Years of Record	Historical Annual Mean Flow Rate(cfs)		
									Max.	Min.	Ave.
08176500	Victoria	Guadalupe	28.79	-97.01	Victoria	5198	1935	73	6993	132	1978
08177500	Victoria	Coleto	28.73	-97.14	Victoria	514	1939	46	302	2	117
08188500	Goliad	San Antonio	28.65	-97.38	Goliad	3921	1924	76	3289	98	781
08188570	McFaddin	San Antonio	28.53	-97.04	Refugio	4134	2006	1	N/A	N/A	N/A
08188800	Tivoli	Guadalupe	28.50	-96.88	Refugio	10,128	2000	0	N/A	N/A	N/A

Note: No complete years of data are available at Tivoli before September 2007
N/A: Data not available
Sources: USGS 2008, USGS 2008A, USGS 2008B, USGS 2008C, USGS 2008F

Table 2.3.1-7 (Sheet 1 of 3)
Monthly Mean Flows for the Guadalupe River at Victoria, Texas USGS 08176500

Year	Monthly mean in cfs											
	January	February	March	April	May	June	July	August	September	October	November	December
1934	—	—	—	—	—	—	—	—	—	—	—	1,674
1935	788.7	1,941	762.6	1,120	7,866	9,037	1,860	1,170	4,594	1,981	1,081	2,057
1936	1,412	1,038	1,056	817.2	4,818	2,328	18,430	1,311	3,246	4,341	1,767	1,548
1937	1,404	1,355	2,834	1,365	959.6	2,733	936.1	685.3	652.8	810	659.7	1,154
1938	2,632	1,722	1,453	5,228	4,920	1,367	952.8	771.9	702.7	603.3	641.2	669
1939	712.5	654.1	611.6	597.2	715.9	728.4	772	419	417.8	516.2	449.8	495.6
1940	513.2	723.4	632	972.4	745	1,110	6,633	524	460.3	629.2	6,397	5,672
1941	2,570	3,964	4,398	4,721	12,990	4,782	2,521	1,410	1,164	1,359	1,195	934.4
1942	864.5	804.3	793.1	2,619	1,598	916.4	6,290	931.9	4,381	2,773	1,768	1,456
1943	1,411	1,109	1,131	1,033	905.6	1,387	939.2	669.8	755.6	658	651.1	732.1
1944	1,337	1,645	2,968	1,519	3,399	3,044	1,208	893.3	1,757	862.6	1,260	2,131
1945	3,235	3,257	2,761	5,570	1,521	1,337	919.2	708.9	645.9	1,268	802.1	1,037
1946	1,264	1,846	3,086	1,542	2,067	2,348	807.6	1,045	4,834	4,137	3,666	2,241
1947	3,588	2,141	2,162	2,185	2,160	1,167	907.3	1,351	693	583.1	637.7	719.6
1948	669.4	824	768.2	552.3	1,414	561	744.3	547.8	395.3	465.9	396.6	426.7
1949	488.1	1,001	1,567	4,101	2,768	1,130	893	660.6	575	2,731	854	990.8
1950	707.5	900	675.1	1,285	910.5	2,340	587.8	368.4	381.2	354.5	353.6	408.6
1951	393.1	423.7	427.5	455.3	564.1	2,279	309.9	186	375.4	238.2	314.6	326.1
1952	336.3	401.3	334.5	590.1	1,350	1,355	471.7	180.3	3,993	706.6	963.2	1,884
1953	1,652	833.8	650.5	730.9	2,551	336.4	319.3	485	1,730	1,684	692.6	885.7
1954	581.8	505	412.6	483.5	702.1	246.2	146.5	107.9	107.2	121.3	200.5	241.5
1955	258.5	950	329	290.3	770.9	797.3	214	210.7	158	100.1	106.9	182.7
1956	194.6	255.3	158.1	157.2	224.4	59.7	53.9	37.6	51.6	163.7	59.6	486.2
1957	118.2	410.1	1,165	4,147	6,954	5,312	676.4	355.4	3,859	7,945	4,209	1,990
1958	4,070	8,645	3,922	2,015	4,293	1,764	1,248	742.9	2,013	1,852	2,229	1,450
1959	1,271	1,967	1,302	3,304	1,675	1,132	1,290	825.7	739.1	2,504	1,299	1,114
1960	1,431	1,509	1,204	1,300	2,392	2,854	2,635	1,805	1,091	9,217	7,761	3,289
1961	3,833	4,640	2,459	1,619	1,151	6,855	2,637	1,175	1,901	1,035	2,235	996.6
1962	905.8	902.4	781	944.6	745.8	880.7	511.3	332	735.8	651.3	687.2	804.5

Table 2.3.1-7 (Sheet 2 of 3)
Monthly Mean Flows for the Guadalupe River at Victoria, Texas USGS 08176500

Year	Monthly mean in cfs											
	January	February	March	April	May	June	July	August	September	October	November	December
1963	697.4	1,043	663.2	738.1	489.4	368.1	303.8	172.3	200.7	213.5	775.3	473.6
1964	450.3	807.6	1,198	678	446.7	558.8	259.7	271.4	716.5	833.7	965.7	526.2
1965	1,599	4,735	1,271	1,220	4,327	4,018	1,116	698.5	706.9	1,275	1,969	2,620
1966	1,235	1,669	1,589	2,051	2,606	1,200	892.8	640.3	869.3	878	703.5	596.3
1967	596.3	540.9	512.5	474.1	392.4	280.3	208.9	302.3	9,335	2,270	2,213	1,114
1968	7,130	2,348	1,869	2,907	4,991	6,178	1,669	961.7	1,649	837.9	943.3	2,048
1969	933.6	3,326	2,982	3,671	3,255	1,535	861.7	708.4	841.5	1,353	1,225	1,532
1970	1,797	1,864	2,814	1,921	3,433	2,757	1,204	852.7	797.6	1,052	730.6	694.9
1971	670.8	612.6	583.2	429.6	367.1	377.8	322.6	1,570	2,914	1,453	1,448	2,026
1972	1,446	1,583	1,056	756.2	12,230	2,789	1,648	1,343	971.4	933	878.4	836.7
1973	1,128	1,635	2,531	5,174	2,253	7,511	4,277	2,721	2,189	10,550	3,397	2,144
1974	3,648	1,892	1,463	1,191	2,211	1,723	861.6	992.4	3,928	1,422	4,685	2,847
1975	2,100	4,611	2,249	2,234	8,850	6,441	3,308	1,995	1,461	1,155	991.2	1,169
1976	930.3	879.8	912.6	5,069	6,339	3,346	2,276	1,706	1,600	4,050	5,101	6,786
1977	2,975	4,726	2,289	10,320	4,645	2,566	1,743	1,169	1,058	929.2	1,561	938.6
1978	921.7	1,013	916.1	971.5	775.6	1,441	624.1	3,724	3,739	1,535	1,878	1,028
1979	4,767	3,911	3,828	5,223	7,601	5,865	2,286	1,988	1,681	923.8	859.9	820.9
1980	1,074	931.2	795.8	732.7	2,674	1,107	603.4	440.7	1,267	948.9	825.5	828.9
1981	847.9	913.5	1,263	1,666	2,146	10,020	3,833	1,875	11,340	2,178	4,397	1,703
1982	1,257	1,641	1,080	965.6	5,427	1,345	770.8	498.5	479.4	598.3	1,032	680.7
1983	707.5	1,525	2,152	1,375	1,457	1,271	1,325	640.9	760.2	702.4	891.8	526.4
1984	748.2	659.1	770.4	456.2	367.3	290.6	111.5	104.7	125.1	629.6	673.4	870.9
1985	2,027	1,564	2,327	2,570	1,595	2,684	2,514	1,022	722.2	1,640	3,527	3,227
1986	1,801	1,763	1,245	976	1,549	3,182	1,193	676.9	1,198	2,380	2,536	5,529
1987	4,476	3,190	4,563	2,136	2,229	23,750	6,759	4,473	2,363	1,692	1,379	1,210
1988	953.8	884.3	1,051	796.4	807.4	1,005	937.6	1,081	603.7	541.8	485.8	541.4
1989	704.5	767.9	768.1	750.9	1,408	640	314.6	186.1	141.6	235.5	397.6	452.2
1990	420.1	421.4	659.3	965.8	1,386	747.9	776	821.8	982.2	527.5	601.3	566
1991	3,000	2,645	1,330	3,992	2,596	1,438	1,495	695.2	1,022	865.8	907.7	9,753
1992	10,650	17,250	10,600	9,821	8,757	8,855	3,103	2,150	1,660	1,360	1,806	1,661

Table 2.3.1-7 (Sheet 3 of 3)
Monthly Mean Flows for the Guadalupe River at Victoria, Texas USGS 08176500

Year	Monthly mean in cfs											
	January	February	March	April	May	June	July	August	September	October	November	December
1993	1,902	2,521	3,132	1,800	5,851	5,473	1,938	918.9	768	912.2	920	887.7
1994	840.6	833.3	1,033	939.1	4,208	1,435	717.1	600.5	657.6	3,768	1,172	1,898
1995	2,080	1,109	2,525	2,018	990.2	3,136	1,231	764	636.3	610.5	689.9	728.6
1996	634.4	591.4	530.3	472	382.5	313.6	163	265	1,963	415.1	444.9	597.9
1997	1,001	767.8	2,546	6,536	3,738	9,942	6,293	2,690	1,272	2,960	1,137	1,221
1998	1,478	3,391	3,509	2,033	996.9	740.2	587.7	1,308	3,026	30,440	9,440	4,711
1999	2,210	1,589	1,494	1,307	1,475	1,942	1,124	713.6	531.4	510.9	558.4	565
2000	661.1	655.5	718.7	636.2	892.9	1,475	424.6	289.5	271.9	485.4	5,365	2,431
2001	2,672	2,267	3,368	1,856	1,701	1,051	792.6	894.1	7,430	1,429	3,493	5,343
2002	2,033	1,525	1,245	2,227	891.2	776	17,060	4,741	5,515	6,091	9,964	5,771
2003	3,878	4,888	3,556	1,900	1,528	1,405	1,385	1,070	1,479	1,401	1,226	1,011
2004	1,399	1,394	1,473	3,276	3,597	6,258	5,420	1,836	1,561	3,395	17,500	7,453
2005	3,157	4,595	6,122	2,228	2,638	1,633	1,237	1,064	953.8	827.5	753.9	773.4
2006	767.6	757.4	737.3	648.9	685.3	588.6	602	296.3	438.2	443.5	396.4	473.2
2007	1,758	835.6	4,824	3,994	4,860	3,870	12,040	7,406	5,105	—	—	—
Mean of Monthly Discharge	1,740	1,990	1,850	2,130	2,810	2,820	2,120	1,110	1,800	2,080	2,030	1,750

Notes:
Shaded months depict periods of extended drought.
October, November and December 2007 are part of the 2008 water year and are not included.

Table 2.3.1-8 (Sheet 1 of 3)
Monthly Mean Flows for the San Antonio River at Goliad, Texas USGS 08188500

Year	Monthly mean in cfs											
	January	February	March	April	May	June	July	August	September	October	November	December
1924	—	—	—	—	—	—	361.9	232.8	283.3	214.4	205.2	278.9
1925	222.4	219.5	193.9	151.7	211.2	104.2	145.3	113.2	215.1	871.6	222.1	153.1
1926	203.1	132.2	385.5	2,023	1,067	298.7	248.3	137.6	100.3	232.7	184.7	188.3
1927	162.3	204.4	299	491.9	149.3	417.7	114.5	53.7	91.2	291.5	91.6	106.5
1928	117.5	112.2	173	145.1	419.8	502.7	91.4	51	391.5	135.7	763.8	289.5
1929	N/A	121	844	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1939	N/A	N/A	175.2	145.6	138.4	166	257.7	185	119.6	95	98.1	134.8
1940	133	249.9	134.7	372.9	207	594.2	1,392	395.6	138.4	302	2,574	1,655
1941	612.5	1,082	692.1	1,438	3,610	1,628	886.2	454.6	917.6	555.5	480	314.1
1942	283.9	311.2	234.7	521.7	431.5	279.6	4,196	409.6	4,924	2,161	666	510.1
1943	484.1	408	464.3	393.5	452.5	871.4	479.7	252.8	339.1	256.3	316	283.1
1944	457.5	369.4	466.8	291.5	1,860	521.8	275.9	356.5	559.8	267.9	268.4	466.4
1945	714.2	870.6	533.1	1,144	401	505.1	260.5	240.1	214.3	438.4	253.9	262.4
1946	341.4	397	501.1	741.7	1,583	1,097	266.4	833.6	4,313	5,531	927.3	561.4
1947	795	515.6	553.1	453.7	933.4	344.9	256.6	347.5	271.7	224.7	274.6	284.5
1948	260.9	301.1	254.4	238.6	308.5	136.5	398.7	763.3	287.9	329.6	167.4	163
1949	186.9	298.6	264	2,288	716.7	1,010	778.6	295.8	209.4	1,195	312.4	425.4
1950	269.7	221.7	231.3	272.8	227.6	617.7	188.5	213.4	179.5	131.3	126.4	132
1951	124.6	198.6	174.5	195	493.5	1,113	121.4	90.2	789.5	150.4	155.6	150.5
1952	137	214.4	175	316.2	498.7	175.5	165.9	77.4	3,306	149.3	225.5	255.8
1953	271.4	163.6	171.1	206.5	940.6	85	123.6	324.5	1,319	233.7	155.8	195.9
1954	149.7	123.6	112.4	159.1	261.3	125.5	82.5	49.9	66.8	124.4	133	86.5
1955	126.6	352.2	177.3	89.3	314.2	166.4	69	165.1	242.5	75.1	76.2	114.9
1956	104.1	106.6	83.9	86.8	192.2	26.2	52.4	60.6	200.1	368	155.6	382.3
1957	109.9	166.8	492.1	2,515	2,904	2,321	164.3	108.8	2,025	952.4	895.7	295.8
1958	1,641	2,884	638.1	366.8	2,065	454.2	505.3	196	932.1	1,202	1,608	582.4
1959	464.5	516.2	398.5	637.7	621.4	349.8	341.5	226.2	221.4	678.9	396.5	335.4

Table 2.3.1-8 (Sheet 2 of 3)
Monthly Mean Flows for the San Antonio River at Goliad, Texas USGS 08188500

Year	Monthly mean in cfs											
	January	February	March	April	May	June	July	August	September	October	November	December
1960	393.8	381.7	393.8	349.5	318.5	572	518.1	553.1	248	2,520	1,769	943.9
1961	867.9	1,358	684.7	422.6	266.6	1,368	1,012	382.7	363.2	554.4	799.2	342.4
1962	331	325.3	244.6	326.8	251.7	696.7	165.7	146.2	317.7	152.6	235	378.5
1963	215	385	198.4	209.3	153.6	125.9	113.5	47.9	150.1	294.6	344.1	245.3
1964	213.7	536.9	446	193.2	152.4	289.6	88.8	472	206.8	316	599	288.8
1965	567.7	1,778	323.6	462	2,605	732.2	230.7	173	176.8	595.9	239.9	709.9
1966	291.6	359.9	322	487.2	595.8	267.9	186.8	240.8	377.1	207.1	162	183.4
1967	194.2	175	175.4	186.3	168.9	71.4	175.1	394.3	12,050	1,052	968.8	384.9
1968	4,309	1,014	647	678.2	2,063	843.1	538.4	292.4	853.6	315.1	317.1	584.4
1969	359.9	989.9	577.1	709	1,333	573.7	170.1	231.9	334.4	383.4	249.6	355.1
1970	458.4	471.2	695.5	350.1	1,134	1,296	232.8	234.3	221.3	272	204.5	202.8
1971	237.2	208.4	193.6	174.2	136.9	225.4	142.7	1,285	961.4	1,402	912.9	794.6
1972	536.5	451.2	353.9	555.6	4,235	1,073	516.9	521.1	517	609.5	463.8	395.9
1973	441.7	618.2	521.3	1,792	596.9	4,253	4,723	1,400	2,244	7,084	1,625	942.2
1974	825	676.1	587.2	513.4	779.4	521	254.4	1,041	1,660	678	1,088	715.3
1975	768.1	2,066	911.3	783.7	2,518	2,272	980.4	591	510	451.5	394.5	517.5
1976	420.9	351	369.7	1,558	2,680	713.1	1,121	573	865	1,847	2,403	1,836
1977	1,460	1,542	996.3	4,357	2,438	1,290	687.6	466.3	794.6	511.8	1,348	567.2
1978	513.6	594.4	532.2	686.2	452.5	937.6	198.4	1,736	1,860	633.8	1,001	572.2
1979	1,539	1,127	1,265	2,864	2,255	2,785	1,062	708.5	492.8	364.4	406.6	485.4
1980	565	483.6	328.9	383.4	1,316	358.2	207.3	701.8	1,018	310.5	404.2	407.5
1981	426.8	417.3	422	464.4	881	4,747	1,520	618.1	2,444	1,505	1,097	578.1
1982	509.7	815.6	546.1	431.3	1,063	420.6	286.8	288.4	254.5	534.8	529.6	440.2
1983	414.4	480.3	642.3	329.5	417.4	374.4	320	337.8	822.1	371.2	480.2	293.3
1984	376.4	338	400.1	254.5	248.5	201.5	156	177	145.1	1,048	603.6	431.1
1985	664.3	437.5	805.4	796	421.2	909.7	950.8	247.3	432	982.9	1,324	560.3
1986	418.6	448.7	279	246	447.9	2,925	511	249.9	535.7	984.3	597.9	2,153
1987	1,495	1,436	1,591	787.7	1,600	15,370	1,774	819.1	719.1	480.7	606.5	626.6

Table 2.3.1-8 (Sheet 3 of 3)
Monthly Mean Flows for the San Antonio River at Goliad, Texas USGS 08188500

Year	Monthly mean in cfs											
	January	February	March	April	May	June	July	August	September	October	November	December
1988	568.1	504.3	521.2	430.6	344.9	383	404.1	252.6	309.9	249.3	260.6	265.3
1989	371.4	376.5	330.1	409.7	360.5	367.7	149.2	184.4	142.1	223.9	403.5	314.1
1990	242.7	360.5	478.1	724.3	515.3	140.4	1,603	389.5	432.3	333.5	365.3	278.8
1991	755.4	1,026	395.9	1,772	822.7	527.8	478.9	289	379.4	266.8	328	4,628
1992	2,869	7,682	4,379	4,488	6,169	5,759	1,456	937.8	728.5	542.1	1,256	876.5
1993	796	920.3	817.9	687.5	3,403	3,037	1,179	419	355.9	462.9	479.1	391.1
1994	449	473.9	863.9	629.8	2,216	534.1	269.2	250.4	457.8	1,244	449.9	502.2
1995	494.8	392.5	645.9	456.2	393.8	738.6	733.3	231.9	424.9	264.9	252.8	329.9
1996	287.8	248.1	250.4	205.1	184.3	203.6	160.1	216	747.8	189.8	235.2	291.6
1997	253.7	297.4	384.5	1,227	853.3	3,623	1,425	319.8	286.2	560.8	368.3	468.2
1998	503.9	1,113	1,053	514.3	241.7	166.6	162.7	699.7	671.3	7,543	2,050	984.5
1999	747.1	588.3	667.4	561.4	573.9	937.6	493.6	259.2	215.9	232.8	277.8	286.2
2000	371.7	393.6	336.7	425.7	495.5	796.7	198.7	136.6	209.7	738	2,747	672.8
2001	863.6	639.3	755.7	889.4	961.3	451.1	201	667	6,176	728.6	1,496	1,474
2002	713.1	533.7	480.7	964.2	382.4	269	15,330	1,392	3,056	4,731	3,805	2,186
2003	1,457	1,540	1,251	824.9	525.9	673.1	965.2	430.6	1,553	816.7	604.6	553.7
2004	587.2	650.8	719.3	2,411	2,460	2,928	2,630	946.7	813.3	1,327	5,914	1,923
2005	1,246	1,568	2,059	905.8	837.8	763.4	490	420.1	471.6	398.1	322.7	420
2006	397.2	273.1	375.5	261.6	453.1	228.5	239.7	136.9	449.2	284	291	351.8
2007	874.8	341.5	2,551	1,675	1,650	1,135	7,235	5,736	2,417	—	—	—
Mean of Monthly Discharge	598	695	589	788	1,050	1,150	904	485	1,010	887	751	585

N/A = data not available

Notes:

Shaded months depict periods of extended drought.

October, November and December 2007 are part of the 2008 water year and are not included.

Table 2.3.1-9 (Sheet 1 of 2)
Monthly Mean Flows for Coleto Creek Near Victoria, Texas USGS 08177500

Year	Monthly Mean in cfs											
	Calculation period restricted by USGS staff due to special conditions at/near site											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	—	—	—	—	—	—	—	—	—	4.62	5.45	5
1981	5.84	5.09	5.44	5.84	447.6	1,115	87.7	89.3	245.3	579.4	273	24.2
1982	15.3	479.2	33.6	21.4	429.5	13.1	4.89	5.18	4.03	4.66	338.3	5.55
1983	5.44	117.4	182.5	6.51	5.61	5.94	335.6	22.9	6.08	208.3	152.8	8.87
1984	58.6	19.9	220.2	4.74	7.05	5.08	5.01	5	5.11	43.6	24.6	22.6
1985	27.7	23.5	291.9	338.7	31.3	13.5	123	5.23	4.73	5.75	5.18	5.01
1986	5.51	5.08	4.85	4.76	5.53	37.5	4.06	2.8	2.62	156	10.9	295.6
1987	90.3	303.4	42.9	11.8	4.46	1,168	10	5.18	6.73	5.3	9.48	5.98
1988	5.65	5.73	6.53	5.1	4.78	5.25	4.7	2.04	2.11	2.53	3.66	2.39
1989	3.01	2.6	3.01	3.75	2.91	2.5	1.97	1.06	1.56	1.65	2.21	2.37
1990	2.34	2.46	2.92	65	2.88	1.82	397.4	3.08	2.13	2.39	2.14	2.4
1991	3.66	3.15	2.67	719.3	3.86	114	50.9	4.14	3.71	3.14	2.46	434.1
1992	347	960.6	32	956	442.2	64	5.34	4.89	4.47	4.09	4.95	5.26
1993	5.34	52.4	236.3	19.2	939.9	1,426	13.9	6.5	7.36	5.41	5.1	4.55
1994	5.5	5.97	40.5	5.13	328.6	27.3	4.46	4.51	4.63	1,074	5.86	5.81
1995	64.6	4.95	85.8	27.9	7.11	4.85	3.67	2.43	1.81	1.61	2.01	2.18
1996	1.93	1.98	2.05	2.07	2.09	2.41	1.31	2.14	1.98	1.71	1.9	2.01
1997	4.58	3.11	545.2	1,817	117.6	1,133	10.9	6.2	5.69	657.5	13.5	5.56
1998	28.5	191.6	149.3	5.02	4.62	4.43	4.15	3.47	989.8	1,313	949.5	83.9
1999	24.2	15.6	14	7.5	6.28	50.3	11.5	4.61	4.97	4.86	5.37	2.61
2000	4.09	3.26	13.4	17.2	14.1	36.1	8.77	3.91	1.78	2.1	2.57	3.06
2001	85.6	2.35	20.6	6.43	158.1	0.043	0.009	369.9	1,202	52.7	249.8	272.1
2002	11.1	3.02	3.08	3.48	2.83	5.1	341.2	0.931	136.3	458.6	511.3	212.4
2003	94.5	57.3	18.6	2.22	2.56	3.07	89.4	3.04	371.7	77.4	144.5	9.09

Table 2.3.1-9 (Sheet 2 of 2)
Monthly Mean Flows for Coleto Creek Near Victoria, Texas USGS 08177500

Year	Monthly Mean in cfs											
	Calculation period restricted by USGS staff due to special conditions at/near site											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	133.5	33	94.7	423.6	725.1	278.6	68.4	5.44	5.32	5.6	1,186	29.3
2005	141.3	465.3	358.7	28.1	225.1	21.9	5.3	5.13	5.31	5.06	5.31	5.28
2006	5.23	5.88	5.66	6.46	5.68	6.99	4.66	4.51	3.48	3.77	3.02	3.95
2007	27.7	9.39	562.9	98.1	76	6.61	1,518	61.3	55.1	—	—	—
Mean of monthly Discharge	45	103	110	171	148	206	115	24	114	174	145	54

Note: October, November, and December 2007 are part of the 2008 water year and are not included.

Table 2.3.1-10
Mean Daily Flows for the Guadalupe River at Victoria, Texas, USGS Gage 08176500

Day of Month	Mean of Daily Mean Values for Each Day of Record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1,790	1,700	2,180	1,630	2,900	2,730	2,600	1,200	1,760	1,720	1,750	1,680
2	1,770	1,530	1,890	1,690	3,360	2,750	3,030	1,170	2,770	1,290	1,940	1,610
3	1,720	1,500	1,760	1,860	3,540	2,700	4,420	1,160	2,970	1,180	2,260	1,570
4	1,580	1,530	1,650	2,050	3,280	2,740	3,880	1,150	2,470	1,180	2,170	1,520
5	1,450	1,720	1,610	2,100	2,980	2,820	3,100	1,150	1,760	1,080	2,030	1,610
6	1,420	1,960	1,670	1,980	2,890	3,440	2,580	1,190	1,380	1,010	2,030	1,620
7	1,430	2,250	1,750	1,850	2,810	3,990	2,530	1,160	1,280	1,110	2,040	1,700
8	1,460	2,420	1,950	1,930	2,850	3,750	2,440	1,150	1,300	1,240	2,410	1,790
9	1,450	2,190	2,040	2,010	2,910	3,280	2,760	1,120	1,380	1,280	2,390	1,820
10	1,430	1,970	1,810	1,910	2,870	2,970	3,090	1,120	1,450	1,300	1,850	1,750
11	1,520	1,790	1,590	1,970	2,740	2,790	2,740	1,110	1,610	1,330	1,570	1,570
12	1,610	1,780	1,550	2,130	2,880	2,730	2,270	1,070	1,870	1,460	1,550	1,530
13	1,760	1,800	1,490	2,020	2,780	2,700	1,990	1,040	1,730	1,570	1,590	1,650
14	1,730	1,790	1,770	1,900	2,880	2,960	1,800	1,040	1,960	1,590	1,650	1,830
15	1,780	1,820	1,980	1,840	3,120	2,970	1,720	1,050	2,020	1,550	1,640	1,800
16	1,770	1,780	2,200	1,910	3,000	2,830	1,750	1,050	1,870	1,880	1,660	1,670
17	1,730	1,770	2,420	2,000	2,810	2,800	1,790	1,050	1,780	2,050	1,750	1,660
18	1,560	1,830	2,230	2,160	2,640	2,780	1,720	1,020	1,530	2,100	1,860	1,730
19	1,630	1,810	2,140	2,200	2,890	2,760	1,640	1,050	1,480	2,890	1,830	1,740
20	1,860	1,810	2,080	2,270	2,770	2,890	1,630	1,080	1,540	6,570	1,780	1,690
21	2,040	1,920	2,010	2,470	2,500	2,720	1,580	1,070	1,910	5,390	1,770	1,680
22	2,110	2,020	1,880	2,340	2,330	3,040	1,470	1,050	1,970	3,610	1,870	1,720
23	1,960	2,030	1,780	2,340	2,540	2,850	1,460	1,070	1,960	2,770	1,910	1,740
24	1,930	2,120	1,760	2,450	2,790	2,540	1,450	1,110	2,010	2,360	1,910	1,830
25	2,220	2,540	1,800	2,320	2,710	2,260	1,490	1,110	1,860	2,220	2,690	2,260
26	2,200	2,950	1,850	2,400	2,380	2,280	1,580	1,080	1,680	2,450	3,150	2,200
27	2,020	2,710	1,740	2,430	2,300	2,410	1,570	1,090	1,630	2,330	2,930	1,990
28	1,860	2,500	1,660	2,460	2,510	2,300	1,450	1,060	1,530	2,250	2,670	1,890
29	1,690	2,810	1,660	2,570	2,720	2,250	1,410	1,110	1,660	2,160	2,330	1,790
30	1,660		1,710	2,650	2,740	2,420	1,390	1,230	1,840	1,890	1,950	1,760
31	1,710		1,700		2,700		1,280	1,360		1,730		1,830

Table 2.3.1-11
Mean Daily Flows for the San Antonio River at Goliad, Texas, USGS Gage 08188500

Day of Month	Mean of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	528	552	639	615	976	1,080	1,110	465	1,240	912	891	516
2	524	533	554	676	1,010	1,120	982	413	1,310	1,080	873	486
3	527	563	502	682	1,070	1,150	915	412	1,140	1,030	832	521
4	492	610	489	670	1,120	1,170	813	420	903	754	780	511
5	484	728	494	629	1,050	1,370	808	428	726	534	809	527
6	506	860	546	673	1,050	1,450	953	452	641	492	915	529
7	509	898	580	703	1,030	1,350	1,180	469	648	577	1,060	562
8	494	894	623	695	978	1,330	1,430	524	781	655	1,090	550
9	489	823	616	649	970	1,310	1,820	584	863	649	834	533
10	471	708	597	626	930	1,250	1,750	540	940	552	567	496
11	479	621	556	687	894	1,050	1,380	459	1,110	687	574	491
12	523	596	531	656	1,040	1,120	1,050	482	1,290	816	568	491
13	577	599	504	591	1,020	1,250	906	481	1,260	768	572	496
14	604	580	606	576	967	1,400	853	409	1,270	748	598	533
15	583	570	685	548	1,120	1,300	692	375	1,060	706	588	515
16	563	597	800	563	1,250	1,220	663	357	808	742	600	506
17	510	662	792	644	1,160	1,170	703	393	752	904	558	545
18	499	639	636	752	1,140	1,110	715	452	783	1,020	561	608
19	528	605	666	877	1,160	967	734	474	756	1,030	690	566
20	645	566	638	837	1,220	972	765	565	849	871	730	547
21	708	572	638	854	983	965	800	557	861	1,180	783	651
22	701	678	616	909	885	1,090	789	584	963	1,480	804	656
23	764	767	662	936	998	1,090	779	580	2,210	1,310	701	647
24	867	810	545	1,040	1,020	897	810	511	1,710	1,040	703	781
25	834	852	516	1,170	1,010	839	807	410	1,160	972	887	900
26	776	906	528	1,130	1,060	877	753	405	959	962	941	913
27	691	906	501	1,060	1,090	1,010	656	445	858	1,100	926	813
28	655	797	475	1,070	1,030	1,130	628	516	786	1,120	852	663
29	684	661	530	1,040	1,070	1,190	604	483	759	1,060	660	563
30	676		582	1,080	1,080	1,230	597	540	823	918	581	503
31	637		615		1,060		566	844		829		507

Table 2.3.1-12
Mean Daily Flows for Coleto Creek near Victoria, Texas, USGS Gage 08177500

Day of	Mean of daily mean values for each day of record in, cfs											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	14	79	36	44	65	46	51	7.8	768	4.6	231	4.5
2	21	87	37	272	127	40	431	8	189	4.4	68	106
3	5.9	78	21	598	219	79	277	7.4	101	4.4	33	73
4	9.4	205	16	1,060	118	180	233	7.4	123	4.5	141	28
5	10	106	5.8	847	124	311	313	13	105	9.3	367	15
6	23	25	96	296	710	66	254	6.7	74	146	146	27
7	6.8	12	131	125	93	164	71	11	57	105	84	19
8	39	7.4	46	53	58	59	38	4.2	37	16	13	34
9	38	13	32	19	77	54	44	12	62	12	13	29
10	11	40	23	88	135	72	21	6.5	54	17	19	35
11	31	159	11	175	46	391	6.6	4.9	395	98	17	51
12	39	25	323	116	78	609	7.8	5.8	332	173	14	92
13	104	20	147	95	67	439	7.5	5.8	72	528	218	53
14	49	12	459	52	526	374	7.5	4.4	43	50	548	54
15	11	61	313	16	267	66	116	5.4	118	10	199	45
16	51	83	246	6.2	131	37	531	19	274	14	222	29
17	129	17	318	296	185	62	590	7.5	188	87	70	17
18	69	11	156	373	371	51	79	4.1	108	974	193	19
19	28	44	84	22	87	91	39	4	104	1,130	227	25
20	22	48	118	47	83	537	70	3.9	98	295	175	7
21	17	78	97	25	113	333	66	3.8	66	170	712	30
22	16	151	26	24	22	1,030	19	3.9	24	65	283	573
23	8	104	139	23	164	178	6.1	4	5.2	179	152	132
24	56	191	94	21	183	74	5.4	4.6	4.8	188	114	38
25	24	469	23	39	122	76	61	3.9	4.5	299	44	37
26	40	474	105	241	52	298	119	4.4	4.3	97	20	11
27	248	228	33	110	44	172	51	8	6.2	51	16	24
28	183	92	20	13	39	72	17	4.7	4.6	15	5.2	19
29	47	14	12	7.3	106	110	5.8	9.5	4.6	24	4.9	9.9
30	26		29	19	116	98	13	9.4	4.6	5.7	7.3	8.6
31	11		223		71		27	524		601		33

Table 2.3.1-13
Maximum of the Daily Mean Flows for the Guadalupe River at Victoria, Texas, USGS Gage 08176500

Day of Month	Max. of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	14,500	23,500	21,300	8,660	22,800	15,300	22,300	8,080	22,300	22,600	15,800	13,000
2	10,500	10,600	16,900	10,300	30,800	20,200	39,800	7,270	77,600	10,900	24,000	10,100
3	9,510	7,430	17,900	12,700	49,700	17,000	129,000	7,680	86,900	14,300	36,200	9,340
4	9,150	10,500	10,500	22,500	30,600	14,300	122,000	8,210	61,400	16,700	27,100	9,290
5	9,130	14,100	7,540	21,300	25,400	20,000	75,200	8,390	35,300	8,920	17,400	9,490
6	9,290	17,500	10,500	19,000	26,400	61,800	44,400	8,580	14,500	4,580	16,900	9,370
7	9,590	34,100	14,600	14,500	30,200	80,700	30,000	8,190	7,280	5,050	22,700	10,900
8	9,980	45,100	27,600	15,800	30,000	66,100	26,600	7,820	8,040	7,570	48,800	13,600
9	9,630	33,300	30,300	16,300	24,400	47,200	42,800	7,580	8,010	9,040	48,700	18,200
10	8,790	23,200	20,900	10,300	18,500	31,500	67,800	7,400	8,960	9,980	30,900	19,800
11	8,670	15,600	9,860	11,000	24,100	30,500	59,400	7,300	9,140	6,760	11,600	12,500
12	10,400	10,400	7,600	14,000	24,600	29,200	42,900	7,200	16,200	17,000	6,280	8,640
13	10,400	9,550	8,270	15,900	20,600	21,100	29,000	7,070	18,500	20,700	13,600	11,600
14	11,200	10,900	12,800	11,500	21,400	35,800	20,300	6,970	25,500	22,500	21,200	14,100
15	9,850	12,200	17,500	10,200	44,900	37,800	14,400	6,900	18,000	23,900	21,700	11,500
16	11,500	10,000	20,500	10,800	52,200	35,800	15,600	7,050	25,300	24,900	20,500	12,100
17	12,000	9,170	26,400	14,600	35,400	31,900	19,100	7,120	23,700	26,000	22,900	12,000
18	7,810	10,700	15,200	20,600	23,900	26,600	13,300	7,270	12,100	20,800	25,200	11,900
19	8,460	11,300	12,300	18,200	17,700	27,100	11,100	7,730	7,100	33,200	20,300	12,400
20	9,940	13,300	11,400	19,900	21,300	36,200	11,800	7,840	8,940	307,000	13,500	15,300
21	11,000	14,700	13,300	20,600	22,000	28,300	12,000	7,810	34,500	235,000	25,000	15,900
22	15,500	12,600	12,100	20,200	17,300	48,000	10,000	7,380	35,400	115,000	31,400	14,400
23	17,600	17,800	10,200	36,000	21,100	43,600	11,500	7,190	41,400	75,400	30,500	17,200
24	26,100	17,800	8,000	50,100	24,700	27,500	15,500	7,060	51,200	52,900	29,200	21,000
25	41,000	29,800	8,450	32,000	15,400	14,300	20,300	6,950	42,500	34,200	64,500	52,700
26	30,400	54,000	7,900	19,900	13,700	15,600	28,200	6,880	28,300	25,600	90,400	54,600
27	19,900	41,400	7,980	15,600	14,600	15,700	27,400	6,820	20,600	22,000	67,900	38,200
28	14,200	36,600	7,890	16,700	22,000	13,500	20,500	6,880	18,800	19,000	45,800	26,700
29	15,000	32,500	8,190	21,800	29,000	15,400	18,900	6,980	22,000	22,400	24,900	20,800
30	18,000		8,710	24,400	25,000	21,400	16,800	8,340	26,300	19,500	15,200	18,800
31	24,200		8,980		21,200		11,200	10,100		16,800		18,200

Table 2.3.1-14
Maximum of the Daily Mean Flows for the San Antonio River at Goliad, Texas, USGS Gage 08188500

Day of Month	Max. of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2,280	5,590	7,230	4,730	15,000	13,000	10,200	8,260	23,600	17,000	7,180	3,530
2	2,110	3,500	4,720	7,100	10,200	10,100	11,300	4,890	26,500	27,800	7,430	3,240
3	1,910	4,220	3,000	7,030	9,380	9,270	8,800	4,150	22,700	25,500	5,850	3,790
4	1,800	7,510	2,790	8,740	9,200	12,200	9,320	3,680	16,800	14,900	5,900	3,210
5	1,870	10,300	2,770	5,530	11,900	18,400	11,400	3,620	14,100	7,160	8,010	3,030
6	2,450	12,600	5,380	7,130	13,200	27,400	15,600	2,930	11,100	3,070	10,900	3,540
7	2,780	14,600	9,220	7,250	10,000	32,800	26,000	3,640	10,700	5,030	14,200	3,810
8	2,340	16,900	12,000	6,690	9,420	32,000	40,100	4,730	14,000	7,130	16,600	3,720
9	2,030	16,100	12,700	6,360	9,740	29,000	62,000	5,680	12,800	6,420	10,500	2,300
10	1,490	12,700	11,400	3,760	9,220	26,300	60,800	5,080	13,100	3,830	3,730	2,960
11	2,580	9,100	8,630	5,280	7,980	23,900	46,300	2,910	23,200	5,480	2,880	2,880
12	5,250	6,660	6,150	4,110	9,130	21,100	35,100	4,260	28,600	11,900	3,770	3,620
13	6,170	5,400	4,900	3,760	9,650	19,700	25,000	5,510	24,000	11,900	4,980	4,290
14	5,120	4,640	5,840	4,070	11,000	24,300	16,500	2,920	23,400	7,820	4,540	5,670
15	6,620	4,170	12,000	3,330	12,500	25,900	11,100	1,750	15,800	7,310	6,190	3,750
16	4,800	4,470	16,600	4,060	12,700	24,000	11,700	1,800	6,130	7,490	4,900	2,710
17	1,800	6,160	15,000	6,530	11,600	22,200	13,000	4,110	5,180	14,900	3,700	5,170
18	1,620	6,160	4,360	9,480	9,640	20,600	14,800	8,190	5,780	19,000	4,210	7,130
19	2,120	5,240	4,150	11,800	15,100	16,500	13,500	9,410	7,680	13,200	7,640	3,170
20	4,690	3,350	3,550	11,200	20,300	13,200	11,100	11,600	7,070	10,900	10,400	4,210
21	7,020	2,720	5,470	11,800	12,000	12,500	9,290	14,700	11,200	34,100	13,300	8,170
22	9,030	5,570	6,280	8,610	9,660	12,400	11,000	19,100	28,800	55,800	14,700	8,660
23	14,900	9,780	10,200	11,300	10,400	10,300	13,100	20,200	121,000	43,300	11,000	11,100
24	24,900	12,400	2,290	14,800	10,500	7,660	14,700	15,000	84,200	29,500	9,140	16,400
25	22,200	15,500	2,550	15,200	11,000	7,730	14,800	6,530	42,900	17,000	12,400	25,100
26	17,700	14,300	2,520	10,700	13,200	9,860	14,200	4,380	25,300	11,000	19,500	25,800
27	12,200	13,900	2,470	12,300	12,900	11,800	12,800	3,800	17,100	13,700	22,600	18,300
28	7,030	11,400	2,370	13,800	10,200	12,600	13,300	9,070	12,300	17,100	16,500	13,000
29	10,100	5,860	2,500	11,400	9,610	13,300	14,700	6,460	8,710	16,900	6,520	8,640
30	11,700		2,720	14,400	11,300	15,600	15,400	6,580	10,300	10,500	4,010	3,450
31	10,400		5,360		13,200		14,100	12,700		7,500		2,570

Table 2.3.1-15
Maximum of the Daily Mean Flows for Coleto Creek near Victoria, Texas, USGS Gage 08177500

Day of Month	Max. of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	127	1,890	343	930	841	282	1,160	95	15,300	19	6,000	15
2	300	1,300	262	6,560	2,320	340	10,600	101	4,430	19	729	2,590
3	18	1,450	261	15,200	4,910	1,330	6,430	92	1,810	19	425	1,270
4	115	5,050	120	27,500	2,470	2,460	3,740	91	2,560	19	3,470	624
5	135	2,330	19	15,300	2,720	4,710	7,070	156	2,460	83	8,550	111
6	280	290	2,350	2,720	14,500	1,260	5,730	70	1,750	3,400	1,930	457
7	42	94	2,180	1,750	1,960	2,510	1,110	172	1,330	2,370	1,240	343
8	554	60	776	505	569	616	363	7.6	857	287	160	511
9	600	141	303	166	1,430	814	617	212	1,560	150	154	377
10	112	696	373	1,860	2,370	1,180	344	42	1,350	189	161	527
11	665	3,710	99	2,900	778	8,430	26	21	9,240	1,440	210	820
12	343	201	4,670	2,280	1,510	9,000	75	51	8,220	4,190	147	1,490
13	1,310	188	1,540	1,320	918	6,790	68	52	1,520	13,400	5,690	1,030
14	722	161	6,960	770	9,390	4,750	67	20	375	1,190	14,500	1,330
15	150	1,000	3,420	228	3,020	1,130	2,640	42	1,260	161	4,380	625
16	692	1,310	1,750	17	2,290	716	6,720	406	5,380	174	5,180	507
17	2,220	266	6,350	7,780	3,100	1,250	10,400	102	3,600	2,210	853	296
18	626	182	3,330	9,780	4,740	372	850	13	2,180	14,700	2,870	217
19	325	1,040	1,660	377	1,140	1,770	404	9	2,300	16,600	4,960	341
20	240	685	1,570	1,000	1,220	13,900	1,220	8.3	1,800	6,890	4,080	75
21	151	1,270	2,350	490	2,330	7,090	1,500	7.1	1,540	3,160	18,600	408
22	221	1,900	454	315	215	23,200	365	7	395	508	6,990	10,600
23	58	1,370	2,750	430	3,510	3,040	34	11	24	3,100	3,620	1,870
24	623	2,910	2,070	352	2,580	635	20	28	25	4,300	2,580	720
25	235	6,410	178	538	1,660	560	1,520	9.8	21	7,260	876	398
26	697	6,210	2,150	3,530	735	3,290	3,090	24	20	1,240	366	105
27	6,420	2,920	235	1,800	407	2,710	1,270	123	56	456	282	340
28	3,040	1,280	151	146	331	959	340	29	20	135	16	148
29	654	59	85	35	1,990	2,130	41	155	20	333	16	81
30	176		152	132	1,740	1,190	234	85	20	14	79	87
31	142		5,690		918		608	11,400		15,800		553

Table 2.3.1-16
Minimum of the Daily Mean Flows for the Guadalupe River at Victoria, Texas, USGS Gage 08176500

Day of Month	Min. of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	127	132	181	113	103	71	47	41	92	22	46	50
2	121	119	188	168	138	71	47	43	81	22	44	50
3	128	147	161	148	106	68	47	44	68	23	46	53
4	119	231	181	127	95	64	47	43	68	24	95	48
5	118	171	181	111	98	59	46	37	66	23	95	46
6	118	126	181	106	106	62	44	29	66	24	100	46
7	116	113	188	111	116	62	44	35	61	30	79	48
8	132	126	174	102	128	61	43	40	66	32	66	48
9	119	111	162	95	106	62	40	37	61	30	54	56
10	113	142	165	94	95	62	40	36	61	25	47	58
11	103	132	174	90	84	66	50	30	66	25	43	53
12	118	116	119	182	79	62	50	25	74	22	48	47
13	108	133	145	210	84	62	76	30	69	20	47	54
14	105	121	134	154	84	59	90	36	58	25	44	52
15	103	239	157	116	90	56	76	37	48	49	54	56
16	116	239	161	94	174	53	71	35	44	54	59	56
17	105	248	181	87	188	56	56	30	41	29	54	50
18	97	231	122	87	328	48	47	25	44	95	56	105
19	150	181	164	82	286	56	40	17	44	91	58	168
20	113	168	154	82	254	56	43	14	44	91	50	144
21	105	208	160	82	188	53	47	25	44	95	43	76
22	121	194	164	79	138	52	41	30	37	95	41	174
23	134	248	160	79	103	58	37	29	36	98	41	174
24	106	231	158	90	87	73	44	29	37	97	48	130
25	110	181	142	81	90	68	47	28	37	94	44	106
26	128	194	158	162	84	61	52	32	35	84	41	188
27	105	208	119	160	89	58	58	52	30	73	39	201
28	113	181	151	188	79	54	53	53	24	64	43	188
29	108	231	168	155	79	50	44	53	19	58	46	181
30	130		134	138	78	47	37	52	19	53	41	165
31	174		113		71		37	87		50		161

Table 2.3.1-17
Minimum of the Daily Mean Flows for the San Antonio River at Goliad, USGS Gage 08188500

Day of Month	Min. of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	81	103	78	63	57	28	6.8	25	37	62	62	76
2	81	102	76	60	57	49	12	23	47	70	66	78
3	81	105	84	58	56	44	19	21	48	44	63	78
4	88	103	84	53	51	23	21	16	48	48	58	78
5	87	108	94	66	45	23	21	18	48	89	62	78
6	84	103	89	78	41	20	20	22	48	72	62	78
7	81	103	78	75	40	14	21	15	46	69	65	78
8	84	86	75	69	40	14	21	16	48	68	63	78
9	92	86	80	69	43	16	25	21	48	56	66	78
10	89	99	76	103	44	24	23	19	47	49	70	74
11	83	97	76	105	59	20	20	16	47	47	78	76
12	83	94	81	89	55	7.2	26	17	54	46	78	65
13	86	102	83	76	56	5	55	18	49	46	78	53
14	84	112	78	78	52	2.1	65	19	46	63	78	52
15	91	108	84	72	66	5	63	16	60	62	78	55
16	89	94	95	69	90	3.4	66	16	65	74	72	65
17	84	84	92	68	90	2.3	51	18	65	67	66	69
18	86	84	89	62	81	9.8	42	20	86	61	66	79
19	94	94	86	62	71	24	34	21	74	61	78	82
20	87	95	78	55	86	35	22	27	74	55	78	84
21	84	89	86	55	93	56	19	24	63	61	76	87
22	107	89	92	59	86	46	27	22	55	61	76	86
23	97	83	105	57	76	56	35	43	62	61	75	82
24	97	87	94	60	63	58	23	37	59	62	75	86
25	97	89	84	63	59	60	23	43	52	60	76	89
26	94	92	86	63	58	43	27	43	48	60	69	92
27	97	84	84	71	54	28	32	37	46	59	70	91
28	108	84	83	65	83	22	25	44	39	65	78	89
29	102	87	76	60	62	16	25	37	39	62	75	92
30	92		78	56	32	8.2	39	37	51	56	76	88
31	103		76		28		34	20		59		83

Table 2.3.1-18
Minimum of the Daily Mean Flows for Coleto Creek near Victoria, Texas, USGS Gage 08177500

Day of Month	Min. of daily mean values for each day of record in, cfs											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.9	0.2	2.4	2	2.2	0.17	0	0	0.71	0.58	1.7	0.71
2	1.9	0.2	2.2	2.1	1.2	0.13	0.02	0	0.79	0.57	1.8	1.5
3	2	0.18	0	2	1.1	0.09	0.02	0	1	0.56	1.8	1.7
4	1.5	0.19	0	1.9	1.1	0.06	0.01	0	1	0.53	2.1	1.7
5	0.8	2.2	0	2	1.9	0.05	0	0	0.98	0.51	2.2	1.4
6	0.72	2	0	1.9	0	0.04	0	0	0.66	0.51	1.9	1
7	0.68	1.8	0	1.9	0	0.03	0	0	0.66	1.6	2	0.92
8	0.7	1.9	0	2	1.3	0.44	0	0	0.66	0.67	1.8	1.6
9	0.71	1.8	2.1	2	2.3	0.07	0	0.01	0.65	0.52	1.7	1.6
10	0.7	1.8	2.1	2	2	0.03	0	0.01	0.66	0.47	1.6	1.6
11	0.69	1.8	2.1	2	2	0.03	0	0.02	1.2	0.43	1.5	1.5
12	2	2	2	1.8	2	0.02	0	0.02	1.2	0.41	1.4	1.5
13	2	2	1.9	1.7	2	0.02	0	0.02	1.3	0.41	1.4	1.5
14	2	1.9	1.9	1.8	2	0.02	0	0.02	1.3	0.42	1.4	1.5
15	1.9	1.9	1.8	1.8	1.6	0.02	0	0.03	1.5	0.4	1.4	1.8
16	0.43	1.9	1.9	1.7	0.89	0.02	0.17	0.03	1.4	0.39	1.5	1.9
17	0.27	1.9	1.9	1.6	0.66	0.01	0.02	0.03	1.3	0.39	1.5	1.1
18	0.65	1.9	2	1.5	0.64	0.01	0.01	0.03	1.4	0.38	1.6	1.8
19	0.6	1.9	2	1.5	0.55	0	0	0.03	1.3	0.41	1.5	2
20	1.9	1.9	2.1	1.3	0.47	0	0	0.05	1.3	0.45	1.5	0.58
21	1.7	1.9	2.2	1.3	0.41	0	0	0.07	1.4	0.41	1.4	1.2
22	0.32	1.6	2.1	1.3	0.37	0.01	0	0.09	1.3	0.43	1.3	0.75
23	0.19	1.6	2.1	1.2	0.35	0	0	0.11	1.3	1.5	1.3	0.72
24	0.2	1.8	2	1.2	0.33	0	0	0.14	1.2	1.5	1.5	1.9
25	0.2	1.9	2.1	1	0.31	0	0	0.17	0.96	1.5	1.1	2
26	0.19	1.9	2.2	0.95	0.29	0.01	0	0.2	0.75	1.5	0.83	2.1
27	0.17	1.8	2.3	1	0.27	0.01	0.01	0.23	0.67	1.5	0.71	1.2
28	0.18	1.9	2.2	0.95	0.24	0	0.01	0.32	0.65	1.4	0.71	0.93
29	0.18	2.2	2.1	1.1	0.2	0	0	0.36	0.62	1.5	0.77	0.7
30	0.16		1.9	2.5	0.17	0	0	0.73	0.6	1.6	0.69	0.74
31	0.19		2		0.2		0	0.71		1.6		0.63

Table 2.3.1-19
Guadalupe River Peak Discharge Frequency at Confluence with Coleto Creek

Flooding Source And Location	Drainage Area (square miles)	Peak Discharges (cfs)			
		10-Year	50-Year	100-Year	500-Year
Guadalupe River at confluence of Coleto Creek	5200	48,000	99,000	129,000	219,000

Source: FEMA 1998

Table 2.3.1-20
Suspended Sediment Concentrations for the Guadalupe River at Victoria, Texas
USGS Gage 08176500

Date	Concentration (mg/l)	Date	Concentration (mg/l)	Date	Concentration (mg/l)	Date	Concentration (mg/l)
1/8/1973	34	6/24/1976	56	10/2/1979	79	5/8/1985	144
2/14/1973	52	7/21/1976	129	11/6/1979	83	7/10/1985	192
3/12/1973	67	8/19/1976	67	12/12/1979	65	10/10/1985	64
4/17/1973	709	9/23/1976	52	1/17/1980	77	1/16/1986	46
6/25/1973	281	10/21/1976	319	2/12/1980	63	4/23/1986	110
7/26/1973	272	11/19/1976	79	3/11/1980	51	9/3/1986	41
8/29/1973	94	12/16/1976	205	4/8/1980	53	10/23/1986	114
9/25/1973	66	1/13/1977	55	5/6/1980	75	2/11/1987	52
10/24/1973	137	2/17/1977	90	6/11/1980	99	6/23/1987	331
11/13/1973	128	3/17/1977	66	7/9/1980	63	8/19/1987	135
12/11/1973	38	4/14/1977	81	8/7/1980	72	10/14/1987	55
1/15/1974	310	5/12/1977	221	9/10/1980	1210	3/1/1988	75
2/20/1974	32	6/9/1977	77	10/15/1980	54	6/29/1988	72
3/19/1974	40	7/14/1977	57	11/13/1980	32	8/10/1988	153
4/23/1974	35	8/18/1977	86	12/9/1980	16	11/9/1988	15
5/21/1974	88	9/15/1977	110	1/7/1981	35	3/8/1989	21
6/25/1974	52	10/20/1977	90	2/4/1981	45	6/15/1989	96
7/23/1974	48	11/10/1977	270	3/5/1981	59	8/16/1989	37
8/28/1974	31	12/8/1977	62	4/9/1981	134	10/17/1989	45
9/24/1974	89	1/26/1978	30	5/15/1981	102	3/6/1990	49
10/23/1974	26	2/16/1978	39	6/22/1981	255	5/24/1990	15
11/14/1974	123	3/16/1978	28	7/17/1981	193	9/5/1990	34
12/11/1974	574	4/24/1978	431	8/21/1981	146	10/30/1990	20
1/30/1975	22	5/22/1978	13	9/18/1981	135	3/6/1991	44
2/20/1975	379	6/12/1978	205	11/19/1981	112	5/21/1991	85
3/27/1975	67	7/17/1978	42	2/10/1982	57	9/5/1991	75
4/23/1975	170	8/22/1978	295	3/30/1982	96	10/23/1991	33
5/22/1975	602	9/26/1978	352	5/3/1982	55	2/12/1992	311
6/18/1975	168	10/17/1978	32	7/26/1982	103	4/7/1992	241
7/17/1975	498	11/7/1978	187	9/1/1982	74	8/28/1992	90
8/20/1975	40	12/20/1978	21	10/14/1982	78	10/15/1992	108
9/18/1975	19	1/16/1979	350	1/12/1983	33	3/9/1993	69
10/23/1975	18	2/21/1979	78	4/12/1983	89	5/3/1993	84
11/20/1975	24	3/20/1979	73	8/23/1983	64	8/20/1993	59
12/10/1975	11	4/10/1979	162	10/12/1983	21	11/15/1993	88
1/22/1976	9	5/9/1979	223	1/17/1984	26	3/25/1994	60
2/26/1976	25	6/5/1979	195	4/11/1984	73	5/17/1994	409
3/25/1976	29	7/12/1979	141	7/11/1984	62	8/25/1994	35
4/29/1976	327	7/31/1979	299	10/17/1984	608		
5/27/1976	317	8/29/1979	64	1/23/1985	147		

Table 2.3.1-21
Suspended Sediment Concentrations for the San Antonio River at Goliad, Texas
USGS Gage 08188500

Date	Concentration (mg/l)	Date	Concentration (mg/l)	Date	Concentration (mg/l)	Date	Concentration (mg/l)
10/24/1974	102	3/15/1978	78	4/10/1981	81	12/14/1987	87
11/14/1974	145	4/25/1978	2450	5/14/1981	186	3/1/1988	62
12/12/1974	885	5/23/1978	295	6/23/1981	262	4/12/1988	103
1/30/1975	111	6/28/1978	87	7/16/1981	380	6/28/1988	104
2/21/1975	250	7/19/1978	84	8/20/1981	179	8/9/1988	89
3/27/1975	160	8/23/1978	181	9/18/1981	361	11/8/1988	63
4/24/1975	138	9/28/1978	265	11/16/1981	149	1/26/1989	145
5/22/1975	231	10/18/1978	243	3/29/1982	80	3/7/1989	71
6/18/1975	322	11/8/1978	2350	5/3/1982	51	5/10/1989	146
7/17/1975	187	12/19/1978	46	7/26/1982	104	6/13/1989	66
8/21/1975	95	1/17/1979	358	8/31/1982	85	8/15/1989	135
9/18/1975	700	2/22/1979	125	10/13/1982	1460	10/17/1989	93
10/22/1975	92	3/21/1979	1380	1/10/1983	57	3/6/1990	486
11/20/1975	71	4/10/1979	260	2/22/1983	142	5/23/1990	5
12/10/1975	54	5/8/1979	100	4/11/1983	138	7/11/1990	80
1/21/1976	67	5/9/1979	390	7/11/1983	176	9/4/1990	90
2/25/1976	78	6/6/1979	706	10/11/1983	66	10/29/1990	78
3/24/1976	398	6/6/1979	77	1/16/1984	105	1/31/1991	141
4/28/1976	493	7/11/1979	124	2/28/1984	63	3/6/1991	83
5/26/1976	475	7/30/1979	106	4/9/1984	83	5/21/1991	184
6/23/1976	137	8/1/1979	442	7/9/1984	78	7/9/1991	540
7/21/1976	417	8/28/1979	148	8/21/1984	186	9/5/1991	425
8/18/1976	152	8/28/1979	68	10/17/1984	1840	10/23/1991	88
9/22/1976	740	10/3/1979	67	1/22/1985	189	12/18/1991	384
10/20/1976	701	11/5/1979	57	3/11/1985	70	2/12/1992	580
11/18/1976	163	12/5/1979	54	5/7/1985	86	4/8/1992	487
12/15/1976	564	1/15/1980	66	7/8/1985	647	6/11/1992	523
1/12/1977	145	2/13/1980	55	8/12/1985	138	8/29/1992	151
2/16/1977	226	3/10/1980	15	10/9/1985	98	10/15/1992	69
3/16/1977	122	4/9/1980	113	1/14/1986	56	1/11/1993	87
4/13/1977	169	5/5/1980	459	2/25/1986	38	3/9/1993	87
5/11/1977	355	6/9/1980	110	4/23/1986	66	5/3/1993	235
6/8/1977	276	7/9/1980	70	7/16/1986	208	7/12/1993	1520
7/13/1977	109	8/5/1980	101	9/3/1986	121	8/18/1993	248
8/17/1977	100	9/9/1980	905	10/21/1986	234	11/15/1993	86
9/14/1977	112	10/14/1980	50	12/8/1986	47	1/18/1994	98
10/19/1977	65	11/12/1980	38	2/10/1987	201	3/24/1994	205
11/9/1977	1240	12/10/1980	66	4/14/1987	89	5/16/1994	685
12/8/1977	61	1/8/1981	60	6/23/1987	793	7/12/1994	76
1/25/1978	67	2/2/1981	79	8/18/1987	125	8/25/1994	68
2/16/1978	130	3/3/1981	69	10/13/1987	85		

2.3.1.2 Groundwater

Regional and local groundwater resources that could be affected by the construction and operation of VCS are described below. The regional and site-specific data on the physical and hydrologic characterization of these groundwater resources are summarized in order to provide the basic data for an evaluation of impacts on the aquifers of the area.

The VCS site covers an area of approximately 11,500 acres and is located on the coastal plain of southeastern Texas in Victoria County, south of the city of Victoria, Texas. The approximately 4900-acre VCS cooling basin is the predominant feature of the VCS site. The basin is fully enclosed with a compacted earth embankment and encompasses most of the southern and central portion of the site. The VCS power block area is located on the northern portion of the site, adjacent to the northern embankment of the cooling basin.

Note that all references to elevations given in this subsection are to North American Vertical Datum of 1988 (NAVD 88), unless otherwise specified.

2.3.1.2.1 Description and Onsite Use

This subsection contains a description of the regional and local physiography and geomorphology, groundwater aquifers, geologic formations, and groundwater sources and sinks. Regional and onsite uses of groundwater are described in Subsection 2.3.2.2, including groundwater production and groundwater flow requirements of the VCS site.

2.3.1.2.1.1 Physiography and Geomorphology

The VCS site is located in Victoria County, Texas, approximately 21 miles north of San Antonio Bay. The closest community is McFaddin, which is located approximately 4 miles from the power block area and approximately 1 mile southwest of the VCS site boundary (Figure 2.3.1.2-1). The closest city is Victoria, located approximately 13 miles north of the VCS site.

The VCS site and surrounding region are situated in the Coastal Prairies sub-province of the Gulf Coastal Plains physiographic province. The Coastal Prairies sub-province forms a broad band of nearly flat prairies along the Texas Gulf Coast (Figure 2.3.1.2-2). Ground surface elevation varies from approximately 0 feet along the coast to approximately 300 feet along the western boundary of the sub-province (Bureau of Economic Geology 1996).

Victoria County is located within the gently rolling plains of South Texas. The ground surface elevation of the plains in Victoria County varies from approximately 100 feet in the moderately dissected upland in the west to approximately 0 feet in the east at the Gulf of Mexico. Regional surface slopes vary from approximately 0 percent to 8 percent, with more pronounced slopes near surface water bodies (Uddameri 2008a). The VCS site is located on a relatively flat plain west of the Guadalupe River valley, downstream (south) of the city of Victoria, Texas. The topographic features of the approximately 11,500 acre VCS site shown in Figure 2.3.1.2-3 are as follows:

- Gently sloping plains cover most of the VCS site. The plains exhibit approximately 20 feet of natural relief in the 10-mile distance between the northwestern and southeastern property boundaries. Ground surface elevation ranges from approximately 85 feet on the northwest side of the VCS site to approximately 65 feet on the southeast side of the VCS site, except where the site slopes down to the Guadalupe River along its eastern boundary. The planned post-construction ground surface elevation for the power block buildings on the northwest side of the VCS site is approximately 95 feet.

- A 50- to 65-foot escarpment is located to the northeast of the VCS cooling basin and separates Linn Lake to the east from the higher elevations of the VCS site. Linn Lake is at an elevation of approximately 15 feet and flows into the Guadalupe River near the southeastern site boundary.

- A gully associated with Kuy Creek is located to the southwest of the VCS cooling basin. Kuy Creek is generally classified as a perennial stream. However, field observations made during the site subsurface investigation indicate that the upper reaches of Kuy Creek adjacent to the VCS cooling basin are ephemeral. The emergency spillway for the VCS cooling basin is to Kuy Creek.

- A gully associated with Dry Kuy Creek, an ephemeral stream, is located at the south-southeastern boundary of the VCS site and extends to the northwest, into the site area to be enclosed by the VCS cooling basin.

- There are several unnamed ephemeral streams located throughout the site. Most are tributaries to Dry Kuy Creek; the others flow to Linn Lake to the east or Kuy Creek to the southwest. Dry Kuy Creek flows southeast into Kuy Creek, which drains into the Guadalupe River. The Guadalupe River flows southeasterly, and is intersected by the San Antonio River southeast of the site boundaries.

- The drainage pattern in the vicinity of the VCS site is generally dendritic, with the local tributaries draining either to the Guadalupe or San Antonio rivers and then to San Antonio Bay.

- Additional landforms present at the VCS site include fluvial terraces, river paleochannels, point bars, natural levees, backswamp deposits, relict barrier islands/dunes, and younger alluvial and man-made (fill) deposits. These landforms are consistent with the geomorphology of the Beaumont Formation.

2.3.1.2.1.2 Regional Groundwater Aquifers

The VCS site is located within the Coastal Prairies sub-province characterized by deltaic sands and muds. The VCS site is underlain by a thick wedge of southeasterly dipping sedimentary deposits of Oligocene through Holocene age. The site overlies what has been referred to as the "Coastal Lowland Aquifer System". This aquifer system contains numerous local aquifers in a thick sequence of mostly unconsolidated Coastal Plain sediments of alternating and interfingering beds of clay, silt, sand, and gravel. The sediments reach thicknesses of thousands of feet and contain groundwater that ranges from fresh to saline. The majority of groundwater usage is for municipal, industrial, and irrigation needs (Ryder 1996).

The lithology of the aquifer system is generally sand, silt, and clay and reflects three depositional environments: continental (alluvial plain), transitional (delta, lagoon, and beach), and marine (continental shelf). The depositional basin thickens toward the Gulf of Mexico, resulting in a wedge-shaped configuration of hydrogeologic units. Numerous oscillations of ancient shorelines resulted in a complex, overlapping mixture of sand, silt, and clay (Ryder 1996).

As part of the U.S. Geological Survey's (USGS) Regional Aquifer-System Analysis program, the aquifer system was subdivided into five permeable zones and two confining units. The term "Gulf Coast Aquifer" is generally used in Texas to describe the composite of the sands, silts, and clays of the Coastal Lowland Aquifer System as shown in Figure 2.3.1.2-4 (TWDB 2006a).

Figure 2.3.1.2-5 compares the Gulf Coast Aquifer and the Coastal Lowlands Aquifer System terminologies. Hydrogeologic cross sections of the Coastal Lowlands Aquifer System and the Gulf Coast Aquifer are shown in Figures 2.3.1.2-6 and 2.3.1.2-7, respectively (Ryder 1996 and Baker 1979). The Gulf Coast Aquifer nomenclature will be used to describe the hydrogeologic units at the VCS site.

The Gulf Coast Aquifer is subdivided into four major hydrogeologic units based on sedimentary formations and hydraulic properties. These include, from deepest to shallowest:

- The Catahoula Confining System, which includes the Frio Formation, Anahuac Formation, and the Catahoula Tuff or Sandstone (Chowdhury et al. 2006).

- The Jasper Aquifer, which consists of the Oakville Sandstone and the Fleming Formation. The upper part of the Fleming Formation forms the Burkeville confining system (Chowdhury et al. 2006).
- The Evangeline Aquifer, which consists of the Goliad Sand (Chowdhury et al. 2006).
- The Chicot Aquifer, which consists of the Willis Formation, Lissie Formation (undifferentiated Bentley and Montgomery formations), Beaumont Formation, and surficial alluvial deposits (Chowdhury et al. 2006).

The base of the Gulf Coast Aquifer is identified as either its contact with the top of the Eocene/ Oligocene Vicksburg-Jackson Confining Unit or the approximate depth where the concentration of total dissolved solids in groundwater exceeds 10,000 milligrams per liter (mg/L). The base of the aquifer varies from approximately elevation 300 feet near the updip limit to approximately elevation -6000 feet midway between the updip limit and the coastline (Ryder 1996).

The Gulf Coast Aquifer is recharged by the infiltration of precipitation that falls on topographically high aquifer outcrop areas in the northern and western portion of the province. Discharge occurs by evapotranspiration, loss of water to streams and rivers as base flow, upward leakage to shallow aquifers in low lying coastal areas or in the Gulf of Mexico, and pumping (Ryder 1996).

Groundwater in the Gulf Coast Aquifer is generally under confined conditions, except for shallow zones in outcrop areas. In the shallow zones, the specific yield for sandy deposits generally ranges from 10 percent to 30 percent. For confined aquifers, the storage coefficient is estimated to range from 1×10^{-4} to 1×10^{-3} (Ryder 1996).

The productivity of the aquifer system is directly related to the thickness of the sands in the aquifer system that contain freshwater. The thickness of the aggregated sand within the aquifer ranges from 0 feet at the updip limit of the aquifer system to as much as 2000 feet in the east. Estimated values of transmissivity are reported to range from approximately 5000 to 35,000 square feet/day (37,000 to 261,800 gallons per day/foot, or gpd/foot) (Ryder 1996).

Groundwater quality in the Gulf Coast Aquifer in the vicinity of Victoria County is generally characterized as good, northeast of the San Antonio River, but declines to the southwest due to increased chloride concentrations and saltwater intrusion near the coast (Chowdhury et al. 2006). The Gulf Coast Aquifer has not been declared a sole-source aquifer by the U.S. EPA in Texas. A sole-source aquifer is defined as the sole or principal source of drinking water that supplies 50 percent or more of drinking water for an area, with no reasonably available alternative source should the aquifer become contaminated. Figure 2.3.1.2-8 shows the location of sole-source aquifers in EPA Region 6, which encompasses the VCS site. The nearest Texas sole-source aquifer is the Edwards I and II Aquifer system, which is located approximately 150 miles northwest of the VCS site (U.S. EPA 2008a).

The identified sole-source aquifers are beyond the boundaries of the local and regional hydrogeologic systems associated with the VCS site. Therefore, the VCS site is not expected to impact any of the sole-source aquifers.

2.3.1.2.1.3 Local Hydrogeology

Victoria County covers an area of approximately 890 square miles and is bounded by Jackson County to the east, DeWitt County to the north, Goliad County to the west, and Calhoun and Refugio Counties to the south. Much of the land use in Victoria County is agriculture (26 percent rangeland and 42 percent cropland and pasture), forest (approximately 27 percent), or urban development (3.5 percent). The remaining few percent of land use is mixed use or surface water. Surface water covers only a small portion of the land surface in Victoria County (0.01 percent bays and estuaries, 0.13 percent streams and canals, and 0.21 percent reservoirs and lakes). The lack of surface water resources in the county highlights the importance of groundwater for stock watering, irrigation, and water supply (Uddameri 2008a).

Groundwater usage in Victoria County is under the jurisdiction of the Victoria County Groundwater Conservation District (VCGCD). The estimated groundwater usage in Victoria County in 1997 was approximately 27,500 acre-feet per year (24.5 million gpd). Groundwater demand has subsequently decreased because the city of Victoria shifted to using surface water for most of its needs in 2001. Current groundwater usage is estimated to be approximately 20,000 acre-feet per year (17.8 million gpd). The estimated surface water usage in Victoria County in 1997 was approximately 29,000 acre-feet per year (25.9 million gpd), with the largest user group being manufacturing (Uddameri 2008a).

The Guadalupe and San Antonio rivers, Linn Lake, San Antonio Bay, the Victoria Barge Canal, Coleto Creek, and Coleto Creek Reservoir are the major surface water bodies in Victoria County. Many ephemeral streams are also present in Victoria County, with stream flow largely influenced by precipitation. Victoria County is situated in a humid, subtropical climate characterized by mild winters and hot summers and is subject to tropical disturbances from the Gulf of Mexico. Therefore, rainfall in Victoria County tends to exhibit spatial and temporal variability (Uddameri 2008a).

A water balance was performed for Victoria County using the average annual precipitation, which was approximately 39 inches from 1951 to 1980. The corresponding average annual runoff was approximately 7 inches. The remaining 32 inches of precipitation evaporated, was transpired by plants, or percolated into the subsurface to recharge the shallow aquifers (Ryder 1996).

The surficial soils in Victoria County tend to limit recharge because they are composed of low-permeability silt and clay intermingled with sand. Recharge in Victoria County is estimated to range from 10,000 to 30,000 acre-feet per year (8.9 to 26.8 million gpd). The northwestern portions of Victoria County exhibit more porous soils and receive higher precipitation, making these areas more suitable for recharge to the shallow aquifers in the vicinity of the VCS site, located in southern Victoria County (Uddameri 2008a).

The principal aquifers in Victoria County are the Chicot and Evangeline Aquifers. As shown in Figure 2.3.1.2-7, the shallower Chicot Aquifer extends to an elevation of approximately –300 feet and the deeper Evangeline Aquifer extends to an elevation of approximately –1000 feet, respectively, in the vicinity of the VCS site. Regional groundwater flow is generally to the southeast from the recharge areas in the northwestern parts of Victoria County toward the Gulf of Mexico (Figure 2.3.1.2-9). Groundwater flow is described in more detail in Subsection 2.3.1.2.2.2.

The Goliad Sand of the Evangeline Aquifer and the Willis Formation, Lissie Formation, Beaumont Formation, and Holocene alluvium of the Chicot Aquifer are the primary stratigraphic units at the VCS site and surrounding area. The following sections describe the pertinent details of these geologic units.

2.3.1.2.1.3.1 Goliad Sand

The Pliocene Goliad Sand consists of whitish- to pinkish-gray, coarse-grained sediments, including cobbles, clay balls, and wood fragments at the base of the formation. The upper part of the Goliad Sand consists of finer-grained sands cemented together with caliche. The sands are interbedded with grayish clays, which are locally marly. The presence of caliche, gravel, and irregular bedding are indicative of a high-energy fluvial depositional environment in the early Pliocene, followed by semi-arid periods later in the Pliocene. The top of the Goliad Sand forms the hydrogeologic boundary between the Evangeline and Chicot Aquifers (Chowdhury and Turco 2006).

2.3.1.2.1.3.2 Willis Formation

The Pleistocene Willis Formation consists of reddish, gravelly, unfossiliferous coarse sand. Sediments of the Willis Formation are fluvial and deltaic deposits in coarsening-upward sequences, indicative of delta-front facies (Chowdhury and Turco 2006).

2.3.1.2.1.3.3 Lissie Formation

The Pleistocene Lissie Formation consists of reddish, orange, and gray, fine- to coarse-grained, cross-bedded sands. The sediments of the Lissie Formation represent sand, silt, and mud deposited on flood plains or in river deltas. The undifferentiated Lissie Formation is considered equivalent in age to the Bentley and Montgomery formations. However, the heterogeneity of the sediments, discontinuity of the beds, and the general absence of index fossils and diagnostic electrical log signatures make correlation of the lithologic units difficult. The undifferentiated Lissie Formation and the Bentley Formation are generally considered the base of the Pleistocene, while the Montgomery Formation is occasionally included in the younger Beaumont Formation (Chowdhury and Turco 2006).

2.3.1.2.1.3.4 Beaumont Formation

The Pleistocene Beaumont Formation consists of poorly bedded, marly, reddish-brown clay interbedded with lenses of sand. Sediments of the Beaumont Formation represent natural levees and deltas deposited largely by rivers and, to a lesser extent, water from shallow-marine and lagoonal bays and embayments. The clays of the Beaumont Formation retard any significant infiltration of rainwater (Chowdhury and Turco 2006).

A total of 11 sand layers and 9 clay layers were identified at the VCS site based on the results of the geotechnical investigation described in detail in Subsection 2.5.4 of the Site Safety Analysis Report (SSAR). The interbedded sands and clays found at the VCS site are considered to be consistent with the Beaumont Formation.

2.3.1.2.1.3.5 Holocene Alluvium

The Holocene alluvium consists of fluvial basin and flood plain deposits. The fluvial basin deposits consist of terrace gravels, buried sand deposits, and point bar deposits with grain sizes ranging from clay to gravel. The flat-lying floodplain deposits consist of sand and gravel in the lower part and silt and clay in the upper part. Holocene alluvium occurs in a relatively narrow band surrounding the rivers. The alluvial deposits are typically coarser-grained than the materials found in the Beaumont Formation. Because the alluvial materials are deposited in a channel incised into the Beaumont Formation, it is likely that the alluvium is in contact with the shallow aquifer units in the Beaumont Formation.

The Holocene alluvium only occurs locally, and cannot be correlated on a regional scale. It is, therefore, typically included in the Chicot Aquifer. The Holocene alluvium exhibits the largest outcrop area of the stratigraphic units in the Texas Gulf Coast and provides a direct hydraulic connection between surface water and groundwater in some cases (Chowdhury and Turco 2006).

2.3.1.2.1.4 Site Specific Hydrogeology

A subsurface investigation was conducted at the VCS site between October 2007 and February 2008 to evaluate soil and groundwater conditions to depths of approximately 600 feet below ground surface (bgs). Subsurface information was collected from more than 200 geotechnical borings, geologic/geophysical borings, cone penetrometer tests (CPTs), shallow test pits, groundwater observation and test wells, and borehole permeameter tests. A supplemental geotechnical subsurface field investigation was conducted in late 2008 within the vicinity of the power block area.

A detailed description of the geotechnical investigation, including the location of these borings and CPTs, boring logs, and soil testing data is provided in SSAR Subsection 2.5.4. A summary of the groundwater field investigation is discussed in this subsection.

- Groundwater observation wells: Twenty-seven groundwater observation well pairs (or 54 individual observation wells) were installed throughout the site. These wells were completed to depths ranging from approximately 45 to 155 feet bgs and were installed to provide an adequate distribution for determining groundwater flow directions and hydraulic gradients beneath the site. Well pairs were selected to determine vertical gradients between the aquifer subunits.

- Slug tests: Field hydraulic conductivity tests (slug tests) were conducted in each of the 54 observation well. The results of the slug tests are discussed in Subsection 2.3.1.2.2.4.1.

- Aquifer pumping tests: Two aquifer pumping test well clusters, each consisting of one test well (pumping well) and four water level observation wells, were installed. A shallow test well and a deep test well were installed to a depths of approximately 80 feet and 180 feet bgs, respectively. Aquifer pumping tests were conducted at each location. The aquifer pumping tests are discussed in Subsection 2.3.1.2.2.4.1.

- Borehole permeameter tests: Borehole permeameter tests were conducted at 16 borehole locations within the footprint of the VCS cooling basin. Permeameter tests were conducted at depths of 5 and 10 feet bgs in each borehole. The permeameter tests are discussed in Subsection 2.3.1.2.2.4.2.

Well installations began in October 2007 and were completed in February 2008. Figure 2.3.1.2-10 shows the locations of observation wells used to identify and characterize the aquifers at the VCS site. Table 2.3.1.2-1 presents the construction information for the observation wells. The groundwater observation wells at the VCS site are named in four series, which represent the location and screen intervals of the observation wells and are as follows:

- "OW" identifies groundwater observation wells. "TW" identifies aquifer pumping tests wells.
  - OW-00 series wells represent the first set of exploratory borings and observation wells installed at the VCS site. With the exception of OW-08U/L through OW-10U/L, the well pairs are located in the VCS cooling basin footprint.

- OW-2100 series wells, with the exception of OW-2185U/L, are located in the western VCS power block area.
- OW-2200 series wells are located in the eastern VCS power block area.
- OW-2300 series wells identify wells located outside of the power block area. With the exception of OW-2301U/L, OW-2307U/L, OW-2324U/L, and OW-2348U/L, the well pairs are located in the vicinity of the VCS cooling basin area.

- A "U" suffix in the observation well name indicates the shallower well of the well pair. The observation well is screened in either the Upper Shallow or Lower Shallow aquifer.
- An "L" suffix in the observation well name indicates the deeper well of the well pair. The observation well is screened in either the Lower Shallow or Deep aquifer.

A geotechnical interpretation of the subsurface conditions encountered across the VCS site was developed from the geotechnical properties described in SSAR Subsection 2.5.4. The series of cross sections presented in SSAR Subsection 2.5.4 illustrate the substrata of the power block area and across the cooling basin.

Three aquifer subsystems were identified at the VCS site based on the subsurface investigation. These include:

- The "Shallow aquifer," consisting of sand layers occurring from existing ground surface to a depth of approximately 120 feet bgs. The Shallow aquifer is further subdivided into the "Upper Shallow aquifer" (from approximately 50 to 80 feet bgs) and the "Lower Shallow aquifer" (from approximately 90 to 120 feet bgs). The Upper Shallow and Lower Shallow aquifers are interpreted as components of the Chicot Aquifer.
- The "Deep aquifer," consisting of sand layers occurring from approximately 130 to 280 feet bgs. The Deep aquifer is also interpreted as a component of the Chicot Aquifer.
- The Evangeline Aquifer, consisting of sand layers at depths greater than 500 feet bgs. Observation wells were not installed into the Evangeline Aquifer because the groundwater investigation at the VCS site was focused on shallow groundwater conditions that may have an impact or be impacted by construction and operation of the VCS.The primary source of water for the VCS is surface water from the cooling basin. Groundwater will be used as described in Subsection 2.3.2. The source of groundwater will be the Evangeline Aquifer. Published reports and data for the Evangeline Aquifer were used to evaluate aquifer properties, VCS production well requirements, and aquifer impacts (well locations, pumping rates, and area of influence of the production wells).

A summary of the well identification and the hydrogeologic units where the well is screened is presented in Table 2.3.1.2-2.

A conceptual hydrostratigraphic model was developed from the geotechnical cross sections to describe the shallow portion of the Chicot Aquifer at the site. This model subdivided the Chicot Aquifer into three units: a confined Deep aquifer and Lower Shallow aquifer, and a partially confined Upper Shallow aquifer. The Upper Shallow, Lower Shallow, and Deep aquifer designations are informal and are based primarily on the hydrogeologic conditions encountered during the subsurface site investigation and the resulting screen intervals of the observation wells. The sand layers at the site were also subdivided into geotechnical units based on soil properties described in SSAR Subsection 2.5.4. The following list relates the geotechnical sand units to the hydrogeological units:

Geotechnical Sand Unit	Hydrogeological Unit
Sand 1	Unsaturated sand zone
Sand 2	Upper Shallow aquifer
Sand 4	Lower Shallow aquifer
Sand 5, 6, and 8	Deep aquifer

Additionally, as discussed in Subsection 2.3.1.2.3.1, the conceptual site model developed and incorporated into a groundwater flow model consists of eleven sand and clay layers chosen to represent the aquifer units.

The top of the Deep aquifer is generally comprised of Sand 5 and/or Sand 6 strata. These strata are typically between 10 and 50 feet thick at the site. However, the top of the Deep aquifer may also include Sand 8 where the intervening confining Clay 7 is absent and Sand 8 is in direct contact with Sand 6. The entire Deep aquifer is considered to include all the strata from Sand 5 down to a depth of about 280 feet, where the top of the Goliad Sand, which separates the Chicot and Evangeline aquifers, is encountered.

Confining the top of the Deep aquifer is Clay 5-T, which at the site varies in thickness from about 5 to 30 feet and is absent at other locations. Above this unit is the Lower Shallow aquifer, which consists of the approximately 5 to 50-foot thick Sand 4. In places, such as at OW-09L and OW-2319U/L, the sand strata that comprise the Deep aquifer can directly contact with Sand 4 and effectively merge to form one aquifer. This is illustrated by the similar water levels between OW-2319U and OW-2319L.

The Lower Shallow aquifer is confined at the top by Clay 3, which ranges in thickness from less than 5 feet to about 50 feet and is absent at several locations at the site. One well (OW-04U) may be screened within a less permeable section of the Upper Shallow aquifer or may be absent at this location. Overlying Clay 3 is the Upper Shallow aquifer, which consists of Sand 2. Sand 2 is about five to 35 feet thick and is absent at some locations. In many areas Sand 2 and Sand 4 are in direct contact because the intervening Clay 3 is absent. In these areas (e.g., OW-03U/L) the Upper Shallow aquifer and the Lower Shallow aquifer are hydraulically connected, and groundwater would flow through these two sand strata as if they comprise one aquifer. At OW-03U/L, where the Shallow aquifers merge, the Upper Shallow aquifer well is typically dry, which indicates unconfined conditions in the Shallow aquifer system prevail at this location.

Above Sand 2 is Clay 1-B, which confines the Upper Shallow aquifer in most places. Above the Upper Shallow aquifer is the vadose zone, which is comprised of Sand 1 and Clay 1-T, with Clay 1-T exposed at the surface. However, in a few areas, Sand 1 is exposed where Clay 1-T is absent or eroded toward the Guadalupe River terrace. The Sand 1 stratum appears to pinch out north and northwest of the power block area to at least the northern site boundary. The vadose zone is generally about 30 to 40 feet thick at the site.

Monthly water level monitoring began in October 2007 with the installation of the first set of wells and continued through February 2009 to complete one year of monthly water level measurements for the complete set of wells installed at VCS. Quarterly water level monitoring was conducted in 62 of the 64 wells installed (excluding the two pumping test wells) through October 2010.

The groundwater level measurements collected from the VCS wells between October 2007 and October 2010 are discussed in the following subsections.

2.3.1.2.1.5 Groundwater Sources and Sinks

The natural regional flow pattern in the Chicot and Evangeline Aquifers is from recharge areas, where the sand layers outcrop at the surface, to discharge areas, which are either at the Gulf of Mexico or the Guadalupe River valley alluvium (for the Chicot Aquifer). The outcrop areas for the Chicot Aquifer sands are considered to be northern Victoria County and those areas north and west of the county. Groundwater within the Upper and Lower Shallow aquifer sands would discharge as seeps or base flow to local streams and rivers or migrate vertically to Deep aquifer. Groundwater within the Deep aquifer would discharge as base flow to the more predominant river valleys such as the Guadalupe River valley or to the Gulf of Mexico.

The outcrop areas for the Evangeline Aquifer are considered to be in areas north and west of Victoria County (Figures 2.3.1.2-4, 2.3.1.2-6, and 2.3.1.2-7). In the outcrop areas, precipitation falling on the ground surface can infiltrate directly into the sands and recharge the aquifer. Superimposed on this generalized flow pattern is the influence of heavy pumping within the aquifer. Concentrated pumping areas can alter or reverse the regional flow pattern. A further description of groundwater flow patterns is presented in Subsection 2.3.1.2.2.

The Holocene alluvium receives recharge from infiltration of precipitation and groundwater flow from the Shallow aquifer sands in the Beaumont Formation. In the vicinity of the site area, flow paths in the alluvium are considered to be short due to the limited surface area. Discharge from the Holocene alluvium contributes to the base flow of the main rivers in the area.

The predominant surface water feature at the VCS site will be the approximately 4900-acre VCS cooling basin. As shown in Figure 2.3.1.2-3, this surface water body encompasses the majority of the southern and western portions of the site. The design pool level of the approximately 4900-acre cooling basin is elevation 90.5 feet, imposing a maximum hydraulic head of up to 25 feet above the existing ground surface in the southeastern portion of the site. The planned bottom of the VCS cooling basin is at an elevation of 69.0 feet. The capacity of the VCS cooling basin at the normal operating level will be approximately 103,600 acre-feet.

The VCS cooling basin will experience seepage through the impoundment floor to the subsurface, through the embankment, and through the spillway. The cooling basin will be fully enclosed by a compacted earth embankment dam. The embankment dam will be constructed of compacted, low permeability, clay fill that will reduce seepage from the cooling basin. Seepage from the cooling basin through the embankment dam will be intercepted, in part, by drainage ditches around the outside of the embankment dam that will discharge to surface water at various locations.

Seepage from the VCS cooling basin to the subsurface is predicted to be approximately 4000 gpm (3930 gpm), based on the results of the groundwater modeling described in Subsection 2.3.1.2.3.

2.3.1.2.1.5.1 Site-Specific Groundwater Recharge

Groundwater flow at the VCS in the Chicot Aquifer is generally to the east towards the Guadalupe River valley as described in Subsection 2.3.1.2.1.5. The Beaumont Formation crops out over much of the VCS site and receives minor to insignificant recharge from infiltration of precipitation. The Holocene alluvium, which crops out along Linn Lake and the San Antonio and Guadalupe Rivers, receives recharge from infiltration of precipitation and groundwater flow from the Chicot Aquifer.

The construction and operation of the cooling basin at the VCS site will result in the removal of approximately 4900 acres of surface drainage area west of Linn Lake. The reduced drainage area will decrease surface recharge to both the Beaumont Formation and the alluvium. However, unmitigated seepage from the basin will increase groundwater contributions to Kuy and Dry Kuy Creeks and downgradient seeps by more than two orders of magnitude above preconstruction seepage amounts. Seepage from the VCS cooling basin into the subsurface is described in greater detail in Subsection 2.3.1.2.3.2.1.

2.3.1.2.1.5.2 Site-Specific Groundwater Discharge

The primary areas for groundwater discharge at the site are where creek and river channels have been incised into the underlying saturated zone. These areas include the Kuy Creek channel on the south side of the site and in the Guadalupe River valley to the east. Groundwater discharge provides base flow to Kuy Creek and the Linn Lake/Black Bayou surface water system. However, during dry periods, the groundwater level may drop below the bottom of these channels eliminating the base flow component.

Filling of the cooling basin will increase recharge to the underlying shallow aquifer as the result of seepage from the cooling basin to the subsurface environment. Seepage from the cooling basin is predicted to alter the groundwater flow direction in the site area. The groundwater level is predicted to rise beneath the basin to saturate previously unsaturated shallow sand layers. Seepage from the cooling basin to the groundwater system is predicted to increase groundwater contribution (groundwater discharge as base flow) to Kuy Creek, Dry Kuy Creek, and the surface seeps to the north and east of the VCS site. Seepage from the VCS cooling basin enters the subsurface and is discharged to the local surface water features as described in more detail in Subsection 2.3.1.2.3.

2.3.1.2.2 Groundwater Sources

This subsection contains a description of the historic groundwater levels; groundwater flow direction and gradients; seasonal and long-term variations of the aquifers; horizontal and vertical permeability and total and effective porosity of the geologic formations beneath the site; reversibility of groundwater flow; the effects of water use on gradients and groundwater levels beneath the site; and groundwater recharge areas. This information has been organized into five subcategories: (1) a summary of historical groundwater use, (2) groundwater flow directions, (3) temporal groundwater trends, (4) aquifer properties, and (5) hydrogeochemical characteristics.

2.3.1.2.2.1 Historical Groundwater Use

A brief summary of regional and local historical groundwater use in the vicinity of the VCS site is provided in this subsection. A detailed historical, current, and projected groundwater use discussion is provided in Subsection 2.3.2.2.

Historically, groundwater pumping in the Gulf Coast Aquifer system was relatively small and constant from 1900 until the late 1930s. Pumping rates increased sharply between 1940 and 1960, and increased relatively slowly through the mid 1980s. Groundwater withdrawals were primarily from the east-central area of the aquifer system, centered mostly in the Houston area of Harris County. Groundwater withdrawal was primarily for public supply and agriculture. (Ryder 1996).

Currently, groundwater use data for Victoria County is available from the EPA, the Texas Water Development Board (TWDB), and the VCGCD. The EPA monitors drinking water supply systems throughout the country and maintains the results in the Safe Drinking Water Information System (SDWIS) (U.S. EPA 2009). The TWDB is legislatively directed to plan for, and financially assist in, the development and management of the water resources of Texas. As a result, the TWDB conducts an annual survey of groundwater and surface water use by municipal and industrial entities so it can maintain accurate information concerning the current use of water in the state. The survey is based on water user-submitted information and may include estimated values. The survey does not include single-family, domestic well groundwater use (TWDB 2009a).

The TWDB maintains the information gathered during the annual survey in a statewide database called the Water Information Integration and Dissemination (WIID) system. As of May 2009, TWDB groundwater and surface water use data for Victoria County are available for 1974 through 2004 (TWDB 2009b). Water use data for Victoria County for 2005 and 2006 are also presented. Based on the TWDB data, the predominant water use categories in Victoria County in 2004 were manufacturing and municipal, followed by irrigation, mining, steam electric, and livestock. Most of the water used in the livestock, manufacturing, and steam electric categories in 2004 was obtained from surface water sources, while the majority of the water used in the irrigation, mining, and municipal categories in 2004 was obtained from groundwater (TWDB 2009b).

The TWDB also prepares estimates of future water use as part of water supply planning in addition to conducting the annual water use survey. This is facilitated through coordination with 16 planning regions throughout the state. Victoria County is a member of the South Central Texas Region (TWDB 2006b).

The population of the South Central Texas region was estimated to be 2.0 million in 2000 and is projected to increase to 4.3 million by 2060 (TWDB 2006b). Future development of the water resources in Victoria County is projected to be primarily around the city of Victoria (Uddameri 2008b). Victoria County was projected to experience a net increase in withdrawal of 3 percent, or 1 million gpd, with pumping rates increasing from 29 to 30 million gpd by 2030 (Ryder 1996). However, as described in Subsection 2.3.1.2.1.3, groundwater demand in Victoria County has decreased since 2000, when the city of Victoria shifted to using surface water for most of its needs.

The VCGCD implemented a District Management Plan for adoption in October 2008 and was approved by TWDB in December 2008 (VCGCD 2008a). The mission of the management plan is to develop sound water conservation and management strategies within Victoria County to conserve, protect, and prevent waste of groundwater resources. A spectrum of groundwater development alternatives were evaluated by the VCGCD. Available groundwater within the district was estimated to range from 25,000 to 45,000 acre-feet per year. For planning purposes, the available groundwater was established at 35,000 acre-feet per year. Historical groundwater use in Victoria County was as high as 40,000 acre-feet per year in the early 1980s, decreasing to about 15,500 acre-feet per year in 2004. The average groundwater use between 2000 and 2004 was approximately 20,200 acre-feet per year (VCGCD 2008a).

The total water demand for 2010 through 2020 is predicted to be nearly 63,000 acre-feet per year and will be met by conjunctive use of both surface water and groundwater resources. There are no unmet water needs projected for Victoria County until 2040. The predicted water shortages from 2040 to 2060 are projected to be small (VCGCD 2008a). The district is in the process of establishing monitoring and management programs, and additional studies to protect the water resources of the county. In October of 2008, the VCGCD adopted rules for groundwater use, which became effective in December 2008 (VCGCD 2008b). These rules included registration of groundwater wells, permitting for new well installations and use, production well pumping limits and minimum well spacing, transfer of groundwater out of the district, enforcement, and other measures.

The groundwater needs for VCS are projected to be approximately 1053 gpm (peak demand) and approximately 464 gpm during normal plant operations. The temporary water supply required for construction activities is estimated to be approximately 580 gpm and is expected to last approximately 4 to 5 years.

It is expected that three onsite groundwater production wells will be installed to meet groundwater demands to support construction and operation. The onsite production wells will be located in the Evangeline Aquifer. It is expected that two wells would be in operation with a third acting as a backup. The wells would be screened in the Evangeline Aquifer at depths ranging between approximately 450 to 1000 feet bgs. Preliminary well locations would be to the east, west, and north of the power block area at spacing greater than 6500 feet to minimize aquifer drawdown beneath the power block area. The exact number, depths, locations, and pumping rates of the onsite production wells are preliminary and will be determined during the detailed design of the VCS site, in accordance with the VCGCD rules in effect at the time.

2.3.1.2.2.2 Groundwater Flow Directions

Limited historical groundwater level data exist for the site proper because it is a greenfield site; however, TWDB does maintain several observation wells close to the site to measure water levels in the Chicot Aquifer. Regionally, groundwater flow in the Chicot Aquifer is generally southeast toward the Gulf of Mexico as shown in Figure 2.3.1.2-11, which is a regional potentiometric surface map of the Chicot Aquifer for 1999. The limited number of data points in the site area obscures any localized impacts from rivers in the site area. Figure 2.3.1.2-12 presents the steady-state simulated groundwater level elevations in the Chicot Aquifer using the calibrated Central Gulf Coast Groundwater Availability Model (GAM) (Chowdhury et al. 2004). This map shows the influence of the

Guadalupe and San Antonio Rivers on localized flow conditions adjacent to the site, where a west to east component of flow is overlain on the regional flow pattern.

Regional groundwater flow in the Evangeline Aquifer is also generally to the south and east toward the Gulf of Mexico, based on groundwater level data collected by the TWDB between 2001 and 2005 (Chowdhury et al. 2006). As depicted in Figure 2.3.1.2-9, localized pumping has caused a decline in water level in some parts of the Gulf Coast Aquifer, such as Harris and Kleberg counties. The pumping has created large cones of depression in these pumping areas, which divert groundwater flow from the Gulf of Mexico to the pumping centers.

As described in Subsection 2.3.1.2.1.4, groundwater observation well pairs were installed at 27 locations (54 individual wells) to investigate groundwater flow directions and horizontal and vertical hydraulic gradients at the VCS site. In addition, the four pumping test observation wells for each of the two test well locations (additional eight wells) were added to the observation well network resulting in 62 groundwater level monitoring wells.

Monthly groundwater level measurements were collected from the newly installed observation wells beginning in October 2007, when the first wells were installed. By February 2008, all of the site investigation wells had been installed and the first complete set of groundwater levels was collected. Monthly groundwater level measurements were collected through February 2009. Approximately quarterly groundwater level measurements were collected thereafter, until October 2010.

For the first three months of data collection, only the OW-01U/L through OW-10U/L well pairs were installed, for a total of 20 observation wells. By February 2008, an additional 42 observation wells (17 well pairs and two sets of 4 observation wells associated with the aquifer pumping test wells). The two aquifer pumping test wells were not incorporated into the groundwater monitoring program. Water level measurements from October 2007 through October 2010 are presented on Table 2.3.1.2-3. (Anomalous or suspect water level measurements due to instrument malfunction, operator error, or typographical errors are indicated in the table).

Groundwater level measurements collected from the observation wells at the VCS site in February, May, August, and November 2008; February, May, and August 2009; and March and October 2010 were used to develop potentiometric surface maps for the Upper Shallow, Lower Shallow, and Deep aquifers (Figure 2.3.1.2-13). These potentiometric surface maps show that groundwater flow direction at the VCS site in the three aquifers is generally to the east toward the Guadalupe River valley.

The potentiometric surface maps are used to estimate horizontal hydraulic gradients at the site. For each map, horizontal hydraulic gradients are calculated by drawing a flow line on the potentiometric surface map and determining the head loss (h) over the horizontal projection of the flow path length (L) to determine the horizontal hydraulic gradient (i_h or h/L).

The Upper Shallow aquifer potentiometric map surfaces indicate a hydraulic gradient of between 0.002 and 0.003 feet/foot. The Lower Shallow aquifer potentiometric map surfaces indicate a hydraulic gradient of between 0.001 and 0.002 feet/foot. The Deep aquifer potentiometric map surfaces indicate a hydraulic gradient of between 0.001 and 0.002 feet/foot.

The vertical hydraulic gradient (i_v) is calculated by dividing the difference in hydraulic head between adjacent upper and lower observation wells by the length of the vertical flow path. The vertical flow path length is assumed to be from the midpoint elevation of the upper observation well screen to the midpoint elevation of the lower observation well screen. Table 2.3.1.2-4 presents the calculated vertical hydraulic gradients.

Measurement data collected from the observation well pairs generally indicate a downward flow between the Upper Shallow, Lower Shallow, and Deep aquifer zones in the Chicot Aquifer. The downward vertical hydraulic gradients at the VCS site range from less than 0.01 to approximately 0.28 feet/foot. Those well pairs indicating upward flow are described as follows:

- Well pairs exhibiting an upward vertical gradient (OW-10U/L, OW-2320U/L, and OW-2350U/L). Excluding anomalous measurements, the upward vertical hydraulic gradient exhibited by these well pairs ranged up to -0.07 feet/foot. Well pair OW-2352U/L consistently shows a subtle, nearly imperceptible upward hydraulic gradient. The August 2009 readings at OW-10U/L indicate a weak downward hydraulic gradient (0.01 foot per foot) at OW-10U/L.

- Well pairs exhibiting occasional to infrequent upward vertical gradients (OW-05U/L, OW-07U/L, OW-09U/L, OW-2321U/L, OW-2348U/L, and OW-2359U1/L1). Some of the readings show a subtle, nearly imperceptible upward hydraulic gradient.

- Well pairs exhibiting an upward gradient only in months where suspect measurements were made (OW-02U/L, OW-06U/L, and OW-2319U/L). Ignoring the suspect readings, these well pairs all show a downward vertical hydraulic gradient.

The well pairs exhibiting upward vertical hydraulic gradients are, in general, located in the eastern half of the site. However, other well pairs in the eastern half of the site exhibit a downward hydraulic gradient, suggesting that the aquifer is heterogeneous.

Construction dewatering, operation of the proposed onsite production wells, and the operation of the cooling basin have the potential to alter or reverse the local flow patterns at the VCS site. Post-construction groundwater flow patterns were simulated through the development of a site groundwater computer model (Subsection 2.3.1.2.3.1).

2.3.1.2.2.3 Temporal Groundwater Trends

As depicted in Figure 2.3.1.2-14, groundwater levels in Victoria County were on the decline from the 1950s to 2000, until the city of Victoria switched to surface water for much of its needs (Uddameri 2008a). Data obtained from the TWDB for three observation wells (well numbers 7924702, 7932602, and 8017502; (TWDB 2009a) located near the VCS site were selected to prepare the regional hydrographs shown on Figure 2.3.1.2-14. Water level data from these wells through approximately 2006 were used in the temporal groundwater analysis based on their proximity to the VCS site.

Well 8017502 is located approximately 6.3 miles northeast of the proposed VCS power block area and is screened in the Goliad Sand of the Evangeline Aquifer to a depth of 1026 feet below ground surface. Historical water level data from this well indicate that between 1958 and 2000 a decrease in groundwater level occurred. Since 2001, the groundwater level has recovered and has surpassed the 1958 level. This coincides with the city of Victoria switching to surface water for much of its needs.

Well number 7932602 is located approximately 5.5 miles northeast of the proposed VCS power block area and is screened in the Lissie Formation of the Chicot Aquifer to a depth of 595 feet below ground surface (TWDB 2009a). As with well 8017502, historical water level data from this well indicates that between 1958 and 2000, a decrease in groundwater level occurred. Since 2001, the groundwater level has recovered and has also surpassed the 1958 level.

Well 7924702 is located approximately 6 miles northwest of the proposed VCS power block area and is screened in the Chicot Aquifer to a depth of 180 feet below ground surface (TWDB 2009a). This well exhibits a generally decreasing water level over the period of record for the well. Groundwater level data are not available from this well from 1998 to 2003. Therefore, the relationship, if any, of the decrease in groundwater level in this well to the city of Victoria switching to surface water for its needs in 2001 is unclear.

Figure 2.3.1.2-15 presents hydrographs for the observation wells installed at the VCS site. Review of the data suggests that there are a few suspect water level readings that deviate from the general water level trend in some wells. These suspect readings may result from misreading of the water level device or from conditions in the well that can produce false readings when using an electric water level measuring device, such as water condensate droplets on the interior wall of the well casing. Excluding the suspect water level measurements, the following trends are apparent for the three monitoring intervals:

- Upper Shallow aquifer: Readings generally show an overall rise in water level elevations of up to 2 feet between October 2007 and January 2008. Between January 2008 and November 2009, the wells in this zone generally show a downward trend of up to approximately 6 feet across the site. From November 2009 to October 2010 readings showed a rise in water levels of up to approximately 3 feet.

- Lower Shallow aquifer: Water levels typically show minor fluctuations of less than 1 foot between October 2007 and January 2008. Between January 2008 and November 2009, the wells in this zone show a general downward trend, with some wells exhibiting stable water levels with minor fluctuations during the fall and winter months of late 2008 into early 2009. Water levels show an overall rise between November 2009 and October 2010 of up to approximately 2.5 feet.

  Wells OW-2324U and OW-2348U stand out as exceptions to these general trends. These wells are screened in the Lower Shallow aquifer and are located in the eastern part of the site near the floodplain of the Guadalupe River and Linn Lake. Groundwater in this area is believed to be influenced by surface water conditions. Some water level fluctuations in wells OW-2324U and OW-2348U (particularly those between September 2008 and May 2009) appear to be related to fluctuations in the stage of the Guadalupe River based on river stage data recorded at USGS Gage 08177520 on the Guadalupe River near Bloomington, Texas (USGS 2011).

  Linn Lake is an oxbow lake on the west side of the Guadalupe River valley. The lake is a former meander that has been cut off from the main channel of the Guadalupe River. The Bloomington, Texas 7.5-minute USGS topographic map (USGS 1995) shows the river to be approximately 1000 feet from the lake at their closest point, and both to be at approximately the same elevation. No water level measurements for Linn Lake are available. However, because of the geomorphology of Linn Lake and its proximity to the river, it is likely that the lake and river are hydraulically connected and that the stage in the lake trends similarly to the stage of the nearby river.

- Deep aquifer: During the winter of 2007, water level readings show small variations of less than 1 foot in this zone. Beginning in 2008, and ending in November 2009, there is an overall downward trend in the water level elevation data, with the exception of a few wells showing a flattening of the hydrograph curve during the fall and winter months of late 2008 and into early 2009. From November 2009 to October 2010, water levels rose up to 2.5 feet. Water levels in wells OW-2324L and OW-2348L, screened in the Deep aquifer and also located near Linn Lake and the Guadalupe River, follow similar trends to those observed in wells OW-2324U and OW-2348U screened in the Lower Shallow aquifer. Some of the water level fluctuations in OW-2324L and OW-2348L also appear to be related to fluctuations in the stage of the Guadalupe River based on river stage data recorded at USGS Gage 08177520 for the Guadalupe River near Bloomington, Texas (USGS 2011).

In general, the difference in groundwater levels between wells screened in the Upper Shallow, Lower Shallow and Deep aquifers is greater in the well pairs located on the western side of the site than in well pairs on the eastern side of the site. This condition appears to be related to transition from an upland area of net groundwater recharge to a lowland area within a river valley where groundwater discharge predominates.

Figure 2.3.1.2-7 is a regional hydrogeologic cross-section through the Gulf Coast aquifer system. The figure shows that the outcrop area of the Chicot aquifer extends inland from the VCS site to approximately the southeastern DeWitt County line, where the ground surface elevation is approximately 150 feet. Precipitation falling on the outcrop area recharges groundwater in the Chicot aquifer. The higher ground surface elevation inland near DeWitt County induces a regional hydraulic gradient within the aquifer toward the southeast and the Gulf of Mexico, where the ground surface elevation is nominally 0 feet.

Figure 2.3.1.2-11 shows that in 1999 a southeastern regional hydraulic gradient was observed in the Chicot aquifer near the VCS site. Figure 2.3.1.2-12 shows groundwater elevations in the Chicot aquifer simulated by the Groundwater Availability Model (GAM) developed by the Texas Water Development Board (Chowdhury et al. 2004). This figure shows a similar regional hydraulic gradient toward the southeast.

Figure 2.3.1.2-12 shows, in the area of the VCS site, the 50-foot equipotential line to be diverted locally near the San Antonio and Guadalupe rivers. That diversion occurs because groundwater from higher elevations in the Chicot aquifer drains down-gradient toward and discharges to the rivers. The surface elevation within the power block area of the VCS site is about 80 feet. At observation well pair OW-2348, near the eastern boundary of the VCS site and the Guadalupe River valley, the surface elevation is approximately 50 feet (Table 2.3.1.2-1). Within the floodplain of the river and near Linn Lake the surface elevation is approximately 15 feet (USGS 1995).

In the upland areas of the Chicot aquifer, and potentially the northern and western parts of the VCS site, groundwater recharge prevails. Vertical hydraulic gradients are predominantly downward in areas of groundwater recharge and upward in areas of groundwater discharge (Fetter 1988). Table 2.3.1.2-4 presents the observed vertical hydraulic gradients in the northern and western parts of the VCS site, which are consistently downward.

In the eastern part of the site, near the floodplain of the Guadalupe River, the observed vertical hydraulic gradients tend to be upward or only weakly downward. This condition in the eastern part of the site suggests transition from an area of groundwater recharge to one of groundwater discharge. None of the VCS observation well pairs are located within the floodplain near the Guadalupe river channel or Linn Lake. Stronger upward vertical hydraulic gradients are likely to exist there, indicating groundwater discharge to the Guadalupe River Valley hydraulic system.

The groundwater potentiometric head of the Upper Shallow aquifer beneath the VCS site power block area ranges between approximately elevation 31 and 49 feet (Table 2.3.1.2-3). Post-construction changes to the hydrogeologic regime were evaluated using a groundwater computer model. The results are described in Subsection 2.3.1.2.3.2.

2.3.1.2.2.4 Aquifer Properties

The properties of the aquifers at the VCS site are divided into hydrogeologically and geotechnically derived parameters and are described in detail in Subsection 2.3.1.2.2.4.1 and 2.3.1.2.2.4.2. The hydrogeologically derived aquifer parameters include transmissivity, storativity, and hydraulic conductivity. The geotechnically derived aquifer parameters include bulk density, porosity, and permeability (hydraulic conductivity) from grain size and in situ Guelph permeameter tests.

2.3.1.2.2.4.1 Hydrogeological Parameters

Hydrogeologic field tests conducted at the VCS site included well slug tests and aquifer pumping tests. Slug tests were conducted in each of the site observation wells with the exception of OW-10U which had insufficient water in the well for testing.

Aquifer pumping tests were conducted at the VCS site in February 2008 at test well clusters TW-2320 (Upper Shallow aquifer) and TW-2359 (Deep aquifer). Each test consisted of a test pumping well and four adjacent observation wells. Nearby observation well pairs installed to monitor site groundwater levels were also monitored during the tests. The information obtained during the testing was used to evaluate the transmissivity and storativity of the aquifers.

- Transmissivity is defined as the rate at which a fluid of a specified density and viscosity is transmitted through a unit width of an aquifer or confining bed under a unit hydraulic gradient. Transmissivity is a function of the properties of the fluid, the porous medium, and the thickness of the porous medium (Fetter 1988).

- Storativity (storage coefficient) is defined as the volume of water released from or taken into storage per unit surface area of the aquifer per unit change in head (Fetter 1988).

- Hydraulic conductivity is defined as the coefficient of proportionality that describes flow per unit time under a unit hydraulic gradient through a unit area of a porous medium and is a function of the properties of the fluid and the porous medium. Hydraulic conductivity can be calculated by dividing the transmissivity by the saturated aquifer thickness (Fetter 1988).

Slug Test Analysis

Hydraulic conductivity can be determined from the slug test method, which evaluates the aquifer response to an instantaneous change in water level in the test well. A disadvantage of the slug test method is that it measures hydraulic conductivity only in the immediate vicinity of the test well. However, because the slug test requires minimal equipment and can be performed rapidly, slug tests can be performed in many wells, allowing a determination of spatial variability in hydraulic conductivity.

Slug tests were conducted in 53 of the 54 observation wells at the VCS site. (Observation well OW-10U had insufficient water in the well for testing.) Slug test results are summarized in Table 2.3.1.2-5. The minimum, maximum and geometric mean hydraulic conductivity values from the slug tests analyses presented in Table 2.3.1.2-5. for the Upper Shallow, Lower Shallow, and Deep aquifer zones at the VCS site are as follows:

Hydraulic Conductivity Based on Slug Tests

Aquifer Zone	Minimum (ft/day)	Maximum (ft/day)	Geometric Mean (ft/day)
Upper Shallow	0.06	56.79	12.29
Lower Shallow	0.02	163.5	24.76
Deep	0.67	142.7	9.80

Notes:
1. Minimum value = lowest value of the mean test results.
2. Maximum value = highest value of the mean test results.
3. Geometric mean = geometric mean of the average value for the analytical method results per well.

The data presented in Table 2.3.1.2-5 suggest variations in the materials tested, indicative of heterogeneous conditions. The slug test results for the Upper Shallow, Lower Shallow, and Deep aquifer zones were contoured to evaluate spatial trends Figure 2.3.1.2-16. For consistency, the hydraulic conductivities calculated from the rising head slug tests, Bouwer-Rice analytical method (Table 2.3.1.2-5) were used.

The Upper Shallow aquifer contour map indicates a discontinuous zone of increased hydraulic conductivity trending north to south from OW-07U to OW-2304U. The Lower Shallow aquifer contour map indicates an area of increased hydraulic conductivity trending northwest to southeast parallel to Linn Lake between OW-2307L and OW-2348U. An isolated area of increased hydraulic conductivity is also present in the Lower Shallow aquifer zone in the vicinity of OW-2320U. The Deep aquifer zone exhibits a general increase in hydraulic conductivity from west to east across the VCS site and does not appear to have any particular zones of increased hydraulic conductivity. The hydraulic conductivity trends in the Lower Shallow and Deep aquifers are generally consistent with coarsening and thickening of alluvial deposits in the direction of the Guadalupe River valley. The contour maps also show the locations of the aquifer pumping tests in the Upper Shallow and Deep aquifers, although the hydraulic conductivity values from the aquifer pumping tests were not used in the contouring.

Pumping Test Analysis

Aquifer pumping tests were conducted at the VCS site in February 2008 at test well clusters TW-2320 (Upper Shallow aquifer) and TW-2359 (Deep aquifer) as shown in Figure 2.3.1.2-10. Each test consisted of a test well and four adjacent observation wells. Nearby observation well pairs installed to monitor site groundwater levels were also monitored during the tests. The information obtained during the testing was used to evaluate the transmissivity and storativity of the aquifers. Test results and analysis are presented in Part 5 of this ESPA. The results of the February 2008 pumping tests, including additional analysis performed since 2008 are summarized in Table 2.3.1.2-6.

The Upper Shallow aquifer pumping test was conducted in the vicinity of observation test well cluster OW-2320, which is located in the approximate center of the cooling basin area. The test well cluster consisted of test well TW-2320U (pumping well) and four observation wells (OW-2320U1 through OW-2320U4), located at distances of approximately 15 to 50 feet from the test well as shown on Figure 2.3.1.2-17. Pressure transducers equipped with data loggers were used to measure water level drawdown and recovery in the test well and the observation wells. The pressure transducer in observation well OW-2320U4 apparently malfunctioned during the test and did not provide usable data.

TW-2320U was pumped at a rate of approximately 3.2 gpm for 48 hours. Based on the results presented in Table 2.3.1.2-6, a transmissivity of approximately 312.2 $feet^2$/day, a storage coefficient of approximately 3.3×10^{-3}, and a hydraulic conductivity of approximately 8.2 feet/day (using a saturated thickness of 38 feet) are estimated for the Upper Shallow aquifer at this location.

A distance drawdown analysis of the data was performed to compare with the single well test data analysis at times of 300 and 3000 seconds after pumping began. At 300 seconds, transmissivity of approximately 1474 square feet per day, hydraulic conductivity of 39 feet per day, and a storage coefficient of approximately 5 x 10^{-4} were estimated for the Upper Shallow aquifer. At 3000 seconds, transmissivity of approximately 738.7 square feet per day, hydraulic conductivity of 19 feet per day, and a storage coefficient of 4 x 10^{-4} were estimated for the aquifer zone at this location. The distance drawdown analysis suggests a higher hydraulic conductivity than that of the single well test analysis.

The Deep aquifer pumping test was located near the northeastern corner of the cooling basin between observation well clusters OW-06, OW-07, and OW-10. The test well cluster consisted of test well TW-2359L and four observation wells (OW-2359L1 through OW-2359L3 screened in the Deep aquifer and OW-2359U1 screened in Lower Shallow aquifer) as shown on Figure 2.3.1.2-18. TW-2359L was pumped at a rate of approximately 21 gpm for 24 hours. The transducer at OW-2359L1 failed during the test resulting in no useable data for this observation point. Based on the results presented in Table 2.3.1.2-6, a transmissivity of approximately 2507.3 $feet^2$/day, a storage coefficient of approximately 4.1 x 10^{-4}, and a hydraulic conductivity of approximately 47.3 feet/day (using a saturated thickness of 53 feet) were estimated for the aquifer zone at this location.

A distance drawdown analysis of the Deep aquifer test data was also performed to compare with the single well test data analysis. This analysis yields an estimated transmissivity of 3157.7 square feet per day after 300 seconds and 2508.2 square feet per day after 3000 seconds of pumping. The corresponding hydraulic conductivity varies between 60 feet per day and 47 feet per day, respectively (assuming a saturated thickness of 53 ft). The distance drawdown analysis after 3000 seconds of pumping yielded virtually the same estimates of transmissivity and hydraulic conductivity in the Deep aquifer as the single well test analysis.

The site-specific hydraulic conductivity and transmissivity values obtained from the pumping tests are, in general, consistent with regional values for the Chicot Aquifer (Young et al. 2006). The Upper Shallow aquifer hydraulic conductivity values of approximately 8 feet/day from the single well test analysis and 39 feet per day from the distance drawdown test analysis plot approximately on the 20 feet/day slug test contour in Figure 2.3.1.2-16, indicating reasonable agreement between the test methods. The Deep aquifer hydraulic conductivity values of approximately 47 feet/day from the single well test analysis and 60 feet per day from the distance drawdown test analysis plots between the 10 and 20 feet/day slug test contours, indicating approximately a 3 to 4 times difference between the test methods. It should be noted that the aquifer pumping test wells were open to a thicker sequence of sands than the slug test wells.

2.3.1.2.2.4.2 Geotechnical Parameters

The geotechnical component of the subsurface investigation program at the VCS site included the collection of soil samples for field and laboratory determination of soil properties. These tests are described below. Additional details are provided in SSAR Subsection 2.5.4. Geotechnical tests of hydrogeologic interest include:

- Geotechnical laboratory derived hydrogeologic parameters from disturbed geotechnical samples include bulk density, porosity, and permeability (hydraulic conductivity) from grain size.
- Geotechnical laboratory derived hydrogeologic parameters from undisturbed geotechnical samples include hydraulic conductivity.
- In situ hydraulic conductivity values from Guelph borehole permeameter field tests.

Porosity and Bulk Density Properties

The geotechnical investigation component of the subsurface investigation program at the VCS site included the collection of soil samples for laboratory determination of soil properties. A summary of the hydrogeologic properties from geotechnical tests is presented in Table 2.3.1.2-7.

Bulk density (γ_m) values for the various subsurface units are determined from the dry density (γ_d) and water content (ω) measurements using the following formula (U.S. ACOE 2004):

$$\gamma_m = \gamma_d \times (1 + \omega / 100)$$

Porosity is defined as the percentage of rock or soil that is void of material. Porosity was calculated as a function of void ratio for individual soil samples using the relationship (U.S. ACOE 2004):

$$n = \frac{e}{1+e}$$

The effective porosity was determined as a function of the average total porosity and median grain size (d_{50}) using Figure 2.3.1.2-19 which is adapted from Davis and DeWiest (1966). For the silty sand that comprises the aquifers (d_{50} equal about 0.1 mm), the ratio of effective porosity to total porosity is 30 percent (effective porosity from the specific yield curve on Figure 2.3.1.2-19) divided by 37 percent (average total porosity), or 0.8. For the clay comprising the intervening confining layers (d_{50} equal about 0.001 mm), the ratio is 8 percent (from the specific yield curve on Figure 2.3.1.2-19) divided by 40 percent (average total porosity for clays) or 0.2. It should be noted that applying this relationship to clays is different than applying it to sand. Differences in clay mineralogy may result in differences in the electrostatic forces binding water molecules to the clay particles, thus introducing variability in the specific retention of the clay. Clays also may contain discontinuities resulting from cyclic wetting and drying (mud cracks) or as a result of post-depositional deformation (fractures). These factors could result in the overestimation or underestimation of the effective porosity of a clay.

Table 2.3.1.2-7 summarizes the total and effective porosities for each sample. The results of the geotechnical laboratory derived hydrogeologic parameters from disturbed geotechnical samples are summarized on Table 2.3.1.2-8, which provides the maximum, minimum, and mean values for each unit.

Hydraulic Conductivity for Sands Derived from Grain Size Analysis

The hydraulic conductivity of sands can be estimated using the Hazen approximation (Fetter 1988) and selected geotechnical laboratory data from Table 2.3.1.2-7.

$$K = C \times (D_{10})^2$$

where:

K = hydraulic conductivity (cm/sec)

D_{10} = the effective grain size (cm)

C = coefficient from the following table:
very fine sand, poorly sorted: 40–80
fine sand, with appreciable fines: 40–80
medium sand, well sorted: 80–120
coarse sand, poorly sorted: 80–120
coarse sand, well sorted, clean: 120–150

The effective grain size D_{10} is defined as the grain-size diameter at which 10 percent by weight of the soil particles are finer and 90 percent are coarser. The formula is valid for D_{10} between 0.1 and 3 mm with a coefficient of uniformity less than 5 (Kresic 1997). For the soils at the VCS site, a C value of 40 is used to represent fine sand with appreciable fines. A summary of the results of the grain size permeability analyses is presented in Table 2.3.1.2-9. Due to the restrictions on the D_{10} size (between 0.1 and 3 mm), the tests are biased toward the more permeable zones in each sand layer. The test results indicate a narrow range of hydraulic conductivity for all the sand zones tested.

The grain size data can also be used to qualitatively asses the hydraulic conductivity of the sand layers. Figure 2.3.1.2-20 shows ternary diagrams for the grain size data from each of the sand layers identified beneath the site. The ternary plots indicate that the unsaturated sand zone (geotechnical Sand 1) and the Upper Shallow aquifer (geotechnical Sand 2) have more fines than the underlying sand layers suggesting that these sands have a lower hydraulic conductivity than the Lower Shallow aquifer and the Deep aquifer.

Hydraulic Conductivity for Clayey Layers Derived from Laboratory Analysis

The vertical hydraulic conductivities of the clayey layers between the sand layers were determined using laboratory hydraulic conductivity measurements of undisturbed soil samples. The laboratory tests are performed using a triaxial cell permeameter with confining pressure. The results of these tests are shown on Table 2.3.1.2-10. The hydraulic conductivity range measured by the test is from a minimum of 2.5×10^{-9} cm/sec (7.1×10^{-6} feet/day) to a maximum of 8.3×10^{-6} cm/sec (2.4×10^{-2} feet/day). All the listed analyses were performed on materials classified as high plasticity clay.

Hydraulic Conductivity from Guelph Borehole Permeameter In Situ Field Tests

The Guelph permeameter is a constant-head borehole permeameter designed for in situ use in the field. The borehole permeameter tests were conducted at 16 locations within and adjacent to the VCS cooling basin at depths of 5 and 10 feet below preconstruction ground surface for a total of 32 tests. Only 18 of the tests are above the method detection limit. The results of the borehole permeameter tests are summarized in Table 2.3.1.2-11. Based on visual classification of the soils made during borehole preparation, the test results were subdivided into tests performed in sandy material and tests performed in clay. The field saturated hydraulic conductivity in sandy materials ranged from 1.44×10^{-6} cm/sec (0.0041 feet/day) to 9.70×10^{-4} cm/sec (2.75 feet/day), while the tests in clay ranged from 6.94×10^{-8} cm/sec (0.0002 feet/day) to 2.40×10^{-5} cm/sec (0.0680 feet/day).

The results of the borehole permeameter tests are contoured, including the tests below the method detection limit, as shown on Figure 2.3.1.2-21. The results in both the shallow (5 feet below ground surface) and deep test zones (10 feet below ground surface) show a higher hydraulic conductivity zone near the center of the cooling basin with lower hydraulic conductivity near the outer margin of the cooling basin. The following table relates the range of test results to the elevation of the test zone:

Elevation of Test	SP-SC		CH or SC	
	cm/sec	feet/day	cm/sec	feet/day
50–60	9.70×10^{-4}	2.75	5.37×10^{-7}–2.40×10^{-5}	0.0015–0.0680
60–70	1.44×10^{-6}–4.00×10^{-5}	0.0041–0.1134	1.38×10^{-6}–4.20×10^{-4}	0.0053–1.1907
70–80	None	None	6.94×10^{-8}–4.73×10^{-6}	0.0002–0.0134

SC — sandy clay
CH — high plasticity clay
SP-SC — poorly graded sand with clay

2.3.1.2.2.4.3 Summary of Aquifer Properties

Based on the results of geotechnical and hydrogeological testing the hydraulic conductivity values derived from grain size analysis, aquifer pumping tests, and slug tests at the VCS site (included in Part 5 of the ESPA) are considered to be in agreement and within the range of hydraulic conductivity values reported for the region (Young et al. 2006). Results of statistical analysis indicate that the slug tests produce the greatest range of hydraulic conductivity. Following is a summary of hydraulic conductivity ranges determined by different methods:

- Chicot Aquifer regional horizontal hydraulic conductivity values (from the technical literature): 8.5 to 170 feet/day
- VCS horizontal hydraulic conductivity pumping test results: 8 to 60 feet/day
- VCS slug test horizontal hydraulic conductivity results: 0.02 to 164 feet/day
- VCS grain size analysis horizontal hydraulic conductivity (sand): 11 to 30 feet/day
- VCS Guelph permeameter test vertical hydraulic conductivity results: less than 3 feet/day

The lower range in the slug test, grain size analysis, and the Guelph permeameter values are up to three orders of magnitude lower than the regional and VCS pumping test values. This may be due to the fact that the regional values are based on the probability of water wells being located in the most permeable sands, while the wells at VCS have short screen lengths and are, located in the more permeable material within the borehole drilled, regardless of whether or not the material is suitable for water production.

As discussed in Subsection 2.3.1.2.1.4, the VCS site is underlain by unconsolidated and discontinuous interbedded layers of sand and clay of the Chicot aquifer that dip toward the Gulf of Mexico. The Chicot aquifer at the site is divided informally into the Upper Shallow, Lower Shallow, and Deep aquifers.

2.3.1.2.2.5 Hydrogeochemical Characteristics

Regional hydrogeochemical data available for observation wells within 7.5 miles of the VCS site were obtained from TWDB (2009a) and are presented in Table 2.3.1.2-12. The analytical data were compared to EPA Primary and Secondary Drinking Water Standards (U.S. EPA 2008b) and exceedances are identified on the table. The principal exceedances were for total dissolved solids and chloride (Secondary Drinking Water Standards). The data indicate that the highest concentrations of total dissolved solids and chlorides are generally present in the Lissie Formation of the Chicot Aquifer.

The VCS site-specific hydrogeochemical data are presented in Table 2.3.1.2-13 and include 20 samples from the Chicot Aquifer. The analytical data were compared to EPA Primary and Secondary Drinking Water Standards and the exceedances are identified in the table. The principal exceedances at the VCS site were total dissolved solids and chloride. The data indicate that total dissolved solids exceedances are present in the Upper Shallow, Lower Shallow, and Deep aquifers at the VCS site. Chloride exceedances are present primarily in the Deep aquifer but are also locally present in the Upper Shallow and Lower Shallow aquifers.

Variations in chemical composition can be used to define hydrochemical facies in the groundwater system. The hydrochemical facies are classified by the dominant cations and anions in a groundwater sample. These facies may be shown graphically on a trilinear diagram (Fetter 1988). A trilinear diagram showing the regional and VCS site-specific geochemical data is presented on Figure 2.3.1.2-22. As depicted in Figure 2.3.1.2-22, the hydrochemical facies of the Chicot Aquifer consists predominantly of calcium chloride in the Deep aquifer, and bicarbonate to chloride anionic range with no dominant cation type in the Upper and Lower Shallow aquifers. The hydrochemical facies of the Evangeline Aquifer is dominated by the sodium cation, with a range of anions from bicarbonate to chloride.

The San Antonio River at McFaddin does not exhibit a dominant cation or anion facies. However, the Guadalupe River at Victoria exhibits a calcium-bicarbonate hydrochemical facies. The difference in facies between the two rivers may be attributed to the proximity of the sampling location on the Guadalupe River to the water treatment facility in Victoria.

Comparison of historical and more recent regional hydrogeochemical data presented in Table 2.3.1.2-12 indicates a general temporal consistency in groundwater chemistry for the individual aquifers present in the site area. This suggests that long-term variations in groundwater chemistry are not likely to occur at the VCS site.

2.3.1.2.3 Subsurface Groundwater Pathways

This section presents the development of a groundwater computer flow model that was used to represent the subsurface groundwater pathways at the VCS site.

2.3.1.2.3.1 Groundwater Flow Model

A numerical groundwater flow model was developed to assist with interpretation of the subsurface hydrogeologic conditions and to simulate post-construction groundwater conditions. Modeling efforts began while the subsurface site investigation was being conducted to provide preliminary estimates of the cooling basin seepage rate, the predicted groundwater elevation in the power block, and expected post-construction groundwater flow paths using preliminary data evaluation and assumptions. The groundwater model was refined as subsurface data interpretation and evaluation were completed. The conclusions of the final groundwater modeling effort are presented in this subsection.

A three-dimensional, eleven layer VCS groundwater flow model was developed to evaluate potential impacts on the groundwater flow system from the construction and operation of the cooling basin. Four specific areas of impact were assessed:

- Seepage rate from the cooling basin into the site groundwater system
- Post-construction groundwater level in the power block area
- Impacts on plant construction dewatering
- Postulated, post construction groundwater accidental release pathway

The groundwater flow model is executed under the Visual MODFLOW Version 4.3 environment developed by Schlumberger Water Services (Schlumberger Water Services 2008). The program consists of a series of pre- and post-processors that feed information to various numerical groundwater flow models developed by others. The groundwater flow model selected for the VCS utilizes a three-dimensional finite-difference groundwater flow model known as MODFLOW-2000 (Harbaugh et al. 2000). A subsidiary program known as MODPATH (Pollock 1999) is used to perform particle tracking to identify the groundwater flow paths and estimate travel time from the power block area to the nearest site boundary.

A detailed description of the construction, calibration, and results of the model are included in SSAR Appendix 2.4.12-C. The area of the model domain is presented in Figure 2.3.1.2-23.

2.3.1.2.3.1.1 Site Conceptual Model

Prior to development of a numerical groundwater model, a conceptual model of the Victoria County Station (VCS) site and surrounding area was developed. The conceptual model is the overall qualitative understanding of how the local and regional topography, climate, geomorphology, stratigraphy, groundwater use patterns, hydrology and boundary conditions affect groundwater flow in the aquifer.

The topography for the groundwater model for the VCS site was established using the U.S. Geological Survey 1999 National Elevation Dataset. This dataset references surface elevations to the NAVD88 vertical datum. Climatic parameters of average rainfall and evapotranspiration were determined from records of the Victoria County Groundwater Conservation District (TWDB 2006a) and the Texas A & M University System Texas ET Network. The regional stratigraphy and geomorphology were established from publications of the TWDB (TWDB 2006a, Chowdhury and Turco 2006, Chowdhury et al. 2004, and Young et al. 2006), the Texas Department of Water Resources (Baker 1979) and the U.S. Geological Survey (Ryder 1996). The stratigraphy at the VCS site was determined by drilling and testing more than 200 geotechnical borings, monitoring wells and cone penetrometer tests in the Chicot aquifer. Groundwater use patterns were established with information available from the U.S. Environmental Protection Agency (U.S. EPA 2009) and TWDB (TWDB 2009a, TWDB 2009b, and TWDB 2006a). Hydrology and boundary conditions were determined from publications of the Texas Department of Water Resources (Baker 1979) and the TWDB (Chowdhury and Turco 2006, Chowdhury et al. 2004, and Young et al. 2006).

The conceptual model of the VCS site includes interbedded sand and clay layers based on the site geotechnical boring logs, geophysical logs, monitoring well data and cone penetrometer test results included in Part 5 of the ESP application. Groundwater levels measured in a total of 62 observation wells at the VCS site at different times during 2008 and 2009 were used to develop potentiometric surface maps for the Upper Shallow, Lower Shallow, and Deep aquifer zones established for the Chicot aquifer based on the geotechnical borings. The bottom of the model domain was set at an elevation of -260 ft, which is the approximate bottom elevation of "Sand 10" at the Powerblock area. The bottom elevation of the "Sand 10" layer was based on the average S-wave velocity profile in SSAR 2.5.4 (Figures 2.5.4-A-71 and 2.5.4-A-72). Based on the potentiometric surface maps the groundwater flow direction at the site is generally to the east toward the Guadalupe River. The site-specific potentiometric surface maps show groundwater trends similar to the regional groundwater flow to the southeast, as measured by the TWDB (Chowdhury et al. 2006) and modeled by the TWDB Groundwater Availability Model (GAM) of the Central Gulf Coast Aquifer System (Chowdhury et al. 2004).

The domain of the GAM model includes the VCS site in Victoria County, Texas. The GAM model is a regional numerical model with four (4) layers and the Chicot aquifer is included as one continuous single layer within the model. In contrast, the site-specific VCS model subdivides the upper Chicot aquifer into various sands and clay units based on the site geotechnical boring logs and test results. Similar subdivision of the upper Chicot aquifer into a series of interbedded sand and clay layers was done for a site-specific groundwater model in Port Arthur, Texas (Haug et al. 1990).

To represent the regional flow at the VCS site, a general head boundary (GHB) was assigned to the cells at the north, east and west perimeters of the groundwater model domain in each of the saturated sand layers. The application of the GHB is to "represent heads in a model that are influenced by a large surface water body outside the model domain with a known water elevation.

The purpose of using this boundary condition is to avoid unnecessarily extending the model domain outward to meet the element influencing the head in the model. As a result, the General Head boundary condition is usually assigned along the outside edges of the model domain" (Schlumberger Water Services 2008). The inclusion of a GHB for cells to the north and west in the VCS model was not related to the presence of a large surface water body, but rather to dictate that groundwater flow within the vicinity of the site is consistent with observed aquifer flow patterns without unnecessarily extending the model. The GHB to the east represents the effect of the Guadalupe River.

Rivers in the VCS model domain such as the San Antonio River, Coleto Creek, Victoria Barge Canal and Guadalupe River were assigned the river package boundary of MODFLOW. The river package boundary models the groundwater and surface water interaction within the aquifer via a seepage layer separating the surface water body from the groundwater system. Small creeks were assigned as drain package boundaries to allow the groundwater model to represent groundwater discharge from the aquifer to the creeks. The drain package is designed to remove groundwater from the aquifer at a rate proportional to the difference between the head in the aquifer and some fixed head or elevation. The drain package assumes the drain has no effect if the head in the aquifer falls below the fixed head of the drain. A constant head boundary was assigned to Linn Lake to represent a steady-state water elevation in the lake and to provide a continuous source of water to the layers below.

The magnitudes of recharge and evapotranspiration assigned to the VCS groundwater model were similar to those assigned to the GAM model. The GAM model included boundary conditions similar to those assigned in the VCS site groundwater model, including GHBs, river package boundaries, drain package boundaries and constant head boundaries. Thus, based on site-specific geotechnical boring logs and test results and a conceptual hydrogeologic understanding of the VCS site it can be deduced that the VCS site groundwater model has the same framework as that of the regional TWDB GAM model and another site-specific groundwater model in the Chicot aquifer (Haug et al. 1990).

2.3.1.2.3.1.2 Groundwater Model Development

Hydrogeologic information for the VCS site was obtained primarily from the site subsurface investigation program and regional publications and databases to develop a stratigraphic model of the Chicot Aquifer within the area of the VCS site. Regional groundwater data and VCS site groundwater level measurements were used as calibration targets for the groundwater model.

The Chicot Aquifer is subdivided into three saturated sandy zones: the Upper Shallow aquifer, the Lower Shallow aquifer, and the Deep aquifer. Additionally, a sand layer designated Sand 1 exists above the saturated zone beneath the cooling basin. These sand units are separated by less permeable layers of clayey materials.

Eleven model layers were chosen to represent the component of the Chicot Aquifer. These layers correspond to geotechnical layers and hydrogeologic units identified by the subsurface investigations as follows: Sand 1 (unsaturated) corresponds to model layer 2; Sand 2 (the Upper Shallow aquifer) corresponds to model layer 4; and Sand 4 (the Lower Shallow aquifer) corresponds to model layer 6. Sand 5, Clay 5-bottom and Sand 6 (collectively the Deep aquifer) correspond to model layers 8, 9, and 10. Model layers 1, 3, 5, and 7 correspond to the inter-fingering clay layers between these aquifer units. The bottom model layer (layer 11) is comprised of Clay 7, Sand 8, Clay 9, and Sand 10. The geotechnical layers are further described in SSAR Subsection 2.5.4.

2.3.1.2.3.1.2.1 Description of Hydro-lithologic Units

The various hydro-lithologic units included in the VCS conceptual model were defined based on the results of a detailed subsurface investigation at the VCS site. The initial subsurface investigation included obtaining samples and data from over 150 soil borings, 27 pairs of observation wells and 2 well clusters each containing a test well and 4 nearby observation wells. The investigation was conducted within and around the power block area and in the area of the cooling basin. Sixty-five cone penetration tests (CPTs), geophysical logging, and laboratory testing were also performed for the subsurface investigation. A supplemental investigation included drilling an additional 94 borings and performing 12 additional CPTs as well as geophysical logging and laboratory testing. Soil samples were collected from the soil borings using standard penetration test (SPT) procedures and were visually examined and logged in the field by a geologist or geotechnical engineer. The number of hammer blows required to advance the soil sampler for each SPT was recorded. Soil index tests to determine grain-size distribution were completed on a total of 706 soil samples. The data produced by these investigative activities is provided in Part 5 of the ESP application.

The soil sample descriptions, sampler blow counts, soil index test results, cone penetrometer measurements, borehole geophysical logs, observations of soil cuttings, rate of loss of drilling fluid to the formation, rig behavior, and rate of advancement as drilling proceeded were all used to determine the depths in each boring at which changes in soil type occurred. Based on these depths and the surveyed elevations of ground surface at each soil boring and cone penetrometer sounding, a series of geotechnical cross-sections was constructed to provide an interpretation of the stratigraphy underlying the site. These cross-sections are provided in SSAR Subsection 2.5.4.

In addition, driller's logs obtained from the Texas Water Development Board of 72 water wells in the vicinity of the VCS site were used to assist in interpretation of the stratigraphy near the site. The elevations of the bottom of each soil layer noted in these well logs were correlated with those from onsite soil borings and cone penetrometer soundings to extend several cross-sections offsite and construct additional regional cross-sections that extend across the domain of the VCS numerical model. The locations of these cross-sections are shown on Figure 2.3.1.2-24a.

The cross-sections provide a conceptual model of the stratigraphy beneath the VCS site and its vicinity. This stratigraphic conceptual model provides the basis for interpolating elevations of the bottom of each soil stratum. The interpolated strata elevations were used to prepare contour maps representing the bottom of each layer in the numerical model. Where strata are absent, the bottom elevation of the corresponding model layer was arbitrarily set to 1 foot below the bottom elevation of the overlying layer. The hydraulic properties of this layer were set to the properties of the underlying layer. Contour maps were prepared by kriging the elevation data and contouring them using contouring and 3D surface-mapping software. Contouring accuracy was verified by manually contouring the data and comparing the results to the maps generated by the contouring and 3D surface-mapping software.

Based on the analyses described above, the stratigraphy of the site and its vicinity is interpreted to be comprised of a sequence of discontinuous and interbedded strata consisting primarily of sand and clay. In many cases, the vertical transition from one stratum to the next is gradational and open to interpretation, as is the continuity of strata from one soil boring to the next. As discussed in SSAR Subsection 2.5.1.1.1.3, the depositional environment within which the local soils accumulated is interpreted to be that of coalescing fluvial deltas containing a complex overlapping series of braided stream, levee, lagoon, and overbank flood deposits. Sediments deposited in this environment would typically vary in grain size, sorting, and hydraulic properties both horizontally and vertically. These variations would occur because of changes over time in the locations of stream meanders and distributaries related to the changing position of the Gulf of Mexico shoreline and the energy available for transporting sediments related to changes in stream flow.

The hydro-lithologic units simulated by the VCS numerical model were defined based on the following investigations and findings. Pairs of observation wells were drilled at 27 locations across the VCS site. The wells in each pair were completed with 10-foot long screens, each in different sand strata. Hydrogeologic cross-sections BB-BB' and HH-HH' (Figures 2.3.1.2-28 and 2.3.1.2-29, respectively) show the approximate elevations of well screens within the various sand strata at a total of six observation well pairs. These cross-sections also show the potentiometric head measured in each observation well on February 18, 2008, and the inferred direction of the vertical groundwater gradient, based on differing heads in the sand strata within which each well screen is completed.

Figure 2.3.1.2-15 contains several hydrographs, each showing a time series of the potentiometric heads in an observation well pair, including those well pairs shown on cross-sections BB-BB' and HH-HH'. The hydrographs demonstrate a generally consistent vertical potentiometric gradient between the upper and lower screen zones in each well pair. The difference in potentiometric head between the sand strata in Figures 2.3.1.2-28 and 2.3.1.2-29 in which the well screens are completed provides evidence that the sands are to some extent hydraulically isolated from each other by the intervening strata comprised predominantly of silt and clay. These finer-grained strata are interpreted to be confining layers acting as aquitards, while the sand strata are interpreted to be aquifers.

This finding forms the basis for subdividing the Chicot Aquifer at the VCS site into the Upper Shallow, Lower Shallow, and Deep aquifer zones. These aquifer zones are represented in the VCS numerical model by Sand 2 (model layer 4), Sand 4 (model layer 6), and Sands 5 and 6 (model layers 8 and 10), respectively. Estimates of the hydraulic properties of the aquitards and aquifers are discussed in Subsection 2.3.1.2.2.4.

Figure 2.3.1.2-13 provides a series of potentiometric surface maps for the Upper Shallow, Lower Shallow, and Deep aquifer zones at approximately quarterly intervals. Comparison of the maps showing potentiometric surfaces of the three aquifer zones on the same date reveals significant differences in the horizontal hydraulic gradients, particularly with respect to the Upper Shallow and Lower Shallow aquifer zones. Further, as indicated by the hydrographs in Figure 2.3.1.2-15, the potentiometric surface maps show that on the same date and at the same location on the VCS site, the elevation of the head in each aquifer differs significantly, especially between the Upper Shallow and Lower Shallow aquifer zones. These differences provide additional evidence that the sand strata interpreted on the hydrogeologic cross-sections in Figures 2.3.1.2-28 and 2.3.1.2-29 behave as discrete aquifer zones that can appropriately be divided into the Upper Shallow, Lower Shallow, and Deep aquifers.

The following additional lines of evidence support subdivision of the Chicot Aquifer at the VCS site:

- The results of slug tests and pumping tests (Tables 2.3.1.2-5 and 2.3.1.2-6, respectively) show that the hydraulic conductivities of the Upper Shallow, Lower Shallow, and Deep aquifer zones differ significantly.

- During the 24-hour pumping test completed in the Deep aquifer, groundwater levels were monitored in a nearby observation well completed in the Lower Shallow aquifer. The results of that testing, provided in Part 5 of the ESP application, indicate that there was no water-level response in the Lower Shallow aquifer, and therefore, the Lower Shallow and Deep aquifers are hydraulically isolated in the area of the test.

- Other investigators, including Haug et al. (1990). have also subdivided the upper Chicot Aquifer in their numerical groundwater model of an area of Port Arthur, Texas.

2.3.1.2.3.1.2.2 Discussion of the Influence of Windows in Confining Units

The confining units of most interest throughout the VCS site are Clay 1-top (model layer 1 in the VCS numerical model), Clay 1-bottom (model layer 3), Clay 3 (model layer 5), and Clay 5-top (model layer 7). A geotechnical description of these clay layers is presented in SSAR Subsection 2.5.4. The incorporation of site stratigraphy into the numerical groundwater model is further discussed in SSAR Appendix 2.4.12-C. Table 2.3.1.2-16 summarizes the locations on the VCS site where one or more of the confining units are absent.

Clay 1-top was identified at all sample locations within the power block area, based on a summary of the bottom elevations of each stratum identified in the 73 soil borings and 28 cone penetrometer soundings completed in the power block area. The apparently continuous coverage of Clay 1-top throughout the power block area suggests relatively uniform hydraulic properties of the shallow soils in the area of the power block.

The summary of strata bottom elevations in the power block area indicates that Clay 1-bottom is absent at three locations in the eastern part of the power block, potentially providing a window that places Sand 1 (model layer 2) in contact with Sand 2 (model layer 4). The power block area will be excavated to allow construction of foundations. The depth of the foundation excavation will be determined based on the reactor design chosen for the site.

In the groundwater numerical model, the deepest foundation in the eastern part of the power block is set at elevation -35 feet, which is approximately the bottom elevation of Sand 4 (model layer 6) in this area (SSAR Figures 2.5.4-9 and 2.5.4-10). Therefore, the foundation excavation will completely remove Clay 1-top, Sand 1, Clay 1-bottom, Sand 2, Clay 3, and Sand 4 (and the three windows between Sand 1 and Sand 2) in the modeled eastern part of the power block area. Although Subsection 2.3.1.2.3.2.2, states that excavation for the building foundations in the power block area could extend to elevation -15 feet, the groundwater numerical model represents a more conservative scenario with respect to groundwater travel time because it would result in placement of relatively high permeability structural fill across the entire thickness of Sand 4 and a correspondingly shorter travel time for a hypothetical release of radionuclides flowing through Sand 4 to their down-gradient discharge point.

The foundations will be surrounded with structural fill with hydraulic conductivity greater than that of the native soils. Therefore, the fill will provide a hydraulic connection between Sand 1, Sand 2, and Sand 4 in the power block area. The effect of this hydraulic connection has been evaluated with the VCS numerical groundwater flow model by a particle-tracking analysis (Subsection 2.3.1.2.3.2). This analysis simulates the flow paths and travel times for transport of liquid effluents postulated to be released from the basement of radwaste buildings in the power block. The particle tracking analysis (Subsection 2.3.1.2.3.2.3) indicates that the postulated release will travel vertically downward within the structural fill until encountering Clay 5-top (model layer 7) and then travel laterally to the east-southeast within the overlying Sand 4 where it eventually discharges into Linn Lake, the Guadalupe River, or the Victoria Barge Canal. The travel time to reach the closest VCS site boundary in this direction is discussed in SSAR Appendix 2.4.12-C.

Figure 2.3.1.2-30 shows 16 sample locations where Clay 1-top (model layer 1) is absent, based on a summary of the bottom elevations of each stratum identified in the 53 soil borings and 27 cone penetrometer soundings completed in the cooling basin area. Eleven of the locations where Clay 1-top is absent are east of the cooling basin. In this area, ground surface elevations are generally lower than those within the footprint of the basin (SSAR Tables 2.5.4-37 and 2.5.4-41). Unnamed streams draining eastward into the Guadalupe River Valley have eroded the shallow soils and completely removed Clay 1-top in some areas east of the cooling basin. In these areas, the underlying Sand 1 is exposed at the ground surface. Near the escarpment at the west side of the river valley the channels of the unnamed streams are incised into Sand 1. The incised channels were denoted as drains in the VCS numerical model to remove excess groundwater that may seep into the channels under high water table conditions. Pre- and post-construction model runs (SSAR Appendix 2.4.12-C) indicate that the combined discharge from the seeps will increase from 0 (pre-construction) to 310 gallons per minute when the cooling basin is filled.

Of the 16 locations where Clay 1-top is absent, five locations are within the footprint of the cooling basin. These five locations are widely distributed over the central portion of the approximately 4,900-acre cooling basin, and the absence of this unit is inferred based on widely spaced discrete sample locations. It can be noted that permeameter testing completed in the vicinity of those five locations where Clay 1-top was absent in samples collected from soil borings indicates that the permeability of the shallow soil is generally less than that assumed for Clay 1-top (layer 1) in the VCS numerical groundwater model (Table 2.3.1.2-11). This finding suggests that in its current pre-construction condition, the permeability of the shallow soil within the footprint of the cooling basin is not greater than that of Clay 1-top.

While excavation of the surficial soils to construct the cooling basin and embankment dam will partially or completely remove Clay 1-top in some areas, silt and clay are expected to accumulate on the floor of the basin when it is filled, due to re-distribution of fine-grained sediments by currents and wave action and importation of fine-grained sediments in makeup water from the Guadalupe River. These sediments will form a layer of relatively low permeability that will limit post-construction seepage through the bottom of the cooling basin and into Sand 1. A sensitivity analysis of the cooling basin seepage rate in the VCS numerical groundwater model demonstrated that a 10-fold increase in the hydraulic conductivity of Clay 1-top results in only a 2-percent increase in the seepage rate (SSAR Appendix 2.4.12-C).

Figure 2.3.1.2-31 shows Clay 1-bottom (model layer 3) to be absent at three locations in the vicinity of the cooling basin, providing a window that places Sand 1 (model layer 2) in contact with Sand 2 (model layer 4). Each of these three locations is outside of the basin footprint; two (B-2346 and B-2348) are near the southwest corner of Linn Lake, and the third (C-2328) is near the southwest corner of the basin. Sand 1 is unsaturated at each of these locations under pre-construction conditions but will become saturated when the cooling basin is filled because of seepage through the bottom of the basin into Sand 1 (SSAR Appendix 2.4.12-C).

With the cooling basin full, the modeled hydraulic head of 90.5 feet in the basin will induce a downward vertical gradient through Clay 1-top into Sand 1 and through Clay 1-bottom into Sand 2 and result in saturation of Sand 1, including the area near the basin embankment dam. The VCS numerical model predicts that post-construction groundwater discharge to Linn Lake (east of the cooling basin) will approximately double relative to pre-construction flow (SSAR Appendix 2.4.12-C).

Clay 3 (model layer 5) is absent at eight locations east of the cooling basin as shown in Figure 2.3.1.2-32, creating areas where Sand 2 (the Upper Shallow aquifer) is in contact with Sand 4 (the Lower Shallow aquifer). The Upper and Lower Shallow aquifers merge into one relatively continuous sand unit in these areas. The eight locations where Clay 3 is absent are located at the western edge of the Guadalupe River Valley. This valley is the principal drainage feature toward which shallow groundwater flows in the region of the VCS site (Figure 2.3.1.2-12). On this basis, it is reasonable to infer that an upward vertical gradient and groundwater flow from Sand 4 to Sand 2 exists within the valley. It is likely that this condition will not be affected significantly by construction of VCS.

Clay 5-top (model layer 7) is shown in Figure 2.3.1.2-33 to be absent at four locations in the area of the cooling basin. The location at the northeast corner of the basin (Boring B-09) is within the down-gradient flow path of a postulated release of radioactive effluent from the basement of a radwaste building in the power block area (SSAR Appendix 2.4.12-C). A particle-tracking analysis of that release determined that the effluent would flow vertically downward within the structural fill surrounding the building foundation until encountering Clay 5-top. The effluent would then flow laterally down-gradient toward the east-southeast within the overlying Sand 4. The absence of Clay 5-top at Boring B-09 places Sand 4 in contact with Sand 5 at this location and may allow the released effluent to disperse into Sand 5. This condition is depicted on the cross-section in SSAR Appendix 2.4.12-C.

Groundwater in both Sand 4 and Sand 5 eventually discharges within the Guadalupe River valley to Linn Lake, the Guadalupe River, and the Victoria Barge Canal. The data in Table 2.3.1.2-4 show that the vertical groundwater gradient at observation well pair OW-2348U/L near Linn Lake is slightly upward, indicating a discharging condition from the Deep aquifer (Sand 5) to the Lower Shallow aquifer (Sand 4). Conversely, at well pair OW-2319U/L near the western side of the cooling basin, the data in Table 2.3.1.2-4 show the vertical groundwater gradient to be slightly downward from Sand 4 to Sand 5, indicating a recharge condition. Neither of these relationships is likely to be affected significantly by construction of VCS.

The explicit method of using a model layer to represent a confining layer was selected for the VCS numerical model. A single value of hydraulic conductivity was selected to represent each sand geotechnical unit. Hydraulic conductivity values were adjusted to match the observed heads as part of model calibration. Other properties used to support model development include recharge rate, evapotranspiration, and effective porosity.

Model development included a preconstruction site elevation at the power block area of approximately 80 feet. The finished plant grade in the power block area is assumed to be elevation 95 feet. The surface elevation on the Guadalupe River floodplain is approximately 15 feet. Local wells are assumed to have average pumping rates of less than 10 gpm, and are considered to have minimal impact on groundwater levels outside of the immediate area of the well.

The VCS cooling basin bottom is approximated at elevation 69 feet. The water level for the cooling basin is assumed to be at elevation 90.5 feet. The cooling basin dikes were not considered in the seepage analysis due to their small size in relation to the cooling basin area. The hydraulic conductivity of the fill material used in plant construction is assumed to be that of a clean sand and gravel.

The primary zones of interest for VCS cooling basin seepage and excavation dewatering are Sand 1 and the Upper Shallow aquifer because these are the uppermost layers through which much of the groundwater flow will occur. The primary zones of concern for VCS cooling basin seepage and excavation dewatering are the Sand 1 and the Upper Shallow aquifer. Sand 1 is unsaturated in the preconstruction groundwater flow system.

2.3.1.2.3.1.2.3 Comparison of Site Specific Hydraulic Conductivities to Published Scientific Literature

The value of vertical hydraulic conductivity of the clay in model layer 1 is based on the results of borehole permeameter tests in layer 1 (the uppermost clay layer) from Table 2.3.1.2-11. The vertical hydraulic conductivity of the remaining clay layers in the model is based on laboratory permeability testing of undisturbed soil samples from the shallow (layers 3 and 5) and deep (layer 9) confining layers (Table 2.3.1.2-10). The horizontal hydraulic conductivity of each clay layer in the model is assumed to be ten times the corresponding vertical hydraulic conductivity (Walton 1984).

The value of horizontal hydraulic conductivity of the sand in model layer 4 is based on the results of a 48-hour pumping test of this layer and optimized through model calibrations. Similarly, the horizontal hydraulic conductivity of the sand in model layer 8 is based on the results of a 24-hour pumping test of this layer and adjusted during model calibration. The horizontal hydraulic conductivity of the sands in model layers 6 and 10 is assumed to be the same as that determined by the pumping test of layer 8 because the grain size distribution of samples from layers 6, 8 and 10 are similar

(Figure 2.3.1.2-20). The vertical hydraulic conductivity of each sand layer in the model is assumed to be one-third of the corresponding horizontal hydraulic conductivity (Walton 1984).

Values for the hydraulic conductivity of sand and clay layers in the VCS groundwater model were compared to values published in the scientific literature for the Chicot aquifer. Young et al. (2006) provides a range of hydraulic conductivity values determined from qualifying pumping tests in the Chicot aquifer. The range of horizontal hydraulic conductivity values reported in Young et al. (2006) for the Chicot aquifer varies between 13 feet/day and 154 feet/day. The values of horizontal hydraulic conductivity assigned to the "sand units" of the Chicot aquifer in the VCS groundwater model range from 68 feet/day to 103 feet/day and are within the range reported in Young et al. (2006).

Bravo et al. (1996) describes a groundwater model that simulates the hydrological conditions of the Chicot and Evangeline aquifers that underlie the Houston area. The Chicot and Evangeline are the same aquifers that extend to the VCS site. The horizontal hydraulic conductivity of the highly permeable zones of the Chicot aquifer in the Houston area is reported to be 170 feet/day (Table 2 of Bravo et al. 1996). The vertical hydraulic conductivity of the permeable unit of the Chicot aquifer reported in Table 2 of Bravo et al. (1996) is 0.01 feet/day. However, in the groundwater model described in Bravo et al. (1996), both the Chicot and Evangeline aquifers are modeled as isotropic, with the horizontal and vertical hydraulic conductivities equal to 170 feet/day.

Cleveland et al. (1992) reports that the vertical hydraulic conductivity of the clay units of the Chicot aquifer in the Houston area ranges between 4.63 x 10^{-4} meters/day (1.52 x 10^{-3} feet/day) and 0.73 x 10^{-5} meters/day (2.4 x 10^{-5} feet/day). Except for Clay 1-Top (6 x 10^{-2} feet/day), the vertical hydraulic conductivity assigned to the clay layers in the VCS groundwater model is 7 x 10^{-5} feet/day. This value is within the range reported in Cleveland et al. (1992).

Haug et al. (1990) provides estimates of the horizontal and vertical hydraulic conductivities of the various sand and clay units of the Upper Chicot aquifer used in a groundwater model of the Port Arthur, Texas area. The vertical extent of that model is the "Sand 2" hydrostratigraphic unit of the Upper Chicot aquifer, which seems to correspond to Sand 2 in the VCS groundwater model.

Table 1 of Haug et al. (1990) lists a horizontal hydraulic conductivity for the surficial clay unit at the Port Arthur site of 1 x 10^{-9} meters/second (2.8 x 10^{-4} feet/day). For the "Sand 1" unit at the Port Arthur site (which seems to correspond to Sand 1 at the VCS site) the values for horizontal hydraulic conductivity range between 3 x 10^{-5} meters/second (8.5 feet/day) and 4 x 10^{-5} meters/second (11.3 feet/day). For the Middle clay unit at the Port Arthur site (which seems to correspond to Clay 2 at the VCS site) the horizontal hydraulic conductivity is listed as 2 x 10^{-5} meters/second (5.7 feet/day) and for the "Sand 2" unit (which seems to correspond to Sand 2 at the VCS site) the value is 1 x 10^{-4} meters/second (28.3 feet/day). The anisotropy ratio of horizontal to vertical hydraulic conductivity for both the sand units and the clay units at the Port Arthur site is modeled as 10:1 (Haug et al. 1990).

The horizontal hydraulic conductivity values reported in Young et al. (2006) for the sand layers in the Chicot aquifer bound the values used in the VCS site groundwater model. The anisotropy ratio of horizontal to vertical hydraulic conductivity of 3:1 assigned to the sand layers in the VCS groundwater model falls within the reported range for the Chicot aquifer of 10:1 at the Port Arthur site (Haug et al. 1990) and 1:1 in the Houston area (Bravo et al. 1996).

The anisotropy ratio of horizontal to vertical hydraulic conductivity of 10:1 used in the VCS groundwater model for the clay layers of the Chicot aquifer agrees with that reported in Haug et al. 1990 for the clay layers of the Chicot aquifer at the Port Arthur site. The vertical hydraulic conductivity values for the clay layers in the VCS groundwater model are nominally within the range reported in Cleveland et al. 1992 for the Chicot aquifer in the Houston area.

The values of hydraulic conductivity for the sand and clay units of the Chicot aquifer represented in the VCS groundwater model are based on the results of site-specific pumping tests, grain size analysis and laboratory permeameter tests. These values and the anisotropy ratio of horizontal to vertical hydraulic conductivity assigned in the VCS groundwater model are within the range of the values published in the scientific literature.

2.3.1.2.3.1.3 Numerical Model

The model area was established to take advantage of natural boundary conditions in the site area. The Guadalupe and San Antonio Rivers, the Victoria Barge Canal, and Coleto Creek form physical boundaries along the north, east, west, and south perimeters of the model domain. Groundwater flow directions are interpreted as generally west to east across the VCS site, based on the regional potentiometric surface in the Chicot Aquifer. Preconstruction groundwater discharge is interpreted to occur on the west side of the Guadalupe River valley into Linn Lake and a series of sloughs that flow eastward along the west side of the valley.

The model grid consists of 189 columns, 193 rows, and 11 layers. Grid spacing ranges from 500 feet at the edges to 250 feet in the power block area. Figure 2.3.1.2-23 is a plan view of model domain showing the grid and calibration wells.

As stated in Subsection 2.3.1.2.3.1.2.1, hydrogeologic cross-sections and structure contour maps were developed from the subsurface data obtained from the VCS site subsurface investigation and from regional driller's log databases. These cross-sections and contour maps were used as the basis for the hydrogeologic layers developed for the numerical groundwater model. The locations of the cross-sections are shown in Figure 2.3.1.2-24a. Figures 2.3.1.2-24b and 2.3.1.2-24c present orthogonal hydrogeologic cross-sections E-E' and G-G'.

Cross-section E-E' is oriented approximately east-west and passes through the central part of the cooling basin. Cross-section G-G' is oriented approximately north-south and passes through the power block area and the western portion of the cooling basin. These cross-sections show the hydro-lithologic units labeled consistent with site nomenclature and the conceptual model of the stratigraphy beneath the VCS area. The hydro-lithologic units were interpreted from logs of geotechnical borings drilled on the VCS site, drillers' logs of water wells drilled in the region of the site, and results of other onsite investigative activities.

Cross-sections E-E' and G-G' both show the stratigraphy at soil boring B-2310 but with slightly different interpretations because of differing perspective due to different orientations of the cross-sections. The stratigraphic interpretation in E-E' is incorporated in the layering of the VCS numerical model because it provides better characterization of layering within the Deep aquifer, based on soil boring information.

Tables 2.3.1.2-1 and 2.3.1.2-3 show construction details and monthly groundwater levels for the observation wells, respectively. Potentiometric levels measured on February 18, 2008, in each of the observation wells in the cross-sections and the direction of the vertical groundwater gradient are also shown. The potentiometric levels shown in the regional water wells were measured as each was drilled during the period between 2003 and 2009.

Figures 2.3.1.2-24d and 2.3.1.2-24e are orthogonal cross-sections showing the modeled hydrostratigraphy along row 110 and column 92, respectively, of the VCS numerical groundwater model grid. As shown in Figure 2.3.1.2-24a, the locations of the cross-sections in Figures 2.3.1.2-24d and 2.3.1.2-24e approximate the locations of the two hydrostratigraphic cross-sections in Figures 2.3.1.2-24b and 2.3.1.2-24c. Comparison of the figures confirms that the hydro-lithologic units of the conceptual model closely match those of the groundwater numerical model. The numerical model cross-sections do not precisely mirror the conceptual model cross-sections because the sets of east-west sections and north-south sections are not constructed on the same vertical plane.

A layer type is defined for each layer in the model. The layer type represents the hydrogeologic conditions anticipated for each layer. For the VCS model, two layer types are used. Type 0 confined (where the transmissivity and storage coefficient are constant throughout the simulation) and type 3 confined/unconfined (with variable storage coefficient and transmissivity). Layer type 3 was assigned to all the layers in the pre-construction model to represent the variable conditions in these layers. Layer type 0 was applied to model layers 4 through 11 in the post-construction model simulations representing the relatively constant confined conditions present in these layers. The MODFLOW default method for assigning inter-block transmissivity using the harmonic mean is used for all layers.

The solver used in the model is the algebraic multigrid (SAMG) solver. The configuration of the model requires the use of the re-wetting function to saturate unsaturated cells in the model.

2.3.1.2.3.1.4 Boundary Conditions

The recharge boundary condition was assigned to the uppermost active model cell. Two zones of recharge were used for preconstruction conditions to represent areas overlain by clay or sandy deposits. The values of recharge in each zone were adjusted during calibration.

The evapotranspiration (ET) boundary condition was a single zone. An extinction depth of 5 feet was used to represent the maximum root penetration depth. It should be noted that Visual MODFLOW stops ET if the groundwater level is below the extinction depth or below the bottom of layer 1.

A constant head boundary was assigned to represent Linn Lake in the model. The lake is represented by an elevation head of 10 feet.

A general head boundary was assigned along the west central and northwestern edge of the model to represent regional inflow of groundwater in the Upper Shallow aquifer (layer 4), the Lower Shallow aquifer (layer 6), and the Deep aquifer (layer 8 and layer 10).

Drain boundaries were assigned in layer 1 and layer 2 along Kuy and Dry Kuy Creeks, other unnamed creeks and streams adjacent to the VCS site, and on the Guadalupe River Valley slope to the east of the proposed cooling basin to simulate seepage areas. Drain boundaries were assigned in layer 3 along Kuy Creek from its confluence with Dry Kuy Creek to its confluence with the Guadalupe River to simulate seepage in this area.

River boundaries were assigned in selected layers for the Guadalupe River, San Antonio River, Coleto Creek, Black Bayou, and the Victoria Barge Canal.

The surface water elevations in the canal, rivers, creeks and seeps were determined from published literature values, U.S. Geological Survey (USGS) topographic maps, and from site observations. Three types of model boundary conditions (river, drain and constant head) were assigned to the surface water features, as shown in Table 2.4.12-C-6 in SSAR Appendix 2.4.12-C.

The elevations of the drains simulating Kuy Creek, Dry Kuy Creek, the primary unnamed creeks and the Guadalupe River Valley seeps were estimated from USGS topographic maps (USGS 1995 and USGS 1962a, 1962b, and 1962c) and interpretation of site stratigraphy in the area of the drainage features. The drain elevations were assigned using a Visual MODFLOW formula ($BOT + 1.0), which places the drain elevation 1 foot above the bottom of the cell that represents the creek or seep.

A river boundary condition was assigned to the Victoria Barge Canal, Guadalupe River, Coleto Creek, San Antonio River, and Black Bayou to represent the groundwater and surface water interactions. The Victoria Barge Canal was assigned a stage elevation of 0 ft and a channel bottom elevation of approximately -12 ft based on VEDC (2009).

The mean stage in the Guadalupe River was estimated using data from USGS stream gages 08176500, 08177520 and 08188800 at Victoria, Bloomington and Tivoli, Texas, respectively (USGS 2009). The elevation of the Guadalupe River channel bottom was derived from channel profiles developed from bathymetric survey data. A linear gradient was assumed in order to assign river stage and bottom elevations in the numerical model. At the north end of the model domain a stage elevation of 20 ft and bottom elevation of 10 ft were estimated. At the southeast corner of the model domain a stage elevation of 5 ft and a bottom elevation of -10 ft were estimated. These bottom elevation estimates were extrapolated from bathymetric survey data for a reach of the river located between the upstream and downstream model boundaries, in conjunction with the topography at the river in these areas.

The stage of the Coleto Creek was estimated using the mean stage at the Coleto Creek Reservoir (USGS gage 08177400) and USGS gage 08177500 located on the Coleto Creek near Victoria, Texas (USGS 2009). The stage was linearly interpolated from an estimated 72 ft downstream of the Coleto Creek Reservoir at the western boundary of the VCS model domain to a stage elevation of 19 ft at the confluence of the Coleto Creek with the Guadalupe River. The bottom elevation of the river at the western boundary of the model domain (67 ft) was estimated based on a regional cross section developed for the model. A bottom elevation of 14 ft at the confluence of the creek with the Guadalupe River was estimated based on extrapolated bathymetric survey data for the Guadalupe River.

The stage of the San Antonio River was based on linear interpolation of the mean stage at USGS gage 08188570 near McFadden, Texas (USGS 2009). A stage elevation of 62 ft was estimated for the San Antonio River at the western boundary of the VCS model domain. The stage elevation was estimated to be approximately 5 feet below the average ground surface elevation within the local river valley, as determined from the National Elevation Dataset and the Lott Lake USGS topographic quadrangle map (USGS 1999 and USGS 1962a, respectively). The bottom elevation at this location was estimated assuming a river depth of approximately 20 feet. These values were then linearly interpolated to a stage elevation of 5 ft and a bottom elevation of -10 ft at the confluence with the Guadalupe River.

Linn Lake was assigned a constant head elevation of 10 ft, based on the estimated stage of the Guadalupe River to the east of Linn Lake.

2.3.1.2.3.1.5 Model Calibration

Model calibration involved adjustment of uncertain input parameters to obtain the best match between observed and simulated groundwater levels and the lowest water balance error. The input parameters with the most uncertainty are the recharge rate, because this value is based on regional observations rather than site-specific measurements, and hydraulic conductivity. The model was calibrated by systematically varying these parameters over a plausible range to determine the values that yielded the best model fit to the observed potentiometric head data.

The model calibration process was accomplished in two stages. The first stage involved adjusting the recharge and hydraulic conductivity to obtain the best match between simulated and observed heads. Review of the stratigraphic model within the Guadalupe River Valley suggests that the clay layers (model layers 7 and 9) may have been eroded and replaced with more permeable valley fill deposits. Using the hydraulic conductivity of the underlying sand, the areas of layers 7 and 9 were revised from the original conceptual model within the Guadalupe River Valley, from south of the confluence with Coleto Creek to the southern edge of the model. This allowed the Deep aquifer to be hydraulically connected with the overlying river and constant head boundaries in layer 6 (Lower Shallow aquifer). This first stage of calibration produced very good agreement between simulated and observed heads in layers 6, 8, and 10 (or the Lower Shallow and Deep aquifers); however layer 4 heads (Upper Shallow aquifer) did not meet the calibration criteria.

The second stage of calibration focused on layer 4 using an automated calibration program called PEST (Parameter ESTimation). This program is part of the Visual MODFLOW program package. The PEST program adjusts model parameters until the fit between model output (head) and field observations is optimized. For the VCS groundwater model, the program was constrained to vary only the hydraulic conductivity values for the Upper Shallow aquifer sand in layer 4. The resulting hydraulic conductivity value was used in the model to finalize the calibration. This stage of the calibration process was performed in lieu of a calibration sensitivity analysis.

2.3.1.2.3.2 Post-Construction Model Simulations

The predictive simulations performed with the calibrated groundwater flow model include estimation of cooling basin seepage, the amount of water removed during power block dewatering, and simulation of a post-construction accidental release of radioactive liquid effluent to groundwater. The following adjustments were made to the preconstruction model for the post-construction conditions:

- Surface elevations within the power block area were set to an elevation of 95 feet and within the cooling basin, the surface elevations were set to elevation 69 feet. Areas within the cooling basin where layer 1 was 1 foot in thickness (surficial clay absent as a result of excavation or erosion) were assigned a hydraulic conductivity of the underlying sand;

- Permeable backfill and inactive model cells were added to the power block area to represent backfill around buildings and the building locations, respectively;

2.3.1.2.3.2.1 Cooling Basin Seepage

Cooling basin seepage was simulated using the river boundary condition to represent the basin. The river stage for the boundary was set at an elevation of 90.5 feet with the riverbed bottom at an elevation of 69 feet. The riverbed conductance is based on a 2-foot thick sediment layer with a vertical hydraulic conductivity values equivalent to sand (34 feet/day) and a channel width equal to the model cell.

In addition to the cooling basin, the post-construction power block area conditions were also simulated. Postulated buildings within the area were based on a generic ABWR layout and are represented by inactive model cells, which were surrounded by cells with permeable backfill. The power block backfill is assumed to be approximately 5 times more permeable than the natural sand units, however mitigating surface features such as finish grading to assure overland flow rather than ponding, storm drains to conduct surface drainage, and vegetation control are assumed to reduce the amount of infiltration through the backfill.

Cooling basin seepage was evaluated by looking at the flow budget in subareas of the model domain. The simulation results indicate an estimated 3930 gpm seepage rate from the cooling basin. The primary impacts of the cooling basin seepage appear to be restricted to the adjacent creeks and seeps. There appears to be minimal impact on Black Bayou, Linn Lake and the Guadalupe River. Kuy Creek, Dry Kuy Creek, and the downgradient seeps show more than two orders of magnitude increase in base flow (contribution from groundwater). Table 2.3.1.2-14 provides pre- and post-construction cooling basin seepage estimates.

Another impact of cooling basin seepage would be to raise groundwater levels beneath the power block area. Figure 2.3.1.2-25 presents a simulated potentiometric surface map in model layer 2 (geotechnical Sand 1) in the power block area. The map indicates that groundwater levels are predicted to rise after filling the cooling basin. However, the permeable backfill around the power block buildings provides a pathway for vertical flow to bypass the underlying clay layers and enter the more permeable sands of the Lower Shallow aquifer. The predicted groundwater elevation in the power block area is 85 feet. Figure 2.3.1.2-26 presents the simulated potentiometric surface surrounding the cooling basin in layer 2. The design of the cooling basin may include additional structures (such as drainage ditches, sand drains, and relief wells) if lowering of the groundwater table is required at areas adjacent to the cooling basin.

A sensitivity analysis was performed on uncertain parameters associated with cooling basin seepage. The two primary uncertainties are the conductance of the cooling basin river boundary and the vertical hydraulic conductivity of the natural material underlying the cooling basin.

The vertical hydraulic conductivity of the sediment was assumed to be 34 feet/day for the base case, which represents a relatively clean sand. A more likely sediment composition would be that of a silty sand (due to sedimentation and chemical precipitation in the bottom of the operated basin), with a hydraulic conductivity approximately an order of magnitude lower (3.4 feet/day). The first sensitivity case uses this lower hydraulic conductivity to estimate seepage from the cooling basin.

A second sensitivity case involves uncertainty regarding the hydraulic conductivity of the clay in model layer 1. Exposure to repeated wetting and drying cycles could result in a higher hydraulic conductivity of the surficial materials. An order of magnitude increase in vertical hydraulic conductivity (0.6 feet/day) of the clay in layer 1 is assumed for the second sensitivity case.

Sensitivity case 1 appears to be sensitive to a change in the vertical hydraulic conductivity of sediment on the bottom of the cooling basin. An order of magnitude reduction in the vertical hydraulic conductivity of the sediment results in an approximately 14.5 percent reduction in the seepage rate from the cooling basin. Sensitivity case 2 appears to be insensitive to a change in the vertical hydraulic conductivity of the surficial clay layer. An order of magnitude increase in the vertical hydraulic conductivity of the clay results in only an approximately 2 percent increase in seepage from the cooling basin. The value selected for the hydraulic conductivity of the layer 1 clay in the base case represents the maximum value from the Guelph Permeameter testing and therefore would provide an upper bound for the hydraulic conductivity in the clay.

2.3.1.2.3.2.2 Power Block Construction Dewatering Effects

Construction dewatering will be required when constructing the plant because the excavations for the deeper building foundations will extend to an estimated elevation of –15 feet, which is in the Lower Shallow aquifer (model layer 6). The Lower Shallow aquifer is assumed to be dewatered to the approximate bottom of the aquifer at an elevation or approximately –20 feet. Two dewatering scenarios were considered:

- Preconstruction groundwater conditions (cooling basin empty) with dewatering the entire power block area.
- Postconstruction groundwater conditions (cooling basin full) with dewatering the entire power block area.

These scenarios were evaluated because the scheduling of the construction activities is still in the planning stage. All scenarios were simulated by assigning constant head boundaries representing the excavation in model layers 4 and 6, and in the post-construction scenario, model layer 2 also.

Dewatering pumping (flow) rates ranged from approximately 990 to 1840 gpm. The finalization of the excavation and the dewatering scheme (areal extent, depth, and construction schedule) will be evaluated once a reactor vendor has been selected, during the COL application stage.

2.3.1.2.3.2.3 Simulation of Accidental Release Pathway

The groundwater flow system downgradient of the power block area was evaluated to identify potential exposure points from an accidental release of radionuclides to groundwater. The release is postulated to occur below the basement of a radwaste building in the backfill present in model layer 4 (Upper Shallow aquifer). The release was simulated by placing particles in the power block backfill. The movement of these particles was calculated using MODPATH, which is a companion program to MODFLOW, that uses its output to perform the particle tracking. Four particle release scenarios are considered:

- No pumping.
- With a hypothetical domestic well pumping on the north site boundary (approximately 4500 feet from the release).
- With a hypothetical domestic well pumping on the west site boundary (approximately 3800 feet from the release).
- With a hypothetical domestic well pumping on the east site boundary (approximately 11,000 feet from the release).

The hypothetical domestic wells are screened to fully penetrate model layer 6 (Lower Shallow aquifer), which is the uppermost aquifer used for water supply in the site area. For the northern well, the screened interval was from an elevation of –4 to –20 feet, and for the western well, the screened interval was from an elevation of –4 to –31 feet, and for the eastern well, the screen interval was from an elevation of 8 to –31 feet. The hypothetical wells were pumped at simulated rate of 50 gpm, which is considered the maximum practical pumping rate for the Lower Shallow aquifer within the site vicinity.

Table 2.3.1.2-15 presents a summary of the travel times from the release point to the exposure point at the property boundary as derived from the particle tracking. The results of the particle tracking indicate a travel time of approximately 41,000 days (110 years) to eastern site boundary. Modeling results indicates that when the particles are released into the fill they migrate down through the fill into model layer 6 (Lower Shallow aquifer) and then travel laterally toward the east or vertically to model layer 8 (Deep aquifer). None of the hypothetical pumping scenarios result in capture of particles by the pumping wells. The primary influence of the offsite pumping is to locally divert the particle tracks toward the north prior to the particle continuing to the eastern site boundary. Figure 2.3.1.2-27 presents the particle track pathways for Scenario 1 (without pumping).

2.3.1.2.3.3 Groundwater Modeling Summary and Conclusions

A three-dimensional eleven layer groundwater flow model was developed and calibrated to evaluate groundwater level and flow changes associated with the operation of a cooling basin at the VCS site, with dewatering of site excavations, and to assess post-construction, groundwater flow paths. Specific findings of the modeling effort include:

- The groundwater levels in the power block area are predicted to be about elevation 85 feet or about ten feet below the final plant grade of elevation 95 feet.
- Filling the cooling basin to an elevation 90.5 feet is predicted to raise groundwater levels beneath the site to a point where the currently unsaturated sand layer referred to as the Sand 1 geotechnical unit becomes saturated.
- Seepage from the cooling basin is predicted to increase groundwater contributions (base flow) to Kuy and Dry Kuy Creeks and seeps to the north and east of the VCS site. Seepage from the cooling basin is estimated to be approximately 3930 gpm.
- Seepage from the cooling basin is also predicted to alter the groundwater flow directions in the site area, particularly in the power block area.
- Construction dewatering scenarios were simulated with the cooling basin empty and full with an estimated range of pumping rates between 990 (empty) and 1840 gpm (full).
- Particle tracking suggests that the closest receptor for an accidental release to groundwater from postulated radwaste buildings would be the eastern property boundary for the VCS site with a travel time of approximately 41,000 days (110 years) to the eastern site boundary.

Additional description of the model results is presented in Section 5.2.

As mentioned in Subsection 2.3.1.2.3.1, an earlier numerical groundwater flow model was developed as the subsurface information was being interpreted. The model consisted of seven model layers and the model boundaries were closer to the VCS site than that used for the final modeling effort. The predominant difference between the final model and the earlier model is that the earlier model was developed with the following:

- Each subsurface model layer had a fixed thickness in the model domain.
- The top 50 feet of the subsurface (layer 1) was treated as sand. Model layer 2 was interpreted to be a 20 foot clay layer separating model layer 1 from model layer 3 (Upper Shallow aquifer). The remaining modeling layers were intervening clay layers separated by aquifer sand layers (the Lower Shallow aquifer and the Deep aquifer).
- The eastern edge of the model domain terminated at the edge of the western edge of the Guadalupe River valley flood plain.

Post-construction simulations utilizing this earlier modeling configuration are summarized as follows:

- The groundwater level in the power block area was predicted to be at an elevation of about 85 feet, which is the same predicted groundwater level obtained from the most recent model.
- Seepage from the cooling basin was estimated to be approximately 5700 gpm. The seepage from the cooling basin was predicted to increase groundwater contributions to the Guadalupe and San Antonio River valleys, and Kuy and Dry Kuy creeks by as much as 15 times the pre-construction amounts.
- Dewatering rates were less than 1000 gpm.
- Particle tracks from the power block area suggested a northeasterly groundwater flow direction.

The results of the final modeling effort have been incorporated into the ESP unless otherwise stated.

2.3.1.2.4 References

U.S. ACOE, 2004. U.S. Army Corps of Engineers, *Soils and Geology Procedures for Foundation Design of Building and Other Structures (Except Hydraulic Structures)*, Department of Defense, Unified Facilities Criteria, UFC 3-220-03FA, January 14, 2004.

Baker, 1979. Baker, E.T., Jr., Texas Department of Water Resources (TDWR), *Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas*, Report 236, July 1979. Available at http://www.twdb.state.tx.us/publications/reports/ GroundWaterReports/GWReports.

Bravo et al. 1996. Bravo, Rolando., Rogers, Jerry R., and Cleveland, Theodore G., *Modeling Ground Water Flow Using Flux Boundary Conditions. Water Resources Bulletin*. Vol. 32, No. 1, 39-46, 1996.

Bureau of Economic Geology, 1996. Bureau of Economic Geology, *Physiographic Map of Texas*, The University of Texas, 1996. Available at http://www.beg.utexas.edu/UTopia/images/pagesizemaps/physiography.pdf, accessed June 6, 2008.

Chowdhury et al., 2004. Chowdhury, A.H., Wade, S., Mace, R.E., and Ridgeway, C., Groundwater Availability Modeling Section, Texas Water Development Board (TWDB), *Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999*, Austin, Texas, 2004.

Chowdhury and Turco, 2006. Chowdhury, A.H. and Turco, M.J., Texas Water Development Board (TWDB), "Chapter 2: Geology of the Gulf Coast Aquifer, Texas," *Aquifers of the Gulf Coast of Texas*, Report 365, February 2006. Available at http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/R365/AGCindex.htm.

Chowdhury et al., 2006. Chowdhury, A.H., Boghici, R., and Hopkins, J., Texas Water Development Board (TWDB), "Chapter 5: Hydrochemistry, Salinity Distribution, and Trace Constituents: Implications for Salinity Sources, Geochemical Evolution, and Flow Systems Characterization, Gulf Coast Aquifer, Texas," *Aquifers of the Gulf Coast of Texas*, Report 365, February 2006. Available at http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/R365/AGCindex.htm.

Cleveland et al. 1992. Cleveland, Theodore G., Bravo, Rolando., and Rogers, Jerry R., *Storage Coefficients and Vertical Hydraulic Conductivities in Aquitards Using Extensometer and Hydrograph Data, Ground Water*, Vol. 30, No. 5, 701-708, 1992.

Davis and DeWiest, 1966. Davis, S.N, and DeWiest, R.J.M., *Hydrogeology*, John Wiley & Sons, Inc., New York, 1966.

Fetter, 1988. Fetter, C.W., *Applied Hydrogeology*, second edition, MacMillen Publishing Company, New York, 1988.

Harbaugh et al., 2000. Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., MODFLOW-2000 *The U.S. Geological Survey Modular Ground-Water Model — User Guide to Modularization Concepts and the Ground-Water Flow Process*, U.S. Geological Survey Open-File Report 00-92, Reston, Virginia, 2000.

Haug et al. 1990. Haug, A; Petrini, R.H.; Grisak, G.E.; and Klahsen, K. (1990). Geostatistical Assessment of Numerically Simulated Groundwater Flow in the Upper Chicot Aquifer Near Port Arthur, Texas. ModelCARE 90: Calibration and Reliability in Groundwater Modeling (Proceedings of the conference held in The Hague, September 1990). IAHS Publ. no. 195, pages 427-437.

Kresic, 1997. Kresic, N., *Quantitative Solutions in Hydrogeology and Groundwater Modeling*, CRC Lewis Publishers, Boca Raton, Florida, 1997.

Pollock 1999. Pollock, D.W., User's Guide for MODPATH/MODPATH-PLOT, version 3: *A Particle Tracking Post-Processing Package for MODFLOW, the U.S. Geological Survey Finite-Difference Ground-Water Flow Model*, U.S. Geological Survey Open-File Report 94-464, Reston Virginia, 1994

Ryder, 1996. Ryder, P.D., U.S. Geological Survey (USGS), *Ground Water Atlas of the United States: Oklahoma, Texas*, HA 730-E, 1996. Available at http://capp.water.usgs.gov/gwa/ch_e/ index.html.

Schlumberger Water Services, 2008. Schlumberger Water Services, *Visual MODFLOW v. 4.3 User's Manual*, Waterloo, Ontario, Canada, 2008.

TWDB, 2006a. Texas Water Development Board (TWDB), *Major Aquifers of Texas, Updated December 2006*. Available at http://www.twdb.state.tx.us/mapping/index.asp/, accessed January 10, 2010.

TWDB, 2006b. Texas Water Development Board (TWDB), *2006 South Central Texas Regional Water Plan, 2006*. Available at http://www.twdb.state.tx.us/RWPG/2006_RWP/RegionL/Volume%20I/ 06%20-%20Executive%20Summary.pdf.

TWDB, 2009a. Texas Water Development Board (TWDB), *Texas Water Development Board Water Information Integration and Dissemination System*. Available at http://wiid.twdb.state.tx.us/, accessed May 20, 2009.

TWDB, 2009b. Texas Water Development Board (TWDB), *Historical Water Use Information*. Available at http://www.twdb.state.tx.us/wushistorical, accessed May 21, 2009.

Uddameri, 2008a. Uddameri, Venkatesh, *Technical Elements Required for the Victoria County Groundwater Conservation District*, submitted to Victoria County Groundwater Conservation District, Department of Environmental Engineering, Texas A&M University-Kingsville, January 30, 2008.

Uddameri, 2008b. Uddameri, Venkatesh, *Stakeholder Approach for Estimating Groundwater Availability in Victoria County Groundwater Conservation District*, submitted to Victoria County Groundwater Conservation District, Department of Environmental Engineering, Texas A&M University-Kingsville, February 1, 2008.

U.S. EPA, 2008a. U.S. Environmental Protection Agency (EPA), *Region VI Sole Source Aquifer* Map. Available at http://www.epa.gov/region6/6wq/swp/ssa/maps.htm, accessed June 6, 2008.

U.S. EPA, 2008b. U.S. Environmental Protection Agency (EPA), Drinking Water Contaminants. Available at http://www.epa.gov/safewater/contaminants/index.html, June 6, 2008.

U.S. EPA, 2009. U.S. Environmental Protection Agency (EPA), *Safe Drinking Water Information System*. Available at http://oaspub.epa.gov/, accessed May 20, 2009.

USGS 1962a. U.S. Geological Survey, 7.5-Minute Topographic Quadrangle Map, Lott Lake, Texas, photorevised 1987.

USGS 1962b, U.S. Geological Survey, 7.5-Minute Topographic Quadrangle Map, McFadden, Texas, photorevised 1987.

USGS 1962c. U.S. Geological Survey, 7.5-Minute Topographic Quadrangle Map, Raisin, Texas, photorevised 1987.

USGS 1995. U.S. Geological Survey, 7.5-Minute Topographic Quadrangle Map, Bloomington, Texas, 1995.

USGS 1999. U.S. Geological Survey, National Elevation Dataset, available on-line at http://gisdata.usgs.net/ned/ accessed October 26, 2009.

USGS 2009. U.S. Geological Survey, *USGS Surface-Water Daily Statistics for Texas*, available online at http://waterdata.usgs.gov/tx/nwis/dvstat?referred_module=sw&county_cd=48469&site_tp_cd=OC &site_tp_cd=OCCO&site_tp_cd=ES&site_tp_cd=LK&site_tp_cd=ST&site_tp_cd=STCA& site_tp_cd=ST-DCH&site_tp_cd=STTS&format=station_list&sort_key=site_no&group_key=NONE&list_of_search_criteria=county_cd%2Csite_tp_cd%2Crealtime_parameter_selection accessed September 27, 2009.

USGS 2011. U.S. Department of the Interior, U.S. Geological Survey, Surface Water Data for Texas, USGS Surface-Water Annual Statistics. Available at: http://waterdata.usgs.gov/tx/nwis/annual?, accessed May 23, 2011.

VCGCD 2008a. Victoria County Groundwater Conservation District (VCGCD), *District Management Plan*, VCGCD Adoption: October 24, 2008, TWDB Administrative Approval: December 22, 2008.

VCGCD 2008b. Victoria County Groundwater Conservation District (VCGCD), *Rules of Victoria County Groundwater Conservation District*, Adopted: October 3, 2008, Effective: December 22, 2008.

VEDC 2009. Victoria Economic Development Corporation, Victoria Barge Canal, available online at http://www.victoriaedc.com/content/view/46/91/ accessed November 11, 2009.

Walton 1984. Walton, W.C., *Practical Aspects of Groundwater Modeling*, National Water Well Association, Dublin, Ohio, 1984.

Young et al., 2006. Young, S.C., Knox, P.R., Budge, T., Kelley, V., Deeds, N., Galloway, W.E., and Baker, E.T., Texas Water Development Board (TWDB), "Chapter 6: Stratigraphy, Lithology, and Hydraulic Properties of the Chicot and Evangeline Aquifers in the LWSP Study Area, Central Texas Coast," Aquifers of the Gulf Coast of Texas, Report 365, February 2006. Available at http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/R365/AGCindex.htm.

Table 2.3.1.2-1 (Sheet 1 of 3) Observation Well Construction Details

Well Number[a]	Hydrogeologic Unit	Northing (ft)[b]	Easting (ft)[b]	Top of Casing Elevation (ft NAVD 88)[b]	Top of Concrete Pad (ft NAVD 88)[b]	Well Diameter (in)	Well Depth (ft bgs)	Top of Screen (ft bgs)[c]	Bottom of Screen (ft bgs) [c]	Top of Screen (ft NAVD 88)[c]	Bottom of Screen (ft NAVD 88)[c]	Top of Filter Pack (ft bgs)	Bottom of Filter Pack (ft bgs)
OW-01L	Lower Shallow	13404252.1	2606686.52	73.74	72.22	2	111	100	110	-27.78	-37.78	96	113
OW-01U	Upper Shallow	13404253.6	2606666.85	73.65	72.16	2	61	50	60	22.16	12.16	47	63
OW-02L	Lower Shallow	13411520.5	2607869.3	76.53	75.07	2	109	98	108	-22.93	-32.93	94	112
OW-02U	Upper Shallow	13411502.4	2607862.19	76.74	75.25	2	64	53	63	22.25	12.25	50	66
OW-03L	Lower Shallow	13414918.7	2609286.61	76.67	75.21	2	98	87	97	-11.79	-21.79	84.1	100
OW-03U	Upper Shallow	13414934.5	2609294.86	77.05	75.6	2	54	43	53	32.6	22.6	40	56
OW-04L	Lower Shallow	13414268.7	2607440.23	80.67	79.13	2	111	100	110	-20.87	-30.87	96	113
OW-04U	Upper Shallow	13414280.5	2607428.57	81.08	79.61	2	86	75	85	4.61	-5.39	71	88
OW-05L	Deep	13414774.2	2605813.28	79.9	78.26	2	131	120	130	-41.74	-51.74	116.3	135
OW-05U	Upper Shallow	13414770.2	2605832.08	79.55	78.07	2	57	46	56	32.07	22.07	43	60
OW-06L	Lower Shallow	13415889.6	2604964.9	81.55	79.49	2	96	85	95	-5.51	-15.51	80.5	99
OW-06U	Upper Shallow	13415875.6	2604966.94	80.77	79.46	2	64	53	63	26.46	16.46	50	66
OW-07L	Deep	13418420.5	2606531.28	79.04	77.47	4	124	113	123	-35.53	-45.53	110	127
OW-07U	Upper Shallow	13418421.4	2606542.01	79.02	77.32	2	64	53	63	24.32	14.32	50.2	66
OW-08L	Deep	13415818.9	2598942.49	84.07	82.56	4	138	127	137	-44.44	-54.44	124	140
OW-08U	Lower Shallow	13415801.2	2598934.58	83.88	82.38	2	101	90	100	-7.62	-17.62	86	103
OW-09L	Deep	13414937.4	2604893.58	80	77.86	2	121	110	120	-32.14	-42.14	106	125
OW-09U	Upper Shallow	13414956.1	2604894.51	79.24	77.91	2	61	50	60	27.91	17.91	47	61
OW-10L	Deep	13418486.4	2604760.99	79.88	78.07	2	138	127	137	-48.93	-58.93	123	141
0W-10U	Upper Shallow	13418474.4	2604768.43	79.53	78.09	2	59	48	58	30.09	20.09	45	62
OW-2150L	Deep	13412552.9	2599585.12	82.45	80.87	2	151.55	140	150	-59.13	-69.13	136	152
OW-2150U	Upper Shallow	13412568.1	2599582.77	82.78	80.91	2	66.15	55	65	25.91	15.91	51	67
OW-2169L	Lower Shallow	13412356.7	2599930.2	81.72	80.04	2	101	90	100	-9.96	-19.96	86	102
OW-2169U	Upper Shallow	13412343.8	2599945.85	81.77	80.11	2	66	55	65	25.11	15.11	51	67
OW-2181L	Lower Shallow	13412138.4	2600071.96	81.32	79.88	2	101	90	100	-10.12	-20.12	86	102
OW-2181U	Upper Shallow	13412147.4	2600052.86	81.31	80.01	2	51	40	50	40.01	30.01	36	52
OW-2185L	Lower Shallow	13412314.5	2600815.69	81.36	79.76	2	101	90	100	-10.24	-20.24	86	102
OW-2185U	Upper Shallow	13412328.1	2600801.11	81.45	79.89	2	76	65	75	14.89	4.89	61	77
OW-2253L	Deep	13413591.6	2600474.37	82.66	81.17	2	146	135	145	-53.83	-63.83	131	147

Table 2.3.1.2-1 (Sheet 2 of 3)
Observation Well Construction Details

Well Number[a]	Hydrogeologic Unit	Northing (ft)[b]	Easting (ft)[b]	Top of Casing Elevation (ft NAVD 88)[b]	Top of Concrete Pad (ft NAVD 88)[b]	Well Diameter (in)	Well Depth (ft bgs)	Top of Screen (ft bgs)[c]	Bottom of Screen (ft bgs)[c]	Top of Screen (ft NAVD 88)[c]	Bottom of Screen (ft NAVD 88)[c]	Top of Filter Pack (ft bgs)	Bottom of Filter Pack (ft bgs)
OW-2253U	Upper Shallow	13413584.8	2600494.74	82.82	81.18	2	66	55	65	26.18	16.18	51	67
OW-2269L	Deep	13413123.3	2600574.23	82.55	80.89	2	141.15	130	140	-49.11	-59.11	126	143
OW-2269U	Lower Shallow	13413110.1	2600589.08	82.43	80.75	2	91.15	80	90	0.75	-9.25	76	92
OW-2284L	Lower Shallow	13413063.7	2600939.04	82.74	80.98	2	111.06	100	110	-19.02	-29.02	96	112
OW-2284U	Upper Shallow	13413055.1	2600956.6	82.62	80.97	2	76.07	65	75	15.97	5.97	61	77
OW-2301L	Deep	13414429.8	2596268.29	83.19	81.89	2	141	130	140	-48.11	-58.11	126	142
OW-2301U	Upper Shallow	13414430.1	2596288.46	83.27	81.77	2	61	50	60	31.77	21.77	46	62
OW-2302L	Deep	13407382.1	2598388.94	81.95	80.46	2	151	140	150	-59.54	-69.54	136	152
OW-2302U	Lower Shallow	13407361.5	2598388.47	81.99	80.52	2	96	85	95	-4.48	-14.48	81	97
OW-2304L	Lower Shallow	13396528.1	2608678.06	69.73	68.88	2	96	85	95	-16.12	-26.12	81	97
OW-2304U	Upper Shallow	13396542.4	2608679.35	70.1	68.8	2	51	40	50	28.8	18.8	36	52
OW-2307L	Lower Shallow	13420879.1	2603152.12	78.56	76.91	2	111	100	110	-23.09	-33.09	95	112
OW-2307U	Upper Shallow	13420896.7	2603164.23	78.59	77.07	2	66	55	65	22.07	12.07	50	67
OW-2319L	Deep	13403611.3	2603051.83	76.05	74.68	2	156	145	155	-70.32	-80.32	141	157
OW-2319U	Lower Shallow	13403590.4	2603046.21	75.97	74.33	2	96	85	95	-10.67	-20.67	81	97
OW-2320L	Deep	13407580.9	2606834.36	73.19	71.76	2	151	140	150	-68.24	-78.24	136	152
OW-2320U	Lower Shallow	13407569.5	2606849.7	73.5	71.8	2	111	100	110	-28.2	-38.2	96	112
OW-2321L	Deep	13410955.5	2610027.59	73.54	71.99	2	151	140	150	-68.01	-78.01	136	152
OW-2321U	Lower Shallow	13410943.6	2610040.96	73.27	71.79	2	111	100	110	-28.21	-38.21	96	112
OW-2324L	Deep	13416300.5	2612217	26.27	24.85	2	126	115	125	-90.15	-100.15	110	127
OW-2324U	Lower Shallow	13416316.5	2612203.23	26.17	24.67	2	46	35	45	-10.33	-20.33	31	47
OW-2348L	Deep	13409617.8	2621644.36	52.7	51.21	2	145	134	144	-82.79	-92.79	130	146
OW-2348U	Lower Shallow	13409636.3	2621660.58	52.12	50.56	2	81	70	80	-19.44	-29.44	66	82
OW-2352L	Lower Shallow	13402468.5	2617518.54	64.6	63.33	2	91	80	90	-16.67	-26.67	76	92
OW-2352U	Upper Shallow	13402470.6	2617538.69	64.47	63.17	2	56	45	55	18.17	8.17	41	57
TW-2320U[d]	Upper Shallow	13407428.6	2607105.51	72.72	71.5	6	82	55	80	16.5	-8.5	50	82
OW-2320U1	Upper Shallow	13407445.7	2607080.05	72.9	71.36	2	81	60	80	11.36	-8.64	55	82
OW-2320U2	Upper Shallow	13407436.8	2607093.25	72.92	71.36	2	81	60	80	11.36	-8.64	55	82
OW-2320U3	Upper Shallow	13407448.2	2607121.37	72.84	71.36	2	81	60	80	11.36	-8.64	55	82
OW-2320U4	Upper Shallow	13407466.5	2607138.42	72.91	71.42	2	81	60	80	11.42	-8.58	55	82

Table 2.3.1.2-1 (Sheet 3 of 3)
Observation Well Construction Details

Well Number(a)	Hydrogeologic Unit	Northing (ft)(b)	Easting (ft)(b)	Top of Casing Elevation (ft NAVD 88)(b)	Top of Concrete Pad (ft NAVD 88)(b)	Well Diameter (in)	Well Depth (ft bgs)	Top of Screen (ft bgs)(c)	Bottom of Screen (ft bgs)(c)	Top of Screen (ft NAVD 88)(c)	Bottom of Screen (ft NAVD 88)(c)	Top of Filter Pack (ft bgs)	Bottom of Filter Pack (ft bgs)
TW-2359L(d)	Deep	13417241.4	2605450.48	79.88	77.69	6	182	150	180	-72.31	-102.31	145	182
OW-2359L1	Deep	13417263.7	2605470.56	79.36	78.08	2	176	155	175	-76.92	-96.92	151	177
OW-2359L2	Deep	13417259.8	2605433.37	78.93	77.56	2	176	155	175	-77.44	-97.44	150	177
OW-2359L3	Deep	13417278.6	2605416.18	78.83	77.26	2	176	155	175	-77.74	-97.74	151	177
OW-2359U1	Lower Shallow	13417252.6	2605460.64	79.29	77.66	2	96	85	95	-7.34	-17.34	80	97

(a) "L" suffix wells are the lower well in well pair, installed in Lower Shallow or Deep aquifer zones. "U" suffix wells are the upper well in well pairs, installed in Upper Shallow or Lower Shallow aquifer zones.
(b) Coordinates based on the North American Datum of 1983 (NAD 83) and elevations based on North American Vertical Datum of 1988 (NAVD 88).
(c) Observation well screens are 0.020 in slot width.
(d) Well screen interval contains a 5 ft casing blank at 65 to 70 ft bgs.

Abbreviations:
bgs = below ground surface
ft = feet
in = inches
OW = Observation Well
TW = Aquifer Test Well

Table 2.3.1.2-2
Groundwater Observation and Test Wells Monitoring the Chicot Aquifer

Upper Shallow	Lower Shallow	Deep
OW-01U	OW-01L	—
OW-02U	OW-02L	—
OW-03U	OW-03L	—
OW-04U	OW-04L	—
OW-05U	—	OW-05L
OW-06U	OW-06L	—
OW-07U	—	OW-07L
—	OW-08U	OW-08L
OW-09U	—	OW-09L
OW-10U	—	OW-10L
OW-2150U	—	OW-2150L
OW-2169U	OW-2169L	—
OW-2181U	OW-2181L	—
OW-2185U	OW-2185L	—
OW-2253U	—	OW-2253L
—	OW-2269U	OW-2269L
OW-2284U	OW-2284L	—
OW-2301U	—	OW-2301L
—	OW-2302U	OW-2302L
OW-2304U	OW-2304L	—
OW-2307U	OW-2307L	—
—	OW-2319U	OW-2319L
—	OW-2320U	OW-2320L
—	OW-2321U	OW-2321L
—	OW-2324U	OW-2324L
—	OW-2348U	OW-2348L
OW-2352U	OW-2352L	—
TW-2320U	—	—
OW-2320-U1	—	—
OW-2320-U2	—	—
OW-2320-U3	—	—
OW-2320-U4	—	—
—	—	—
—	—	TW-2359L
—	OW-2359-U1	OW-2359-L1
—	—	OW-2359-L2
—	—	OW-2359-L3

Table 2.3.1.2-3 (Sheet 1 of 3)
VCS Monthly Groundwater Level Measurements

Well No.	Ref. Elev. (NAVD88)	Hydro-geologic Unit	25-Oct-07			17-Nov-07			18-Dec-07			30-Jan-08			18-Feb-08			31-Mar-08			26-Apr-08			23-May-08		
			Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)
OW-01L	73.74	Lower	12:28	42.39	31.35	9:37	42.39	31.35	16:33	42.51	31.23	9:16	42.77	30.97	10:20	42.94	30.80	10:51	42.99	30.75	14:12	42.41	31.33	12:31	43.32	30.42
OW-01U	73.65	Upper	12:33	41.46	32.19	9:34	41.45	32.20	16:30	41.56	32.09	9:14	41.97	31.68	10:19	42.19	31.46	10:50	42.18	31.47	14:11	41.91	31.74	12:28	42.52	31.13
OW-02L	76.53	Lower	12:16	51.36	25.17	9:26	51.21	25.32	16:20	51.12	25.41	9:30	51.21	25.32	10:48	51.31	25.22	10:29	51.32	25.21	12:54	50.81	25.72	11:37	51.66	24.87
OW-02U	76.74	Upper	12:19	51.49	25.25	9:29	51.35	25.39	16:22	51.19	25.55	9:28	51.25	25.49	10:46	51.35	25.39	10:28	51.29	25.45	12:56	51.46	25.28	11:30	51.58	25.16
OW-03L	76.67	Lower	12:02	55.63	21.04	9:15	55.73	20.94	16:13	55.88	20.79	9:39	56.17	20.50	10:55	56.31	20.36	10:20	56.47	20.20	12:46	56.69	19.98	11:19	56.84	19.83
OW-03U	77.05	Upper	12:06	55.96	21.09	9:18	55.04	22.01	16:16	DRY	NA	9:40	DRY	NA	10:53	DRY	NA	10:19	DRY	NA	12:48	DRY	NA	11:23	DRY	NA
OW-04L	80.67	Lower	11:55	56.69	23.98	9:07	56.61	24.06	16:09	56.54	24.13	9:49	56.75	23.92	11:02	56.91	23.76	10:10	56.98	23.69	12:41	57.22	23.45	11:10	57.39	23.28
OW-04U	81.08	Upper	11:49	56.15	24.93	9:04	56.02	25.06	16:07	56.06	25.02	9:47	56.20	24.88	11:00	56.32	24.76	10:09	56.44	24.64	12:39	56.70	24.38	11:12	56.87	24.21
OW-05L	79.90	Deep	11:37	53.17	26.73	8:57	53.02	26.88	16:03	52.97	26.93	9:58	53.05	26.85	11:08	53.21	26.69	10:04	53.25	26.65	12:34	53.52	26.38	11:04	53.71	26.19
OW-05U	79.55	Upper	11:44	52.71	26.84	9:00	52.48	27.07	16:02	52.31	27.24	9:56	52.33	27.22	11:06	52.45	27.10	10:03	52.50	27.05	12:36	52.75	26.80	11:02	52.88	26.67
OW-06L	81.55	Lower	11:12	54.46	27.09	8:47	54.25	27.30	15:50	53.86	27.69	10:15	54.22	27.33	11:23	54.34	27.21	9:55	54.41	27.14	12:21	54.22	27.33	10:48	54.82	26.73
OW-06U	80.77	Upper	11:18	53.59	27.18	8:49	53.38	27.39	15:51	53.20	27.57	10:12	53.23	27.54	11:22	53.35	27.42	9:53	53.43	27.34	12:23	53.66	27.11	10:45	53.84	26.93
OW-07L	79.04	Deep	11:00	57.78	21.26	8:39	57.88	21.16	15:40	57.99	21.05	10:25	58.17	20.87	11:50	58.33	20.71	9:20	58.41	20.63	11:44	58.68	20.36	10:17	58.88	20.16
OW-07U	79.02	Upper	11:04	58.02	21.00	8:42	57.99	21.03	15:42	55.98	23.04	10:24	58.17	20.85	11:48	58.30	20.72	9:18	58.39	20.63	11:42	58.55	20.47	10:14	58.66	20.36
OW-08L	84.07	Deep	10:00	49.75	34.32	8:17	49.98	34.09	15:23	50.1	33.97	11:07	50.08	33.99	12:40	50.16	33.91	8:55	50.30	33.77	9:56	50.69	33.38	9:00	51.02	33.05
OW-08U	83.88	Lower	10:03	46.26	37.62	8:21	46.24	37.64	15:26	46.36	37.52	11:05	46.49	37.39	12:38	46.64	37.24	8:53	46.79	37.09	9:54	46.98	36.90	8:55	47.25	36.63
OW-09L	80.00	Deep	11:26	52.19	27.81	8:53	51.91	28.09	15:56	51.82	28.18	10:06	51.97	28.03	11:14	52.13	27.87	9:59	52.10	27.90	12:29	46.74	33.26	10:55	52.58	27.42
OW-09U	79.24	Upper	11:32	51.77	27.47	8:51	51.37	27.87	15:55	50.83	28.41	10:04	51.31	27.93	11:13	51.46	27.78	9:58	51.32	27.92	12:28	51.71	27.53	10:52	51.77	27.47
OW-10L	79.88	Deep	10:45	54.52	25.36	8:31	54.76	25.12	15:35	54.81	25.07	10:35	54.80	25.08	12:16	54.98	24.90	9:13	55.15	24.73	11:33	53.61	26.27	9:36	56.00	23.88
OW-10U	79.53	Upper	10:50	57.24	22.29	8:34	57.04	22.49	15:37	56.92	22.61	10:33	57.00	22.53	12:14	57.04	22.49	9:11	56.83	22.70	11:35	56.91	22.62	9:32	56.90	22.63
OW-2150L	82.45	Deep	-	-	-	-	-	-	-	-	-	13:46	48.01	34.44	13:27	47.90	34.55	8:15	47.87	34.58	10:40	48.11	34.34	18:09	48.29	34.16
OW-2150U	82.78	Upper	-	-	-	-	-	-	-	-	-	13:43	36.49	46.29	13:26	36.70	46.08	8:13	36.51	46.27	10:38	36.73	46.05	18:07	36.93	45.85
OW-2169L	81.72	Lower	-	-	-	-	-	-	-	-	-	13:52	44.58	37.14	14:42	44.76	36.96	8:24	44.91	36.81	10:44	45.15	36.57	18:15	45.40	36.32
OW-2169U	81.77	Upper	-	-	-	-	-	-	-	-	-	13:54	38.29	43.48	14:40	38.59	43.18	8:20	38.40	43.37	10:46	38.71	43.06	18:17	38.82	42.95
OW-2181L	81.32	Lower	-	-	-	-	-	-	-	-	-	14:00	44.87	36.45	14:04	44.74	36.58	8:29	44.78	36.54	10:51	44.86	36.46	18:23	44.91	36.41
OW-2181U	81.31	Upper	-	-	-	-	-	-	-	-	-	13:58	38.07	43.24	13:51	38.46	42.85	8:27	38.27	43.04	10:50	38.60	42.71	18:21	38.67	42.64
OW-2185L	81.36	Lower	-	-	-	-	-	-	-	-	-	14:17	45.54	35.82	14:16	45.72	35.64	8:37	45.88	35.48	11:02	46.13	35.23	18:34	46.38	34.98
OW-2185U	81.45	Upper	-	-	-	-	-	-	-	-	-	14:15	41.64	39.81	14:15	41.76	39.69	8:35	41.77	39.68	10:59	41.96	39.49	18:30	42.19	39.26
OW-2253L	82.82	Deep	-	-	-	-	-	-	-	-	-	13:09	49.23	33.59	14:48	49.39	33.43	7:43	49.52	33.30	10:29	49.82	33.00	17:56	50.10	32.72
OW-2253U	82.66	Upper	-	-	-	-	-	-	-	-	-	13:11	34.35	48.31	14:49	34.82	47.84	7:41	34.48	48.18	10:27	34.65	48.01	17:58	35.68	46.98
OW-2269L	82.55	Deep	-	-	-	-	-	-	-	-	-	13:21	48.87	33.68	15:03	48.99	33.56	7:53	49.12	33.43	10:16	49.42	33.13	17:47	49.70	32.85
OW-2269U	82.43	Lower	-	-	-	-	-	-	-	-	-	13:18	46.70	35.73	15:00	46.88	35.55	7:50	47.02	35.41	10:12	47.25	35.18	17:50	47.55	34.88
OW-2284L	82.74	Lower	-	-	-	-	-	-	-	-	-	13:28	47.40	35.34	15:09	47.58	35.16	8:03	47.73	35.01	10:06	47.96	34.78	17:34	48.32	34.42
OW-2284U	82.62	Upper	-	-	-	-	-	-	-	-	-	13:25	38.13	44.49	15:07	38.32	44.30	8:01	38.18	44.44	10:08	38.21	44.41	17:38	38.62	44.00
OW-2301L	83.19	Deep	-	-	-	-	-	-	-	-	-	-	-	-	7:39	44.84	38.35	7:16	44.97	38.22	9:19	45.23	37.96	17:21	45.51	37.68
OW-2301U	83.27	Upper	-	-	-	-	-	-	-	-	-	-	-	-	7:37	33.03	50.24	7:14	32.75	50.52	9:15	33.07	50.20	17:18	33.27	50.00
OW-2302L	81.95	Deep	-	-	-	-	-	-	-	-	-	-	-	-	7:54	44.94	37.01	7:27	45.02	36.93	9:37	45.27	36.68	8:31	45.48	36.47
OW-2302U	81.99	Lower	-	-	-	-	-	-	-	-	-	-	-	-	7:53	43.10	38.89	7:26	43.22	38.77	9:39	43.49	38.50	8:37	43.70	38.29
OW-2304L	69.73	Lower	-	-	-	-	-	-	-	-	-	-	-	-	8:33	42.26	27.47	11:01	42.31	27.42	16:04	42.41	27.32	15:58	42.84	26.89
OW-2304U	70.10	Upper	-	-	-	-	-	-	-	-	-	-	-	-	8:31	33.96	36.14	11:10	34.17	35.93	16:05	34.37	35.73	16:00	34.57	35.53
OW-2307L	78.56	Lower	-	-	-	-	-	-	-	-	-	10:47	51.54	27.02	12:31	51.75	26.81	9:05	51.92	26.64	11:26	52.35	26.21	9:25	52.53	26.03
OW-2307U	78.59	Upper	-	-	-	-	-	-	-	-	-	10:44	45.77	32.82	12:29	45.91	32.68	9:03	46.09	32.50	11:23	46.32	32.27	9:20	46.45	32.14
OW-2319L	76.05	Deep	-	-	-	-	-	-	-	-	-	9:00	42.37	33.68	8:13	41.54	34.51	11:01	42.31	33.74	14:22	37.44	38.61	12:42	42.71	33.34
OW-2319U	75.97	Lower	-	-	-	-	-	-	-	-	-	9:01	40.62	35.35	8:11	40.74	35.23	11:00	40.84	35.13	14:25	41.02	34.95	12:49	41.23	34.74
OW-2320L	73.19	Deep	-	-	-	-	-	-	-	-	-	8:10	43.02	30.17	10:28	43.14	30.05	10:35	43.24	29.95	13:54	43.51	29.68	16:20	43.68	29.51
OW-2320U	73.50	Lower	-	-	-	-	-	-	-	-	-	8:09	44.59	28.91	10:27	44.69	28.81	10:34	44.70	28.80	13:52	44.86	28.64	16:17	45.02	28.48
OW-2320U1	72.90	Upper	-	-	-	-	-	-	-	-	-	8:03	43.52	29.38	10:33	43.65	29.25	10:45	43.62	29.28	13:57	43.79	29.11	12:08	43.90	29.00
OW-2320U2	72.92	Upper	-	-	-	-	-	-	-	-	-	8:04	43.53	29.39	10:35	43.69	29.23	10:44	43.65	29.27	14:00	43.80	29.12	12:11	43.93	28.99
OW-2320U3	72.84	Upper	-	-	-	-	-	-	-	-	-	8:00	43.58	29.26	10:37	43.72	29.12	10:42	43.69	29.15	14:02	42.89	29.95	12:14	43.97	28.87
OW-2320U4	72.91	Upper	-	-	-	-	-	-	-	-	-	8:01	43.79	29.12	10:39	43.91	29.00	10:41	43.89	29.02	14:05	40.87	32.04	12:21	44.19	28.72
OW-2321L	73.54	Deep	-	-	-	-	-	-	-	-	-	-	-	-	9:58	51.68	21.86	12:17	51.79	21.75	13:31	52.02	21.52	11:57	52.28	21.26
OW-2321U	73.27	Lower	-	-	-	-	-	-	-	-	-	-	-	-	9:56	51.70	21.57	12:16	51.70	21.57	13:29	51.86	21.41	11:55	52.01	21.26
OW-2324L	26.27	Deep	-	-	-	-	-	-	-	-	-	-	-	-	12:03	11.79	14.48	9:29	11.99	14.28	11:52	12.13	14.14	10:03	13.08	13.19
OW-2324U	26.17	Lower	-	-	-	-	-	-	-	-	-	-	-	-	12:02	11.28	14.89	9:28	11.38	14.79	11:53	11.54	14.63	9:58	12.44	13.73
OW-2348L	52.70	Deep	-	-	-	-	-	-	-	-	-	-	-	-	9:31	39.53	13.17	11:55	39.73	12.97	15:04	39.31	13.39	13:24	40.66	12.04
OW-2348U	52.12	Lower	-	-	-	-	-	-	-	-	-	-	-	-	9:29	39.06	13.06	11:54	39.17	12.95	14:55	39.12	13.00	13:32	40.07	12.05
OW-2352L	64.60	Lower	-	-	-	-	-	-	-	-	-	-	-	-	9:03	45.17	19.43	11:39	45.09	19.51	15:30	45.19	19.41	13:56	45.21	19.39
OW-2352U	64.47	Upper	-	-	-	-	-	-	-	-	-	-	-	-	9:02	45.09	19.38	11:38	45.00	19.47	15:32	45.08	19.39	13:54	45.13	19.34
OW-2359L1	79.36	Deep	-	-	-	-	-	-	-	-	-	-	-	-	11:42	54.54	24.82	9:44	54.72	24.64	12:11	53.72	25.64	16:49	55.52	23.84
OW-2359L2	78.93	Deep	-	-	-	-	-	-	-	-	-	-	-	-	11:38	54.12	24.81	9:46	54.30	24.63	12:07	52.40	26.53	16:59	55.12	23.81
OW-2359L3	78.83	Deep	-	-	-	-	-	-	-	-	-	-	-	-	11:36	53.89	24.94	9:47	54.05	24.78	12:05	52.12	26.71	16:56	54.89	23.94
OW-2359U1	79.29	Lower	-	-	-	-	-	-	-	-	-	-	-	-	11:40	55.01	24.28	9:45	55.09	24.20	12:09	55.29	24.00	16:47	55.45	23.84

Table 2.3.1.2-3 (Sheet 2 of 3)
VCS Monthly Groundwater Level Measurements

Well No.	Ref. Elev. (NAVD88)	Hydro-geologic Unit	17-Jun-08			15-Jul-08			11-Aug-08			24-Sep-08			22-Oct-08			12-Nov-08			16-Dec-08			13-Jan-09		
			Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)
OW-01L	73.74	Lower	11:24	43.57	30.17	11:14	43.67	30.07	14:25	43.85	29.89	11:15	44.14	29.60	13:08	44.26	29.48	15:18	44.34	29.40	11:46	44.59	29.15	12:46	44.74	29.00
OW-01U	73.65	Upper	11:20	42.72	30.93	11:11	42.86	30.79	14:23	42.99	30.66	11:18	43.33	30.32	13:07	43.40	30.25	15:20	43.54	30.11	11:45	43.75	29.90	12:45	43.93	29.72
OW-02L	76.53	Lower	10:26	51.87	24.66	10:11	52.00	24.53	13:30	52.16	24.37	11:05	52.49	24.04	12:22	52.64	23.89	14:41	52.78	23.75	11:16	53.06	23.47	12:04	53.26	23.27
OW-02U	76.74	Upper	10:24	51.80	24.94	10:13	51.94	24.80	13:32	52.05	24.69	11:07	52.40	24.34	12:21	52.48	24.26	14:39	52.62	24.12	11:14	52.90	23.84	12:03	53.12	23.62
OW-03L	76.67	Lower	10:17	57.11	19.56	10:05	57.42	19.25	13:21	57.76	18.91	10:57	58.26	18.41	12:15	58.52	18.15	14:33	58.75	17.92	11:08	59.01	17.66	11:54	59.43	17.24
OW-03U	77.05	Upper	10:19	DRY	NA	10:07	DRY	NA	13:24	DRY	NA	10:59	DRY	NA	12:17	DRY	NA	14:35	DRY	NA	11:10	DRY	NA	11:53	DRY	NA
OW-04L	80.67	Lower	10:06	57.57	23.10	9:55	57.78	22.89	13:12	58.01	22.66	10:50	58.43	22.24	12:08	58.63	22.04	14:24	58.81	21.86	11:03	59.12	21.55	11:46	59.35	21.32
OW-04U	81.08	Upper	10:08	57.03	24.05	9:58	57.22	23.86	13:15	57.47	23.61	10:53	57.83	23.25	12:10	58.02	23.06	14:22	58.20	22.88	11:05	58.52	22.56	11:45	58.74	22.34
OW-05L	79.90	Deep	10:06	53.93	25.97	9:43	54.11	25.79	13:07	54.31	25.59	10:42	54.64	25.26	12:05	54.79	25.11	14:17	54.93	24.97	10:59	55.23	24.67	11:39	55.45	24.45
OW-05U	79.55	Upper	10:03	53.06	26.49	9:45	53.21	26.34	13:04	53.36	26.19	10:39	53.71	25.84	12:04	53.83	25.72	14:19	53.98	25.57	10:58	54.29	25.26	11:38	54.51	25.04
OW-06L	81.55	Lower	9:55	55.02	26.53	9:25	55.19	26.36	12:52	55.38	26.17	10:27	55.71	25.84	11:52	55.85	25.70	14:08	55.98	25.57	10:46	56.27	25.28	11:26	56.50	25.05
OW-06U	80.77	Upper	9:53	54.02	26.75	9:23	54.20	26.57	12:54	54.36	26.41	10:29	54.71	26.06	11:54	54.84	25.93	14:06	54.97	25.80	10:47	55.26	25.51	11:27	55.49	25.28
OW-07L	79.04	Deep	9:17	59.14	19.90	8:59	59.41	19.63	12:07	59.75	19.29	9:40	59.97	19.07	11:31	60.21	18.83	13:31	60.29	18.75	10:06	60.37	18.67	10:51	60.44	18.60
OW-07U	79.02	Upper	9:13	58.81	20.21	8:57	59.00	20.02	12:04	59.21	19.81	9:37	59.58	19.44	11:33	59.78	19.24	13:33	59.91	19.11	10:04	60.16	18.86	10:52	60.30	18.72
OW-08L	84.07	Deep	8:46	51.39	32.68	8:08	51.56	32.51	10:07	52.03	32.04	9:02	52.16	31.91	11:08	52.33	31.74	8:32	52.34	31.73	8:58	52.56	31.51	10:26	52.63	31.44
OW-08U	83.88	Lower	8:43	47.60	36.28	8:10	47.79	36.09	10:05	48.17	35.71	9:05	48.38	35.50	11:09	48.54	35.34	8:35	48.62	35.26	8:59	48.90	34.98	10:27	49.03	34.85
OW-09L	80.00	Deep	9:59	52.75	27.25	9:30	52.91	27.09	13:00	53.11	26.89	10:35	53.41	26.59	11:58	53.51	26.49	14:12	53.68	26.32	10:55	54.02	25.98	11:32	54.27	25.73
OW-09U	79.24	Upper	9:57	51.93	27.31	9:33	52.07	27.17	12:58	52.02	27.22	10:33	52.53	26.71	11:56	52.59	26.65	14:14	52.76	26.48	10:53	53.13	26.11	11:31	53.43	25.81
OW-10L	79.88	Deep	9:05	56.54	23.34	8:48	56.84	23.04	11:54	57.34	22.54	9:28	57.35	22.53	11:27	57.56	22.32	13:25	57.52	22.36	9:58	57.51	22.37	10:44	57.42	22.46
OW-10U	79.53	Upper	9:07	56.95	22.58	8:50	57.01	22.52	11:58	57.09	22.44	9:25	57.29	22.24	11:26	57.29	22.24	13:27	57.36	22.17	9:56	57.53	22.00	10:43	57.75	21.78
OW-2150L	82.45	Deep	15:18	48.61	33.84	13:33	48.85	33.60	10:54	49.21	33.24	12:52	49.46	32.99	10:06	49.71	32.74	15:52	49.84	32.61	12:17	49.95	32.50	9:11	50.00	32.45
OW-2150U	82.78	Upper	15:16	37.17	45.61	13:30	37.43	45.35	10:52	37.66	45.12	12:54	38.00	44.78	10:04	38.12	44.66	15:50	38.38	44.40	12:18	38.58	44.20	9:10	38.81	43.97
OW-2169L	81.72	Lower	15:25	45.72	36.00	13:36	45.91	35.81	11:00	46.23	35.49	12:59	46.49	35.23	9:55	46.65	35.07	15:56	46.72	35.00	12:22	47.01	34.71	9:20	47.13	34.59
OW-2169U	81.77	Upper	15:29	39.19	42.58	13:38	39.38	42.39	11:01	39.62	42.15	13:01	39.99	41.78	9:57	40.08	41.69	15:59	40.15	41.62	12:23	40.55	41.22	9:19	40.82	40.95
OW-2181L	81.32	Lower	15:33	45.06	36.26	13:43	45.20	36.12	11:09	45.41	35.91	13:07	45.68	35.64	10:13	45.86	35.46	16:04	46.03	35.29	12:32	46.23	35.09	9:28	46.36	34.96
OW-2181U	81.31	Upper	15:30	39.05	42.26	13:41	39.23	42.08	11:07	39.48	41.83	13:05	39.85	41.46	10:12	39.91	41.40	16:07	39.98	41.33	12:30	40.41	40.90	9:27	40.70	40.61
OW-2185L	81.36	Lower	15:55	46.69	34.67	17:35	46.87	34.49	11:18	47.18	34.18	15:30	47.45	33.91	10:58	47.61	33.75	9:00	47.69	33.67	9:31	47.99	33.37	10:15	48.12	33.24
OW-2185U	81.45	Upper	15:57	42.54	38.91	17:37	42.73	38.72	11:16	43.01	38.44	15:34	43.32	38.13	10:57	43.47	37.98	9:02	43.53	37.92	9:33	43.87	37.58	10:16	44.03	37.42
OW-2253L	82.82	Deep	16:08	50.51	32.31	14:08	50.70	32.12	10:40	51.08	31.74	14:38	51.24	31.58	9:02	51.43	31.39	9:56	51.44	31.38	9:09	51.65	31.17	10:00	51.71	31.11
OW-2253U	82.66	Upper	16:10	36.14	46.52	14:10	36.59	46.07	10:43	37.01	45.65	14:41	37.61	45.05	9:03	37.95	44.71	9:58	38.24	44.42	9:11	38.67	43.99	9:59	39.05	43.61
OW-2269L	82.55	Deep	15:43	50.07	32.48	13:56	50.26	32.29	10:34	50.64	31.91	8:41	50.81	31.74	9:34	51.00	31.55	10:21	51.00	31.55	9:17	51.21	31.34	9:50	51.28	31.27
OW-2269U	82.43	Lower	15:40	47.84	34.59	13:54	48.03	34.40	10:33	48.37	34.06	8:46	48.62	33.81	9:38	48.78	33.65	10:23	48.86	33.57	9:15	49.16	33.27	9:51	49.28	33.15
OW-2284L	82.74	Lower	15:50	48.55	34.19	14:00	48.75	33.99	10:24	49.05	33.69	8:31	49.32	33.42	9:28	49.48	33.26	8:48	49.57	33.17	9:24	49.88	32.86	9:41	50.00	32.74
OW-2284U	82.62	Upper	15:52	38.94	43.68	14:02	39.26	43.36	10:29	39.55	43.07	8:27	39.98	42.64	9:25	40.22	42.40	8:46	40.44	42.18	9:22	40.77	41.85	9:40	41.05	41.57
OW-2301L	83.19	Deep	8:31	45.88	37.31	8:02	46.05	37.14	9:35	46.45	36.74	8:47	46.60	36.59	8:40	46.77	36.42	17:25	46.75	36.44	8:48	47.00	36.19	8:55	47.11	36.08
OW-2301U	83.27	Upper	8:34	33.60	49.67	7:59	33.74	49.53	9:39	33.89	49.38	8:52	34.08	49.19	8:37	34.11	49.16	17:28	34.24	49.03	8:47	34.48	48.79	8:54	34.67	48.60
OW-2302L	81.95	Deep	11:44	45.88	36.07	11:39	45.97	35.98	9:52	46.31	35.64	12:32	46.51	35.44	16:01	46.65	35.30	15:40	46.68	35.27	12:06	46.96	34.99	13:09	47.08	34.87
OW-2302U	81.99	Lower	11:46	44.12	37.87	11:42	44.23	37.76	9:54	44.57	37.42	12:34	44.79	37.20	16:03	44.96	37.03	15:42	45.02	36.97	12:05	45.29	36.70	13:08	45.42	36.57
OW-2304L	69.73	Lower	13:29	42.94	26.79	14:35	43.12	26.61	16:01	43.45	26.28	9:37	43.65	26.08	15:36	43.79	25.94	16:29	43.82	25.91	14:26	44.04	25.69	14:16	44.15	25.58
OW-2304U	70.10	Upper	13:31	34.84	35.26	14:37	35.16	34.94	15:59	35.50	34.60	9:41	36.00	34.10	15:34	36.30	33.80	16:32	36.52	33.58	14:28	36.81	33.29	14:15	37.03	33.07
OW-2307L	78.56	Lower	8:55	53.46	25.10	8:17	53.89	24.67	11:45	54.46	24.10	9:19	54.50	24.06	11:21	54.83	23.73	10:36	54.87	23.69	9:49	54.87	23.69	10:36	54.89	23.67
OW-2307U	78.59	Upper	8:57	46.59	32.00	8:15	46.73	31.86	11:43	46.92	31.67	9:15	47.21	31.38	11:20	47.37	31.22	10:38	47.52	31.07	9:47	47.79	30.80	10:35	48.02	30.57
OW-2319L	76.05	Deep	12:02	43.19	32.86	11:20	43.17	32.88	14:35	43.47	32.58	12:13	43.71	32.34	15:49	43.82	32.23	15:25	43.87	32.18	11:52	44.15	31.90	12:56	44.29	31.76
OW-2319U	75.97	Lower	12:04	41.63	34.34	11:23	41.67	34.30	14:37	41.94	34.03	12:15	42.20	33.77	15:50	42.33	33.64	15:27	42.40	33.57	11:54	42.67	33.30	12:55	42.79	33.18
OW-2320L	73.19	Deep	10:41	44.07	29.12	10:44	44.14	29.05	14:04	44.42	28.77	11:34	44.67	28.52	12:45	44.81	28.38	15:01	44.84	28.35	11:39	45.11	28.08	12:28	45.22	27.97
OW-2320U	73.50	Lower	10:44	45.24	28.26	10:40	45.38	28.12	14:01	45.54	27.96	11:36	45.84	27.66	12:47	45.96	27.54	15:03	46.07	27.43	11:40	46.31	27.19	12:27	46.47	27.03
OW-2320U1	72.90	Upper	10:35	44.09	28.81	10:53	44.23	28.67	14:11	44.36	28.54	11:27	44.66	28.24	12:56	44.78	28.12	15:08	44.89	28.01	11:34	45.10	27.80	12:38	45.24	27.66
OW-2320U2	72.92	Upper	10:33	44.10	28.82	10:50	44.24	28.68	14:13	44.38	28.54	11:29	44.67	28.25	12:54	44.77	28.15	15:06	44.91	28.01	11:35	45.10	27.82	12:39	45.25	27.67
OW-2320U3	72.84	Upper	10:37	44.15	28.69	10:56	44.29	28.55	14:16	44.42	28.42	11:23	44.72	28.12	12:59	44.83	28.01	15:13	44.96	27.88	11:33	45.15	27.69	12:40	45.30	27.54
OW-2320U4	72.91	Upper	10:39	44.35	28.56	10:58	44.49	28.42	14:17	44.62	28.29	11:25	44.92	27.99	12:58	45.04	27.87	15:11	45.14	27.77	11:32	45.35	27.56	12:41	45.49	27.42
OW-2321L	73.54	Deep	11:06	52.68	20.86	10:21	52.91	20.63	13:47	53.28	20.26	11:57	53.55	19.99	12:34	53.76	19.78	14:52	53.84	19.70	11:24	54.01	19.53	12:14	54.07	19.47
OW-2321U	73.27	Lower	11:04	52.17	21.10	10:25	52.31	20.96	13:50	52.48	20.79	11:59	52.82	20.45	12:35	52.99	20.28	14:50	53.14	20.13	11:22	53.41	19.86	12:13	53.62	19.65
OW-2324L	26.27	Deep	9:28	13.84	12.43	8:27	14.29	11.98	12:22	14.91	11.36	9:54	14.86	11.41	15:16	15.07	11.20	13:40	14.93	11.34	10:16	14.37	11.90	11:04	14.14	12.13
OW-2324U	26.17	Lower	9:25	13.26	12.91	8:30	13.69	12.48	12:24	14.38	11.79	9:57	14.19	11.98	15:15	14.45	11.72	13:42	14.14	12.03	10:18	13.74	12.43	11:03	13.71	12.46
OW-2348L	52.70	Deep	14:15	41.20	11.50	15:00	41.61	11.09	15:27	42.16	10.54	10:11	42.23	10.47	13:35	42.49	10.21	16:47	42.45	10.25	14:51	42.40	10.30	14:36	42.35	10.35
OW-2348U	52.12	Lower	14:18	40.63	11.49	15:03	41.15	10.97	15:28	41.75	10.37	10:14	41.81	10.31	13:37	42.11	10.01	16:50	42.00	10.12	14:53	41.85	10.27	14:35	43.76	8.36
OW-2352L	64.60	Lower	13:55	45.36	19.24	15:23	45.47	19.13	15:04	45.56	19.04	12:25	45.74	18.86	13:58	45.79	18.81	17:05	45.89	18.71	15:15	45.98	18.62	14:58	46.06	18.54
OW-2352U	64.47	Upper	13:57	45.27	19.20	15:21	45.38	19.09	15:02	45.47	19.00	12:22	45.66	18.81	13:59	45.70	18.77	17:02	45.81	18.66	15:12	45.88	18.59	14:57	45.96	18.51
OW-2359L1	79.36	Deep	9:50	56.02	23.34	9:10	56.33	23.03	12:38	56.82	22.54	10:06	56.85	22.51	11:42	57.08	22.28	13:56	57.04	22.32	10:35	57.08	22.28	11:15	57.01	22.35
OW-2359L2	78.93	Deep	9:41	55.61	23.32	9:08	55.91	23.02	12:42	56.41	22.52	10:21	56.44	22.49	11:45	56.66	22.27	14:02	56.62	22.31	10:41	56.66	22.27	11:17	56.60	22.33
OW-2359L3	78.83	Deep	9:44	55.37	23.46	9:06	55.67	23.16	12:44	56.18	22.65	10:19	56.20	22.63	11:44	56.42	22.41	14:00	56.38	22.45	10:39	56.42	22.41	11:18	56.34	22.49
OW-2359U1	79.29	Lower	9:47	55.67	23.62	9:13	55.87	23.42	12:40	56.07	23.22	10:15	56.42	22.87	11:40	56.60	22.69	13:58	56.43	22.86	10:37	56.98	22.31	11:16	57.16	22.13

Table 2.3.1.2-3 (Sheet 3 of 3)
VCS Monthly Groundwater Level Measurements

Well No.	Ref. Elev. (NAVD88)	Hydro-geologic Unit	18-Feb-09			19-May-09			25-Aug-09			19-Nov-09			17-Mar-10			8-Jun-10			18-Oct-10		
			Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)	Time	Depth to Water (ftbtc)	Elevation of Water (NAVD88)
OW-01L	73.74	Lower	11:42	44.86	28.88	11:00	45.32	28.42	10:26	45.96	27.78	13:22	46.24	27.50	12:46	46.02	27.72	11:43	45.90	27.84	15:57	44.93	28.81
OW-01U	73.65	Upper	11:44	44.03	29.62	10:59	44.56	29.09	10:25	45.15	28.50	13:24	45.49	28.16	12:44	45.35	28.30	11:42	45.23	28.42	15:55	44.14	29.51
OW-02L	76.53	Lower	10:54	53.41	23.12	10:28	53.95	22.58	10:04	54.53	22.00	12:40	54.91	21.62	11:56	54.87	21.66	11:10	54.65	21.88	16:27	53.99	22.54
OW-02U	76.74	Upper	10:56	53.22	23.52	10:30	53.79	22.95	10:03	54.33	22.41	12:42	54.70	22.04	11:55	54.90	21.84	11:08	54.69	22.05	16:25	54.16	22.58
OW-03L	76.67	Lower	10:48	59.25	17.42	10:19	59.54	17.13	9:59	60.44	16.23	12:32	60.26	16.41	11:49	58.98	17.69	11:04	58.73	17.94	16:31	58.12	18.55
OW-03U	77.05	Upper	10:46	DRY	NA	10:20	DRY	NA	9:58	DRY	NA	12:31	DRY	NA	11:47	DRY	NA	11:05	DRY	NA	16:33	DRY	NA
OW-04L	80.67	Lower	10:39	59.50	21.17	10:13	59.97	20.70	9:52	60.67	20.00	12:25	60.94	19.73	11:42	60.46	20.21	10:58	60.22	20.45	16:52	Damaged	NA
OW-04U	81.08	Upper	10:37	58.91	22.17	10:14	59.45	21.63	9:51	60.09	20.99	12:23	60.46	20.62	11:40	60.20	20.88	10:56	59.95	21.13	16:50	59.15	21.93
OW-05L	79.90	Deep	10:29	55.47	24.43	10:10	56.04	23.86	9:47	56.74	23.16	12:18	56.95	22.95	11:34	56.82	23.08	10:50	56.62	23.28	16:56	55.95	23.95
OW-05U	79.55	Upper	10:31	54.64	24.91	10:08	55.22	24.33	9:46	55.83	23.72	12:20	56.25	23.30	11:32	56.48	23.07	10:52	56.28	23.27	16:58	55.62	23.93
OW-06L	81.55	Lower	10:18	56.58	24.97	9:58	57.10	24.45	9:37	57.75	23.80	12:11	58.12	23.43	11:22	58.07	23.48	10:43	57.88	23.67	15:11	57.36	24.19
OW-06U	80.77	Upper	10:15	55.59	25.18	10:00	56.12	24.65	9:38	56.74	24.03	12:09	57.13	23.64	11:19	57.21	23.56	10:42	57.04	23.73	15:14	56.52	24.25
OW-07L	79.04	Deep	9:51	60.45	18.59	9:40	60.83	18.21	8:57	61.95	17.09	11:32	61.41	17.63	10:34	60.45	18.59	10:02	60.32	18.72	17:48	59.97	19.07
OW-07U	79.02	Upper	9:53	60.39	18.63	9:39	60.63	18.39	8:56	61.34	17.68	11:33	61.55	17.47	10:36	60.82	18.20	10:04	60.59	18.43	17:51	60.36	18.66
OW-08L	84.07	Deep	8:32	52.66	31.41	7:56	53.17	30.90	8:34	54.14	29.93	9:05	53.76	30.31	9:25	52.38	31.69	9:09	52.28	31.79	13:19	51.46	32.61
OW-08U	83.88	Lower	8:33	49.11	34.77	7:58	49.71	34.17	8:33	50.46	33.42	9:03	50.66	33.22	9:28	49.65	34.23	9:07	49.38	34.50	13:17	48.48	35.40
OW-09L	80.00	Deep	10:22	54.25	25.75	10:04	54.85	25.15	9:42	55.49	24.51	12:14	55.83	24.17	11:28	55.89	24.11	10:47	55.70	24.30	17:05	55.04	24.96
OW-09U	79.24	Upper	10:24	53.36	25.88	10:03	53.99	25.25	9:41	54.56	24.68	12:15	54.95	24.29	11:26	55.29	23.95	10:48	55.12	24.12	17:03	54.50	24.74
OW-10L	79.88	Deep	9:30	57.38	22.50	9:07	58.07	21.81	8:51	59.52	20.36	11:25	58.17	21.71	10:25	56.64	23.24	9:38	56.64	23.24	18:30	56.38	23.50
OW-10U	79.53	Upper	9:32	57.65	21.88	9:08	57.92	21.61	8:49	58.19	21.34	11:26	58.43	21.10	10:27	58.70	20.83	9:40	58.72	20.81	18:32	58.37	21.16
OW-2150L	82.45	Deep	12:18	50.09	32.36	11:30	50.44	32.01	11:03	51.30	31.15	9:42	51.34	31.11	13:19	50.10	32.35	12:46	49.94	32.51	14:41	49.02	33.43
OW-2150U	82.78	Upper	12:16	38.87	43.91	11:28	39.80	42.98	11:02	40.76	42.02	9:44	41.21	41.57	13:17	40.35	42.43	12:48	40.18	42.60	14:43	38.43	44.35
OW-2169L	81.72	Lower	12:22	47.23	34.49	11:35	47.84	33.88	11:09	48.57	33.15	9:50	48.78	32.94	13:25	47.98	33.74	12:35	47.74	33.98	14:48	46.56	35.16
OW-2169U	81.77	Upper	12:23	40.76	41.01	11:37	41.68	40.09	11:08	42.56	39.21	9:52	42.93	38.84	13:23	42.22	39.55	12:38	42.06	39.71	14:50	40.47	41.30
OW-2181L	81.32	Lower	12:28	46.54	34.78	11:42	46.90	34.42	11:11	47.53	33.79	9:56	47.99	33.33	13:32	47.89	33.43	12:54	47.69	33.63	15:01	47.11	34.21
OW-2181U	81.31	Upper	12:27	40.57	40.74	11:40	41.50	39.81	11:13	42.33	38.98	9:54	42.68	38.63	13:34	42.08	39.23	12:53	39.93	41.38	14:59	40.43	40.88
OW-2185L	81.36	Lower	9:07	48.22	33.14	8:49	48.79	32.57	8:21	49.54	31.82	11:06	49.73	31.63	10:04	49.05	32.31	8:32	48.84	32.52	14:19	47.70	33.66
OW-2185U	81.45	Upper	9:08	44.12	37.33	8:48	44.81	36.64	8:19	45.59	35.86	11:08	45.89	35.56	10:02	45.40	36.05	8:35	45.23	36.22	14:21	43.98	37.47
OW-2253L	82.82	Deep	8:43	51.76	31.06	8:06	52.27	30.55	7:54	53.20	29.62	9:16	52.86	29.96	9:34	51.69	31.13	8:55	51.55	31.27	13:55	50.68	32.14
OW-2253U	82.66	Upper	8:45	39.34	43.32	8:07	40.32	42.34	7:52	41.27	41.39	9:14	41.94	40.72	9:36	38.94	43.72	8:57	38.57	44.09	13:53	35.22	47.44
OW-2269L	82.55	Deep	8:49	51.31	31.24	8:27	51.85	30.70	8:02	52.77	29.78	10:45	52.45	30.10	9:43	51.30	31.25	8:50	51.17	31.38	13:46	50.27	32.28
OW-2269U	82.43	Lower	8:51	49.38	33.05	8:28	49.97	32.46	7:59	50.72	31.71	10:42	50.92	31.51	9:41	50.23	32.20	8:48	50.01	32.42	13:44	48.91	33.52
OW-2284L	82.74	Lower	8:57	50.10	32.64	8:39	50.67	32.07	8:10	51.42	31.32	10:28	51.63	31.11	9:50	51.00	31.74	8:45	50.74	32.00	13:33	49.70	33.04
OW-2284U	82.62	Upper	8:55	41.19	41.43	8:37	42.06	40.56	8:08	43.02	39.60	10:32	43.61	39.01	9:53	43.09	39.53	8:43	43.00	39.62	13:31	41.32	41.30
OW-2301L	83.19	Deep	8:23	47.19	36.00	7:48	47.68	35.51	7:40	48.50	34.69	8:53	48.36	34.83	9:14	47.11	36.08	8:05	46.90	36.29	13:03	45.83	37.36
OW-2301U	83.27	Upper	8:25	34.63	48.64	7:50	35.15	48.12	7:39	35.61	47.66	8:55	35.54	47.73	9:17	34.71	48.56	8:03	34.42	48.85	13:05	32.22	51.05
OW-2302L	81.95	Deep	12:04	47.14	34.81	11:17	47.62	34.33	10:49	48.39	33.56	14:02	48.38	33.57	13:07	47.35	34.60	12:17	47.18	34.77	15:24	46.07	35.88
OW-2302U	81.99	Lower	12:05	45.51	36.48	11:18	46.04	35.95	10:50	46.82	35.17	14:04	46.90	35.09	13:08	45.73	36.26	12:19	45.51	36.48	15:26	44.00	37.99
OW-2304L	69.73	Lower	13:46	44.20	25.53	12:59	44.66	25.07	12:42	45.41	24.32	14:20	45.51	24.22	13:56	44.65	25.08	14:07	44.60	25.13	8:16	43.12	26.61
OW-2304U	70.10	Upper	13:48	37.28	32.82	13:02	37.99	32.11	12:40	39.14	30.96	14:19	39.70	30.40	13:54	39.12	30.98	14:05	39.06	31.04	8:18	38.15	31.95
OW-2307L	78.56	Lower	9:21	54.90	23.66	9:03	55.82	22.74	8:44	57.32	21.24	11:20	56.39	22.17	10:18	53.05	25.51	9:30	52.91	25.65	10:56	52.42	26.14
OW-2307U	78.59	Upper	9:23	48.18	30.41	9:01	48.81	29.78	8:43	49.54	29.05	11:18	50.10	28.49	10:16	49.98	28.61	9:32	49.79	28.80	10:58	49.52	29.07
OW-2319L	76.05	Deep	11:53	44.43	31.62	11:06	44.84	31.21	10:31	45.57	30.48	13:52	45.69	30.36	12:54	45.01	31.04	12:01	44.90	31.15	15:44	43.97	32.08
OW-2319U	75.97	Lower	11:50	42.86	33.11	11:07	43.34	32.63	10:33	44.06	31.91	13:54	44.20	31.77	12:53	43.53	32.44	12:00	43.39	32.58	15:46	42.33	33.64
OW-2320L	73.19	Deep	11:25	45.29	27.90	10:46	45.71	27.48	10:11	46.47	26.72	13:06	46.41	26.78	12:27	45.71	27.48	11:18	45.57	27.62	16:16	44.16	29.03
OW-2320U	73.50	Lower	11:24	46.57	26.93	10:48	47.09	26.41	10:12	47.71	25.79	13:04	48.05	25.45	12:25	48.01	25.49	11:17	47.89	25.61	16:18	47.15	26.35
OW-2320U1	72.90	Upper	11:35	45.36	27.54	10:51	45.88	27.02	10:16	46.49	26.41	13:11	46.88	26.02	12:31	46.92	25.98	11:26	46.84	26.06	16:06	46.11	26.79
OW-2320U2	72.92	Upper	11:33	45.36	27.56	10:50	45.89	27.03	10:17	46.51	26.41	13:13	46.89	26.03	12:32	46.93	25.99	11:28	46.87	26.05	16:07	46.13	26.79
OW-2320U3	72.84	Upper	11:29	45.41	27.43	10:54	45.94	26.90	10:19	46.55	26.29	13:14	46.92	25.92	12:35	46.95	25.89	11:24	46.89	25.95	16:10	46.15	26.69
OW-2320U4	72.91	Upper	11:31	45.61	27.30	10:53	46.14	26.77	10:20	46.74	26.17	13:16	47.10	25.81	12:37	47.15	25.76	11:22	47.08	25.83	16:09	46.35	26.56
OW-2321L	73.54	Deep	11:10	54.11	19.43	10:36	54.31	19.23	11:40	55.40	18.14	12:54	54.63	18.91	12:14	53.60	19.94	13:48	53.49	20.05	9:52	53.10	20.44
OW-2321U	73.27	Lower	11:12	53.78	19.49	10:38	54.25	19.02	11:39	54.77	18.50	12:56	55.08	18.19	12:12	54.63	18.64	13:46	54.52	18.75	9:50	54.04	19.23
OW-2324L	26.27	Deep	9:43	13.99	12.28	9:26	13.87	12.40	9:07	16.66	9.61	11:46	12.78	13.49	10:55	11.87	14.40	9:52	11.74	14.53	10:28	12.36	13.91
OW-2324U	26.17	Lower	9:41	13.47	12.70	9:24	13.64	12.53	9:09	16.10	10.07	11:42	12.71	13.46	10:52	11.62	14.55	9:51	11.60	14.57	10:30	11.96	14.21
OW-2348L	52.70	Deep	14:10	42.29	10.41	13:19	41.25	11.45	12:06	43.68	9.02	15:00	40.09	12.61	14:16	39.19	13.51	14:28	39.06	13.64	9:28	39.90	12.80
OW-2348U	52.12	Lower	14:14	41.71	10.41	13:21	40.56	11.56	12:08	43.34	8.78	14:57	39.56	12.56	14:17	38.34	13.78	14:27	38.25	13.87	9:30	38.97	13.15
OW-2352L	64.60	Lower	14:54	46.16	18.44	13:39	46.48	18.12	12:23	46.88	17.72	15:42	47.17	17.43	15:23	47.04	17.56	14:45	47.02	17.58	9:02	46.62	17.98
OW-2352U	64.47	Upper	14:52	46.06	18.41	13:35	46.38	18.09	12:21	46.79	17.68	15:40	47.09	17.38	15:24	46.97	17.50	14:43	46.94	17.53	9:00	46.56	17.91
OW-2359L1	79.36	Deep	10:07	56.97	22.39	9:50	57.59	21.77	9:24	58.97	20.39	11:57	57.72	21.64	11:12	56.31	23.05	10:24	56.28	23.08	17:31	55.93	23.43
OW-2359L2	78.93	Deep	9:59	56.55	22.38	9:53	57.16	21.77	9:21	58.55	20.38	12:01	57.30	21.63	11:05	55.89	23.04	10:26	55.85	23.08	17:34	55.50	23.43
OW-2359L3	78.83	Deep	10:01	56.31	22.52	9:51	56.92	21.91	9:20	58.31	20.52	12:03	57.07	21.76	11:07	55.63	23.20	10:34	55.61	23.22	17:36	55.26	23.57
OW-2359U1	79.29	Lower	10:09	57.24	22.05	9:48	57.66	21.63	9:22	58.37	20.92	11:59	58.61	20.68	11:10	58.13	21.16	10:36	57.93	21.36	17:33	57.54	21.75

Purple-shaded areas indicate an anomaly or suspect reading
Yellow-shaded areas indicate water level collected on a different date
September 2008 water levels were collected on 9/25/08.
October 2010 water levels were collected on 10/19/10.

Abbreviations:
NAVD88 = North American Vertical Datum 1988
fbtc = feet below top of casing
NA = Not Applicable

Table 2.3.1.2-4 (Sheet 1 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone				Lower Zone				Δx	Δh	i_v
		Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)			
OW-01U/L (Upper Shallow/Lower Shallow)	25-Oct-07	22.16	12.16	17.16	32.19	-27.78	-37.78	-32.78	31.35	49.94	0.84	0.02
	17-Nov-07	22.16	12.16	17.16	32.20	-27.78	-37.78	-32.78	31.35	49.94	0.85	0.02
	18-Dec-07	22.16	12.16	17.16	32.09	-27.78	-37.78	-32.78	31.23	49.94	0.86	0.02
	30-Jan-08	22.16	12.16	17.16	31.68	-27.78	-37.78	-32.78	30.97	49.94	0.71	0.01
	18-Feb-08	22.16	12.16	17.16	31.46	-27.78	-37.78	-32.78	30.80	49.94	0.66	0.01
	31-Mar-08	22.16	12.16	17.16	31.47	-27.78	-37.78	-32.78	30.75	49.94	0.72	0.01
	26-Apr-08	22.16	12.16	17.16	31.74	-27.78	-37.78	-32.78	31.33	49.94	0.41	0.01
	23-May-08	22.16	12.16	17.16	31.13	-27.78	-37.78	-32.78	30.42	49.94	0.71	0.01
	17-Jun-08	22.16	12.16	17.16	30.93	-27.78	-37.78	-32.78	30.17	49.94	0.76	0.02
	15-Jul-08	22.16	12.16	17.16	30.79	-27.78	-37.78	-32.78	30.07	49.94	0.72	0.01
	11-Aug-08	22.16	12.16	17.16	30.66	-27.78	-37.78	-32.78	29.89	49.94	0.77	0.02
	24-Sep-08	22.16	12.16	17.16	30.32	-27.78	-37.78	-32.78	29.60	49.94	0.72	0.01
	22-Oct-08	22.16	12.16	17.16	30.25	-27.78	-37.78	-32.78	29.48	49.94	0.77	0.02
	12-Nov-08	22.16	12.16	17.16	30.11	-27.78	-37.78	-32.78	29.40	49.94	0.71	0.01
	16-Dec-08	22.16	12.16	17.16	29.90	-27.78	-37.78	-32.78	29.15	49.94	0.75	0.02
	13-Jan-09	22.16	12.16	17.16	29.72	-27.78	-37.78	-32.78	29.00	49.94	0.72	0.01
	18-Feb-09	22.16	12.16	17.16	29.62	-27.78	-37.78	-32.78	28.88	49.94	0.74	0.01
	19-May-09	22.16	12.16	17.16	29.09	-27.78	-37.78	-32.78	28.42	49.94	0.67	0.01
	25-Aug-09	22.16	12.16	17.16	28.50	-27.78	-37.78	-32.78	27.78	49.94	0.72	0.01
	19-Nov-09	22.16	12.16	17.16	28.16	-27.78	-37.78	-32.78	27.50	49.94	0.66	0.01
	17-Mar-10	22.16	12.16	17.16	28.30	-27.78	-37.78	-32.78	27.72	49.94	0.58	0.01
	8-Jun-10	22.16	12.16	17.16	28.42	-27.78	-37.78	-32.78	27.84	49.94	0.58	0.01
	18-Oct-10	22.16	12.16	17.16	29.51	-27.78	-37.78	-32.78	28.81	49.94	0.70	0.01
OW-02U/L (Upper Shallow/Lower Shallow)	25-Oct-07	22.25	12.25	17.25	25.25	-22.93	-32.93	-27.93	25.17	45.18	0.08	0.00
	17-Nov-07	22.25	12.25	17.25	25.39	-22.93	-32.93	-27.93	25.32	45.18	0.07	0.00
	18-Dec-07	22.25	12.25	17.25	25.55	-22.93	-32.93	-27.93	25.41	45.18	0.14	0.00
	30-Jan-08	22.25	12.25	17.25	25.49	-22.93	-32.93	-27.93	25.32	45.18	0.17	0.00
	18-Feb-08	22.25	12.25	17.25	25.39	-22.93	-32.93	-27.93	25.22	45.18	0.17	0.00
	31-Mar-08	22.25	12.25	17.25	25.45	-22.93	-32.93	-27.93	25.21	45.18	0.24	0.01
	26-Apr-08	22.25	12.25	17.25	25.28	-22.93	-32.93	-27.93	25.72	45.18	-0.44	-0.01
	23-May-08	22.25	12.25	17.25	25.16	-22.93	-32.93	-27.93	24.87	45.18	0.29	0.01
	17-Jun-08	22.25	12.25	17.25	24.94	-22.93	-32.93	-27.93	24.66	45.18	0.28	0.01
	15-Jul-08	22.25	12.25	17.25	24.80	-22.93	-32.93	-27.93	24.53	45.18	0.27	0.01
	11-Aug-08	22.25	12.25	17.25	24.69	-22.93	-32.93	-27.93	24.37	45.18	0.32	0.01
	24-Sep-08	22.25	12.25	17.25	24.34	-22.93	-32.93	-27.93	24.04	45.18	0.30	0.01
	22-Oct-08	22.25	12.25	17.25	24.26	-22.93	-32.93	-27.93	23.89	45.18	0.37	0.01
	12-Nov-08	22.25	12.25	17.25	24.12	-22.93	-32.93	-27.93	23.75	45.18	0.37	0.01
	16-Dec-08	22.25	12.25	17.25	23.84	-22.93	-32.93	-27.93	23.47	45.18	0.37	0.01
	13-Jan-09	22.25	12.25	17.25	23.62	-22.93	-32.93	-27.93	23.27	45.18	0.35	0.01
	18-Feb-09	22.25	12.25	17.25	23.52	-22.93	-32.93	-27.93	23.12	45.18	0.40	0.01
	19-May-09	22.25	12.25	17.25	22.95	-22.93	-32.93	-27.93	22.58	45.18	0.37	0.01
	25-Aug-09	22.25	12.25	17.25	22.41	-22.93	-32.93	-27.93	22.00	45.18	0.41	0.01
	19-Nov-09	22.25	12.25	17.25	22.04	-22.93	-32.93	-27.93	21.62	45.18	0.42	0.01
	17-Mar-10	22.25	12.25	17.25	21.84	-22.93	-32.93	-27.93	21.66	45.18	0.18	0.00
	8-Jun-10	22.25	12.25	17.25	22.05	-22.93	-32.93	-27.93	21.88	45.18	0.17	0.00
	18-Oct-10	22.25	12.25	17.25	22.58	-22.93	-32.93	-27.93	22.54	45.18	0.04	0.00

Table 2.3.1.2-4 (Sheet 2 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone Top of screen (NAVD88)	Upper Zone Bottom of screen (NAVD88)	Upper Zone Midpoint (NAVD88)	Upper Zone Elevation of Water (NAVD88)	Lower Zone Top of screen (NAVD88)	Lower Zone Bottom of screen (NAVD88)	Lower Zone Midpoint (NAVD88)	Lower Zone Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-03U/L (Upper Shallow/Lower Shallow)	25-Oct-07	32.60	22.60	27.60	21.09	-11.79	-21.79	-16.79	21.04	44.39	0.05	0.00
	17-Nov-07	32.60	22.60	27.60	22.01	-11.79	-21.79	-16.79	20.94	44.39	1.07	0.02
	18-Dec-07	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	20.79	44.39	NA	NA
	30-Jan-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	20.50	44.39	NA	NA
	18-Feb-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	20.36	44.39	NA	NA
	31-Mar-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	20.20	44.39	NA	NA
	26-Apr-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	19.98	44.39	NA	NA
	23-May-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	19.83	44.39	NA	NA
	17-Jun-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	19.56	44.39	NA	NA
	15-Jul-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	19.25	44.39	NA	NA
	11-Aug-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	18.91	44.39	NA	NA
	24-Sep-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	18.41	44.39	NA	NA
	22-Oct-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	18.15	44.39	NA	NA
	12-Nov-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.92	44.39	NA	NA
	16-Dec-08	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.66	44.39	NA	NA
	13-Jan-09	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.24	44.39	NA	NA
	18-Feb-09	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.42	44.39	NA	NA
	19-May-09	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.13	44.39	NA	NA
	25-Aug-09	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	16.23	44.39	NA	NA
	19-Nov-09	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	16.41	44.39	NA	NA
	17-Mar-10	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.69	44.39	NA	NA
	8-Jun-10	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	17.94	44.39	NA	NA
	18-Oct-10	32.60	22.60	27.60	DRY	-11.79	-21.79	-16.79	18.55	44.39	NA	NA
OW-04U/L (Upper Shallow/Lower Shallow)	25-Oct-07	4.61	-5.39	-0.39	24.93	-20.87	-30.87	-25.87	23.98	25.48	0.95	0.04
	17-Nov-07	4.61	-5.39	-0.39	25.06	-20.87	-30.87	-25.87	24.06	25.48	1.00	0.04
	18-Dec-07	4.61	-5.39	-0.39	25.02	-20.87	-30.87	-25.87	24.13	25.48	0.89	0.03
	30-Jan-08	4.61	-5.39	-0.39	24.88	-20.87	-30.87	-25.87	23.92	25.48	0.96	0.04
	18-Feb-08	4.61	-5.39	-0.39	24.76	-20.87	-30.87	-25.87	23.76	25.48	1.00	0.04
	31-Mar-08	4.61	-5.39	-0.39	24.64	-20.87	-30.87	-25.87	23.69	25.48	0.95	0.04
	26-Apr-08	4.61	-5.39	-0.39	24.38	-20.87	-30.87	-25.87	23.45	25.48	0.93	0.04
	23-May-08	4.61	-5.39	-0.39	24.21	-20.87	-30.87	-25.87	23.28	25.48	0.93	0.04
	17-Jun-08	4.61	-5.39	-0.39	24.05	-20.87	-30.87	-25.87	23.10	25.48	0.95	0.04
	15-Jul-08	4.61	-5.39	-0.39	23.86	-20.87	-30.87	-25.87	22.89	25.48	0.97	0.04
	11-Aug-08	4.61	-5.39	-0.39	23.61	-20.87	-30.87	-25.87	22.66	25.48	0.95	0.04
	24-Sep-08	4.61	-5.39	-0.39	23.25	-20.87	-30.87	-25.87	22.24	25.48	1.01	0.04
	22-Oct-08	4.61	-5.39	-0.39	23.06	-20.87	-30.87	-25.87	22.04	25.48	1.02	0.04
	12-Nov-08	4.61	-5.39	-0.39	22.88	-20.87	-30.87	-25.87	21.86	25.48	1.02	0.04
	16-Dec-08	4.61	-5.39	-0.39	22.56	-20.87	-30.87	-25.87	21.55	25.48	1.01	0.04
	13-Jan-09	4.61	-5.39	-0.39	22.34	-20.87	-30.87	-25.87	21.32	25.48	1.02	0.04
	18-Feb-09	4.61	-5.39	-0.39	22.17	-20.87	-30.87	-25.87	21.17	25.48	1.00	0.04
	19-May-09	4.61	-5.39	-0.39	21.63	-20.87	-30.87	-25.87	20.70	25.48	0.93	0.04
	25-Aug-09	4.61	-5.39	-0.39	20.99	-20.87	-30.87	-25.87	20.00	25.48	0.99	0.04
	19-Nov-09	4.61	-5.39	-0.39	20.62	-20.87	-30.87	-25.87	19.73	25.48	0.89	0.03
	17-Mar-10	4.61	-5.39	-0.39	20.88	-20.87	-30.87	-25.87	20.21	25.48	0.67	0.03
	8-Jun-10	4.61	-5.39	-0.39	21.13	-20.87	-30.87	-25.87	20.45	25.48	0.68	0.03
	18-Oct-10	4.61	-5.39	-0.39	21.93	-20.87	-30.87	-25.87	Damaged	25.48	NA	NA

Table 2.3.1.2-4 (Sheet 3 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone: Top of screen (NAVD88)	Upper Zone: Bottom of screen (NAVD88)	Upper Zone: Midpoint (NAVD88)	Upper Zone: Elevation of Water (NAVD88)	Lower Zone: Top of screen (NAVD88)	Lower Zone: Bottom of screen (NAVD88)	Lower Zone: Midpoint (NAVD88)	Lower Zone: Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-05U/L (Upper Shallow/Deep)	25-Oct-07	32.07	22.07	27.07	26.84	-41.74	-51.74	-46.74	26.73	73.81	0.11	0.00
	17-Nov-07	32.07	22.07	27.07	27.07	-41.74	-51.74	-46.74	26.88	73.81	0.19	0.00
	18-Dec-07	32.07	22.07	27.07	27.24	-41.74	-51.74	-46.74	26.93	73.81	0.31	0.00
	30-Jan-08	32.07	22.07	27.07	27.22	-41.74	-51.74	-46.74	26.85	73.81	0.37	0.01
	18-Feb-08	32.07	22.07	27.07	27.10	-41.74	-51.74	-46.74	26.69	73.81	0.41	0.01
	31-Mar-08	32.07	22.07	27.07	27.05	-41.74	-51.74	-46.74	26.65	73.81	0.40	0.01
	26-Apr-08	32.07	22.07	27.07	26.80	-41.74	-51.74	-46.74	26.38	73.81	0.42	0.01
	23-May-08	32.07	22.07	27.07	26.67	-41.74	-51.74	-46.74	26.19	73.81	0.48	0.01
	17-Jun-08	32.07	22.07	27.07	26.49	-41.74	-51.74	-46.74	25.97	73.81	0.52	0.01
	15-Jul-08	32.07	22.07	27.07	26.34	-41.74	-51.74	-46.74	25.79	73.81	0.55	0.01
	11-Aug-08	32.07	22.07	27.07	26.19	-41.74	-51.74	-46.74	25.59	73.81	0.60	0.01
	24-Sep-08	32.07	22.07	27.07	25.84	-41.74	-51.74	-46.74	25.26	73.81	0.58	0.01
	22-Oct-08	32.07	22.07	27.07	25.72	-41.74	-51.74	-46.74	25.11	73.81	0.61	0.01
	12-Nov-08	32.07	22.07	27.07	25.57	-41.74	-51.74	-46.74	24.97	73.81	0.60	0.01
	16-Dec-08	32.07	22.07	27.07	25.26	-41.74	-51.74	-46.74	24.67	73.81	0.59	0.01
	13-Jan-09	32.07	22.07	27.07	25.04	-41.74	-51.74	-46.74	24.45	73.81	0.59	0.01
	18-Feb-09	32.07	22.07	27.07	24.91	-41.74	-51.74	-46.74	24.43	73.81	0.48	0.01
	19-May-09	32.07	22.07	27.07	24.33	-41.74	-51.74	-46.74	23.86	73.81	0.47	0.01
	25-Aug-09	32.07	22.07	27.07	23.72	-41.74	-51.74	-46.74	23.16	73.81	0.56	0.01
	19-Nov-09	32.07	22.07	27.07	23.30	-41.74	-51.74	-46.74	22.95	73.81	0.35	0.00
	17-Mar-10	32.07	22.07	27.07	23.07	-41.74	-51.74	-46.74	23.08	73.81	-0.01	0.00
	8-Jun-10	32.07	22.07	27.07	23.27	-41.74	-51.74	-46.74	23.28	73.81	-0.01	0.00
	18-Oct-10	32.07	22.07	27.07	23.93	-41.74	-51.74	-46.74	23.95	73.81	-0.02	0.00
OW-06U/L (Upper Shallow/Lower Shallow)	25-Oct-07	26.46	16.46	21.46	27.18	-5.51	-15.51	-10.51	27.09	31.97	0.09	0.00
	17-Nov-07	26.46	16.46	21.46	27.39	-5.51	-15.51	-10.51	27.30	31.97	0.09	0.00
	18-Dec-07	26.46	16.46	21.46	27.57	-5.51	-15.51	-10.51	27.69	31.97	-0.12	0.00
	30-Jan-08	26.46	16.46	21.46	27.54	-5.51	-15.51	-10.51	27.33	31.97	0.21	0.01
	18-Feb-08	26.46	16.46	21.46	27.42	-5.51	-15.51	-10.51	27.21	31.97	0.21	0.01
	31-Mar-08	26.46	16.46	21.46	27.34	-5.51	-15.51	-10.51	27.14	31.97	0.20	0.01
	26-Apr-08	26.46	16.46	21.46	27.11	-5.51	-15.51	-10.51	27.33	31.97	-0.22	-0.01
	23-May-08	26.46	16.46	21.46	26.93	-5.51	-15.51	-10.51	26.73	31.97	0.20	0.01
	17-Jun-08	26.46	16.46	21.46	26.75	-5.51	-15.51	-10.51	26.53	31.97	0.22	0.01
	15-Jul-08	26.46	16.46	21.46	26.57	-5.51	-15.51	-10.51	26.36	31.97	0.21	0.01
	11-Aug-08	26.46	16.46	21.46	26.41	-5.51	-15.51	-10.51	26.17	31.97	0.24	0.01
	24-Sep-08	26.46	16.46	21.46	26.06	-5.51	-15.51	-10.51	25.84	31.97	0.22	0.01
	22-Oct-08	26.46	16.46	21.46	25.93	-5.51	-15.51	-10.51	25.70	31.97	0.23	0.01
	12-Nov-08	26.46	16.46	21.46	25.80	-5.51	-15.51	-10.51	25.57	31.97	0.23	0.01
	16-Dec-08	26.46	16.46	21.46	25.51	-5.51	-15.51	-10.51	25.28	31.97	0.23	0.01
	13-Jan-09	26.46	16.46	21.46	25.28	-5.51	-15.51	-10.51	25.05	31.97	0.23	0.01
	18-Feb-09	26.46	16.46	21.46	25.18	-5.51	-15.51	-10.51	24.97	31.97	0.21	0.01
	19-May-09	26.46	16.46	21.46	24.65	-5.51	-15.51	-10.51	24.45	31.97	0.20	0.01
	25-Aug-09	26.46	16.46	21.46	24.03	-5.51	-15.51	-10.51	23.80	31.97	0.23	0.01
	19-Nov-09	26.46	16.46	21.46	23.64	-5.51	-15.51	-10.51	23.43	31.97	0.21	0.01
	17-Mar-10	26.46	16.46	21.46	23.56	-5.51	-15.51	-10.51	23.48	31.97	0.08	0.00
	8-Jun-10	26.46	16.46	21.46	23.73	-5.51	-15.51	-10.51	23.67	31.97	0.06	0.00
	18-Oct-10	26.46	16.46	21.46	24.25	-5.51	-15.51	-10.51	24.19	31.97	0.06	0.00

Table 2.3.1.2-4 (Sheet 4 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone Top of screen (NAVD88)	Upper Zone Bottom of screen (NAVD88)	Upper Zone Midpoint (NAVD88)	Upper Zone Elevation of Water (NAVD88)	Lower Zone Top of screen (NAVD88)	Lower Zone Bottom of screen (NAVD88)	Lower Zone Midpoint (NAVD88)	Lower Zone Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-07U/L (Upper Shallow/Deep)	25-Oct-07	24.32	14.32	19.32	21.00	-35.53	-45.53	-40.53	21.26	59.85	-0.26	0.00
	17-Nov-07	24.32	14.32	19.32	21.03	-35.53	-45.53	-40.53	21.16	59.85	-0.13	0.00
	18-Dec-07	24.32	14.32	19.32	23.04	-35.53	-45.53	-40.53	21.05	59.85	1.99	0.03
	30-Jan-08	24.32	14.32	19.32	20.85	-35.53	-45.53	-40.53	20.87	59.85	-0.02	0.00
	18-Feb-08	24.32	14.32	19.32	20.72	-35.53	-45.53	-40.53	20.71	59.85	0.01	0.00
	31-Mar-08	24.32	14.32	19.32	20.63	-35.53	-45.53	-40.53	20.63	59.85	0.00	0.00
	26-Apr-08	24.32	14.32	19.32	20.47	-35.53	-45.53	-40.53	20.36	59.85	0.11	0.00
	23-May-08	24.32	14.32	19.32	20.36	-35.53	-45.53	-40.53	20.16	59.85	0.20	0.00
	17-Jun-08	24.32	14.32	19.32	20.21	-35.53	-45.53	-40.53	19.90	59.85	0.31	0.01
	15-Jul-08	24.32	14.32	19.32	20.02	-35.53	-45.53	-40.53	19.63	59.85	0.39	0.01
	11-Aug-08	24.32	14.32	19.32	19.81	-35.53	-45.53	-40.53	19.29	59.85	0.52	0.01
	24-Sep-08	24.32	14.32	19.32	19.44	-35.53	-45.53	-40.53	19.07	59.85	0.37	0.01
	22-Oct-08	24.32	14.32	19.32	19.24	-35.53	-45.53	-40.53	18.83	59.85	0.41	0.01
	12-Nov-08	24.32	14.32	19.32	19.11	-35.53	-45.53	-40.53	18.75	59.85	0.36	0.01
	16-Dec-08	24.32	14.32	19.32	18.86	-35.53	-45.53	-40.53	18.67	59.85	0.19	0.00
	13-Jan-09	24.32	14.32	19.32	18.72	-35.53	-45.53	-40.53	18.60	59.85	0.12	0.00
	18-Feb-09	24.32	14.32	19.32	18.63	-35.53	-45.53	-40.53	18.59	59.85	0.04	0.00
	19-May-09	24.32	14.32	19.32	18.39	-35.53	-45.53	-40.53	18.21	59.85	0.18	0.00
	25-Aug-09	24.32	14.32	19.32	17.68	-35.53	-45.53	-40.53	17.09	59.85	0.59	0.01
	19-Nov-09	24.32	14.32	19.32	17.47	-35.53	-45.53	-40.53	17.63	59.85	-0.16	0.00
	17-Mar-10	24.32	14.32	19.32	18.20	-35.53	-45.53	-40.53	18.59	59.85	-0.39	-0.01
	8-Jun-10	24.32	14.32	19.32	18.43	-35.53	-45.53	-40.53	18.72	59.85	-0.29	0.00
	18-Oct-10	24.32	14.32	19.32	18.66	-35.53	-45.53	-40.53	19.07	59.85	-0.41	-0.01
OW-08U/L (Lower Shallow/Deep)	25-Oct-07	-7.62	-17.62	-12.62	37.62	-44.44	-54.44	-49.44	34.32	36.82	3.30	0.09
	17-Nov-07	-7.62	-17.62	-12.62	37.64	-44.44	-54.44	-49.44	34.09	36.82	3.55	0.10
	18-Dec-07	-7.62	-17.62	-12.62	37.52	-44.44	-54.44	-49.44	33.97	36.82	3.55	0.10
	30-Jan-08	-7.62	-17.62	-12.62	37.39	-44.44	-54.44	-49.44	33.99	36.82	3.40	0.09
	18-Feb-08	-7.62	-17.62	-12.62	37.24	-44.44	-54.44	-49.44	33.91	36.82	3.33	0.09
	31-Mar-08	-7.62	-17.62	-12.62	37.09	-44.44	-54.44	-49.44	33.77	36.82	3.32	0.09
	26-Apr-08	-7.62	-17.62	-12.62	36.90	-44.44	-54.44	-49.44	33.38	36.82	3.52	0.10
	23-May-08	-7.62	-17.62	-12.62	36.63	-44.44	-54.44	-49.44	33.05	36.82	3.58	0.10
	17-Jun-08	-7.62	-17.62	-12.62	36.28	-44.44	-54.44	-49.44	32.68	36.82	3.60	0.10
	15-Jul-08	-7.62	-17.62	-12.62	36.09	-44.44	-54.44	-49.44	32.51	36.82	3.58	0.10
	11-Aug-08	-7.62	-17.62	-12.62	35.71	-44.44	-54.44	-49.44	32.04	36.82	3.67	0.10
	24-Sep-08	-7.62	-17.62	-12.62	35.50	-44.44	-54.44	-49.44	31.91	36.82	3.59	0.10
	22-Oct-08	-7.62	-17.62	-12.62	35.34	-44.44	-54.44	-49.44	31.74	36.82	3.60	0.10
	12-Nov-08	-7.62	-17.62	-12.62	35.26	-44.44	-54.44	-49.44	31.73	36.82	3.53	0.10
	16-Dec-08	-7.62	-17.62	-12.62	34.98	-44.44	-54.44	-49.44	31.51	36.82	3.47	0.09
	13-Jan-09	-7.62	-17.62	-12.62	34.85	-44.44	-54.44	-49.44	31.44	36.82	3.41	0.09
	18-Feb-09	-7.62	-17.62	-12.62	34.77	-44.44	-54.44	-49.44	31.41	36.82	3.36	0.09
	19-May-09	-7.62	-17.62	-12.62	34.17	-44.44	-54.44	-49.44	30.90	36.82	3.27	0.09
	25-Aug-09	-7.62	-17.62	-12.62	33.42	-44.44	-54.44	-49.44	29.93	36.82	3.49	0.09
	19-Nov-09	-7.62	-17.62	-12.62	33.22	-44.44	-54.44	-49.44	30.31	36.82	2.91	0.08
	17-Mar-10	-7.62	-17.62	-12.62	34.23	-44.44	-54.44	-49.44	31.69	36.82	2.54	0.07
	8-Jun-10	-7.62	-17.62	-12.62	34.50	-44.44	-54.44	-49.44	31.79	36.82	2.71	0.07
	18-Oct-10	-7.62	-17.62	-12.62	35.40	-44.44	-54.44	-49.44	32.61	36.82	2.79	0.08

Table 2.3.1.2-4 (Sheet 5 of 14)
Vertical Hydraulic Gradient Calculations

		Upper Zone				Lower Zone						
Well Pair	Date	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-09U/L (Upper Shallow/Deep)	25-Oct-07	27.91	17.91	22.91	27.47	-32.14	-42.14	-37.14	27.81	60.05	-0.34	-0.01
	17-Nov-07	27.91	17.91	22.91	27.87	-32.14	-42.14	-37.14	28.09	60.05	-0.22	0.00
	18-Dec-07	27.91	17.91	22.91	28.41	-32.14	-42.14	-37.14	28.18	60.05	0.23	0.00
	30-Jan-08	27.91	17.91	22.91	27.93	-32.14	-42.14	-37.14	28.03	60.05	-0.10	0.00
	18-Feb-08	27.91	17.91	22.91	27.78	-32.14	-42.14	-37.14	27.87	60.05	-0.09	0.00
	31-Mar-08	27.91	17.91	22.91	27.92	-32.14	-42.14	-37.14	27.90	60.05	0.02	0.00
	26-Apr-08	27.91	17.91	22.91	27.53	-32.14	-42.14	-37.14	33.26	60.05	-5.73	-0.10
	23-May-08	27.91	17.91	22.91	27.47	-32.14	-42.14	-37.14	27.42	60.05	0.05	0.00
	17-Jun-08	27.91	17.91	22.91	27.31	-32.14	-42.14	-37.14	27.25	60.05	0.06	0.00
	15-Jul-08	27.91	17.91	22.91	27.17	-32.14	-42.14	-37.14	27.09	60.05	0.08	0.00
	11-Aug-08	27.91	17.91	22.91	27.22	-32.14	-42.14	-37.14	26.89	60.05	0.33	0.01
	24-Sep-08	27.91	17.91	22.91	26.71	-32.14	-42.14	-37.14	26.59	60.05	0.12	0.00
	22-Oct-08	27.91	17.91	22.91	26.65	-32.14	-42.14	-37.14	26.49	60.05	0.16	0.00
	12-Nov-08	27.91	17.91	22.91	26.48	-32.14	-42.14	-37.14	26.32	60.05	0.16	0.00
	16-Dec-08	27.91	17.91	22.91	26.11	-32.14	-42.14	-37.14	25.98	60.05	0.13	0.00
	13-Jan-09	27.91	17.91	22.91	25.81	-32.14	-42.14	-37.14	25.73	60.05	0.08	0.00
	18-Feb-09	27.91	17.91	22.91	25.88	-32.14	-42.14	-37.14	25.75	60.05	0.13	0.00
	19-May-09	27.91	17.91	22.91	25.25	-32.14	-42.14	-37.14	25.15	60.05	0.10	0.00
	25-Aug-09	27.91	17.91	22.91	24.68	-32.14	-42.14	-37.14	24.51	60.05	0.17	0.00
	19-Nov-09	27.91	17.91	22.91	24.29	-32.14	-42.14	-37.14	24.17	60.05	0.12	0.00
	17-Mar-10	27.91	17.91	22.91	23.95	-32.14	-42.14	-37.14	24.11	60.05	-0.16	0.00
	8-Jun-10	27.91	17.91	22.91	24.12	-32.14	-42.14	-37.14	24.30	60.05	-0.18	0.00
	18-Oct-10	27.91	17.91	22.91	24.74	-32.14	-42.14	-37.14	24.96	60.05	-0.22	0.00
OW-10U/L (Upper Shallow/Deep)	25-Oct-07	30.09	20.09	25.09	22.29	-48.93	-58.93	-53.93	25.36	79.02	-3.07	-0.04
	17-Nov-07	30.09	20.09	25.09	22.49	-48.93	-58.93	-53.93	25.12	79.02	-2.63	-0.03
	18-Dec-07	30.09	20.09	25.09	22.61	-48.93	-58.93	-53.93	25.07	79.02	-2.46	-0.03
	30-Jan-08	30.09	20.09	25.09	22.53	-48.93	-58.93	-53.93	25.08	79.02	-2.55	-0.03
	18-Feb-08	30.09	20.09	25.09	22.49	-48.93	-58.93	-53.93	24.90	79.02	-2.41	-0.03
	31-Mar-08	30.09	20.09	25.09	22.70	-48.93	-58.93	-53.93	24.73	79.02	-2.03	-0.03
	26-Apr-08	30.09	20.09	25.09	22.62	-48.93	-58.93	-53.93	26.27	79.02	-3.65	-0.05
	23-May-08	30.09	20.09	25.09	22.63	-48.93	-58.93	-53.93	23.88	79.02	-1.25	-0.02
	17-Jun-08	30.09	20.09	25.09	22.58	-48.93	-58.93	-53.93	23.34	79.02	-0.76	-0.01
	15-Jul-08	30.09	20.09	25.09	22.52	-48.93	-58.93	-53.93	23.04	79.02	-0.52	-0.01
	11-Aug-08	30.09	20.09	25.09	22.44	-48.93	-58.93	-53.93	22.54	79.02	-0.10	0.00
	24-Sep-08	30.09	20.09	25.09	22.24	-48.93	-58.93	-53.93	22.53	79.02	-0.29	0.00
	22-Oct-08	30.09	20.09	25.09	22.24	-48.93	-58.93	-53.93	22.32	79.02	-0.08	0.00
	12-Nov-08	30.09	20.09	25.09	22.17	-48.93	-58.93	-53.93	22.36	79.02	-0.19	0.00
	16-Dec-08	30.09	20.09	25.09	22.00	-48.93	-58.93	-53.93	22.37	79.02	-0.37	0.00
	13-Jan-09	30.09	20.09	25.09	21.78	-48.93	-58.93	-53.93	22.46	79.02	-0.68	-0.01
	18-Feb-09	30.09	20.09	25.09	21.88	-48.93	-58.93	-53.93	22.50	79.02	-0.62	-0.01
	19-May-09	30.09	20.09	25.09	21.61	-48.93	-58.93	-53.93	21.81	79.02	-0.20	0.00
	25-Aug-09	30.09	20.09	25.09	21.34	-48.93	-58.93	-53.93	20.36	79.02	0.98	0.01
	19-Nov-09	30.09	20.09	25.09	21.10	-48.93	-58.93	-53.93	21.71	79.02	-0.61	-0.01
	17-Mar-10	30.09	20.09	25.09	20.83	-48.93	-58.93	-53.93	23.24	79.02	-2.41	-0.03
	8-Jun-10	30.09	20.09	25.09	20.81	-48.93	-58.93	-53.93	23.24	79.02	-2.43	-0.03
	18-Oct-10	30.09	20.09	25.09	21.16	-48.93	-58.93	-53.93	23.50	79.02	-2.34	-0.03

Table 2.3.1.2-4 (Sheet 6 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone Top of screen (NAVD88)	Upper Zone Bottom of screen (NAVD88)	Upper Zone Midpoint (NAVD88)	Upper Zone Elevation of Water (NAVD88)	Lower Zone Top of screen (NAVD88)	Lower Zone Bottom of screen (NAVD88)	Lower Zone Midpoint (NAVD88)	Lower Zone Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2150U/L (Upper Shallow/Deep)	30-Jan-08	25.91	15.91	20.91	46.29	-59.13	-69.13	-64.13	34.44	85.04	11.85	0.14
	18-Feb-08	25.91	15.91	20.91	46.08	-59.13	-69.13	-64.13	34.55	85.04	11.53	0.14
	31-Mar-08	25.91	15.91	20.91	46.27	-59.13	-69.13	-64.13	34.58	85.04	11.69	0.14
	26-Apr-08	25.91	15.91	20.91	46.05	-59.13	-69.13	-64.13	34.34	85.04	11.71	0.14
	23-May-08	25.91	15.91	20.91	45.85	-59.13	-69.13	-64.13	34.16	85.04	11.69	0.14
	17-Jun-08	25.91	15.91	20.91	45.61	-59.13	-69.13	-64.13	33.84	85.04	11.77	0.14
	15-Jul-08	25.91	15.91	20.91	45.35	-59.13	-69.13	-64.13	33.60	85.04	11.75	0.14
	11-Aug-08	25.91	15.91	20.91	45.12	-59.13	-69.13	-64.13	33.24	85.04	11.88	0.14
	24-Sep-08	25.91	15.91	20.91	44.78	-59.13	-69.13	-64.13	32.99	85.04	11.79	0.14
	22-Oct-08	25.91	15.91	20.91	44.66	-59.13	-69.13	-64.13	32.74	85.04	11.92	0.14
	12-Nov-08	25.91	15.91	20.91	44.40	-59.13	-69.13	-64.13	32.61	85.04	11.79	0.14
	16-Dec-08	25.91	15.91	20.91	44.20	-59.13	-69.13	-64.13	32.50	85.04	11.70	0.14
	13-Jan-09	25.91	15.91	20.91	43.97	-59.13	-69.13	-64.13	32.45	85.04	11.52	0.14
	18-Feb-09	25.91	15.91	20.91	43.91	-59.13	-69.13	-64.13	32.36	85.04	11.55	0.14
	19-May-09	25.91	15.91	20.91	42.98	-59.13	-69.13	-64.13	32.01	85.04	10.97	0.13
	25-Aug-09	25.91	15.91	20.91	42.02	-59.13	-69.13	-64.13	31.15	85.04	10.87	0.13
	19-Nov-09	25.91	15.91	20.91	41.57	-59.13	-69.13	-64.13	31.11	85.04	10.46	0.12
	17-Mar-10	25.91	15.91	20.91	42.43	-59.13	-69.13	-64.13	32.35	85.04	10.08	0.12
	8-Jun-10	25.91	15.91	20.91	42.60	-59.13	-69.13	-64.13	32.51	85.04	10.09	0.12
	18-Oct-10	25.91	15.91	20.91	44.35	-59.13	-69.13	-64.13	33.43	85.04	10.92	0.13
OW-2169U/L (Upper Shallow/Lower Shallow)	30-Jan-08	25.11	15.11	20.11	43.48	-9.96	-19.96	-14.96	37.14	35.07	6.34	0.18
	18-Feb-08	25.11	15.11	20.11	43.18	-9.96	-19.96	-14.96	36.96	35.07	6.22	0.18
	31-Mar-08	25.11	15.11	20.11	43.37	-9.96	-19.96	-14.96	36.81	35.07	6.56	0.19
	26-Apr-08	25.11	15.11	20.11	43.06	-9.96	-19.96	-14.96	36.57	35.07	6.49	0.19
	23-May-08	25.11	15.11	20.11	42.95	-9.96	-19.96	-14.96	36.32	35.07	6.63	0.19
	17-Jun-08	25.11	15.11	20.11	42.58	-9.96	-19.96	-14.96	36.00	35.07	6.58	0.19
	15-Jul-08	25.11	15.11	20.11	42.39	-9.96	-19.96	-14.96	35.81	35.07	6.58	0.19
	11-Aug-08	25.11	15.11	20.11	42.15	-9.96	-19.96	-14.96	35.49	35.07	6.66	0.19
	24-Sep-08	25.11	15.11	20.11	41.78	-9.96	-19.96	-14.96	35.23	35.07	6.55	0.19
	22-Oct-08	25.11	15.11	20.11	41.69	-9.96	-19.96	-14.96	35.07	35.07	6.62	0.19
	12-Nov-08	25.11	15.11	20.11	41.62	-9.96	-19.96	-14.96	35.00	35.07	6.62	0.19
	16-Dec-08	25.11	15.11	20.11	41.22	-9.96	-19.96	-14.96	34.71	35.07	6.51	0.19
	13-Jan-09	25.11	15.11	20.11	40.95	-9.96	-19.96	-14.96	34.59	35.07	6.36	0.18
	18-Feb-09	25.11	15.11	20.11	41.01	-9.96	-19.96	-14.96	34.49	35.07	6.52	0.19
	19-May-09	25.11	15.11	20.11	40.09	-9.96	-19.96	-14.96	33.88	35.07	6.21	0.18
	25-Aug-09	25.11	15.11	20.11	39.21	-9.96	-19.96	-14.96	33.15	35.07	6.06	0.17
	19-Nov-09	25.11	15.11	20.11	38.84	-9.96	-19.96	-14.96	32.94	35.07	5.90	0.17
	17-Mar-10	25.11	15.11	20.11	39.55	-9.96	-19.96	-14.96	33.74	35.07	5.81	0.17
	8-Jun-10	25.11	15.11	20.11	39.71	-9.96	-19.96	-14.96	33.98	35.07	5.73	0.16
	18-Oct-10	25.11	15.11	20.11	41.30	-9.96	-19.96	-14.96	35.16	35.07	6.14	0.18

Table 2.3.1.2-4 (Sheet 7 of 14)
Vertical Hydraulic Gradient Calculations

		Upper Zone				Lower Zone						
Well Pair	Date	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2181U/L (Upper Shallow/Lower Shallow)	30-Jan-08	40.01	30.01	35.01	43.24	-10.12	-20.12	-15.12	36.45	50.13	6.79	0.14
	18-Feb-08	40.01	30.01	35.01	42.85	-10.12	-20.12	-15.12	36.58	50.13	6.27	0.13
	31-Mar-08	40.01	30.01	35.01	43.04	-10.12	-20.12	-15.12	36.54	50.13	6.50	0.13
	26-Apr-08	40.01	30.01	35.01	42.71	-10.12	-20.12	-15.12	36.46	50.13	6.25	0.12
	23-May-08	40.01	30.01	35.01	42.64	-10.12	-20.12	-15.12	36.41	50.13	6.23	0.12
	17-Jun-08	40.01	30.01	35.01	42.26	-10.12	-20.12	-15.12	36.26	50.13	6.00	0.12
	15-Jul-08	40.01	30.01	35.01	42.08	-10.12	-20.12	-15.12	36.12	50.13	5.96	0.12
	11-Aug-08	40.01	30.01	35.01	41.83	-10.12	-20.12	-15.12	35.91	50.13	5.92	0.12
	24-Sep-08	40.01	30.01	35.01	41.46	-10.12	-20.12	-15.12	35.64	50.13	5.82	0.12
	22-Oct-08	40.01	30.01	35.01	41.40	-10.12	-20.12	-15.12	35.46	50.13	5.94	0.12
	12-Nov-08	40.01	30.01	35.01	41.33	-10.12	-20.12	-15.12	35.29	50.13	6.04	0.12
	16-Dec-08	40.01	30.01	35.01	40.90	-10.12	-20.12	-15.12	35.09	50.13	5.81	0.12
	13-Jan-09	40.01	30.01	35.01	40.61	-10.12	-20.12	-15.12	34.96	50.13	5.65	0.11
	18-Feb-09	40.01	30.01	35.01	40.74	-10.12	-20.12	-15.12	34.78	50.13	5.96	0.12
	19-May-09	40.01	30.01	35.01	39.81	-10.12	-20.12	-15.12	34.42	50.13	5.39	0.11
	25-Aug-09	40.01	30.01	35.01	38.98	-10.12	-20.12	-15.12	33.79	50.13	5.19	0.10
	19-Nov-09	40.01	30.01	35.01	38.63	-10.12	-20.12	-15.12	33.33	50.13	5.30	0.11
	17-Mar-10	40.01	30.01	35.01	39.23	-10.12	-20.12	-15.12	33.43	50.13	5.80	0.12
	8-Jun-10	40.01	30.01	35.01	41.38	-10.12	-20.12	-15.12	33.63	50.13	7.75	0.15
	18-Oct-10	40.01	30.01	35.01	40.88	-10.12	-20.12	-15.12	34.21	50.13	6.67	0.13
OW-2185U/L (Upper Shallow/Lower Shallow)	30-Jan-08	14.89	4.89	9.89	39.81	-10.24	-20.24	-15.24	35.82	25.13	3.99	0.16
	18-Feb-08	14.89	4.89	9.89	39.69	-10.24	-20.24	-15.24	35.64	25.13	4.05	0.16
	31-Mar-08	14.89	4.89	9.89	39.68	-10.24	-20.24	-15.24	35.48	25.13	4.20	0.17
	26-Apr-08	14.89	4.89	9.89	39.49	-10.24	-20.24	-15.24	35.23	25.13	4.26	0.17
	23-May-08	14.89	4.89	9.89	39.26	-10.24	-20.24	-15.24	34.98	25.13	4.28	0.17
	17-Jun-08	14.89	4.89	9.89	38.91	-10.24	-20.24	-15.24	34.67	25.13	4.24	0.17
	15-Jul-08	14.89	4.89	9.89	38.72	-10.24	-20.24	-15.24	34.49	25.13	4.23	0.17
	11-Aug-08	14.89	4.89	9.89	38.44	-10.24	-20.24	-15.24	34.18	25.13	4.26	0.17
	24-Sep-08	14.89	4.89	9.89	38.13	-10.24	-20.24	-15.24	33.91	25.13	4.22	0.17
	22-Oct-08	14.89	4.89	9.89	37.98	-10.24	-20.24	-15.24	33.75	25.13	4.23	0.17
	12-Nov-08	14.89	4.89	9.89	37.92	-10.24	-20.24	-15.24	33.67	25.13	4.25	0.17
	16-Dec-08	14.89	4.89	9.89	37.58	-10.24	-20.24	-15.24	33.37	25.13	4.21	0.17
	13-Jan-09	14.89	4.89	9.89	37.42	-10.24	-20.24	-15.24	33.24	25.13	4.18	0.17
	18-Feb-09	14.89	4.89	9.89	37.33	-10.24	-20.24	-15.24	33.14	25.13	4.19	0.17
	19-May-09	14.89	4.89	9.89	36.64	-10.24	-20.24	-15.24	32.57	25.13	4.07	0.16
	25-Aug-09	14.89	4.89	9.89	35.86	-10.24	-20.24	-15.24	31.82	25.13	4.04	0.16
	19-Nov-09	14.89	4.89	9.89	35.56	-10.24	-20.24	-15.24	31.63	25.13	3.93	0.16
	17-Mar-10	14.89	4.89	9.89	36.05	-10.24	-20.24	-15.24	32.31	25.13	3.74	0.15
	8-Jun-10	14.89	4.89	9.89	36.22	-10.24	-20.24	-15.24	32.52	25.13	3.70	0.15
	18-Oct-10	14.89	4.89	9.89	37.47	-10.24	-20.24	-15.24	33.66	25.13	3.81	0.15

Table 2.3.1.2-4 (Sheet 8 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone: Top of screen (NAVD88)	Upper Zone: Bottom of screen (NAVD88)	Upper Zone: Midpoint (NAVD88)	Upper Zone: Elevation of Water (NAVD88)	Lower Zone: Top of screen (NAVD88)	Lower Zone: Bottom of screen (NAVD88)	Lower Zone: Midpoint (NAVD88)	Lower Zone: Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2253U/L (Upper Shallow/Deep)	30-Jan-08	26.18	16.18	21.18	48.31	-53.83	-63.83	-58.83	33.59	80.01	14.72	0.18
	18-Feb-08	26.18	16.18	21.18	47.84	-53.83	-63.83	-58.83	33.43	80.01	14.41	0.18
	31-Mar-08	26.18	16.18	21.18	48.18	-53.83	-63.83	-58.83	33.30	80.01	14.88	0.19
	26-Apr-08	26.18	16.18	21.18	48.01	-53.83	-63.83	-58.83	33.00	80.01	15.01	0.19
	23-May-08	26.18	16.18	21.18	46.98	-53.83	-63.83	-58.83	32.72	80.01	14.26	0.18
	17-Jun-08	26.18	16.18	21.18	46.52	-53.83	-63.83	-58.83	32.31	80.01	14.21	0.18
	15-Jul-08	26.18	16.18	21.18	46.07	-53.83	-63.83	-58.83	32.12	80.01	13.95	0.17
	11-Aug-08	26.18	16.18	21.18	45.65	-53.83	-63.83	-58.83	31.74	80.01	13.91	0.17
	24-Sep-08	26.18	16.18	21.18	45.05	-53.83	-63.83	-58.83	31.58	80.01	13.47	0.17
	22-Oct-08	26.18	16.18	21.18	44.71	-53.83	-63.83	-58.83	31.39	80.01	13.32	0.17
	12-Nov-08	26.18	16.18	21.18	44.42	-53.83	-63.83	-58.83	31.38	80.01	13.04	0.16
	16-Dec-08	26.18	16.18	21.18	43.99	-53.83	-63.83	-58.83	31.17	80.01	12.82	0.16
	13-Jan-09	26.18	16.18	21.18	43.61	-53.83	-63.83	-58.83	31.11	80.01	12.50	0.16
	18-Feb-09	26.18	16.18	21.18	43.32	-53.83	-63.83	-58.83	31.06	80.01	12.26	0.15
	19-May-09	26.18	16.18	21.18	42.34	-53.83	-63.83	-58.83	30.55	80.01	11.79	0.15
	25-Aug-09	26.18	16.18	21.18	41.39	-53.83	-63.83	-58.83	29.62	80.01	11.77	0.15
	19-Nov-09	26.18	16.18	21.18	40.72	-53.83	-63.83	-58.83	29.96	80.01	10.76	0.13
	17-Mar-10	26.18	16.18	21.18	43.72	-53.83	-63.83	-58.83	31.13	80.01	12.59	0.16
	8-Jun-10	26.18	16.18	21.18	44.09	-53.83	-63.83	-58.83	31.27	80.01	12.82	0.16
	18-Oct-10	26.18	16.18	21.18	47.44	-53.83	-63.83	-58.83	32.14	80.01	15.30	0.19
OW-2269U/L (Lower Shallow/Deep)	30-Jan-08	0.75	-9.25	-4.25	35.73	-49.11	-59.11	-54.11	33.68	49.86	2.05	0.04
	18-Feb-08	0.75	-9.25	-4.25	35.55	-49.11	-59.11	-54.11	33.56	49.86	1.99	0.04
	31-Mar-08	0.75	-9.25	-4.25	35.41	-49.11	-59.11	-54.11	33.43	49.86	1.98	0.04
	26-Apr-08	0.75	-9.25	-4.25	35.18	-49.11	-59.11	-54.11	33.13	49.86	2.05	0.04
	23-May-08	0.75	-9.25	-4.25	34.88	-49.11	-59.11	-54.11	32.85	49.86	2.03	0.04
	17-Jun-08	0.75	-9.25	-4.25	34.59	-49.11	-59.11	-54.11	32.48	49.86	2.11	0.04
	15-Jul-08	0.75	-9.25	-4.25	34.40	-49.11	-59.11	-54.11	32.29	49.86	2.11	0.04
	11-Aug-08	0.75	-9.25	-4.25	34.06	-49.11	-59.11	-54.11	31.91	49.86	2.15	0.04
	25-Sep-08	0.75	-9.25	-4.25	33.81	-49.11	-59.11	-54.11	31.74	49.86	2.07	0.04
	22-Oct-08	0.75	-9.25	-4.25	33.65	-49.11	-59.11	-54.11	31.55	49.86	2.10	0.04
	12-Nov-08	0.75	-9.25	-4.25	33.57	-49.11	-59.11	-54.11	31.55	49.86	2.02	0.04
	16-Dec-08	0.75	-9.25	-4.25	33.27	-49.11	-59.11	-54.11	31.34	49.86	1.93	0.04
	13-Jan-09	0.75	-9.25	-4.25	33.15	-49.11	-59.11	-54.11	31.27	49.86	1.88	0.04
	18-Feb-09	0.75	-9.25	-4.25	33.05	-49.11	-59.11	-54.11	31.24	49.86	1.81	0.04
	19-May-09	0.75	-9.25	-4.25	32.46	-49.11	-59.11	-54.11	30.70	49.86	1.76	0.04
	25-Aug-09	0.75	-9.25	-4.25	31.71	-49.11	-59.11	-54.11	29.78	49.86	1.93	0.04
	19-Nov-09	0.75	-9.25	-4.25	31.51	-49.11	-59.11	-54.11	30.10	49.86	1.41	0.03
	17-Mar-10	0.75	-9.25	-4.25	32.20	-49.11	-59.11	-54.11	31.25	49.86	0.95	0.02
	8-Jun-10	0.75	-9.25	-4.25	32.42	-49.11	-59.11	-54.11	31.38	49.86	1.04	0.02
	18-Oct-10	0.75	-9.25	-4.25	33.52	-49.11	-59.11	-54.11	32.28	49.86	1.24	0.02

Table 2.3.1.2-4 (Sheet 9 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone: Top of screen (NAVD88)	Upper Zone: Bottom of screen (NAVD88)	Upper Zone: Midpoint (NAVD88)	Upper Zone: Elevation of Water (NAVD88)	Lower Zone: Top of screen (NAVD88)	Lower Zone: Bottom of screen (NAVD88)	Lower Zone: Midpoint (NAVD88)	Lower Zone: Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2284U/L (Upper Shallow/Lower Shallow)	30-Jan-08	15.97	5.97	10.97	44.49	-19.02	-29.02	-24.02	35.34	34.99	9.15	0.26
	18-Feb-08	15.97	5.97	10.97	44.30	-19.02	-29.02	-24.02	35.16	34.99	9.14	0.26
	31-Mar-08	15.97	5.97	10.97	44.44	-19.02	-29.02	-24.02	35.01	34.99	9.43	0.27
	26-Apr-08	15.97	5.97	10.97	44.41	-19.02	-29.02	-24.02	34.78	34.99	9.63	0.28
	23-May-08	15.97	5.97	10.97	44.00	-19.02	-29.02	-24.02	34.42	34.99	9.58	0.27
	17-Jun-08	15.97	5.97	10.97	43.68	-19.02	-29.02	-24.02	34.19	34.99	9.49	0.27
	15-Jul-08	15.97	5.97	10.97	43.36	-19.02	-29.02	-24.02	33.99	34.99	9.37	0.27
	11-Aug-08	15.97	5.97	10.97	43.07	-19.02	-29.02	-24.02	33.69	34.99	9.38	0.27
	25-Sep-08	15.97	5.97	10.97	42.64	-19.02	-29.02	-24.02	33.42	34.99	9.22	0.26
	22-Oct-08	15.97	5.97	10.97	42.40	-19.02	-29.02	-24.02	33.26	34.99	9.14	0.26
	12-Nov-08	15.97	5.97	10.97	42.18	-19.02	-29.02	-24.02	33.17	34.99	9.01	0.26
	16-Dec-08	15.97	5.97	10.97	41.85	-19.02	-29.02	-24.02	32.86	34.99	8.99	0.26
	13-Jan-09	15.97	5.97	10.97	41.57	-19.02	-29.02	-24.02	32.74	34.99	8.83	0.25
	18-Feb-09	15.97	5.97	10.97	41.43	-19.02	-29.02	-24.02	32.64	34.99	8.79	0.25
	19-May-09	15.97	5.97	10.97	40.56	-19.02	-29.02	-24.02	32.07	34.99	8.49	0.24
	25-Aug-09	15.97	5.97	10.97	39.60	-19.02	-29.02	-24.02	31.32	34.99	8.28	0.24
	19-Nov-09	15.97	5.97	10.97	39.01	-19.02	-29.02	-24.02	31.11	34.99	7.90	0.23
	17-Mar-10	15.97	5.97	10.97	39.53	-19.02	-29.02	-24.02	31.74	34.99	7.79	0.22
	8-Jun-10	15.97	5.97	10.97	39.62	-19.02	-29.02	-24.02	32.00	34.99	7.62	0.22
	18-Oct-10	15.97	5.97	10.97	41.30	-19.02	-29.02	-24.02	33.04	34.99	8.26	0.24
OW-2301U/L (Upper Shallow/Deep)	18-Feb-08	31.77	21.77	26.77	50.24	-48.11	-58.11	-53.11	38.35	79.88	11.89	0.15
	31-Mar-08	31.77	21.77	26.77	50.52	-48.11	-58.11	-53.11	38.22	79.88	12.30	0.15
	26-Apr-08	31.77	21.77	26.77	50.20	-48.11	-58.11	-53.11	37.96	79.88	12.24	0.15
	23-May-08	31.77	21.77	26.77	50.00	-48.11	-58.11	-53.11	37.68	79.88	12.32	0.15
	17-Jun-08	31.77	21.77	26.77	49.67	-48.11	-58.11	-53.11	37.31	79.88	12.36	0.15
	15-Jul-08	31.77	21.77	26.77	49.53	-48.11	-58.11	-53.11	37.14	79.88	12.39	0.16
	11-Aug-08	31.77	21.77	26.77	49.38	-48.11	-58.11	-53.11	36.74	79.88	12.64	0.16
	24-Sep-08	31.77	21.77	26.77	49.19	-48.11	-58.11	-53.11	36.59	79.88	12.60	0.16
	22-Oct-08	31.77	21.77	26.77	49.16	-48.11	-58.11	-53.11	36.42	79.88	12.74	0.16
	12-Nov-08	31.77	21.77	26.77	49.03	-48.11	-58.11	-53.11	36.44	79.88	12.59	0.16
	16-Dec-08	31.77	21.77	26.77	48.79	-48.11	-58.11	-53.11	36.19	79.88	12.60	0.16
	13-Jan-09	31.77	21.77	26.77	48.60	-48.11	-58.11	-53.11	36.08	79.88	12.52	0.16
	18-Feb-09	31.77	21.77	26.77	48.64	-48.11	-58.11	-53.11	36.00	79.88	12.64	0.16
	19-May-09	31.77	21.77	26.77	48.12	-48.11	-58.11	-53.11	35.51	79.88	12.61	0.16
	25-Aug-09	31.77	21.77	26.77	47.66	-48.11	-58.11	-53.11	34.69	79.88	12.97	0.16
	19-Nov-09	31.77	21.77	26.77	47.73	-48.11	-58.11	-53.11	34.83	79.88	12.90	0.16
	17-Mar-10	31.77	21.77	26.77	48.56	-48.11	-58.11	-53.11	36.08	79.88	12.48	0.16
	8-Jun-10	31.77	21.77	26.77	48.85	-48.11	-58.11	-53.11	36.29	79.88	12.56	0.16
	18-Oct-10	31.77	21.77	26.77	51.05	-48.11	-58.11	-53.11	37.36	79.88	13.69	0.17

Table 2.3.1.2-4 (Sheet 10 of 14)
Vertical Hydraulic Gradient Calculations

		Upper Zone				Lower Zone						
Well Pair	Date	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2302U/L (Lower Shallow/Deep)	18-Feb-08	-4.48	-14.48	-9.48	38.89	-59.54	-69.54	-64.54	37.01	55.06	1.88	0.03
	31-Mar-08	-4.48	-14.48	-9.48	38.77	-59.54	-69.54	-64.54	36.93	55.06	1.84	0.03
	26-Apr-08	-4.48	-14.48	-9.48	38.50	-59.54	-69.54	-64.54	36.68	55.06	1.82	0.03
	23-May-08	-4.48	-14.48	-9.48	38.29	-59.54	-69.54	-64.54	36.47	55.06	1.82	0.03
	17-Jun-08	-4.48	-14.48	-9.48	37.87	-59.54	-69.54	-64.54	36.07	55.06	1.80	0.03
	15-Jul-08	-4.48	-14.48	-9.48	37.76	-59.54	-69.54	-64.54	35.98	55.06	1.78	0.03
	11-Aug-08	-4.48	-14.48	-9.48	37.42	-59.54	-69.54	-64.54	35.64	55.06	1.78	0.03
	24-Sep-08	-4.48	-14.48	-9.48	37.20	-59.54	-69.54	-64.54	35.44	55.06	1.76	0.03
	22-Oct-08	-4.48	-14.48	-9.48	37.03	-59.54	-69.54	-64.54	35.30	55.06	1.73	0.03
	12-Nov-08	-4.48	-14.48	-9.48	36.97	-59.54	-69.54	-64.54	35.27	55.06	1.70	0.03
	16-Dec-08	-4.48	-14.48	-9.48	36.70	-59.54	-69.54	-64.54	34.99	55.06	1.71	0.03
	13-Jan-09	-4.48	-14.48	-9.48	36.57	-59.54	-69.54	-64.54	34.87	55.06	1.70	0.03
	18-Feb-09	-4.48	-14.48	-9.48	36.48	-59.54	-69.54	-64.54	34.81	55.06	1.67	0.03
	19-May-09	-4.48	-14.48	-9.48	35.95	-59.54	-69.54	-64.54	34.33	55.06	1.62	0.03
	25-Aug-09	-4.48	-14.48	-9.48	35.17	-59.54	-69.54	-64.54	33.56	55.06	1.61	0.03
	19-Nov-09	-4.48	-14.48	-9.48	35.09	-59.54	-69.54	-64.54	33.57	55.06	1.52	0.03
	17-Mar-10	-4.48	-14.48	-9.48	36.26	-59.54	-69.54	-64.54	34.60	55.06	1.66	0.03
	8-Jun-10	-4.48	-14.48	-9.48	36.48	-59.54	-69.54	-64.54	34.77	55.06	1.71	0.03
	18-Oct-10	-4.48	-14.48	-9.48	37.99	-59.54	-69.54	-64.54	35.88	55.06	2.11	0.04
OW-2304U/L (Upper Shallow/Lower Shallow)	18-Feb-08	28.80	18.80	23.80	36.14	-16.12	-26.12	-21.12	27.47	44.92	8.67	0.19
	31-Mar-08	28.80	18.80	23.80	35.93	-16.12	-26.12	-21.12	27.42	44.92	8.51	0.19
	26-Apr-08	28.80	18.80	23.80	35.73	-16.12	-26.12	-21.12	27.32	44.92	8.41	0.19
	23-May-08	28.80	18.80	23.80	35.53	-16.12	-26.12	-21.12	26.89	44.92	8.64	0.19
	17-Jun-08	28.80	18.80	23.80	35.26	-16.12	-26.12	-21.12	26.79	44.92	8.47	0.19
	15-Jul-08	28.80	18.80	23.80	34.94	-16.12	-26.12	-21.12	26.61	44.92	8.33	0.19
	11-Aug-08	28.80	18.80	23.80	34.60	-16.12	-26.12	-21.12	26.28	44.92	8.32	0.19
	24-Sep-08	28.80	18.80	23.80	34.10	-16.12	-26.12	-21.12	26.08	44.92	8.02	0.18
	22-Oct-08	28.80	18.80	23.80	33.80	-16.12	-26.12	-21.12	25.94	44.92	7.86	0.17
	12-Nov-08	28.80	18.80	23.80	33.58	-16.12	-26.12	-21.12	25.91	44.92	7.67	0.17
	16-Dec-08	28.80	18.80	23.80	33.29	-16.12	-26.12	-21.12	25.69	44.92	7.60	0.17
	13-Jan-09	28.80	18.80	23.80	33.07	-16.12	-26.12	-21.12	25.58	44.92	7.49	0.17
	18-Feb-09	28.80	18.80	23.80	32.82	-16.12	-26.12	-21.12	25.53	44.92	7.29	0.16
	19-May-09	28.80	18.80	23.80	32.11	-16.12	-26.12	-21.12	25.07	44.92	7.04	0.16
	25-Aug-09	28.80	18.80	23.80	30.96	-16.12	-26.12	-21.12	24.32	44.92	6.64	0.15
	19-Nov-09	28.80	18.80	23.80	30.40	-16.12	-26.12	-21.12	24.22	44.92	6.18	0.14
	17-Mar-10	28.80	18.80	23.80	30.98	-16.12	-26.12	-21.12	25.08	44.92	5.90	0.13
	8-Jun-10	28.80	18.80	23.80	31.04	-16.12	-26.12	-21.12	25.13	44.92	5.91	0.13
	18-Oct-10	28.80	18.80	23.80	31.95	-16.12	-26.12	-21.12	26.61	44.92	5.34	0.12

Table 2.3.1.2-4 (Sheet 11 of 14)
Vertical Hydraulic Gradient Calculations

		Upper Zone				Lower Zone						
Well Pair	**Date**	**Top of screen (NAVD88)**	**Bottom of screen (NAVD88)**	**Midpoint (NAVD88)**	**Elevation of Water (NAVD88)**	**Top of screen (NAVD88)**	**Bottom of screen (NAVD88)**	**Midpoint (NAVD88)**	**Elevation of Water (NAVD88)**	**Δx**	**Δh**	**i_v**
OW-2307U/L (Upper Shallow/Lower Shallow)	30-Jan-08	22.07	12.07	17.07	32.82	-23.09	-33.09	-28.09	27.02	45.16	5.80	0.13
	18-Feb-08	22.07	12.07	17.07	32.68	-23.09	-33.09	-28.09	26.81	45.16	5.87	0.13
	31-Mar-08	22.07	12.07	17.07	32.50	-23.09	-33.09	-28.09	26.64	45.16	5.86	0.13
	26-Apr-08	22.07	12.07	17.07	32.27	-23.09	-33.09	-28.09	26.21	45.16	6.06	0.13
	23-May-08	22.07	12.07	17.07	32.14	-23.09	-33.09	-28.09	26.03	45.16	6.11	0.14
	17-Jun-08	22.07	12.07	17.07	32.00	-23.09	-33.09	-28.09	25.10	45.16	6.90	0.15
	15-Jul-08	22.07	12.07	17.07	31.86	-23.09	-33.09	-28.09	24.67	45.16	7.19	0.16
	11-Aug-08	22.07	12.07	17.07	31.67	-23.09	-33.09	-28.09	24.10	45.16	7.57	0.17
	24-Sep-08	22.07	12.07	17.07	31.38	-23.09	-33.09	-28.09	24.06	45.16	7.32	0.16
	22-Oct-08	22.07	12.07	17.07	31.22	-23.09	-33.09	-28.09	23.73	45.16	7.49	0.17
	12-Nov-08	22.07	12.07	17.07	31.07	-23.09	-33.09	-28.09	23.69	45.16	7.38	0.16
	16-Dec-08	22.07	12.07	17.07	30.80	-23.09	-33.09	-28.09	23.69	45.16	7.11	0.16
	13-Jan-09	22.07	12.07	17.07	30.57	-23.09	-33.09	-28.09	23.67	45.16	6.90	0.15
	18-Feb-09	22.07	12.07	17.07	30.41	-23.09	-33.09	-28.09	23.66	45.16	6.75	0.15
	19-May-09	22.07	12.07	17.07	29.78	-23.09	-33.09	-28.09	22.74	45.16	7.04	0.16
	25-Aug-09	22.07	12.07	17.07	29.05	-23.09	-33.09	-28.09	21.24	45.16	7.81	0.17
	19-Nov-09	22.07	12.07	17.07	28.49	-23.09	-33.09	-28.09	22.17	45.16	6.32	0.14
	17-Mar-10	22.07	12.07	17.07	28.61	-23.09	-33.09	-28.09	25.51	45.16	3.10	0.07
	8-Jun-10	22.07	12.07	17.07	28.80	-23.09	-33.09	-28.09	25.65	45.16	3.15	0.07
	18-Oct-10	22.07	12.07	17.07	29.07	-23.09	-33.09	-28.09	26.14	45.16	2.93	0.06
OW-2319U/L(Lower Shallow/Deep)	30-Jan-08	-10.67	-20.67	-15.67	35.35	-70.32	-80.32	-75.32	33.68	59.65	1.67	0.03
	18-Feb-08	-10.67	-20.67	-15.67	35.23	-70.32	-80.32	-75.32	34.51	59.65	0.72	0.01
	31-Mar-08	-10.67	-20.67	-15.67	35.13	-70.32	-80.32	-75.32	33.74	59.65	1.39	0.02
	26-Apr-08	-10.67	-20.67	-15.67	34.95	-70.32	-80.32	-75.32	38.61	59.65	-3.66	-0.06
	23-May-08	-10.67	-20.67	-15.67	34.74	-70.32	-80.32	-75.32	33.34	59.65	1.40	0.02
	17-Jun-08	-10.67	-20.67	-15.67	34.34	-70.32	-80.32	-75.32	32.86	59.65	1.48	0.02
	15-Jul-08	-10.67	-20.67	-15.67	34.30	-70.32	-80.32	-75.32	32.88	59.65	1.42	0.02
	11-Aug-08	-10.67	-20.67	-15.67	34.03	-70.32	-80.32	-75.32	32.58	59.65	1.45	0.02
	24-Sep-08	-10.67	-20.67	-15.67	33.77	-70.32	-80.32	-75.32	32.34	59.65	1.43	0.02
	22-Oct-08	-10.67	-20.67	-15.67	33.64	-70.32	-80.32	-75.32	32.23	59.65	1.41	0.02
	12-Nov-08	-10.67	-20.67	-15.67	33.57	-70.32	-80.32	-75.32	32.18	59.65	1.39	0.02
	16-Dec-08	-10.67	-20.67	-15.67	33.30	-70.32	-80.32	-75.32	31.90	59.65	1.40	0.02
	13-Jan-09	-10.67	-20.67	-15.67	33.18	-70.32	-80.32	-75.32	31.76	59.65	1.42	0.02
	18-Feb-09	-10.67	-20.67	-15.67	33.11	-70.32	-80.32	-75.32	31.62	59.65	1.49	0.02
	19-May-09	-10.67	-20.67	-15.67	32.63	-70.32	-80.32	-75.32	31.21	59.65	1.42	0.02
	25-Aug-09	-10.67	-20.67	-15.67	31.91	-70.32	-80.32	-75.32	30.48	59.65	1.43	0.02
	19-Nov-09	-10.67	-20.67	-15.67	31.77	-70.32	-80.32	-75.32	30.36	59.65	1.41	0.02
	17-Mar-10	-10.67	-20.67	-15.67	32.44	-70.32	-80.32	-75.32	31.04	59.65	1.40	0.02
	8-Jun-10	-10.67	-20.67	-15.67	32.58	-70.32	-80.32	-75.32	31.15	59.65	1.43	0.02
	18-Oct-10	-10.67	-20.67	-15.67	33.64	-70.32	-80.32	-75.32	32.08	59.65	1.56	0.03

Table 2.3.1.2-4 (Sheet 12 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone Top of screen (NAVD88)	Upper Zone Bottom of screen (NAVD88)	Upper Zone Midpoint (NAVD88)	Upper Zone Elevation of Water (NAVD88)	Lower Zone Top of screen (NAVD88)	Lower Zone Bottom of screen (NAVD88)	Lower Zone Midpoint (NAVD88)	Lower Zone Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2320U/L (Lower Shallow/Deep)	30-Jan-08	-28.20	-38.20	-33.20	28.91	-68.24	-78.24	-73.24	30.17	40.04	-1.26	-0.03
	18-Feb-08	-28.20	-38.20	-33.20	28.81	-68.24	-78.24	-73.24	30.05	40.04	-1.24	-0.03
	31-Mar-08	-28.20	-38.20	-33.20	28.80	-68.24	-78.24	-73.24	29.95	40.04	-1.15	-0.03
	26-Apr-08	-28.20	-38.20	-33.20	28.64	-68.24	-78.24	-73.24	29.68	40.04	-1.04	-0.03
	23-May-08	-28.20	-38.20	-33.20	28.48	-68.24	-78.24	-73.24	29.51	40.04	-1.03	-0.03
	17-Jun-08	-28.20	-38.20	-33.20	28.62	-68.24	-78.24	-73.24	29.12	40.04	-0.50	-0.01
	15-Jul-08	-28.20	-38.20	-33.20	28.12	-68.24	-78.24	-73.24	29.05	40.04	-0.93	-0.02
	11-Aug-08	-28.20	-38.20	-33.20	27.96	-68.24	-78.24	-73.24	28.77	40.04	-0.81	-0.02
	24-Sep-08	-28.20	-38.20	-33.20	27.66	-68.24	-78.24	-73.24	28.52	40.04	-0.86	-0.02
	22-Oct-08	-28.20	-38.20	-33.20	27.54	-68.24	-78.24	-73.24	28.38	40.04	-0.84	-0.02
	12-Nov-08	-28.20	-38.20	-33.20	27.43	-68.24	-78.24	-73.24	28.35	40.04	-0.92	-0.02
	16-Dec-08	-28.20	-38.20	-33.20	27.19	-68.24	-78.24	-73.24	28.08	40.04	-0.89	-0.02
	13-Jan-09	-28.20	-38.20	-33.20	27.03	-68.24	-78.24	-73.24	27.97	40.04	-0.94	-0.02
	18-Feb-09	-28.20	-38.20	-33.20	26.93	-68.24	-78.24	-73.24	27.90	40.04	-0.97	-0.02
	19-May-09	-28.20	-38.20	-33.20	26.41	-68.24	-78.24	-73.24	27.48	40.04	-1.07	-0.03
	25-Aug-09	-28.20	-38.20	-33.20	25.79	-68.24	-78.24	-73.24	26.72	40.04	-0.93	-0.02
	19-Nov-09	-28.20	-38.20	-33.20	25.45	-68.24	-78.24	-73.24	26.78	40.04	-1.33	-0.03
	17-Mar-10	-28.20	-38.20	-33.20	25.49	-68.24	-78.24	-73.24	27.48	40.04	-1.99	-0.05
	8-Jun-10	-28.20	-38.20	-33.20	25.61	-68.24	-78.24	-73.24	27.62	40.04	-2.01	-0.05
	18-Oct-10	-28.20	-38.20	-33.20	26.35	-68.24	-78.24	-73.24	29.03	40.04	-2.68	-0.07
OW-2321U/L (Lower Shallow/Deep)	18-Feb-08	-28.21	-38.21	-33.21	21.57	-68.01	-78.01	-73.01	21.86	39.80	-0.29	-0.01
	31-Mar-08	-28.21	-38.21	-33.21	21.57	-68.01	-78.01	-73.01	21.75	39.80	-0.18	0.00
	26-Apr-08	-28.21	-38.21	-33.21	21.41	-68.01	-78.01	-73.01	21.52	39.80	-0.11	0.00
	23-May-08	-28.21	-38.21	-33.21	21.26	-68.01	-78.01	-73.01	21.26	39.80	0.00	0.00
	17-Jun-08	-28.21	-38.21	-33.21	21.10	-68.01	-78.01	-73.01	20.86	39.80	0.24	0.01
	15-Jul-08	-28.21	-38.21	-33.21	20.96	-68.01	-78.01	-73.01	20.63	39.80	0.33	0.01
	11-Aug-08	-28.21	-38.21	-33.21	20.79	-68.01	-78.01	-73.01	20.26	39.80	0.53	0.01
	24-Sep-08	-28.21	-38.21	-33.21	20.45	-68.01	-78.01	-73.01	19.99	39.80	0.46	0.01
	22-Oct-08	-28.21	-38.21	-33.21	20.28	-68.01	-78.01	-73.01	19.78	39.80	0.50	0.01
	12-Nov-08	-28.21	-38.21	-33.21	20.13	-68.01	-78.01	-73.01	19.70	39.80	0.43	0.01
	16-Dec-08	-28.21	-38.21	-33.21	19.86	-68.01	-78.01	-73.01	19.53	39.80	0.33	0.01
	13-Jan-09	-28.21	-38.21	-33.21	19.65	-68.01	-78.01	-73.01	19.47	39.80	0.18	0.00
	18-Feb-09	-28.21	-38.21	-33.21	19.49	-68.01	-78.01	-73.01	19.43	39.80	0.06	0.00
	19-May-09	-28.21	-38.21	-33.21	19.02	-68.01	-78.01	-73.01	19.23	39.80	-0.21	-0.01
	25-Aug-09	-28.21	-38.21	-33.21	18.50	-68.01	-78.01	-73.01	18.14	39.80	0.36	0.01
	19-Nov-09	-28.21	-38.21	-33.21	18.19	-68.01	-78.01	-73.01	18.91	39.80	-0.72	-0.02
	17-Mar-10	-28.21	-38.21	-33.21	18.64	-68.01	-78.01	-73.01	19.94	39.80	-1.30	-0.03
	8-Jun-10	-28.21	-38.21	-33.21	18.75	-68.01	-78.01	-73.01	20.05	39.80	-1.30	-0.03
	18-Oct-10	-28.21	-38.21	-33.21	19.23	-68.01	-78.01	-73.01	20.44	39.80	-1.21	-0.03

Table 2.3.1.2-4 (Sheet 13 of 14)
Vertical Hydraulic Gradient Calculations

		Upper Zone				Lower Zone						
Well Pair	Date	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Top of screen (NAVD88)	Bottom of screen (NAVD88)	Midpoint (NAVD88)	Elevation of Water (NAVD88)	Δx	Δh	i_v
OW-2324U/L (Lower Shallow/Deep)	18-Feb-08	-10.33	-20.33	-15.33	14.89	-90.15	-100.15	-95.15	14.48	79.82	0.41	0.01
	31-Mar-08	-10.33	-20.33	-15.33	14.79	-90.15	-100.15	-95.15	14.28	79.82	0.51	0.01
	26-Apr-08	-10.33	-20.33	-15.33	14.63	-90.15	-100.15	-95.15	14.14	79.82	0.49	0.01
	23-May-08	-10.33	-20.33	-15.33	13.73	-90.15	-100.15	-95.15	13.19	79.82	0.54	0.01
	17-Jun-08	-10.33	-20.33	-15.33	12.91	-90.15	-100.15	-95.15	12.43	79.82	0.48	0.01
	15-Jul-08	-10.33	-20.33	-15.33	12.48	-90.15	-100.15	-95.15	11.98	79.82	0.50	0.01
	11-Aug-08	-10.33	-20.33	-15.33	11.79	-90.15	-100.15	-95.15	11.36	79.82	0.43	0.01
	24-Sep-08	-10.33	-20.33	-15.33	11.98	-90.15	-100.15	-95.15	11.41	79.82	0.57	0.01
	22-Oct-08	-10.33	-20.33	-15.33	11.72	-90.15	-100.15	-95.15	11.20	79.82	0.52	0.01
	12-Nov-08	-10.33	-20.33	-15.33	12.03	-90.15	-100.15	-95.15	11.34	79.82	0.69	0.01
	16-Dec-08	-10.33	-20.33	-15.33	12.43	-90.15	-100.15	-95.15	11.90	79.82	0.53	0.01
	13-Jan-09	-10.33	-20.33	-15.33	12.46	-90.15	-100.15	-95.15	12.13	79.82	0.33	0.00
	18-Feb-09	-10.33	-20.33	-15.33	12.70	-90.15	-100.15	-95.15	12.28	79.82	0.42	0.01
	19-May-09	-10.33	-20.33	-15.33	12.53	-90.15	-100.15	-95.15	12.40	79.82	0.13	0.00
	25-Aug-09	-10.33	-20.33	-15.33	10.07	-90.15	-100.15	-95.15	9.61	79.82	0.46	0.01
	19-Nov-09	-10.33	-20.33	-15.33	13.46	-90.15	-100.15	-95.15	13.49	79.82	-0.03	0.00
	17-Mar-10	-10.33	-20.33	-15.33	14.55	-90.15	-100.15	-95.15	14.40	79.82	0.15	0.00
	8-Jun-10	-10.33	-20.33	-15.33	14.57	-90.15	-100.15	-95.15	14.53	79.82	0.04	0.00
	18-Oct-10	-10.33	-20.33	-15.33	14.21	-90.15	-100.15	-95.15	13.91	79.82	0.30	0.00
OW-2348U/L (Lower Shallow/Deep)	18-Feb-08	-19.44	-29.44	-24.44	13.06	-82.79	-92.79	-87.79	13.17	63.35	-0.11	0.00
	31-Mar-08	-19.44	-29.44	-24.44	12.95	-82.79	-92.79	-87.79	12.97	63.35	-0.02	0.00
	26-Apr-08	-19.44	-29.44	-24.44	13.00	-82.79	-92.79	-87.79	13.39	63.35	-0.39	-0.01
	23-May-08	-19.44	-29.44	-24.44	12.05	-82.79	-92.79	-87.79	12.04	63.35	0.01	0.00
	17-Jun-08	-19.44	-29.44	-24.44	11.49	-82.79	-92.79	-87.79	11.50	63.35	-0.01	0.00
	15-Jul-08	-19.44	-29.44	-24.44	10.97	-82.79	-92.79	-87.79	11.09	63.35	-0.12	0.00
	11-Aug-08	-19.44	-29.44	-24.44	10.37	-82.79	-92.79	-87.79	10.54	63.35	-0.17	0.00
	25-Sep-08	-19.44	-29.44	-24.44	10.31	-82.79	-92.79	-87.79	10.47	63.35	-0.16	0.00
	22-Oct-08	-19.44	-29.44	-24.44	10.01	-82.79	-92.79	-87.79	10.21	63.35	-0.20	0.00
	12-Nov-08	-19.44	-29.44	-24.44	10.12	-82.79	-92.79	-87.79	10.25	63.35	-0.13	0.00
	16-Dec-08	-19.44	-29.44	-24.44	10.27	-82.79	-92.79	-87.79	10.30	63.35	-0.03	0.00
	13-Jan-09	-19.44	-29.44	-24.44	8.36	-82.79	-92.79	-87.79	10.35	63.35	-1.99	-0.03
	18-Feb-09	-19.44	-29.44	-24.44	10.41	-82.79	-92.79	-87.79	10.41	63.35	0.00	0.00
	19-May-09	-19.44	-29.44	-24.44	11.56	-82.79	-92.79	-87.79	11.45	63.35	0.11	0.00
	25-Aug-09	-19.44	-29.44	-24.44	8.78	-82.79	-92.79	-87.79	9.02	63.35	-0.24	0.00
	19-Nov-09	-19.44	-29.44	-24.44	12.56	-82.79	-92.79	-87.79	12.61	63.35	-0.05	0.00
	17-Mar-10	-19.44	-29.44	-24.44	13.78	-82.79	-92.79	-87.79	13.51	63.35	0.27	0.00
	8-Jun-10	-19.44	-29.44	-24.44	13.87	-82.79	-92.79	-87.79	13.64	63.35	0.23	0.00
	18-Oct-10	-19.44	-29.44	-24.44	13.15	-82.79	-92.79	-87.79	12.80	63.35	0.35	0.01

Table 2.3.1.2-4 (Sheet 14 of 14)
Vertical Hydraulic Gradient Calculations

Well Pair	Date	Upper Zone: Top of screen (NAVD88)	Upper Zone: Bottom of screen (NAVD88)	Upper Zone: Midpoint (NAVD88)	Upper Zone: Elevation of Water (NAVD88)	Lower Zone: Top of screen (NAVD88)	Lower Zone: Bottom of screen (NAVD88)	Lower Zone: Midpoint (NAVD88)	Lower Zone: Elevation of Water (NAVD88)	Δx	Δh	i_v
W-2352U/L (Upper Shallow/Lower Shallow)	18-Feb-08	18.17	8.17	13.17	19.38	-16.67	-26.67	-21.67	19.43	34.84	-0.05	0.00
	31-Mar-08	18.17	8.17	13.17	19.47	-16.67	-26.67	-21.67	19.51	34.84	-0.04	0.00
	26-Apr-08	18.17	8.17	13.17	19.39	-16.67	-26.67	-21.67	19.41	34.84	-0.02	0.00
	23-May-08	18.17	8.17	13.17	19.34	-16.67	-26.67	-21.67	19.39	34.84	-0.05	0.00
	17-Jun-08	18.17	8.17	13.17	19.20	-16.67	-26.67	-21.67	19.24	34.84	-0.04	0.00
	15-Jul-08	18.17	8.17	13.17	19.09	-16.67	-26.67	-21.67	19.13	34.84	-0.04	0.00
	11-Aug-08	18.17	8.17	13.17	19.00	-16.67	-26.67	-21.67	19.04	34.84	-0.04	0.00
	25-Sep-08	18.17	8.17	13.17	18.81	-16.67	-26.67	-21.67	18.86	34.84	-0.05	0.00
	22-Oct-08	18.17	8.17	13.17	18.77	-16.67	-26.67	-21.67	18.81	34.84	-0.04	0.00
	12-Nov-08	18.17	8.17	13.17	18.66	-16.67	-26.67	-21.67	18.71	34.84	-0.05	0.00
	16-Dec-08	18.17	8.17	13.17	18.59	-16.67	-26.67	-21.67	18.62	34.84	-0.03	0.00
	13-Jan-09	18.17	8.17	13.17	18.51	-16.67	-26.67	-21.67	18.54	34.84	-0.03	0.00
	18-Feb-09	18.17	8.17	13.17	18.41	-16.67	-26.67	-21.67	18.44	34.84	-0.03	0.00
	19-May-09	18.17	8.17	13.17	18.09	-16.67	-26.67	-21.67	18.12	34.84	-0.03	0.00
	25-Aug-09	18.17	8.17	13.17	17.68	-16.67	-26.67	-21.67	17.72	34.84	-0.04	0.00
	19-Nov-09	18.17	8.17	13.17	17.38	-16.67	-26.67	-21.67	17.43	34.84	-0.05	0.00
	17-Mar-10	18.17	8.17	13.17	17.50	-16.67	-26.67	-21.67	17.56	34.84	-0.06	0.00
	8-Jun-10	18.17	8.17	13.17	17.53	-16.67	-26.67	-21.67	17.58	34.84	-0.05	0.00
	18-Oct-10	18.17	8.17	13.17	17.91	-16.67	-26.67	-21.67	17.98	34.84	-0.07	0.00
OW-2359U1/L1 (Upper Shallow/Deep)	18-Feb-08	-7.34	-17.34	-12.34	24.28	-76.92	-96.92	-86.92	24.82	74.58	-0.54	-0.01
	31-Mar-08	-7.34	-17.34	-12.34	24.20	-76.92	-96.92	-86.92	24.64	74.58	-0.44	-0.01
	26-Apr-08	-7.34	-17.34	-12.34	24.00	-76.92	-96.92	-86.92	25.64	74.58	-1.64	-0.02
	23-May-08	-7.34	-17.34	-12.34	23.84	-76.92	-96.92	-86.92	23.84	74.58	0.00	0.00
	17-Jun-08	-7.34	-17.34	-12.34	23.62	-76.92	-96.92	-86.92	23.34	74.58	0.28	0.00
	15-Jul-08	-7.34	-17.34	-12.34	23.42	-76.92	-96.92	-86.92	23.03	74.58	0.39	0.01
	11-Aug-08	-7.34	-17.34	-12.34	23.22	-76.92	-96.92	-86.92	22.54	74.58	0.68	0.01
	24-Sep-08	-7.34	-17.34	-12.34	22.87	-76.92	-96.92	-86.92	22.51	74.58	0.36	0.00
	22-Oct-08	-7.34	-17.34	-12.34	22.69	-76.92	-96.92	-86.92	22.28	74.58	0.41	0.01
	12-Nov-08	-7.34	-17.34	-12.34	22.86	-76.92	-96.92	-86.92	22.32	74.58	0.54	0.01
	16-Dec-08	-7.34	-17.34	-12.34	22.31	-76.92	-96.92	-86.92	22.28	74.58	0.03	0.00
	13-Jan-09	-7.34	-17.34	-12.34	22.13	-76.92	-96.92	-86.92	22.35	74.58	-0.22	0.00
	18-Feb-09	-7.34	-17.34	-12.34	22.05	-76.92	-96.92	-86.92	22.39	74.58	-0.34	0.00
	19-May-09	-7.34	-17.34	-12.34	21.63	-76.92	-96.92	-86.92	21.77	74.58	-0.14	0.00
	25-Aug-09	-7.34	-17.34	-12.34	20.92	-76.92	-96.92	-86.92	20.39	74.58	0.53	0.01
	19-Nov-09	-7.34	-17.34	-12.34	20.68	-76.92	-96.92	-86.92	21.64	74.58	-0.96	-0.01
	17-Mar-10	-7.34	-17.34	-12.34	21.16	-76.92	-96.92	-86.92	23.05	74.58	-1.89	-0.03
	8-Jun-10	-7.34	-17.34	-12.34	21.36	-76.92	-96.92	-86.92	23.08	74.58	-1.72	-0.02
	18-Oct-10	-7.34	-17.34	-12.34	21.75	-76.92	-96.92	-86.92	23.43	74.58	-1.68	-0.02

Notes: All Screen elevations are in ft NAVD 88.
Purple shaded areas indicate an anomaly or suspect measurement.
Blue shaded areas: Wells OW-2253U/L were field mislabeled. Shaded areas indicate data corrected to reflect the true well identities.
A positive i_v represents a downward hydraulic gradient.
A negative i_v represents an upwards hydraulic gradient.

Table 2.3.1.2-5 (Sheet 1 of 4)
VCS Site Slug Test Results

Observation Well	Surface Elevation (NAVD 88)	Depth (ft)	Geologic Unit	Saturated Thickness (ft)	Hydraulic Conductivity in ft/d					Notes
					Falling		Rising		Arithmetic Mean	
					Bouwer-Rice	Butler	Bouwer-Rice	Butler		
OW-01U	71.46	63	Upper	10	13.97	20.70	37.10	31.69	25.87	
OW-02U	74.68	66	Upper	10	4.46	11.45	12.62	23.37	12.98	
OW-03U	74.89	56	Upper	NA	NA	NA	NA	NA	NA	Dry
OW-04U	78.97	88.13	Upper	3.5	3.34	3.49	1.91	1.81	2.64	
OW-05U	77.56	59.28	Upper	10	NA	NA	26.79	31.06	28.93	Missing Falling Head data
OW-06U	78.98	65.98	Upper	7	10.63	17.70	23.25	23.08	18.67	
OW-07U	77.39	66.13	Upper	10	NA	NA	26.43	87.14	56.79	Missing Falling Head data
OW-09U	77.36	62.85	Upper	10	28.71	33.84	26.18	23.02	27.94	
OW-10U	77.69	60.1	Upper	NA	NA	NA	NA	NA	NA	Insufficient water for testing
OW-2150U	80.44	67.05	Upper	9.1	0.05	0.08	2.46	4.46	1.76	
OW-2150U	80.44	67.05	Upper	9.1	0.05	0.07	NA	NA	0.06	Duplicate Test
OW-2150 Average	80.44	67.05	Upper	9.1	0.05	0.08	2.46	4.46	0.91	Well Average
OW-2169U	79.47	68.7	Upper	10	14.50	30.15	28.44	30.87	25.99	
OW-2181U	79.24	53.02	Upper	10	4.08	13.53	8.95	12.82	9.85	
OW-2185U	79.48	78.24	Upper	4.5	9.92	15.15	10.79	13.86	12.43	
OW-2253U	80.86	68.25	Upper	8.5	10.80	11.58	12.48	15.36	12.56	
OW-2284U	80.42	78.45	Upper	5	0.85	0.95	1.37	1.82	1.25	
OW-2284U	80.42	78.45	Upper	5	0.58	3.04	NA	NA	1.81	Duplicate Test
OW-2284U Average	80.42	78.45	Upper	5	0.72	2.00	1.37	1.82	1.53	Well Average
OW-2301U	81.23	63	Upper	7	12.29	20.62	14.24	21.46	17.15	

Table 2.3.1.2-5 (Sheet 2 of 4)
VCS Site Slug Test Results

Observation Well	Surface Elevation (NAVD 88)	Depth (ft)	Geologic Unit	Saturated Thickness (ft)	Hydraulic Conductivity in ft/d					Notes
					Falling		Rising		Arithmetic Mean	
					Bouwer-Rice	Butler	Bouwer-Rice	Butler		
OW-2304U	68.33	54.33	Upper	10	60.44	61.99	35.62	53.45	52.88	
OW-2307U	76.75	68.11	Upper	10	9.64	10.33	7.13	14.67	10.44	
OW-2352U	62.91	58.6	Upper	10	3.78	5.03	11.53	12.79	8.28	
OW-01L	71.46	112.95	Lower	10	43.26	73.30	48.94	49.32	53.71	
OW-01L	71.46	112.95	Lower	10	33.55	25.72	45.98	59.56	41.20	Duplicate Test
OW-01L Average	71.46	112.95	Lower	10	38.41	49.51	47.46	54.44	47.45	Well Average
OW-02L	74.68	109.13	Lower	10	23.26	24.84	20.46	36.29	26.21	
OW-03L	74.89	100	Lower	10	83.66	94.77	120.80	120.80	105.01	
OW-03L	74.89	100	Lower	0	80.62	96.53	NA	NA	88.58	Duplicate Test
OW-03L Average	74.89	100	Lower	10	82.14	95.65	120.80	120.80	96.79	Well Average
OW-04L	78.97	113.49	Lower	10	4.18	8.40	7.39	11.66	7.91	
OW-06L	78.98	98.62	Lower	10	87.21	88.25	31.36	29.45	59.07	
OW-08U	81.71	103.03	Lower	10	24.67	39.35	82.12	69.06	53.80	
OW-2169L	79.47	103.2	Lower	10	1.07	1.32	36.16	36.52	18.77	
OW-2181L	79.24	99.2	Lower	5.2	0.01	0.03	0.01	0.03	0.02	Multiple sat. thicknesses
OW-2185L	79.48	102.96	Lower	10	6.17	8.10	19.40	27.27	15.24	
OW-2269U	80.45	93.35	Lower	9.6	0.79	1.13	2.49	3.41	1.96	
OW-2269U	80.45	93.35	Lower	9.6	1.56	2.25	NA	NA	1.91	Duplicate Test
OW-2269U Average	80.45	93.35	Lower	9.6	1.18	1.69	2.49	3.41	1.93	Well Average
OW-2284L	80.42	113.4	Lower	10	26.23	38.88	23.94	35.84	31.22	
OW-2304L	68.33	98.44	Lower	5	16.58	115.20	55.97	60.49	62.06	

Table 2.3.1.2-5 (Sheet 3 of 4)
VCS Site Slug Test Results

Observation Well	Surface Elevation (NAVD 88)	Depth (ft)	Geologic Unit	Saturated Thickness (ft)	Hydraulic Conductivity in ft/d					Notes
					Falling		Rising		Arithmetic Mean	
					Bouwer-Rice	Butler	Bouwer-Rice	Butler		
OW-2307L	76.75	113.27	Lower	10	10.65	19.05	43.17	63.09	33.99	
OW-2319U	74.16	98.15	Lower	7	37.72	58.38	69.49	75.61	60.30	
OW-2320U	71.46	113.35	Lower	10	77.06	82.09	110.20	152.50	105.46	
OW-2321U	71.62	113.17	Lower	10	12.55	18.51	13.45	18.42	15.73	
OW-2324U	24.47	47.98	Lower	8	169.10	233.90	78.51	134.50	154.00	
OW-2324U	24.47	47.98	Lower	8	147.30	226.00	130.40	150.30	163.50	Duplicate Test
OW-2324U Average	24.47	47.98	Lower	8	158.20	229.95	104.46	142.40	158.75	Well Average
OW-2348U	50.63	83.09	Lower	10	95.58	121.50	140.70	167.20	131.25	
OW-2348U	50.63	83.09	Lower	10	135.60	185.00	128.90	158.50	152.00	Duplicate Test
OW-2348U Average	50.63	83.09	Lower	10	115.59	153.25	134.80	162.85	141.62	Well Average
OW-2352L	62.91	84.9	Lower	10	27.26	37.82	42.33	38.63	36.51	
OW-05L	77.56	133.28	Deep	10	8.62	12.78	9.04	8.34	9.70	
OW-07L	77.39	126.3	Deep	7	11.55	8.15	12.09	13.05	11.21	
OW-08L	81.71	135.6	Deep	10	0.63	0.69	0.88	0.87	0.77	
OW-09L	77.36	122.43	Deep	9	0.90	1.16	0.91	0.99	0.99	
OW-09L	77.36	122.43	Deep	9	NA	NA	5.36	7.94	6.65	Duplicate Test
OW-09L Average	77.36	122.43	Deep	9	0.90	1.16	3.14	4.47	3.82	Well Average
OW-10L	77.69	140.66	Deep	10	9.82	12.90	14.94	14.89	13.14	
OW-2150L	80.44	153.71	Deep	1.5	2.46	4.10	8.67	16.44	7.92	
OW-2253L	80.86	148.35	Deep	10	101.40	105.20	77.25	87.90	92.94	
OW-2253L	80.86	148.35	Deep	10	99.76	115.20	NA	NA	107.48	Duplicate Test
OW-2253L	80.86	148.35	Deep	10	137.60	147.80	NA	NA	142.70	Triplicate test

Table 2.3.1.2-5 (Sheet 4 of 4)
VCS Site Slug Test Results

Observation Well	Surface Elevation (NAVD 88)	Depth (ft)	Geologic Unit	Saturated Thickness (ft)	Hydraulic Conductivity in ft/d					Notes
					Falling		Rising		Arithmetic Mean	
					Bouwer-Rice	Butler	Bouwer-Rice	Butler		
OW-2253L Average	80.86	148.35	Deep	10	112.92	122.73	77.25	87.90	114.37	Well Average
OW-2269L	80.45	138.52	Deep	9.6	0.63	1.26	1.17	1.50	1.14	
OW-2301L	81.23	143.15	Deep	10	26.18	38.14	30.29	42.90	34.38	
OW-2302L	80.32	153.5	Deep	3	0.97	1.17	9.16	9.96	9.56	
OW-2319L	74.16	156.8	Deep	10	0.78	0.71	0.60	0.60	0.67	
OW-2320L	71.46	153.55	Deep	5	10.62	13.74	12.76	17.09	13.55	
OW-2321L	71.62	153.06	Deep	10	2.40	3.21	17.81	21.56	11.25	
OW-2324L	24.47	128.17	Deep	10	77.00	85.12	48.21	52.80	65.78	
OW-2348L	50.63	148.32	Deep	10	86.08	86.70	41.74	62.03	69.14	
OW-2348L	50.63	148.32	Deep	10	50.94	49.39	36.72	37.56	43.65	Duplicate Test
OW-2348L Average	50.63	148.32	Deep	10	68.51	68.05	39.23	49.80	56.40	Well Average

Geometric Mean:	Upper	12.29
	Lower	24.76
	Deep	9.60
Minimum:	Upper	0.06
	Lower	0.02
	Deep	0.67
Maximum:	Upper	56.79
	Lower	163.5
	Deep	142.7

Highlighted rows indicate multiple tests on the same well with the arithmetic mean (average) determined for all tests on the well.
Data source: Site Geotechnical Subsurface Investigation, SSAR Reference 2.5.4-2

Table 2.3.1.2-6 (Sheet 1 of 2)
Summary of Aquifer Pumping Test Results

TW-2320U Aquifer Pumping Test

48 hour test

Observation Well	Saturated Thickness (ft)	Theis Method		Cooper-Jacob Method		Neumann Method		Vertical/ Horizontal Hydraulic Conductivity
		Transmissivity (ft^2/d)	Storage Coefficient (unitless)	Transmissivity (ft^2/d)	Storage Coefficient (unitless)	Transmissivity (ft^2/d)	Storage Coefficient (unitless)	(unitless)
OW-2320U1	38	295	1.89×10^{-3}	371	1.40×10^{-3}	295	1.98×10^{-3}	0.16
OW-2320U2	38	248	6.10×10^{-3}	310	4.42×10^{-3}	248	6.07×10^{-3}	0.14
OW-2320U3	38	276	2.94×10^{-3}	361	2.23×10^{-3}	276	2.94×10^{-3}	0.17
Combination/ Drawdown	38	370	2.85×10^{-3}	378	2.36×10^{-3}	283	5.75×10^{-3}	0.15
Combination/ Recovery	38	340	—	—	—	—	—	—
mean		306	3.45×10^{-3}	355	2.59×10^{-3}	275.5	4.19×10^{-3}	0.16
Hydraulic Conductivity (ft/d)		8.0	—	9.3	—	7.2	—	—

Mean of Transmissivity (Theis, Cooper-Jacobs, and Neumann Methods): 312.2 ft^2/d
Mean of Hydraulic Conductivity (Theis, Cooper-Jacobs, and Neumann Methods): 8.2 ft/d
Mean of Storage Coefficient (Theis, Cooper-Jacobs, and Neumann Methods): 3.3×10^{-3}

Table 2.3.1.2-6 (Sheet 2 of 2)
Summary of Aquifer Pumping Test Results

TW-2359L Aquifer Pumping Test

24 hour test

Observation Well	Saturated Thickness (ft)	Theis Method		Cooper-Jacob Method		Hantush-Jacob Method		Vertical/ Horizontal Hydraulic Conductivity (unitless)
		Transmissivity (ft^2/d)	Storage Coefficient (unitless)	Transmissivity (ft^2/d)	Storage Coefficient (unitless)	Transmissivity (ft^2/d)	Storage Coefficient (unitless)	
OW-2359L2	53	2526	7.33×10^{-5}	2546	6.43×10^{-5}	2455	1.59×10^{-3}	0.0073
OW-2359L3	53	2502	7.64×10^{-5}	2509	7.48×10^{-5}	2527	7.33×10^{-4}	0.0055
Combination/ Drawdown	53	2508	7.35×10^{-5}	2495	7.36×10^{-5}	2551	1.04×10^{-3}	0.0014
Combination/ Recovery	54	2440	—	—	—	—	—	—
mean		2494	7.44×10^{-5}	2517	7.09×10^{-5}	2511	1.12×10^{-3}	0.0047
Hydraulic Conductivity (ft/d)		47.0	—	47.5	—	47.4	—	—

Mean of Transmissivity (Theis, Cooper-Jacobs, and Hantush-Jacob Methods): 2507.3 ft^2/d
Mean of Hydraulic Conductivity (Theis, Cooper-Jacobs, and Hantush-Jacob Methods): 47.3 ft/d
Mean of Storage Coefficient (Theis, Cooper-Jacobs, and Hantush-Jacob Methods): 4.1×10^{-4}

Notes:
ft^2/d = square feet per day
ft/d = feet per day

Table 2.3.1.2-7 (Sheet 1 of 6)
Hydrogeologic Properties from Geotechnical Tests

Boring No.	Sample No.	Sample Depth (ftbgs)	USCS Symbol	Geotechnical Unit	Hydrogeologic Unit	Dry Unit Weight (γ_d) (pcf)	Void Ratio (e)	Specific Gravity (G_s)	Moisture Content (ω) (%)	Porosity[(a)] (n) (%)	Effective Porosity[(b)] (n_e) (%)	Bulk Density[(c)] (γ_m) (pcf)	Bulk Density (γ_m) (g/cm^3)
B-2174UD	UD 1	10-11.7	CL	Clay 1 Top	Shallow Confining layer	109.4	0.53	—	19.5	34.6	6.9	130.7	2.09
B-2182UD	UD-1	10-11.7	CL	Clay 1 Top	Shallow Confining layer	113.0	0.53	2.76	14.0	34.5	6.9	128.8	2.06
B-2269UD	UD-1	10-12	CL	Clay 1 Top	Shallow Confining layer	109.7	—	2.67	17.8	—	—	129.2	2.07
B-2269UD	UD-1	10-12	CL	Clay 1 Top	Shallow Confining layer	114.4	0.46	2.67	17.6	31.3	6.3	134.5	2.15
B-2269UD	UD-2	13-15	CH	Clay 1 Top	Shallow Confining layer	104.9	0.58	2.66	23.0	36.8	7.4	129.0	2.06
B-2274UD	UD-1	10.2-11.9	CL	Clay 1 Top	Shallow Confining layer	113.8	—	2.75	16.4	—	—	132.5	2.12
B-2274UD	UD-1	10.2-11.9	CL	Clay 1 Top	Shallow Confining layer	109.2	0.57	2.75	19.3	36.4	7.3	130.3	2.08
B-2304UD	UD 2	11-13.3	ML	Clay 1 Top	Shallow Confining layer	98.6	0.74	2.74	11.9	42.4	8.5	110.3	1.77
B-2321UD	UD 3	10.0-11.7	CH	Clay 1 Top	Shallow Confining layer	111.9	—	2.71	16.4	—	—	130.2	2.08
B-2321UD	UD 3	10.0-11.7	CH	Clay 1 Top	Shallow Confining layer	110.3	—	—	18.8	—	—	131.0	2.10
B-2321UD	UD 5	17.0-18.7	CL	Clay 1 Top	Shallow Confining layer	100.2	—	—	18.8	—	—	119.1	1.90
B-2321UD	UD-1	5.2	CL	Clay 1 Top	Shallow Confining layer	102.4	—	2.71	17.4	—	—	120.3	1.92
B-2321UD	UD-3	11.35	CH	Clay 1 Top	Shallow Confining layer	106.6	—	2.71	15.4	—	—	122.9	1.97
B-2321UD	UD-4	15.15	CH	Clay 1 Top	Shallow Confining layer	102.0	—	2.72	21.8	—	—	124.3	1.99
B-2321UD	UD-5	18.7	CL	Clay 1 Top	Shallow Confining layer	97.0	—	2.72	19.5	—	—	115.9	1.85
B-2352UD	1	3.5-5.2	CL	Clay 1 Top	Shallow Confining layer	111.5	—	2.7	17.3	—	—	130.7	2.09
B-2352UD	3	11.5-13.2	CL	Clay 1 Top	Shallow Confining layer	108.8	—	2.71	18.4	—	—	128.8	2.06
B-2352UD	UD 1	3.5-5.2	CL	Clay 1 Top	Shallow Confining layer	110.8	0.52	2.70	18.3	34.3	6.9	131.1	2.10
B-2352UD	UD 3	11.5-13.2	CL	Clay 1 Top	Shallow Confining layer	108.7	0.56	2.71	18.6	35.7	7.1	128.9	2.06
B-2269UD	UD-3	30-32	CL	Sand 1	Sand 1	110.7	—	2.66	15.4	—	—	127.7	2.04
B-2269UD	UD-3	30-32	CL	Sand 1	Sand 1	116.6	0.42	2.66	15.8	29.7	23.7	135.0	2.16
B-2269UD	UD-4	33-34.8	CL	Sand 1	Sand 1	116.7	0.47	2.74	15.0	31.9	25.5	134.2	2.15
B-2302UD	UD 3	13.5-16.0	SM	Sand 1	Sand 1	103.3	—	—	17.4	—	—	121.3	1.94
B-2319UD	2	5.5-7.5	SC	Sand 1	Sand 1	116.2	—	2.73	13.7	—	—	132.1	2.11
B-2319UD	UD 2	5.5-7.5	SC	Sand 1	Sand 1	117.1	0.46	2.73	13.7	31.3	25.0	133.1	2.13
B-2319UD	UD 3	11.0-13.0	SM	Sand 1	Sand 1	102.8	—	2.72	8.7	—	—	111.7	1.79
B-2174UD	UD 2	30-31.7	CH	Clay 1 Bottom	Shallow Confining layer	100.5	0.71	—	24.0	41.5	8.3	124.6	1.99
B-2182UD	UD-5	33-34.7	CH	Clay 1 Bottom	Shallow Confining layer	97.2	0.78	2.77	29.6	43.8	8.8	126.0	2.02

Table 2.3.1.2-7 (Sheet 2 of 6)
Hydrogeologic Properties from Geotechnical Tests

Boring No.	Sample No.	Sample Depth (ftbgs)	USCS Symbol	Geotechnical Unit	Hydrogeologic Unit	Dry Unit Weight (γ_d) (pcf)	Void Ratio (e)	Specific Gravity (G_s)	Moisture Content (ω) (%)	Porosity[(a)] (n) (%)	Effective Porosity[(b)] (n_e) (%)	Bulk Density[(c)] (γ_m) (pcf)	Bulk Density (γ_m) (g/cm^3)
B-2269UD	UD-5	50-51.7	CH	Clay 1 Bottom	Shallow Confining layer	103.0	0.64	2.70	21.8	38.9	—	125.5	2.01
B-2319UD	UD 4	25.0-27.0	CH	Clay 1 Bottom	Shallow Confining layer	106.5	—	2.72	20.7	—	—	128.5	2.06
B-2319UD	UD 4	25.0-27.0	CH	Clay 1 Bottom	Shallow Confining layer	105.3	—	—	21.4	—	7.8	127.8	2.05
B-2319UD	UD-4	26.65	CH	Clay 1 Bottom	Shallow Confining layer	103.0	0.64	2.70	21.8	38.9	—	125.5	2.01
B-2321UD	7	38.5-40.2	CH	Clay 1 Bottom	Shallow Confining layer	106.5	—	2.72	20.7	—	—	128.5	2.06
B-2321UD	UD 6	28.5-30.2	CH	Clay 1 Bottom	Shallow Confining layer	105.3	—	—	21.4	—	7.8	127.8	2.05
B-2321UD	UD 7	38.5-40.2	CH	Clay 1 Bottom	Shallow Confining layer	109.1	—	2.72	19.2	—	—	130.1	2.08
B-2321UD	UD 7	38.5-40.2	CH	Clay 1 Bottom	Shallow Confining layer	101.9	—	2.78	21.3	—	—	123.6	1.98
B-2321UD	UD-6	30.2	CH	Clay 1 Bottom	Shallow Confining layer	96.4	—	2.72	25.5	—	—	121.0	1.94
B-2321UD	UD-8	49.75	CH	Clay 1 Bottom	Shallow Confining layer	102.8	—	2.78	21.0	—	—	124.4	1.99
B-2352UD	5	24.0-25.7	CH	Clay 1 Bottom	Shallow Confining layer	106.6	0.63	2.78	14.8	38.6	—	122.4	1.96
B-2352UD	UD 5	24-25.7	CH	Clay 1 Bottom	Shallow Confining layer	96.1	—	2.72	23.9	—	—	119.1	1.91
B-2359UD	3	30.8-32.8	CH	Clay 1 Bottom	Shallow Confining layer	92.2	—	2.72	28.5	—	7.7	118.4	1.89
B-2359UD	UD 5	40.0-41.7	CH	Clay 1 Bottom	Shallow Confining layer	94.4	—	2.67	28.0	—	—	120.8	1.93
B-2359UD	UD-4	36.45	CH	Clay 1 Bottom	Shallow Confining layer	100.7	0.66	2.67	22.7	39.6	—	123.6	1.98
B-2359UD	UD-5	41.15	CH	Clay 1 Bottom	Shallow Confining layer	108.96	—	2.71	18.4	—	—	129.0	2.06
B-2302UD	UD 7	59.0-60.2	SC-SM	Sand 2	Upper Shallow Aquifer	106.4	—	—	20.1	—	—	127.8	2.04
B-2302UD	UD 9	63.5-66	SP-SM	Sand 2	Upper Shallow Aquifer	103.0	0.63	2.68	21.1	38.7	30.9	124.7	2.00
B-2319UD	UD 5	35.0-37.0	ML	Sand 2	Upper Shallow Aquifer	106.2	—	2.72	18.8	—	—	126.2	2.02
B-2359UD	UD 7	55.0-56.7	ML	Sand 2	Upper Shallow Aquifer	108.4	0.53	2.65	14.3	34.6	27.6	123.9	1.98
B-2174UD	UD 3	75-76.7	CL	Clay 3	Lower Confining layer	117.1	0.47	—	15.8	32.0	6.40	135.6	2.17
B-2182UD	UD-7	65-66.7	SC	Clay 3	Lower Confining layer	95.4	—	2.74	20.9	—	—	115.3	1.85
B-2182UD	UD-7	65-66.7	SC	Clay 3	Lower Confining layer	93.3	0.84	2.74	25.0	45.5	9.10	116.7	1.87
B-2269UD	UD-7	70-71.7	CH	Clay 3	Lower Confining layer	84.4	—	2.72	36.6	—	—	115.2	1.84
B-2269UD	UD-7	70-71.7	CH	Clay 3	Lower Confining layer	95.5	0.78	2.72	28.3	43.7	8.75	122.5	1.96
B-2269UD	UD-8	73-74.7	CH	Clay 3	Lower Confining layer	100.6	0.66	2.67	22.4	39.6	7.92	123.1	1.97
B-2274UD	UD-4	67-68.7	CH	Clay 3	Lower Confining layer	89.24	—	2.76	32.6	—	—	118.3	1.89
B-2274UD	UD-4	67-68.7	CH	Clay 3	Lower Confining layer	93.6	0.84	2.76	28.1	45.7	9.14	119.9	1.92
B-2302UD	11	69.5-71.5	CH	Clay 3	Lower Confining layer	96.8	—	2.74	24.2	—	—	120.2	1.92

Table 2.3.1.2-7 (Sheet 3 of 6)
Hydrogeologic Properties from Geotechnical Tests

Boring No.	Sample No.	Sample Depth (ftbgs)	USCS Symbol	Geotechnical Unit	Hydrogeologic Unit	Dry Unit Weight (γ_d) (pcf)	Void Ratio (e)	Specific Gravity (G_s)	Moisture Content (ω) (%)	Porosity[(a)] (n) (%)	Effective Porosity[(b)] (n_e) (%)	Bulk Density[(c)] (γ_m) (pcf)	Bulk Density (γ_m) (g/cm^3)
B-2302UD	UD 10	66.0-68.5	CH	Clay 3	Lower Confining layer	103.7	—	—	22.5	—	—	127.0	2.03
B-2304UD	7	73.5-75.5	MH	Clay 3	Lower Confining layer	92.6	—	2.78	29.8	—	8.2	119.7	1.91
B-2304UD	UD 7	73.5-75.5	MH	Clay 3	Lower Confining layer	92.3	0.9	2.78	27.6	46.8	—	122.8	1.97
B-2304UD	UD 8	83.5-85.5	CH	Clay 3	Lower Confining layer	90.8	—	—	30.9	—	—	120.2	1.92
B-2304UD	UD-8	85.3	CH	Clay 3	Lower Confining layer	90.8	—	2.71	29.6	—	9.4	117.8	1.88
B-2319UD	8	75-77	SP-SM	Clay 3	Lower Confining layer	96.6	—	2.73	25.3	—	—	118.9	1.90
B-2319UD	UD 6	55.0-57.0	ML	Clay 3	Lower Confining layer	91.9	—	2.71	30.7	—	—	117.7	1.88
B-2319UD	UD 7	65.0-67.0	CL	Clay 3	Lower Confining layer	103.4	—	—	20.1	—	—	121.0	1.94
B-2319UD	UD 8	75.0-77.0	SP-SM	Clay 3	Lower Confining layer	98.7	0.73	2.73	24.6	42.1	—	120.1	1.92
B-2319UD	UD-7	66.6	CL	Clay 3	Lower Confining layer	103.2	—	2.66	18.8	—	—	124.2	1.99
B-2321UD	UD 9	58.5-61.0	CL	Clay 3	Lower Confining layer	106.6	—	—	20.0	—	8.4	123.0	1.97
B-2321UD	UD-10	65.05	CL	Clay 3	Lower Confining layer	116.5	—	2.67	13.7	—	—	122.6	1.96
B-2321UD	UD-9	59.45	CL	Clay 3	Lower Confining layer	104.0	—	2.68	19.3	—	—	127.9	2.05
B-2352UD	UD 8	68.0-69.4	SM	Clay 3	Lower Confining layer	107.3	0.56	2.68	14.4	35.9	—	132.4	2.12
B-2359UD	UD 10	70.0-71.7	CH	Clay 3	Lower Confining layer	114.1	—	—	16.6	—	—	124.0	1.98
B-2359UD	UD-10	71.6	CH	Clay 3	Lower Confining layer	110.7	—	2.72	16.8	—	7.2	122.8	1.96
B-2174UD	UD 4	90-90.9	CL	Sand 4	Lower Shallow Aquifer	118.1	0.44	—	15.6	30.7	24.6	133.0	2.13
B-2182UD	UD 12B	95-97.5	SP-SM	Sand 4	Lower Shallow Aquifer	103.5	0.64	2.72	17.7	39.0	31.2	129.3	2.07
B-2182UD	UD-11	90.5-93	CL	Sand 4	Lower Shallow Aquifer	114.3	—	2.77	15.8	—	—	136.5	2.18
B-2182UD	UD-11	90.5-93.0	CL	Sand 4	Lower Shallow Aquifer	125.6	0.38	2.77	12.3	27.3	21.9	121.8	1.95
B-2182UD	UD-12T	95-97.5	CL	Sand 4	Lower Shallow Aquifer	117.4	—	2.73	15.4	—	—	132.3	2.12
B-2302UD	UD 14	108.5-111	SM	Sand 4	Lower Shallow Aquifer	110.2	0.54	2.71	17.8	34.9	27.9	141.0	2.26
B-2302UD	UD-16	122.2	CH	Sand 4	Lower Shallow Aquifer	97.6	—	2.72	25.5	—	—	135.5	2.17
B-2319UD	UD 10	95.0-97.0	SP	Sand 4	Lower Shallow Aquifer	103.2	—	2.72	11.2	—	—	129.8	2.08
B-2321UD	UD 12	93.0-95.7	SP-SM	Sand 4	Lower Shallow Aquifer	101.2	0.66	2.69	22.7	39.8	31.8	122.5	1.96
B-2321UD	UD 12	93.0-95.7	SP-SM	Sand 4	Lower Shallow Aquifer	101.9	—	2.69	21.3	—	—	114.8	1.84
B-2359UD	11	77.0-78.7	SC-SM	Sand 4	Lower Shallow Aquifer	106.2	—	2.72	19.4	—	—	124.2	1.99
B-2359UD	UD 11	77.0-78.7	SC-SM	Sand 4	Lower Shallow Aquifer	101.9	0.67	2.72	19.9	40.0	32.0	123.6	1.98
B-2359UD	UD 14	88.5-90.5	ML	Sand 4	Lower Shallow Aquifer	96.6	0.78	2.74	25.3	43.8	35.1	121.0	1.94

Table 2.3.1.2-7 (Sheet 4 of 6)
Hydrogeologic Properties from Geotechnical Tests

Boring No.	Sample No.	Sample Depth (ftbgs)	USCS Symbol	Geotechnical Unit	Hydrogeologic Unit	Dry Unit Weight (γ_d) (pcf)	Void Ratio (e)	Specific Gravity (G_s)	Moisture Content (ω) (%)	Porosity[a] (n) (%)	Effective Porosity[b] (n_e) (%)	Bulk Density[c] (γ_m) (pcf)	Bulk Density (γ_m) (g/cm^3)
B-2359UD	UD-12	80.25	SC	Sand 4	Lower Shallow Aquifer	107.2	—	2.66	18.2	—	—	126.7	2.03
B-2182UD	UD-13	120-121.7	SC	Clay 5 Top	Deep Confining layer	111.0	0.52	2.71	18.7	34.3	6.9	131.8	2.11
B-2182UD	UD-13	120-121.7	SC	Clay 5 Top	Deep Confining layer	104.6	—	2.71	20.4	—	—	125.9	2.02
B-2302UD	UD-19	147	CL	Clay 5 Top	Deep Confining layer	—	—	2.69	21.5	—	10.0	116.6	1.87
B-2304UD	UD 11	111.0-113.0	CH	Clay 5 Top	Deep Confining layer	103.6	—	—	22.7	—	6.2	135.1	2.16
B-2304UD	UD 13	121.0-123.0	CH	Clay 5 Top	Deep Confining layer	110.0	—	—	21.0	—	—	—	—
B-2304UD	9	98.5-101	CH	Clay 5 Top	Deep Confining layer	99.8	—	2.74	25.8	—	—	127.1	2.03
B-2304UD	UD 9	98.5-101.0	CH	Clay 5 Top	Deep Confining layer	101.5	0.69	2.74	22.8	40.7	—	133.1	2.13
B-2304UD	UD-11	112.9	CH	Clay 5 Top	Deep Confining layer	103.6	—	2.71	21.7	—	—	125.5	2.01
B-2304UD	UD-13	122.95	CH	Clay 5 Top	Deep Confining layer	108.0	—	2.71	18.6	—	8.1	124.6	1.99
B-2321UD	14	128.5-130	CH	Clay 5 Top	Deep Confining layer	96.8	—	2.75	25.5	—	—	126.0	2.02
B-2321UD	UD 14	128.5-130.3	CH	Clay 5 Top	Deep Confining layer	97.0	—	2.75	25.0	—	—	128.1	2.05
B-2321UD	UD 15	130.5-132.5	CH	Clay 5 Top	Deep Confining layer	106.8	—	—	20.3	—	—	121.5	1.94
B-2321UD	UD-15	132.5	CH	Clay 5 Top	Deep Confining layer	102.2	—	2.71	21.0	—	—	121.3	1.94
B-2359UD	18	112-113.1	SC	Clay 5 Top	Deep Confining layer	92.4	—	2.77	25.5	—	—	128.5	2.06
B-2359UD	UD 17	110-111.7	SM	Clay 5 Top	Deep Confining layer	106.9	0.58	2.71	17.4	36.8	—	123.6	1.98
B-2359UD	UD 19	114.0-116.6	SM	Clay 5 Top	Deep Confining layer	105.7	0.60	2.70	17.3	37.4	—	116.0	1.86
B-2304UD	UD 15	141.0-143.5	SP-SM	Sand 5	Deep Confining layer	99.2	0.69	2.68	17.9	40.8	7.4	125.5	2.01
B-2182UD	UD-15	145-147.5	ML	Clay 5 Bottom	Deep Confining layer	95.4	—	2.70	26.8	—	7.5	124.0	1.98
B-2182UD	UD-15	145-147.5	ML	Clay 5 Bottom	Deep Confining layer	102.5	0.65	2.70	25.3	39.2	8.2	116.9	1.87
B-2269UD	UD-11	150-151.7	CH	Clay 5 Bottom	Deep Confining layer	103.7	—	2.70	21.8	—	—	121.0	1.94
B-2269UD	UD-11	150-151.7	CH	Clay 5 Bottom	Deep Confining layer	105.0	0.60	2.70	21.8	37.7	7.8	128.4	2.05
B-2359UD	UD-20	121.25	CH	Clay 5 Bottom	Deep Confining layer	85.9	—	2.72	34.0	—	—	126.3	2.02
B-2174UD	UD 8	145-147	SM	Sand 6	Deep Aquifer	101.0	0.66	2.68	17.5	39.8	31.8	127.9	2.05
B-2174UD	UD 10	183-185	SM	Sand 6	Deep Aquifer	109.8	0.55	2.72	15.7	35.5	28.4	115.1	1.84
B-2182UD	UD 16	180-182.5	SM	Sand 6	Deep Aquifer	107.0	0.57	2.68	15.1	36.3	29.0	118.7	1.90
B-2269UD	UD 16	280-281.2	SC	Sand 6	Deep Aquifer	107.5	0.56	2.69	18.6	35.9	28.8	127.0	2.03
B-2182UD	UD-17	215-217.5	CL	Clay 7	Deep Aquifer	101.7	—	2.72	22.8	—	—	123.2	1.97
B-2174UD	UD 15	265-267	SC	Sand 8	Deep Aquifer	108.6	0.52	2.65	19.3	34.2	27.4	127.5	2.04

Table 2.3.1.2-7 (Sheet 5 of 6)
Hydrogeologic Properties from Geotechnical Tests

Boring No.	Sample No.	Sample Depth (ftbgs)	USCS Symbol	Geotechnical Unit	Hydrogeologic Unit	Dry Unit Weight (γ_d) (pcf)	Void Ratio (e)	Specific Gravity (G_s)	Moisture Content (ω) (%)	Porosity[(a)] (n) (%)	Effective Porosity[(b)] (n_e) (%)	Bulk Density[(c)] (γ_m) (pcf)	Bulk Density (γ_m) (g/cm^3)
B-2274UD	UD 12	221.1-223.6	SC	Sand 8	Deep Aquifer	114.7	0.45	2.66	10.6	31.0	24.8	126.9	2.03
B-2274UD	UD 13	240-242.5	CL	Sand 8	Deep Aquifer	114.1	0.48	—	15.6	32.4	26.0	131.9	2.11
B-2274UD	UD-13	240-242.5	CL	Sand 8	Deep Aquifer	112.9	—	2.70	17.1	—	—	132.2	2.12
B-2182UD	UD-25	303-304.2	CH	Clay 9	Deep Bottom Confining layer	91.3	—	2.79	26.5	—	—	115.5	1.85
B-2182UD	UD-26	320-321.5	CL	Clay 9	Deep Bottom Confining layer	115.5	—	2.73	14.9	—	9.0	119.8	1.92
B-2182UD	UD-28	330-332	CH	Clay 9	Deep Bottom Confining layer	97.3	0.76	2.74	28.0	43.1	6.6	132.2	2.12
B-2182UD	UD-29	333-334.7	CH	Clay 9	Deep Bottom Confining layer	96.9	—	2.72	24.7	—	—	132.7	2.12
B-2182UD	UD-30	340-341.1	CL	Clay 9	Deep Bottom Confining layer	116.9	—	2.73	15.5	—	8.6	124.6	1.99
B-2182UD	UD-30	340-341.1	CL	Clay 9	Deep Bottom Confining layer	117.6	0.45	2.73	15.0	31.1	—	120.8	1.93
B-2182UD	UD-31	343-344	CL	Clay 9	Deep Bottom Confining layer	115.9	0.48	2.74	15.8	32.2	—	135.1	2.16
B-2274UD	UD-16	300-301.8	CH	Clay 9	Deep Bottom Confining layer	90.9	—	2.76	26.8	—	6.2	135.2	2.16
B-2274UD	UD-16	300-301.8	CH	Clay 9	Deep Bottom Confining layer	95.4	0.81	2.76	25.0	44.7	6.4	134.2	2.15
B-2274UD	UD-17	320-322.5	MH	Clay 9	Deep Bottom Confining layer	99.2	0.71	2.72	24.3	41.6	—	115.2	1.84
B-2274UD	UD 18	330.1-332.6	SM	Sand 10	Deep Bottom Confining layer	110.6	0.54	2.71	14.0	35.1	8.9	119.2	1.91
B-2274UD	UD 19	350.1-352.6	SM	Sand 10	Deep Bottom Confining layer	104.7	0.60	2.69	20.5	37.5	8.3	123.3	1.97
B-2182UD	UD-33	380-381.7	CH	Clay 11	Deep Bottom Confining layer	84.9	—	2.78	33.8	—	7.0	126.1	2.02
B-2182UD	UD-33	380-381.7	CH	Clay 11	Deep Bottom Confining layer	86.6	1.00	2.78	32.2	50.0	7.5	126.2	2.02
B-2182UD	UD-37	400-402.5	CL	Clay 11	Deep Bottom Confining layer	91.4	—	2.76	29.3	—	—	113.6	1.82
B-2182UD	UD-37	400-402.5	CL	Clay 11	Deep Bottom Confining layer	103.1	0.67	2.76	23.6	40.1	10.0	114.4	1.83
B-2269UD	UD-18	375-376.6	CL	Clay 11	Deep Bottom Confining layer	104.1	0.67	2.78	22.3	40.0	—	118.1	1.89
B-2269UD	UD-20	400-402.1	CH	Clay 11	Deep Bottom Confining layer	85.7	—	2.77	32.9	—	8.0	127.4	2.04
B-2269UD	UD-20	400-402.1	CH	Clay 11	Deep Bottom Confining layer	102.7	0.69	2.77	24.1	40.7	8.0	127.3	2.04
B-2274UD	UD-20	380-381.8	MH	Clay 11	Deep Bottom Confining layer	86.0	—	2.76	34.9	—	—	113.8	1.82
B-2274UD	UD-20	380-381.8	MH	Clay 11	Deep Bottom Confining layer	89.6	0.92	2.76	31.0	48.0	8.1	127.5	2.04
B-2274UD	UD-21	390-391.8	CH	Clay 11	Deep Bottom Confining layer	83.6	—	2.75	36.7	—	—	116.0	1.86
B-2274UD	UD-22	400-401.3	CH	Clay 11	Deep Bottom Confining layer	98.2	—	2.72	26.3	—	9.6	117.4	1.88
B-2274UD	UD-22	400-401.3	CH	Clay 11	Deep Bottom Confining layer	96.7	0.76	2.72	25.6	43.1	—	114.3	1.83
B-2174UDR	UD-26	445-446	CH	Clay 13	Deep Bottom Confining layer	96.2	—	2.78	27.6	—	—	124.0	1.98
B-2174UDR	UD-26	445-446	CH	Clay 13	Deep Bottom Confining layer	98.7	0.76	2.78	26.2	43.2	8.6	121.5	1.94

Table 2.3.1.2-7 (Sheet 6 of 6)
Hydrogeologic Properties from Geotechnical Tests

Boring No.	Sample No.	Sample Depth (ftbgs)	USCS Symbol	Geotechnical Unit	Hydrogeologic Unit	Dry Unit Weight (γ_d) (pcf)	Void Ratio (e)	Specific Gravity (G_s)	Moisture Content (ω) (%)	Porosity[(a)] (n) (%)	Effective Porosity[(b)] (n_e) (%)	Bulk Density[(c)] (γ_m) (pcf)	Bulk Density (γ_m) (g/cm^3)
B-2174UDR	UD-27	490-492.5	CH	Clay 13	Deep Bottom Confining layer	109.6	—	2.73	20.2	—	—	122.8	1.96
B-2274UD	UD-26	580-582.5	CL	Clay 17	Deep Bottom Confining layer	111.0	—	2.70	17.8	—	—	130.8	2.09

(a) $$n = \frac{e}{1+e} \times 100$$ (U.S. ACOE, 2004)

(b) Effective Porosity (ne) for sands = n × 0.8 and the Effective Porosity for clays = n × 0.2

(c) $$\gamma_m = \gamma_d \times (1 + \omega / 100)$$ (U.S. ACOE, 2004)

Abbreviations:

ftbgs = feet below ground surface

USCS = Unified Soil Classification System

pcf = pounds per cubic foot

Data Source: Site Geotechnical Subsurface Investigation, SSAR Reference 2.5.4-1 and Reference 2.5.4-2.

Table 2.3.1.2-8
Summary Statistics for Hydrogeologic Properties from Geotechnical Tests

Hydrogeologic Unit	Number of Tests	Total Porosity (%)			Effective Porosity(%)			Bulk Density (pcf)			Bulk Density (g/cm^3)		
		Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Shallow Confining Layer	39	31.3	43.8	37.6	6.3	8.8	7.5	110.3	134.5	125.7	1.77	2.15	2.01
Sand 1	7	29.7	31.9	31.0	23.7	25.5	24.8	111.7	135.0	127.9	1.79	2.16	2.05
Upper Shallow Aquifer	4	34.6	38.6	36.6	27.6	30.9	29.3	123.9	127.8	125.6	1.98	2.04	2.01
Lower Confining Layer	27	32.0	46.8	41.4	6.4	9.4	8.3	115.2	135.6	122.6	1.84	2.17	1.96
Lower Shallow Aquifer	14	27.3	43.8	36.5	21.9	35.1	29.2	114.8	141.0	127.1	1.84	2.26	2.03
Deep Confining Layer	24	31.1	50.0	38.7	6.2	10.0	7.7	115.1	135.1	124.8	1.84	2.16	2.00
Deep Aquifer	9	31.0	39.8	35.0	24.8	31.8	28.0	118.7	132.2	126.9	1.90	2.12	2.03
Deep Bottom Confining Layer	30	31.1	50.0	40.5	6.2	10.0	8.1	113.6	135.2	123.5	1.82	2.16	1.98

Abbreviations:
pcf = pounds per cubic foot
g/cm^3 = grams per cubic centimeter

Table 2.3.1.2-9
Grain-Size Derived Hydraulic Conductivity

Boring	Sample Interval	Geologic Unit	D_{10} (mm)	D_{10} (cm)	C_u	K (cm/sec)	K (ft/day)
B-2319	13.5-15	Sand 1	0.1287	0.01287	1.85	6.63E-03	18.8
B-2359	19.8-21.3	Sand 1	0.1039	0.01039	1.73	4.32E-03	12.2
B-2359	24.8-26.3	Sand 1	0.1327	0.01327	1.67	7.04E-03	20.0
B-2304A	38.5-40	Upper	0.1018	0.01018	1.76	4.15E-03	11.8
B-2320UD	63.5-66	Upper	0.10	0.01	2.08	4.00E-03	11.3
B-2320	75-76.5	Upper	0.1090	0.0109	2.37	4.75E-03	13.5
B-2321	78.5-80	Upper	0.1295	0.01295	1.70	6.71E-03	19.0
B-2174UD	95-96.4	Lower	0.1425	0.01425	2.37	8.12E-03	23.0
B-2265	98.5-98.9	Lower	0.1620	0.0162	1.73	1.05E-02	29.8
B-2304	88.5-90	Lower	0.1283	0.01283	2.15	6.58E-03	18.7
B-2319	90-91.5	Lower	0.1151	0.01151	2.48	5.30E-03	15.0
B-2319UD	95-97	Lower	0.13	0.013	2.02	6.76E-03	19.2
B-2319	100-101.5	Lower	0.1434	0.01434	2.91	8.23E-03	23.3
B-2321UD	93-95.7	Lower	0.13	0.013	2.12	6.76E-03	19.2
B-2352	73.5-75	Lower	0.1050	0.0105	4.00	4.41E-03	12.5
B-2359	94.8-96.3	Lower	0.1527	0.01527	2.36	9.33E-03	26.4
B-2160	168.5-170	Deep	0.1134	0.01134	4.60	5.14E-03	14.6
B-2170R	153.5-155	Deep	0.1094	0.01094	2.12	4.79E-03	13.6
B-2304UD	141-143.5	Deep	0.11	0.011	1.87	4.84E-03	13.7

Geologic Unit	Minimum	Maximum	Geometric Mean
Sand 1	12.2	20	16.6
Upper	11.3	19	13.6
Lower	12.5	29.8	20.1
Deep	13.6	14.6	13.9

Table 2.3.1.2-10
Laboratory Hydraulic Conductivity Test

Boring No.	Sample No.	Sample Depth	USCS Symbol	Geologic Unit	Confining Stress (psi)	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (ft/d)
B-2319UD	UD-4	25.0–27.0	CH	Shallow Confining Layer	20.0	3.4×10^{-9}	9.6×10^{-6}
B-2421UD	UD-3	10.0–11.7	CH	Shallow Confining Layer	10.0	8.3×10^{-6}	2.4×10^{-2}
B-2321UD	UD-6	28.5–30.2	CH	Shallow Confining Layer	25.0	1.8×10^{-8}	5.1×10^{-5}
B-2321UD	UD-7	38.5–40.2	CH	Shallow Confining Layer	35.0	8.4×10^{-9}	2.4×10^{-5}
B-2321UD	UD-14	128.5–130.3	CH	Deep Confining Layer	75.0	2.5×10^{-9}	7.1×10^{-6}
					Minimum	2.5×10^{-9}	7.1×10^{-6}
					Maximum	8.3×10^{-6}	2.4×10^{-2}
					Geometric Mean	2×10^{-8}	7×10^{-5}

Data Source: Site Geotechnical Subsurface Investigation, SSAR Reference 2.5.4-1
USCS = Unified Soil Classification System (CH = high plasticity clay)

Table 2.3.1.2-11 (Sheet 1 of 2)
VCS Cooling Basin Permeability Values from Borehole Permeameter Tests

Borehole Number	Northing (NAD 83 TXSC)	Easting (NAD 83 TXSC)	Surface Elevation (NAVD 88)	Material Type USCS	Test Elevation (NAVD 88)	Saturated Permeability (cm/s)	Saturated Permeability (ft/d)
B-2309P-U	13405492.3	2600435.2	76.25	SC	71.25	1.0×10^{-8}	3.0×10^{-5}
B-2309P-L	13405491.6	2600445.1	76.13	SP-SC	66.13	1.44×10^{-6}	0.0041
B-2311P-U	13407705.7	2602287.6	75.71	SC	70.71	6.94×10^{-8}	0.0002
B-2311P-L	13407703	2602296.9	75.33	CH	65.33	1.0×10^{-8}	3.0×10^{-5}
B-2312P-U	13410699.8	2604161.2	75.46	SC	70.46	1.76×10^{-7}	0.0005
B-2312P-L	13410694.3	2604153.2	75.5	SP-SC	65.5	4.00×10^{-5}	0.1134
B-2313P-U	13412117.4	2605610.9	77.88	SC	72.88	1.0×10^{-8}	3.0×10^{-5}
B-2313P-L	13412115.6	2605606.1	77.97	SC	67.97	2.67×10^{-6}	0.0076
B-2314P-U	13413938	2607776.5	75.48	CH	70.48	4.73×10^{-6}	0.0134
B-2314P-L	13413940.7	2607782.6	75.42	CH	65.42	1.0×10^{-8}	3.0×10^{-5}
B-2325P-U	13401288.3	2603699.2	73.79	SP-SC	68.79	1.71×10^{-6}	0.0049
B-2325P-L	13401292.3	2603696.5	73.85	SC	63.85	4.20×10^{-4}	1.1907
B-2326P-U	13403069.2	2605616.5	70.97	SC	65.97	1.0×10^{-8}	3.0×10^{-5}
B-2326P-L	13403074.7	2605620.4	70.76	SC	60.76	1.44×10^{-6}	0.0041
B-2327P-U	13404711.4	2607393.8	71.24	SC	66.24	1.0×10^{-8}	3.0×10^{-5}
B-2327P-L	13404712.2	2607384	70.81	SC	60.81	1.60×10^{-5}	0.0454
B-2328P-U	13406233.3	2609021.3	68.13	SC	63.13	1.60×10^{-5}	0.0454
B-2328P-L	13406222.9	2609021.2	68.42	SP-SC	58.42	9.70×10^{-4}	2.7500
B-2329P-U	13407878	2610791.9	68.07	SC	63.07	1.0×10^{-8}	3.0×10^{-5}
B-2329P-L	13407871.4	2610784.7	68.06	SC	58.06	1.0×10^{-8}	3.0×10^{-5}
B-2330P-U	13410096.3	2613184	67.89	CH	62.89	1.88×10^{-6}	0.0053
B-2330P-L	13410088.7	2613185	68.18	SC	58.18	5.37×10^{-7}	0.0015
B-2339P-U	13399916.5	2608670.1	68.75	CH	63.75	1.99×10^{-6}	0.00564
B-2339P-L	13399911.2	2608674.7	68.63	CH	58.63	2.40×10^{-5}	0.06804

Table 2.3.1.2-11 (Sheet 2 of 2)
VCS Cooling Basin Permeability Values from Borehole Permeameter Tests

Borehole Number	Northing (NAD 83 TXSC)	Easting (NAD 83 TXSC)	Surface Elevation (NAVD 88)	Material Type USCS	Test Elevation (NAVD 88)	Saturated Permeability (cm/s)	Saturated Permeability (ft/d)
B-2341P-U	13401608.5	2610954.3	65.22	CH	60.22	2.70×10^{-6}	0.0077
B-2341P-L	13401608.5	2610954.3	65.22	SC	55.22	1.08×10^{-5}	0.0306
B-2342P-U	13402788.9	2612523.3	67.61	CH	62.61	1.0×10^{-8}	3.0×10^{-5}
B-2342P-L	13402761	2612526.3	67.34	CH	57.34	1.0×10^{-8}	3.0×10^{-5}
B-2343P-U	13404159.4	2614386.7	64.62	CH	59.62	1.0×10^{-8}	3.0×10^{-5}
B-2343P-L	13404159.4	2614395.9	64.95	CH	54.95	1.0×10^{-8}	3.0×10^{-5}
B-2345P-U	13405835.3	2616662.5	67.91	CH	62.91	1.0×10^{-8}	3.0×10^{-5}
B-2345P-L	13405831.4	2616657.3	67.79	CH	57.79	1.0×10^{-8}	3.0×10^{-5}

Summary Statistics				
	Sand (SP-SC)		Clay (CH or SC)	
	cm/sec	ft/d	cm/sec	ft/d
Count	4	4	14	14
Minimum	1.44×10^{-6}	0.0041	6.94×10^{-8}	0.0002
Maximum	9.70×10^{-4}	2.75	2.40×10^{-5}	0.06804
Geometric Mean	1.8×10^{-5}	0.05	3.45×10^{-6}	0.0098

USCS is the Unified Soil Classification System:

SC - sandy clay
CH - high plasticity clay
SP-SC - poorly graded sand with clay

Shaded values indicate a permeability below the method detection limit and are interpreted as 1.0×10^{-8} cm/s or 3.0×10^{-5} feet/day; values not used in summary statistics.

Table 2.3.1.2-12 (Sheet 1 of 2)
Regional Hydrogeochemical Data

Sample Location	Sample Date	Sample Depth (ft bgs)	Unit	pH (standard units)	Specific Conductance (µmhos/cm)	Total Dissolved Solids (mg/L)	Total Hardness (mg/L as $CaCO_3$)	Total Iron (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	ORP (mV)	Temperature (°C)
National Primary DWS	**—**	**—**	**—**	—	—	—	—	—	**15**	—	—	—
National Secondary DWS	**—**	**—**	**—**	**6.5-8.5**	—	**500**	—	—	—	—	—	—
7924601	4/11/2001	40	Lissie	6.75	1646	**913**	401	1.36	1.8 ± 1.7	4.9 ± 2.6	NA	22.2
7924601	3/30/2005	40	Lissie	NA	2150	**1217**	501	2.09	2.1 ± 4.6	1.9 ± 4.2	NA	22.4
7924901	2/5/1959	90	Lissie	7.8	967	**560**	294	NA	NA	NA	NA	NA
7924901	6/28/1979	90	Lissie	8.2	987	**560**	306	NA	NA	NA	NA	NA
7924901	8/25/1983	90	Lissie	8.3	1072	**584**	286	NA	NA	NA	NA	NA
7924902	3/26/1997	125	Lissie	7.2	918	**531**	293	NA	NA	NA	57.5	22.8
7924902	4/11/2001	125	Lissie	6.91	1016	**572**	286	NA	2.6 ± 1.6	4.1 ± 2.7	NA	23.2
7924902	3/22/2005	125	Lissie	NA	994	**575**	292	NA	4.8 ± 3.2	10 ± 2	NA	23.2
7924904	2/4/1959	254	Chicot	7.2	2050	**1113**	597	NA	NA	NA	NA	NA
7932101	5/16/1969	250	Lissie	7.5	1848	**899**	541	NA	NA	NA	NA	NA
7932101	8/16/1975	250	Lissie	7.7	1823	**904**	529	NA	NA	NA	NA	NA
7932101	6/28/1979	250	Lissie	7.8	1573	**782**	399	NA	NA	NA	NA	NA
7932103	3/26/1997	142	Lissie	7.09	1750	**1088**	493	NA	NA	NA	52.2	23.3
7932103	4/11/2001	142	Lissie	6.77	1940	**1107**	451	NA	4.5 ± 2.7	6.3 ± 3.9	NA	23.2
7932403	4/20/1992	150	Chicot	6.51	1579	**936**	545	0.025	4.8 ± 2.2	9.6 ± 2.1	53.3	23.6
7932404	2/4/1959	100	Chicot	7.4	1430	**753**	429	NA	NA	NA	NA	NA
7932602	4/28/1959	595	Lissie	7.9	1940	**1064**	57	NA	NA	NA	NA	NA
7932602	4/14/1971	595	Lissie	7.6	2058	**1040**	56	NA	NA	NA	NA	NA
8017501	8/25/1983	1026	Goliad	**8.6**	1430	**733**	44	NA	NA	NA	NA	NA
8017503	5/31/1949	1062	Evangeline	7.8	NA	**718**	120	NA	<4.0	4.6 ± 2.6	-165.3	28.3
8017503	4/22/1992	1062	Evangeline	7.63	1265	**725**	126	NA	NA	NA	NA	NA
8017504	5/12/1949	1059	Evangeline	7.7	NA	**700**	126	NA	NA	NA	NA	NA
8017506	7/30/1965	420	Evangeline	7.81	1050	**591**	131	0.02	NA	NA	NA	NA
8017511	5/12/1949	1130	Evangeline	7.7	NA	**700**	126	NA	NA	NA	NA	NA
8017902	1/29/1959	500	Gulf Coast	7.5	1640	**898**	164	NA	NA	NA	NA	NA
8017904	7/22/1981	1001	Gulf Coast	8.5	1591	**832**	132	NA	NA	NA	NA	NA
8017904	8/25/1983	1001	Gulf Coast	8.2	1584	**827**	129	NA	NA	NA	NA	NA
8017905	6/4/1981	1010	Evangeline	7.93	1240	**843**	132	NA	NA	NA	NA	NA
8017905	4/22/1992	1010	Evangeline	7.69	1489	**856**	115	0.138	<4	6.3 ± 2.9	-219.4	29.7
8017905	3/26/1997	1010	Evangeline	7.56	1403	**823**	113	0.098	NA	NA	-98	29.3
8017905	3/29/2005	1010	Evangeline	NA	1538	**830**	117	0.135	7.4 ± 4.7	6.4 ± 2.7	NA	29.3
San Antonio River (USGS 08188570)	12/19/2006	0	—	8.1	1310	**740**	350	NA	NA	NA	NA	20
Guadalupe River (USGS 08176500)	3/25/1994	0	—	8.1	579	339	240	0.008	NA	NA	NA	22.5

Table 2.3.1.2-12 (Sheet 2 of 2)
Regional Hydrogeochemical Data

Sample Location	Sample Date	Sample Depth (ft bgs)	Unit	Silica (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Bicarbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Fluoride (mg/L)	Nitrate (mg/L)
National Primary DWS	—	—	—	—	—	—	—	—	—	—	—	**4.0**	**10**
National Secondary DWS	—	—	—	—	—	—	—	—	—	**250**	**250**	**2.0**	—
7924601	4/11/2001	40	Lissie	34.4	127	20.4	169	2.77	489.36	**260**	58.4	0.31	<0.09
7924601	3/30/2005	40	Lissie	36.6	153	28.5	235	2.84	510.1	**424**	84.5	0.52	<0.09
7924901	2/5/1959	90	Lissie	30	100	11	94	NA	387	111	22	0.5	2
7924901	6/28/1979	90	Lissie	45	103	12	79	NA	353.9	115	24	0.3	8
7924901	8/25/1983	90	Lissie	44	95	12	94	3	362.44	128	25	0.4	5.01
7924902	3/26/1997	125	Lissie	19.7	96.5	12.6	92.7	3.25	356.34	102	19.8	0.26	9.3
7924902	4/11/2001	125	Lissie	42.4	94.4	12.3	87.4	2.89	346.58	125	22.5	0.38	**14.3**
7924902	3/22/2005	125	Lissie	46	96.3	12.3	92	3.19	346.57	120	21.1	0.56	**13.11**
7924904	2/4/1959	254	Chicot	31	185	33	177	NA	280	**488**	61	0.3	0.8
7932101	5/16/1969	250	Lissie	33	171	28	113	NA	303.87	**347**	58	<0.1	<0.4
7932101	8/16/1975	250	Lissie	32	186	16	120	NA	302.65	**351**	50	0.1	<0.4
7932101	6/28/1979	250	Lissie	33	150	6	122	6	244.07	**285**	59	0.2	1
7932103	3/26/1997	142	Lissie	20.5	158	23.9	224	6.44	353.9	**371**	108	<0.02	1.77
7932103	4/11/2001	142	Lissie	36.7	144	22.1	206	5.57	346.58	**390**	129	0.29	2.16
7932403	4/20/1992	150	Chicot	34	170	29	120	8.2	273.36	**376**	63	0.22	NA
7932404	2/4/1959	100	Chicot	34	131	25	106	NA	297	**252**	59	0.3	<0.4
7932602	4/28/1959	595	Lissie	15	12	6.6	404	2.8	362.1	**435**	8.6	0.7	2
7932602	4/14/1971	595	Lissie	15	11.4	6.9	384	NA	358.78	**437**	8.65	0.5	<0.4
8017501	8/25/1983	1026	Goliad	9	9.6	5.1	276	2	339.26	250	2	0.6	<0.1
8017503	5/31/1949	1062	Evangeline	8.4	25	14	247	NA	427	195	19	NA	NA
8017503	4/22/1992	1062	Evangeline	19	25	15	233	4.4	406.38	211	16	0.5	NA
8017504	5/12/1949	1059	Evangeline	13	26	15	233	NA	422	183	23	NA	NA
8017506	7/30/1965	420	Evangeline	18	33	12	185	NA	388	152	1	NA	NA
8017511	5/12/1949	1130	Evangeline	13	26	15	233	NA	422	183	23	NA	NA
8017902	1/29/1959	500	Gulf Coast	20	38	17	281	3.3	312.09	**348**	36	1	<0.4
8017904	7/22/1981	1001	Gulf Coast	31	40	8	258	4	356.34	234	70	0.4	<0.04
8017904	8/25/1983	1001	Gulf Coast	22	27	15	261	4	378.31	242	70	0.4	<0.1
8017905	6/4/1981	1010	Evangeline	12	30	14	279	NA	347.01	**266**	64	0.2	0.1
8017905	4/22/1992	1010	Evangeline	21	24	13	279	5.3	352.68	**275**	63	0.48	NA
8017905	3/26/1997	1010	Evangeline	12.5	22.1	13.6	291	4.2	356.34	244	58.1	0.32	<0.44
8017905	3/29/2005	1010	Evangeline	22.7	22.7	23.8	273	3.56	355.12	**264**	51.7	0.69	<0.09
San Antonio River (USGS 08188570)	12/19/2006	0	—	15.3	103	21.4	116	11.8	283	159	118	0.72	**10.9**
Guadalupe River (USGS 08176500)	3/25/1994	0	—	10	68	16	32	2.6	262	42	34	0.3	<0.01 0

Source: U.S. EPA, 2008b
Abbreviations:
— = Not Applicable
DWS = Drinking Water Standard
NA = Not Analyzed
Bold values exceed National Primary or Secondary DWS (U.S. EPA, 2008b)

Table 2.3.1.2-13 (Sheet 1 of 2)
VCS Site Hydrogeochemical Data

Sample Location	Sample Date	Sample Elevation (ft NAVD 88)(a)	Unit(b)	pH (standard units)	Specific Conductance (μmhos/cm)	Total Dissolved Solids (mg/L)	Total Hardness (mg/L as CaCO3)	Total Fe (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	ORP (mV)	Temperature (°C)
National Primary DWS	—	—	—	—	—	—	—	—	**15**	—	—	—
National Secondary DWS	—	—	—	**6.5-8.5**	—	**500**	—	—	—	—	—	—
OW-2301 U	2/18/2008	28.27	Upper	7.20	921	**520**	—	<0.500	—	—	151.5	22.61
OW-2301 L	2/18/2008	–51.81	Deep	6.82	1162	**669**	—	<0.500	—	—	74.6	23.40
OW-2302 U	2/21/2008	–8.01	Lower	6.89	1019	**574**	—	<0.500	—	—	77.5	24.39
OW-2302 L	2/21/2008	–63.05	Deep	6.65	2066	**1,180**	—	18.3	—	—	211.7	23.37
OW-2304 U	2/21/2008	25.1	Upper	6.53	2043	**1,200**	—	0.14 B	—	—	81.2	22.43
OW-2304 L	2/21/2008	–20.27	Lower	6.73	1997	**1,160**	—	<0.500	—	—	119.3	23.05
OW-2307 U	2/20/2008	21.59	Upper	7.20	1106	**566**	—	0.564	—	—	56.8	23.10
OW-2307 L	2/20/2008	–26.44	Lower	6.91	1053	**466**	—	<0.500	—	—	152.2	23.17
OW-2319 U	2/21/2008	–14.03	Lower	6.95	1199	**665**	—	<0.500	—	—	81.2	22.84
OW-2319 L	2/21/2008	–73.95	Deep	6.71	2258	**1,340**	—	6.65	—	—	100.2	22.96
OW-2321 U	2/19/2008	–31.73	Lower	6.85	1687	**733**	—	<0.500	—	—	109.9	23.52
OW-2321 L	2/19/2008	–71.46	Deep	6.58	3819	**919**	—	3.78	—	—	97.7	23.90
OW-2324 U	2/20/2008	–13.83	Lower	6.83	1281	**586**	—	<0.500	—	—	110.9	22.14
OW-2324 L	2/20/2008	–93.73	Deep	6.68	2158	**1,090**	—	<0.500	—	—	59.8	22.82
OW-2348 U	2/19/2008	–22.88	Lower	6.82	2414	**1,110**	—	<0.500	—	—	164.3	22.67
OW-2348 L	2/19/2008	–86.3	Deep	6.60	4122	**1,050**	—	<0.500	—	—	42.1	23.19
OW-2352 U	2/19/2008	14.47	Upper	7.13	1515	**602**	—	0.14 B	—	—	180.7	22.45
OW-2352 L	2/19/2008	–20.4	Lower	6.79	3437	**788**	—	1.30	—	—	61.5	22.40
OW-2359 U1	2/20/2008	–10.71	Lower	6.87	1192	**554**	—	<0.500	—	—	27.3	23.29
OW-2359 L2	2/20/2008	–86.07	Deep	6.74	2031	**973**	—	<0.500	—	—	87.7	23.44

Table 2.3.1.2-13 (Sheet 2 of 2)
VCS Site Hydrogeochemical Data

Sample Location	Sample Date	Sample Elevation (ft NAVD 88)[a]	Unit[b]	Silica (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Bicarbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Fluoride (mg/L)	Nitrate (mg/L)
National Primary DWS	—	—	—	—	—	—	—	—	—	—	—	**4.0**	**10**
National Secondary DWS	—	—	—	—	—	—	—	—	—	**250**	**250**	**2.0**	—
OW-2301 U	2/18/2008	28.27	Upper	58.4	77.4 N	8.66	130	3.86	333	73.5	35.4	0.66	0.68
OW-2301 L	2/18/2008	–51.81	Deep	36.0	114 N	14.6	122	5.13	300	155	62.5	0.26	0.36
OW-2302 U	2/21/2008	–8.01	Lower	39.6	91	12.4 E	119	4.55	339	110	26.1	0.44	0.73
OW-2302 L	2/21/2008	–63.05	Deep	155	265	30.8 E	167	9.69	308	**440**	125	0.23	0.56
OW-2304 U	2/21/2008	25.1	Upper	41.5	206	27.0 E	152	3.50	399	**441**	17.1	0.30	2.1
OW-2304 L	2/21/2008	–20.27	Lower	40.7	192	38.2 E	151	5.20	300	**436**	153	0.38	0.32
OW-2307 U	2/20/2008	21.59	Upper	48.4	44.9 N	7.04	163	3.34	490	59.9	18.9	1.0	0.36
OW-2307 L	2/20/2008	–26.44	Lower	41.5	83.9 N	12.0	100	4.97	298	100	25.4	0.40	1.4
OW-2319 U	2/21/2008	–14.03	Lower	40.2	73	12.4 E	147	4.10	378	163	41.1	0.53	0.63
OW-2319 L	2/21/2008	–73.95	Deep	92.7	229	35.7 E	189	7.58	310	**480**	198	0.26	0.43
OW-2321 U	2/19/2008	–31.73	Lower	41.9	111 N	18.4	133	4.61	300	220	65.3	0.41	0.50
OW-2321 L	2/19/2008	–71.46	Deep	66.3	166 N	27.1	128	6.59	279	**355**	59.6	0.28	0.52
OW-2324 U	2/20/2008	–13.83	Lower	38.3	111 N	15.6	100	3.61	289	160	58.3	0.29	0.67
OW-2324 L	2/20/2008	–93.73	Deep	33.6	196 N	33.6	138	6.74	249	**517**	86.0	0.22	0.54
OW-2348 U	2/19/2008	–22.88	Lower	35.5	159 N	30.4	166	4.38	252	**453**	106	0.37	0.57
OW-2348 L	2/19/2008	–86.3	Deep	34.0	175 N	33.3	111	5.42	252	**424**	93.3	0.27	0.41
OW-2352 U	2/19/2008	14.47	Upper	37.0	82.2 N	19.5	139	2.18	329	164	55.7	0.74	0.61
OW-2352 L	2/19/2008	–20.4	Lower	45.4	95.8 N	19.7	184	4.09	311	234	118	0.37	1.1
OW-2359 U1	2/20/2008	–10.71	Lower	37.9	93.1 N	13.4	111	3.85	309	148	45.6	0.44	0.71
OW-2359 L2	2/20/2008	–86.07	Deep	32.7	169 N	26.7	124	6.10	247	**415**	76.0	0.23	0.55

Abbreviations:

-- = Not Applicable

B = Estimated result. Result is less than the reporting limit.

DWS = Drinking Water Standard

E = Matrix interference

N = Spiked analyte recovery is outside stated control limits. Method performance confirmed using Laboratory Control Spike sample results.

NA = Not Analyzed

Bold values exceed National Primary or Secondary DWS (U.S. EPA, 2008b)

(a) Calculated from Table 2.3.1.2-1 by the following equation: (Top of screen - Bottom of Screen)/2

(b) Upper = Upper Shallow aquifer; Lower = Lower Shallow aquifer; and Deep = Deep aquifer

Table 2.3.1.2-14
Estimated Cooling Basin Seepage

Flow Component	Pre-Construction (gpm)	Post-Construction (gpm)	Change[a] (gpm)
Cooling Basin	0	3930	+3930
Evapotranspiration	(880)	(3770)	+2890
Kuy Creek	0	(220)	+220
Dry Kuy Creek	0	(460)	+460
Downgradient Drains	0	(310)	+310
Black Bayou and Linn Lake	(130)	(130)	0
Victoria Barge Canal	(16,240)	(16,520)	+280
Guadalupe River	7510	7510	0
San Antonio River	(940)	(1110)	+170

(RED) numbers indicate flow out of the model or base flow to creeks and rivers.
BLUE numbers indicate flow into the model — surface water inflow to groundwater.
Rates rounded to the nearest 10 gpm.
(a) "+" indicates an increase in flow from pre- to post-construction conditions and a "-" indicates a decrease.

Flow Mass Balance	Pre-Construction (%)	Post-Construction (%)
Overall Flow Discrepancy	0.04	0.15

Table 2.3.1.2-15
Summary of Particle Tracking Analysis

Scenario	Minimum Travel Time days (years)	Approximate Distance (ft)
1. No Pumping	41,000 (110)	14,000
2. Northern Domestic Well pumping 50 gpm	41,000 (110)	14,000
3. Western Domestic Well pumping 50 gpm	41,000 (110)	14,000
4. Eastern Domestic Well pumping 50 gpm	41,000 (110)	14,000

Travel time in days reported to the nearest 1000 days, travel time in years reported to the nearest 5 years, and distance reported to the nearest 500 feet.

Table 2.3.1.2-16
Summary of Locations Where Confining Layers are Absent

Confining Layer	Location
Clay 1 – Top	
	B-01
	B-03
	B-2306
	B-2315
	B-2322
	B-2324
	B-2332
	B-2334
	B-2336
	C-2305
	C-2307
	C-2308
	C-2309
	C-2311
	C-2311A
	C-2317
Clay 1 – Bottom	
	B-2346
	B-2348
	C-2328
Clay 3	
	B-2315
	B-2322
	B-2346
	B-2353
	B-2357
	C-2308
	C-2311
	C-2311A
Clay 5 – Top	
	B-09
	B-2319
	B-2348
	B-2352

2.3.2 Water Use

This subsection describes the groundwater and surface water uses that could affect or be affected by the construction and operation of the facility. Included are a description of the types of consumptive water uses; identification of their locations; and quantification of current and projected water demands, supplies and needs. A description of surface water returns upstream of the proposed VCS water intake location is provided in Subsection 2.3.3.2.7.

2.3.2.1 Water Resources Planning and Appropriation

2.3.2.1.1 Regional Surface and Groundwater Planning

Section 16.051 of the Texas Water Code (TWC) directs the Texas Water Development Board (TWDB) to prepare a comprehensive state water plan that provides for the development, management, and conservation of water resources and preparation for and response to drought conditions (TWDB Sep 2007). Under Senate Bill 1 (Texas Legislature, 75th Regular Session), enacted in 1997, the Regional Water Planning Groups (RWPGs) are required to plan for the future water needs under drought conditions. In 1998, the TWDB adopted rules for establishing 16 regional water planning areas and requiring that each RWPG prepare a regional water plan that would be assembled into the state water plan. Regional water plans are required to be updated every five years (TWDB Sep 2007).

The VCS site is located in the South Central Texas regional water planning area, initially designated by the TWDB as "Region L." As shown in Figure 2.3.2-1, Region L encompasses all or part of 21 counties. These 21 counties are included in whole or in part in the Rio Grande, Nueces, San Antonio, Guadalupe, and Lavaca River Basins and the Colorado-Lavaca, Lavaca-Guadalupe, and San Antonio-Nueces Coastal Basins. (TWDB Jan 2006)

One of the fundamental elements of the South Central Texas (Region L) water planning process is the quantification of surface and groundwater supplies reliably available during a repeat of the drought of record (1950-1957) and throughout the planning horizon. The 2006 South Central Texas (Region L) Regional Water Plan was adopted in September 2009 with an associated addendum to the 2007 State Water Plan in December 2009 and is the water plan currently in use for the region encompassing the VCS site. Accordingly, the 2006 plan provides the basis for analyzing water availability for VCS as well as potential water use impacts, in Chapters 4 and 5. As discussed in Subsection 2.3.2.3.5, the 2011 Region L Water Plan is currently under development and is expected to recognize the proposed VCS project (referred to as the “GBRA-Exelon Project”) as a recommended project. (TWDB Jan 2006 and TWDB Feb 2010)

Senate Bill 1 established a statewide comprehensive regional planning initiative and included amendments to Chapter 36 of the TWC. This chapter requires that groundwater conservation districts (GCDs) develop and implement a comprehensive management plan for groundwater resources within their jurisdiction, in coordination with the surface water management entities. TWC 36.108 requires each GCD to determine the desired future conditions of the managed water resources via a joint planning process with other GCDs within a groundwater management area. These determined conditions will be submitted to the TWDB who, in turn with the approval of the Texas Commission on Environmental Quality (TCEQ), will provide each managed area with the amount of managed available resources.

There are 15 GCDs in the South Central Texas Region. The Texas legislature created the Victoria County Groundwater Conservation District (VCGCD) in 2005 and their rules for protection and conservation of groundwater resources beneath the area of Victoria County were promulgated in December 2008. Registration is required for all new wells and all existing non-exempt wells.

Senate Bill 2 (Texas Legislature, 77th Regular Session), enacted in 2001, established the Texas Instream Flow Program, which is jointly administrated by the TCEQ, Texas Parks and Wildlife Department (TPWD), and TWDB. The purpose of the program is to perform scientific and engineering studies to determine flow conditions necessary for supporting a sound ecological environment in the river basins of Texas.

Senate Bill 3 (Texas Legislature, 80th Regular Session), passed in 2007, is a stakeholder-driven process to establish instream flow and freshwater inflow standards basin by basin. It directs the TCEQ to promulgate rules establishing flow standards starting in 2010. These new standards are to be reviewed once every 10 years for efficacy. In turn, the Bill authorizes the TCEQ to impose special conditions on new water rights in order to ensure sufficient in-stream flows and freshwater inflows to bays and estuaries are maintained. These restrictions are intended to promote the ecological soundness of the state's rivers, bay, and estuary systems.

2.3.2.1.2 Surface Water Resource Appropriation

Water in the rivers, streams, underflow, creeks, tides, lakes and bays in the State of Texas is considered state water. Its use (i.e., authorizations to divert, store and use) may be appropriated via the permitting process established in TWC Chapter 11, and Title 30, Texas Administrative Code Chapters 295 and 297 (and other applicable statutes and administrative rules). The permitting process is administrated by the TCEQ.

There are a number of types of appropriated water rights including:

- Perpetual rights, including certificates of adjudication and permits that have assigned priority dates
- Limited-term rights, including term permits and temporary permits

The TCEQ must take into consideration several factors during the appropriations permitting process:

- Water availability and its effect on other existing water rights holders, as well as requirements for in-stream flow and fresh water inflow to bays and estuaries (see Subsection 2.3.2.3.4)
- Consistency, pursuant to TWC Section 11.134(b)(3)(E), with the regional water plan
- Shortages or water use conflicts in the basin of origin (e.g., the Guadalupe-San Antonio River Basin)

2.3.2.2 Groundwater Use

As discussed in Subsection 2.3.1, the VCS site is located over the central portion of the Gulf Coast Aquifer System. The principal aquifer used in Victoria County for domestic and livestock wells is the Chicot Aquifer (TBWE Jan 1962), the shallowest aquifer in the Gulf Coast Aquifer System (TDWR Jul 1979). The primary source of groundwater for municipal and industrial use in Victoria County is the Evangeline Aquifer (TCEQ Oct 2007a), which underlies the Chicot Aquifer and is the most productive aquifer of the Gulf Coast System.

The Gulf Coast Aquifer has not been declared a sole source aquifer by the EPA (U.S. EPA Mar 2008). The nearest sole source aquifer in Texas is the Edwards Aquifer System, located approximately 100 miles north of the site. The Edwards Aquifer is hydraulically upgradient (TWDB Sep 2004, TWDB Feb 2006) and beyond the boundaries of the regional and local hydrogeologic systems associated with the site. Springs from the Edwards Aquifer are sources of tributary waters to the Guadalupe River and are discussed further in Subsection 2.3.2.3.

2.3.2.2.1 Regional Groundwater Use

Groundwater use as reported to the TWDB by each of the 13 counties within 50 miles of the site is summarized in Table 2.3.2-1. Groundwater from several major and minor aquifers is the primary source of drinking water for 6 of the 13 counties. Irrigation systems are the largest users (79.2 percent) of groundwater in the 50-mile region, followed by municipal water supply systems (13.1 percent), and manufacturing (3.7 percent). Smaller amounts of groundwater are used by steam electric power generation, mining, and livestock (TWDB 2007a).

Significant decreases in water levels in the eastern portion of the Gulf Coast Aquifer during the 1970s and 1980s prompted concern regarding the allocation of groundwater, causing a number of users, including municipalities, to revert to surface water as their primary source of water. New development, recent droughts, and the potential for saltwater intrusion have also heightened concerns about long-term groundwater availability in the Gulf Coast Aquifer System (TWDB Jan 2003). Aquifer declines of 200 to 300 feet have been measured in some areas of eastern and southeastern Harris and northern Galveston Counties. Other areas of significant water-level declines include the Kingsville area in Kleberg County and portions of Jefferson, Orange, and Wharton Counties. Some of the declines have resulted in compaction of dewatered clays and significant land surface subsidence. Subsidence is generally less than 0.5 foot over most of the Texas coast but has been as much as 9 feet in Harris and surrounding counties. Conversion to surface water use in many of the problem areas has reversed the declining trend (TWDB Nov 1995).

As discussed in Subsection 2.3.2.1, there are 15 GCDs in the South Central Texas Region. With the exception of Calhoun County, a GCD serves all or a portion of each county in the region. The responsibilities and authorities of these GCDs vary depending on their creating legislation and governing law, and some districts are not responsible for all aquifers within the geographic boundaries of the district.

Since the late 1990s, the TWDB has commissioned the development of mathematical groundwater availability models for the north, south, and central portions of the Gulf Coast Aquifer to predict how the aquifer might respond to increased pumping and drought. The groundwater availability models were developed with substantial stakeholder input. The goal is to provide reliable projections of groundwater availability to ensure adequate supplies or identify inadequate supplies over the current planning period.

2.3.2.2.2 Gulf Coast Aquifer Availability Projections

The regional water plan adopted by Region L in 2006 defines groundwater availability as the amount of groundwater available for use in the region as determined by analysis of aquifer recharge, existing groundwater demands, projected groundwater demands, limits of drawdown, and the annual groundwater availability calculations provided in each of the Region L GCD's comprehensive water plans.

The projected groundwater supply available in Region L from the Gulf Coast Aquifer during a drought of record condition is 132,348 acre-feet per year throughout the 2010-through-2060 projection period (TWDB Jan 2006).

Available and allocated groundwater supply projections for Victoria, Calhoun, and Refugio Counties, as given in the 2006 South Central Regional Water Plan (TWDB Jan 2006), are provided in Tables 2.3.2-2, 2.3.2-3, and 2.3.2-4, respectively. Because neither Victoria County nor Calhoun County had a GCD when the 2006 plan was being prepared, the 2006 Region L Plan used earlier groundwater availability estimates developed by the TWDB for the 1997 state water plan and used in the 2001 Region L Plan. Refugio County does have an established GCD, so the groundwater availability numbers from their approved 2003 management plan were used for the 2006 Region L Plan. None of the groundwater availability projections for these three counties came from the Central

Gulf Coast groundwater availability modeling, because that groundwater availability modeling was not satisfactorily completed when the 2006 Region L Plan was in development.

Uddameri and Kuchanur (Aug 2006) developed a three-dimensional, county-scale, mathematical model to represent groundwater flow characteristics in Refugio County using the United States Geological Survey MODFLOW model. Simulation-optimization schemes estimate groundwater availability as a function of both science and policy choices and risk-preference of stakeholders involved. The stakeholder concerns were incorporated as constraints, which included prevention of saltwater intrusion in the aquifer, limiting the amount of allowable drawdown in the Chicot and Evangeline aquifers, and maintaining current flow gradients (especially near baseflow-dependent streams and rivers). For the conditions assumed, the results of the study indicated that approximately 39,968 acre-feet per year of groundwater could be extracted without violating the specified constraints. The groundwater availability results of the Uddameri and Kuchanur study for Refugio County are nearly identical to the Refugio County groundwater availability projections provided in the 2006 South Central Regional Water Plan (TWDB Jan 2006).

2.3.2.2.3 Local Groundwater Use

Reported permitted groundwater uses for Victoria County are included in Table 2.3.2-1. In 2004, groundwater pumping in Victoria County was 15,529 acre-feet per year. The largest consumer of groundwater that year was municipal water use, followed by irrigation (TWDB 2007a).

Groundwater in the vicinity of the site is primarily used for domestic and livestock purposes. A data query of the TWDB statewide well database on water wells located within 6 miles of the site (TWDB 2007b) is summarized in Table 2.3.2-5, and the locations of the wells are shown in Figure 2.3.2-2. A series of stock wells at the site and a domestic well located at the McCan Ranch house are not listed in the TWDB well database.

A Texas Commission on Environmental Quality (TCEQ) public water systems database query (TCEQ Oct 2007a) indicates that the nearest public water system (TX-2350014) is located more than 5 miles east of the site. It consists of three wells at an industrial facility (INVISTA, formerly DuPont) that produce from the Evangeline Aquifer. These wells have a total production capacity of approximately 3550 acre-feet per year and serve a population of 900 people (TCEQ 2008b). Table 2.3.2-6 summarizes the public water systems located within 10 miles of the site. The locations of the systems are shown on Figure 2.3.2-3.

The city of Victoria switched from a groundwater supply to a primarily surface water supply in September 2001, with groundwater as a backup during drought periods. The average daily consumption of surface water by the Victoria water system is approximately 11,100 acre-feet per year

(TCEQ 2008e). This implies an approximate decrease in groundwater use from the Evangeline aquifer of 11,100 acre-feet per year during non-drought periods.

As discussed in Subsection 2.3.2.1, the Texas legislature created the VCGCD in 2005. The district management plan was adopted by the VCGCD and the TWDB in October and December 2008, respectively.

At the time of adoption of the VCGCD District Management Plan, the 13 GCDs within the TWDB groundwater management area (GMA) had not completed their joint planning process to define the desired future condition of the aquifer. Thus, for the purposes of managing groundwater within the district, the VCGCD selected benchmark management conditions and applied them to the TWDB groundwater availability model (GAM) for the Gulf Coast Aquifer in Victoria County. Key criteria identified by the VCGCD to define the condition of the aquifer included drawdowns in the Chicot and Evangeline formations, stream-aquifer interactions, and cross-formational flows. A spectrum of groundwater development scenarios under wet, average, and dry recharge conditions were evaluated, resulting in an estimated range of available groundwater from 25,000 acre-feet per year to 45,000 acre-feet per year. For planning purposes, the district management plan established an estimated value of 35,000 acre-feet per year as the amount of groundwater that can be produced within the district and beneficially used (VCGD Oct 2008).

The groundwater availability of approximately 41,000 acre-feet per year estimated by the South Central Regional Water Planning Group as reported in the 2006 Region L Plan (TWDB, 2007) lies within the estimated range of the VCGCD estimate (VCGCD, Oct 2008). Note that the estimated groundwater availability is a function of both science, and policy. Selection of an appropriate value for management depends upon the risk-preferences of the decision makers.

The rules of VCGCD were adopted in December 2008 (VCGCD Dec 2008). Registration is required for all new wells drilled in the District and all existing non-exempt wells. An "exempt well" is a well that does not require an operating permit and is used for domestic purposes or for providing water for livestock, poultry or personal recreation use. An exempt well would be drilled, completed, or equipped so that it is incapable of producing more than 28,800 gallons of groundwater per day (20 gpm).

All existing wells within the district can be registered on a voluntary basis if the well does not require a permit. Wells constructed after adoption of the rules must have a valid drilling permit prior to drilling, pass a district inspection, and be registered and obtain an operation permit before operation.

By April 2009, a total of 40 drilling permit applications for exempt wells had been approved since the rules were adopted. One exempt well drilling permit application and 12 non-exempt well applications were under review, as of April 2009 (VCGCD Apr 2009).

2.3.2.3 Surface Water Use

Major hydrologic features in the region of the VCS site are shown on Figure 2.3.1-2**.** Permitted surface water users within counties located within 50-miles of the VCS site are indicated in Table 2.3.2-7. Permitted uses of surface water bodies include municipal water supply, manufacturing, steam electric, irrigation, mining, and livestock.

The Guadalupe River is a spring-fed river that rises in the western part of Kerr County and flows more than 430 river miles (TWDB Jan 2006). Both the Comal and San Marcos Rivers are fed by springs from the Edwards Aquifer, and these two rivers are major tributaries to the Guadalupe River (GBRA 2008). Edwards Aquifer water flows from Comal Springs in New Braunfels into the Comal River. Water from the Edwards Aquifer also flows from San Marcos Springs in San Marcos into the San Marcos River.

The Guadalupe River drains approximately 10,128 square miles above the Guadalupe-Blanco River Authority (GBRA) Saltwater Barrier, of which approximately 4180 square miles are in the San Antonio River Basin (TWDB Jan 2006). The Guadalupe River drains into the Guadalupe Bay and San Antonio Bay approximately 11 miles downstream of the GBRA Saltwater Barrier (SARA 2007). Although the Guadalupe and San Antonio River Basins have been delineated as separate river basins by the TWDB, the two rivers join prior to discharge into San Antonio Bay and they are hydrologically considered as one.

Major reservoirs in the Guadalupe River Basin include Canyon Reservoir and Coleto Creek Reservoir. Canyon Reservoir is a large water supply and flood control project located in Comal County on the mainstream of the Guadalupe River. It is owned and operated by the GBRA under certificate of adjudication 18-2074, as amended. Canyon Dam was completed in 1964, resulting in a total authorized impoundment of 740,900 acre-feet. At present, 386,200 acre-feet of this amount is considered the conservation storage capacity for water supply purposes (TNRCC Dec 1999). Conservation storage capacity is used for water supply during drought conditions. Uses of the reservoir include water supply for municipal, industrial, steam-electric power generation, irrigation, and hydroelectric power generation, as well as flood protection and recreation. Diversions from Canyon Reservoir are currently authorized up to 90,000 acre-feet per year, as shown in Table 2.3.2-8. Water supplies are managed by the GBRA and made available to customers in their 10-county district as well as in adjacent counties and river basins (TWDB Jan 2006).

Coleto Creek Reservoir is located approximately 11 miles northwest of the site in Goliad County. The reservoir is operated by the GBRA and is a cooling reservoir for steam-electric power generation. Sources of water include runoff from the Coleto Creek watershed and diversions from the Guadalupe River, backed by storage in Canyon Reservoir when needed. The reservoir supplies water for steam-electric power generation at Coleto Creek Power Station in Goliad County, and as shown in Table 2.3.2-8, it has a permitted consumptive use of 12,500 acre-feet per year. (TWDB Jan 2006).

The San Antonio River is approximately 240 miles long and drains approximately 4180 square miles (SARA 2007). The San Antonio River drains into the Guadalupe River upstream of the GBRA Saltwater Barrier.

Besides the lower Guadalupe River (which starts just below the northern boundary of Victoria County), the San Antonio River, and the Coleto Creek Reservoir, other notable surface water bodies located within 50 miles of the site in the lower Guadalupe River hydrologic system include the Victoria Barge Canal, Coleto Creek, Green Lake, Linn Lake, the GBRA Calhoun Canal System, and the San Antonio Bay (which is an embayment of the Gulf of Mexico).

The lower Guadalupe and San Antonio Rivers, Coleto Creek Reservoir, and Coleto Creek are used for recreational fishing and birding. Green Lake is a shallow lake (about 3 feet deep) that is privately owned with no public access. San Antonio Bay is used for commercial and recreational fishing, birding, and navigation. Linn Lake is a small, shallow cut-off meander of the lower Guadalupe River and is privately used for recreational purposes; its remote location limits access to the public. The man-made sea-level Victoria Barge Canal connects Victoria to the Gulf Intracoastal Waterway and transports barge traffic for the local industry (VEDC 2008). The GBRA Calhoun Canal System is a water delivery system that diverts water from the Guadalupe River for delivery to customers, including the Port Lavaca water treatment plant.

2.3.2.3.1 Drought Management and Preparation

As discussed in Subsection 2.3.1.1.1, there have been major droughts in the lower Guadalupe-San Antonio basin in almost every decade since stream gaging began in the 1930s. The most severe drought, referred to as the drought of record, occurred between 1950 and 1957 (TWDB Jan 2007c).

As discussed in Subsections 2.3.2.1.1 and 2.3.2.3.5, the South Central Texas (Region L) water planning process utilizes the Guadalupe-San Antonio Basin Water Availability Model (TNRCC Dec 1999), modified for regional planning purposes, to quantify water availability through a repeat of the drought of record and throughout the planning horizon. Because the water availability model was developed using hydrologic data from 1934-1989, an evaluation was performed to compare the regional droughts from 1990-2009 with the 1950s drought of record used in the water planning process. Lowest river flows during the drought of record occurred during the 3-year period from 1954-1956.

Historical flow records for the Guadalupe and San Antonio Rivers were used to compare the flow magnitudes for the drought of record with those from the 1990-2009 droughts (considering drought durations from 3 months up to 3 years). In making these comparisons, the effects of Canyon Reservoir on the historical Guadalupe River flows were eliminated by only considering the historical flows for the Spring Branch gage located immediately upstream of the reservoir and the historical incremental inflows into the Guadalupe River between the cities of New Braunfels and Victoria. These incremental inflows were derived by subtraction of the monthly gaged flows at the upstream location from the monthly gaged flows at downstream location, and as such, they reflect only inflows to the river and do not include the effects of Canyon Reservoir upstream. Incremental inflows to the San Antonio River also were analyzed as part of the drought assessment using historical monthly flow records for the gages at the cities of Falls City and Goliad. These gages, which are downstream of the City of San Antonio's major wastewater treatment plant discharge points, were selected to ensure that the effects of return flows from the City of San Antonio were consistently reflected in both gages. Since the VCS raw water makeup intake canal will be located just upstream of the GBRA Saltwater Barrier, below the confluence of the Guadalupe River and the San Antonio River, incremental inflows from both rivers were combined for some of the drought comparisons.

Table 2.3.2-15 presents the flow values for the 1950s drought and for the droughts from the 1990-2009 period, estimated as described above. Considering the consistently and significantly lower historical minimum river flow magnitudes associated with the 1950s drought relative to those that occurred since 1990, the hydrologic conditions reflected by the 1950s drought still are the more critical with regard to water availability planning in the lower Guadalupe-San Antonio Basin. Accordingly, the Guadalupe-San Antonio Basin Water Availability Model and the 1950s drought of record are considered to be appropriate for evaluating water availability for the proposed VCS during periods of drought. Under the requirements of Title 30 Texas Administrative Code Chapter 288, the requirements of TWC Section 11.1272, local public and private water suppliers and water districts are required by the TCEQ to adopt a Drought Contingency Plan that contains drought triggers and responses unique to each specific entity. These entities have the authority and responsibility to manage their particular water supply within the bounds created by applicable law.

Water supplies available from the Gulf Coast Aquifer are generally less subject to transient hydrologic drought conditions. If depletion in the Gulf Coast Aquifer were to occur at an unacceptable pace (typically measured over many years, rather than a few months), there would likely be sufficient time to amend groundwater district rules and/or develop alternative sources of supply.

Supplies from surface water sources as run-of-the-river water rights and reservoirs are determined on the basis of minimum year availability and firm yield, respectively. Hence, the current water supplies modeled in the regional water plan adopted by Region L in 2006 are considered dependable during drought (TWDB Jan 2006).

2.3.2.3.2 Local Surface Water Use

The discussion of local surface water use includes Victoria, Refugio, Calhoun, and Goliad counties. Victoria County is discussed because it is the proposed location of the plant; Refugio County is discussed because it is included downstream in the same hydrologic system of the site and is the location of the proposed site's water intake; and Calhoun County is discussed because it is the location of the alternate freshwater intake, evaluated in Section 9.4. Goliad County is discussed because it is the location of the Coleto Creek Reservoir, which lies within both Goliad and Victoria counties.

In addition to the associated major reservoirs, surface water rights have been issued by the TCEQ and predecessor agencies to individuals, cities, industries, water districts, and water authorities for diversion from flowing streams in the South Central Texas Region. Each right bears a priority date, diversion location, maximum diversion rate, and annual quantity of diversion. Some rights may include off-channel storage authorization, instream flow requirements, and various special conditions (such as a temporary water permit).

Tables 2.3.2-9 through 2.3.2-11 identify the surface water user, the body of water from which withdrawals are made, and the permitted maximum volume of surface water withdrawal, where available, for the Guadalupe-San Antonio River Basin. The locations of the surface water users are plotted on Figure 2.3.2-4 using latitude and longitude information provided by the TCEQ (2008a). Note that there were surface water users for livestock use only in Refugio County as reported in Table 2.3.2-7. As of April 2, 2009, there have been no additional permitted surface water users in Victoria, Calhoun, Goliad, and Refugio counties, other than those reported in Table 2.3.2-9 through 2.3.2-11 (TCEQ 2009a).

Downstream of the site, surface water is withdrawn by a number of industries and private users. However, the largest downstream surface water user is the GBRA. The GBRA Saltwater Barrier creates an impoundment that facilitates diversions under Certificate of Adjudication rights 18-5173 through 18-5178 and 18-3863 held either jointly or singularly by the GBRA and Union Carbide Corporation (UCC). Although UCC now operates as Dow Chemical Corporation, the water rights are held under the UCC name. These rights total 175,501 acre-feet per year and are authorized for municipal, industrial, and irrigation use, as shown in Table 2.3.2-12 (GBRA Nov 2007).

The maximum reported water use under GBRA/UCC rights at the GBRA Saltwater Barrier did not exceed 51,670 acre-feet per year from 2000 to 2006 (GBRA Nov 2007). Table 2.3.2-13 provides a record of GBRA-reported Calhoun (Main) Canal water use by water use category. The table also provides a list of the GBRA's industrial, municipal, and irrigation customers.

The TCEQ Pending Surface Water Rights Applications database has three pending applications in the lower Guadalupe River basin. The applicants are Coleto Creek Power, LP for Victoria/Goliad counties; San Marcos River Foundation for Refugio/Gonzales counties (in stream uses) (TCEQ Jan 2008); and GBRA junior water right permit for multiple counties adjacent to the Guadalupe River (water diversion/reservoir) (TCEQ 2009b).

2.3.2.3.3 Surface Water Availability Projections

Although the Guadalupe and San Antonio River Basins have been delineated as separate river basins by the TWDB, the two rivers join prior to discharge into the San Antonio Bay system, and the two watersheds are considered as one (the Guadalupe-San Antonio River Basin) when evaluating surface water supplies available under existing water rights. This arrangement is due, in part, to the large concentration of senior water rights below the confluence of the two rivers (TWDB Jan 2006).

Senior water right holders have priority when stream flows are low, as in periods of drought. This priority renders junior rights less reliable during droughts. The most junior water right holders may not be able to divert any water during severe droughts.

Surface water supplies for the Guadalupe and San Antonio River Basins have been quantified using the state's Guadalupe-San Antonio River Basin Water Availability Model prepared by HDR Engineering, Inc. (TNRCC Dec 1999). The Water Availability Model quantifies, through the period of record (1934–1989), the water availability associated with run-of-the-river water rights, calculates the firm yields associated with Canyon Reservoir, and simulates the reliability of authorized consumptive uses associated with steam-electric power generation.

The South Central Texas RWPG conducted a detailed analysis of the projected water demands for various water users including municipal, industrial, irrigation, livestock, mining, and domestic use in each of the counties that comprise Region L. The RWPG used the Guadalupe-San Antonio River Basin Water Availability Model (modified for regional planning purposes) to evaluate the projected surface water demands for Victoria and Calhoun Counties. The modelers followed a procedure that accounts for historical hydrologic conditions from 1934–1989, seniority (priority) of water rights, and other factors to calculate surface water availability and reliability.

Projected surface water demands, supplies, and needs (i.e., the difference between projected demands and available supplies) for Victoria and Calhoun Counties are summarized in Table 2.3.2-14. In that table, projected Calhoun County demands and projected Victoria County needs are compared against the GBRA/UCC water rights. The GBRA currently does not supply Victoria County with water from the GBRA/UCC water rights, but because of projected shortages of surface water for Victoria County industrial users, the GBRA will supply surface water to Victoria County starting in 2040 to offset the projected surface water shortages (GBRA Feb 2008). As shown in the table, after meeting the Calhoun County surface water demands and Victoria County surface water needs, a surplus of approximately 115,926 acre-feet per year remains in 2060 under the GBRA/UCC water rights.

2.3.2.3.4 Guadalupe Estuary Freshwater Inflows

In 1998, the TWDB and the Texas Parks and Wildlife Department (TPWD) prepared *Freshwater Inflow Recommendations for the Guadalupe Estuary of Texas* (TPWD Dec 1998), a coastal studies technical report "that summarizes studies which form the basis for TPWD's recommendations of target freshwater inflows needed to maintain the unique biological communities and ecosystems characteristic of a healthy Guadalupe Estuary." As part of determining the estuary's freshwater inflow needs, the TWDB and TPWD incorporated hydrographic surveys, hydrodynamic and salinity modeling, and verification of needs into the report. Modeling produced theoretical estimates of a minimum freshwater inflow pattern (termed MinQ) and a freshwater inflow pattern intended to maximize fisheries harvests (termed MaxH), given certain constraints.

Historical freshwater inflows to the estuary from 1941 to 1987 and available fisheries harvest data from 1959 to 1987 were used to develop functional relationships for seven selected species: blue crab, eastern oyster, red drum, black drum, spotted seatrout, brown shrimp, and white shrimp. The freshwater inflow-fisheries harvest relationships were then used in a mathematical optimization process to satisfy species harvest goals of maintaining 80 percent of mean historical harvest, more than 50 percent of the time, subject to various inflow and biomass ratio bounds (i.e., the "state methodology"). Simulations using the TPWD and TWDB model yielded MinQ and maximum inflow (termed MaxQ) patterns of 1.03 million acre-feet per year and 1.29 million acre-feet per year, respectively, with estimated monthly inflow needs ranging from 52,400 acre-feet (March, April, September, and October) to between 186,000 and 222,600 acre-feet (May). The freshwater inflow pattern to the Guadalupe Estuary for optimization of fisheries harvest (i.e., MaxH) was estimated to be approximately 1.15 million acre-feet per year.

The inflow to the Guadalupe Estuary, like most Texas Estuaries, is highly variable. The study reports that the average annual inflow to the Guadalupe Estuary during the 1941–1987 period was greater than 1.52 million acre-feet at least 50 percent of the years. Only 23 percent of these years had annual flows less than the 1.15 million acre feet target volume. Inflows below the simulated MinQ of 1.03 million acre-feet per year occurred less than 15 percent of the time (TPWD Dec 1998).

Recent TPWD studies have focused on evaluation of fisheries survey data (as compared to harvest data used in the 1998 study) from the TPWD Coastal Fisheries Resource Monitoring Database. Observed abundances of estuarine fishery species were empirically evaluated against freshwater inflow regimes proposed from the theoretical modeling. By comparing predicted results with observed fisheries survey data. TPWD staff recommended the pattern of optimal harvest inflows (totalling

1.15 million acre-feet per year) as the lowest target value to fulfill the biological needs of the Guadalupe Estuary System on a seasonal basis (TPWD Oct 2007).

Pursuant to passage of Senate Bill 3, a new process has been established for TCEQ to adopt appropriate environmental flow standards for each bay system that are adequate to support a sound ecological environment to the maximum extent reasonable considering other public interests and other relevant factors (TWC 11.1471[a][1]). Bay and basin advisory groups, stakeholder committees, and expert science teams will work with technical support from the TPWD, TWDB, and TCEQ over the next few years to develop recommendations regarding environmental flow standards which TCEQ must consider in rulemaking. Recommendations of the expert science teams shall be developed through a collaborative process designed to achieve consensus and must be based solely on the best science available (TWC 11.02362(m)). The TCEQ permitting decisions shall establish an amount of unappropriated water, if available, to be set aside to satisfy the Senate Bill 3 environmental flow standards to the maximum extent reasonable when considering human water needs. Although this process has been created to establish environmental flow standards and set-asides to be considered in evaluating applications for new water rights and amendments, the statute does not apply the environmental flow standards to existing water rights.

2.3.2.3.5 Water Availability for the Proposed VCS

The source of the plant's makeup water would be the Guadalupe River as described in Section 3.4. Long-term stream flow data is not available for the Guadalupe River at the location of the diversion into the Raw Water Makeup (RWMU) intake system, approximately 430 feet upstream of the GBRA Saltwater Barrier. However, two upstream USGS gaging stations (Victoria gage on the Guadalupe River and Goliad gage on the San Antonio River) have long-term stream flow records and were used to estimate (in combination with runoff estimated from the drainage area downstream of the gages) the stream flow at the RWMU system location. The results indicated that the annual mean flow in the Guadalupe River is 4341 cfs based on 10 years of flow data (1997 through 2006).

The required makeup water could be secured under existing water rights via contract with an existing water rights holder or obtaining ownership of existing water right(s). Alternatively, water could be withdrawn from the Guadalupe River under a new water right or via a combination of new and existing water rights.

<u>Existing Water Right(s)</u>

As an example, water rights totaling 175,501 acre-feet per year and authorized for municipal, industrial, and irrigation use are held either jointly or directly by the GBRA and Union Carbide Corporation (GBRA/UCC). The maximum reported water use under GBRA/UCC rights at the GBRA Saltwater Barrier did not exceed 51,670 acre-feet per year from 2000 to 2006, thereby leaving approximately 70 percent of the joint water rights available. As described in Section 2.3.2.3.3, approximately 115,926 acre-feet per year are projected to be available in 2060 under the GBRA/UCC water rights, excluding the proposed VCS water withdrawal, after Victoria County needs and Calhoun County demands have been satisfied.

In addition to the available portion of the GBRA/UCC rights, there are many water rights holders that do not divert the full amount of their authorized diversions. Because the available portions of these water rights in the Guadalupe-San Antonio (GSA) River Basin represent a potential source of surface water for the proposed VCS, these water rights are being evaluated by Exelon. In order to determine the amount of water that is potentially available, an analysis was performed using the water supply information derived from the outputs from the existing GSA Water Availability Model (WAM), previously developed by the TCEQ. Two scenarios were evaluated by comparing (i) the maximum authorized annual diversion amounts to the maximum diversion amounts reported in the 10 years prior to development of the GSA WAM, and (ii) the simulated average diversion quantities under the full utilization WAM run to the simulated average of actual diversion amounts. The total amount of unused diversion authority is about 52,000 acre-feet/year for Scenario (i) and 39,000 acre-feet per year for Scenario (ii). The latter scenario is considered to be a more conservative estimate of the available portions of water rights in the GSA basin, because many of the evaluated water rights are subject to streamflow availability.

New Surface Water Appropriations

For a new appropriation or an amendment to an existing water right, an applicant submits a request to the TCEQ regarding annual volume, rate and place of diversion, type of use and additional information as required. The TCEQ will analyze the request with respect to water availability, effect on other water right holders and the environment, and other considerations as authorized. Therefore, each new permit application is reviewed for technical requirements to evaluate its impact on other water rights, bays and estuaries, conservation, water availability, public welfare, etc. For a new permit to be granted, it implies that there would be water available at the permitted location and the amount and rate of withdrawals or diversions would not have a significant impact on water right holders downstream and the surrounding ecosystem.

2011 Region L Plan

The development of the 2011 South Central Texas Region (Region L) Water Plan has been ongoing since February 2006. The Initially Prepared Plan was approved during February 2010. The Initially Prepared Plan includes updated regional water demand projections for steam-electric power generation including those projected for the VCS Project. The Initially Prepared Plan also includes a recommended project to supply water to the VCS Project (i.e., the

"GBRA-Exelon Project"). Analysis conducted for the Regional Water Planning Group using the state's surface water availability model as modified for regional planning purposes, concludes that sufficient water is available to support plant and cooling basin operations for the VCS Project (TWDB Feb 2010). Exelon continues to work closely with GBRA to ensure that adequate water would be available for VCS at the COL stage.

2.3.2.4 References

GBRA Apr 2006. Guadalupe-Blanco River Authority, *Drought of Record Not Record Drought; Adding 50 Years of History Proves Texas Had Much Worse Droughts*, April 20, 2006.

GBRA Nov 2007. Guadalupe-Blanco River Authority, *GBRA Water Delivery System and Water Rights Records*, e-mail to Krista Dearing-Tetra Tech from Bryan Serold, GBRA Lower Guadalupe River Basin Operations Manager on November 8, 2007.

GBRA 2008. Guadalupe-Blanco River Authority, *Edwards Aquifer*. Available at http://www.gbra.org/Drought/EA.aspx, accessed January 21, 2008.

GBRA Jan 2008. Guadalupe-Blanco River Authority, *Future GBRA Surface Water Users*. E-mail to Krista Dearing-Tetra Tech from Bryan Serold, GBRA Lower Guadalupe River Basin Operations Manager on January 23, 2008.

GBRA Feb 2008. Guadalupe-Blanco River Authority, *GBRA (Calhoun Canal) Surface Water Supply to Victoria County*, Phone call to Krista Dearing-Tetra Tech from Tommy Hill, GBRA Lower Guadalupe River Senior Engineer on February 21, 2008.

HDR Feb 2008. HDR Engineering, Inc., *Calhoun and Victoria Supplies and Demands*. E-mail to Krista Dearing-Tetra Tech from Samuel Vaugh, P.E. Vice President HDR Engineering on February 15, 2008.

SARA 2007. San Antonio River Authority, *San Antonio River Basin 2007 Basin Highlights Report*. Available at http://www.sara-tx.org/site/water_quality/water_qual_mon/clean_rivers/basin_reports.html, accessed January 8, 2008.

TBWE Jan 1962. Texas Board of Water Engineers, *Ground-Water Resources of Victoria and Calhoun Counties, Texas*, Bulletin 6202, January 1962.

TCEQ Oct 2007a. Texas Commission on Environmental Quality, *PWS Wells Located in Victoria County, Texas*. E-mail to Krista Dearing-Tetra Tech from John Meyer, TCEQ Water Supply Division on October 31, 2007.

TCEQ Oct 2007b. Texas Commission on Environmental Quality, *Surface Water Users in Victoria, Calhoun, and Refugio Counties*. E-mails to Robin Henderson-Tetra Tech from Marian Cherenka, TCEQ Water Rights Permitting on October 26, 2007 and November 9, 2007.

TCEQ 2008a. Texas Commission on Environmental Quality, *Surface Water Users in Goliad County*. E-mail to Krista Dearing-Tetra Tech from Marian Cherenka, TCEQ Water Rights Permitting on January 3, 2008.

TCEQ 2008b. Texas Commission on Environmental Quality, *TCEQ Water Utility Database Public Water Systems Details/Data Sheet for INVISTA/SARL*. Available at http://www3.tceq.state.tx.us/iwud/pws/index, accessed January 15, 2008.

TCEQ 2008c. Texas Commission on Environmental Quality, *TCEQ Water Utility Database List of Water Districts in Texas*. Available at http://www3.tceq.state.tx.us/iwud/dist/index, accessed January 23, 2008.

TCEQ 2008e. Texas Commission on Environmental Quality, *Public Water Systems Details/Data Sheet for City of Victoria* (2350002). Available at http://www3.tceq.state.tx.us/iwud/pws/index.cfm?fuseaction=DetailPWS&ID=10119, accessed March 22, 2008.

TCEQ Jan 2008. Texas Commission on Environmental Quality, *TCEQ Pending Surface Water Applicant — San Marcos River Foundation*. Phone call to Krista Dearing-Tetra Tech from Iliana Delgado, TCEQ Water Rights Permitting Team on January 23, 2008.

TCEQ 2009a. Texas Commission on Environmental Quality, *TECQ Water Rights Database and Related Files*. Available at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/wr_databases.htm, accessed May 6, 2009.

TCEQ 2009b. Texas Commission on Environmental Quality, *TECQ Pending Water Rights Applications*. Available at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/pending.html, accessed April 19, 2009.

TDWR Jul 1979. Texas Department of Water Resources, *Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas*, Report 236, July 1979.

TNRCC Dec 1999. Texas Natural Resource Conservation Commission, *Water Availability in the Guadalupe-San Antonio River Basin*, December 1999.

TPWD Dec 1998. Texas Parks and Wildlife Department, *Freshwater Inflow Recommendation for the Guadalupe Estuary of Texas*, Coastal Studies Technical Report No. 98-1, December 1998.

TPWD Oct 2009. Texas Parks and Wildlife Department, *Freshwater Inflow Recommendation for the Guadalupe Estuary of Texas, Executive Summary*. Available at http://www.tpwd.state.tx.us/landwater/water/conservation/freshwater_inflow/guadalupe/index.

TWC Sep 2007. Texas Water Code, Title 2, Water Administration, Subtitle C, Water Development, Chapter 16, Provisions Generally Applicable to Water Development, Subchapter C, Planning, Section 16.051, State Water Plan: Drought, Conservation Development, and Management: Effect of Plan, September 2007.

TWDB Nov 1995. Texas Water Development Board, *Aquifers of Texas*, Report 345, November 1995.

TWDB Jan 2003. Texas Water Development Board, *Groundwater Availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050 Central Gulf Coast, Texas*, Final Report, January 2003.

TWDB Sep 2004. Texas Water Development Board, *Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999*, Model Report, September 2004.

TWDB Jan 2006. Texas Water Development Board, *2006 Regional Water Plan*, January 2006.

TWDB Feb 2006. Texas Water Development Board, *Aquifers of the Gulf Coast of Texas: Report 365*, Chapter 5—Hydrochemistry, Salinity Distribution, and Trace Constituents: Implications for Salinity Sources, Geochemical Evolution, and Flow Systems Characterization, Gulf Coast Aquifer, Texas, February 2006.

TWDB 2007a. Texas Water Development Board, *Historical Water Use Information*. Available at http://www.twdb.state.tx.us/wushistorical/DesktopDefault.aspx?PageID=1, accessed October 8, 2007.

TWDB 2007b. Texas Water Development Board, *TWDB Groundwater Database*. Available at http://wiid.twdb.state.tx.us/ims/wwm_drl/viewer.htm?, accessed October 9, 2007.

TWDB 2007c. Texas Water Development Board, *Water for Texas 2007*, Volume II, Document No. GP-8-1, January 2007.

TWDB 2007d. Texas Water Development Board, Regional Water Planning. Available at http://www.twdp.status.tx.us/wrpi/rwp/rwp.htm.

TWDB Feb 2010. Texas Water Development Board, *2011 South Central Texas Regional Water Plan.* DRAFT Initially Prepared Plan, February 2010.

Uddameri and Kuchanur Aug 2006. Uddameri, V. and M. Kuchanur, "Simulation-Optimization Approach to Assess Groundwater Availability in Refugio County TX," *Environmental Geology* 51:921-929, August 2006.

U.S. EPA Mar 2008. U.S. Environmental Protection Agency, *U.S. EPA Region IV Sole Source Aquifer Map*. Available at http://www.epa.Gov/region6 /6wq/ swp/ssa/maps.htm, accessed May 5, 2009.

VCGCD Oct 2008. Victoria County Groundwater Conservation District, District Management Plan, adopted by the VCGCD Board on October 24, 2008 and approved by the TWDB Administrative on December 22, 2008.

VCGCD Dec 2008. Rules of Victoria County Groundwater Conservation District were adopted on October 3, 2008 and effective on December 22, 2008.

VCGCD Apr 2009. Victoria County Groundwater Conservation District Well Permit Application List. Available at http://www.vcgcd.org/PacketPDFs/20090417_Packet.pdf (page 144).

VEDC 2008. Victoria Economic Development Corporation, *Victoria Barge Canal*. Available at http://www.victoriaedc.com/content/view/46/91, accessed January 15, 2008.

Table 2.3.2-1
Groundwater Use (Acre-Feet per Year) by County in 50-Mile Radius of VCS Site (2004)

County	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
Aransas	308	76	0	0	81	4	469
Bee	2658	1	0	3458	15	69	6201
Calhoun	188	2081	30	0	12	195	2506
DeWitt	2357	414	0	96	40	112	3019
Goliad	659	0	98	1585	7	40	2389
Gonzales	2150	1332	0	1140	29	460	5111
Jackson	1439	39	0	44,599	72	205	46,354
Lavaca	2515	308	0	6009	1	227	9060
Matagorda	4955	4979	4656	32,196	131	362	47,279
Refugio	1002	0	0	527	6	62	1597
San Patricio	1449	3	0	8937	114	24	10,527
Victoria	9156	508	303	2966	2293	303	15,529
Wharton	5407	25	0	104,910	200	204	110,746
Total	34,243	9766	5087	206,423	3001	2267	260,787
Percent Use	13.1%	3.7%	2.0%	79.2%	1.2%	0.9%	100%

Source: TWDB 2007a

Table 2.3.2-2
Available and Allocated Groundwater Supplies (Acre-Feet per Year) in Victoria County, Texas (2000–2060)

Groundwater Supplies per Basin	2000	2010	2020	2030	2040	2050	2060
Available							
Guadalupe	18,669	18,669	18,669	18,669	18,669	18,669	18,669
Lavaca	271	271	271	271	271	271	271
Lavaca-Guadalupe	20,389	20,389	20,389	20,389	20,389	20,389	20,389
San Antonio	1800	1800	1800	1800	1800	1800	1800
Total Available	41,129	41,129	41,129	41,129	41,129	41,129	41,129
Allocated							
Guadalupe	16,467	17,330	17,687	17,924	18,174	18,441	18,642
Lavaca	9	9	9	9	9	9	9
Lavaca-Guadalupe	15,125	18,113	17,091	16,187	15,422	14,777	14,212
San Antonio	37	37	37	37	37	37	37
Total Allocated	31,638	35,489	34,824	34,157	33,642	33,264	32,900
Total Unallocated	9491	5640	6305	6972	7487	7865	8229

Source: TWDB Jan 2006
Note: Groundwater supply source is the Gulf Coast Aquifer.

Table 2.3.2-3
Available and Allocated Groundwater Supplies (Acre-Feet/Year) in Calhoun County, Texas (2000–2060)

	2000	2010	2020	2030	2040	2050	2060
Available							
Guadalupe Basin	42	42	42	42	42	42	42
Lavaca-Guadalupe Basin	1334	1334	1334	1334	1334	1334	1334
Colorado-Lavaca Basin	1467	1467	1467	1467	1467	1467	1467
San Antonio-Nueces Basin	97	97	97	97	97	97	97
Total Available	2940	2940	2940	2940	2940	2940	2940
Allocated							
Guadalupe Basin	14	16	17	18	18	19	19
Lavaca-Guadalupe Basin	840	841	842	842	842	842	842
Colorado-Lavaca Basin	1286	1286	1286	1286	1286	1286	1286
San Antonio-Nueces Basin	17	18	19	19	20	20	20
Total Allocated	2157	2161	2164	2165	2166	2167	2167
Total Unallocated	783	779	776	775	774	773	773

Source: TWDB Jan 2006
Note: Groundwater supply source is the Gulf Coast Aquifer.

Table 2.3.2-4
Available and Allocated Groundwater Supplies (Acre-Feet per Year) in Refugio County, Texas (2000–2060)

	2000	2010	2020	2030	2040	2050	2060
Available							
San Antonio Basin	1961	1961	1961	1961	1961	1961	1961
San Antonio-Nueces Basin	40,359	40,359	40,359	40,359	40,359	40,359	40,359
Total Available	42,320	42,320	42,320	42,320	42,320	42,320	42,320
Allocated							
San Antonio Basin	22	22	22	22	22	22	22
San Antonio-Nueces Basin	3820	3040	3041	3041	3041	3041	3041
Total Allocated	3842	3062	3063	3063	3063	3063	3063
Total Unallocated	38,479	39,259	39,258	39,258	39,258	39,258	39,258

Source: TWDB Jan 2006
Note: Groundwater supply source is the Gulf Coast Aquifer.

Table 2.3.2-5
TWDB Wells Located Within 6 Miles of the VCS Site

TWDB Well ID	Owner	Latitude	Longitude	Primary Use	Well Depth (feet)	Water Quality Data	Aquifer	Well Type
7924601	Pat Witte	284029	970018	Stock	40	Y	Chicot	Water
7924701	Rose Morris Estate	283803	970611	Domestic	84	N	Chicot	Water
7924801	Elmo Heller	283845	970430	Domestic	81	N	Chicot	Water
7924901	Pat Witte	283924	970202	Unused	90	Y	Chicot	Water
7924902	Pat Witte	283924	970203	Domestic	125	Y	Chicot	Water
7924903	Henry Witte	283948	970125	Stock	30	N	Chicot	Water
7924904	D.H. Braman	283759	970227	Domestic	254	Y	Chicot	Water
7932101	J.J. Murphy Estate	283554	970514	Unused	250	Y	Chicot	Water
7932102	J.J. Murphy	283533	970546	Unused	1475	N	L. Goliad	Water
7932103	Mary Murphy Greer	283554	970514	Domestic	142	Y	Chicot	Water
7932404	Gussie Smith	283354	970548	Domestic	100	Y	Chicot	Water
7932602	J.A. McFaddin Estate	283248	970020	Irrigation	595	Y	Chicot	Water
7932804	O'Connor Brothers	283231	970306	Stock	716	N	L. Goliad	Water
8025101	J.A. McFaddin Estate	283613	965813	Stock	888	N	Chicot	Water
8025102	J.A. McFaddin Estate	283631	965904	Stock	131	N	Chicot	Water
8025501	J.A. McFaddin Estate	283405	965701	Stock	700	N	Evangeline	Water

Source: TWDB 2007b

Table 2.3.2-6
TCEQ Public Water Supply Wells Located Within 10 Miles of the VCS Site

TCEQ PWS No.	State Well No.	System Name	Latitude	Longitude	Drill Date	Well Depth (feet)	Aquifer
TX-2350001	8017904	Victoria County WCID 1	28.64	96.90	1969	1001	Evangeline
TX-2350001	8017905	Victoria County WCID 1	28.65	96.90	1981	1010	Evangeline
TX-2350014	8017503	INVISTA S.A.R.L.—Victoria	28.68	96.95	1949	1062	Evangeline
TX-2350014	8017504	INVISTA S.A.R.L.—Victoria	28.68	96.95	1949	1059	Evangeline
TX-2350014	8017505	INVISTA S.A.R.L.—Victoria	28.68	96.95	1956	447	Evangeline
TX-2350036	7923301	Coleto Water Co.	28.72	97.14	1977	222	Evangeline
TX-2350044	N/A	Speedy Stop 46	28.70	97.05	1986	130	Chicot
TX-2350051	N/A	Victoria County Navigation District	28.70	96.95	2000	190	Chicot
TX-2350051	N/A	Victoria County Navigation District	28.69	96.95	2004	260	Chicot

Source: TCEQ Oct 2007a
NA = Not available
PWS = Public Water Supply
WCID = Water Control and Improvement District

Table 2.3.2-7
Surface Water Use (Acre-Feet per Year) by County in 50-Mile Radius of the VCS Site (2007)

County	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
Aransas	2950	43	0	0	0	33	3026
Bee	3354	0	0	0	0	807	4161
Calhoun	2194	54,297	0	15,509	0	169	72,169
DeWitt	512	0	0	0	0	1813	2325
Goliad	0	0	2055	0	0	1100	3155
Gonzales	2289	162	0	360	0	4227	7038
Jackson	0	417	0	621	0	677	1715
Lavaca	3	0	0	591	0	2153	2747
Matagorda	0	9335	40,836	154,625	0	1140	205,936
Refugio	0	0	0	0	0	600	600
San Patricio	8190	14,453	0	223	57	403	23,326
Victoria	0	19,966	952	0	0	834	21,752
Wharton	0	0	0	211,126	437	1082	212,645
Total	19,492	98,673	43,843	383,055	494	15,038	560,595
Percent Use	3.5%	17.6%	8.0%	68.2%	0.09%	2.68%	100%

Source: TWDB 2007a

Table 2.3.2-8
List of major Guadalupe River Basin Reservoirs

Reservoir	Water Right Owner	Certificate of Adjudication Number	Authorized Diversion (ac-ft per yr)	Firm Yield (ac-ft per yr)	Purposes
Canyon Reservoir	GBRA	18-2074	90,000[a]	~90,000[a]	Municipal, industrial, steam-electric, hydropower, irrigation, flood protection
Coleto Creek Reservoir	Coleto Creek Power	18-5486	12,500[b]	>12,500[c]	Steam-electric power generation

(a) Subject to the hydrologic assumptions and operational procedures listed in Section 3.2.3.1 of the 2006 South Central Texas Regional Water Plan, estimates of Canyon Reservoir firm yield range from 88,232 acre-feet per year to 87,484 acre-feet per year in years 2000 and 2060, respectively.

(b) Includes rights to divert up to 20,000 acre-feet per year from the Guadalupe River to Coleto Creek Reservoir and to consume up to 12,500 acre-feet per year.

(c) The reservoir and supplemental authorized diversions from the Guadalupe River could support a firm yield in excess of the authorized consumptive use; however, operations of Coleto Creek Power steam- electric power generation facilities could be impaired.

Source: TWDB Jan 2006

Table 2.3.2-9 (Sheet 1 of 2)
Surface Water Users in Victoria County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft per Yr	Use	Priority Date
3858	Cert of Adj	First Victoria Natl Bank Trust I	28.93	–97.15	Guadalupe	Guadalupe River	1000	Irrigation	6/27/1951
3859	Cert of Adj	South Texas Electric Coop Inc.	28.89	–97.14	Guadalupe	Guadalupe River	110,000	Industrial	2/18/1964
3860	Cert of Adj	City of Victoria	28.81	–97.03	Guadalupe	Guadalupe River	260	Municipal/ Domestic	8/15/1951
3860	Cert of Adj	City of Victoria	28.81	–97.03	Lavaca-Guadalupe	Guadalupe River	__	Municipal/ Domestic	8/15/1951
3860	Cert of Adj	City of Victoria	28.81	–97.03	Guadalupe	Guadalupe River	__	Storage	8/15/1951
3860	Cert of Adj	City of Victoria	28.81	–97.03	Lavaca-Guadalupe	Guadalupe River	__	Storage	8/15/1951
3861	Cert of Adj	E.I. Dupont De Nemours & Co	28.66	–96.96	Guadalupe	Guadalupe River	60,000	Industrial	8/16/1948
3862	Cert of Adj	Paradise Ranch Landowners Assn. Inc.	28.65	–96.96	Guadalupe	Guadalupe River	263	Irrigation	12/12/1951
3862	Cert of Adj	E.I. Dupont De Nemours & Co	28.65	–96.96	Guadalupe	Guadalupe River	137	Irrigation	12/12/1951
3863	Cert of Adj	Jess Womack II et al.	28.57	–96.91	Guadalupe	Guadalupe River	200	Irrigation	3/1/1951
3863	Cert of Adj	Guadalupe-Blanco River Authority	28.57	–96.91	Guadalupe	Guadalupe River	3000	Municipal/ Domestic	3/1/1951
3863	Cert of Adj	Guadalupe-Blanco River Authority	28.57	–96.91	Guadalupe	Guadalupe River	__	Industrial	3/1/1951
3863	Cert of Adj	Guadalupe-Blanco River Authority	28.57	–96.91	Guadalupe	Guadalupe River	__	Irrigation	3/1/1951
3895	Permit	Kate S O'Connor Trust	28.64	–96.96	Guadalupe	Guadalupe River	9676	Industrial	7/10/1978
4020	Permit	Nelson Pantel	28.92	–97.15	Guadalupe	Guadalupe River	100	Irrigation	1/21/1980
4062	Permit	Jay M. Easley et al.	28.88	–97.10	Guadalupe	Guadalupe River	90	Irrigation	7/14/1980
4182	Permit	William A. Kyle Jr. et al.	28.90	–97.14	Guadalupe	Guadalupe River	200	Irrigation	12/21/1981
4324	Permit	Spring Creek Development Co.	28.85	–97.01	Guadalupe	Spring Creek	__	Recreation	2/7/1983
4441	Permit	S.F. Ruschhaupt III	28.95	–97.16	Guadalupe	Guadalupe River	200	Irrigation	4/2/1984
5012	Permit	Joe D. Hawes	28.51	–96.92	Guadalupe	Elm Bayou	140	Irrigation	9/10/1985

Table 2.3.2-9 (Sheet 2 of 2)
Surface Water Users in Victoria County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft per Yr	Use	Priority Date
5376	Permit	Heldenfels Brothers Inc.	28.84	–97.01	Guadalupe	Spring Creek	2	Industrial	8/16/1991
5424	Permit	Housing Authority of City of Victoria	28.87	–97.01	Guadalupe	Unnamed Trib. Spring Creek	—	Recreation	7/23/1992
5466	Permit	City of Victoria	28.81	–97.03	Guadalupe	Guadalupe River	20,000	Municipal/ Domestic	5/28/1993
5485	Cert of Adj	Victoria WLE LP	28.79	–97.01	Guadalupe	Guadalupe River	209,189	Industrial	8/15/1951
5486	Cert of Adj	Coleto Creek WLE LP	28.72	–97.17	Guadalupe	Guadalupe River	20,000	Industrial	1/7/1952
5486	Cert of Adj	Coleto Creek WLE LP	28.72	–97.17	Guadalupe	Guadalupe River & Coleto Creek	12,500	Industrial	1/10/1977
5489	Permit	Jess Womack II et al.	28.52	–96.92	Guadalupe	Cushman Bayou	750	Other	5/12/1994

Source: TCEQ Oct 2007b

Table 2.3.2-10 (Sheet 1 of 6)
Surface Water Users in Calhoun County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft/Year	Use	Priority Date	Remarks
3746	Permit	Patrick H. Welder, Jr.	28.55	–96.83	Lavaca-Guadalupe	Victoria Barge Canal	1284.3	Irrigation	10/1/1979	None
3746	Permit	Standard Oil Chemical Co.	28.55	–96.83	Lavaca-Guadalupe	Victoria Barge Canal	715.7	Irrigation	10/1/1979	None
3864	Cert of Adj	Texas Parks & Wildlife Dept.	28.49	–96.81	Lavaca-Guadalupe	Hog Bayou	50	Irrigation	12/31/1955	Guadalupe Delta WMA
4276	Permit	Del & Gloria Williams	28.46	–96.83	Guadalupe	Guadalupe River	272	Industrial	6/25/1985	Crawfish Farm
5173	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	2500	Irrigation	2/3/1941	Amend. 5/21/04, 9/27/0, 5/1/2007: Stat Dist.
5173	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	8/12/1988	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5173	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	2/3/1941	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5173	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	2/3/1941	Part Owner with GBRA
5173	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	2/3/1941	Part Owner of 2500 Ac-Ft with GBRA
5173	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	8/12/1988	Amend. 4/17/91. Part Owner with GBRA

Table 2.3.2-10 (Sheet 2 of 6)
Surface Water Users in Calhoun County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft/Year	Use	Priority Date	Remarks
5174	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	1870	Irrigation	6/15/1944	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5174	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	6/15/1944	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5174	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	6/15/1944	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5174	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	6/15/1944	Part Owner of 1870 Ac-Ft with GBRA
5174	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	6/15/1944	Part Owner with GBRA
5174	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	6/15/1944	Amend. 4/17/91. Part Owner with GBRA
5175	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	940	Industrial	2/13/1951	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5175	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	2/13/1951	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.

Table 2.3.2-10 (Sheet 3 of 6)
Surface Water Users in Calhoun County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft/Year	Use	Priority Date	Remarks
5175	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Mining	2/13/1951	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5175	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Other (stockraising)	2/13/1951	Stockraising Amend. 4/91, 5/04, 9/04, 5/1/2007
5175	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	2/13/1951	Amend. 4/17/91. Part Owner with GBRA
5175	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	2/13/1951	Amend. 4/17/91. Part Owner with GBRA
5175	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Mining	2/13/1951	Amend. 4/17/91. Part Owner with GBRA
5175	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Other	2/13/1951	Stockraising, Amend. 4/91, 5/2004, 9/27/2004
5176	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	9944	Municipal/ Domestic	6/21/1951	Amend. 5/21/04, 9/27/04, 5/1/2007: Stat Dist.
5176	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	6/21/1951	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat. District

**Table 2.3.2-10 (Sheet 4 of 6)
Surface Water Users in Calhoun County**

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft/Year	Use	Priority Date	Remarks
5176	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	6/21/1951	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat District
5176	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Municipal/ Domestic	6/21/1951	Part Owner of 9944 Ac-Ft with GBRA
5176	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	6/21/1951	Part Owner of 9944 Ac-Ft with GBRA
5176	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	6/21/1951	Part Owner of 9944 Ac-Ft with GBRA
5177	Cert of Adj	Guadalupe–Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	32,615	Municipal/ Domestic	1/3/1944	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat District
5177	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	1/3/1944	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat District
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Municipal/ Domestic	1/3/1944	Part Owner of 3,2615 Ac-Ft with GBRA
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	1/3/1944	Part Owner of 3,2615 Ac-Ft with GBRA

Table 2.3.2-10 (Sheet 5 of 6)
Surface Water Users in Calhoun County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft/Year	Use	Priority Date	Remarks
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	1/3/1944	Part Owner of 3,2615 Ac-Ft with GBRA
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	10,000	Municipal/ Domestic	1/3/1944	1,0000 Ac-Ft Uses 1,2,3: Union Carbide Only
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	1/3/1944	1,0000 Ac-Ft Uses 1,2,3: Union Carbide Only
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	1/3/1944	1,0000 Ac-Ft Uses 1,2,3: Union Carbide Only
5177	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	8632	Industrial	1/26/1948	8632 Ac-Ft Uses 2 & 3. AM 1991, 2004, 5/1/2007
5177	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	1/26/1948	8632 Ac-Ft Uses 2 & 3 AM 1991, 2004, 5/1/2007
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	1/26/1948	Part Owner with GBRA, 8632 Ac-Ft Uses 2 & 3
5177	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	1/26/1948	Part Owner with GBRA, 8632 Ac-Ft Uses 2 & 3

Table 2.3.2-10 (Sheet 6 of 6)
Surface Water Users in Calhoun County

Water Right Number	Type	Owner Name	Latitude	Longitude	River Basin	Stream Name	Amount in Ac-Ft/Year	Use	Priority Date	Remarks
5178	Cert of Adj	Guadalupe- Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	106,000	Municipal/ Domestic	5/5/1954	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat District
5178	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	5/5/1954	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat District
5178	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	5/5/1954	Amend. 4/91, 5/04, 9/04, 5/1/2007: Stat District
5178	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Municipal/ Domestic	5/5/1954	Seadrift Plant Part Owner of 106,000 Ac-Ft with GBRA
5178	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Industrial	5/5/1954	Seadrift Plant Part Owner of 106,000 Ac-Ft with GBRA
5178	Cert of Adj	Union Carbide Chem. & Plastics	28.51	–96.89	Guadalupe	Guadalupe River: Mission Bay, Green Lake, Hog Bayou, Goff Bayou	—	Irrigation	5/5/1954	Part Owner of 106,000 Ac-Ft with GBRA
5484	Cert of Adj	Guadalupe-Blanco River Authority	28.51	–96.89	Guadalupe	Guadalupe River	—	Industrial	5/15/1964	& Co 196. In Accordance w/5173-517 8
5639	Cert of Adj	Terry M. Whitaker et al.	28.59	–96.77	Lavaca-Guadalupe	Coloma Creek	40	Irrigation	8/23/1999	SC

Source: TCEQ Oct 2007b

Table 2.3.2-11
Surface Water Users in Goliad County

Water Right Number	Type	Owner Name	Longitude	Latitude	River Basin	Stream Name	Amount in Acre-Feet per Year	Use	Priority Date	Remarks
2193	Cert of Adj	James M. Pettus et al.	–97.603798	28.692085	San Antonio	San Antonio River	284	Irrigation	12/31/1963	None
2194	Cert of Adj	Julia Gannt Newton et al.	–97.581062	28.686396	San Antonio	San Antonio River	1020	Irrigation	11/14/1947	None
2195	Cert of Adj	Kenneth B. Perkins	–97.571136	28.685186	San Antonio	San Antonio River	410	Irrigation	1/13/1956	None
2196	Cert of Adj	Coleto Cattle Company	–97.565994	28.680069	San Antonio	San Antonio River	336	Irrigation	11/30/1950	None
2197	Cert of Adj	James M. Pettus et al.	–97.52832	28.653498	San Antonio	San Antonio River	86	Irrigation	1/31/1967	None
2198	Cert of Adj	San Antonio River Authority	–97.507668	28.647745	San Antonio	San Antonio River	333	Irrigation	4/25/1950	No land; subject to amendment
2199	Cert of Adj	Sam Houston Clinton et al.	–97.491386	28.642643	San Antonio	San Antonio River	325	Irrigation	1/20/1949	None
3820	Permit	June Pettus	–97.52449	28.649004	San Antonio	San Antonio River	950	Irrigation	4/20/1981	Jointly owns 950 acre-feet to irrigate 380 acre-feet
3820	Permit	Mrs. Joe Cohn	–97.52449	28.649004	San Antonio	San Antonio River	—	Irrigation	4/20/1981	Jointly owns 950 acre-feet to irrigate 380 acre-feet
2195	Cert of Adj	Kenneth B. Perkins	–97.571136	28.685186	San Antonio	San Antonio River	410	Irrigation	1/13/1956	None
5079	Permit	John Brooke	–97.539726	28.66877	San Antonio	San Antonio River	114	Irrigation	7/28/1986	None
5220	Permit	Clarence F. Schendel et al.	–97.459122	28.648272	San Antonio	San Antonio River	330	Irrigation	2/27/1989	None
5313	Permit	Edwin Jacobson et al.	–97.610405	28.707199	San Antonio	San Antonio River	100	Irrigation	8/30/1990	Amended 4/11/97: 181.6 acre-feet off-channel imp.
5478	Permit	Patricia Pittman Light	–97.486397	28.642387	San Antonio	San Antonio River	300	Irrigation	1/14/1994	Off-channel reservoir

Source: TCEQ 2008a

Table 2.3.2-12
Summary of GBRA/UCC Water Rights in the Lower Guadalupe River Basin

Permit Number	Certificate of Adjudication	Priority Date	Authorized Use	Owner	Authorized Diversion Ac-Ft per Yr
1319	18-5173	2/3/1941	Irrigation/Industrial	GBRA/Union Carbide	2,500
1362	18-5174	6/15/1944	Irrigation/Industrial	GBRA/Union Carbide	1,870
1564	18-5175	2/13/1951	Irrigation/Industrial/ Mining/Livestock	GBRA/Union Carbide	940
1592	18-5176	6/21/1951	Irrigation/Industrial/ Municipal	GBRA/Union Carbide	9,944
1375	18-5177	1/3/1944	Industrial/Irrigation/ Municipal	GBRA/Union Carbide	32,615
1375	18-5177	1/3/1944	Irrigation/Industrial	GBRA/Union Carbide	8,632
1375	18-5177	1/3/1944	Irrigation/Industrial/ Municipal	Union Carbide	10,000
1614	18-5178	1/7/1952	Irrigation/Industrial/ Municipal	GBRA/Union Carbide	106,000
1562	18-3863	3/1/1951	Irrigation/Industrial/ Municipal	GBRA	3,000
2120	18-5484	5/15/1964	Diversion Dam & Salt Water Barrier	GBRA	N/A
Totals:					175,501

Source: Derived from TCEQ Oct 2007b

Table 2.3.2-13
GBRA Record of Reported Calhoun Canal Water Use and Availability

	2000	2001	2002	2003	2004	2005	2006	Average
GBRA/UCC (Calhoun Canal) Water Rights[(a)]	175,501	175,501	175,501	175,501	175,501	175,501	175,501	175,501
Industrial Customers Ineos Nitriles (formerly BP Chemicals) DOW Chemical Company (formerly Union Carbide Corp [UCC]) Seadrift Coke	26,637	26,047	21,919	20,482	19,370	20,254	22,264	22,425
Municipal Customers City of Port Lavaca Port O'Connor Municipal Utility District (MUD) GBRA Calhoun County Rural Water System	4754	3849	5837	10,398	4882	8482	6946	6450
Irrigation Customers Rice Farmers Aquaculture Farmers Waterfowl Enhancement	18,539	21,774	23,893	14,030	15,508	19,809	15,813	18,481
Total GBRA Calhoun Canal Water Used	49,930	51,670	51,649	44,910	39,760	48,545	45,023	47,355
Total Underutilized GBRA/UCC Water Rights	125,571	123,831	123,852	130,591	135,741	126,956	130,478	128,146

(a) For a detailed breakdown of the GBRA/UCC water rights, see Table 2.3.2-12.
Source: GBRA Nov 2007

Table 2.3.2-14
Projected Surface Water Demands, Supplies, and Needs for Victoria and Calhoun Counties (Acre-Feet per Year) (2000–2060)

	Actual 2000	2010	2020	2030	2040	2050	2060
GBRA/UCC (Calhoun Canal) Water Rights[(a)]	175,501	175,501	175,501	175,501	175,501	175,501	175,501
Calhoun County							
Total Calhoun County Water Demands[(b)]	49,930[(c)]	69,243	72,564	75,795	79,489	82,816	87,247
Less Calhoun Eastern Industrial Demands met by Lake Texana[(b)]	–20,128	–23,392	–25,644	–27,861	–30,086	–31,917	–34,238
Calhoun County Water Demands	29,802	45,851	46,920	47,934	49,403	50,899	53,009
Victoria County							
Victoria County Industrial Needs[(b)]	0	0	0	0	1008	3624	6566
Total Underutilized GBRA/UCC Water Rights	145,699	129,650	128,581	127,567	125,090	120,978	115,926

(a) For a detailed breakdown of the GBRA/UCC Surface Water Rights, see Table 2.3.2-12.

(b) Source of projected demands, Lake Texana supplies, and needs is the 2006 South Central Texas Region L Water Plan. In the Region L Water Plan, “needs” are projected shortages or projected demands not met by existing supplies. GBRA currently does not supply Victoria County with water from the GBRA/UCC (Calhoun County) water rights, but due to projected shortages in Victoria County, GBRA will supply water to Victoria County starting in 2040 to offset the projected water shortages.

(c) Total Calhoun County Water Demands for 2000 provided by GBRA Nov 2007 as shown in Table 2.3.2-13.

Source: HDR Feb 2008 except as noted

Table 2.3.2-15
Comparison of 1990–2009 Historical Droughts to the 1950s Drought of Record(a)

HISTORICAL PERIODS	MINIMUM CUMULATIVE FLOWS FOR INDICATED MONTHLY DURATIONS					
	3 Months	6 Months	12 Months	18 Months	24 Months	36 Months
	GUADALUPE RIVER FLOW AT SPRING BRANCH UPSTREAM OF CANYON RESERVOIR					
1950s Drought	66	1,830	7,171	14,661	38,986	61,483
1990 - 2009	2,515	13,947	33,217	60,925	128,566	453,186
	INCREMENTAL INFLOW INTO GUADALUPE RIVER FROM NEW BRAUNFELS TO VICTORIA					
1950s Drought	7,992	23,252	85,484	151,008	296,035	507,874
1990 - 2009	25,831	97,525	274,762	467,752	820,794	1,990,216
	INCREMENTAL INFLOW INTO SAN ANTONIO RIVER FROM FALLS CITY TO GOLIAD					
1950s Drought	-6,248 *	1,188	4,506	29,611	46,587	77,137
1990 - 2009	1,006	4,812	14,041	27,773	60,171	213,122
	COMBINED INCREMENTAL INFLOWS INTO GUADALUPE RIVER FROM NEW BRAUNFELS TO VICTORIA AND INTO SAN ANTONIO RIVER FROM FALLS CITY TO GOLIAD					
1950s Drought	1,744	32,739	89,990	195,199	358,984	597,159
1990 - 2009	32,836	103,686	288,803	543,840	971,890	2,225,148

* Negative incremental flows are likely the result of diversions and channel losses within the river reach that exceed the sum of river flows at the upstream end of the reach and natural inflows within the reach.

(a) Summary of minimum cumulative flows for different consecutive-month durations based on historical flows during the 1950s drought and the 1990-2009 period for key locations and reaches of the Guadalupe and San Antonio Rivers relevant to supplying water for VCS from a diversion point immediately upstream of the GBRA Saltwater Barrier.

2.3.3 Water Quality

This subsection considers the water quality of surface water bodies and groundwater aquifers that could affect plant water use and effluent discharge, or be affected by the construction or operation of the proposed plant to be built at the VCS site.

2.3.3.1 Groundwater

Groundwater quality in the Gulf Coast aquifer, consisting of the Chicot, Evangeline, and Jasper aquifers from youngest to oldest (TWDB Jan 2007), is generally good in the shallower portion of the aquifer. Groundwater containing less than 500 mg/L total dissolved solids (TDS) is usually encountered to a maximum depth of 3200 feet in the aquifer from the San Antonio River Basin northeastward. From the San Antonio River Basin southwestward, quality deterioration is evident in the form of increased chloride concentrations and saltwater encroachment along the coast (TWDB Jan 2006).

Groundwater from the Evangeline aquifer in areas south of Bee County, which is hydraulically downgradient of the site, has elevated concentrations of radioactivity relative to the rest of the aquifer system. Radioactivity generally increases from the northern part to the southern part of the Gulf Coast aquifer, occurs irregularly with depth, and shows no trend in composition. Radioactivity in the Texas Water Development Board (TWDB) Groundwater Database is mainly expressed as gross alpha and gross beta. Approximately 6.27 percent of 272 samples collected by the TWDB from the Evangeline Aquifer exceeded 15 pCi/L, the EPA maximum contaminant level (MCL) for alpha activity (not including radon or uranium). The gross alpha activity was reported in the 272 TWDB water samples at a maximum concentration of 208 picocuries per liter (pCi per L), a mean concentration of 6.05 pCi per L and a median concentration of 2.60 pCi per L. Nearly all the samples analyzed for beta activity were below the MCL.

The Texas Water Commission (TWC March 1989) reports, during a 1987 and 1988 study, anomalous radium concentrations of up to 65 pCi per L peaked at a depth of 585–1140 feet below the ground surface and were associated with wells near salt domes and/or streams. The study indicated that the proximity of salt domes and associated fault systems was an important predictor for the presence of radon and radium in the groundwater. Concentrations decreased as distance from the domes increased. It was concluded that radium and radon in the groundwater may have originated in the Catahoula Formation, a known source of uranium mineralization, and migrated upward into the shallower portion of the Gulf Coast aquifer. Avenues for migration may be located along flanks of piercement salt domes, along faults, and through permeable sediments deposited by streams. Alternatively, it was proposed that uranium could have migrated through the upper aquifer strata and concentrated in the reducing halo surrounding the domes (TWC Mar 1989).

Groundwater quality data for six of the TWDB wells located within 6 miles of the site (Figure 2.3.2-2) is summarized in Table 2.3.3-1**.** The data collected from the six wells includes a total of 12 samples collected between 1959 and 2005. The data indicates that chloride and total dissolved solids (TDS) concentrations in these wells exceed their EPA secondary maximum contaminant levels (SMCL). Nitrate concentrations in some of the groundwater samples are also in excess of the EPA MCL for nitrate (U.S. EPA 2008a).

In November 2007, groundwater samples were collected from eight groundwater wells at the site. The wells included two McCan Ranch livestock wells (i.e., Northwest Gate Well and Southwest Windmill Well) and six VCS site observation wells (i.e., OW-01 U/L, OW-03 L, OW-08 U/L, and OW-10 L), all of which are screened in the Chicot Aquifer. The depth of the livestock well referred to as the Southeast Windmill well is reportedly 135 feet deep (Banks Aug 2007), while the depth of the livestock well referred to as the Northwest Gate well is unknown. The VCS site observation wells that were included in the sampling program are screened at depths ranging from 56 feet to 142 feet below the ground surface.

In April 2008, a second groundwater sampling event was conducted for the same eight onsite wells sampled in November 2007, as well as one additional site observation well (i.e., OW-10 U) that was dry during the November sampling event. In addition, an offsite well (TWDB #7932602) screened in the deeper Evangeline Aquifer was sampled in March 2008.

The locations of the nine onsite and one offsite groundwater wells sampled in November 2007 and April 2008 are shown in Figure 2.3.3-1.

Each of the ten groundwater samples from the nine onsite wells and the offsite well was analyzed for the parameters selected from NRC guidance, as well as parameters used for permitting and plant design purposes. The parameter list for the nine onsite well samples and the offsite well sample is shown in Tables 2.3.3-2 and 2.3.3-3, respectively.

As shown in Table 2.3.3-1, the six TWDB wells located within 6 miles of the VCS site that have water quality data were analyzed for many of the same sample parameters as those in the November 2007 and April 2008 investigation (Table 2.3.3-2). The results from the recent (November 2007 and April 2008) groundwater investigation indicate that the general chemistry of groundwater at the site is within the ranges of concentrations seen in the TWDB wells from 1959 to 2005.

The April 2008 groundwater sampling results were compared to the analytical results of the November 2007 groundwater investigation to evaluate seasonal changes in groundwater quality of the nine onsite wells installed in the shallow Chicot Aquifer. Chloride concentrations increased in all the wells between the November and April sampling events. In November, the average chloride concentration in the wells was 173 milligrams per liter versus an average chloride concentration of

2098 mg per liter reported in April. Temperature, total hardness, alkalinity, sulfate, total silica, sodium, and total iron concentrations also increased in the water samples between the November and April sampling events. The increase in these groundwater quality parameters is most likely a reflection of the lower groundwater levels in April and resultant stagnant groundwater flow regime. Dissolved oxygen, pH, and conductivity remained relatively constant between the two sampling events, while TDS, barium, magnesium and total coliform concentrations decreased.

Most of the parameters for site groundwater were within the MCL or SMCL, with the following exceptions: chloride, aluminum, arsenic, barium, iron, lead, manganese, TDS, and Ra-228. The metals strontium and potassium were detected in shallow groundwater at the site during the November sampling event (the parameters were not included in the April sampling event). Analytical results for the nine onsite groundwater wells are summarized in Table 2.3.3-2.

Analytical results from the March 2008 sampling of the offsite well (TWDB #7932602) are summarized in Table 2.3.3-3. TDS and sodium were reported in the well at concentrations higher than the onsite well concentrations reported in November and April.

High chloride in groundwater has been mapped for all the major aquifers of Texas. Chloride leaches into the groundwater from sedimentary rocks, soils, and salt deposits. The metals aluminum, arsenic, barium, iron, lead, and manganese also occur naturally by leaching from aquifer materials into the groundwater. The high TDS concentrations in groundwater are a result of the high levels of metals and organics in the groundwater. Radium is also found naturally in groundwater in parts of Texas and was reported in two of the TWDB wells located within 6 miles of the site (included in gross alpha analysis in Table 2.3.3-1). Strontium and potassium are also detected in groundwater, but neither has associated drinking water standards (MCL or SMCL). Both strontium and potassium are naturally occurring in rock. In addition, potassium can be attributed to contamination from animal waste.

2.3.3.2 Surface Water

Surface water bodies of primary interest include: lower Guadalupe River, lower San Antonio River, Guadalupe-Blanco River Authority (GBRA) Calhoun Canal (which receives water diverted from an impoundment formed by the GBRA Saltwater Barrier), Victoria Barge Canal and Kuy Creek. These water bodies are important because the proposed VCS would withdraw makeup water through an intake structure assumed to be located on the west bank of the Guadalupe River approximately 0.6 miles southwest of the GBRA Saltwater Barrier and Diversion Dam; cooling basin blowdown would be discharged to the Guadalupe River upstream of the intake location; and an existing barge offload facility at the Port of Victoria Turning Basin located east of the site on the Victoria Barge Canal would be upgraded, as necessary, as part of the VCND transportation corridor project evaluated in Sections 4.7 and 5.11. Kuy Creek will intercept runoff from the site's cooling basin spillway during storms that exceed the 100-year rain event. The GBRA Calhoun Canal is considered as an alternate source of makeup water in Section 9.4. Coleto Creek is a major tributary to the Guadalupe River upstream of the proposed cooling basin blowdown location. The RWMU intake location is approximately 11 miles southeast of the VCS site, and three routes for the makeup water pipeline are evaluated as shown in Figure 2.2-5. Each of the routes would cross the San Antonio River and Elm Bayou.

The southern half of the site is bisected north to south by the ephemeral Dry Kuy Creek, which drains into the intermittent/ephemeral Kuy Creek south of the site**.** Other surface water bodies on the site include several unnamed intermittent or ephemeral tributaries to Kuy Creek (along the western section of the site), several unnamed intermittent or ephemeral tributaries to Linn Lake (along the eastern section of the site), four isolated wetlands ranging in size from approximately 5 to 40 acres, and more than two dozen small, isolated stock ponds.

One important goal of both the TCEQ and EPA, through the Clean Water Act, is maintaining the quality of surface waters to provide for the survival and propagation of a balanced, indigenous, aquatic flora and fauna community. The TCEQ established five subcategories of aquatic life (limited, intermediate, high, and exceptional aquatic life, and oyster waters). The aquatic life subcategories recognize the natural variability of aquatic community requirements and local environmental conditions. Biological data are considered to be a better indicator of water quality than chemical conditions. Therefore, if biological data shows a healthy, balanced community, the use is considered supported even if chemical parameters do not meet the applicable criteria. The criteria for “contact recreational use” are attained based on the frequency of E. coli and fecal coliform excursions. That is, the criteria are attained if E. coli do not exceed 126 organisms per 100 milliliters based upon the geometric mean of samples, with no single sample exceeding 394 per 100 milliliters, and fecal coliform organisms do not exceed 200 colonies per 100 milliliters based upon the geometric mean of samples, with no single sample exceeding 400 colonies per 100 milliliters (TCEQ 2000).

The TCEQ Surface Water Quality Segments located in the site’s hydrologic system are shown in Figure 2.3.3-2, and the designated uses of each segment are summarized in Table 2.3.3-4. The San Antonio River Segment 1901 and the San Antonio Bay/Hines Bay/Guadalupe Bay Segment 2462, Area 2462-02, are included on the 2008 Texas Water Quality Inventory and 303(d) List of Impaired Waters for high levels of bacteria (TCEQ 2008a).

Table 2.3.3-5 provides a list of 11 U.S. Geological Survey (USGS) and TCEQ surface water monitoring stations from which surface water quality data was collected. The locations of the monitoring stations are shown on Figure 2.3.3-3, and the water quality data is summarized in Tables 2.3.3-6 through 2.3.3-17.

In November 2007 and April 2008, surface water quality data were collected from a series of surface water bodies at and near the site as part of the site surface water characterization. The sample locations are shown in Figure 2.3.3-4**.** Each of the surface water samples was analyzed for a list of parameters that included those based on NRC guidance, as well as those used for permitting and plant design purposes. The water quality data are summarized in Table 2.3.3-18.

2.3.3.2.1 Guadalupe River

Water quality data for two USGS and five TCEQ surface water quality stations located on the lower Guadalupe River is summarized in Tables 2.3.3-6 through 2.3.3-13. Table 2.3.3-8 presents water quality data collected from the TCEQ Station 16579, which is located near the Invista-DuPont effluent discharge. TCEQ and GBRA discontinued collecting data at Station 16579 in 2008 because the integrity of the data was deemed suspect due to the station's proximity to the industrial outfall (GBRA Nov 2007).

Downgradient of the confluence with the San Marcos River, the Guadalupe River flows through an area occupied by a number of large poultry farms and cattle ranches. To date, there have been no problems in the main segment associated with these land uses, although the tributary Sandies Creek and Peach Creek watersheds have been listed as impaired (GBRA May 2006). In early assessments, there were concerns for nutrient enrichment and depressed oxygen in the tidal segment of the river; however, the tidal segment has been removed from the 2008 List of Impaired Waters for aquatic life use.

In November 2007 and April 2008, surface water samples (SW-01 and SW-05) were collected from the lower Guadalupe River as part of the Victoria County site surface water characterization. The locations of the river samples are shown in Figure 2.3.3-4, and the analytical data is summarized in Table 2.3.3-18.

Guadalupe River at Highway 59 (SW-05)

The November 2007 sampling event reported relatively high metal concentrations at SW-05, but the higher metals concentrations seen in November may be due to higher turbidity in the river, resulting from a rain event during the sampling period. The turbidity of the sample collected at SW-05 during the November sampling event was 482 nepthelometric turbidity units (NTUs) compared to the high historical (from 2004 to 2007) turbidity of 384 NTUs reported from TCEQ 12590.

The river flow during the April 2008 sampling event was near normal, and as a result turbidity was much less than that measured in November. Other water quality parameters, including color, phosphorous, total and fecal coliform, and iron also decreased.

Comparison of historical surface water quality data from monitoring stations USGS Station 08176500, TCEQ Station 12590, and TCEQ Station 12581 indicates that the general chemistry of the surface water collected from SW-05 in April shows little discernible variation from the historical data (GBRA Undated, USGS 2008, U.S. EPA 2008b).

Guadalupe River at the GBRA Saltwater Barrier (SW-01)

Historical water quality data collected from TCEQ Station 12578, which is located at the GBRA Saltwater Barrier, is summarized in Tables 2.3.3-6 and 2.3.3-7.

The general chemistry of the November 2007 and April 2008 samples collected at the saltwater barrier is typical of the historical general chemistry of the river at that location. Similar to SW-05, the November sampling data shows higher turbidity concentrations relative to the April data.

2.3.3.2.2 San Antonio River

Historical water quality data collected from TCEQ Station 12789 located on the lower San Antonio River are summarized in Table 2.3.3-14.

In the past, water quality in the San Antonio Basin has varied from very good in the upper basin to relatively poor in the lower basin, particularly during periods of low flow. Since 1987, advanced water treatment has been instituted at the three major San Antonio area water recycling plants. As a result, dissolved oxygen concentrations in the San Antonio River have been maintained well above the state of Texas stream standard of 5.0 mg per liter and aquatic life has been significantly enhanced. Of the 13 TCEQ water segments comprising the San Antonio Basin, all but two segments are rated as either high or excellent for aquatic life. Of the remaining two segments, Segment 1912 (Medio Creek) has a rating of impaired and Segment 1913 (Mid Cibolo Creek) has a rating of limited aquatic life (TCEQ 2000). As shown in Table 2.3.3-14, the lower San Antonio River is impaired for high levels of bacteria (TWDB Jan 2006).

The TCEQ completed a total maximum daily load (TMDL) study to determine the measures necessary to restore water quality in lower San Antonio River (LSAR) Segment 1901. The goal of the LSAR TMDL study was to determine the load of pollutants that the river can receive and still support its designated uses. The load was allocated to the source of pollution in the watershed. An implementation plan to reduce pollutant loads was then developed. The LSAR TMDL Report was completed and adopted by the TCEQ on August 20, 2008. EPA Region 6 approved the LSAR TMDL on October 20, 2008 (TCEQ Mar 2009).

2.3.3.2.3 GBRA Calhoun Canal (SW-06)

Water quality data collected from USGS Station 08188600, located on the GBRA Calhoun Canal near the GBRA Relift #1 Station is summarized in Table 2.3.3-15. The parameters measured and reported at the USGS monitoring station include primarily pesticides and herbicides, of which none were detected.

In November 2007 and April 2008, surface water samples were collected from sample location SW-06 (shown in Figure 2.3.3-4), which is located on the GBRA Calhoun Canal. The April water quality data collected at SW-06 indicated higher concentrations of many of the parameters such as TDS, hardness, total suspended solids (TSS), alkalinity, chloride, sulfate, sodium, iron, and magnesium than those reported during the November sampling event. However, turbidity concentrations decreased.

2.3.3.2.4 Victoria Barge Canal

Water quality data collected from TCEQ Station 12536 located on the Victoria Barge Canal is summarized in Table 2.3.3-16.

All water quality standards and uses are supported on the Victoria Barge Canal. Although the canal has high aquatic life use (Table 2.3.3-4), phosphorous and chlorophyll-a levels are occasionally elevated. At certain times during the year, the canal is very biologically productive and other parameters do not indicate water quality instability (TWDB Jan 2006).

2.3.3.2.5 Kuy Creek (SW-02)

In November 2007 and April 2008, surface water samples were collected at sample location SW-02, which is shown in Figure 2.3.3-4.

The April water quality data indicated higher TSS, chloride, and iron concentrations relative to the November data. However, turbidity, TDS, and magnesium concentration decreased from November to April. The creek had high total coliform concentrations during both sampling events that are assumed to result from cattle loitering in and around the creek.

Based on a review of surface water quality data from USGS and TCEQ monitoring stations located in the lower San Antonio and lower Guadalupe River basins, the general chemical and biological characteristics of the Kuy Creek water samples are typical for the area (GBRA Undated and Dec 2007, USGS 2008, U.S. EPA 2008b). However, chloride, sulfate, sodium, iron, and magnesium are relatively elevated in Kuy Creek and may be a result of the constituents leaching into the water from the alluvial sediments that comprise the creek channel.

2.3.3.2.6 Coleto Creek (SW-04)

Historical water quality data for TCEQ Station 12622 located on Coleto Creek is summarized in Table 2.3.3-17.

In November 2007 and April 2008, surface water samples were collected at SW-04 at the location shown in Figure 2.3.3-4. Based on a comparison of the data sets, there is no discernible variability between the two water quality data sets, with the exception of an increase in total iron concentrations in April. Based on a review of surface water quality data from the TCEQ monitoring stations in Coleto Creek and the lower Guadalupe River, the general chemical, physical and biological characteristics of the surface water samples are typical for the area (GBRA Dec 2007, U.S. EPA 2008b).

2.3.3.2.7 Factors Affecting Water Quality

Several upstream factors have the potential to affect water quality at the GBRA Saltwater Barrier impoundment. The potential sources of pollution include wastewater discharges from municipal treatment, industrial, and manufacturing facilities, as well as agricultural runoff.

Texas Pollutant Discharge Elimination System (TPDES) permitted discharges were identified within the lower Guadalupe River and lower San Antonio River basins located within Victoria, Refugio, and Goliad Counties. Table 2.3.3-19 provides a summary of permit numbers, facility information, flow rates, receiving streams, and distances to the VCS site.

There are seven permitted discharges that release effluent to the lower Guadalupe River basin below Victoria. The nearest to the GBRA Saltwater Barrier is the Invista facility, which is located approximately 5.5 miles northeast of the proposed VCS site. The facility is permitted to discharge 21.8 million gallons per day (mgd) into the Guadalupe River at a location on the opposite side of the river downstream from the proposed VCS discharge structure. According to files accessed on the EPA Envirofacts web site (U.S. EPA Feb 2008), the facility has had no TPDES violations in the past 5 years. The city of Victoria has two wastewater treatment plants that have combined permitted discharges of 12.1 mgd. There are four other non-major permitted discharges to the lower Guadalupe River that have no recorded discharge volumes.

There are two permitted discharges that release effluent to the lower San Antonio River. The city of Goliad wastewater treatment plant has a permitted discharge of 0.35 mgd. The second is a concrete plant with no recorded discharge volume. There are no TPDES permitted discharges to the lower Guadalupe River or the lower San Antonio River from Refugio County. Goliad County has two permitted discharges to the lower San Antonio River.

2.3.3.3 References

Banks, Aug. 2007. *Banks Environmental Data. Water Well Report.* McCann Property, Victoria, Texas. BISMap#:081507-565.

GBRA Dec 2007. Guadalupe-Blanco River Authority, *GBRA Historical Water Data*, e-mails to Krista Dearing-Tetra Tech from Debbie Magin, GBRA Water Monitoring Program Lower Guadalupe River Basin, December 4 and 5, 2007.

GBRA May 2006. Guadalupe-Blanco River Authority, *Guadalupe River Basin: Basin Highlights Report—Spring 2007*, May 2006.

GBRA Nov 2007. Guadalupe-Blanco River Authority, *Water Quality for the Guadalupe River*, Phone conversation between Krista Dearing-Tetra Tech and Debbie Magin, GBRA Water Quality Division, November 5, 2007.

GBRA Undated. Guadalupe-Blanco River Authority, *GBRA Clean Rivers Program: Water Quality Data Collection*, available at http://www.gbra.org/CRP/WaterQualityDataCollection.aspx, accessed January 22, 2008.

SARA 2008. San Antonio River Authority, *San Antonio River Authority Water Quality*, available at http://www.sara-tx.org/site/water_quality/water_qual_mon/clean_rivers/Basin_Reports/, accessed January 29, 2008.

TCEQ 2000. Texas Commission on Environmental Quality, *Texas Surface Water Quality Standards §§307.1-307.10*, available at http://www.tceq.state.tx.us/permitting/water_quality/wq_assess ment/standards/WQ_standards_2000.html, accessed August 12, 2007.

TCEQ 2008a. Texas Commission on Environmental Quality, *2008 Texas Water Body Inventory and 303(d) List*, available at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/ 08twqi/twqi08.html, accessed October, 2009.

TCEQ Mar 2009. Texas Commission on Environmental Quality, *Lower San Antonio River: A TMDL Project for Bacteria A TMDL Project for Bacteria*, available at http://www.tceq.state.tx.us/ implementation/water/tmdl/34-lowersanantoniobac.html#info, accessed May 4, 2009.

TWC Mar 1989. Texas Water Commission. *Ground Water Quality of Texas —An Overview of Natural and Manmade Affected Conditions*, Report 89-01, March 1989.

TWDB Jan 2006. Texas Water Development Board, *2006 Region L Water Plan, South Central Regional Water Planning Group*, available at http://www.regionltexas.org/2006_ waterplandownloadsvol1.php, accessed October 20, 2007.

TWDB Jan 2007. Texas Water Development Board, *Water for Texas 2007 State Water Plan*, January 5, 2007.

URS Oct 2004. URS, *Final Report: Conceptual Delivery Study Lower Guadalupe Water Supply Project*, October 2004.

U.S. EPA 2008a. U.S. Environmental Protection Agency, *List of Contaminants and Their Maximum Contaminant Levels (MCLs)*, available at http://www.epa.gov/safewater/contaminants/index.html, accessed January 2, 2008.

U.S. EPA 2008b. U.S. Environmental Protection Agency, *STORET Data Warehouse*, available at http://www.epa.gov/storet/dw_home.html, accessed January 2, 2008.

U.S. EPA Feb 2008. U.S. Environmental Protection Agency, *Envirofacts Data Warehouse*, available at http://www.epa.gov/enviro/, accessed November 2, 2009.

USGS 2008. U.S. Geological Survey, *National Water Information System Database*, available at http://waterdata.usgs.gov/nwis/gw, accessed January 29, 2008.

Table 2.3.3-1
Summary of Groundwater Quality Data for TWDB Wells Located within 6 Miles of the VCS Site

State Well Number	7924601	7924601	7924901	7924901	7924901	7924902	7924902	7924902	7924904	7932404	7932602	7932602	Mean	Maximum
Date Sampled	4/11/01	3/30/05	2/5/59	6/28/79	8/25/83	3/26/97	4/11/01	3/22/05	2/4/59	2/4/59	4/28/59	4/14/71		
Parameter														
Temperature (°Celsius)	22	22	–	–	–	23	23	23	–	–	–	28	23.5	28
Silica (mg per L)	34.4	36.6	30	45	44	19.7	42.4	46	31	34	15	15	32.8	46
Calcium (mg per L)	127	153	100	103	95	96.5	94.4	96.3	185	131	12	11.4	100.4	185
Magnesium (mg per L)	20.4	28.5	11	12	12	12.6	12.3	12.3	33	25	6.6	6.9	16.1	33
Sodium (mg per L)	169	235	94	79	94	92.7	87.4	92	177	106	404	384	168	404
Potassium (mg per L)	2.77	2.84	–	–	3	3.25	2.89	3.19	–	–	2.8	–	2.96	3.25
Strontium (mg per L)	0.92	1.14	–	–	–	0.41	0.42	0.4	–	–	–	–	0.66	1.14
Carbonate (mg per L)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicarbonate (mg per L)	489.36	510.1	387	353.9	362.44	356.34	346.58	346.57	280	297	362.1	358.78	370.9	510.1
Sulfate (mg per L)	58.4	84.5	22	24	25	19.8	22.5	21.1	61	59	8.6	8.65	34.5	84.5
Chloride (mg per L)	**260**	**424**	111	115	128	102	125	120	**488**	**252**	**435**	**437**	**250**	**488**
Fluoride (mg per L)	0.31	0.52	0.5	0.3	0.4	0.26	0.38	0.56	0.3	0.3	0.7	0.5	0.42	0.7
Nitrate (mg per L)	<0.09	<0.09	2	8	5.01	9.3	**14.3**	**13.11**	0.8	<0.4	2	<0.4	6.8	14.3
pH (standard)	6.75	–	7.8	8.2	8.3	7.2	6.91	–	7.2	7.4	7.9	7.6	7.5	8.3
Total Dissolved Solids (mg per L)	**913**	**1217**	**560**	**560**	**584**	**531**	**572**	**575**	**1113**	**753**	**1064**	**1040**	**790**	**1217**
Total Alkalinity (mg per L)	401	418	317.12	290	297	292	284	284	229.44	243.37	296.72	294	303.9	418
Total Hardness (mg per L)	401	501	294	306	286	293	286	292	597	429	57	56	317	597
Sodium (percent)	47	51	40	35	41	40	39	41	39	34	93	93	49	93
Specific Conductance (µmhos per cm)	1646	2150	967	987	1072	918	1016	994	2050	1430	1940	2058	1436	2150
Gross Alpha (pCi per L)	1.8 ± 1.7	2.1 ± 4.6	–	–	–	–	2.6 ± 1.6	4.8 ± 3.2	–	–	–	–	–	–
Gross Beta (pCi per L)	4.9 ± 2.6	1.9 ± 4.2	–	–	–	–	4.1 ± 2.7	10 ± 2	–	–	–	–	–	–

Source: TWDB 2007
See Table 2.3.2-5 for well depths and aquifer for which well is screened.
µmhos per cm = micro-mhos per centimeter
mg per L = milligrams per liter
pCi per L = pico Curies per liter
– Not available
Bold = Parameter concentration exceeds MCL or SMCL
MCL = Maximum Contaminant Level (U.S. EPA 2008a)
SMCL = Secondary Maximum Contaminant Level (U.S. EPA 2008a)

Table 2.3.3-2 (Sheet 1 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

Parameter	Analytical Method	MCL or *SMCL	OW-1U 11.29.07	OW-1U 04.15.08	OW-1L 11.29.07	OW-1L 04.15.08	OW-3L 11.29.07	OW-3L 04.15.07	OW-3L Duplicate 04.15.08	OW-8U 11.29.07	OW-8U 04.15.08
General Chemistry											
Temperature (°C)	Field Measurement	NE	22.55	20.8	22.61	23.51	22.43	24.23	24.23	21.10	24.33
pH (standard units)	Field Measurement	6.5 - 8.5*	7.53	7	7.57	7.6	7.53	7.4	7.4	7.55	7.4
Salinity (percent)	Field Measurement	NE	0.05	0.1	0.06	0.1	0.06	0.1	0.1	0.04	0
Total Suspended Solids (mg per L)	SM[2] 2540/USEPA 160.2	NE	13	371	21.7	0.67†	119	43.3	2.3	1120	7610
Total Dissolved Solids (mg per L)	SM 2540/USEPA 160.1	500*	**677**	**625**	**719**	**669**	**836**	**796**	**829**	**566**	**519**
Hardness, Total as $CaCO_3$ (mg per L)	USEPA 130.0	NE	340	610	314	336	330	380	372	408	352
Turbidity (NTU)	USEPA 180.1	0.3**	93.7	77.6	86.2	1.3	119	3.9	1.7	<0.75	82.5
Color, Apparent (Cobalt Units)	USEPA 110.2	15*	5	**25**	5	<5	5	<5	10	5	**20**
Odor (Threshold Odor Number)	USEPA 140.1	3*	<1	<1	<1	<1	<1	<1	<1	<1	<1
Specific Conductance (μmhos per cm)	USEPA 120.1	NE	1130	988	1210	1120	1360	1320	1310	902	831
Dissolved Oxygen (mg per L)	Field Measurement	NE	10.52	8.2	8.90	8.62	7.94	9.83	9.83	10.77	10.27
Biochemical Oxygen Demand (mg per L)	SM 5210/USEPA 405.1	NE	<1.0	<0.89	6.0	<0.89	<1.0	<0.89	<0.89	<2.0	<0.89
Chemical Oxygen Demand (mg per L)	SM 5220/USEPA 410	NE	<4.5	8.4†	22.5	<4.5	22.5	19†	16.3†	<4.5	34.9
Total Organic Carbon (mg per L)	USEPA 415.1	NE	<0.48	–	<0.30	–	<0.25	–	–	<0.43	–
Phosphorus, Total (mg per L)	SM 4500/USEPA 365	NE	0.038	0.55	0.031	<0.0040	0.15	<0.0090†	<0.013†	0.13	0.071
Phosphorus, Orthophosphate (mg per L)	SM 4500/USEPA 365.2	NE	0.036	0.014†	0.034	0.0040†	0.041	<0.0070†	<0.010†	0.084	0.010†
Nitrogen, Ammonia (mg per L)	SM 4500/USEPA 350.1	NE	<0.050	<0.10	<0.050	<0.10	<0.50	<0.10	<0.10	<0.050	<0.050
Nitrogen, Nitrite (mg per L)	SM 4500/USEPA 353.2	100	<0.011	<0.010	<0.011	<0.010	<0.015	<0.010	<0.010	0.053	<0.010
Nitrate-N (mg per L)	SM 4500	10	<1.0	0.77	<1.0	0.94	<1.0	0.55	0.61	<1.0	0.66
Nitrogen, Total Kjeldahl (mg per L)	USEPA 351.2	NE	0.29	–	<0.011	–	<0.20	–	–	–	–
Nitrogen, Organic (mg per L)	SM 4500-N	NE	0.29	<0.10	<0.011	<0.10	<0.20	<0.10	<0.10	<0.050	<0.050
Carbon Dioxide (mg per L)	SM4500 CO2 D	NE	51.55	67.8	53.55	37	64.1	34.8	20.7	93.97	47.3
Bicarbonate Alkalinity (mg per L)	SM2320	NE	257.75	324	267.74	280	272.78	340	320	364.73	412
Alkalinity, Total as $CaCO_3$ (mg per L)	SM 2320/USEPA 310	NE	258	324	268	280	273	340	320	365	412
Fluoride (mg per L)	USEPA 340.2	4	0.17	–	0.34	–	0.30	–	–	0.53	–

Table 2.3.3-2 (Sheet 2 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

Parameter	Analytical Method	MCL or *SMCL	OW-1U 11.29.07	OW-1U 04.15.08	OW-1L 11.29.07	OW-1L 04.15.08	OW-3L 11.29.07	OW-3L 04.15.07	OW-3L Duplicate 04.15.08	OW-8U 11.29.07	OW-8U 04.15.08
Chloride (mg per L)	SM 5220/USEPA 410	250*	69.8	**2100**	185	**3200**	147	**2180**	**3080**	11.6	**2180**
Chlorine Demand (mg per L)	HACH 10223	NE	1.58	NA	0.99	NA	3.21	–	–	2.63	–
Calcium (mg per L)	EPA 200.7	NE	114	222	119	115	124	118	121	159	119
Silica, Dissolved (mg per L)	USEPA 370.1	NE	32.6	–	34	–	33.6	–	–	29.7	–
Silica, Total (mg per L)	USEPA 6010B	NE	22.8	52.3	16.9	18.1	25.2	17.8	18.6	59.9	60.5
Silt Density Index	ASTM D4189	NE	0.28	–	IV	–	filter failed	–	–	IV	–
Sulfide (mg per L)	USEPA 376.1	NE	1.0	–	1.0	–	1.0	–	–	2.0	–
Sulfate (mg per L)	SM 4500/USEPA 375.3	250*	48.6	49.4	28.0	20.6	97.9	111	113	10.3	28
Sodium (mg per L)	USEPA 6010B	NE	135	106	103	131	171	172	178	116	115
Bacteria											
Total Coliform (CFUs per 100 mL)	SM 9223B/9221D	TCR	152	50	52	20	44	<10	<10	4200	1680
Fecal Coliform (CFUs per 100 mL)	SM 9222D	NE	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fecal Streptococci (CFUs per 100 mL)	SM 9230C	NE	<10	<10	<10	<10	<10	<10	<10	<10	<10
Radionuclides (pCi per L)											
Potassium-40 (K-40)	USEPA 901.1	NE	-27.1	32.1	43.9	12.9	29.0	52.3	67.6	-22.6	14.4
Cesium-137 (Cs-137)	USEPA 901.1	NE	-0.891	0.629	-1.46	2.72	1.63	0.984	0.171	-0.38	1.54
Thallium-208 (Tl-208)	USEPA 901.1	NE	-1.23	0.14	-2.74	-2.22	-2.21	1.8	-3.77	1.48	8.34
Bismuth-212 (Bi-212)	USEPA 901.1	NE	-30.2	23.8	13.6	8.96	-13.3	28.5	8.77	0.01	50.2
Lead-212 (Pb-212)	USEPA 901.1	NE	-6.84	-1.18	-8.48	3.19	0.47	-1.08	0.01	-0.167	15.2
Bismuth-214 (Bi-214)	USEPA 901.1	NE	9.23	37.6	25.8	37.9	-0.93	27	22.3	13.4	37.7
Lead-214 (Pb-214)	USEPA 901.1	NE	5.21	48.9	17.7	38.9	14.1	35.3	23.2	15.0	29.9
Radium-226 (Ra-226)	USEPA 901.1	5.0	-10.7	-9.04	19.7	-3.14	-8.02	-14.4	-6.71	-11.0	7.08
Radium-228 (Ra-228)	USEPA 904.0	5.0	1.93	–	2.59	–	3.34	–	–	**5.68**	–
Tritium (H-3)	USEPA 906.0	NE	52.4	126	158	96	141	102	197	50.5	86.4
Metals (µg per L)											
Aluminum	USEPA 6010B	50 to 200*	488	–	290	–	2270	–	–	23,000	NA
Arsenic	USEPA 6010B	10	<2.7	6.6	<2.7	<2.8	<2.7	<2.7	3.1†	**12.2**	4.5†

Table 2.3.3-2 (Sheet 3 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

Parameter	Analytical Method	MCL or *SMCL	OW-1U 11.29.07	OW-1U 04.15.08	OW-1L 11.29.07	OW-1L 04.15.08	OW-3L 11.29.07	OW-3L 04.15.07	OW-3L Duplicate 04.15.08	OW-8U 11.29.07	OW-8U 04.15.08
Barium	USEPA 6010B	200	**261**	**428**	**382**	**204**	<108	81.3†	84.7†	**436**	**229**
Cadmium	USEPA 6010B	5	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Chromium	USEPA 6010B	100	<1.5	18	<1.5	<1.5	<2.6	<1.5	<1.5	19.8	2.3†
Cobalt	USEPA 6010B	NE	<9.6	–	<9.6	–	<9.6	–	–	<12.9	–
Copper	USEPA 6010B	1.0*	<5.9	–	<7.7	–	<7.9	–	–	<13.4	–
Iron (Dissolved)	USEPA 6010B	100*	<24	–	<24	–	<24	–	–	<24	–
Iron (Total)	USEPA 6010B	100*	**447**	**14,900**	**305**	55.8†	**1930**	68.9†	75.8†	**20,500**	**3,060**
Lead	USEPA 6010B	15	<2.8	12.4	<2.8	<2.8	3.4	<2.8	<2.8	19.0	6.9
Magnesium	USEPA 6010B	NE	18,900	20500	16,900	18600	17,800	16800	17300	17,300	12700
Manganese (Dissolved)	USEPA 6010B	50*	<12.8	–	6.6	–	<11.2	–	–	**270**	–
Manganese (Total)	USEPA 6010B	50*	<9.6	–	15.2	–	26.7	–	–	**541**	–
Mercury	USEPA 7470B	200	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094
Molybdenum	USEPA 6010B	NE	<1.2	–	<1.2	–	<1.2	–	–	<1.5	–
Nickel	USEPA 6010B	NE	<2.6	–	<2.6	–	<2.8	–	–	<15.0	–
Potassium	USEPA 7470B	NE	4800	–	3240	–	4990	–	–	7050	–
Selenium	USEPA 6010B	50	<2.3	–	<2.3	–	<3.8	–	–	<2.3	–
Silver	USEPA 6010B	100*	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
Strontium	USEPA 6010B	NE	622	–	333	–	523	–	–	450	NA
Titanium	USEPA 6010B	NE	<4.1	–	<3.4	–	<15.0	–	–	67	NA
Vanadium	USEPA 6010B	NE	<9.6	–	<6.5	–	<12.1	–	–	51.5	NA
Zinc	USEPA 6010B	500*	<7.5	–	<7.5	–	<11.2	–	–	46.5	NA
Oil and Grease	USEPA 1664	NE	<1.4	–	<1.4	–	<1.4	–	–	<1.4	–

Table 2.3.3-2 (Sheet 4 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

Parameter	Analytical Method	MCL or *SMCL	OW-8L 11.29.07	OW-8L 04.15.08	OW-10U 04.15.08	OW-10L 11.29.07	OW-10L Duplicate 11.29.07	OW-10L 04.15.08	Northwest Gate Well 11.29.07	Northwest Gate Well 04.15.08	Southeast Windmill Well 11.29.07	Southeast Windmill Well 04.15.08	Mean	Maximum
General Chemistry														
Temperature (°C)	Field Measurement	NE	20.82	23.9	25.26	21.67	21.67	25.8	16.62	21.54	20.49	23.49	22.5	25.8
pH (standard units)	Field Measurement	6.5 - 8.5*	7.34	7.3	7.4	7.56	7.56	7.2	7.17	7.6	7.53	7.1	7.41	7.6
Salinity (percent)	Field Measurement	NE	0.04	0.1	0.1	0.06	0.06	0.1	0.07	0.1	0.09	0.1	0.1	0.1
Total Suspended Solids (mg per L)	SM[2] 2540/USEPA 160.2	NE	36.0	1850.0	2.7	<1.7	2.3	1.0†	8.7	2	<1.3	1.3†	590	7610
Total Dissolved Solids (mg per L)	SM 2540/USEPA 160.1	500*	**560**	**650**	**778**	**889**	**885**	**575**	**823**	**563**	**1290**	731	736	1290
Hardness, Total as $CaCO_3$ (mg per L)	USEPA 130.0	NE	292	850	270	232	424	480	268	150	500	590	395	850
Turbidity (NTU)	USEPA 180.1	0.3**	47.8	95.4	77.4	1.3	1.8	0.44†	46.2	5.9	<0.88	0.88†	39.2	119
Color, Apparent (Cobalt Units)	USEPA 110.2	15*	5	**20**	**20**	5	5	<5	10	**60**	5	<5	12	60
Odor (Threshold Odor Number)	USEPA 140.1	3*	**40**	<1	<1	<1	<1	<1	<1	<1	<1	<1	3.1	40
Specific Conductance (µmhos per cm)	USEPA 120.1	NE	805	1030	1230	1440	1440	1310	1410	1030	1880	1740	1236	1880
Dissolved Oxygen (mg per L)	Field Measurement	NE	8.18	10.12	10.51	5.17	5.17	8.55	10.97	7.46	9.35	8.6	8.89	10.97
Biochemical Oxygen Demand (mg per L)	SM 5210/USEPA 405.1	NE	<9.0	<0.89	<0.89	<1.0	<8.0	1.0†	6.0	<0.89	2.0	<0.89	<2.4	9
Chemical Oxygen Demand (mg per L)	SM 5220/USEPA 410	NE	57.1	5.7†	5.7†	<4.5	<4.5	29.6	25.0	<4.5	<4.5	<4.5	<14.9	57.1
Total Organic Carbon (mg per L)	USEPA 415.1	NE	19.8	–	–	<0.39	<0.40	–	<0.20	–	<0.12	–	<2.5	19.8
Phosphorus, Total (mg per L)	SM 4500/USEPA 365	NE	0.051	0.25	0.048	0.023	0.043	<0.0060†	<0.015	0.0030†	<0.017	0.0090†	<0.08	0.55
Phosphorus, Orthophosphate (mg per L)	SM 4500/USEPA 365.2	NE	0.029	0.0030†	0.02	<0.019	<0.019	<0.0040†	<0.011	<0.0030	<0.011	<0.0030	<0.02	0.084
Nitrogen, Ammonia (mg per L)	SM 4500/USEPA 350.1	NE	0.17	0.11	<0.10	<0.25	<0.50	<0.10	<0.50	<0.10	0.24	<0.10	<0.17	0.5
Nitrogen, Nitrite (mg per L)	SM 4500/USEPA 353.2	100	<0.034	<0.010	0.025	<0.011	<0.011	<0.010	<0.011	<0.010	<0.011	<0.010	<0.01	0.053
Nitrate-N (mg per L)	SM 4500	10	<1.0	<0.11	0.6	<1.0	<1.0	0.45	<1.0	<0.11	<1.0	0.31	<0.74	1
Nitrogen, Total Kjeldahl (mg per L)	USEPA 351.2	NE	–	–	–	<0.13	2.0	–	–	–	–	–	<0.53	2
Nitrogen, Organic (mg per L)	SM 4500-N	NE	0.17	0.11	<0.10	<0.25	<0.50	<0.10	<0.50	<0.10	0.24	<0.10	<0.17	0.5
Carbon Dioxide (mg per L)	SM4500 CO2 D	NE	63.82	58.5	54.2	57.35	46.1	62.8	643.39	9.5	18.12	61	81.3	643.4
Bicarbonate Alkalinity (mg per L)	SM2320	NE	304.72	344	420	286.73	264.7	300	377.96	316	92.71	248	305	420
Alkalinity, Total as $CaCO_3$ (mg per L)	SM 2320/USEPA 310	NE	305	344	420	287	265	300	378	316	92.8	248	305	420
Fluoride	USEPA 340.2	4	0.56	–	–	0.12	0.18	–	0.55	–	0.41	–	0.35	0.56

Table 2.3.3-2 (Sheet 5 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

Parameter	Analytical Method	MCL or *SMCL	OW-8L 11.29.07	OW-8L 04.15.08	OW-10U 04.15.08	OW-10L 11.29.07	OW-10L Duplicate 11.29.07	OW-10L 04.15.08	Northwest Gate Well 11.29.07	Northwest Gate Well 04.15.08	Southeast Windmill Well 11.29.07	Southeast Windmill Well 04.15.08	Mean	Maximum
Chloride (mg per L)	SM 5220/USEPA 410	250*	54	**2750**	**2680**	224	225	**1530**	175	**1300**	**462**	**1900**	**1287**	**3200**
Chlorine Demand (mg per L)	HACH 10223	NE	31.22	–	–	1.08	0.98	–	20.42	–	1.05	–	7	31.2
Calcium (mg per L)	EPA 200.7	NE	92.2	331.0	84.3	153	153	148	66.5	235	162	174	148	331
Silica, Dissolved (mg per L)	USEPA 370.1	NE	26.6	–	–	25.4	25.9	–	<0.015	–	28.6	–	26.3	34
Silica, Total (mg per L)	USEPA 6010B	NE	18.1	118	24.2	16.1	15.8	15.7	13.5	4.37	16.7	170	37.1	170
Silt Density Index	ASTM D4189	NE	IV	–	–	IV	IV	–	0.62	–	0.01	–	0.30	0.62
Sulfide (mg per L)	USEPA 376.1	NE	13	–	–	2.0	2.0	–	3.0	–	3.0	–	3	13
Sulfate (mg per L)	SM 4500/USEPA 375.3	250*	12.8	45.7	70	60.5	59.7	68.3	89.3	14.8	93.4	105	59	113
Sodium (mg per L)	USEPA 6010B	NE	66.7	124	219	127	124	116	214	185	176	177	145	219
Bacteria														
Total Coliform (CFUs per 100 mL)	SM 9223B/9221D	TCR	80,000	12,400	180	166	256	<10	<10	60	100	160	<5240	80,000
Fecal Coliform (CFUs per 100 mL)	SM 9222D	NE	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fecal Streptococci (CFUs per 100 mL)	SM 9230C	NE	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Radionuclides (pCi per L)***														
Potassium-40 (K-40)	USEPA 901.1	NE	-32.3	73.6	52.3	4.4	-44.3	1.8	6.18	68.5	-45.0	15.3	15.9	73.6
Cesium-137 (Cs-137)	USEPA 901.1	NE	0.73	-3.93	0.317	-4.22	-1.26	-2.02	1.18	-0.912	-0.705	-1.01	-0.36	2.72
Thallium-208 (Tl-208)	USEPA 901.1	NE	0.129	1.56	0.156	-2.52	-0.161	1.03	-0.988	0.28	3.20	3.32	0.29	8.34
Bismuth-212 (Bi-212)	USEPA 901.1	NE	6.88	10.1	-22.3	-1.72	5.0	9.21	-2.8	-13.9	28.9	-8.92	5.3	50.2
Lead-212 (Pb-212)	USEPA 901.1	NE	-4.2	20.9	5.29	0.51	18.8	16.5	-1.13	-1.52	-3.25	-4.98	2.53	20.9
Bismuth-214 (Bi-214)	USEPA 901.1	NE	-1.77	48.7	36.3	24.5	4.38	36.9	26	57.9	20	30.6	26	57.9
Lead-214 (Pb-214)	USEPA 901.1	NE	7.80	40.5	15.3	3.78	3.66	32.7	29.9	61	10.2	37.7	24.8	61
Radium-226 (Ra-226)	USEPA 901.1	5.0	-3.48	-5.52	-0.267	1.96	-8.68	23.6	-0.866	**10**	4.56	12.1	-0.15	23.6
Radium-228 (Ra-228)	USEPA 904.0	5.0	4.71	–	–	3.76	4.37	–	0.905	–	4.56	–	3.54	5.68
Tritium (H-3)	USEPA 906.0	NE	79.8	33.3	72.5	79.8	82.5	74.6	105	183	117	207	108	207
Metals (µg per L)														
Aluminum	USEPA 6010B	50 to 200*	**871**	NA	NA	<86	**1180**	NA	<86	NA	<86	NA	<3151	23,000
Arsenic	USEPA 6010B	10	29.5	**67.7**	<2.7	<2.7	<2.7	<2.7	<2.7	3.8†	<2.7	4.7†	<8.5	67.7

Table 2.3.3-2 (Sheet 6 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

Parameter	Analytical Method	MCL or *SMCL	OW-8L 11.29.07	OW-8L 04.15.08	OW-10U 04.15.08	OW-10L 11.29.07	OW-10L Duplicate 11.29.07	OW-10L 04.15.08	Northwest Gate Well 11.29.07	Northwest Gate Well 04.15.08	Southeast Windmill Well 11.29.07	Southeast Windmill Well 04.15.08	Mean	Maximum
Barium	USEPA 6010B	200	**506**	**1280**	91.8†	**348**	**341**	**210**	<50	50.8†	<117	119†	280	1280
Cadmium	USEPA 6010B	5	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	1.8
Chromium	USEPA 6010B	100	<7.5	15.8	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	4.5	19.8
Cobalt	USEPA 6010B	NE	<9.6	–	–	<9.6	<9.6	–	<9.6	–	<9.6	–	<10.0	12.9
Copper	USEPA 6010B	1.0*	<9.3	–	–	<6.2	<7.2	–	<10.2	–	<20.2	–	<9.8	20.2
Iron (Dissolved)	USEPA 6010B	100*	<24	–	–	<24	<24	–	<24	–	<24	–	<24	24
Iron (Total)	USEPA 6010B	100*	**1260**	**19,200**	**480**	<24	<24	33.4†	**2260**	**2130**	<24	**372**	**<3534**	**20,500**
Lead	USEPA 6010B	15	<2.8	**15.3**	3.6	<2.8	<2.9	3.6	6.1	<2.8	4.9	4.8	<5.5	19
Magnesium	USEPA 6010B	NE	13,600	21100	13300	23,100	22,800	21100	27,900	21400	36,900	37700	20826	37,700
Manganese (Dissolved)	USEPA 6010B	50*	**793**	–	–	<7.8	<7.9	–	31.9	–	<14.2	–	128.4	793
Manganese (Total)	USEPA 6010B	50*	**823**	–	–	<8.8	<9.2	–	33.3	–	15.7	–	164.7	823
Mercury	USEPA 7470B	200	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094
Molybdenum	USEPA 6010B	NE	<6.0	–	–	<1.2	<1.2	–	<8.4	–	<1.2	–	<2.6	8.4
Nickel	USEPA 6010B	NE	<3.3	–	–	<2.6	<2.6	–	<2.6	–	<2.6	–	<4.1	15
Potassium	USEPA 7470B	NE	8590	–	–	7380	7160	–	4550	–	5280	–	5893	8590
Selenium	USEPA 6010B	50	<2.3	–	–	<2.3	<2.6	–	<2.3	–	<2.8	–	<2.6	3.8
Silver	USEPA 6010B	100*	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
Strontium	USEPA 6010B	NE	398	–	–	795	783	–	2140	–	1570	–	846	2140
Titanium	USEPA 6010B	NE	<5.0	–	–	<0.71	<1.7	–	<0.71	–	<0.71	–	<10.9	67
Vanadium	USEPA 6010B	NE	<5.2	–	–	<6.0	<6.2	–	<1.6	–	<9.4	–	<12	51.5
Zinc	USEPA 6010B	500*	<11.8	–	–	<17.1	21.6	–	**1310**	–	**814**	–	<250	1310
Oil and Grease	USEPA 1664	NE	<1.4	NA	NA	<1.4	<1.4	NA	<1.4	NA	<1.4	–	<1.4	<1.4

NE = Not established
SM = Standard Methods for Examination of Water and Waste Water, 19th Edition
NTU = Nepthelometric turbidity unit
μmhos = Micromhos per centimeter
CFU = Colony Forming Unit
TCR = Total Coliform Rule: No more than 5% of monthly samples may be positive for presence of coliforms
BOLD = Parameter concentration exceeds MCL or SMCL.
– = Parameter not analyzed
MCL = Maximum Contaminant Level (US EPA 2008a)
*SMCL = Secondary Maximum Contaminant Level (USEPA 2008a)

Table 2.3.3-2 (Sheet 7 of 7)
Summary of Exelon Victoria County Onsite Groundwater Analytical Results

*** = Radionuclide analyses usually required the subtraction of the instrument background counts from the sample counts. Even though both background and the sample values are positive, sometimes when the sample activity is low, variations in the two measurements can cause the sample value to be less than the background, resulting in a measured activity less than zero.
† = Parameter also detected in the laboratory method blank
> = Parameter detected at or below the method detection limit
IV = Insufficient volume of sample was provided by Accutest to their subcontract lab
OW-1U = Observation well screened in upper Chicot Aquifer
OW-1L = Observation well screened in lower Chicot Aquifer

Table 2.3.3-3 (Sheet 1 of 3)
Summary of Exelon Victoria County Offsite TWDB Well #7932602
Groundwater Analytical Results (03/25/08)

Parameter	Analytical Method	MCL or *SMCL	TWDB #7932602
General Chemistry			
Temperature (°C)	Field Measurement	NE	21.8
pH (standard units)	Field Measurement	6.5 - 8.5*	8.76
Salinity (percent)	Field Measurement	NE	0.1
Total Suspended Solids (mg per L)	SM 2540/EPA 160.2	NE	10
Total Dissolved Solids (mg per L)	SM 2540/EPA 160.1	500*	1120
Hardness, Total as $CaCO_3$ (mg per L)	EPA 130.0	NE	54
Turbidity (NTU)	EPA 180.1	0.3**	4.09
Color, Apparent (Cobalt Units)	EPA 110.2	15*	<5
Odor (Threshold Odor Number)	EPA 140.1	3*	<1
Specific Conductance (µmhos per cm)	EPA 120.1	NE	1820
Biochemical Oxygen Demand (mg per L)	SM 5210/EPA 405.1	NE	5.0†
Chemical Oxygen Demand (mg per L)	SM 5220/EPA 410	NE	12.5†
Total Organic Carbon (mg per L)	EPA 415.1	NE	49.5
Phosphorus, Total (mg per L)	SM 4500/EPA 365	NE	0.013†
Orthophosphate (mg per L)	SM 4500/EPA 365.2	NE	0.012†
Nitrogen, Ammonia (mg per L)	SM 4500/EPA 350.1	NE	<0.050
Nitrogen, Nitrite (mg per L)	SM 4500/EPA 353.2	100	<0.010
Nitrate-N (mg per L)	SM 4500	10	<0.11
Nitrogen, Total Kjeldahl (mg per L)	EPA 351.2	NE	0.20†
Carbon Dioxide (mg per L)	SM4500 CO2 D	NE	3.2†
Bicarbonate Alkalinity (mg per L)	SM 2320	NE	274
Alkalinity, Total as $CaCO_3$ (mg per L)	SM 2320/EPA 310	NE	274
Fluoride (mg per L)	EPA 340.2	4	0.34
Chloride (mg per L)	SM 5220/EPA 410	250*	1120
Chlorine Demand (mg per L)	HACH 10223	NE	0.68
Calcium (mg per L)	EPA 200.7	NE	11
Silica, Dissolved (mg per L)	EPA 370.1	NE	4.3
Silica, Total (mg per L)	EPA 6010B	NE	8.7
Silt Density Index	ASTM D4189	NE	0.26
Sulfide (mg per L)	EPA 376.1	NE	2
Sulfate (mg per L)	SM 4500/EPA 375.3	250*	4.1†
Sodium (mg per L)	EPA 6010B	NE	385
Cyanide, Total (mg per L)	EPA 335.4	0.2	<0.0050

Table 2.3.3-3 (Sheet 2 of 3)
Summary of Exelon Victoria County Offsite TWDB Well #7932602
Groundwater Analytical Results (03/25/08)

Parameter	Analytical Method	MCL or *SMCL	TWDB #7932602
Bacteria			
Sulfate Reducing Bacteria (units per L)	SM 9240C	NE	200
Iron Reducing Bacteria (units per mL)	SM 9240B	NE	9000
Bacteria Counts (Standard Units)	SM Sim Plate	NE	33
Total Coliform (CFUs per 100mL)	m-ColiBlue 24	TCR	***Positive
Fecal Coliform (CFUs per 100mL)	SM 9222D	NE	NA
Fecal Streptococci (CFUs per 100mL)	SM 9230C	NE	NA
Radionuclides (pCi per L)			
Potassium-40 (K-40)	EPA 901.1	NE	-9.1
Cesium-137 (Cs-137)	EPA 901.1	NE	1
Thallium-208 (Tl-208)	EPA 901.1	NE	-5.83
Bismuth-121 (Bi-212)	EPA 901.1	NE	-10.5
Lead-212 (Pb-212)	EPA 901.1	NE	2.79
Bismuth-214 (Bi-214)	EPA 901.1	NE	54.7
Lead-214 (Pb-214)	EPA 901.1	NE	74.6
Radium-226 (Ra-226)	EPA 903.1	5.0	0.341
Radium-228 (Ra-228)	EPA 901.1	5.0	**5.41**
Tritium (H-3)	EPA 906.0	NE	98.2
Metals (µg per L)			
Aluminum	EPA 6010B	50 to 200*	**838**
Antimony	EPA 6010B	6.0	<2.7
Arsenic	EPA 6010B	10	<2.7
Barium	EPA 6010B	200	**472**
Beryllium	EPA 6010B	4.0	<0.26
Boron	EPA 6010B	NE	408
Bromide	EPA 6010B	NE	3
Cadmium	EPA 6010B	5	<1.8
Chromium	EPA 6010B	100	<1.5
Cobalt	EPA 6010B	NE	<9.6
Copper	EPA 6010B	1.0*	<5.9
Iron (Dissolved)	EPA 6010B	100*	**345**
Iron (Total)	EPA 6010B	100*	**736**
Lead	EPA 6010B	15	<2.8
Magnesium	EPA 6010B	NE	6470
Manganese (Dissolved)	EPA 6010B	50*	<8.8
Manganese (Total)	EPA 6010B	50*	17.6
Mercury	EPA 7470B	200	<0.094
Molybdenum	EPA 6010B	NE	<1.2
Nickel	EPA 6010B	NE	<2.6

Table 2.3.3-3 (Sheet 3 of 3)
Summary of Exelon Victoria County Offsite TWDB Well #7932602 Groundwater Analytical Results (03/25/08)

Parameter	Analytical Method	MCL or *SMCL	TWDB #7932602
Metals (µg per L) (continued)			
Potassium	EPA 7470B	NE	2760†
Selenium	EPA 6010B	50	<2.3
Silver	EPA 6010B	100*	<1.1
Strontium	EPA 6010B	NE	1160
Thallium	EPA 6010B	0.5	3.8†
Vanadium	EPA 6010B	NE	1.7†
Zinc	EPA 6010B	500*	8.0†
Volatile Organic Compounds (VOCs) mg per L	EPA 8260B	Various	ND
Semi-Volatile Organic Compounds (SVOCs) mg per L	EPA 8270C	Various	ND
Pesticides & Herbicides (mg per L)	USEPA 8141/8151	Various	ND
PCBs (mg per L)	USEPA 8081	Various	ND
Oil and Grease (mg per L)	EPA 1664	NE	<1.4

TWDB = Texas Water Development Board
ND = Parameter Not Detected Above the Method Detection Limit
NE = not established
µg per L = micrograms per liter
mg per L = milligrams per liter
NTU = Nepthelometric turbidity unit
µmhos/cm = micromhos per centimeter
units per mL = units per milliliter
pCi per L = pico Curies per liter
PCBs = Polychlorinated biphenyls
CFU = Colony Forming Unit
TCR = Total Coliform Rule: No more than 5% of monthly samples may be positive for presence of coliforms
-9.1 = Radiochemical analyses usually require the subtraction of the instrument background counts from the sample counts. Even though both background and the sample values are positive, sometimes when the sample activity is low, variations in the two measurements can cause the sample value to be less than the background, resulting in a measured activity less than zero.
BOLD = Parameter concentration exceeds MCL or SMCL.
– = Parameter not analyzed
MCL = Maximum Contaminant Level
*SMCL = Secondary Maximum Contaminant Level (U.S. EPA 2008a)
** = Performance standard; no more than 5% of monthly samples may exceed 0.3 NTU
***Positive = Sample exceeded the 30-hour hold time due to lab error so colony counts were not possible
† - Parameter Also Detected in the Laboratory Method Blank

Table 2.3.3-4
TCEQ Water Quality Segment Designated Uses

Segment Number[a]	Segment Name[a]	Uses[b]		
		Recreation	Aquatic Life	Water Supply
1701	Victoria Barge Canal	Non-contract recreation	High aquatic life use	NA
1801	Guadalupe River Tidal (from GBRA Salt Water Barrier to Guadalupe Bay)	Contact recreation	Exception aquatic life use	NA
1802	Guadalupe River Below San Antonio River (below San Antonio and Guadalupe River confluence to GBRA Salt Water Barrier)	Contact recreation	High aquatic life use	Public water supply
1803	Guadalupe River Below San Marcos River (below San Marcos River to San Antonio River)	Contact recreation	High aquatic life use	Public water supply
1807	Coleto Creek	Contact recreation	High aquatic life use	Public water supply
1901	Lower San Antonio River (from Farm Road 791 near Falls City in Karnes County to the Confluence with the Guadalupe River)	Non-contact recreation	High aquatic life use	NA
2462	San Antonio/Haynes Bay/Guadalupe Bay	Contact recreation	Exception aquatic life use/Oyster Waters	NA

(a) TCEQ 2008a
(b) TCEQ 2000
NA = Not applicable

Table 2.3.3-5
Summary of USGS and TCEQ Surface Water Monitoring Stations

Agency/Station No.	Water Body	Latitude	Longitude
TCEQ 12622	Coleto Creek At Highway 77	28.711	–97.034
TCEQ 12536	Victoria Barge Canal	28.518	–96.804
TCEQ 12577	Guadalupe River Tidal Hwy 35	28.478	–96.862
TCEQ 12578	Guadalupe River at GBRA Salt Water Barrier	28.506	–96.885
TCEQ 16579	Guadalupe River at DuPont	28.658	–96.963
TCEQ 12581	Guadalupe River 0.5 mile N of Hwy 175 bridge S. of Victoria	28.752	–97.008
TCEQ 12590	Guadalupe River at Farm Market Road 447	28.790	–97.010
TCEQ 12789	Lower San Antonio River at Highway 77	28.531	–97.043
USGS 08176500	Guadalupe River at Victoria	28.793	–97.013
USGS 08188600	GBRA Calhoun Canal Uplift #1 Station	28.510	–96.752
USGS 08188800	Guadalupe River at GBRA Salt Water Barrier	28.505	–96.884

Table 2.3.3-6
Summary of Guadalupe River at GBRA Saltwater Barrier (TCEQ Station 12578) Surface Water Metals Data (1999–2006)

Parameter (µg per L)	Nov-99	Jul-01	Sep-02	Jun-03	Aug-04	Mar-05	Mar-06
Aluminum	3	5.69	<2	5.43	20.7	17.1	8.23
Arsenic	3.26	2.53	2.92	1.42	2.69	2.07	2.01
Barium	118	72.2	—	86.4	—	—	—
Cadmium	<0.05	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	4	<1	2.61	1.61	<1.0	<1.0	3.8
Copper	1.3	<1	1.42	1	0.87	1.03	0.892
Iron	191	<50	—	—	—	—	—
Lead	<0.05	<1.0	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	—	1.26	2.5	3.31	6.1	—	—
Mercury	<0.006	2.07	0.0148	0.0027	0.00179	0.00374	0.00161
Nickel	2.3	3.05	2.62	3.52	0.87	2.41	2.94
Selenium	0.67	<4.0	0.68	0.514	0.46	0.375	0.711
Silver	<0.05	<1.0	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	1.4	1.9	1.21	0.75	1.23	1	0.952

Source: GBRA Undated
– = Data not available
< = parameter was detected at or below the method detection limit
µg per L = microgram per liter

Table 2.3.3-7
Summary of Guadalupe River at GBRA Saltwater Barrier (TCEQ Station 12578) Surface Water General Chemistry Data (2004–2007)

Parameter	1/3/2004	4/14/2004	7/15/2004	10/18/2004	1/11/2006	4/5/2005	7/7/2005	10/4/2005	1/4/2006	4/5/2006	7/12/2006	10/12/2006	1/9/2007	3/6/2007	6/12/2007	2004–2007 Minimum	2004–2007 Average	2004–2007 Maximum
Flow (cfs)	1390	3080	—	—	2890	2920	1460	1140	1330	1070	1550	575	1960	1030	2890	575	1791	3080
E. coli (org per 100 mL)	130	1312	32	276	86	67	11	36	81	47	70	43	920	43	25	11	211	1312
Suspended Solids (mg per L)	40.7	382	111	142	67.1	74.6	85.9	31.7	38.7	30.3	97.3	36	176	42.7	62.7	30.3	94.6	382
Turbidity (NTU)	24.5	284	86.3	113	52.4	62	29.3	24	31.3	52.9	71.9	34.2	221	11.3	46.7	11.3	76.3	284
pH (standard)	8.14	8.26	7.79	7.85	7.77	7.82	8.04	8.07	8.13	8.17	7.65	7.99	7.95	8.19	7.72	7.65	7.97	8.26
Temperature (C)	14.1	18.1	29.4	24.6	18.2	21.4	31.4	29.3	17.5	24.8	29.4	25.8	13.6	16.8	28.3	13.6	22.8	31.4
Dissolved Oxygen (mg per L)	10.2	7.27	5.18	7.4	8.89	8.83	6.3	7.41	9.8	8.57	5.1	7.18	9.45	10.4	8.68	5.10	8.04	10.40
Conductivity (µmhos per cm)	823	450	628	618	811	739	749	711	821	815	605	798	670	828	586	450	710	828
Total Phosphorous (mg per L)	0.21	0.27	0.38	0.44	0.23	0.14	0.21	0.25	0.37	0.09	0.38	0.38	0.71	0.49	0.16	0.09	0.31	0.71
Nitrate-N (mg per L)	1.8	1.11	0.64	0.83	2.36	1.68	1.42	2.32	4.05	4.05	1.34	3.16	3.84	2.68	1.2	0.64	2.17	4.05
Chloride (mg per L)	66.5	40.7	43.4	49.1	53.9	49	61.3	54.3	65.5	73	43.8	76.8	32	69.6	40.7	32	54.6	76.8
Sulfate (mg per L)	56.6	30.9	52.3	44.6	65.7	50.4	56.6	47.5	56.2	61.5	36.6	55.6	43.2	59.6	41.4	30.9	50.6	65.7
Total Hardness (mg per L)	297	229	281	267	317	314	294	293	320	261	196	242	290	280	244	196	275	320
Ammonia-N (mg per L)	—	0.11	—	0.08	—	0.04	—	0.04	—	0.03	—	<0.02	—	—	0.04	<0.02	0.06	0.11
Chlorophyll a (mg per m^3)	<5	<5	11.9	1.9	6.5	38.3	17.4	7.6	4.2	4.3	6.5	7.1	2.1	6.5	5.5	<5	9.2	38.3
Pheophytin (mg per m^3)	<3	9.8	<3	<3	<3	<3	4.6	3.3	<1	2.3	<1	1.6	<1	1.4	<1	<1	3.8	9.8

Source: GBRA 2008
cfs = cubic feet per second
mL = milliliters
mg per L = milligrams per liter
mg per m^3 = milligrams per cubic meter
NTU = Nepthelometric turbidity unit
– = parameter not analyzed
< = parameter detected at or below the method detection limit.
µmhos per cm = micromhos per centimeter

Table 2.3.3-8
Summary of Guadalupe River Near Dupont Invista (TCEQ Station 16579) Surface Water General Chemistry Data (2003–2006)

Parameter	2/24/2003	5/13/2003	7/15/2003	10/18/2003	2/17/2004	5/19/2004	8/10/2004	11/5/2004	2/7/2005	3/18/2005	7/7/2005	10/4/2005	2/2/2006	3/3/2006	6/7/2006	10/12/2006	2003–2006 Minimum	2003–2006 Average	2003–2006 Maximum
E. coli (org per 100mL)	2908	30	4	46	548	168	36	765	448	173	10	28	72	140	44	41	4	341.3	2908
Suspended Solids (mg per L)	194	67.4	39.6	24.8	54	94.3	48.7	216	87	75.9	79.5	37	9.3	38	35.7	5.3	5.3	69.2	216
Turbidity (NTU)	60	31	22.5	21.5	47.6	94.6	39.7	178	70.1	52.6	47.1	51	8.9	25.7	30.8	5.9	5.9	49.2	178
pH (standard)	7.98	7.74	8.3	8.2	8.15	7.93	8.26	7.75	7.75	7.92	8.08	8.02	8.35	8.21	8.2	7.63	7.63	8.03	8.35
Temperature (C)	14.6	28.3	32.5	24.3	13.1	25.5	31.5	20.7	13.1	17.9	32.1	29.4	19.5	22.2	30.5	29.6	13.1	24.1	32.5
Dissolved Oxygen (mg per L)	9.86	7.38	6.81	6.96	10.5	5.85	6.83	7.5	10.8	9.82	7.32	8.06	10.2	10.6	8.22	7.63	5.85	8.40	10.8
Conductivity (μmhos per cm)	335	727	739	601	500	347	697	373	483	609	555	541	1265	758	660	1024	335	638	1265
Total Phosphorous (mg per L)	0.54	0.18	0.16	0.15	0.16	0.25	0.19	0.7	0.21	0.16	0.24	0.11	0.33	0.17	0.3	0.35	0.11	0.26	0.7
Nitrate-N (mg per L)	0.44	1.83	0.67	0.37	0.59	0.64	0.19	0.63	1.08	1.14	0.85	1.02	12.2	2	0.18	11.2	0.18	2.19	12.2
Chloride (mg per L)	21.6	55.4	72.6	35	35.5	23.1	40.9	22.7	30.9	34.6	36.3	30.1	97	47	55.5	87.9	21.6	45.4	97
Sulfate (mg per L)	22.3	44.2	38.9	30.6	30	17.7	34.3	20.9	33.2	31.7	33.2	29.6	67	40.4	40.4	58.5	17.7	35.8	67
Total Hardness (mg per L)	199	288	223	261	208	148	256	234	220	276	256	276	296	254	185	242	148	239	296
Ammonia-N (mg per L)	0.12	0.06	0.04	<0.02	0.06	0.04	0.06	0.02	0.08	0.15	0.08	0.17	0.08	0.05	0.09	0.03	<0.02	0.08	0.17
Chlorophyll a (mg per m^3)	<1	<1	9.9	3.7	<5.0	<5.0	39.3	<1	<1	5.9	10.7	7.2	11.6	10.3	58.1	5.3	<1	16.2	58.1
Pheophytin (mg per m^3)	11.8	7.39	10.2	1.9	<3	<3	<3	<3	5.4	<3	3.7	2.1	5.2	3.2	7.7	2	1.9	5.5	11.8

Source: GBRA 2008
cfs = cubic feet per second
mL = Milliliters
mg per L = Milligrams per liter
mg per m^3 = milligrams per cubic meter
μmhos per cm = micromhos per centimeter
NTU = Nepthelometric turbidity unit
< = parameter detected at or below the method detection limit

Table 2.3.3-9
Summary of Guadalupe River at Highway 77 (TCEQ Station 12590) Surface Water General Chemistry Data (2004–2007)

Parameter	1/13/2004	4/14/2004	7/5/2004	10/18/2004	1/11/2005	3/2/2005	6/7/2005	12/7/2005	4/5/2006	8/10/2006	11/1/2006	1/19/2007	4/3/2007	2004–2007 Minimum	2004–2007 Average	2004–2007 Maximum
Flow (cfs)	870	7630	6070	2390	3230	4970	2030	757	684	325	483	844	12000	325	3252	12000
E. coli (org per 100mL)	55	804	46	291	62	520	13	50	60	62	59	1540	2300	13	450	2300
Suspended Solids (mg per L)	14.6	375	197	88.2	37.5	114	51.7	15.3	31	11	1437	79.5	948	11	261	1437
Turbidity (NTU)	9.94	140	147	73	27.1	47.3	38.3	15.2	28.3	10.2	12.8	69.9	384	9.94	77.2	384
pH	7.9	8.1	7.84	7.5	7.49	7.65	8.11	8.09	8.13	8.03	8.17	7.94	7.61	7.49	7.89	8.17
Temperature (°C)	14.7	18.6	28.7	24.4	18.4	17.1	29.8	14.5	25.3	30	22.1	13.2	22.4	13.2	21.5	30
Dissolved Oxygen (mg per L)	11.6	9.16	6.78	7.95	9.91	10.47	8.03	11.1	9.81	7.81	7.57	9.68	7.13	6.78	9.00	11.6
Conductivity (umhos per cm)	647	411	641	440	661	657	536	594	585	521	569	548	302	302	547	661
Total Phosphorous (mg per L)	0.13	0.19	0.34	0.25	0.1	0.16	0.1	<0.05	<0.05	<0.05	<0.05	0.38	0.29	<0.05	0.22	0.38
Nitrate-N (mg per L)	1.04	0.68	0.55	0.34	1.39	1.2	1.24	1.54	1.08	0.18	0.76	1.28	0.57	0.18	0.91	1.54
Chloride (mg per L)	34.4	20.4	17.9	28.4	33.1	41	24.2	33	34.8	36.2	32.5	36.2	9.1	9.1	29.3	41
Sulfate (mg per L)	32.1	22	21.4	21.9	38	47.9	29.3	32.6	32.4	31.5	30.5	26.6	12.3	12.3	29.1	47.9
Total Hardness (mg per L)	268	345	296	193	297	304	260	271	205	204	232	170	232	170	252	345
Ammonia-N (mg per L)	0.02	0.12	0.02	0.05	0.02	0.09	0.27	0.02	0.02	0.04	0.03	0.07	0.06	0.02	0.06	0.27
Chlorophyll a (mg per m^3)	<5	<5	<5	<1	3.3	2.3	7.8	3.1	2.5	4.9	2.6	1.1	<1	<1	3.5	7.8
Pheophytin (mg per m^3)	<3	9.2	<3	<3	<3	<3	<3	<1	1.9	<1	<1	<1	<1	<1	5.6	9.2

Source: GBRA 2008
cfs = cubic feet per second
mL = milliliters
mg per L = milligrams per liter
mg per m^3 = milligrams per cubic meter
NTU = Nepthelometric turbidity unit
μmhos per cm = micromhos per centimeter

Table 2.3.3-10 (Sheet 1 of 2)
Summary of Guadalupe River Tidal (TCEQ Station 12577) Surface Water Quality Data (2002–2007)

Parameter	1/17/2002	4/1/2002	6/25/2002	12/19/2002	4/7/2003	9/11/2003	12/10/2003	3/4/2004	5/26/2004	9/14/2004	12/21/2004	4/21/2005	6/16/2005	9/7/2005	12/1/2005	4/19/2006	7/11/2006	10/11/2006	1/25/2007	2002–2006 Minimum	2002–2006 Average	2002–2006 Maximum
Sample Depth Interval: 0.3 Feet																						
Temperature (°C)	14.8	22.2	29.7	17.8	22.4	28.9	15	19.4	27.3	28.3	14.7	23	30.8	29.6	16.8	27.5	30	26.9	8.9	8.9	22.8	30.8
Specific Conductance (µmhos per cm)	8062	787	770	579	800	748	773	632	613	659	636	786	648	671	714	795	460	800	445	445	1072	8062
Dissolved Oxygen (mg per L)	9.5	7.84	6.73	7.51	7.2	6.4	9.8	8.2	5.7	6.2	9.4	7.81	6.49	6.62	6.74	7.6	5.1	6.7	12.3	5.1	7.57	12.3
pH (Standard Units)	8.14	8.23	–	7.68	7.8	8.1	8.3	8.1	7.9	8.2	7.8	7.75	7.85	8	7.96	8.2	7.6	8.1	8.3	7.6	8.00	8.3
Salinity (parts per 1000)	0.42	0.41	0.4	0.3	–	1	1	0.32	1	1	1	0.41	0.33	0.35	0.37	1	2	2	–	0.3	0.78	2
Alkalinity, Total (As CaCO3)(mg per L)	231	232	215	180	246	220	236	204	181	230	248	271	209	220	230	222	156	194	154	154	214	271
Residue, Total Nonfiltrable (mg per L)	44	74	77	135	72	183	44	84	131	102	91	96	39	76	20	61	4	44	160	4	80.9	183
Nitrite/Nitrate (mg per L)	2.25	2.3	1.88	–	–	–	–	–	–	–	–	2.17	1.5	2.62	4.09	2.29	0.06	2.75	2	0.06	2.17	4.09
Nitrite Nitrogen, Total (mg per L)	–	–	–	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	–	–	–	–	–	–	–	–	0.05	0.05	0.05
Nitrate Nitrogen, Total (mg per L)	–	–	–	2	2.03	4.72	3.1	1.84	1.59	2.06	1.84	–	–	–	–	–	–	–	–	1.59	2.40	4.72
Nitrogen as Ammonia (mg per L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.09	0.05	0.06	0.05	0.05	0.05	0.09	0.05	0.06	0.09
Nitrogen, KJELDAHL (mg per L)	0.44	0.59	0.59	0.92	0.59	1.15	0.73	0.62	0.82	0.5	0.38	0.51	0.81	0.62	0.4	0.68	0.5	0.58	0.91	0.38	0.65	1.15
Phosphorus, Total (mg per L)	0.2	0.16	0.26	0.29	0.16	0.44	0.2	0.19	0.3	0.23	0.19	0.22	0.23	0.32	0.42	0.32	0.06	0.46	0.42	0.06	0.27	0.46
Orthophosphate phosphorus, diss.(mg per L)	0.17	0.14	0.22	0.13	0.06	0.31	0.2	0.14	0.14	0.14	0.12	0.17	0.15	0.27	0.37	0.26	0.04	0.36	0.22	0.04	0.19	0.37
Total Organic Carbon	3	3	2	5	2	4	3	4	4	2	2	2	2	2	2	2	5	4	5	2	3.1	5
Sodium, Total (mg per L)	–	–	–	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14	14	14
Chloride (mg per L)	51	63	70	53	67	143	74	62	50	49	47	64	56	63	64	135	125	84	29	29	71	143
Sulfate (mg per L)	48	51	54	55	63	67	59	48	43	44	54	60	48	54	56	93	26	59	29	26	53	93
Fluoride, Total (mg per L)	0.27	0.28	0.33	0.36	0.35	0.38	0.41	0.32	0.28	0.29	0.27	0.24	0.27	0.32	0.33	1.32	0.27	0.36	0.25	0.24	0.36	1.32
Residue, Total Filtrable (mg per L)	420	470	460	372	500	438	508	388	374	408	460	488	408	430	466	472	484	462	472	372	446	508
Chlorophyll-A (µg per L)	10	10	–	10	10	10	11.3	10	10	10	10	12.8	30.7	19.2	10	27.1	3	12.3	3	3	12.2	30.7
Pheophytyn-A (µg per L)	15.2	22.3	–	5	42.8	5	5	5	5.79	5.98	5	5	17.9	8.44	–	–	–	–	–	5	11.42	42.8

Table 2.3.3-10 (Sheet 2 of 2)
Summary of Guadalupe River Tidal (TCEQ Station 12577) Surface Water Quality Data (2002–2007)

Parameter	1/17/2002	4/1/2002	6/25/2002	12/19/2002	4/7/2003	9/11/2003	12/10/2003	3/4/2004	5/26/2004	9/14/2004	12/21/2004	4/21/2005	6/16/2005	9/7/2005	12/1/2005	4/19/2006	7/11/2006	10/11/2006	1/25/2007	2002–2006 Minimum	2002–2006 Average	2002–2006 Maximum
Fecal Coliform (# per 100 mL)	56	32	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32	44.0	56
E. Coli, Colilert (mpn per 1000 mL)	–	–	–	–	–	–	–	–	–	–	–	–	–	25.6	–	5	3	61	722	3	163	722
Enterococci, Enterolert (mpn per 1000 mL)	41	41	10	52	41	–	–	31	10	51	10	10	10	–	6.1	–	–	–	–	6.1	26.1	52

Source: GBRA 2008
– = parameter not analyzed
per 100 mL = number of colony-forming units per 100 milliliters
MPN per 1000 mL = most probable number per 1000 milliliters

Table 2.3.3-11 (Sheet 1 of 2)
Summary of Guadalupe River at GBRA Saltwater Barrier (USGS Station 08188800) Water Quality Data (1980–1999)

Parameter	1/15/1980	8/5/1980	1/22/1985	8/20/1985	3/5/1990	7/24/1990	1/24/1995	8/23/1995	1/26/1999	8/24/1999	1980–1999 Minimum	1980–1999 Average	1980–1999 Maximum
Sample Depth Interval: 0.98 feet													
Temperature (°C)	15	30	7	28.6	18	28	13.5	30	19.5	—	7	21.1	30
Turbidity, Hach (Formazin Turb Unit)	26	36	140	—	—	—	—	—	—	—	26	67	140
Specific Conductance (µmhos per cm)	849	880	428	696	795	425	676	767	801	790	425	710	880
Oxygen, Dissolved (mg per L)	9.6	5.9	11.1	8.1	9.1	4.8	9.2	6.6	—	5.7	4.8	7.8	11.1
BOD, 5 day (mg per L)	1.8	1.4	3.1	1.9	2.2	2.4	1.5	3.7	—	—	1.4	2.3	3.7
Bicarbonate, Diss. Field as HCO_3, (mg per L)	290	270	—	—	—	—	—	—	—	—	270	280	290
Nitrogen (mg per L)	2.1	1.6	3.3	2.1	4.1	1.7	—	—	—	—	1.6	2.5	4.1
Ammonia (mg per L)	0.05	0.02	0.15	0.07	0.13	0.17	—	—	—	—	0.02	0.10	0.17
Nitrite (mg per L)	0.04	0.04	0.07	0.01	0.09	0.24	—	—	—	—	0.01	0.08	0.24
Nitrate (mg per L)	0.87	0.71	1.33	1.09	3.41	0.46	—	—	—	—	0.46	1.31	3.41
Nitrite & Nitrate (mg per L)	0.91	0.75	1.4	1.1	3.5	0.7				—	0.7	1.39	3.5
Phosphate, Ortho (mg per L)	—	—	—	—	—	—	0.675	0.613	—	—	0.613	0.644	0.675
Phosphorus (mg per L)	0.68	0.57	0.63	0.36	1.4	0.53	—	—	—	—	0.36	0.70	1.4
Hardness, Total as $CaCO_3$ (mg per L)	300	270	150	240	250	140	260	240	280	260	140	239	300
Calcium (mg per L)	89	77	45	69	72	44	76	68	83.3	75.6	44	69.9	89
Sodium (mg per L)	64	70	26	48	63	27	42	58	49.6	62.2	26	51.0	70
Potassium (mg per L)	3.7	4.7	3.5	3.9	5.1	7.7	3.8	4.2	2.99	4.32	2.99	4.39	7.7
Chloride (mg per L)	99	110	34	72	81	37	66	81	68.8	82	34	73.1	110
Sulfate (mg per L)	70	69	37	47	53	36	46	56	61.8	53.8	36	53.0	70
Silica (mg per L)	14	17	10	12	12	13	12	15	11.4	19	10	13.5	19
Arsenic (µg per L)	2	5	1	3	—	3	1	—	—	—	1	2.5	5
Barium (µg per L)	100	100	57	98	—	130	80	—	—	—	57	94	130
Copper (µg per L)	0	—	—	3	—	< 10	< 10	—	—	—	0	1.5	3

Table 2.3.3-11 (Sheet 2 of 2)
Summary of Guadalupe River at GBRA Saltwater Barrier (USGS Station 08188800) Water Quality Data (1980–1999)

Parameter	1/15/1980	8/5/1980	1/22/1985	8/20/1985	3/5/1990	7/24/1990	1/24/1995	8/23/1995	1/26/1999	8/24/1999	1980–1999 Minimum	1980–1999 Average	1980–1999 Maximum
Lead (µg per L)	—	—	< 1	< 1	—	< 10	< 100	—	—	—	<1	0	0
Manganese (µg per L)	—	—	—	9	—	9	2	—	—	—	2	6.7	9
Strontium (µg per L)	—	—	—	—	—	280	580		—	—	280	430	580

Source: USGS 2008
– = Parameter not analyzed
µg per L = micrograms per liter
< = parameter was detected at or below method detection limits

Table 2.3.3-12 (Sheet 1 of 2)
Summary of Guadalupe River at Victoria (USGS Station 08176500) Water Quality Data (1980–1999)

Parameter	1/17/1980	7/9/1980	1/23/1985	7/10/1985	3/6/1990	5/24/1990	3/25/1994	8/25/1994	12/13/1999	1980–1999 Minimum	1980–1999 Average	1980–1999 Maximum
Sample Depth Interval: 0.98 feet												
Temperature (°C)	16.5	31.5	7	28	18.5	28.5	22.5	29	18	7	22.2	31.5
Turbidity, Hach (Formazin Turb Unit)	4.9	17	74	95	23	56	14	6.2	—	4.9	36.3	95
Specific Conductance (μmhos per cm)	649	544	434	415	601	416	579	590	629	415	539	649
Oxygen, Dissolved (mg per L)	9.9	7.4	8.6	6.8	8.6	7.1	8.6	6.8	—	6.8	8.0	9.9
BOD, 5 day (mg per L)	1.3	2.8	1.1	1	0.8	0.8	0.6	2	—	0.6	1.3	2.8
Bicarbonate, Diss. Field as HCO_3, (mg per L)	280	240	—	—	—	—	—	—	—	240	260	280
Nitrogen (mg per L)	1.7	1.3	1.7	1.5	0.9	1.3		1	—	0.9	1.3	1.7
Ammonia (mg per L)	0.02	0.06	—	—	0.04	0.07	—	—	—	0.02	0.05	0.07
Nitrite (mg per L)	—	—	—	—	0.03	0.03	<0.010	<0.010	—	<0.010	0.03	0.03
Nitrate (mg per L)	—	—	—	—	0.67	0.97	—	—	—	0.67	0.82	0.97
Nitrite and Nitrate (mg per L)	0.91	0.67	0.76	0.55	0.7	1	1.1	0.7	—	0.55	0.80	1.1
Phosphate, Ortho (mg per L)		3.6	0.245	0.184	0.276	0.368	0.184	0.123	—	0.123	0.71	3.6
Phosphorus (mg per L)	0.09	0.06	0.18	0.23	0.12	0.21	0.09	0.05	—	0.05	0.13	0.23
Hardness, Total as $CaCO_3$ (mg per L)	250	220	200	170	230	180	240	200	—	170	211	250
Calcium (mg per L)	75	61	55	53	64	52	68	57	—	52	60	75
Sodium (mg per L)	30	26	19	14	37	15	32	34	—	14	25	37
Potassium (mg per L)	2.1	2.3	2.9	4.1	3.1	3.6	2.6	2.9	—	2.1	3.0	4.1
Chloride (mg per L)	47	37	25	17	38	18	42	44	—	17	33	47
Sulfate (mg per L)	34	28	28	23	28	20	34	31	—	20	28	34
Silica (mg per L)	10	15	11	14	8.7	11	10	14	—	8.7	11.7	15
Arsenic (μg per L)	—	—	1	3	2	2	—	—	—	1	2.0	3
Barium (μg per L)	—	—	59	68	64	120	66	75	—	59	75.3	120

Table 2.3.3-12 (Sheet 2 of 2)
Summary of Guadalupe River at Victoria (USGS Station 08176500) Water Quality Data (1980–1999)

Parameter	1/17/1980	7/9/1980	1/23/1985	7/10/1985	3/6/1990	5/24/1990	3/25/1994	8/25/1994	12/13/1999	1980–1999 Minimum	1980–1999 Average	1980–1999 Maximum
Copper (µg per L)	—	—	1	1	< 10	1	—	—	—	1	1	1
Manganese (µg per L)	—	—	< 1	2	2	1	4	5	—	<1	2.8	5
Strontium (µg per L)	—	—	420	350	530	350	520	470	—	350	440.0	530

Source: USGS 2008
– = Parameter not analyzed
< = parameter was detected at or below the method detection limit
µg per L = micrograms per liter

Table 2.3.3-13
Summary of Guadalupe River at Highway 59 (TCEQ Station 12581) Water Quality Data (1990–1994)

Parameter	4/16/1990	6/7/1990	10/11/1990	1/29/1991	4/17/1991	7/22/1991	11/13/1991	2/3/1992	4/28/1992	7/1/1992	10/5/1992	5/7/1993	11/9/1993	4/13/1994	1990–1994 Minimum	1990–1994 Average	1990–1994 Maximum
Sampling Depth Interval: 0.98 Feet																	
Temperature (°C)	24.4	30.1	19.6	13.3	22.7	29.8	17.1	15.3	23.1	29	23.7	22.9	15.7	22.1	13.3	22.1	30.1
Specific Conductance (µmhos per cm)	598	524	541	424	306	551	637	440	702	633	646	333	544	632	306	536	702
Oxygen, Dissolved (mg per L)	7.7	6.8	8.5	9.6	5.7	6.2	9.5	9.3	7.3	6.6	8.2	6.4	10.4	8.7	5.7	7.9	10.4
pH (Standard Units)	8.7	8.2	8.1	7.9	7.6	8.2	8.4	—	7.8	7.9	8.1	7.9	8.1	8.4	7.6	8.1	8.7
Alkalinity, Total ($CaCO_3$) (mg per L)	216	198	194	152	169	226	214	205	260	234	202	124	216	225	124	202	260
Residue, Total nonfiltrable (mg per L)	64	61	18	76	462	68	23	304	192	35	30	292	38	46	18	122	462
Nitrogen as Ammonia, Total (mg per L)	0.32	0.33	0.08	0.24	0.18	0.21	0.39	0.1	0.16	0.17	0.15	0.02	0.03	0.03	0.02	0.17	0.39
Nitrite Nitrogen, Total (mg per L)	0.06	—	—	0.08	0.26	—	0.05	0.06	0.07	< 0.01	0.05	0.05	0.03	< 0.01	<0.01	0.08	0.26
Nitrate Nitrogen, Total (mg per L)	1.02	0.44	—	1.36	0.73	0.54	0.78	0.53	1.45	1.09	1.09	0.58	0.1	1.43	0.1	0.86	1.45
Phosphorus, Total (mg per L)	0.56	0.26	0.25	0.29	0.72	0.3	0.25	0.38	0.16	0.2	0.32	0.28	0.13	0.26	0.13	0.31	0.72
Phosphorus, Diss. Orthopohosphate (mg per L)	0.49	0.17	0.21	0.29	0.44	0.26	0.24	0.23	0.12	0.12	0.28	0.18	0.11	0.22	0.11	0.24	0.49
Carbon, Total Organic (mg per L)	5	6	4	8	13	6	4	10	5	6	2	10	2	—	2	6.2	13
Chloride, Total (mg per L)	34	32	30	19	9	34	35	23	40	37	38	24	33	45	9	31	45
Sulfate, Total (mg per L)	26	27	20	< 1	< 1	17	31	28	32	32	32	27	32	34	<1	28	34
Fecal Coliform, membrane filter (# per 100 mLl)	17	< 17	—	< 17	—	—	< 16	—	373	140	40	—	20	53	<17	107	373
Chlorophyll-A (µg per L)	1.7	4	1.6	1.2	5.1	< 1	1	< 1	7.8	3.6	2.8	8.62	3.78	3.2	<1	3.70	8.62
Pheophytin-A (µg per L)	2.3	2	0	<1	2	8.5	5.3	0	< 1	3.9	< 1	0	0	< 1	0	2.4	8.5

Source: USEPA, 2008b
— = Parameter not analyzed
µg per L = micrograms per liter
mg per L = milligrams per liter
< = parameter detected at or below the method detection limit
per 100 mL = number of colony-forming units per 100 milliliters
µmhos per cm = micromhos per centimeter

Table 2.3.3-14
Summary of Lower San Antonio River at Highway 77 (TCEQ Station 12789) Water Quality Data (2003–2007)

Parameter	8/18/2003	12/17/2003	8/25/2004	12/8/2004	8/10/2005	12/21/2005	8/16/2006	12/20/2006	8/15/2007	2003–2007 Minimum	2003–2007 Average	2003–2007 Maximum
Flow rate, instantaneous (cfs)	512	505	511	2728	362	407	164	253	3260	164	966	3260
Temperature (°C)	30	13.3	29.8	18	30.6	12	30.4	20.7	29	12	23.8	30.6
pH (Standard Units)	8	8.1	8	8.1	8.2	8.2	8.3	8.1	8	8	8.1	8.3
Specific Conductance (µmhos per cm)	1206	1137	1080	777	1090	1100	1510	1220	805	777	1102	1510
Oxygen, Dissolved (mg per L)	6.8	10.5	7.2	8.9	8.6	11	7	8.6	6.7	6.7	8.4	11
Nitrogen, Total (Kjeldahl) (mg per L)	—	—	0.548	0.865	0.944	0.54	1.1	0.688	0.713	0.54	0.77	1.1
Ammonia (mg per L)	—	—	< 0.02	0.031	< 0.02	< 0.02	< 0.02	0.033	< 0.02	<0.02	0.032	0.033
Nitrite Nitrogen (mg per L)	—	—	< 0.02	< 0.02	0.021	< 0.02	0.042	< 0.02	< 0.02	<0.02	0.032	0.042
Nitrate Nitrogen (mg per L)	—	—	—	2.27	4.58	7.63	4.48	12.1	2.33	2.27	5.57	12.1
Carbon, Total Organic (mg per L)	—	—	2.18	3.18	3.51	2.9	3.37	2.88	2.79	2.18	2.97	3.51
Phosphorus (mg per L)	—	—	0.368	0.435	0.546	0.965	0.827	1.06	0.337	0.337	0.65	1.06
Chloride (mg per L)	—	—	108	62.1	126	130	206	164	54.4	54.4	121	206
Sulfate (mg per L)	—	—	107	69.2	105	106	171	115	66.3	66.3	105	171

Data downloaded from SARA, 2008
— = parameter not analyzed
cfs = cubic feet per second
mg per L = milligrams per liter
µmhos per cm = micromhos per centimeter
< = parameter detected at or below the method detection limit

Table 2.3.3-15 (Sheet 1 of 2)
Summary of GBRA Calhoun Canal Uplift Station #1 (USGS Station 08188600)
Water Quality Data (1995–2005)

Parameter (µg per L)	5/18/1995[a]	12/12/1996[b]	9/10/1997[b]	8/25/1998[b]	7/18/2000[b]	6/7/2005[b]
Trifluralin	–	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Propachlor	–	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Hexazinone	–	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Butachlor	–	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Carboxin	–	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Butylate	–	< 0.05	< 0.05	< 0.05	< 0.05	<0.05
Bromacil	–	< 0.05	< 0.05	0.14	< 0.02	0.12
Simatryn	–	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cycloate	–	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Terbacil	–	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Diphenamid	–	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Vernolate	–	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Simazine	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02
Prometryn	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Prometon	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CEAT	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CIAT	< 0.05	< 0.05	< 0.05	< 0.05	< 0.04	< 0.02
Cyanazine	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Ametryn	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Propazine	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chlorpyrifos	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	–
Disulfoton	< 0.01	–	< 0.01	< 0.01	< 0.03	–
Phorate	< 0.01	< 0.10	< 0.1	< 0.1	<0.02	–
p,p'-Ethyl-DDD	< 0.1	< 0.1	< 0.1	< 0.1	–	–
Tribuphos	< 0.01	< 0.03	< 0.01	< 0.01	< 0.02	–
PCNs	< 0.1	< 0.1	< 0.1	< 0.1	–	–
Aldrin	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Lindane	< 0.010	< 0.010	< 0.010	< 0.010	< 0.012	< 0.014
Chlordane technical	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
p,p'-DDD	< 0.010	< 0.010	< 0.010	< 0.010	< 0.014	< 0.016
p,p'-DDE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.016	< 0.014
p,p'-DDT	< 0.010	< 0.010	< 0.010	< 0.010	< 0.017	< 0.010
Dieldrin,	< 0.010	< 0.010	< 0.010	< 0.010	< 0.009	< 0.008
Alpha Endosulfan	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endrin,	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethion	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	–

Table 2.3.3-15 (Sheet 2 of 2)
Summary of GBRA Calhoun Canal Uplift Station #1 (USGS Station 08188600)
Water Quality Data (1995–2005)

Parameter (µg per L)	5/18/1995[(a)]	12/12/1996[(b)]	9/10/1997[(b)]	8/25/1998[(b)]	7/18/2000[(b)]	6/7/2005[(b)]
Toxaphene	< 1	< 1	< 1	< 1	< 1	< 1
Heptachlor	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Metolachlor	< 0.05	< 0.05	< 0.05	< 0.02	< 0.05	< 0.05
Helptachlorepoxide	< 0.006	< 0.007	< 0.008	< 0.009	< 0.009	<0.009

(a) USGS 2008
(b) URS Oct 2004
– = parameter not analyzed
µg per L = micrograms per liter
< = parameter detected at or below the method detection limit

Table 2.3.3-16
Summary of Victoria Barge Canal (TCEQ Station 12536) Water Quality Data (2004–2007)

Parameter	3/16/2004	5/26/2004	9/14/2004	12/21/2004	4/21/2005	6/16/2005	9/20/2005	12/1/2005	4/19/2006	7/11/2006	10/11/2006	1/25/2007	2004–2007 Minimum	2004–2007 Average	2004–2007 Maximum
Sampling Depth Interval: 0.3 Feet															
Temperature (°C)	26.867	27.9	28.8	15.9	24.4	31.9	31.4	19.02	27.5	31.4	28.6	9.9	9.9	25.3	31.86
Specific Conductance (µmhos per cm)	10,700	1050	2270	1810	1651	1896	6185	12,039	10,300	6220	5300	16,700	1050	6343	16700
Dissolved Oxygen (mg per L)	7.8	5.9	5.7	9.4	8.68	7.41	7.99	7.74	8.9	7.6	6.7	11.9	5.7	8.0	11.9
pH (Standard Units)	8.1	7.7	8.1	7.9	7.7	7.82	7.94	7.69	8.2	8	8	8.3	7.69	8.0	8.3
Salinity (parts per 1000)	6	1	2	1	0.88	1.01	3.42	6.89	5.8	3.4	2.9	9.8	0.88	3.7	9.8
Alkalinity, Total (As $CaCO_3$)(mg per L)	188	110	166	209	187	155	172	120	196	120	132	120	110	156	209
Residue, Total Nonfiltrable (mg per L)	16	55	38	28	25	4	52	55	56	33	19	59	4	36.7	59
Nitrite/Nitrate (mg per L)	—	—	—	—	0.33	0.04	0.11	0.37	1.4	0.1	0.16	1.02	0.04	0.44	1.4
Nitrite Nitrogen, Total (mg per L)	0.25	0.05	0.05	0.05	—	—	—	—	—	—	—	—	0.05	0.10	0.25
Nitrate Nitrogen, Total (mg per L)	1.04	0.19	0.22	0.2	—	—	—	—	—	—	—	—	0.19	0.41	1.04
Nitrogen as Ammonia (mg per L)	0.18	0.1	0.06	0.06	0.08	0.05	0.05	0.13	0.05	0.05	0.05	0.1	0.05	0.08	0.18
Nitrogen, KJELDAHL (mg per L)	0.78	1.01	0.81	0.58	0.9	0.82	1.14	1.04	1.37	1.06	0.67	0.85	0.58	0.92	1.37
Phosphorus, Total (mg per L)	0.06	0.2	0.14	0.19	0.19	0.16	0.09	0.16	0.22	0.16	0.17	0.25	0.06	0.17	0.25
Orthophosphate, diss. (mg per L)	0.3	0.18	0.06	0.08	0.18	0.11	0.05	0.12	0.16	0.08	0.12	0.11	0.05	0.13	0.3
Total Organic Carbon (mg per L)	2	8	6	5	7	5	4	3	3	7	6	3	2	4.9	8
Chloride (mg per L)	3270	234	526	435	373	454	1900	3860	3330	974	1450	5060	234	1822	5060
Sulfate (mg per L)	491	35	104	82	76	99	313	540	488	311	228	709	35	289	709
Fluoride, Total (mg per L)	0.41	0.23	0.3	0.26	0.17	0.28	0.4	0.43	0.49	0.5	0.25	0.5	0.17	0.35	0.5
Residue, Total Filtrable (mg per L)	6240	648	1200	1160	940	1120		7580	6300	3550	2910	9310	648	3723	9310
Chlorophyll-a (µg per L)	10	10	20	10	21.9	16	22.4	12.2	59.7	24.9	8.52	8.61	8.52	18.7	59.7
Pheophytyn-a (µg per L)	5	5	5	5	5	7.65	5	5	—	—	—	—	5	5.3	7.65
Enterococci, Enterolert (MPN per 100mL)	10	10	10	20	10	10	10	14.5	4	48	1	1250	1	116	1250

Source: GBRA, 2007a
— = Parameter not analyzed
µmhos per cm = micromhos per centimeter
mg per L = milligrams per liter
µg per L = micrograms per liter
MPN per 100 mL = most probable number per 100 milliliters

Table 2.3.3-17 (Sheet 1 of 2)
Summary of Coleto Creek at Highway 77 (TCEQ Station 12622) Water Quality Data (1994–1997)

Parameter	4/13/1994	10/25/1994	1/23/1995	4/18/1995	7/6/1995	10/24/1995	1/17/1996	4/15/1996	7/24/1996	10/29/1996	1/22/1997	4/22/1997	7/17/1997	12/16/1997	1990–1994 Minimum	1990–1994 Average	1990–1994 Maximum
Sampling Depth: 0.98 Feet																	
Temperature (°C)	25.3	24.6	15.91	23.7	30.66	24.65	19.23	24.31	33.58	—	15.97	25.71	33.68	15.74	15.74	24.1	33.68
Specific Conductance (μmhos per cm)	1002	878	678	929	881	1163	1053	1203	921	—	309	597	783	945	309	872	1203
Oxygen, Dissolved (mg per L)	10.2	4.8	8.29	7.12	6.89	8.95	8.64	9.39	9.09	—	6.65	8.8	7.8	9.75	4.8	8.18	10.2
pH (Standard Units)	8.1	7.3	7.79	7.93	8.23	8.24	8.02	8.28	8.83	—	8.92	7.9	8.38	8.37	7.3	8.18	8.92
Alkalinity, Total ($CaCO_3$) (mg per L)	247	146	180	222	174	210	243	—	130	153	76	154	186	—	76	177	247
Salinity (parts per 1000)	—	< 2	0.3	0.5	0.5	—	—	—	—	—	< 1	< 1	< 1	< 1	0.3	0.4	0.5
Residue, Total nonfiltrable (mg per L)	10	15	13	37	8	8	8	—	24	—	100	15	5	—	5	22.1	100
Nitrogen as Ammonia, Total (mg per L)	< 0.01	0.04	< 0.01	0.01	0.05	< 0.01	< 0.01	—	0.02	0.03	0.01	0.07	< 0.05	—	<0.01	0.03	0.07
Nitrite Nitrogen, Total (mg per L)	< 0.01	0.04	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	0.04	0.04
Nitrate Nitrogen, Total (mg per L)	0.08	0.15	—	—	—	—	—	—	—	—	—	—	—	—	0.08	0.12	0.15
Nitrogen, KJELDAHL, Total (mg per L)	0.4	0.62	0.44	0.41	0.51	0.26	0.25	—	0.69	0.62	1.74	0.89	0.65	—	0.25	0.62	1.74
Nitrite & Nitrate, Total (mg per L)	—	—	0.03	0.03	< 0.01	0.01	< 0.1	—	< 0.1	< 0.1	0.44	< 0.1	< 0.1	—	<0.01	0.13	0.44
Phosphorus, Total (mg per L)	< 0.01	0.08	0.04	0.04	0.05	0.04	0.02	—	0.07	0.05	0.21	0.07	0.02	—	<0.01	0.06	0.21
Phosphorus, Diss. (mg per L)	< 0.01	0.06	0.01	0.02	0.02	0.04	—	—	—	—	0.21	—	—	—	<0.01	0.06	0.21
Phosphorus, Total (mg per L)	—	—	—	—	—	—	<0.1	—	< 0.1	< 0.2	—	< 0.06	< 0.06	—	<0.06	0	0
Carbon, Total Organic, (mg per L)	2	6	5	3	4	5	3	—	5	7	12	6	5	—	2	5.3	12
Chloride, Total (mg per L)	152	57	82	102	122	57	138	—	139	174	40	75	113	—	40	104	174
Sulfate, Total (mg per L)	27	13	18	23	28	33	30.1	—	35	32	< 1	12	17	—	< 1	24.4	35
Fecal Coliform (# per 100 mL)	673	107	33	7	20	< 7	20	73	73	—	1560	84	12.2	65	< 7	227	1560

Table 2.3.3-17 (Sheet 2 of 2)
Summary of Coleto Creek at Highway 77 (TCEQ Station 12622) Water Quality Data (1994–1997)

Parameter	4/13/1994	10/25/1994	1/23/1995	4/18/1995	7/6/1995	10/24/1995	1/17/1996	4/15/1996	7/24/1996	10/29/1996	1/22/1997	4/22/1997	7/17/1997	12/16/1997	1990–1994 Minimum	1990–1994 Average	1990–1994 Maximum
Chlorophyll-A (µg per L)	12.1	< 1	< 1	2.4	2.04	< 1	< 1	—	7.61	< 1	< 1	11.8	7.82	—	< 1	7.3	12.1
Pheophytin-A (µg per L)	0	13.6	6.09	< 1	2.04	10.2	< 1	—	< 1	0	< 1	12.2	< 1	—	0	6.3	13.6

Source: USEPA 2008b
— = parameter not analyzed
µg per L = micrograms per liter
mg per L = milligrams per liter
< = parameter detected at or below the method detection limit
per 100 ML = number of colony-forming units per 100 milliliters
µmhos per cm = micromhos per centimeter

Table 2.3.3-18 (Sheet 1 of 5)
VCS Site Surface Water Analytical Results

Parameter	Analytical Method	GBRA Uplift #1 Calhoun Canal	GBRA Uplift #1 Calhoun Canal SW-06	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier Duplicate	Linn Lake SW-03	Linn Lake Duplicate	Kuy Creek SW-02	Kuy Creek SW-02	Coleto Creek at Hwy 77 SW-04	Coleto Creek at Hwy 77 SW-04	Guadalupe River at Hwy 59 SW-05	Guadalupe River at Hwy 59 SW-05
		11.27.07	4.16.08	11.27.07	4.16.08	4.16.08	11.27.07	11.27.07	11.28.07	4.16.08	11.28.07	4.16.08	11.28.07	4.16.08
General Chemistry														
Temperature (°C)	Field Measurement	13.82	24.73	14.07	23.44	23.44	13.85	13.85	17.14	19.33	19.18	21.63	15.14	20.66
pH (standard units)	Field Measurement	7.34	8.18	8.11	8.11	8.11	8.54	8.54	7.53	7.77	8.03	8.16	8.37	8.21
Salinity (percent)	Field Measurement	0.02	0	0.03	0	0	0.03	0.03	0.08	0.1	0.04	0	0.01	0
Total Suspended Solids (mg per L)	SM 2540/USEPA 160.2	21.3	47.3	31.0	89.5	89.3	20.0	21.0	2.0	63.6	4.0	3.3	40.0	79.3
Total Dissolved Solids (mg per L)	SM 2540/USEPA 160.1	323	509	398	530	523	987	336	1020	847	539	592	219	371
Hardness, Total as $CaCO_3$ (mg per L)	USEPA 130.2	200	300	260	320	320	220	226	486	464	258	284	144	264
Turbidity (NTU)	USEPA 180.1	91.3	23.5	197	8.4	9.9	88.2	60.5	16.5	7.9	2.1	2.2	482	7.5
Color, Apparent (Cobalt Units)	USEPA 110.2	40	15	25	10	10	25	25	35	25	5	10	240	10
Odor (Threshold Odor Number)	USEPA 140.1	2	<1	4	<1	<1	4	4	>1	<1	>1	<1	>1	<1
Conductivity (mS per cm)	Field Measurement	0.604	0.741	0.716	0.759	0.759	0.565	0.565	1.74	1.44	0.903	0.820	0.363	0.542
Dissolved Oxygen (mg per L)	Field Measurement	5.12	102.3	12.32	10.47	10.47	14.79	14.79	16.22	11.29	10.76	9.34	14.22	9.53
Biochemical Oxygen Demand (mg per L)	SM 5210/USEPA 405.1	2.0	<0.89	2.0	<0.89	<0.89	2.0	2.0	7.0	<0.89	2.0	<0.89	7.0	17
Chemical Oxygen Demand (mg per L)	SM 5220/USEPA 410	28.6	<4.5	<4.5	<4.5	5†	35.5	24.1	35.5	59.2	<14.9	15.3†	20.1	7.6†
Total Organic Carbon (mg per L)	USEPA 415.1	8.3	—	5.2	—	—	5.3	5.4	—	—	—	—	—	—
Phosphorus, Total (mg per L)	USEPA 365.2	0.11	0.099	0.27	0.27	0.27	0.11	0.12	0.040	0.094	0.038	0.003†	0.25	0.057
Orthophosphorus (mg per L)	USEPA 365.2	0.14	0.11	0.22	0.21	0.19	0.12	0.1	0.023	0.018†	<0.013	<0.003	0.29	1.6
Nitrogen, Ammonia (mg per L)	SM 4500/USEPA 350.1	0.10	<0.05	<0.050	<.010	<0.10	<0.050	<0.050	<0.1	0.13	<0.10	<0.10	0.28	0.21
Nitrogen, Nitrate (mg per L)	SM18 4500N03E/NO2B	0.50	1.60	2.4	2.6	2.6	0.89	0.91	—	<0.11	—	<0.11	—	0.86
Nitrogen, Nitrate, Nitrite (mg per L)	SM18 4500N03E	0.76	1.7	2.4	2.6	2.6	0.89	0.91	—	<0.10	—	<0.10	—	0.87

Table 2.3.3-18 (Sheet 2 of 5)
VCS Site Surface Water Analytical Results

Parameter	Analytical Method	GBRA Uplift #1 Calhoun Canal	GBRA Uplift #1 Calhoun Canal SW-06	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier Duplicate	Linn Lake SW-03	Linn Lake Duplicate	Kuy Creek SW-02	Kuy Creek SW-02	Coleto Creek at Hwy 77 SW-04	Coleto Creek at Hwy 77 SW-04	Guadalupe River at Hwy 59 SW-05	Guadalupe River at Hwy 59 SW-05
		11.27.07	4.16.08	11.27.07	4.16.08	4.16.08	11.27.07	11.27.07	11.28.07	4.16.08	11.28.07	4.16.08	11.28.07	4.16.08
Nitrogen, Nitrite (mg per L)	USEPA 352.2	0.26	0.051	<0.24	0.019	0.02	<0.050	<0.026	<0.011	<0.10	<0.041	<0.10	<0.043	0.015
Nitrate, Nitrite (mg per L)	SM 4500/NO3	—	—	—	—	—	—	—	<1.0	—	<1.0	—	<1.0	—
Nitrogen, Total Kjeldahl (mg per L)	USEPA 351.2	0.80	—	0.88	—	—	0.56	0.58	<0.1	—	<0.1	—	0.72	—
Nitrogen, Organic (mg per L)	SM 4500-N	0.70	—	0.88	<.010	<0.10	0.56	0.58	<0.1	0.13	<0.1	<0.10	—	<0.10
Alkalinity, total as $CaCO_3$ (mg per L)	SM 2320/USEPA 310	168	268	223	232	316	205	200	440	392	261	252	119	224
Carbon Dioxide (mg per L)	SM4500 CO2 D	168	5.6	223	3.4†	3.5†	205	200	440	18.7	261	4.9†	119	4.7†
Bicarbonate Alkalinity (mg per L)	SM2320	167.42	268	221.31	232	316	202.65	198.04	438.01	392	258.63	252	118.44	224
Chloride (mg per L)	SM 5220/USEPA 325.3	48.8	77.5	48.3	73.5	74.5	31.2	31.7	196	204	98.2	124	21.3	24.8
Sulfide (mg per L)	USEPA 376.1	2.0	—	2.0	—	—	3.0	2.0	0.0	—	0.0	—	0.0	—
Sulfate (mg per L)	SM 4500/USEPA 375.3	12.8	66.77	11.9	63.4	69.1	<3.3	<5.4	81.1	15.6	10.3	22.6	10.3	33.3
Sodium (mg per L)	USEPA 6010B	36.6	58.7	44.9	58.7	59.1	25.5	25.4	155	107	69.9	82.4	17.5	30.4
MBAS as LAS (mg per L)	SM 5540C	<0.02	—	<0.02	—	—	—	—	—	—	—	—	—	—
Fluoride (mg per L)	USEPA 340.2	0.18	—	0.30	—	—	0.23	0.25	—	—	—	—	—	—
Calcium (mg per L)	USEPA 200.7	58.2	81.5	88.2	87.9	91.3	—	—	—	150	—	98.4	—	753
Silica (Dissolved) (mg per L)	USEPA 370.1	6.7	—	9.8	—	—	35.7	5.3	—	—	—	—	—	—
Silica (Total) (mg per L)	USEPA 6010B	10.9	11.1	14.2	10.6	11.2	—	—	—	10.3	—	13.4	—	71.5
Bacteria and Plankton														
Total Coliform (CFUs per 100 mL)	SM 9223B/9221D	6590	>2000	10,910	>2000	>2000	7820	6240	810	>2000	1900	900	10,000	>2000
Fecal Coliform (CFUs per 100 mL)	SM 9222D	—	10	—	90	210	—	—	40	250	40	20	140	10
Fecal Streptococci (CFUs per 100 mL)	SM 9230C	—	<10	—	50	100	—	—	10	20	2200	10	60	10

Table 2.3.3-18 (Sheet 3 of 5)
VCS Site Surface Water Analytical Results

Parameter	Analytical Method	GBRA Uplift #1 Calhoun Canal	GBRA Uplift #1 Calhoun Canal SW-06	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier Duplicate	Linn Lake SW-03	Linn Lake Duplicate	Kuy Creek \SW-02	Kuy Creek SW-02	Coleto Creek at Hwy 77 SW-04	Coleto Creek at Hwy 77 SW-04	Guadalupe River at Hwy 59 SW-05	Guadalupe River at Hwy 59 SW-05
		11.27.07	4.16.08	11.27.07	4.16.08	4.16.08	11.27.07	11.27.07	11.28.07	4.16.08	11.28.07	4.16.08	11.28.07	4.16.08
Chlorophyll-a (mg per m^3)	SM 10200	<0.1	HT	<0.1	HT	HT	—	—	—	HT	—	HT	—	HT
Phytoplankton (cells per 5 ml)	Palmer-Maloney	4.33	600	0	2902	3854	—	—	—	632	—	2371	—	2239
Radionuclides (pCi per L)**														
Potassium-40 (K-40)	USEPA 901.1	39.2	-4.88	-9.67	81.3	20.1	-5.27	23.6	-35.9	31.6	-21.2	39.5	-22.6	29.8
Cesium-137 (Cs-137)	USEPA 901.1	1.04	-1.8	-1.75	0.85	-1.26	0.988	1.55	3.67	-4.17	1.98	1.07	-0.712	0.019
Thallium-208 (Tl-208)	USEPA 901.1	-1.96	9.61	-3.62	0.957	-1.14	2.74	-0.862	5.79	-6.02	-1.84	-1.73	1.04	1.87
Bismuth-212 (Bi-212)	USEPA 901.1	15.2	40.4	-32.2	18.6	-27.5	-6.93	1.49	17.2	-25.7	-19.4	-25.5	-6.24	-33.7
Lead-212 (Pb-212)	USEPA 901.1	-0.042	12	-5.05	3.87	-0.003	3.05	0.168	14.8	-0.813	0.991	3.33	2.26	3.93
Bismuth-214 (Bi-214)	USEPA 901.1	-2.74	88.3	1.64	36.2	30.6	15.9	19.3	17.6	2.23	-2.18	8.52	1.57	24.9
Lead-214 (Pb-214)	USEPA 901.1	-4.71	55.4	4.32	12.4	19.6	1.31	15.2	6.96	-0.348	-5.15	13	10.6	27.2
Radium-228 (Ra-228)	USEPA 901.1	6.04	-1.21	2.12	-7.65	-4.32	-0.915	-16.8	7.15	0.465	-3.9	-16.8	-3.47	-0.459
Radium-228 (Ra-228)	USEPA 904.0	0.250	—	0.956	—	—	70.7	0.556	1.69	—	0.752	—	76.6	—
Tritium (H-3)	USEPA 906.0	73.3	126	107	131	148	0.64	27.6	77.6	76	148	181	2.21	145
Metals (µg per L)														
Aluminum	USEPA 6010B	1240	—	4940	—	—	701	1760	<86	—	<86	—	3090	—
Antimony	USEPA 6010B	<2.7	—	<2.7	—	—	<2.7	<2.7	<2.7	—	<2.7	—	<2.7	—
Arsenic	USEPA 6010B	<3.4	<2.7	<2.9	<2.7	<2.7	<2.7	<2.7	<4.6	7.5	<3.7	10.1	<2.7	<2.7
Barium	USEPA 6010B	<79.2	109†	<99.3	92.6†	99.8†	<86.0	87.4	495	433	422	455	<71.5	82.3†
Beryllium	USEPA 6010B	<0.26	—	<0.26	—	—	<0.26	<0.26	<0.26	—	<0.26	—	<0.26	—
Boron	USEPA 6010B	<65.7	—	127	—	—	<64.1	<66.3	208	—	140	—	<62.2	—
Cadmium	USEPA 6010B	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Chromium	USEPA 6010B	<1.5	<1.5	<1.8	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.7	<1.5
Chromium +6	USEPA 7195	<0.0040	—	<0.0040	—	—	<0.0040	<0.0040	<0.0040	—	<0.0040	—	<0.0040	—

Table 2.3.3-18 (Sheet 4 of 5)
VCS Site Surface Water Analytical Results

Parameter	Analytical Method	GBRA Uplift #1 Calhoun Canal	GBRA Uplift #1 Calhoun Canal SW-06	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier Duplicate	Linn Lake SW-03	Linn Lake Duplicate	Kuy Creek SW-02	Kuy Creek SW-02	Coleto Creek at Hwy 77 SW-04	Coleto Creek at Hwy 77 SW-04	Guadalupe River at Hwy 59 SW-05	Guadalupe River at Hwy 59 SW-05
		11.27.07	4.16.08	11.27.07	4.16.08	4.16.08	11.27.07	11.27.07	11.28.07	4.16.08	11.28.07	4.16.08	11.28.07	4.16.08
Cobalt	USEPA 6010B	<9.6	—	<9.6	—	—	<9.6	<9.6	<9.6	—	<9.6	—	<9.6	—
Copper	USEPA 6010B	<5.9	—	<5.9	—	—	<5.9	<5.9	<11.5	—	<18.3	—	<12.8	—
Iron (Dissolved)	USEPA 6010B	<24	—	<24	—	—	—	—	—	—	—	—	—	—
Iron (Total)	USEPA 6010B	800	1990	2800	1260	2010	434	1090	519	1250	<63.7	184	3080	865
Lead	USEPA 6010B	<2.8	3	<2.8	<2.8†	3.2	<2.8	<2.8	<2.8	<2.8	<2.8	4.9	4.4	<2.8
Magnesium	USEPA 6010B	13,600	18900	16,600	18900	19600	13,200	13,300	20,600	16300	9800	10600	8960	17900
Manganese (Total)	USEPA 6010B	50.2	—	58.8	—	—	43.8	45.8	920	—	62.5	—	60.5	—
Manganese (Dissolved)	USEPA 6010B	<4.1	—	<4.8	—	—	—	—	—	—	—	—	—	—
Mercury	USEPA 7470B	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094	<0.094
Molybdenum	USEPA 6010B	<1.2	—	<1.4	—	—	<1.2	<1.2	<1.2	—	<1.2	—	<1.2	—
Nickel	USEPA 6010B	<2.6	—	<2.6	—	—	<2.6	<2.6	<4.7	—	<2.6	—	<3.7	—
Potassium	USEPA 7470B	6540	—	6720	—	—	4200	4360	7840	—	2660	—	6460	—
Selenium	USEPA 6010B	<2.3	—	<2.3	—	—	<2.3	<2.3	<2.3	—	<2.3	—	<2.3	—
Silver	USEPA 6010B	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
Strontium	USEPA 6010B	362	—	576	—	—	406	404	576	—	288	—	231	—
Tin	USEPA 6010B	<3.2	—	<2.6	—	—	<2.4	<3.2	<1.9	—	<1.9	—	<1.9	—
Titanium	USEPA 6010B	9	—	45.4	—	—	<5.4	<14.0	<0.71	—	<0.71	—	21.1	—
Vanadium	USEPA 6010B	<5.1	—	<10.3	—	—	<4.7	<5.8	<0.04	—	<1.8	—	<7.0	—
Zinc	USEPA 6010B	<9.3	—	<15.6	—	—	<7.8	<9.8	<9.5	—	<12.9	—	20.2	—
Volatile Organic Compounds (VOCs) (mg per L)	USEPA 8260B	<0.0073	—	<0.0073	—	—	—	—	—	—	—	—	—	—

Table 2.3.3-18 (Sheet 5 of 5)
VCS Site Surface Water Analytical Results

Parameter	Analytical Method	GBRA Uplift #1 Calhoun Canal	GBRA Uplift #1 Calhoun Canal SW-06	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier SW-01	GBRA Salt Water Barrier Duplicate	Linn Lake SW-03	Linn Lake Duplicate	Kuy Creek SW-02	Kuy Creek SW-02	Coleto Creek at Hwy 77 SW-04	Coleto Creek at Hwy 77 SW-04	Guadalupe River at Hwy 59 SW-05	Guadalupe River at Hwy 59 SW-05
		11.27.07	4.16.08	11.27.07	4.16.08	4.16.08	11.27.07	11.27.07	11.28.07	4.16.08	11.28.07	4.16.08	11.28.07	4.16.08
Semi-Volatile Compounds (SVOCs) (µg per L)	USEPA 8270C	<0.025	—	<0.025	—	—	—	—	—	—	—	—	—	—
Pesticides & Herbicides (mg per L)	EPA 8141/8151	<0.050	—	<0.050	—	—	—	—	—	—	—	—	—	—
Polychlorinated biphenyls (mg per L)	USEPA 8081A	<0.050	—	<0.050	—	—	—	—	—	—	—	—	—	—
Oil and Grease (mg per L)	USEPA 1664	<1.4	—	<1.4	—	—	—	—	—	—	—	—	—	—
Tributylin (nanograms per L)	Unger Method	16*	—	87*	—	—	—	—	—	—	—	—	—	—
Cyanide (Total) (mg per L)	USEPA 335.2	<0.0050	—	<0.0050	—	—	—	—	—	—	—	—	—	—
Asbestos (mg per L)	USEPA 100.1/100.2	ND	—	ND	—	—	—	—	—	—	—	—	—	—

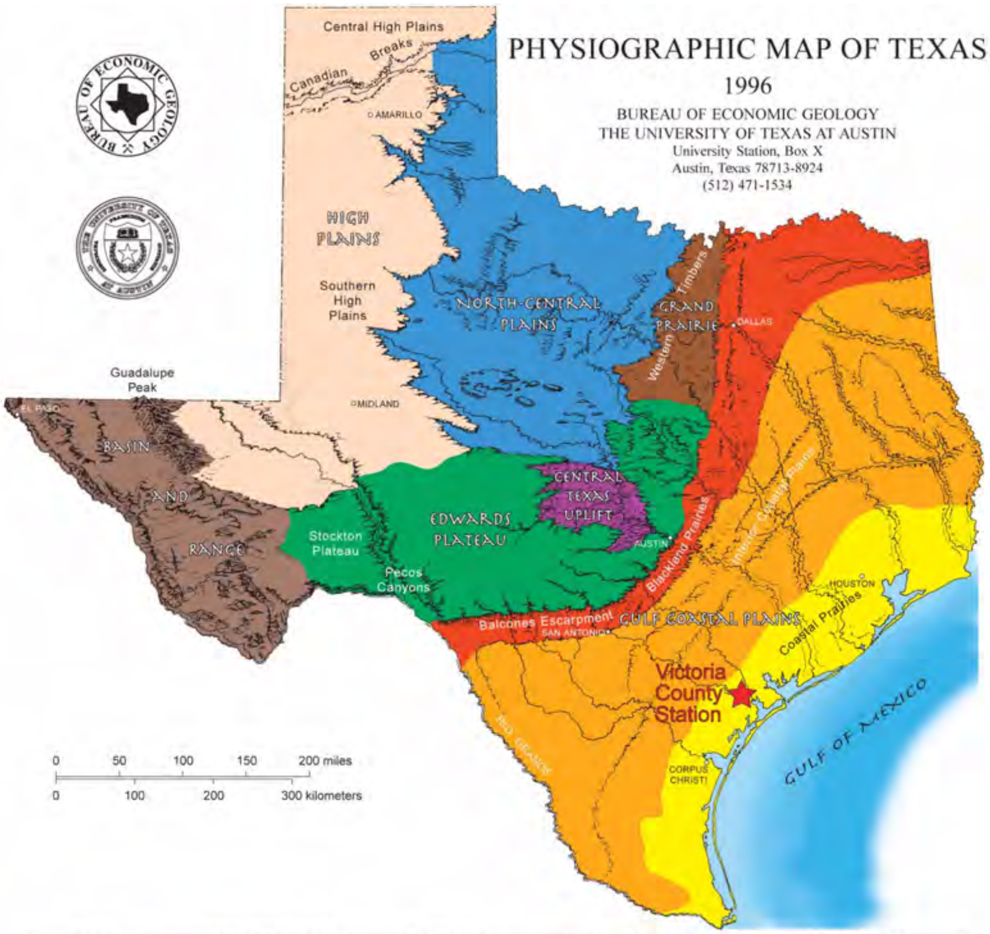
NA = Not available due to equipment malfunction
mS per cm= milli-Siemens per centimeter
MBAS as LAS = Methylene blue active substances as standardized against Lineares Alkybenzosulfonate
mg per L = Micrograms per liter
µg per L = Micrograms per liter
CFU = Colony-Forming Units
HT = Sample exceeded holding time due to lab error and was therefore not analyzed
– = Parameter not analyzed
* = tributylin was detected at a concentration of 90 nanograms per liter in each of the three blanks as a result of lab contamination. Therefore, the three sample concentrations were “normalized” by using the standard method of simply subtracting the blank concentration from the samples’ reported concentrations.
** = Radionuclide analyses usually required the subtraction of the instrument background counts from the sample counts. Even though both background and the sample values are positive, sometimes when the sample activity is low, variations in the two measurements can cause the sample value to be less than the background, resulting in a measured activity less than zero
† = Parameter also detected in the Laboratory Method Blank
< = parameter was detected at or below the method detection limit

Table 2.3.3-19
TPDES Sites in Lower Guadalupe and Lower San Antonio River Basins
(Victoria, Refugio, and Goliad Counties)

TPDES Permit Number	Permit Status	County	Facility Name	Receiving Stream	Permitted Flow (mgd)	Approximate Distance/ Direction to the VCS Site (mi)	Up Gradient/ Down Gradient with Respect to SWB
TXG110085	Active	Victoria	Alamo Concrete Products, LTD	Guadalupe River	NA	13-N	Up
TXG110086	Active	Victoria	Alamo Concrete Products, LTD	Guadalupe River	NA	20-N	Up
TX0003603	Active	Victoria	AEP Texas Central CO (CPL Victoria Power Station)	Guadalupe River	202	12-N	Up
TX0006050	Active	Victoria	Invista S.A.R.L.	Guadalupe River	21.8	5-NE	Up
TX0005118	Active	Victoria	South Texas Electric Cooperative	Guadalupe River	34.26	31-N	Up
TX0025186	Active	Victoria	Victoria Regional Wastewater Treatment Plant	Guadalupe River	9.6	9-N	Up
TX0025194	Active	Victoria	Victoria Willow Plant	Guadalupe River	2.5	12-N	Up
TX0022411	Active	Goliad	City of Goliad WWTP	San Antonio	0.35	24-W	Up
TXG110075	Active	Goliad	Goliad Plant No. 81 (Alamo Concrete Products, LTD)	San Antonio	NA	24-W	Up

Source: USEPA Feb 2008
SWB = GBRA Saltwater Barrier
NA = Data not available

Figure 2.3.1.2-1 Regional Site Location Plan



PROVINCE	MAX. ELEV. (ft)	MIN. ELEV. (ft)	TOPOGRAPHY	GEOLOGIC STRUCTURE	BEDROCK TYPES
Gulf Coastal Plains					
Coastal Prairies	300	0	Nearly flat prairie, <1 ft/mi to Gulf	Nearly flat strata	Deltaic sands and muds
Interior Coastal Plains	800	300	Parallel ridges (questas) and valleys	Beds tilted toward Gulf	Unconsolidated sands and muds
Blackland Prairies	1000	450	Low rolling terrain	Beds tilted south and east	Chalks and marls
Grand Prairie	1250	450	Low stairstep hills west; plains east	Strata dip east	Calcareous east; sandy west
Edwards Plateau					
Principal	3000	450	Flat upper surface with box canyons	Beds dip south; normal faulted	Limestones and dolomites
Pecos Canyons	2000	1200	Steep-walled canyons		Limestones and dolomites
Stockton Plateau	4200	1700	Mesa-formed terrain; highs to west	Unfaulted, near-horizontal beds	Carbonates and alluvial sediments
Central Texas Uplift	2000	800	Knobby plain; surrounded by questas	Centripetal dips, strongly faulted	Granites; metamorphics; sediments
North-Central Plains	3000	900	Low north-south ridges (questas)	West dip; minor faults	Limestones; sandstones; shales
High Plains					
Central	4750	2900	Flat prairies slope east and south	Slight dips east and south	Eolian silts and fine sands
Canadian Breaks	3800	2350	Highly dissected; local solution valleys		
Southern	3800	2200	Flat; many playas; local dune fields		
Basin and Range	8750	1700	North-south mountains and basins	Some complex folding and faulting	Igneous; metamorphics; sediments

Modified from Bureau of Economic Geology, 1996.

Figure 2.3.1.2-2 Physiographic Map of Texas

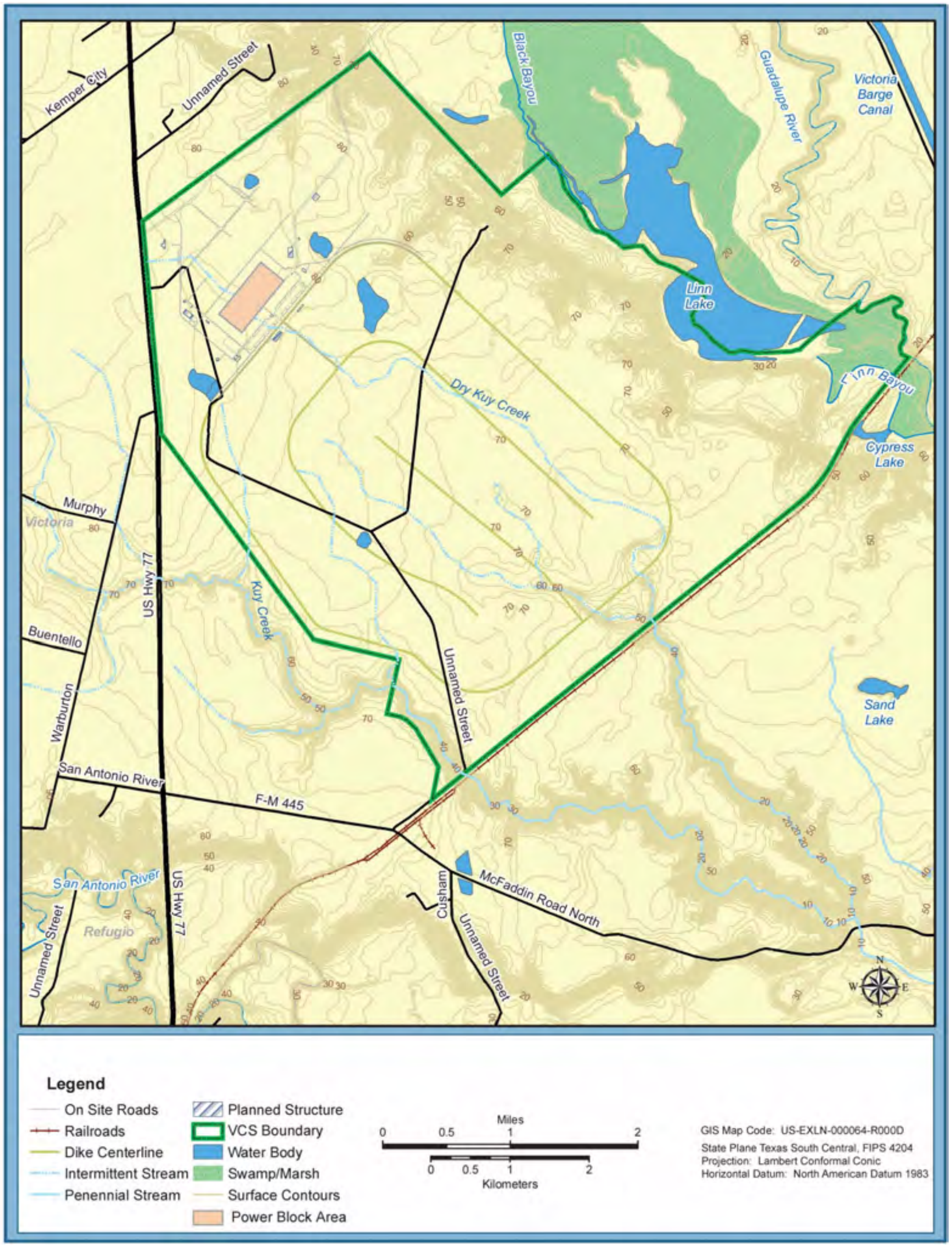
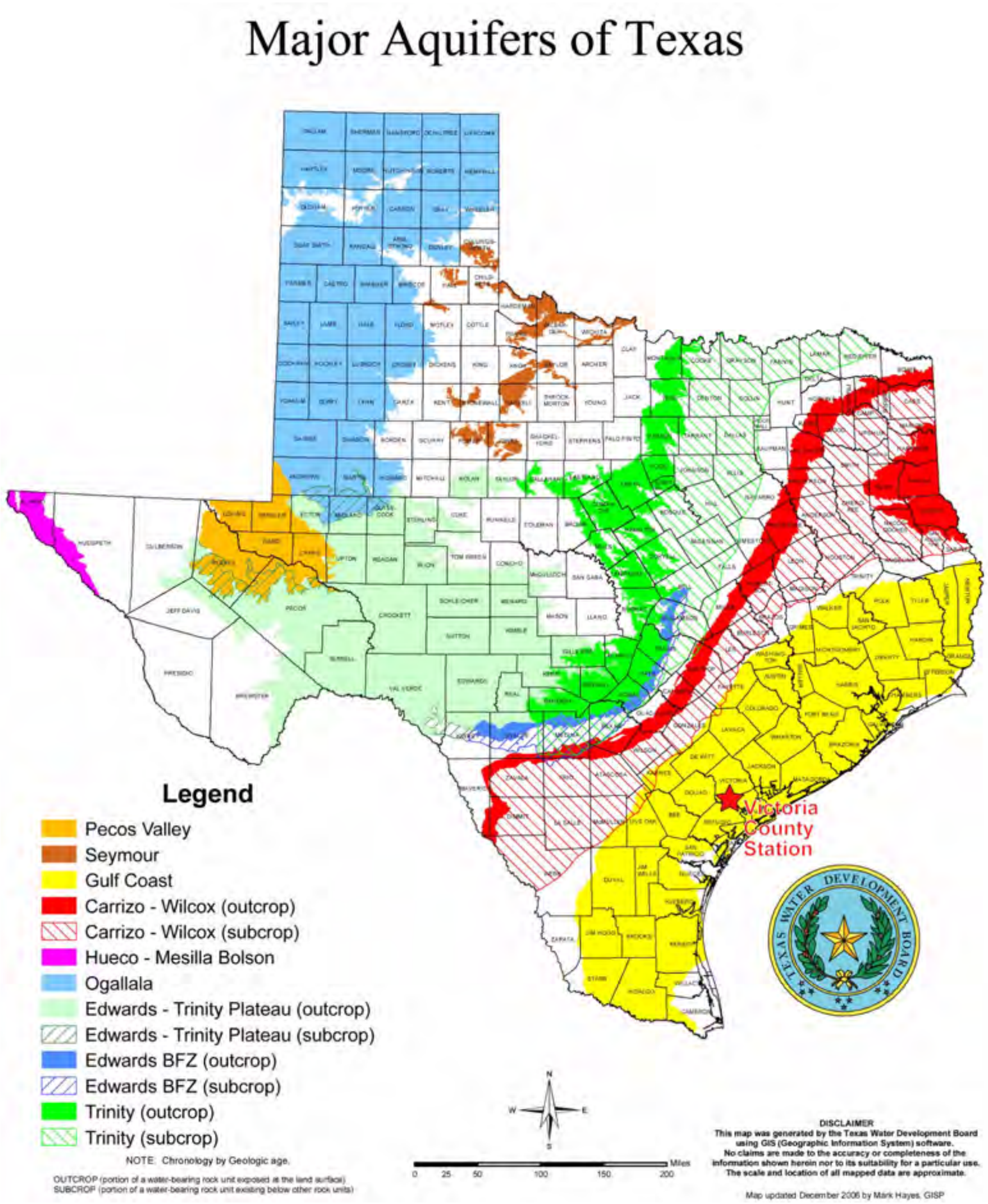
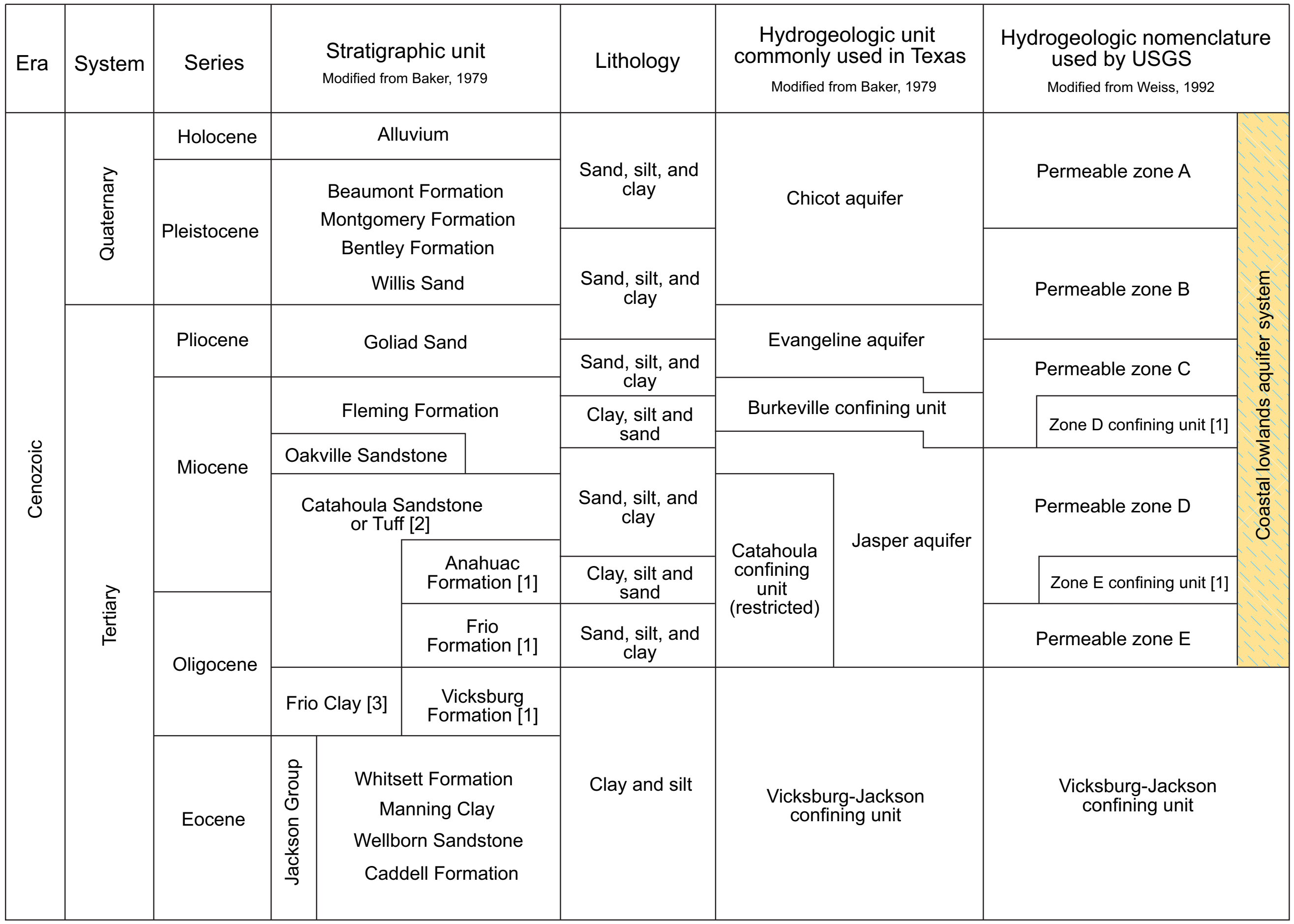


Figure 2.3.1.2-3 Detailed Site Location Plan



Modified from TWDB, 2006a.

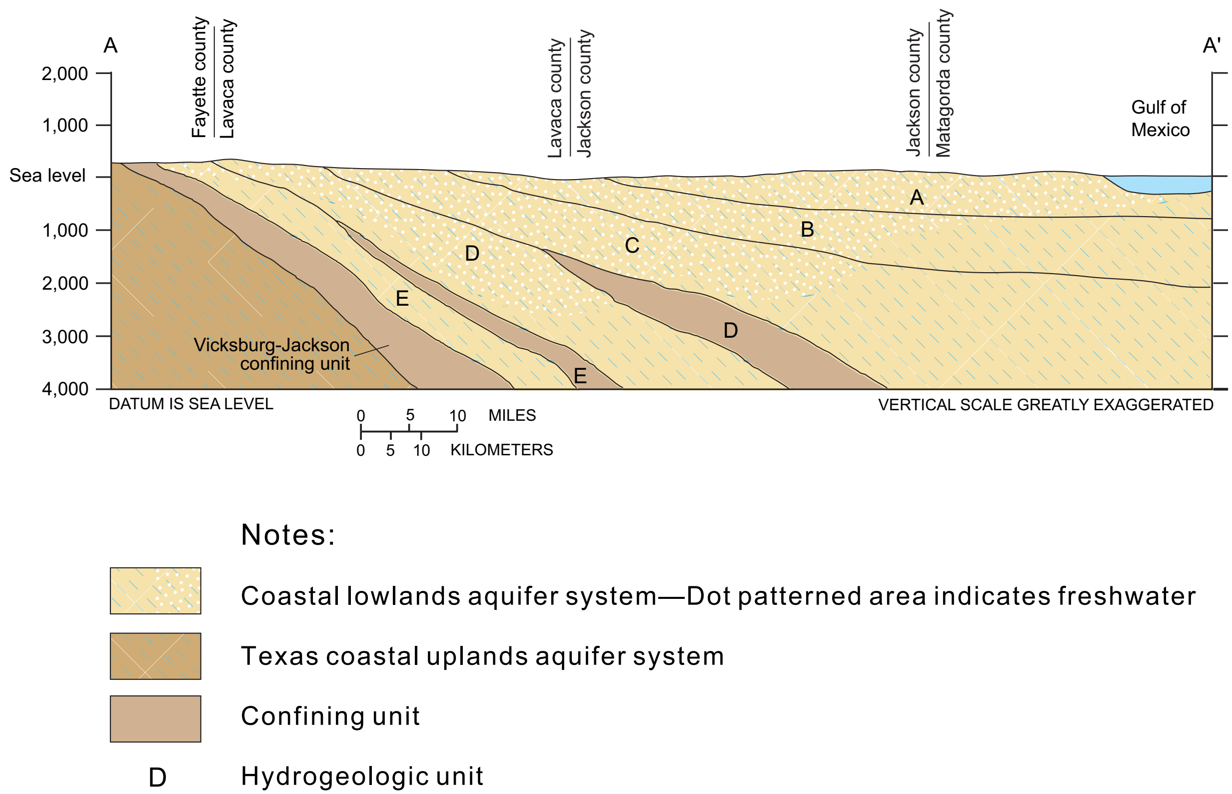
Figure 2.3.1.2-4 Major Aquifers of Texas



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

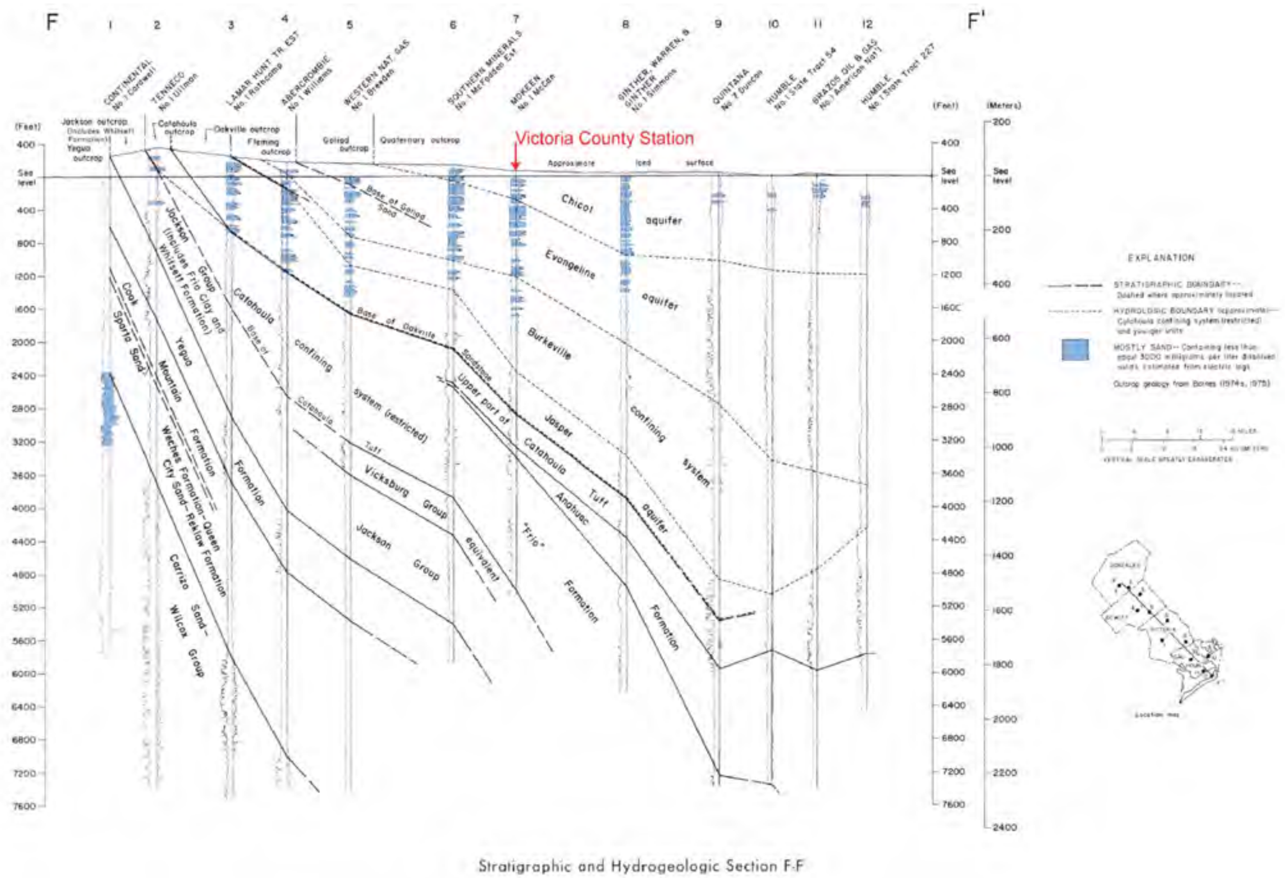
Modfied from Ryder, 1996.

Figure 2.3.1.2-5 Correlation of USGS and Texas Nomenclature



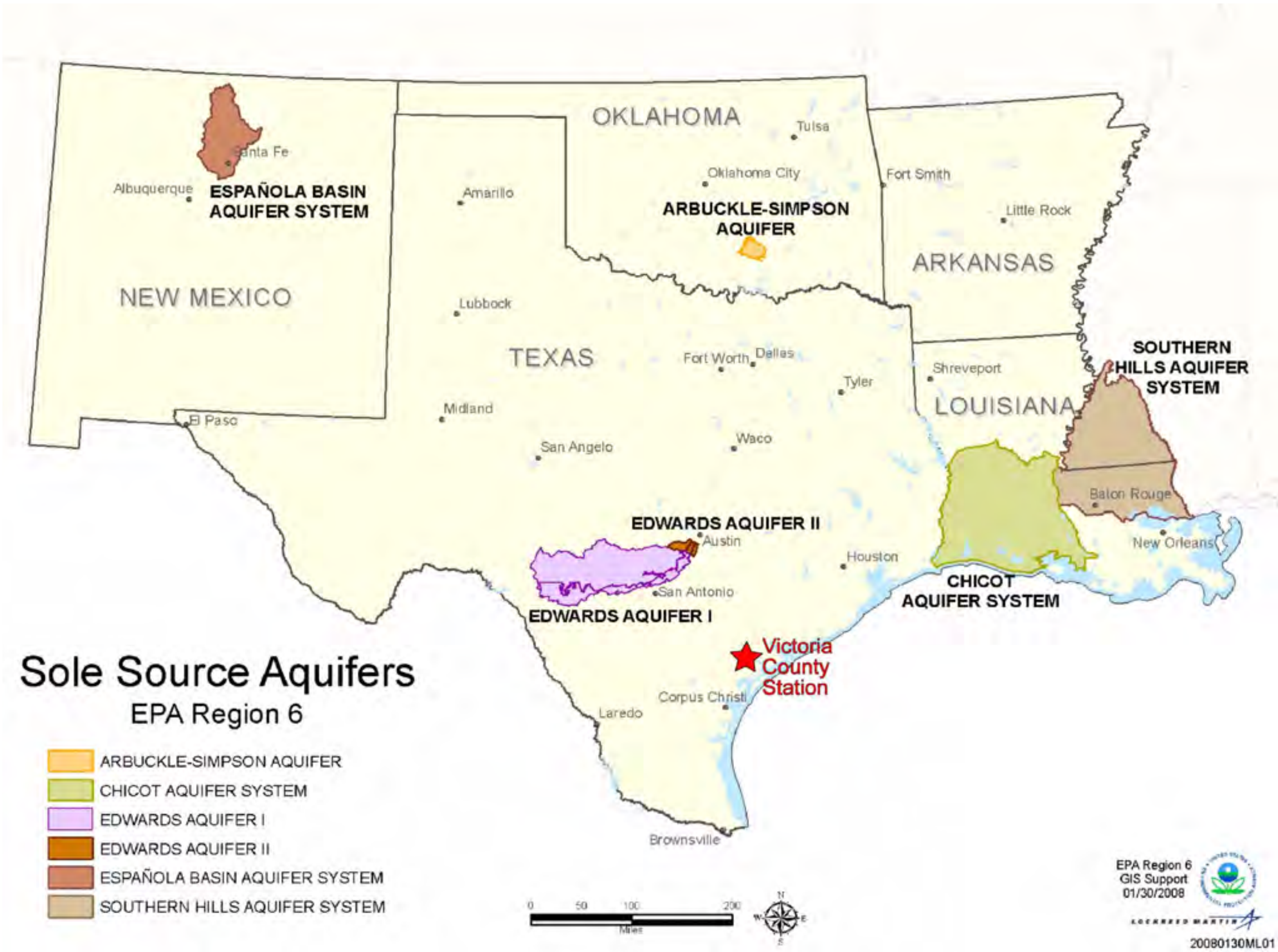
Modified from Ryder, 1996.

Figure 2.3.1.2-6 Generalized Cross Section through the Coastal Lowlands/Coastal Uplands Aquifer Systems



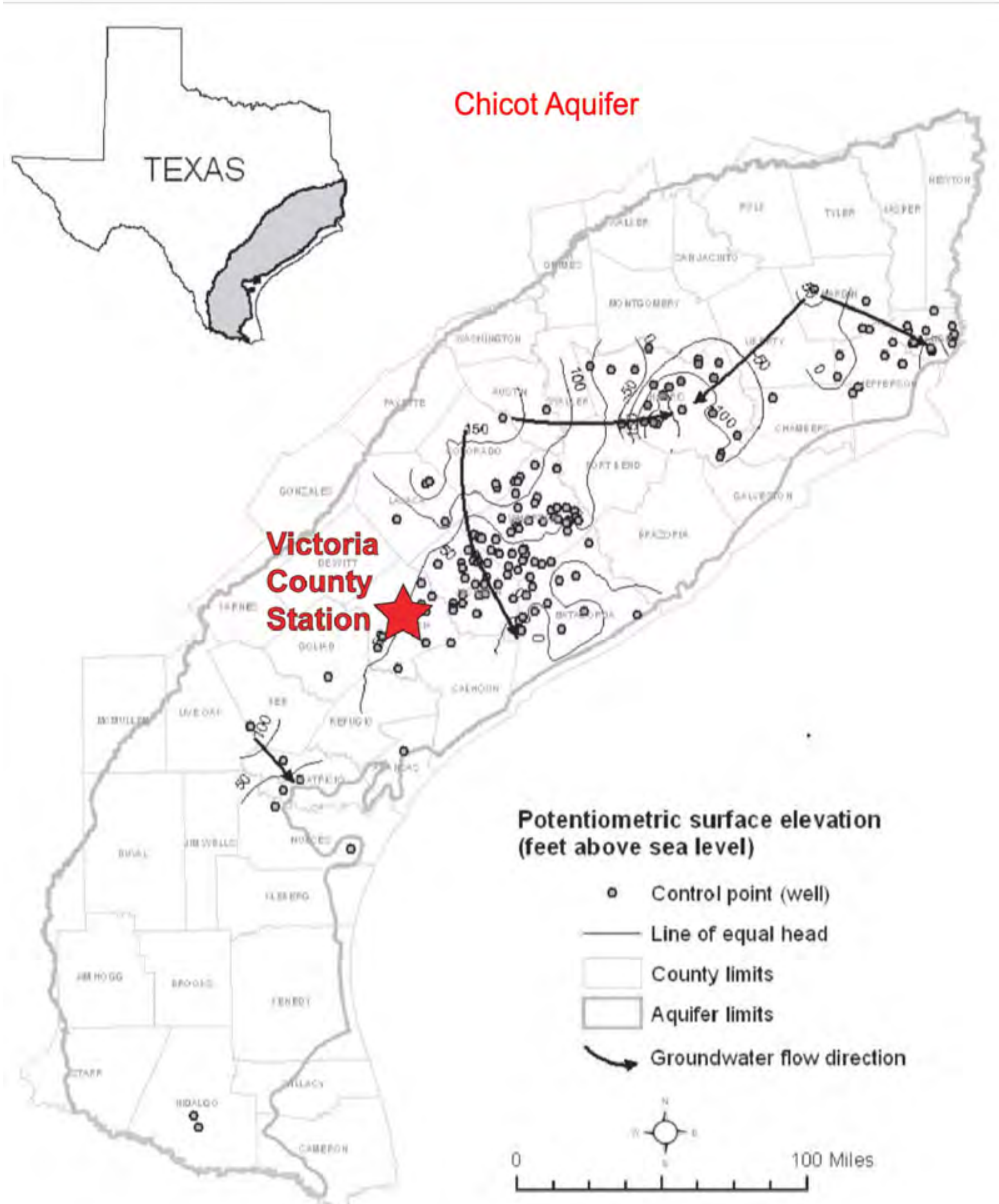
Modified from Baker, 1979.

Figure 2.3.1.2-7 Regional Hydrogeologic Cross Section through the Gulf Coast Aquifer System



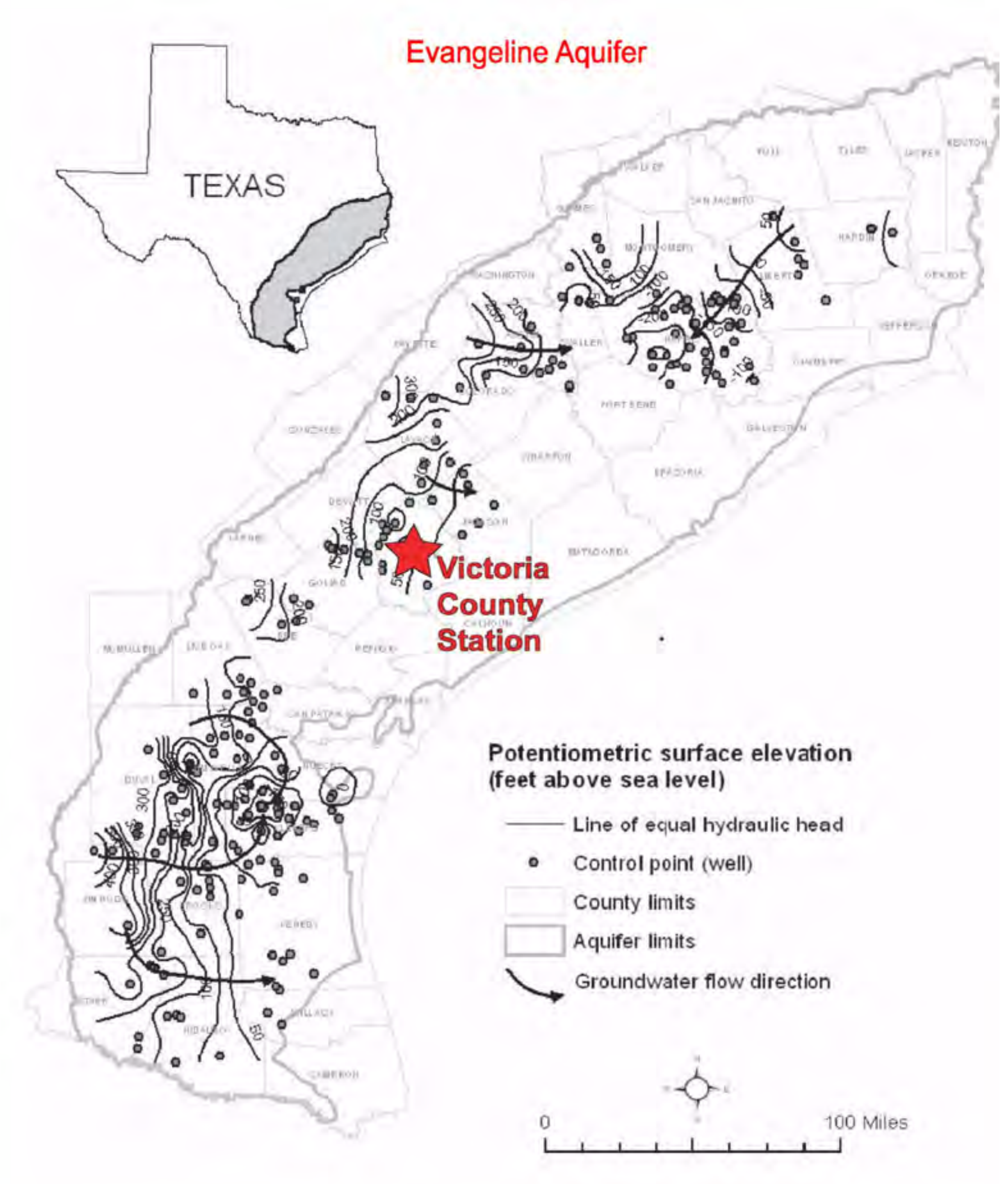
Modified from U.S. EPA, 2008a.

Figure 2.3.1.2-8 Sole Source Aquifers EPA Region 6



Modified from Chowdhury, et al., 2006.

Figure 2.3.1.2-9 Regional Potentiometric Surface Map for the Chicot Aquifer, including Water Level Measurements from 2001 to 2005 (Sheet 1 of 2)



Modified from Chowdhury, et al., 2006.

Figure 2.3.1.2-9 Regional Potentiometric Surface Map for the Chicot Aquifer, including Water Level Measurements from 2001 to 2005 (Sheet 2 of 2)

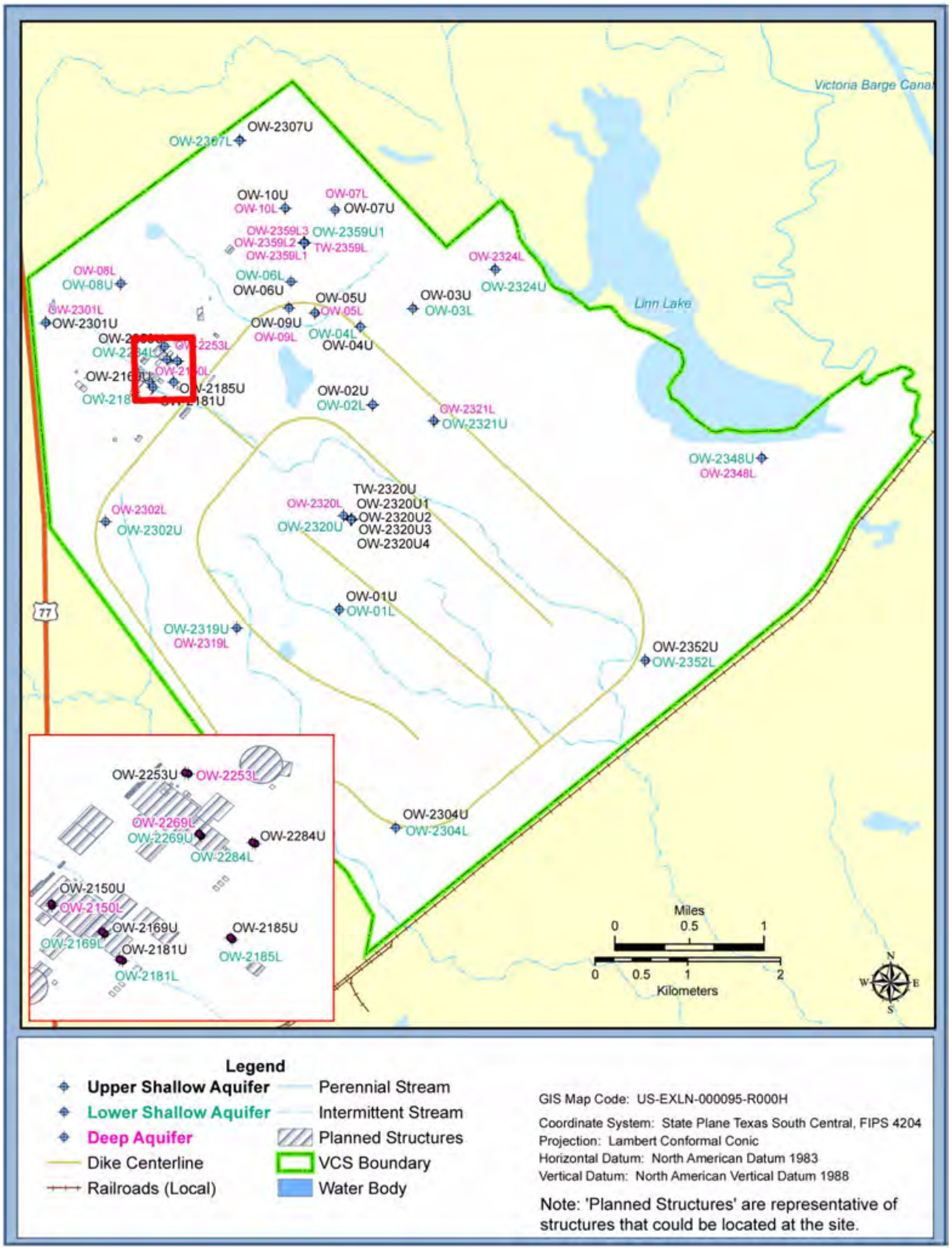
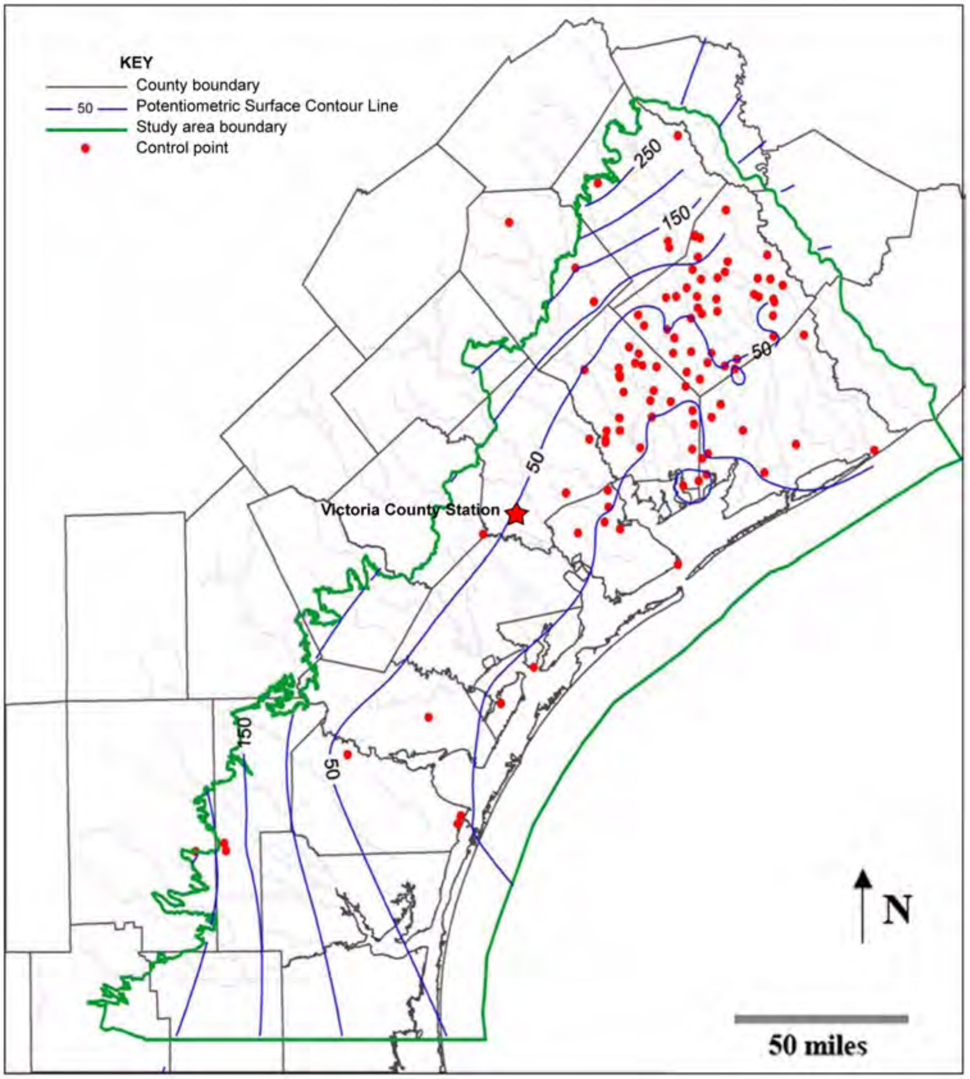
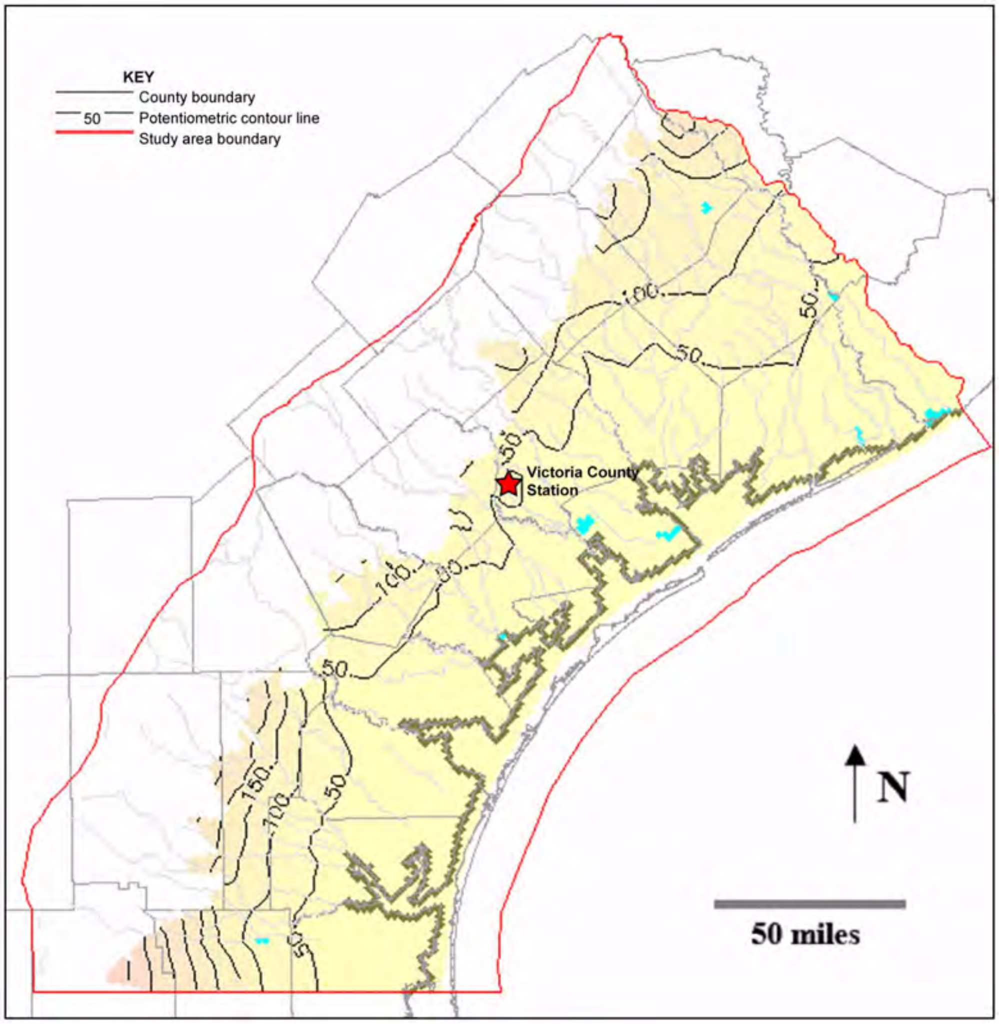


Figure 2.3.1.2-10 VCS Site Well Location Plan



Modified from Chowdhury, et al., 2004.

Figure 2.3.1.2-11 1999 Potentiometric Surface of the Chicot Aquifer



Modified from Chowdhury, et al., 2004.

Figure 2.3.1.2-12 Simulated Chicot Aquifer Groundwater Levels from GAM Steady-State Model

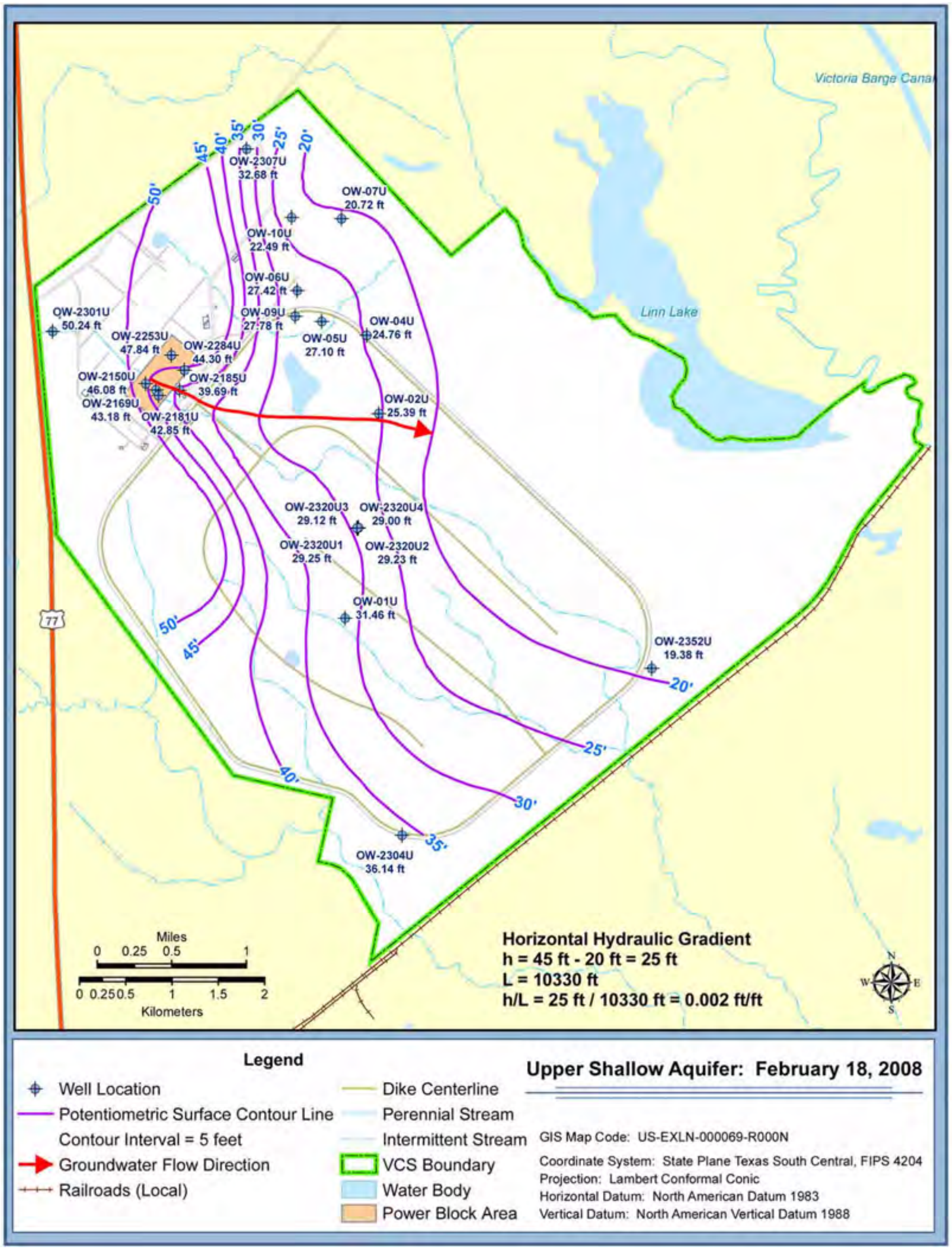


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 1 of 27)

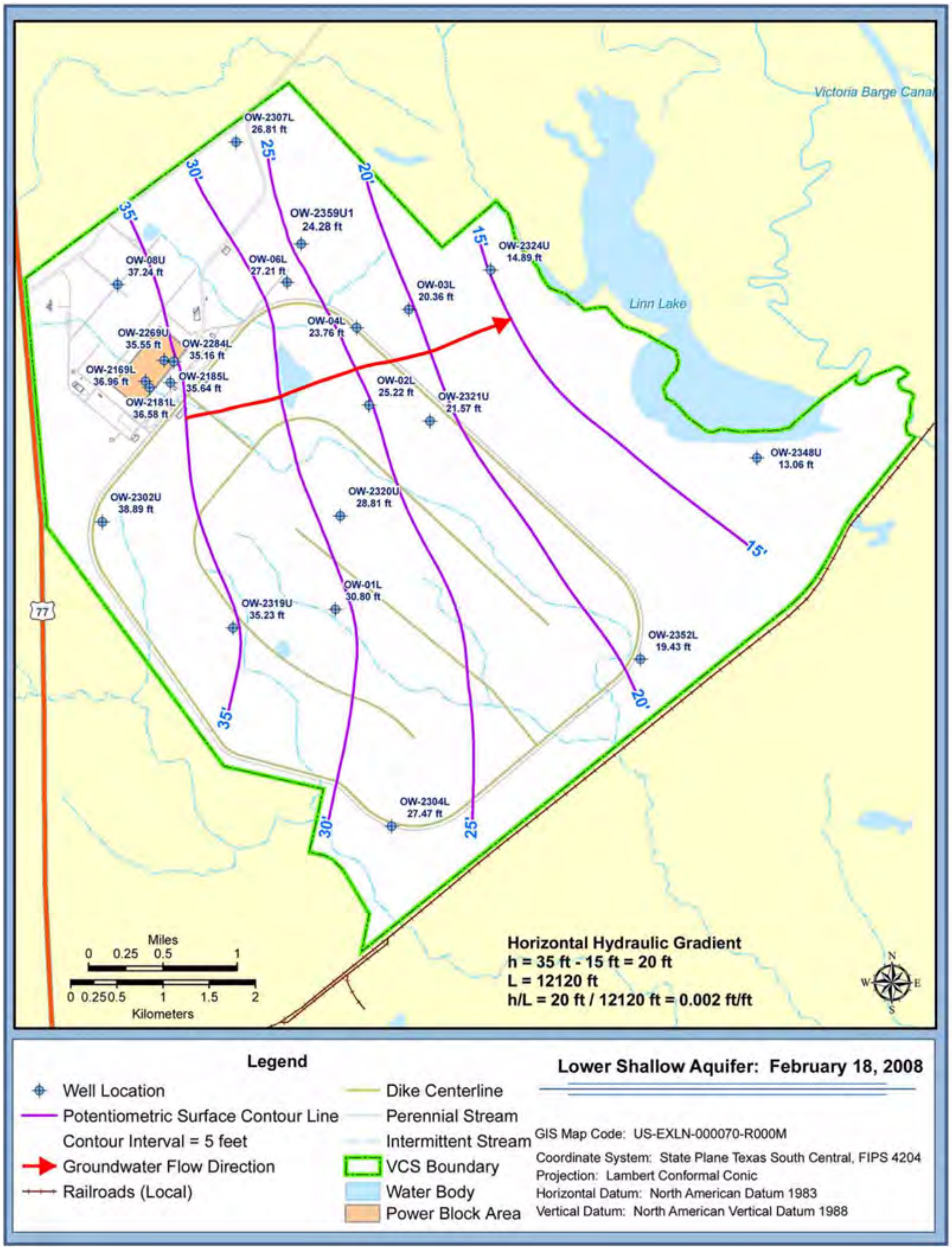


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 2 of 27)

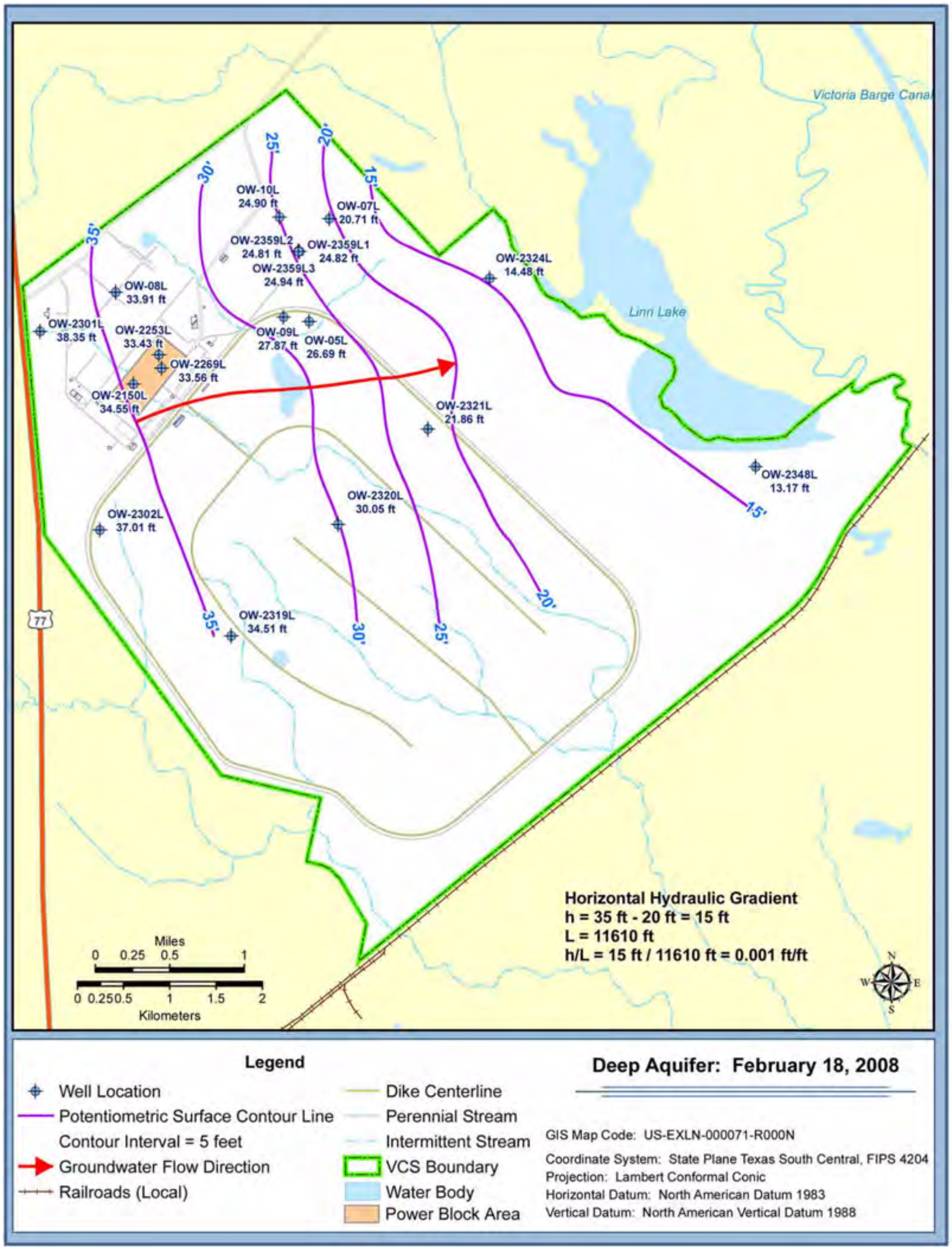


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 3 of 27)

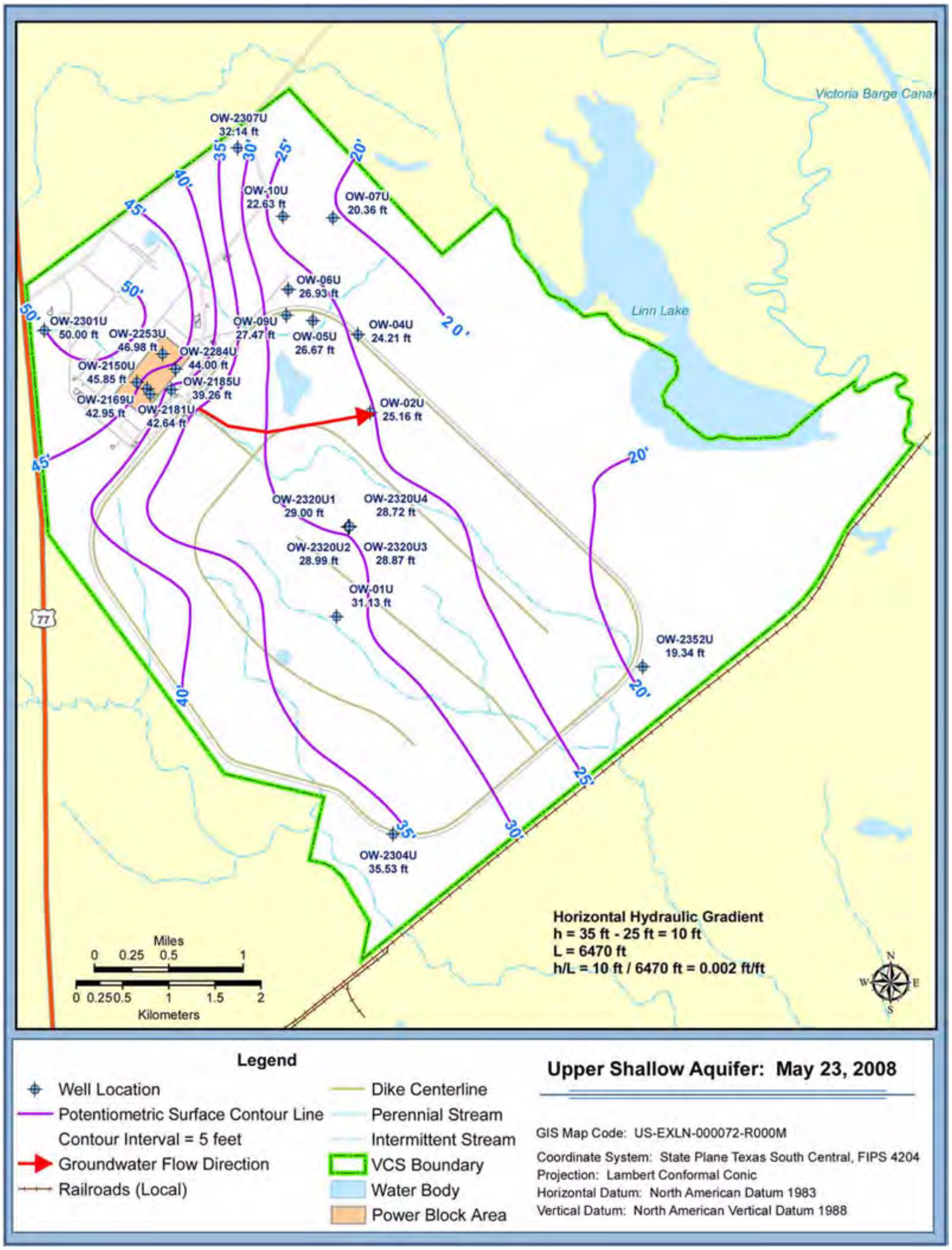


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 4 of 27)

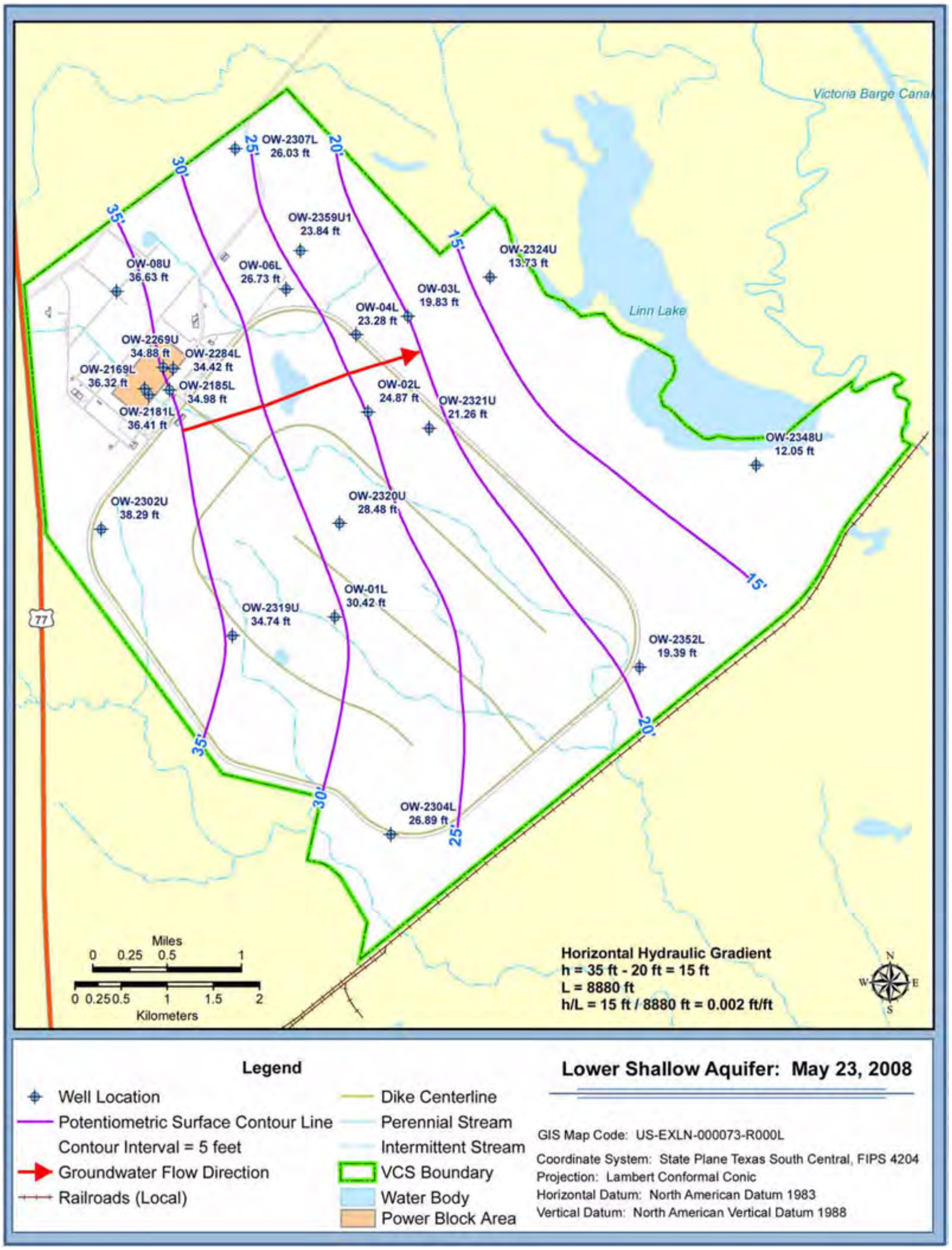


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 5 of 27)

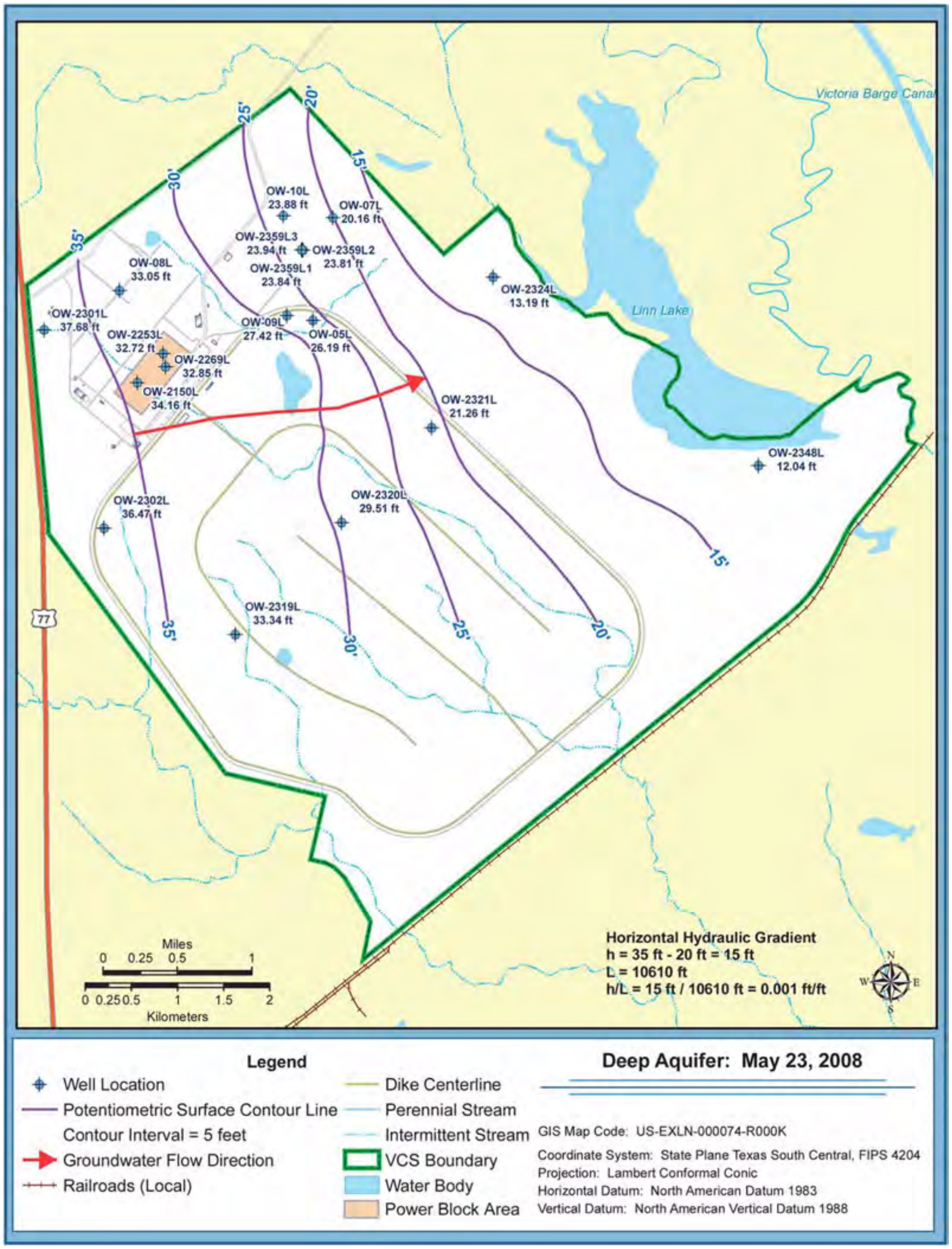


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 6 of 27)

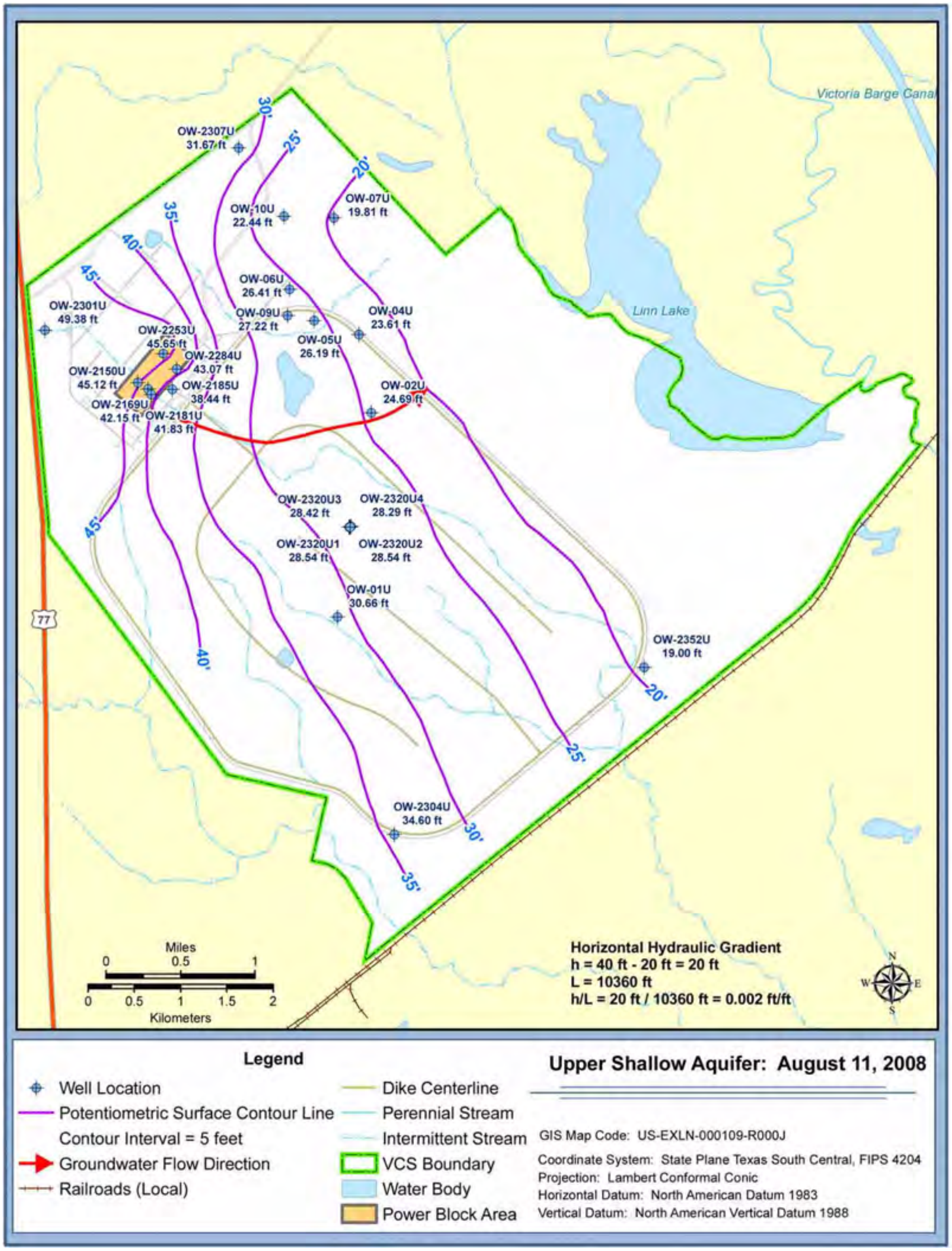


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 7 of 27)

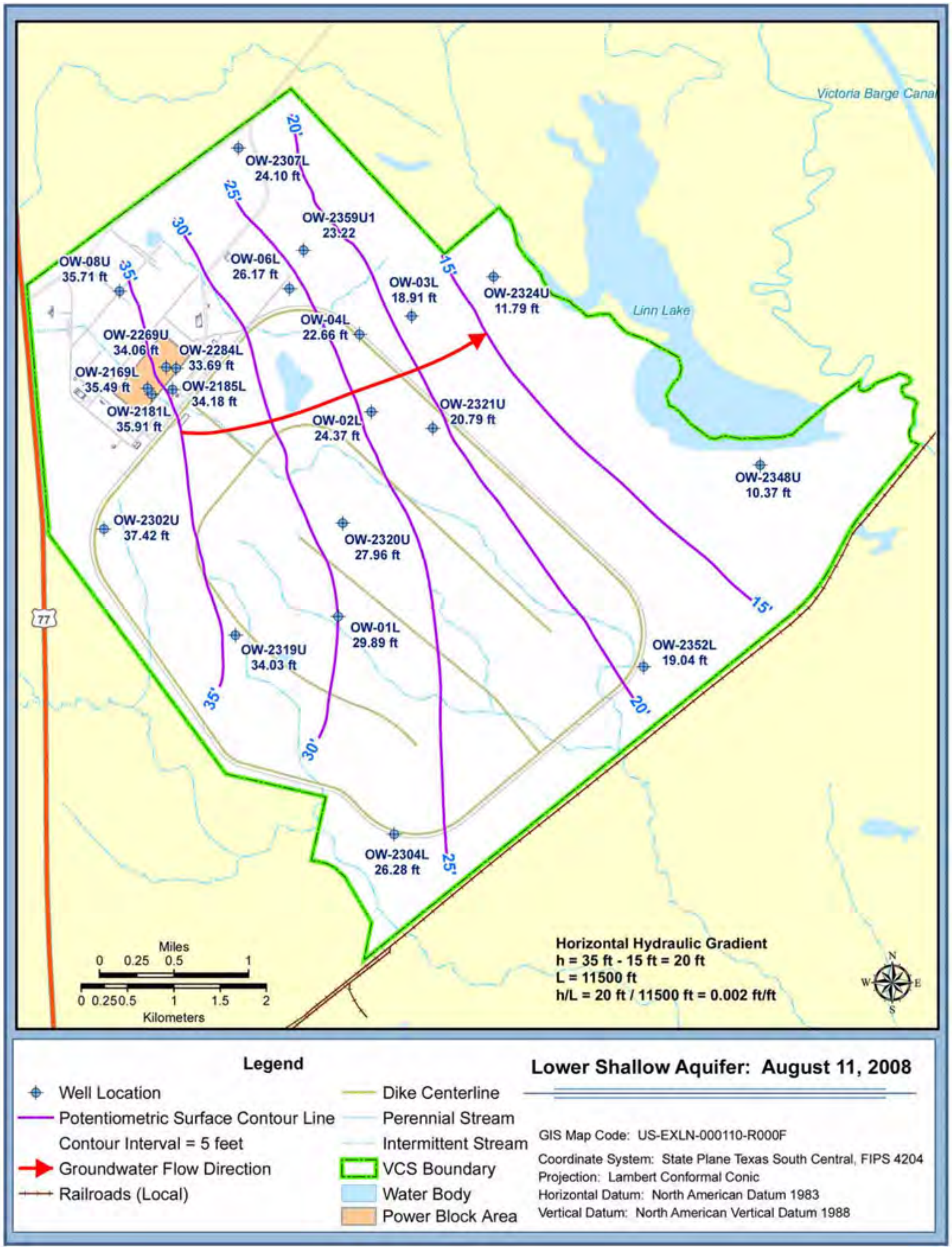


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 8 of 27)

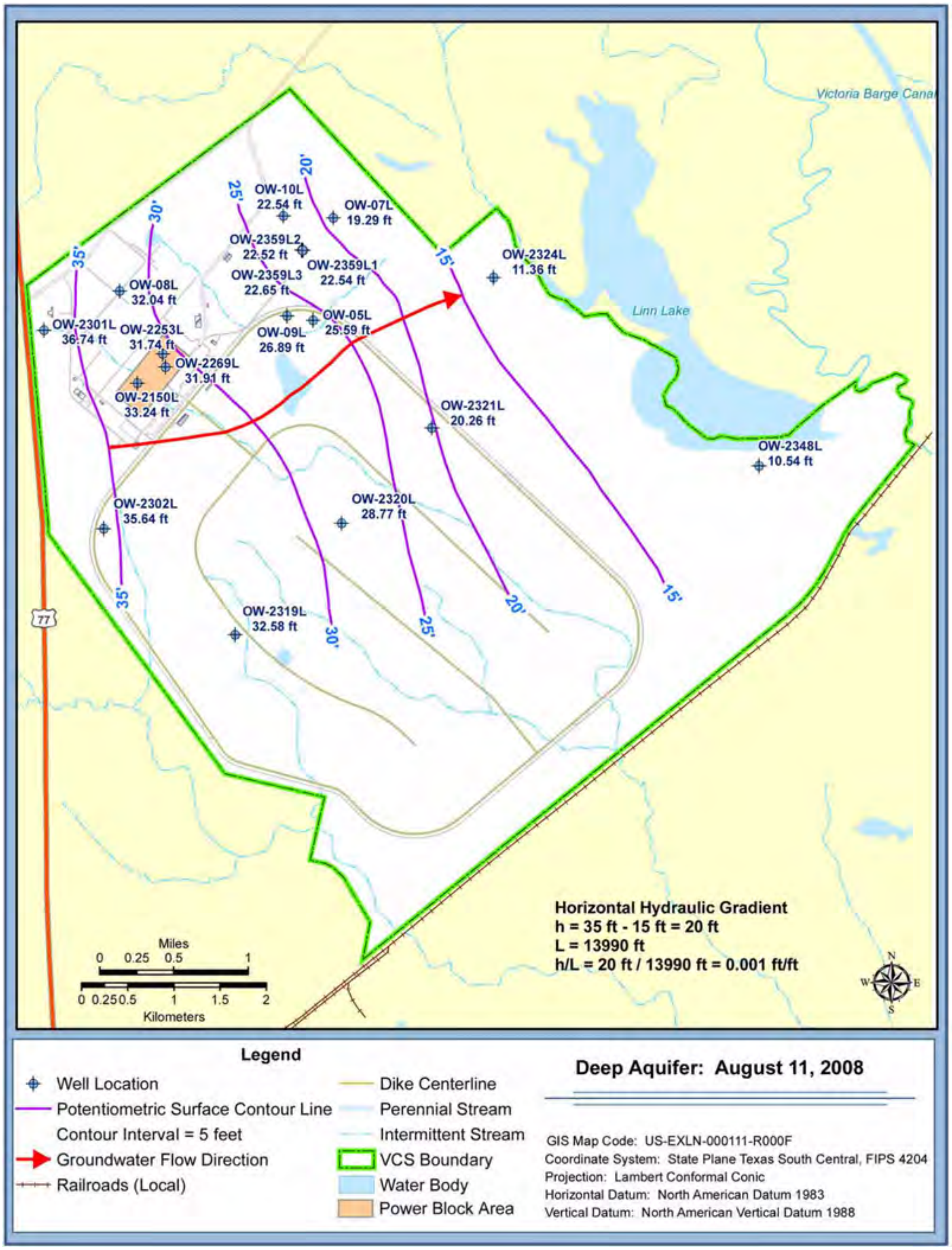


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 9 of 27)

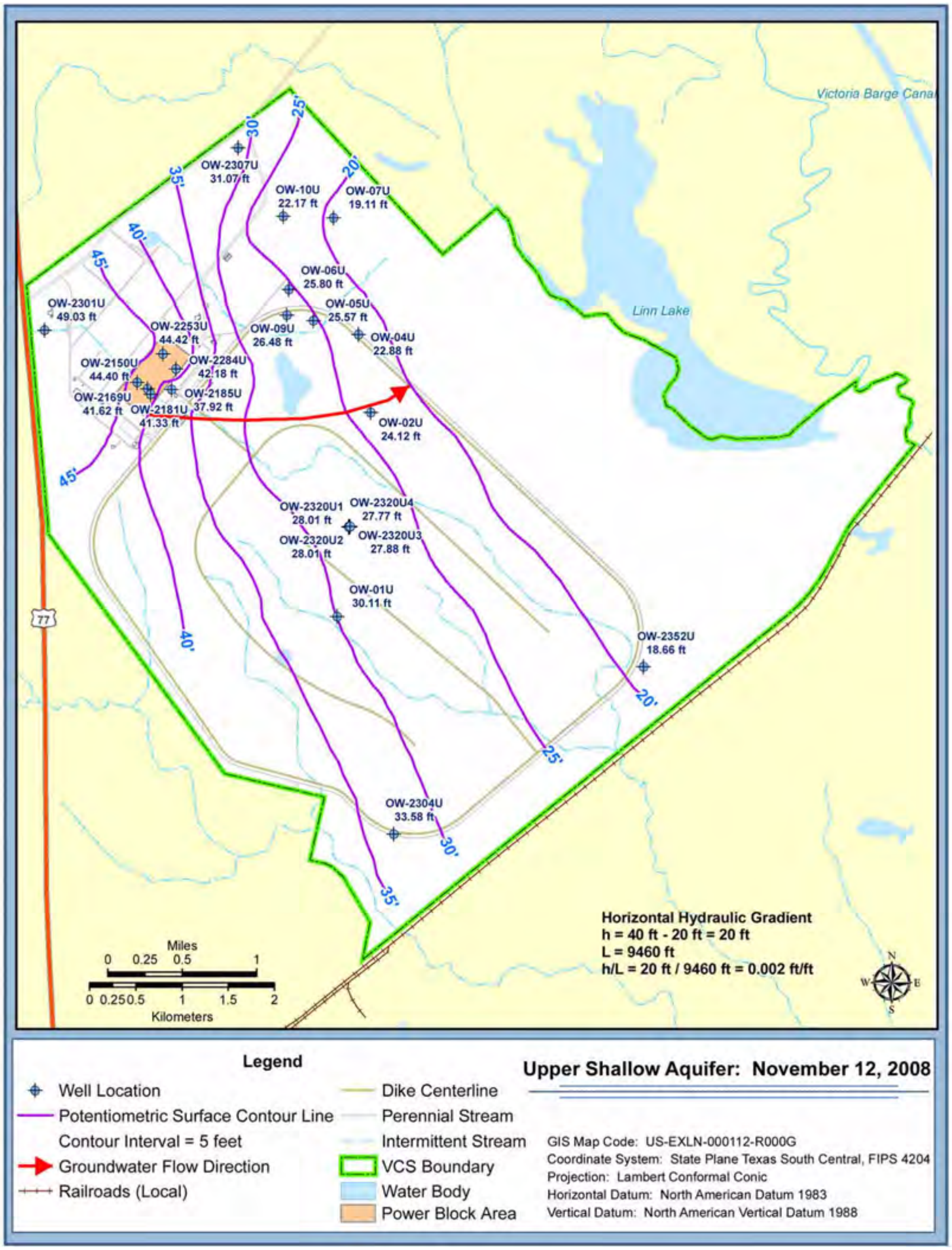


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 10 of 27)

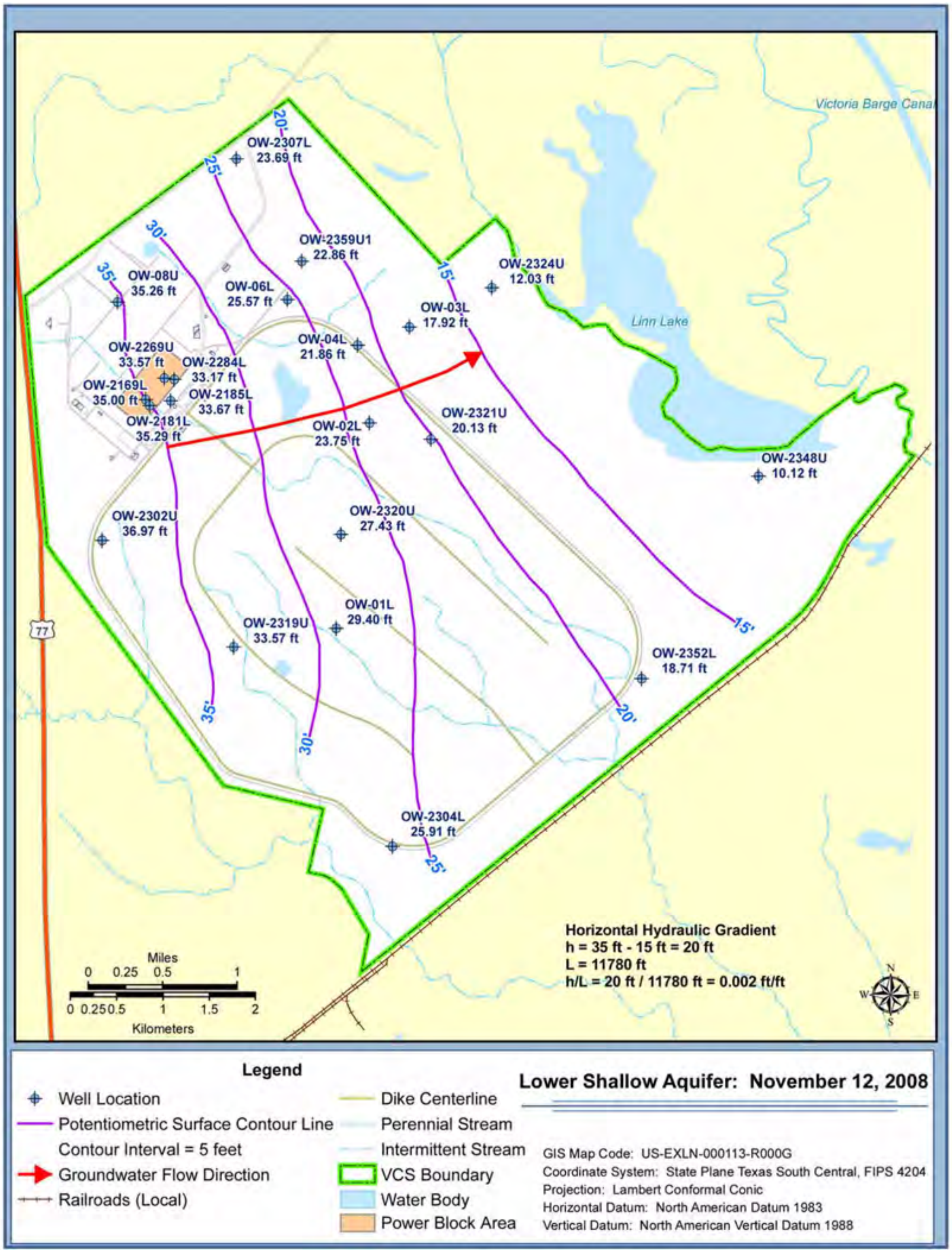


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 11 of 27)

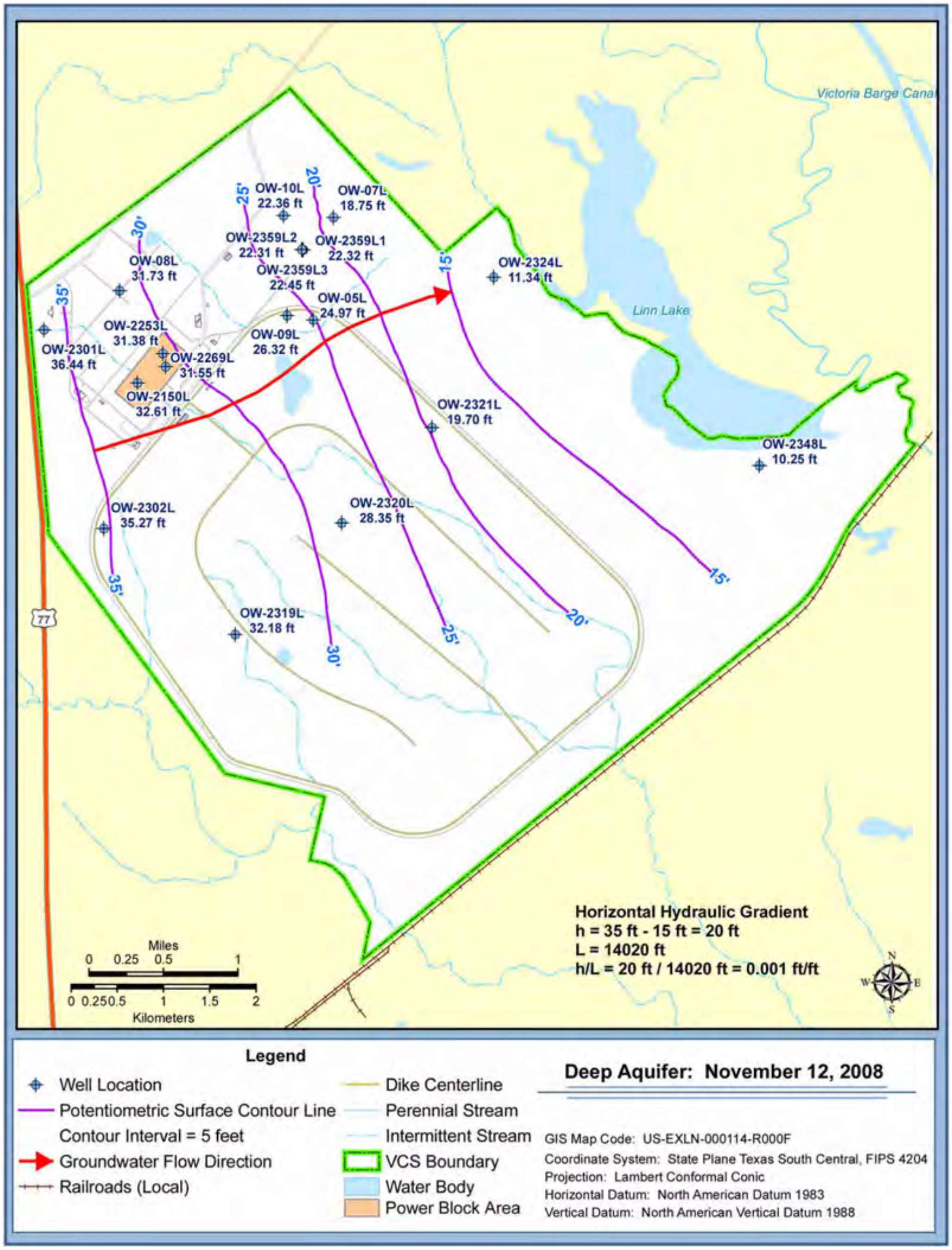


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 12 of 27)

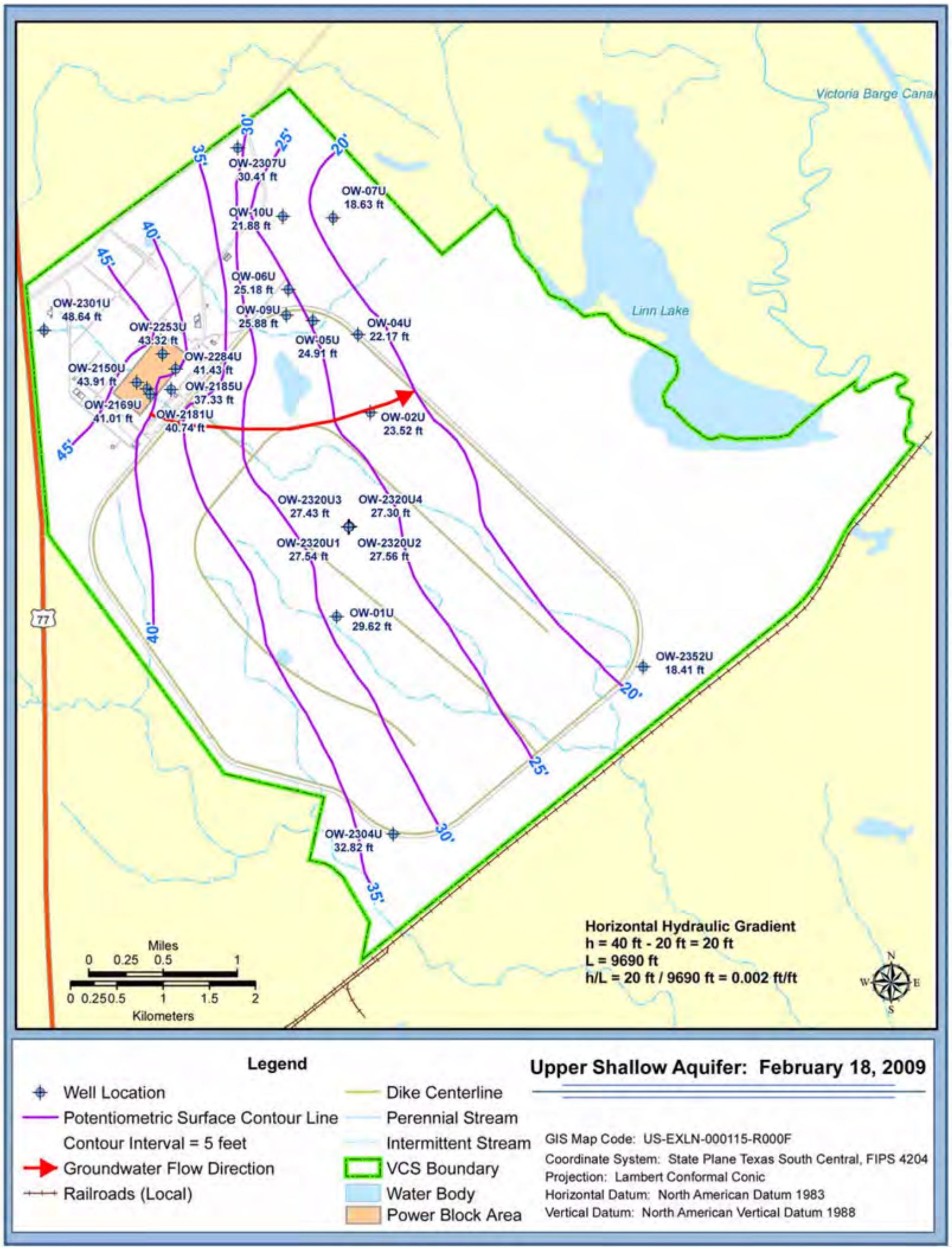


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 13 of 27)

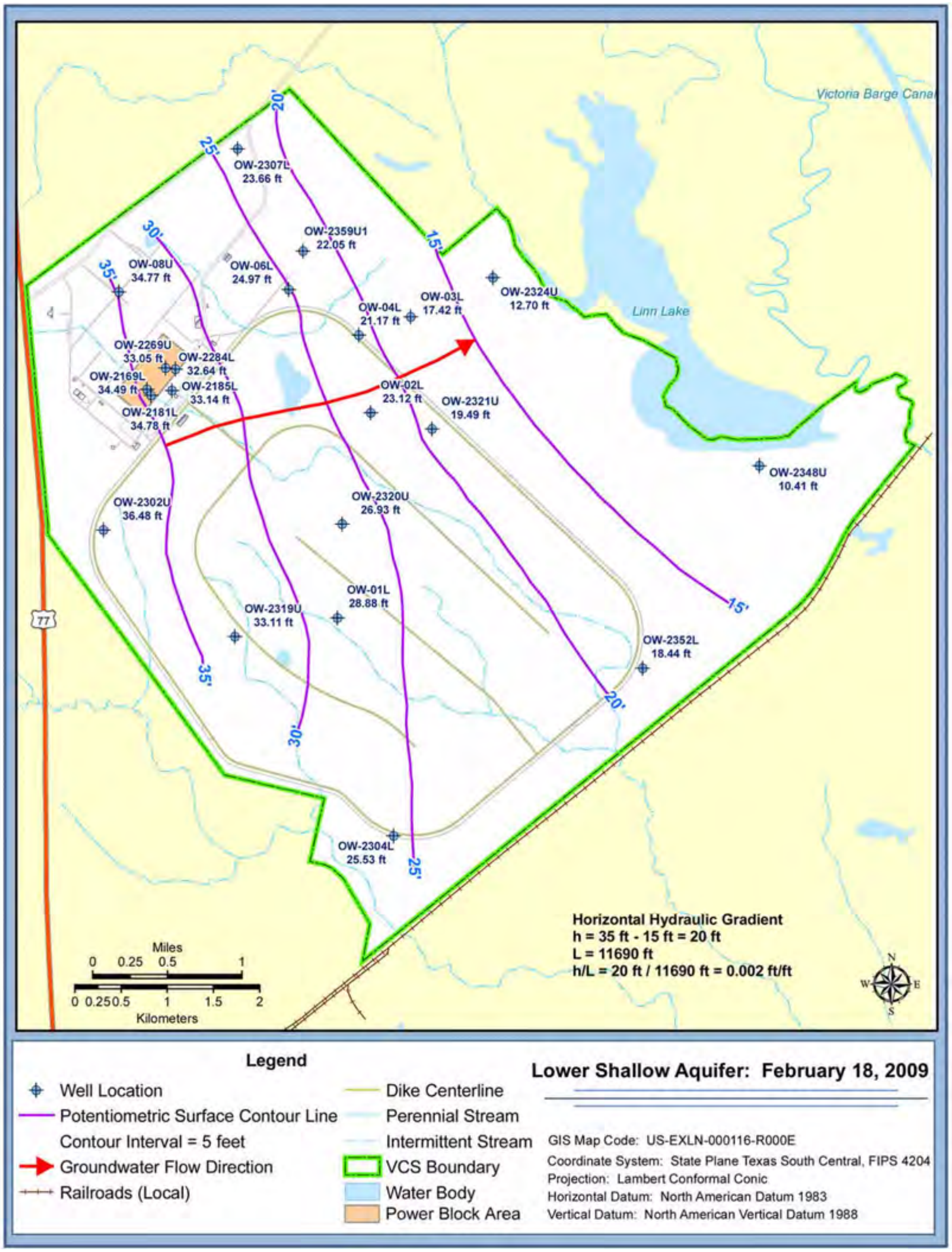


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 14 of 27)

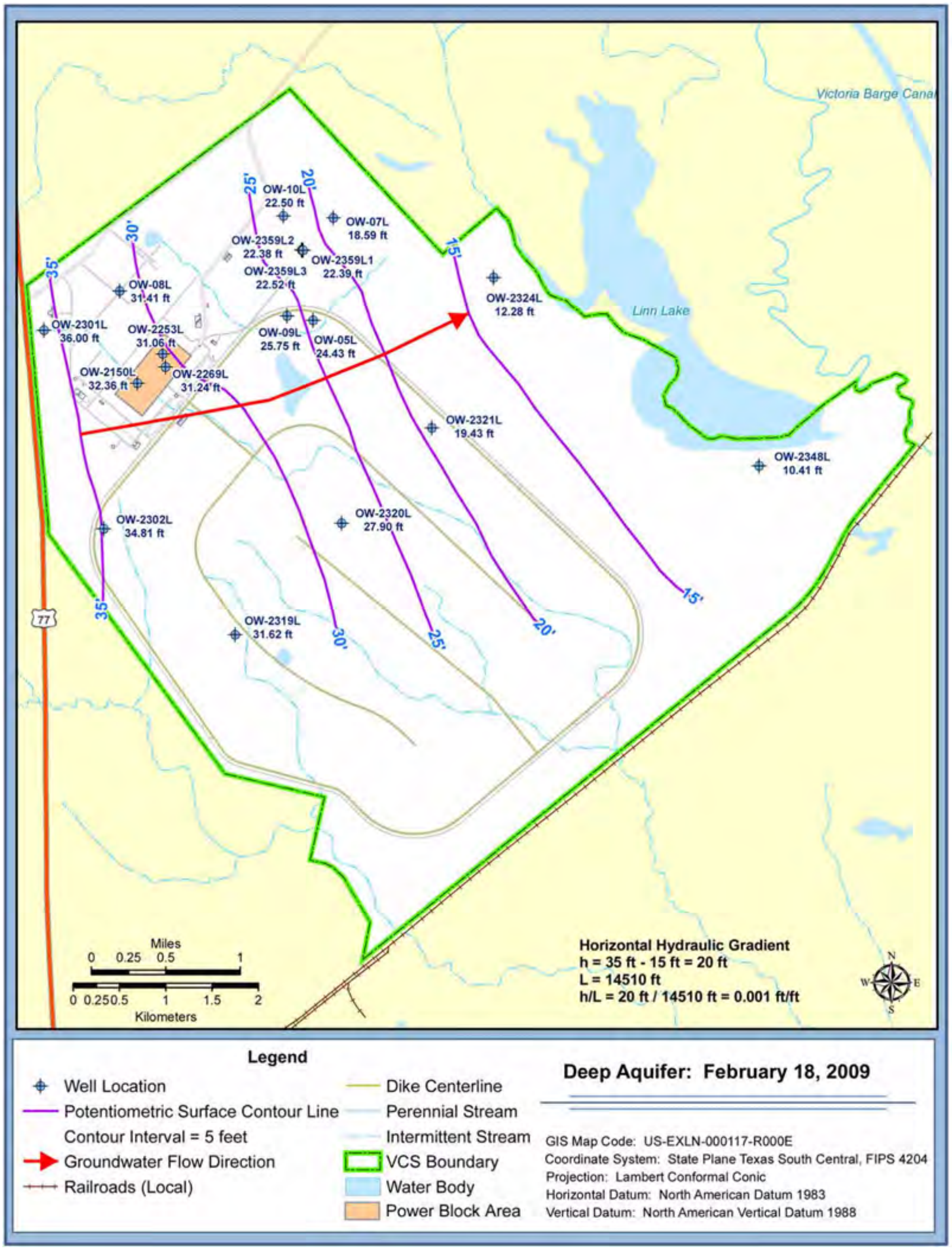


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 15 of 27)

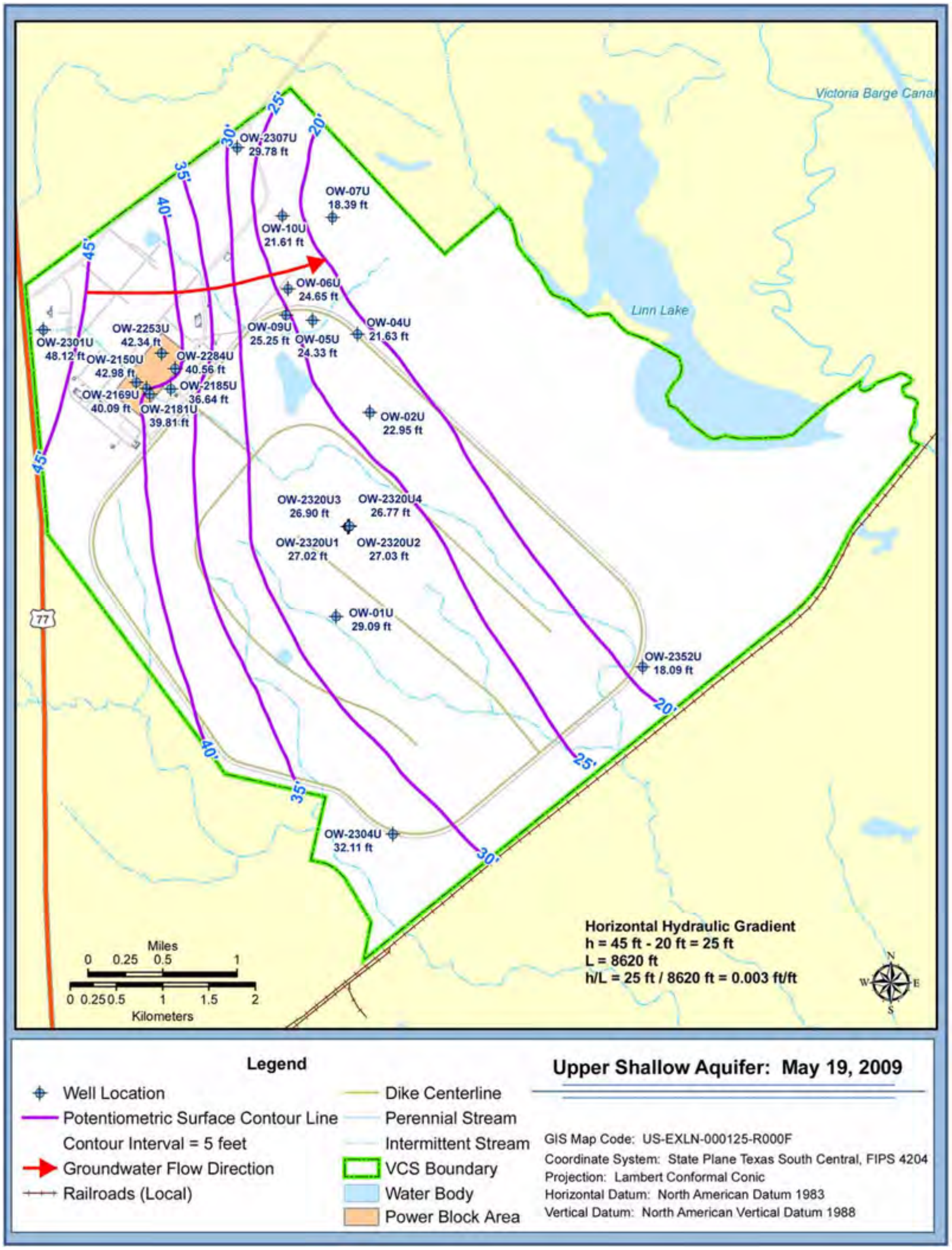


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 16 of 27)

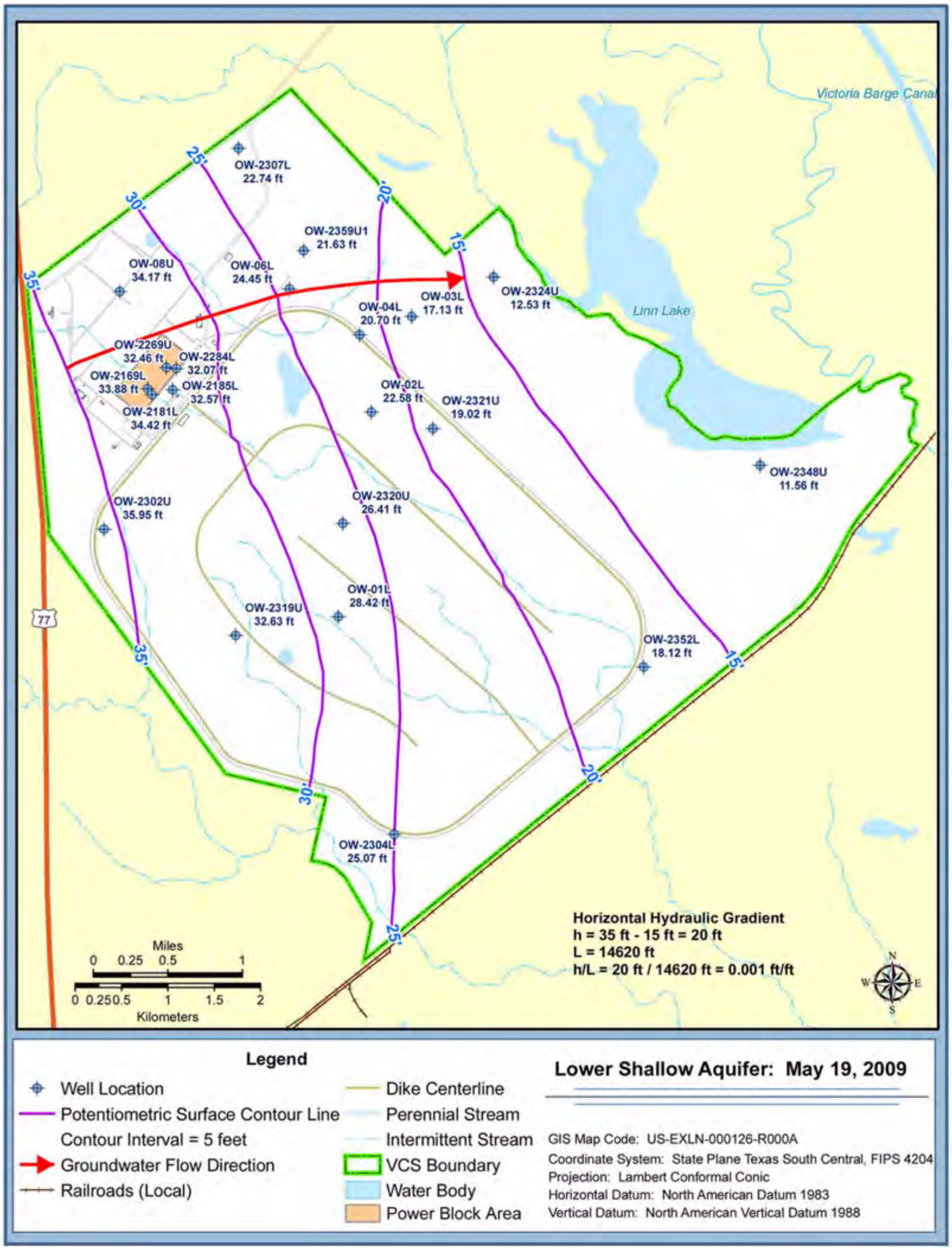


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 17 of 27)

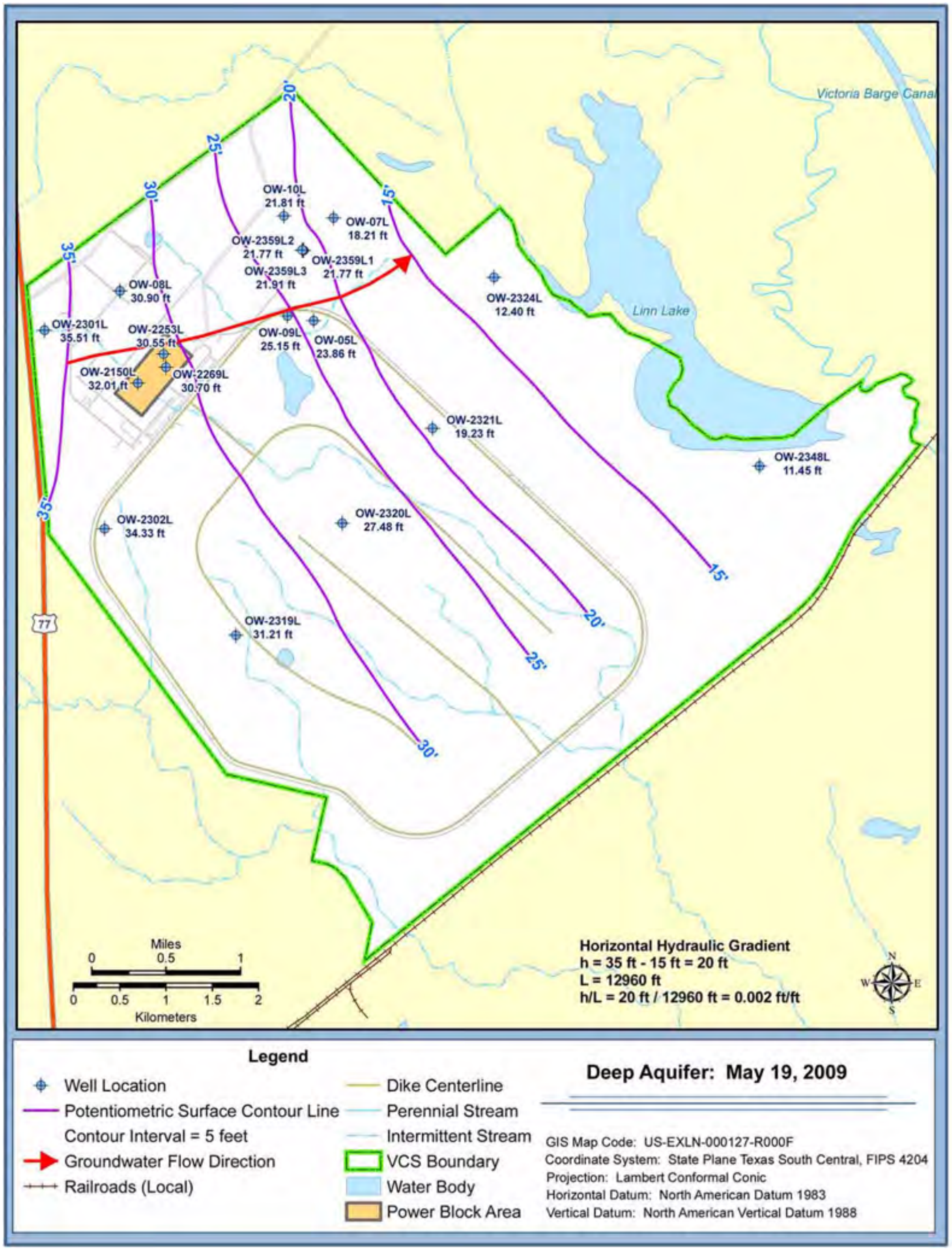


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 18 of 27)

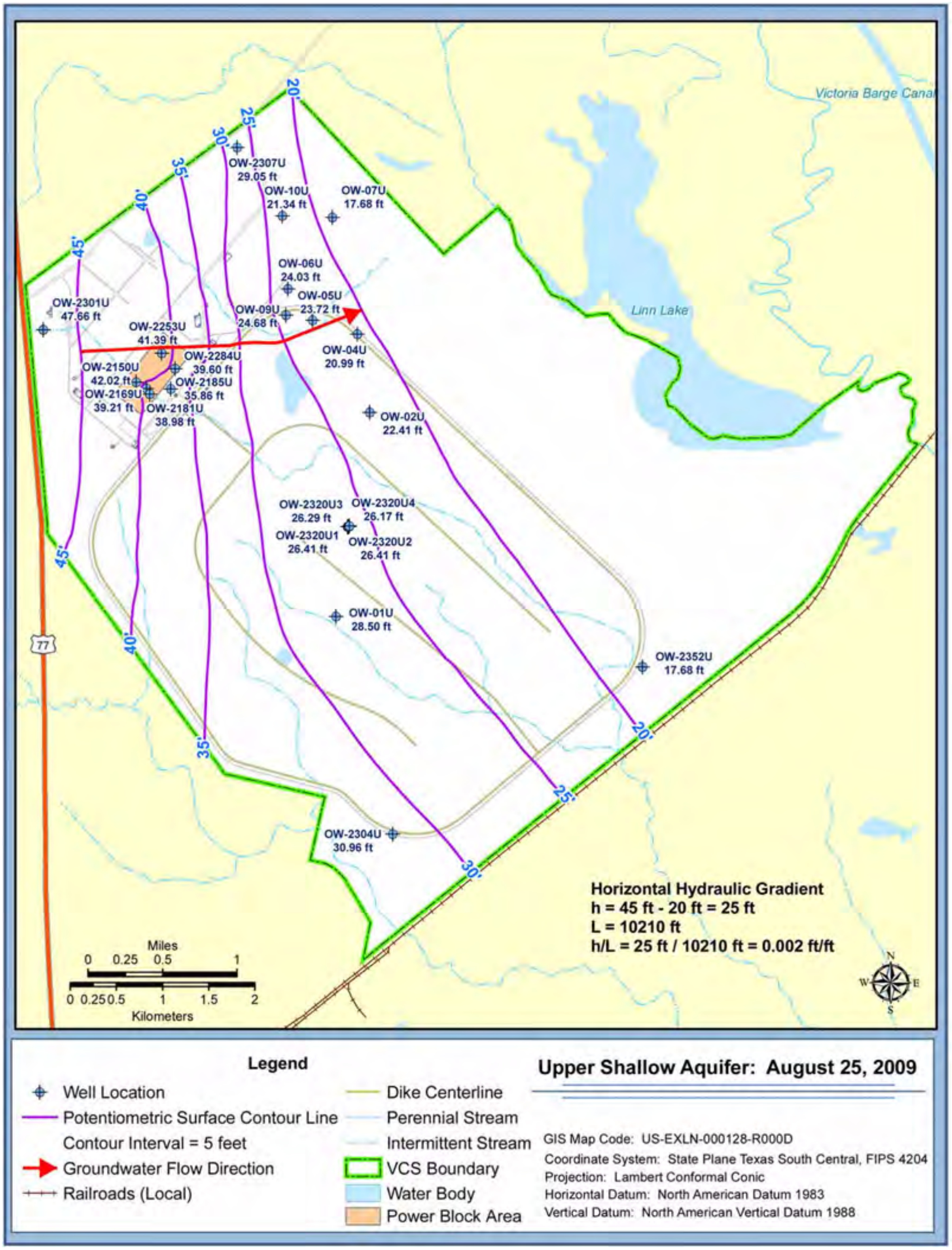


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 19 of 27)

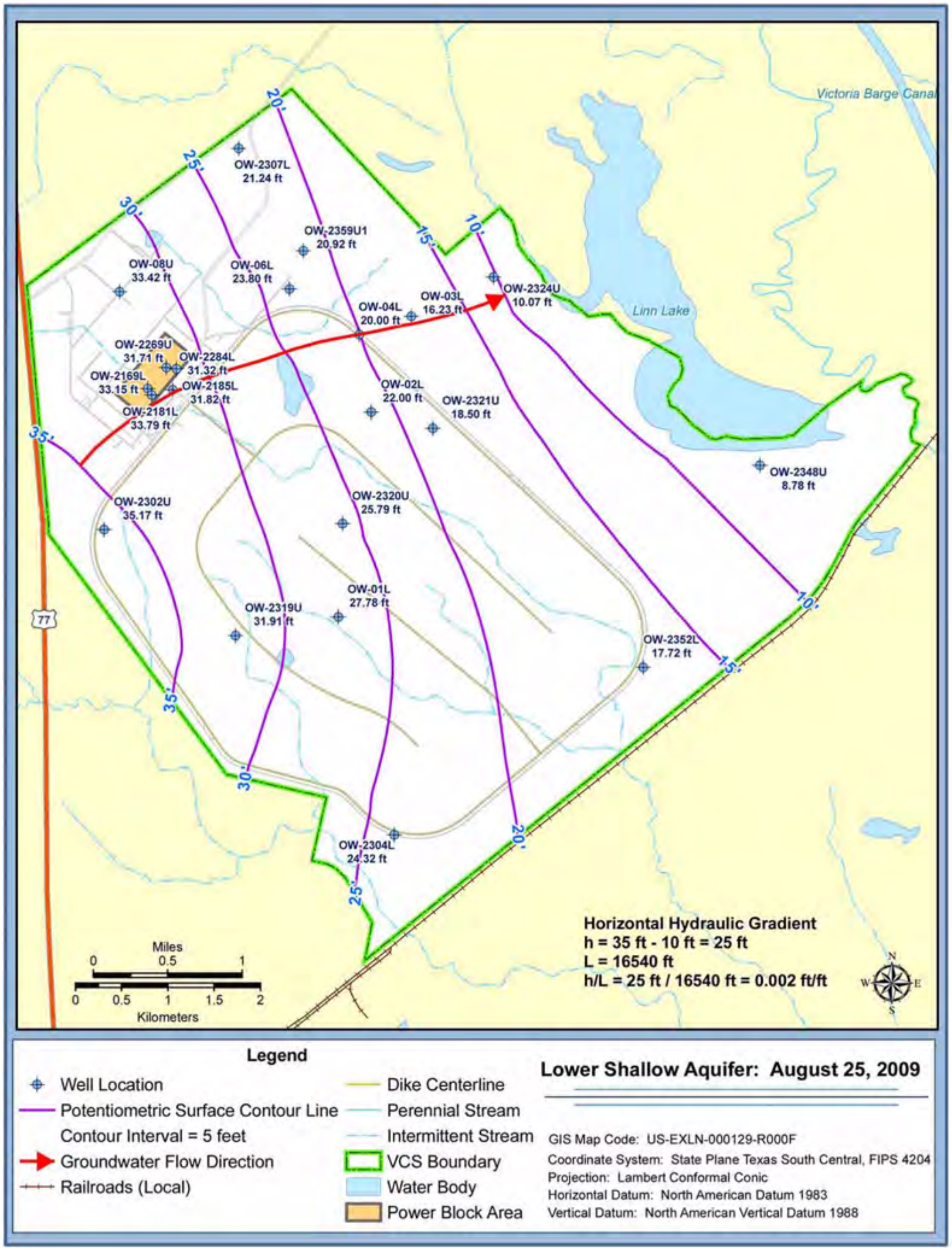


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 20 of 27)

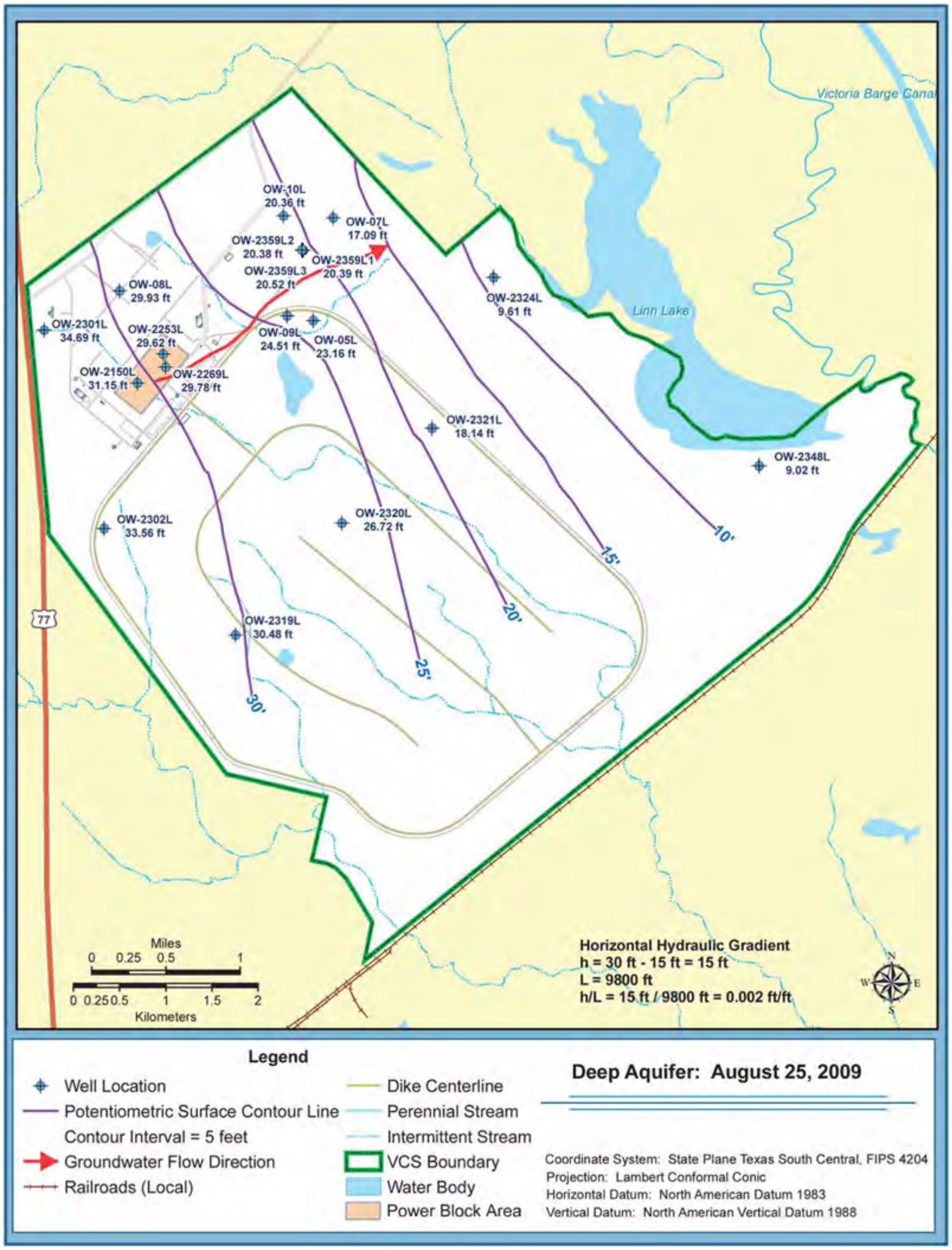


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 21 of 27)

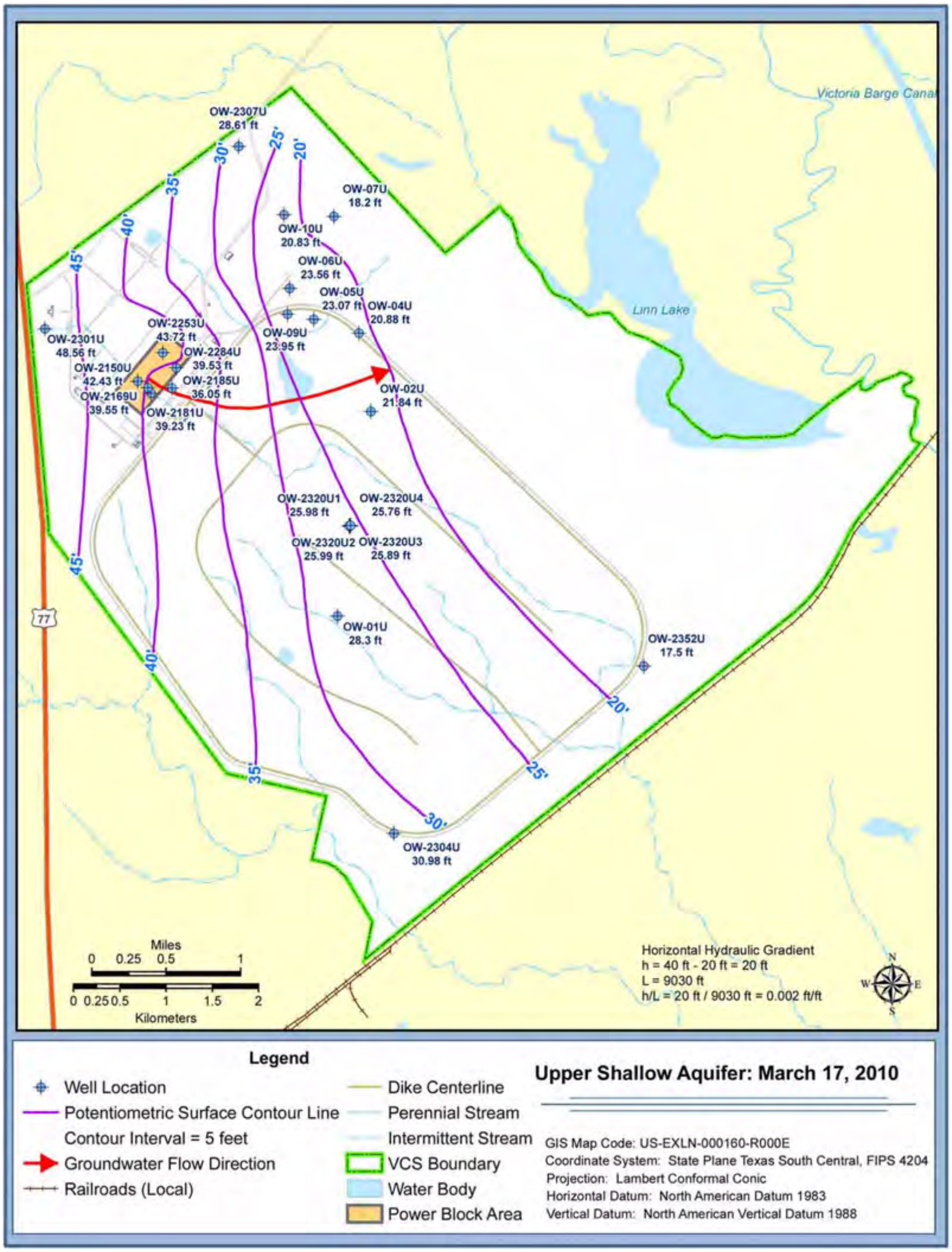


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 22 of 27)

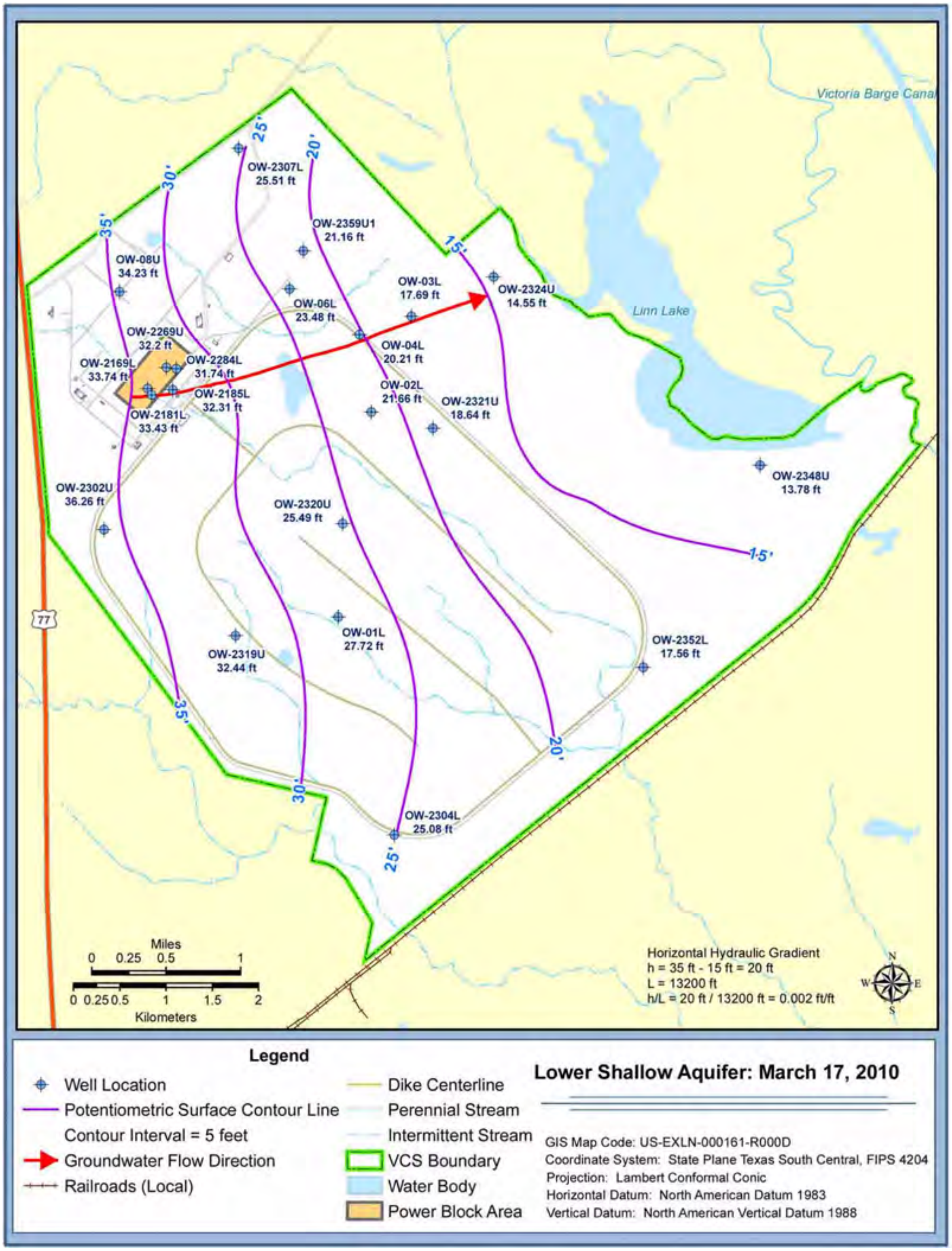


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 23 of 27)

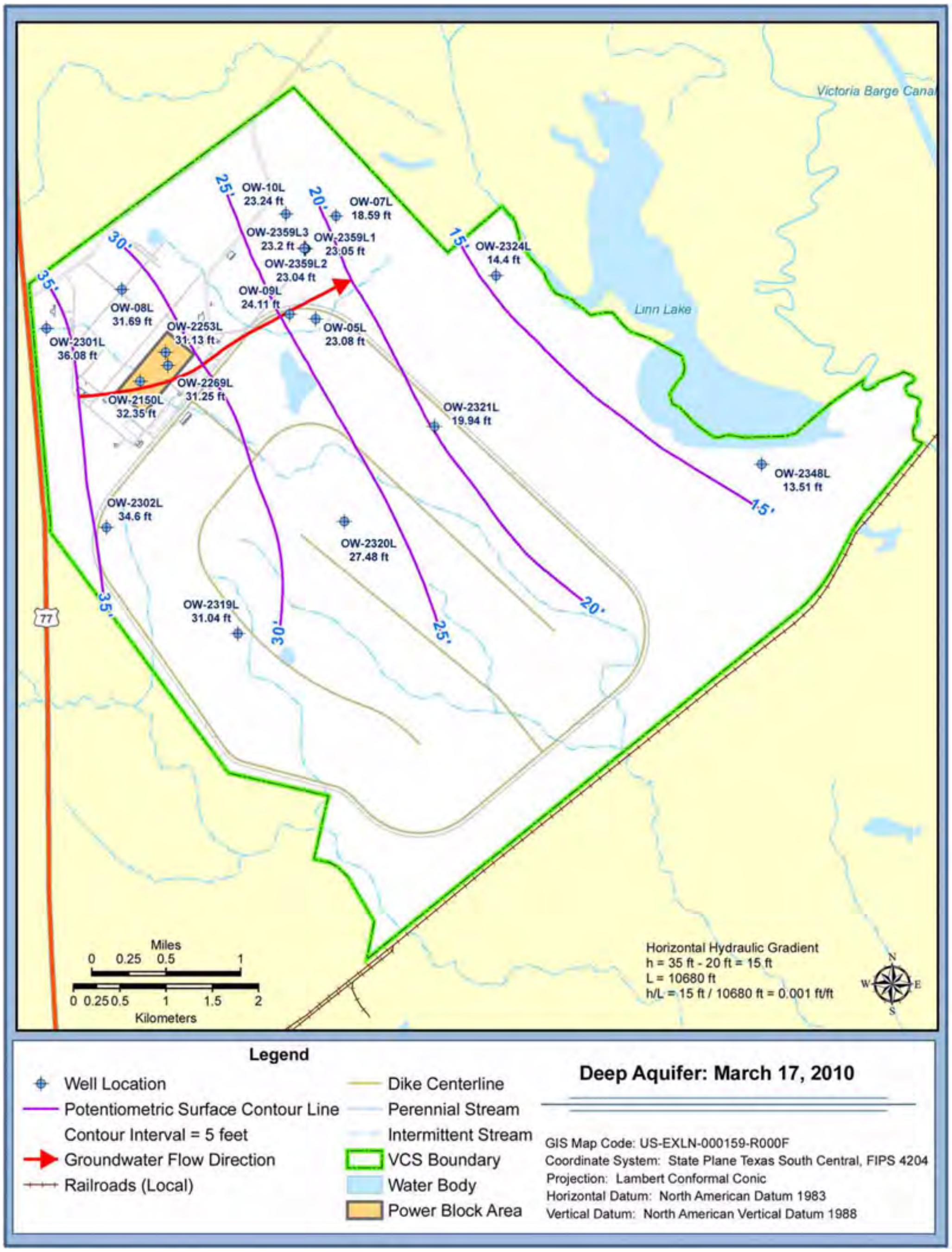


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 24 of 27)

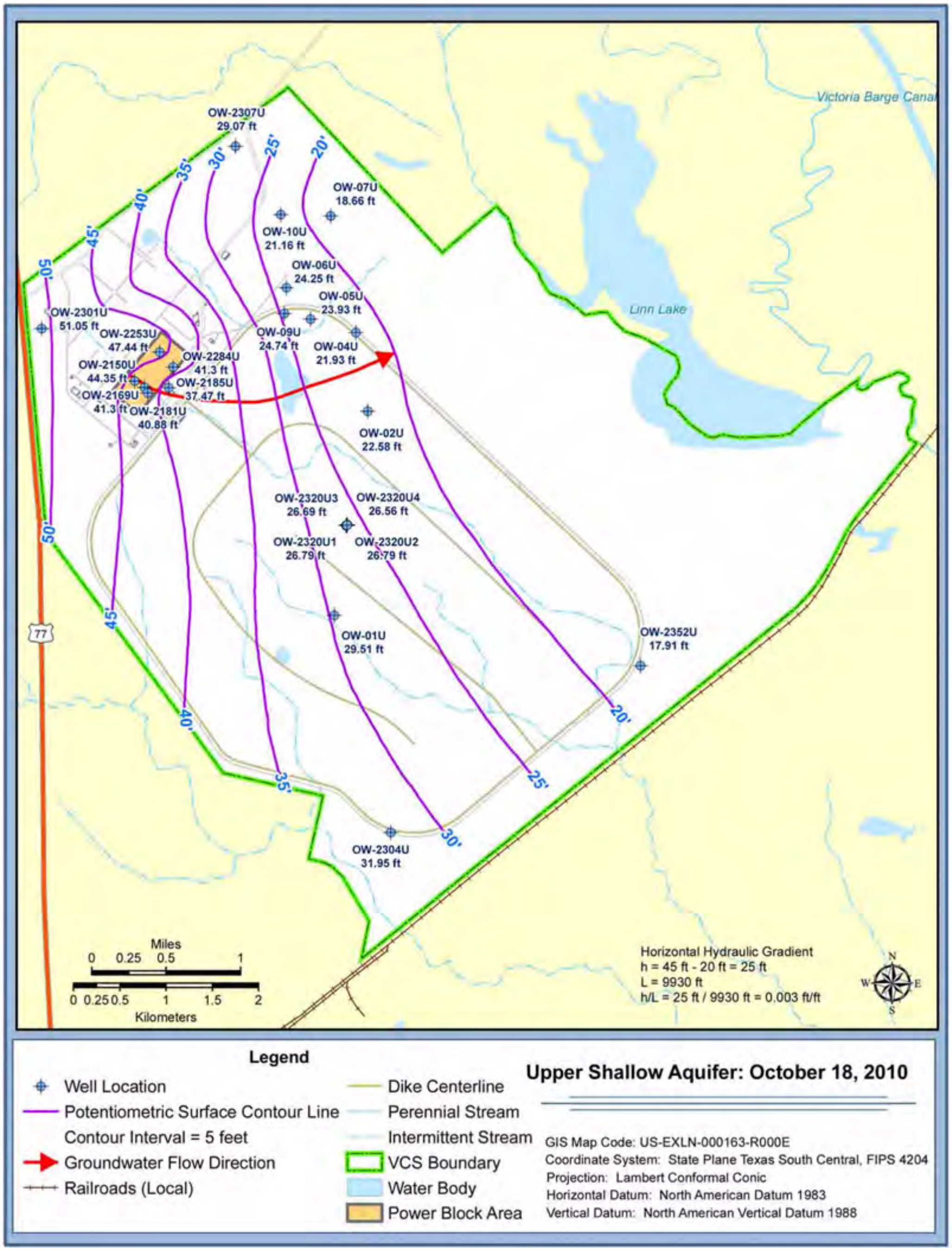


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 25 of 27)

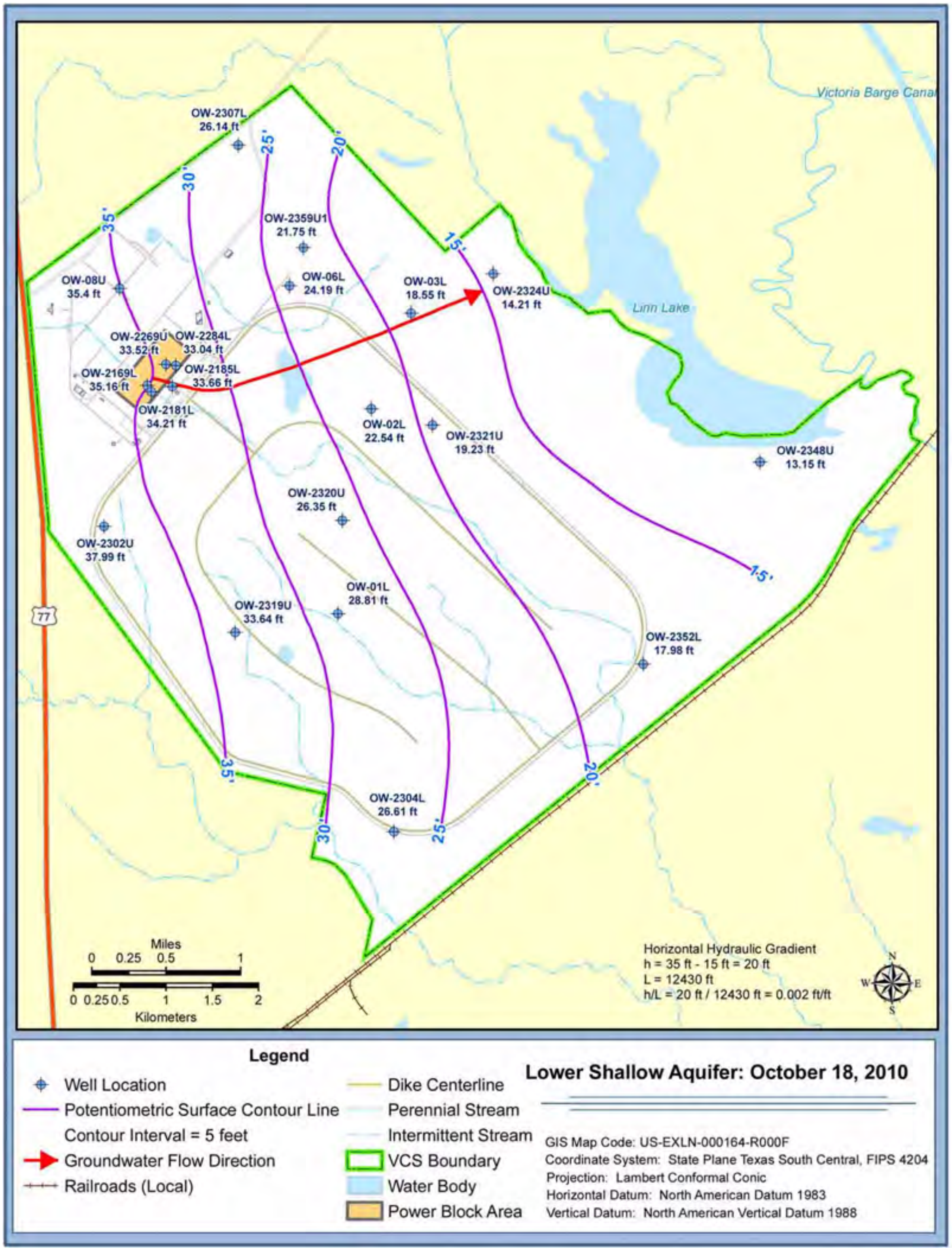


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 26 of 27)

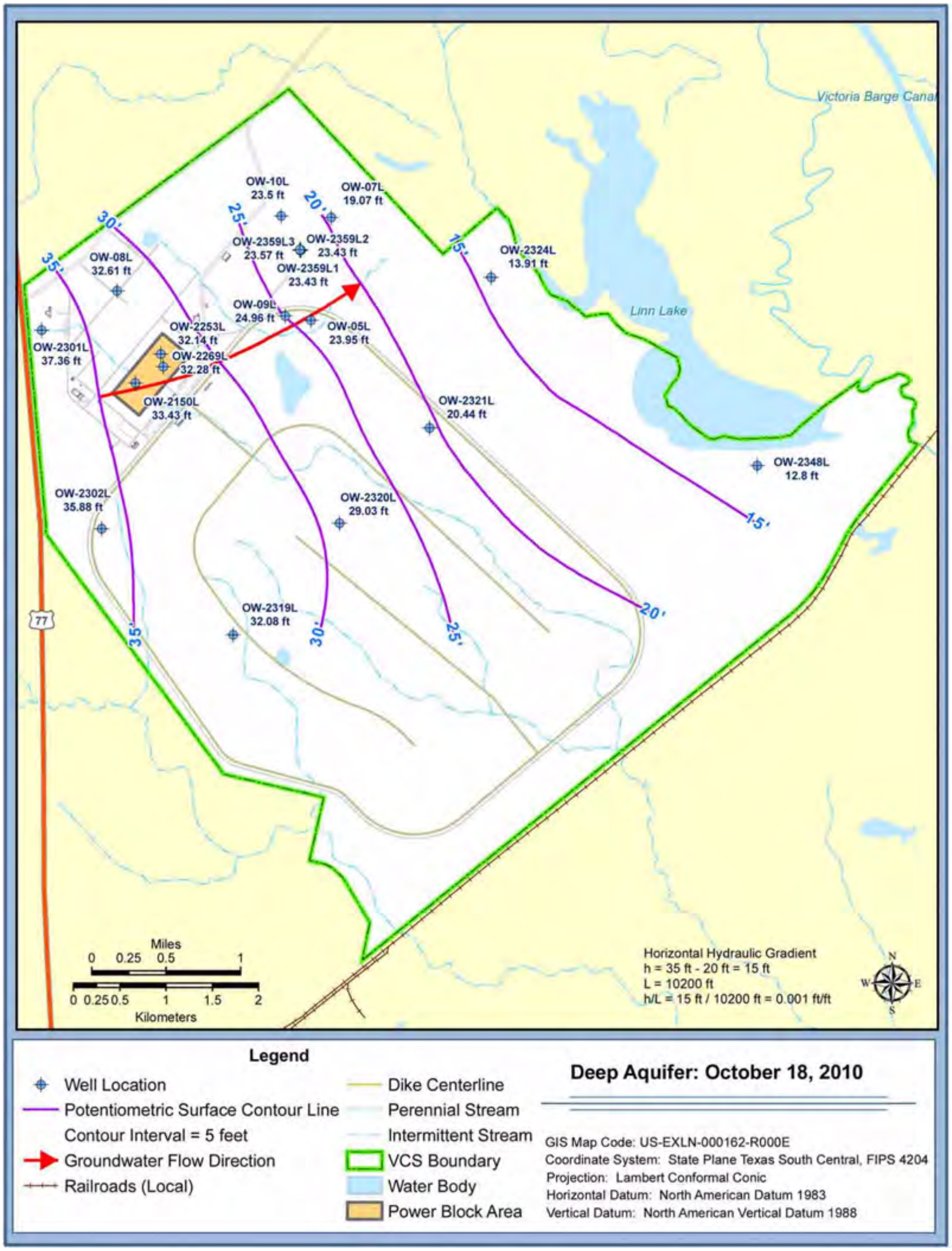
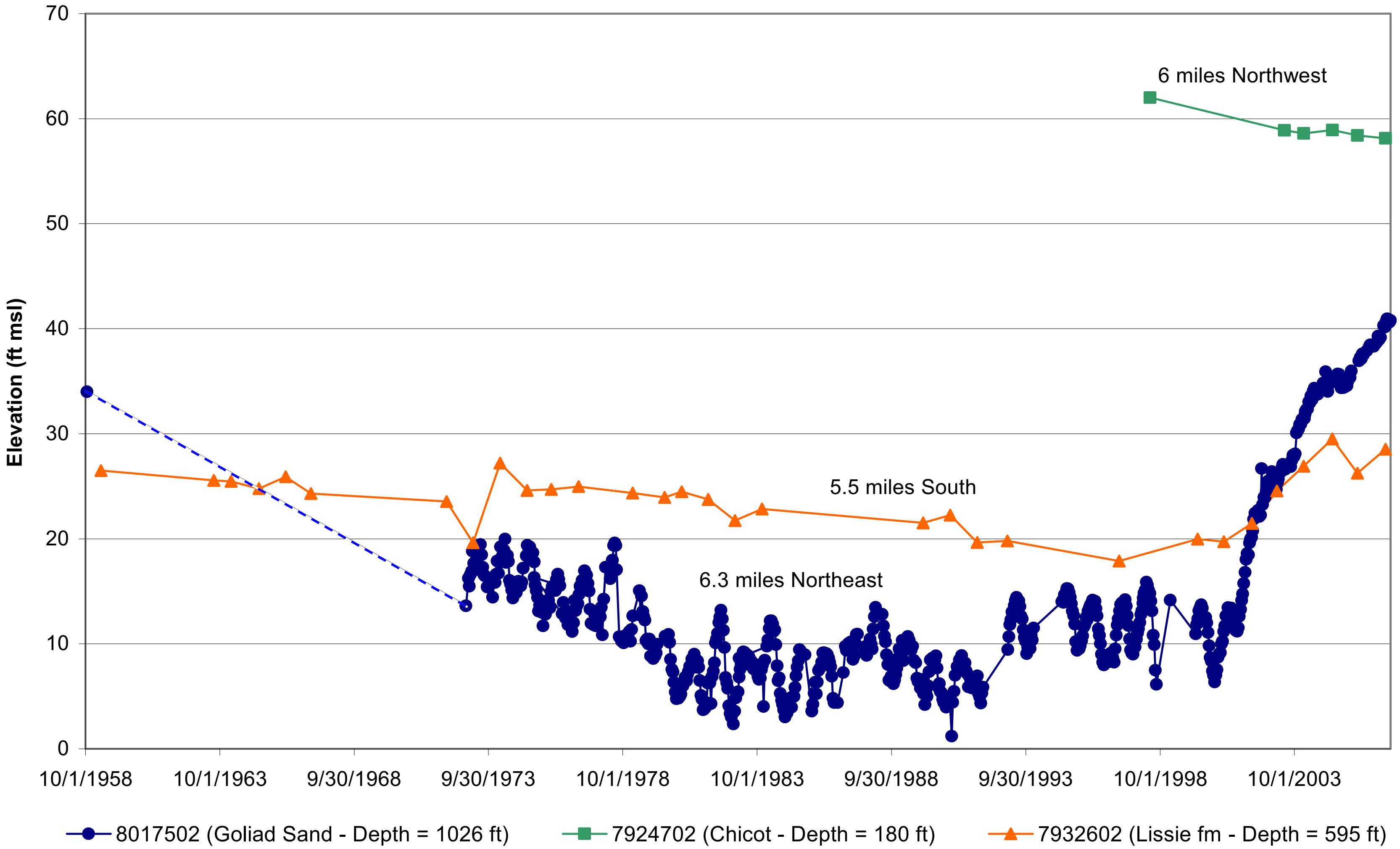


Figure 2.3.1.2-13 Potentiometric Surface Maps (Sheet 27 of 27)



Source: TWDB, 2009a.

Figure 2.3.1.2-14 Regional Hydrographs

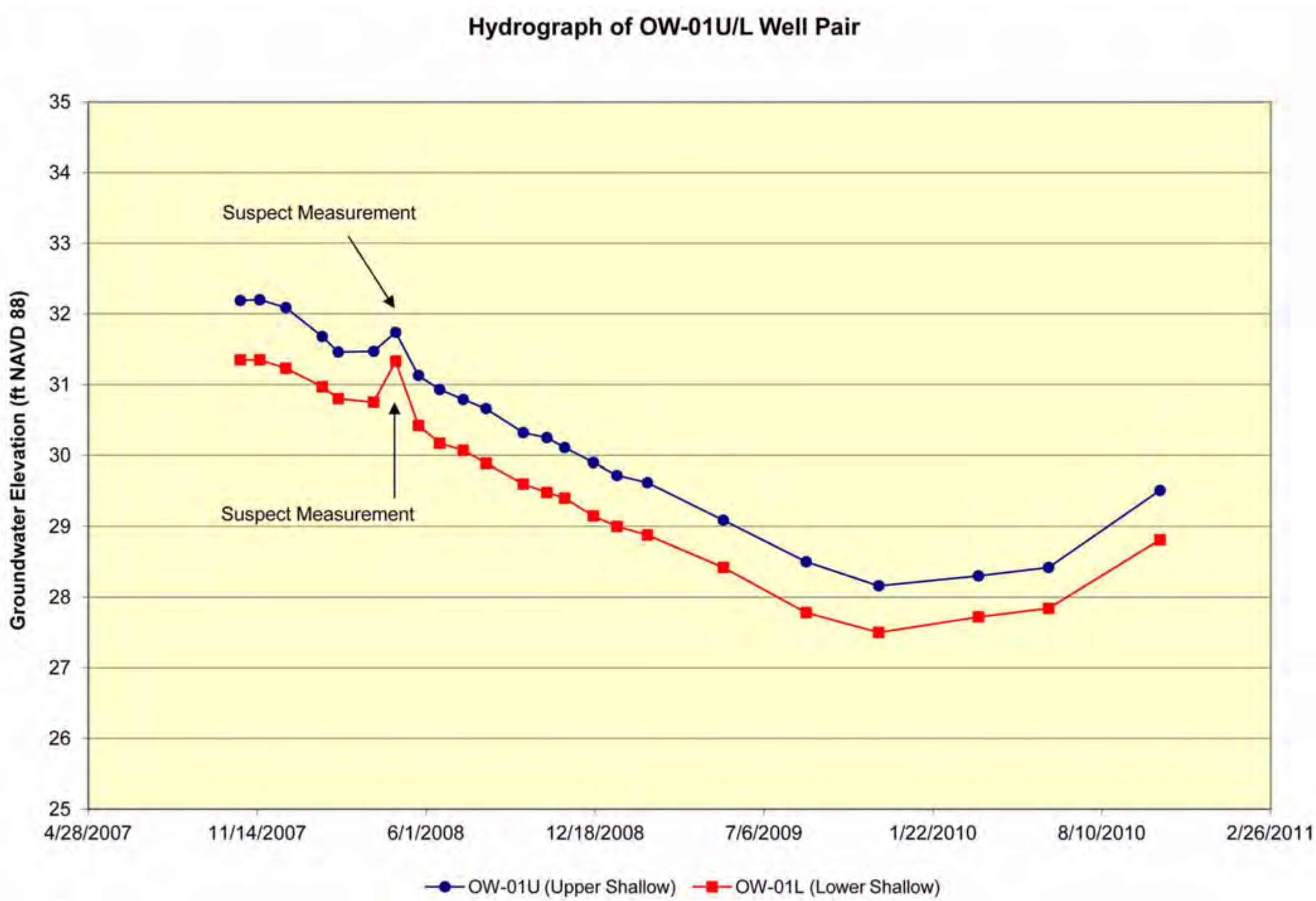


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-01U/L Well Pair (Sheet 1 of 28)

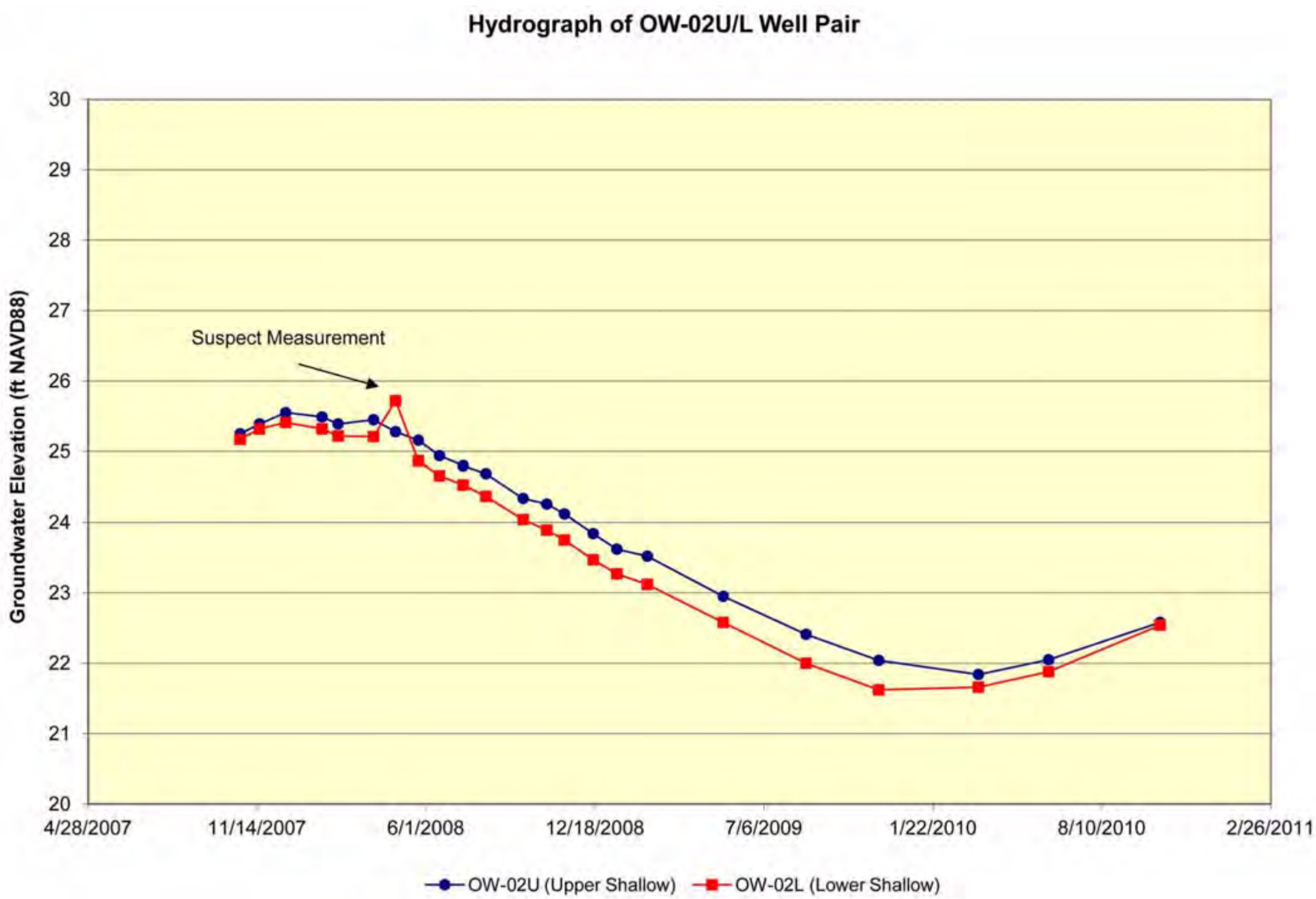


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-02U/L Well Pair (Sheet 2 of 28)

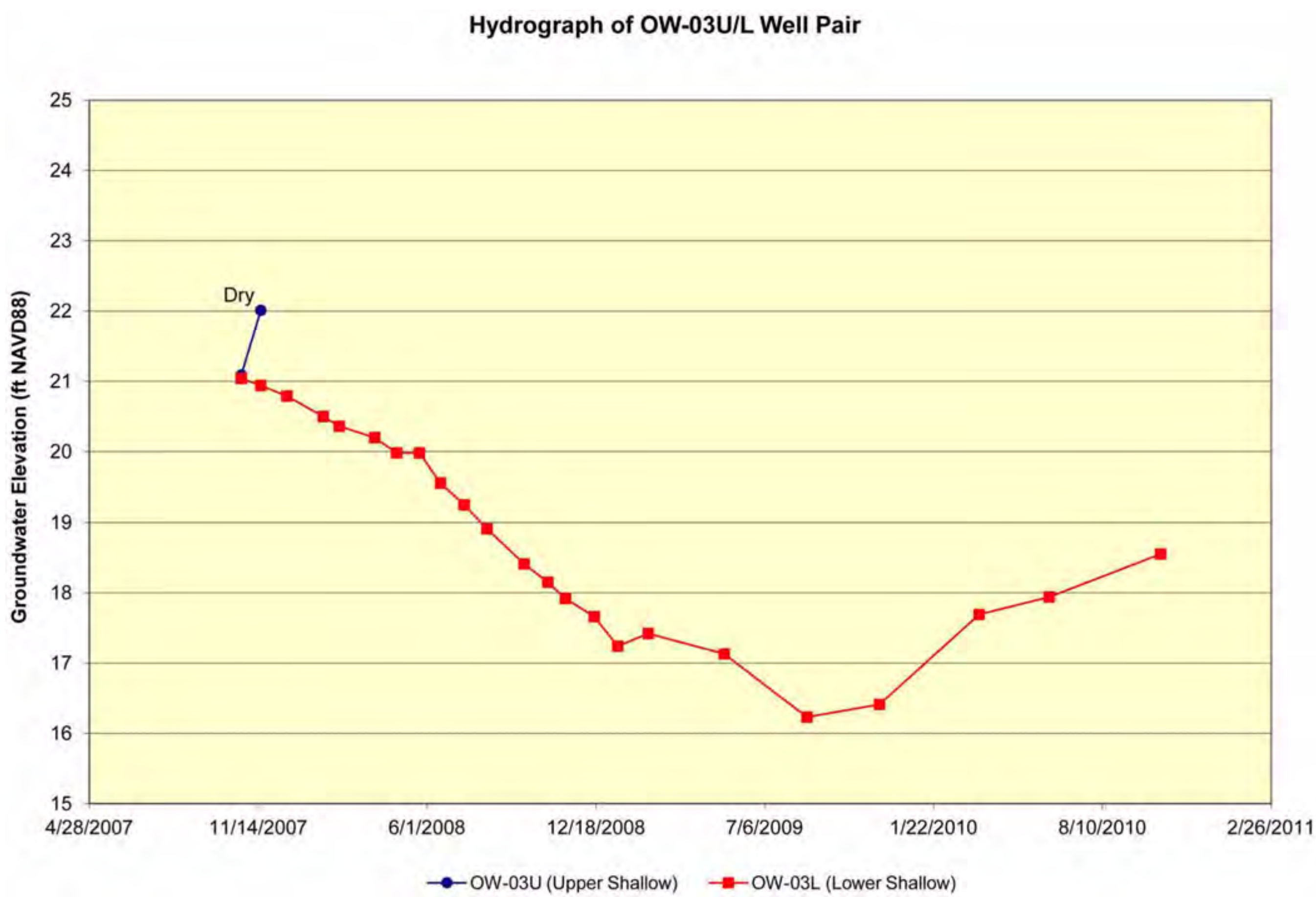


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-03U/L Well Pair (Sheet 3 of 28)

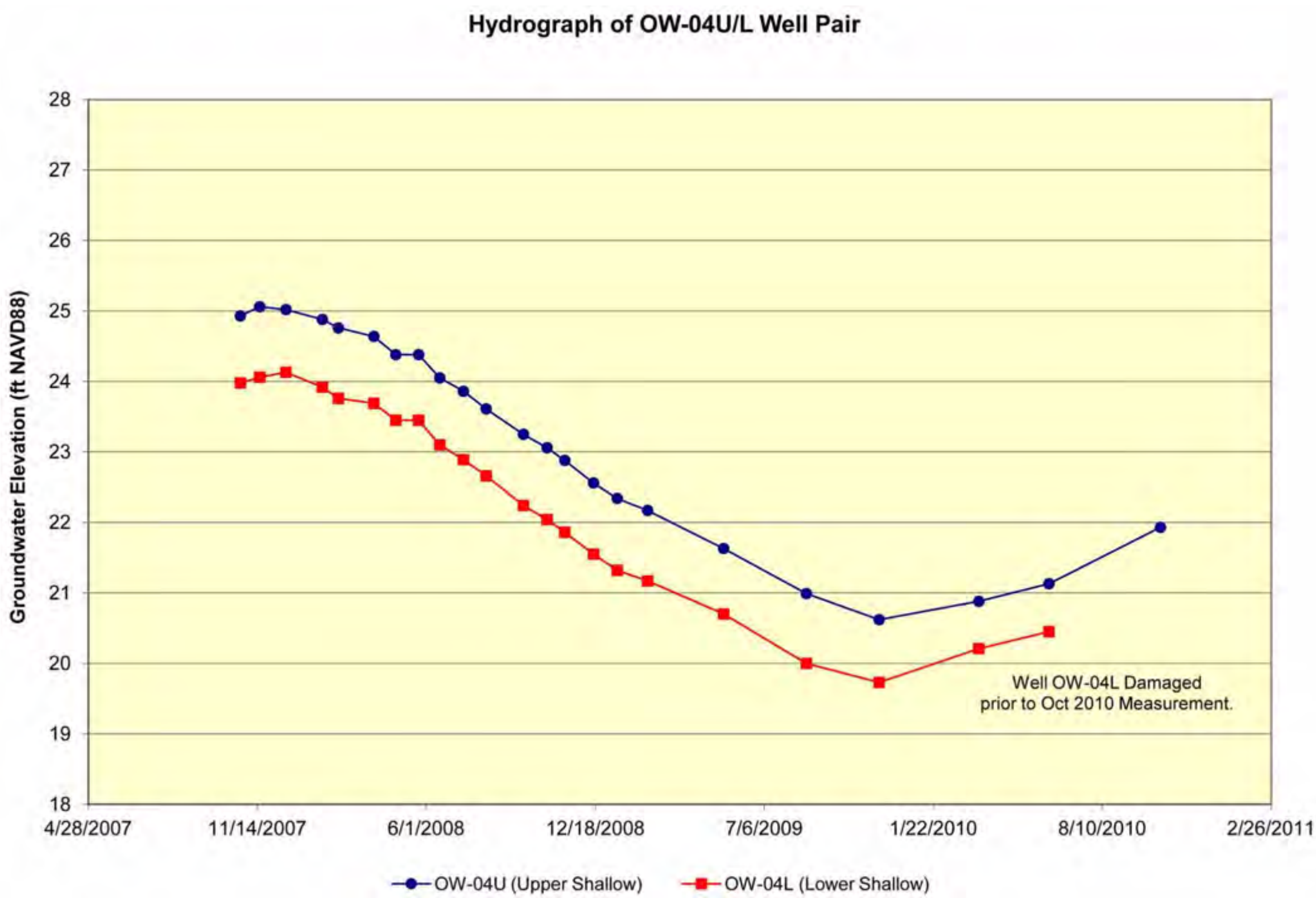


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-04U/L Well Pair (Sheet 4 of 28)

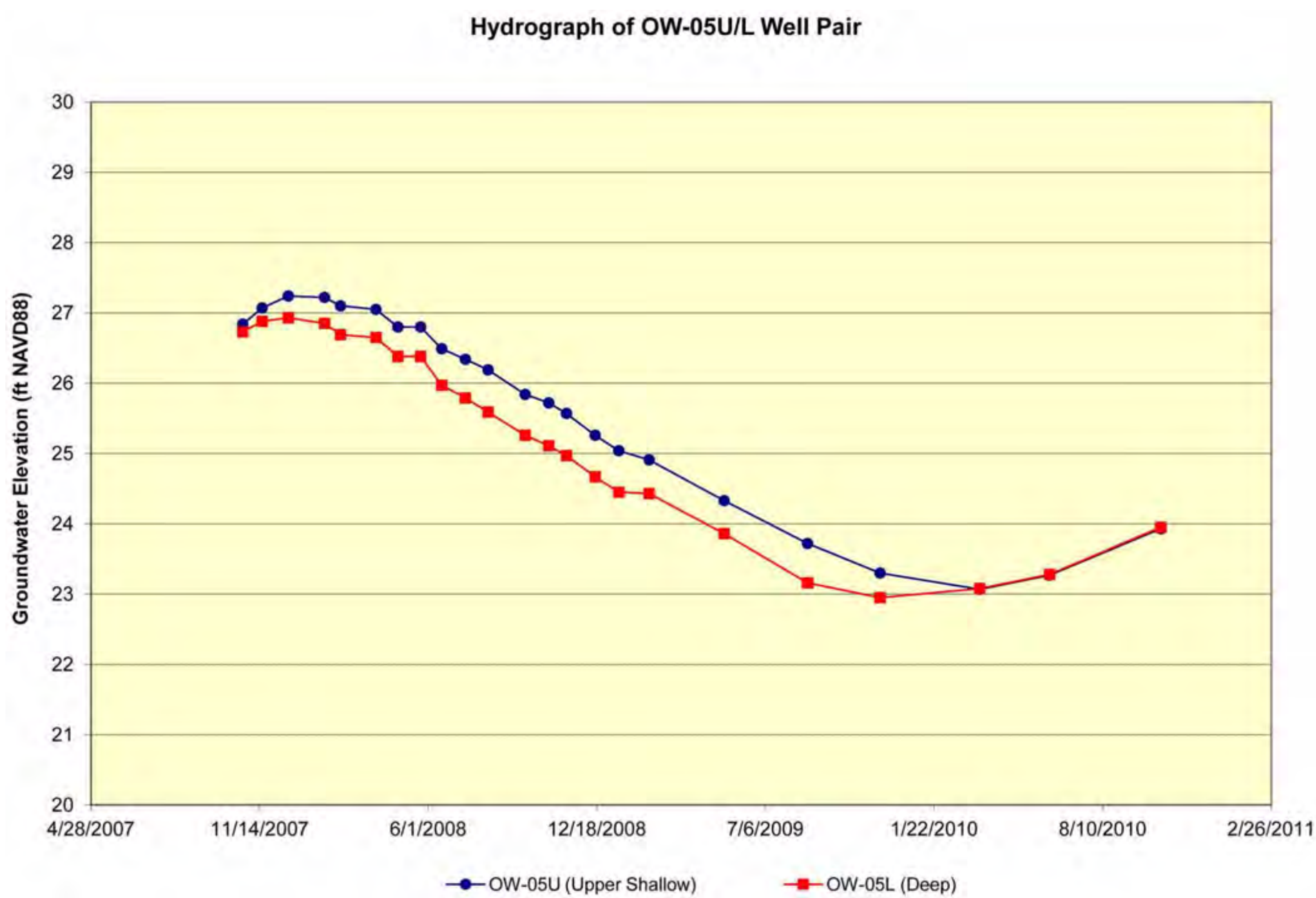


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-05U/L Well Pair (Sheet 5 of 28)

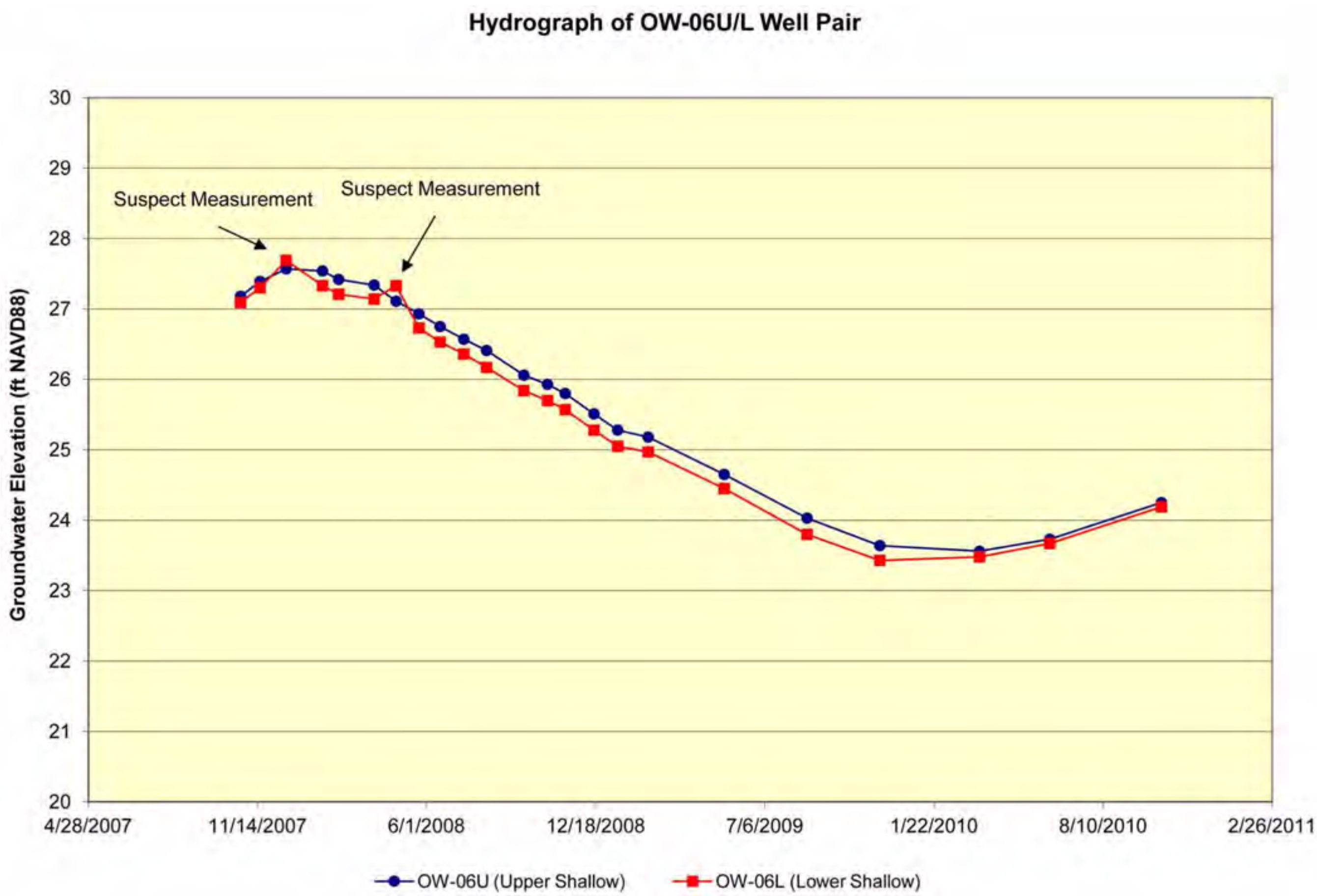


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-06U/L Well Pair (Sheet 6 of 28)

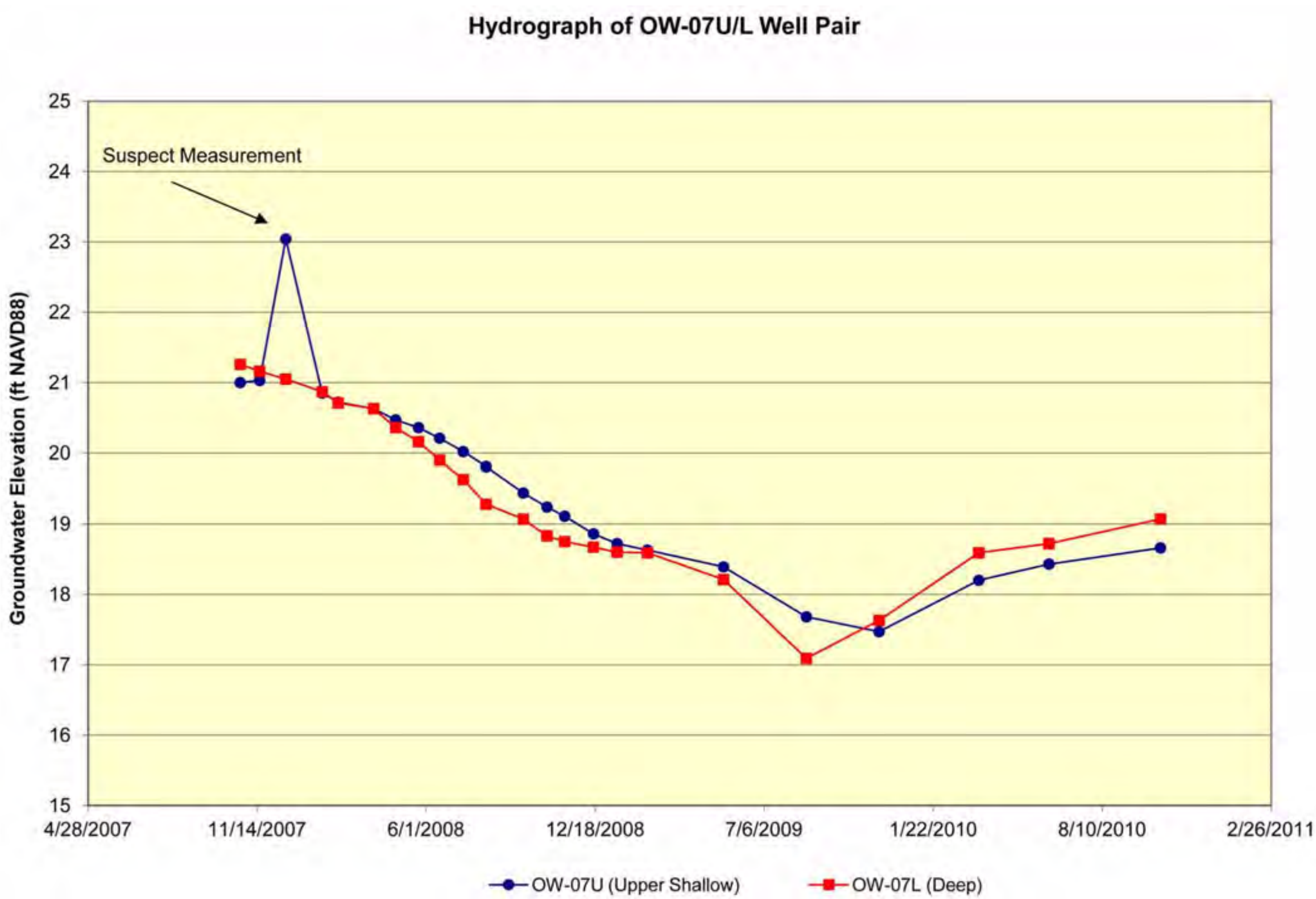


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-07U/L Well Pair (Sheet 7 of 28)

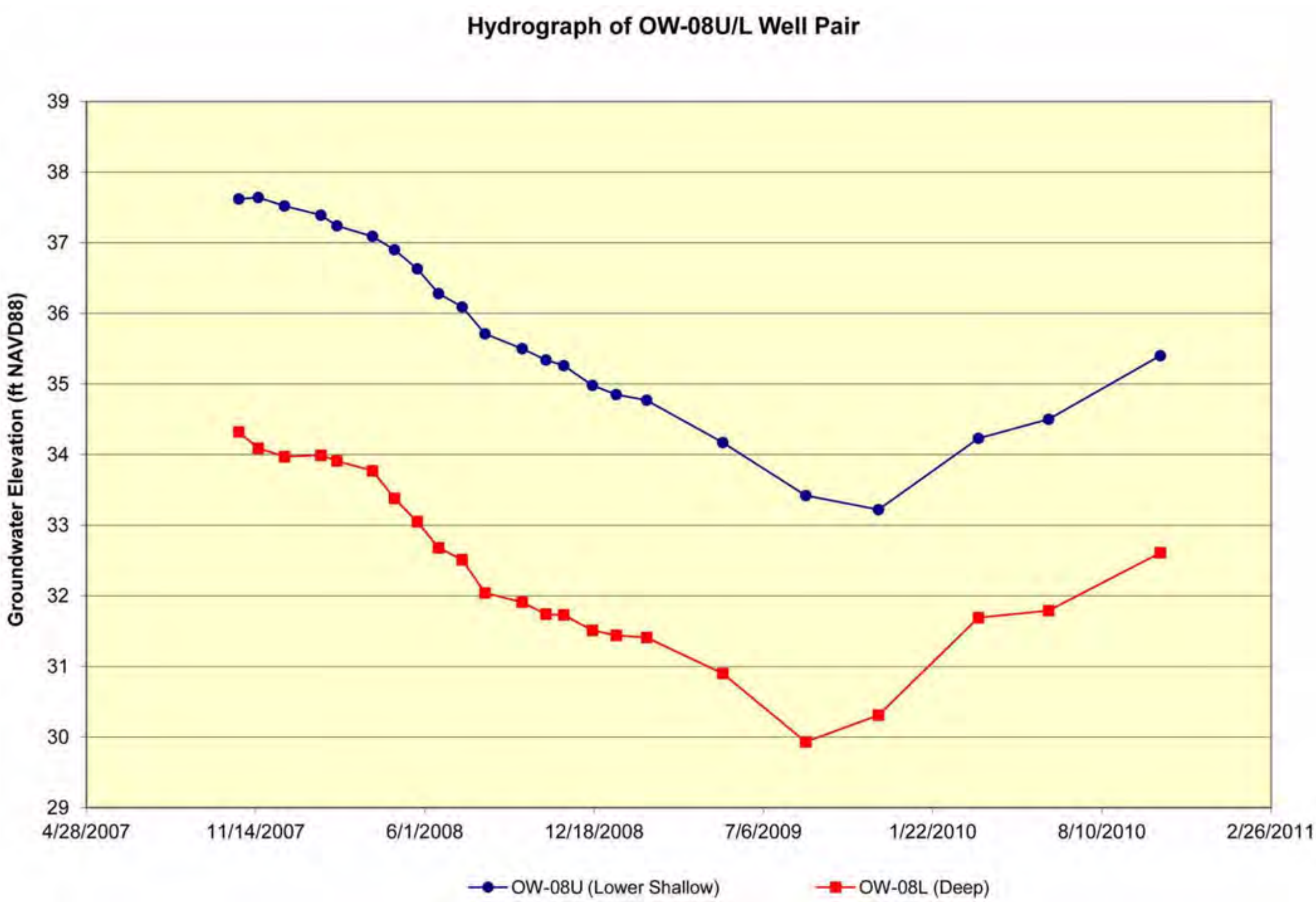


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-08U/L Well Pair (Sheet 8 of 28)

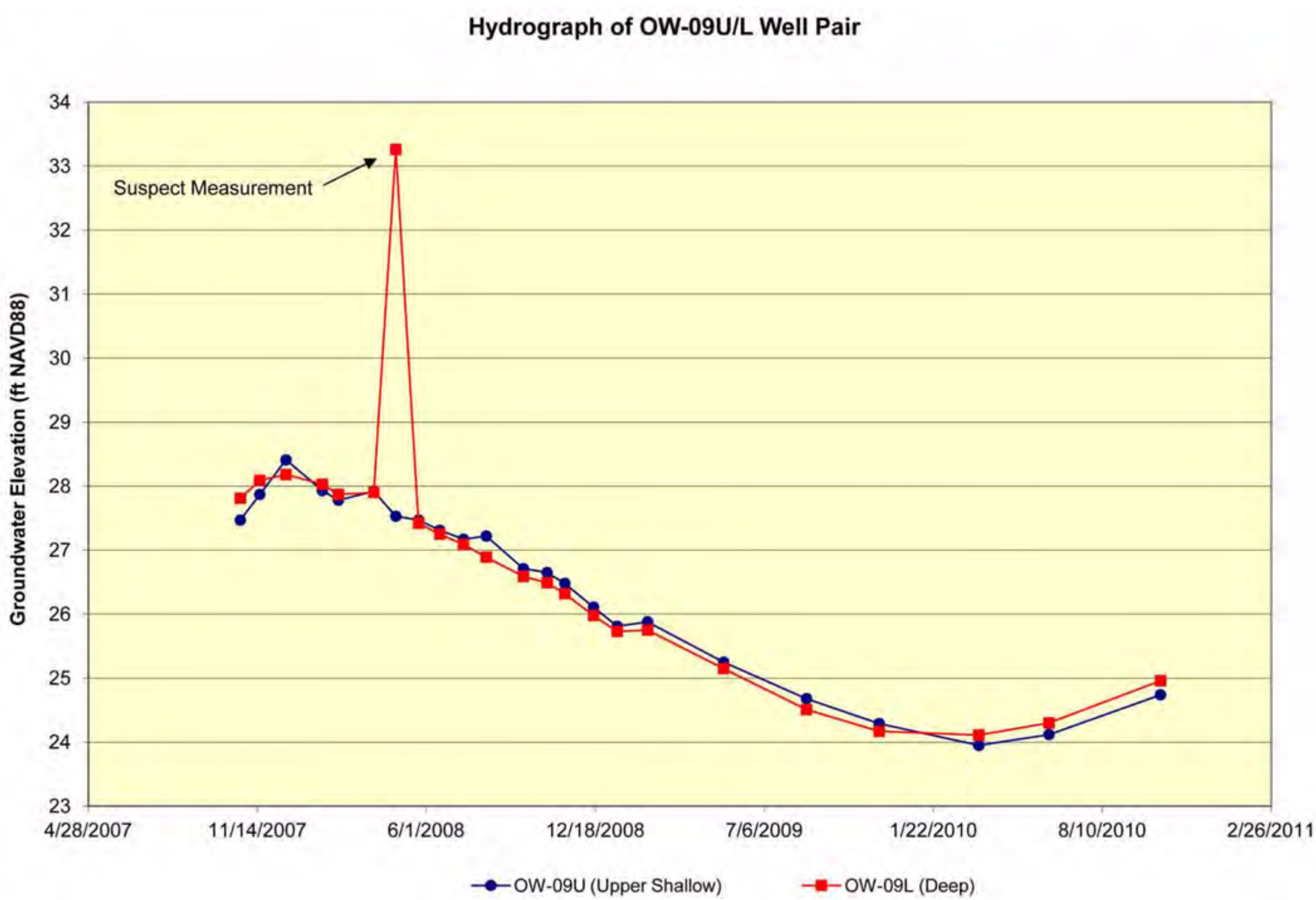


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-09U/L Well Pair (Sheet 9 of 28)

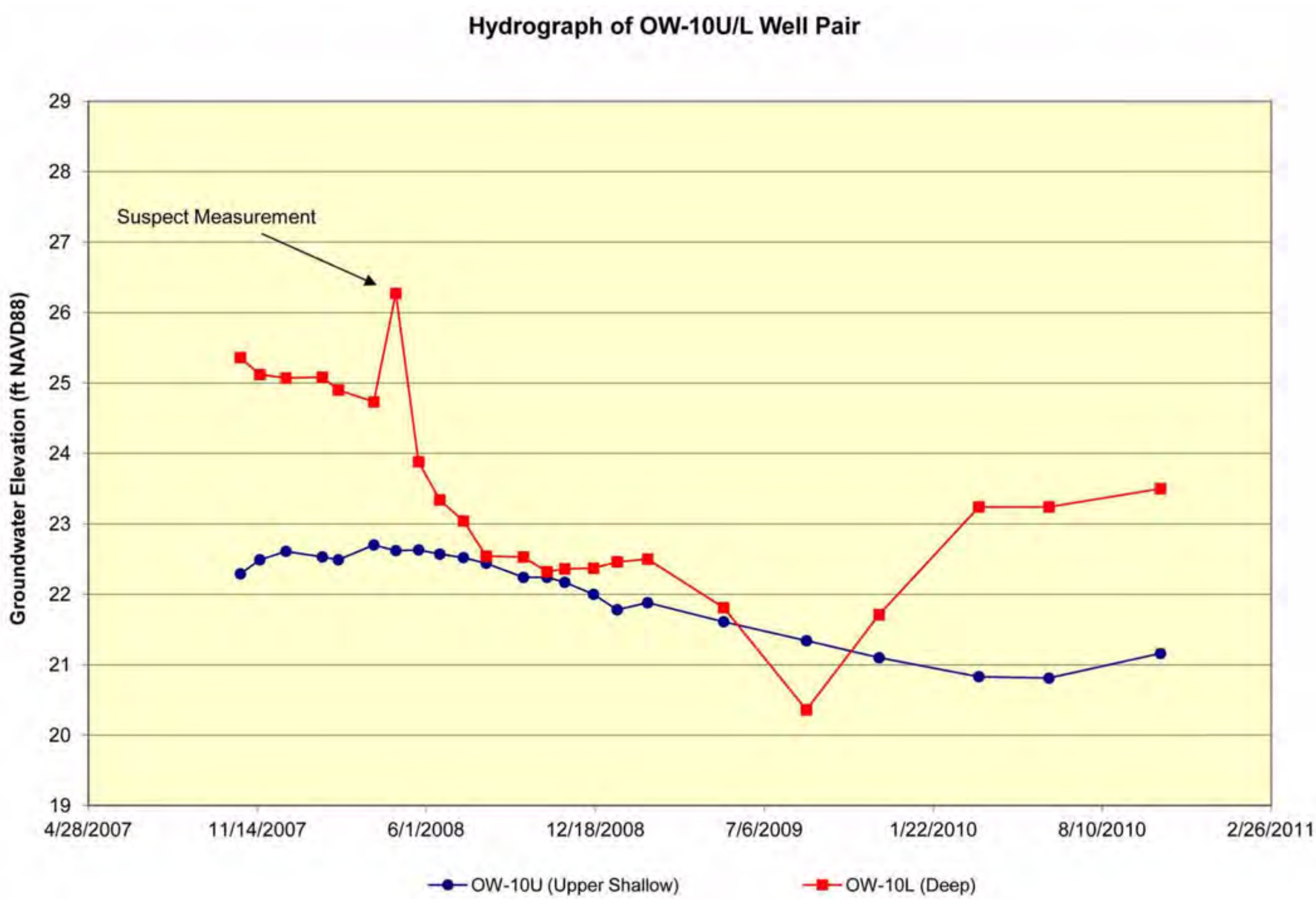


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-010U/L Well Pair (Sheet 10 of 28)

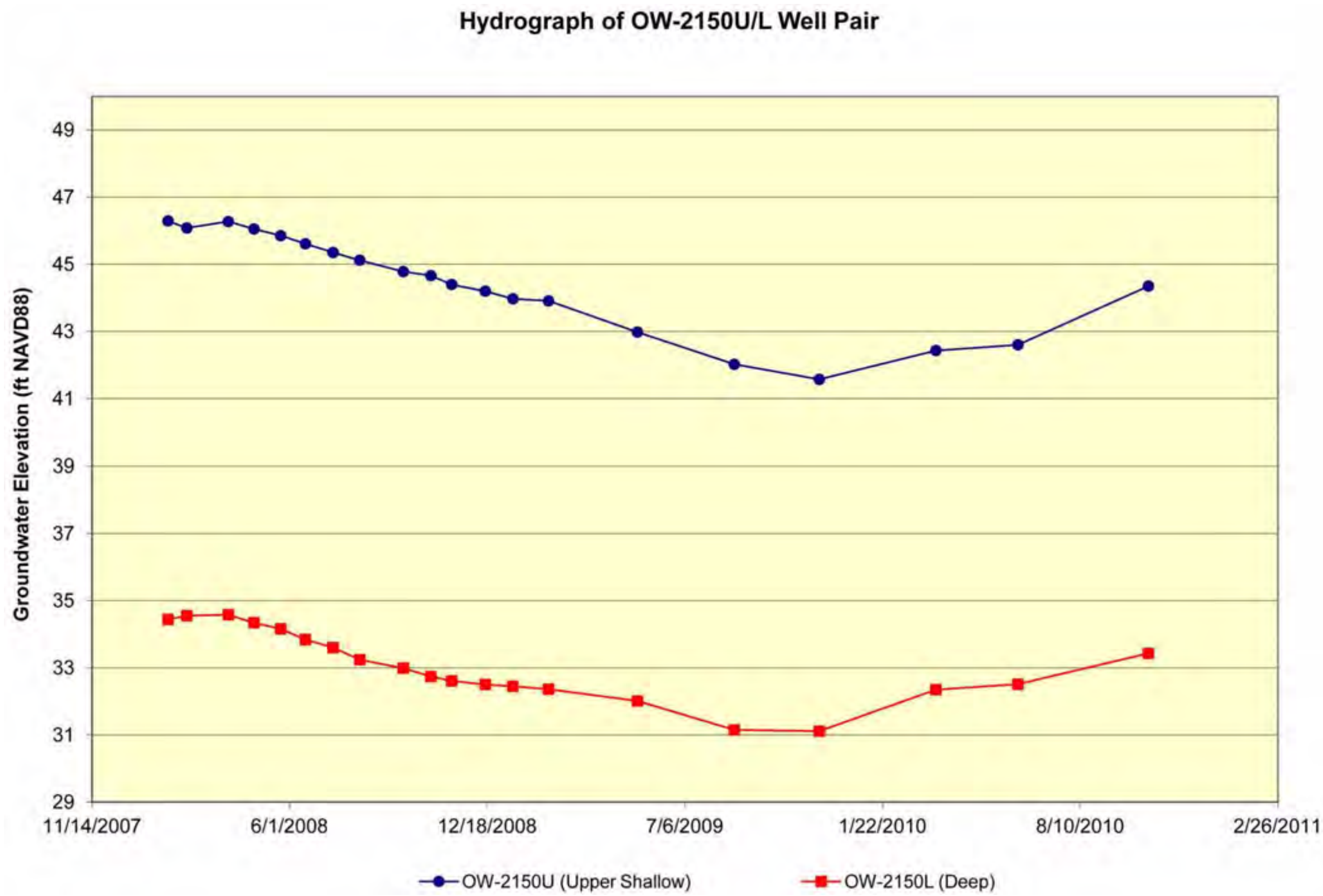


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2150U/L Well Pair (Sheet 11 of 28)

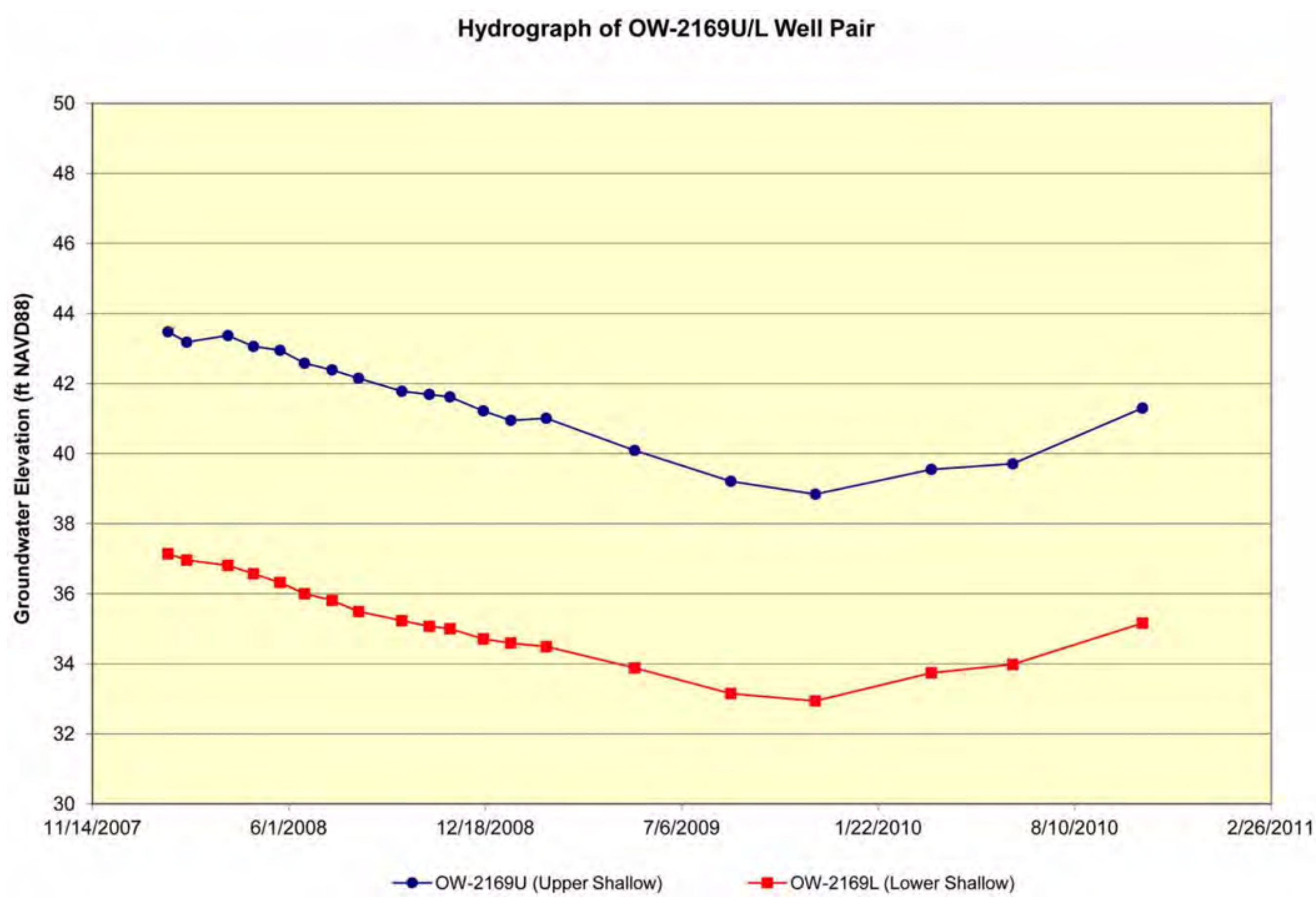


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2169U/L Well Pair (Sheet 12 of 28)

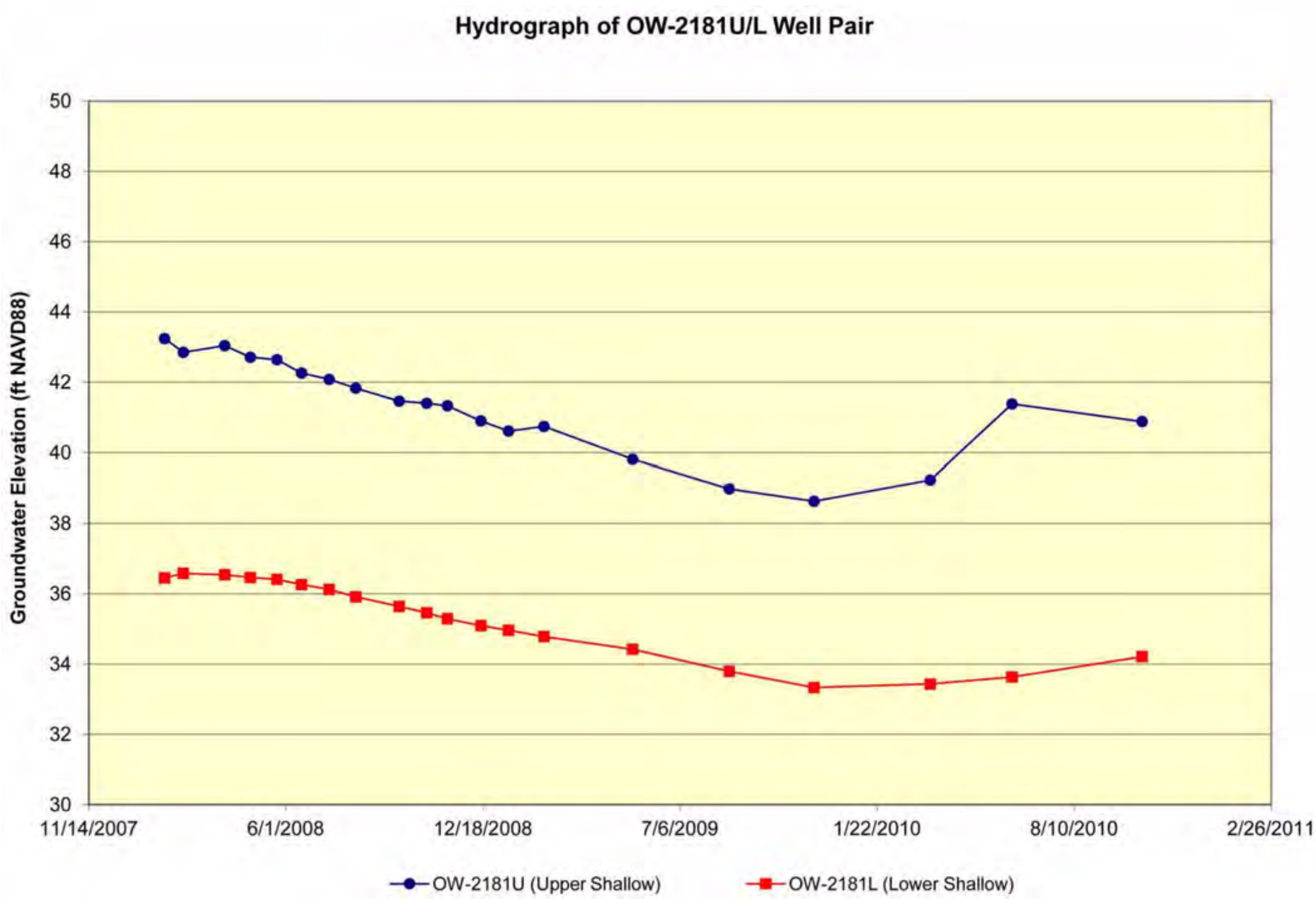


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2181U/L Well Pair (Sheet 13 of 28)

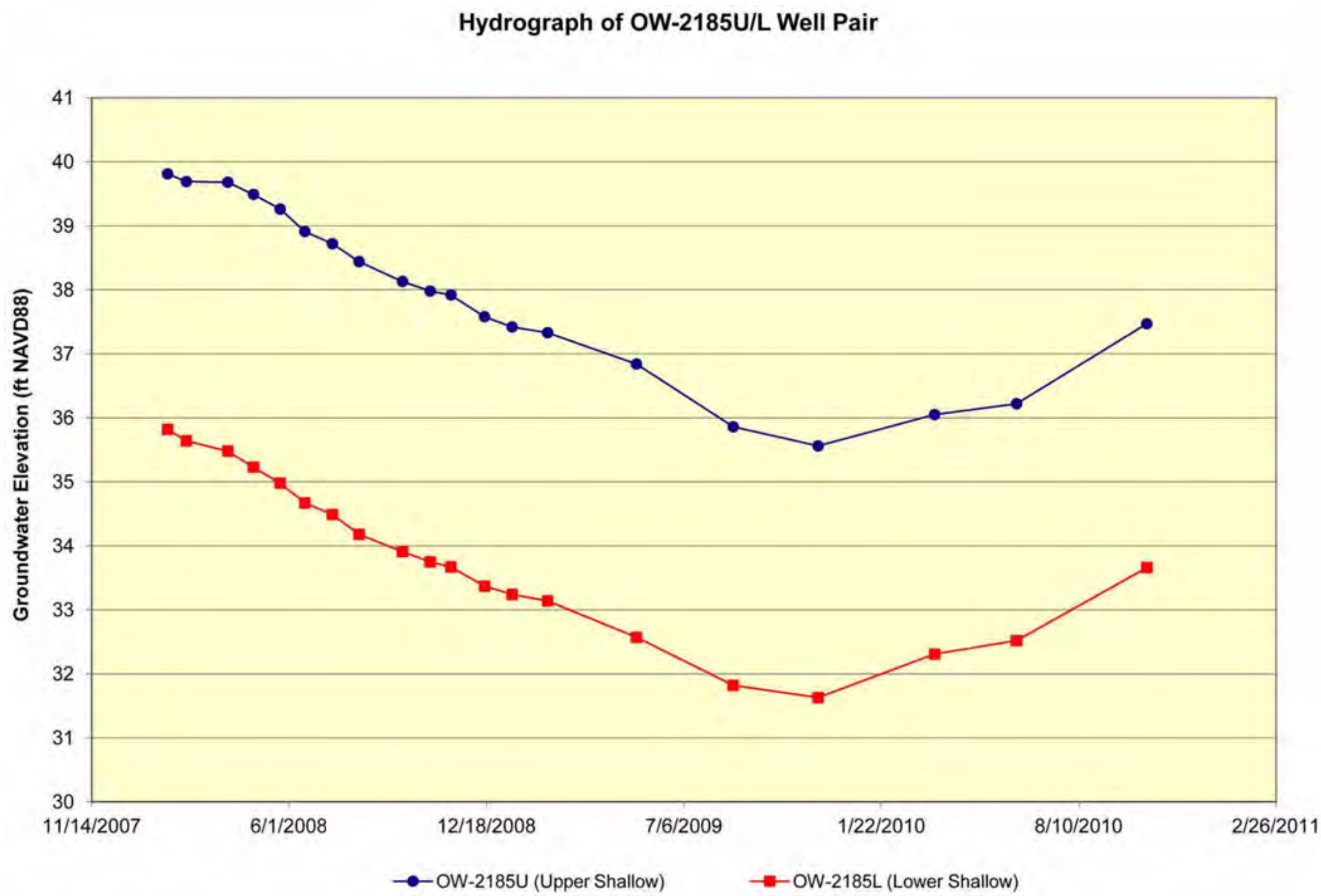


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2185U/L Well Pair (Sheet 14 of 28)

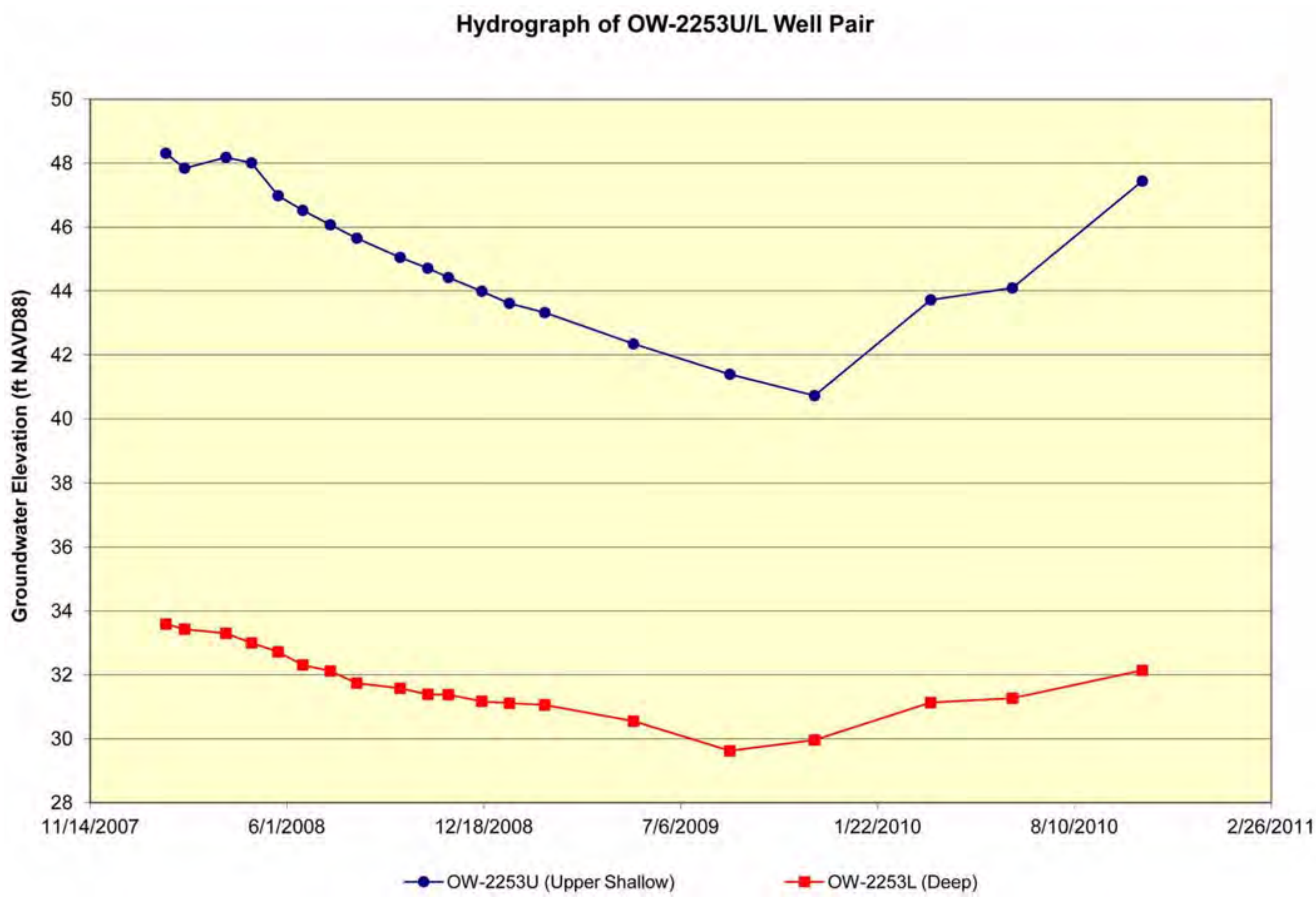


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2253U/L Well Pair (Sheet 15 of 28)

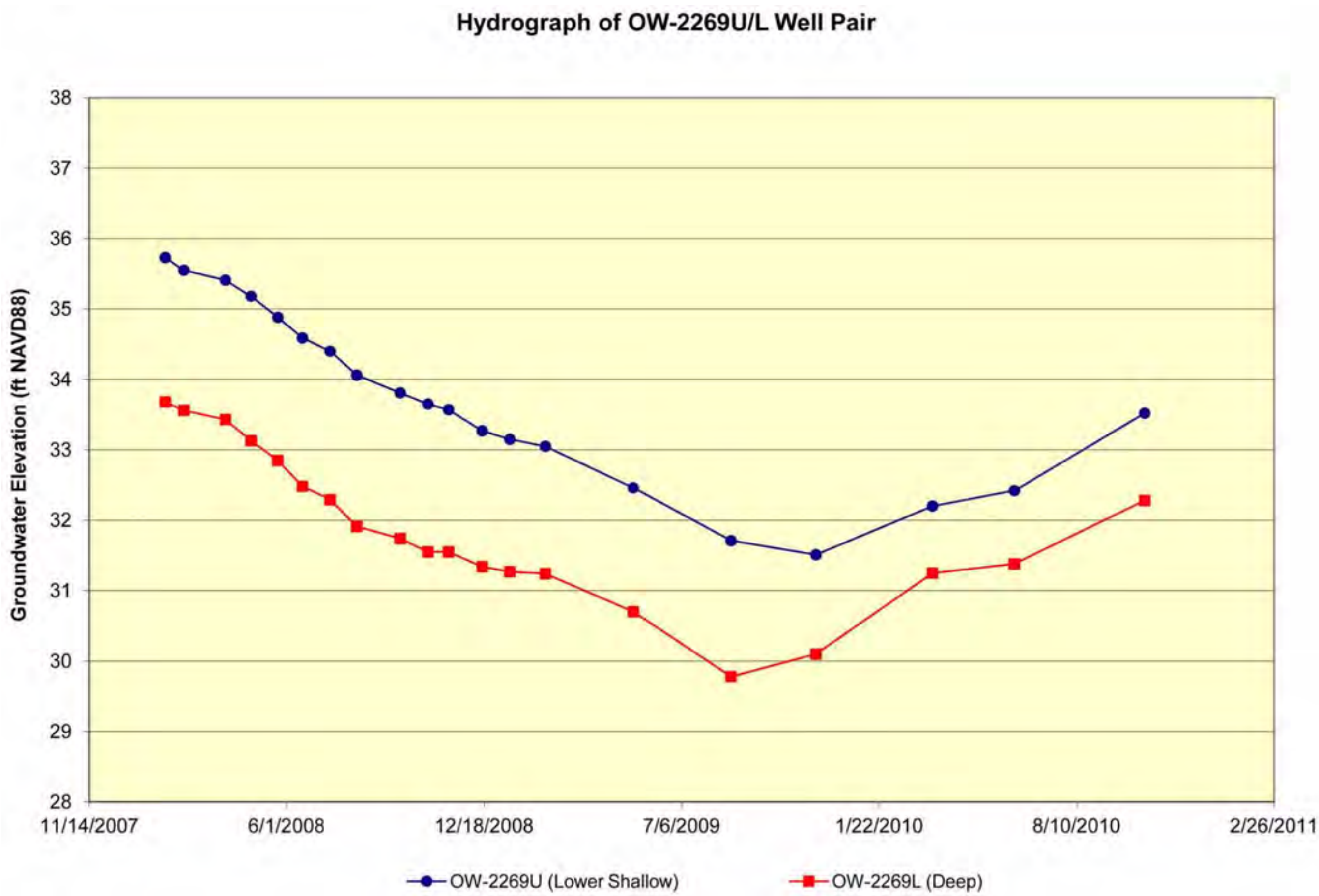


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2269U/L Well Pair (Sheet 16 of 28)

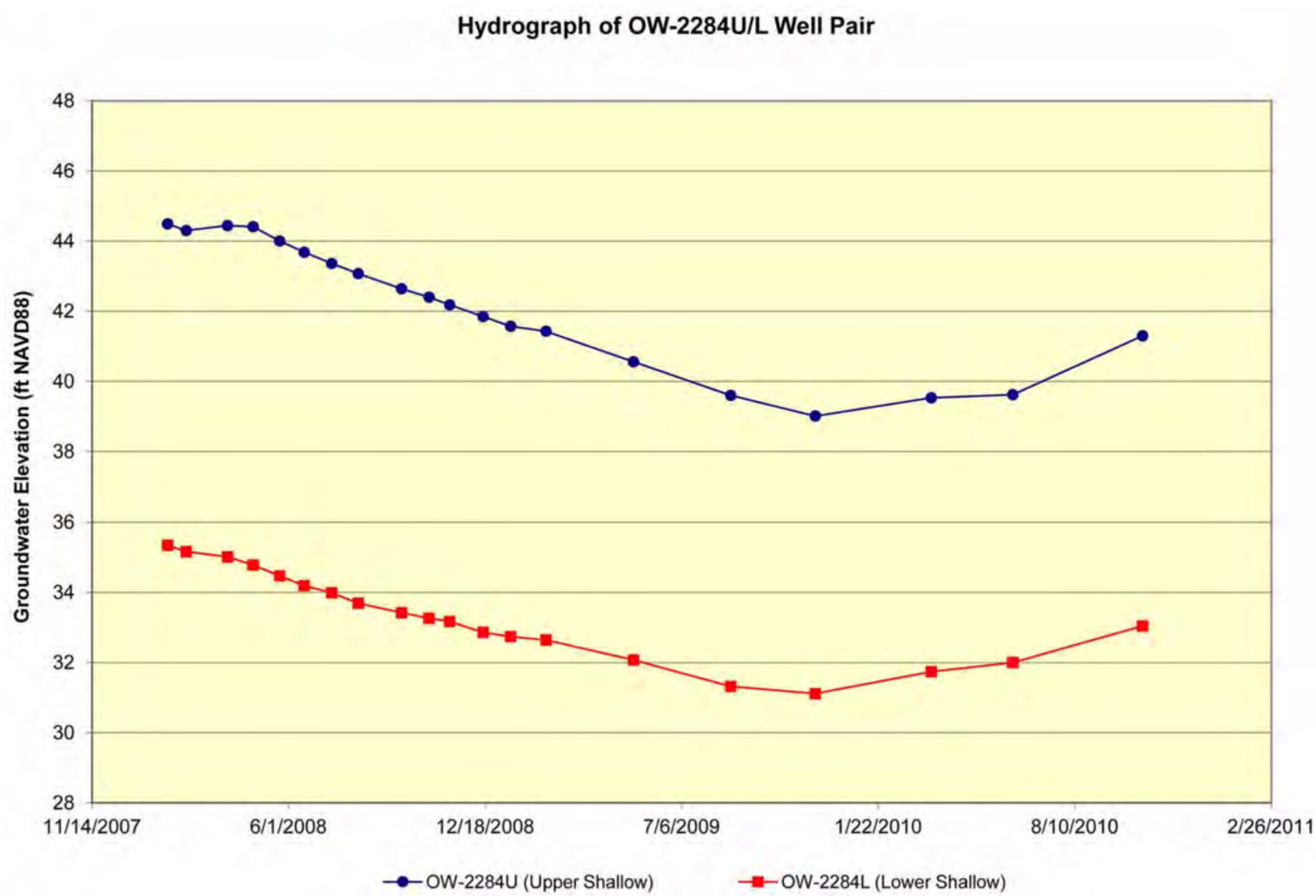


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2284U/L Well Pair (Sheet 17 of 28)

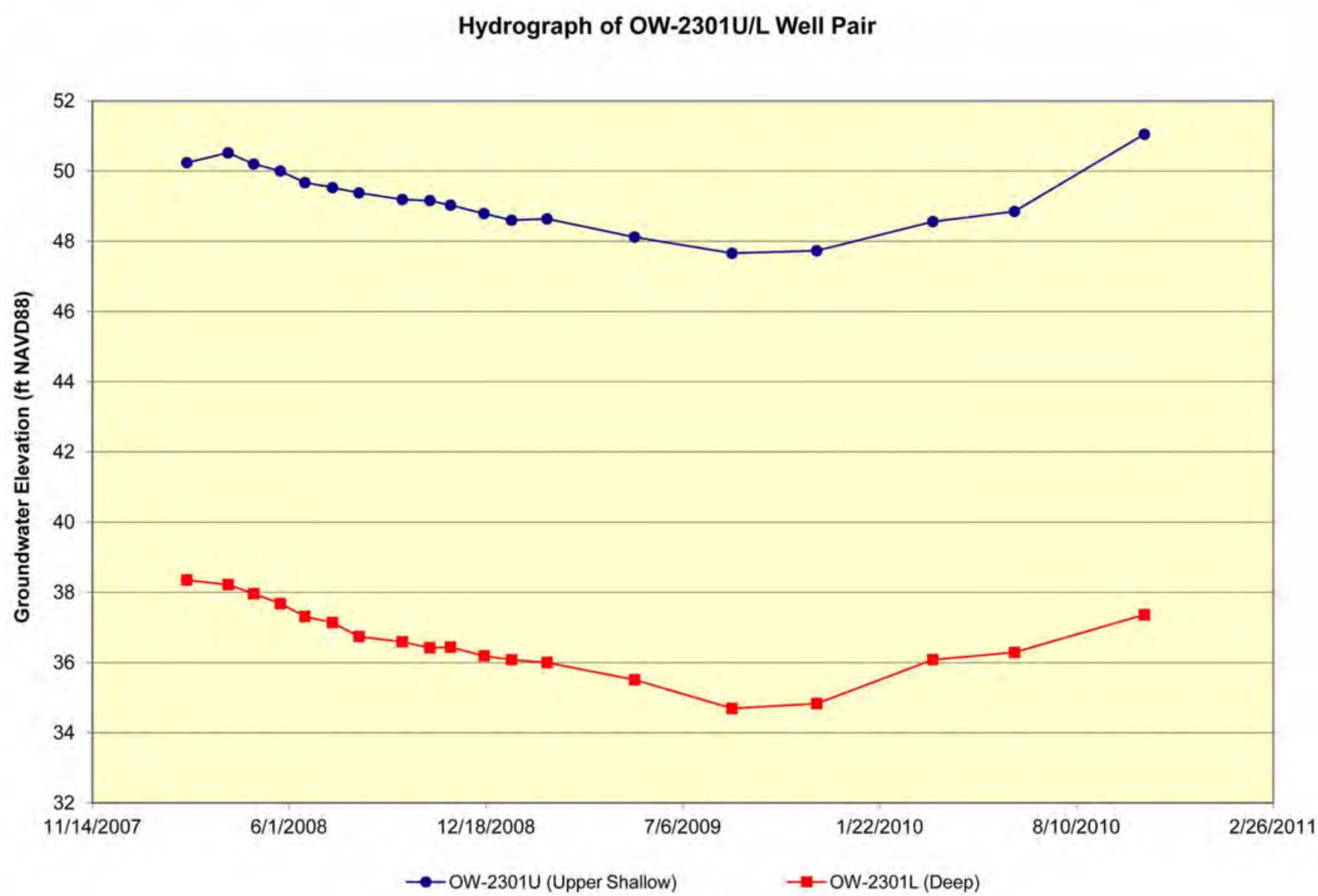


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2301U/L Well Pair (Sheet 18 of 28)

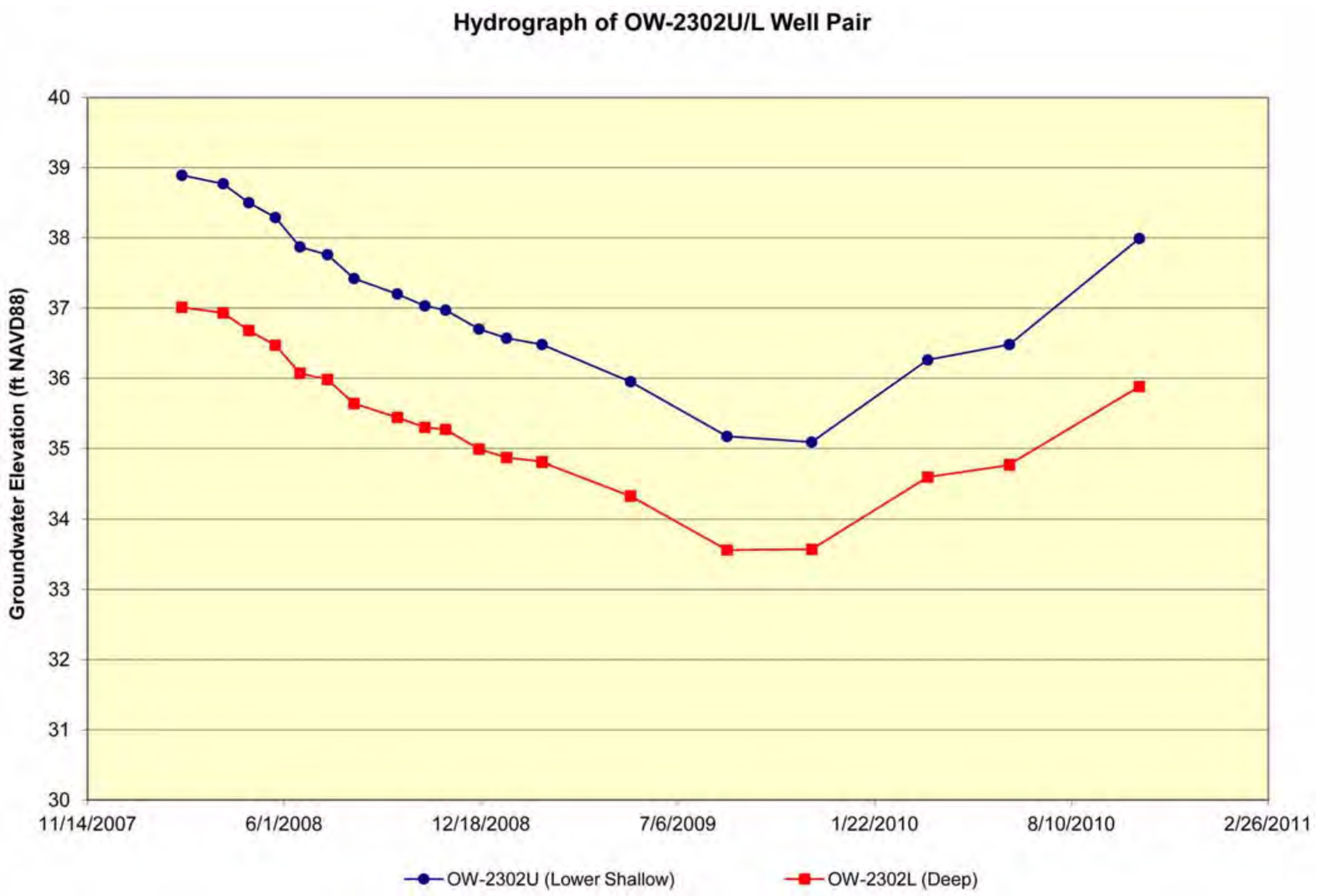


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2302U/L Well Pair (Sheet 19 of 28)

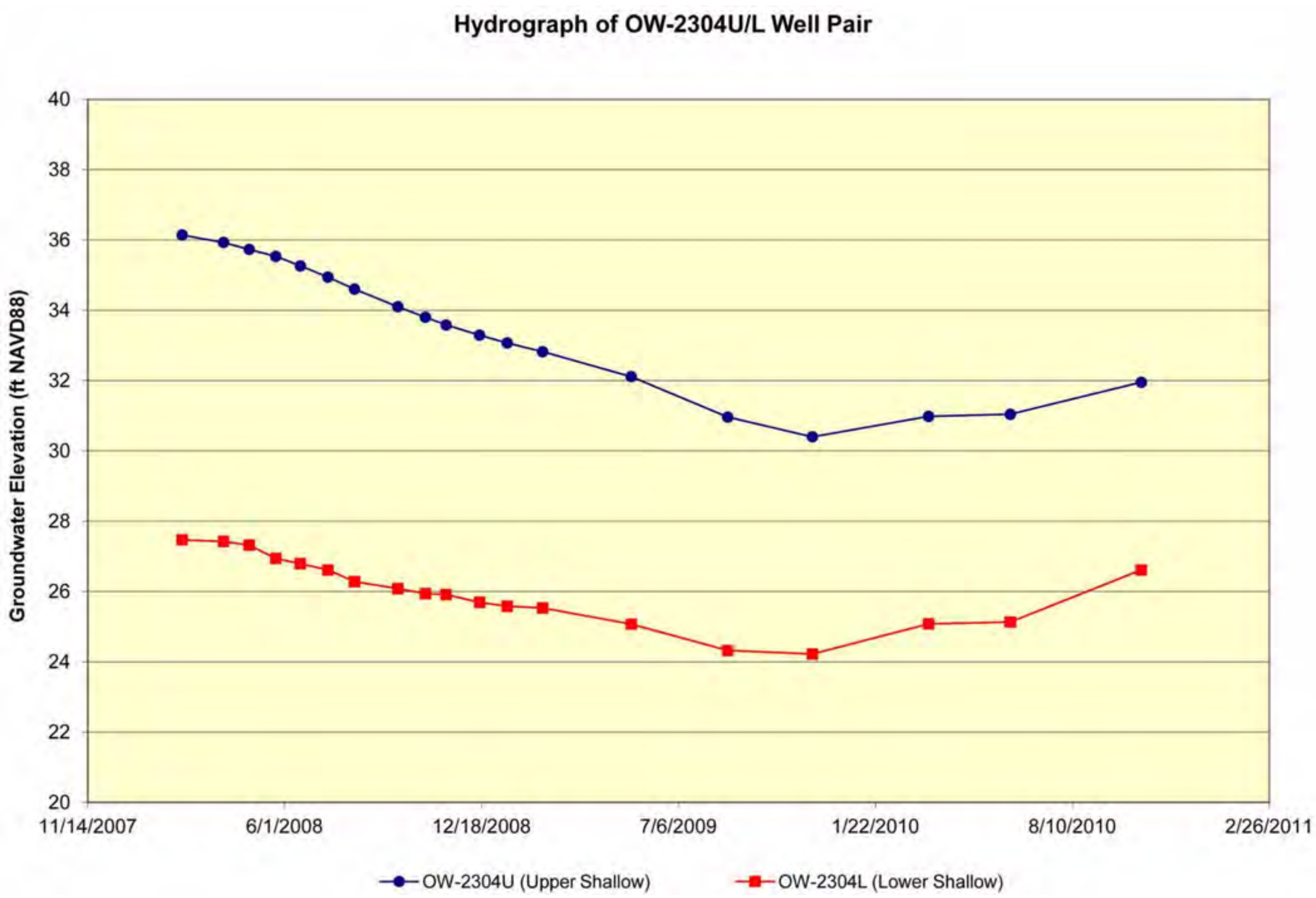


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2304U/L Well Pair (Sheet 20 of 28)

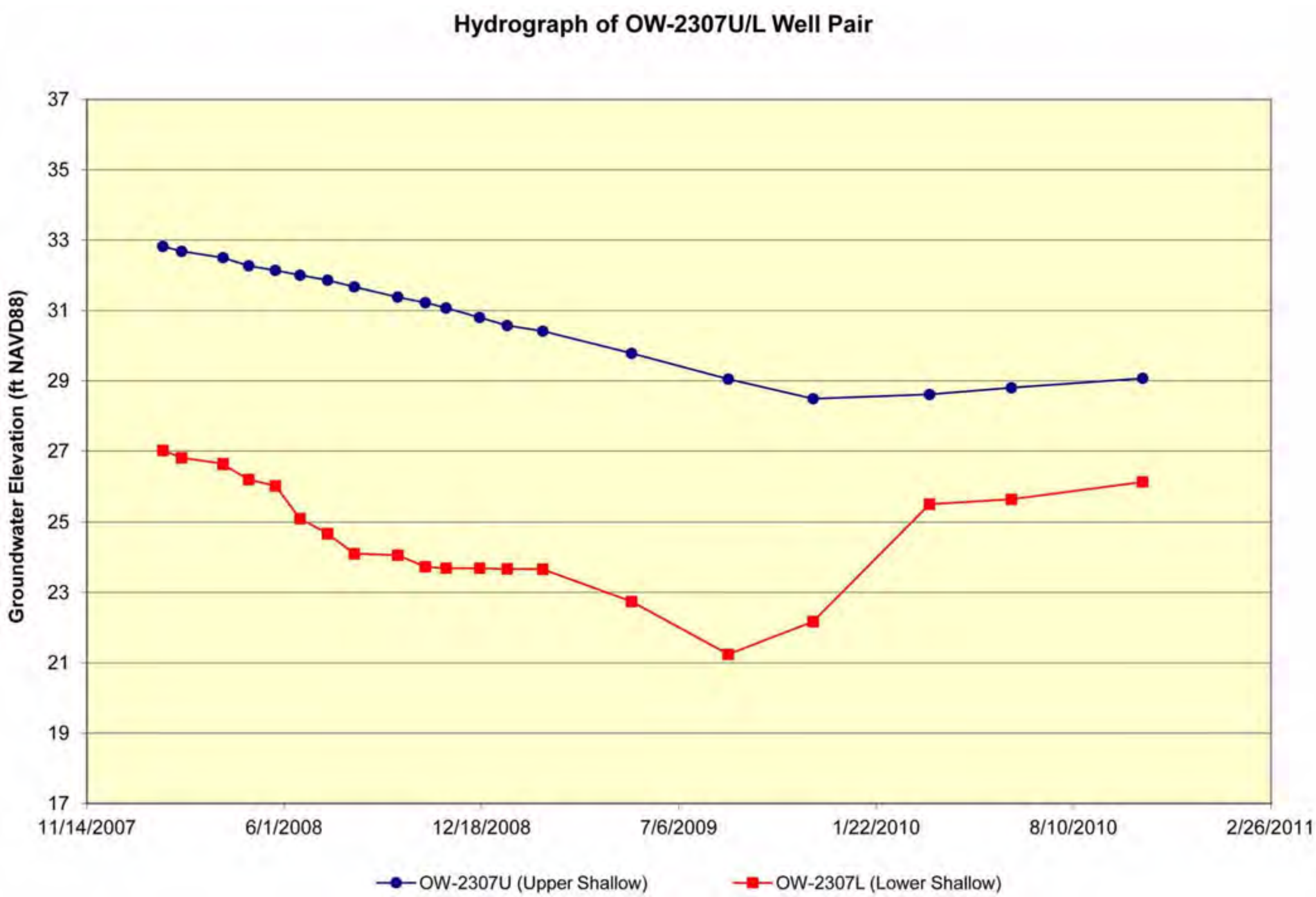


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2307U/L Well Pair (Sheet 21 of 28)

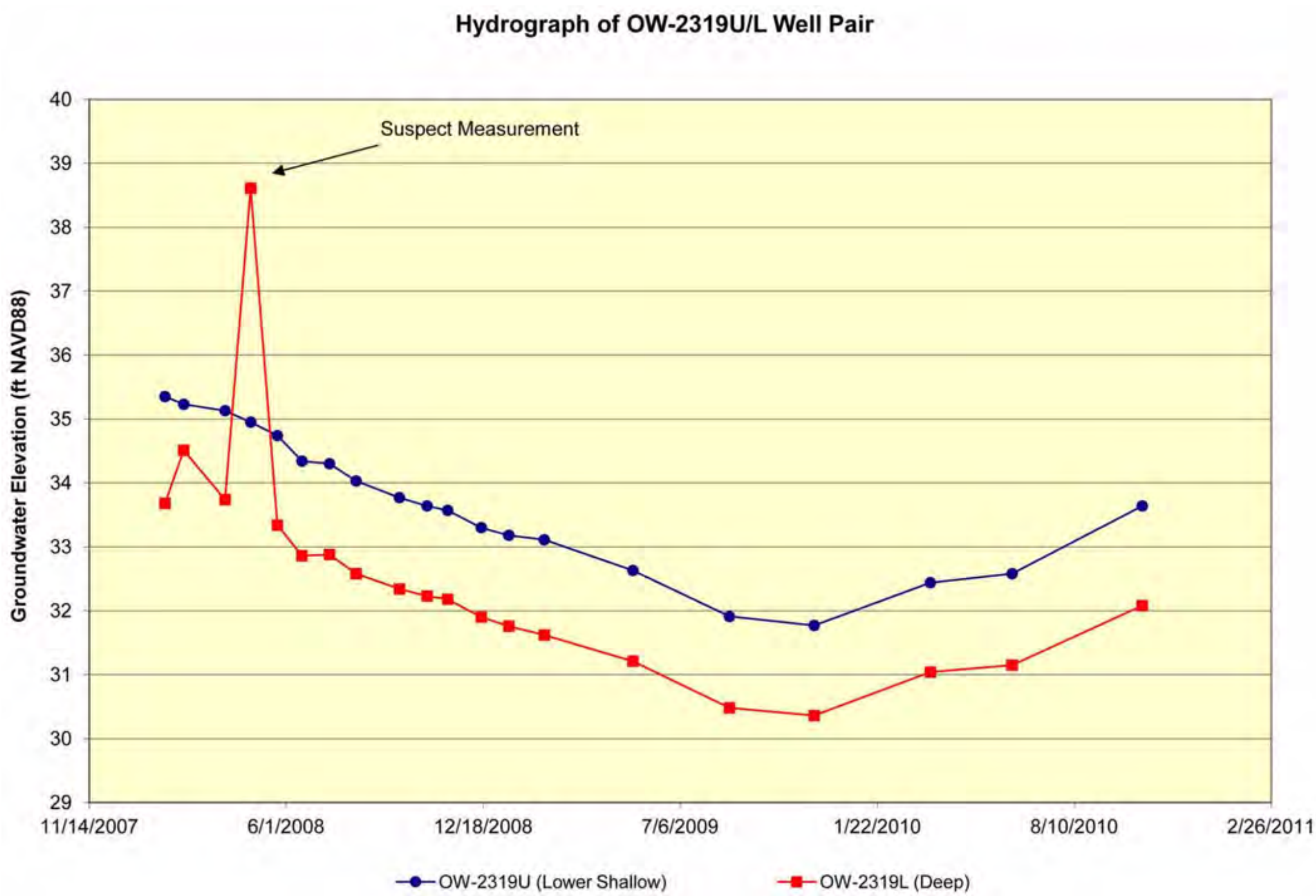


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2319U/L Well Pair (Sheet 22 of 28)

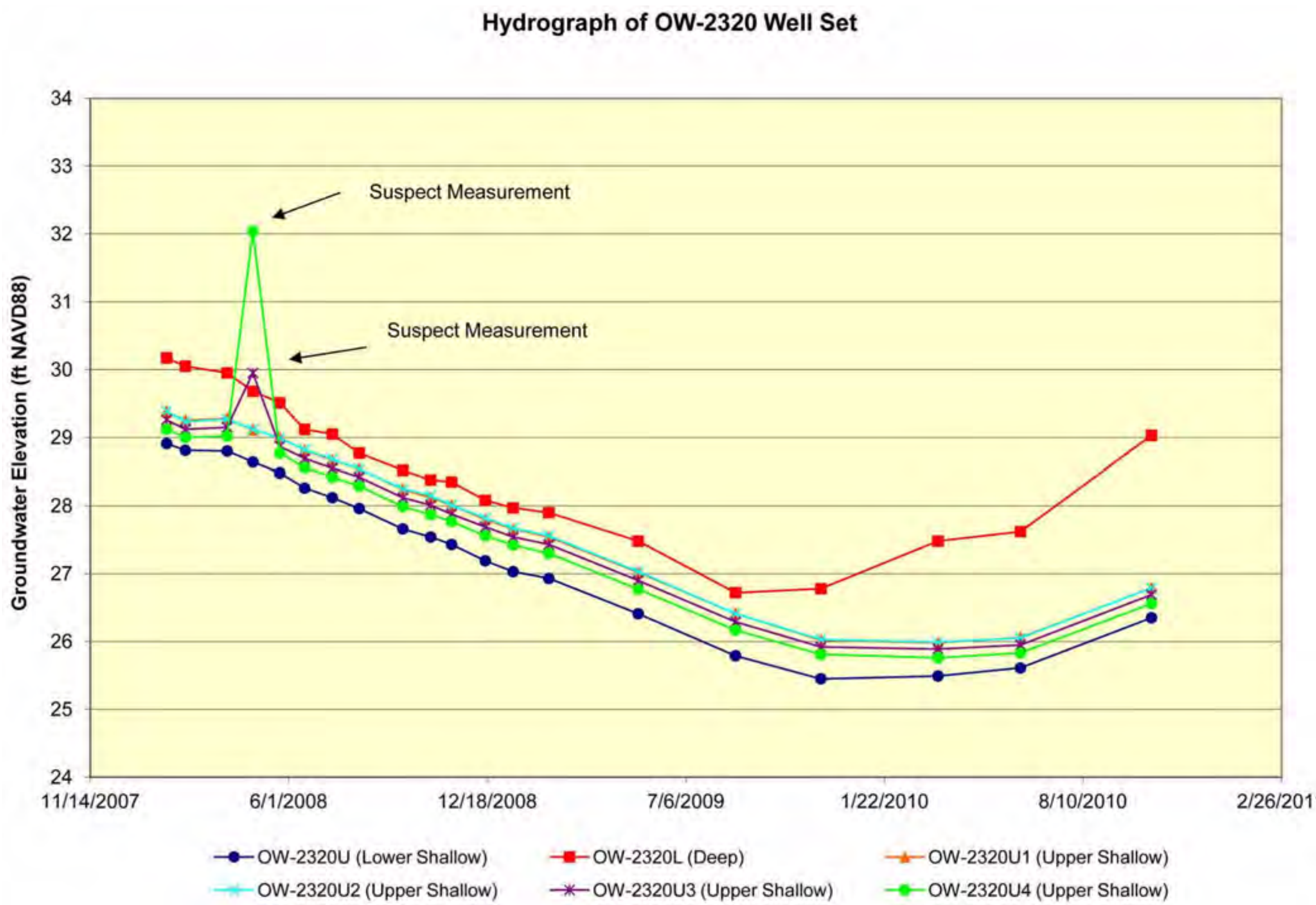


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2320U/L Well Pair (Sheet 23 of 28)

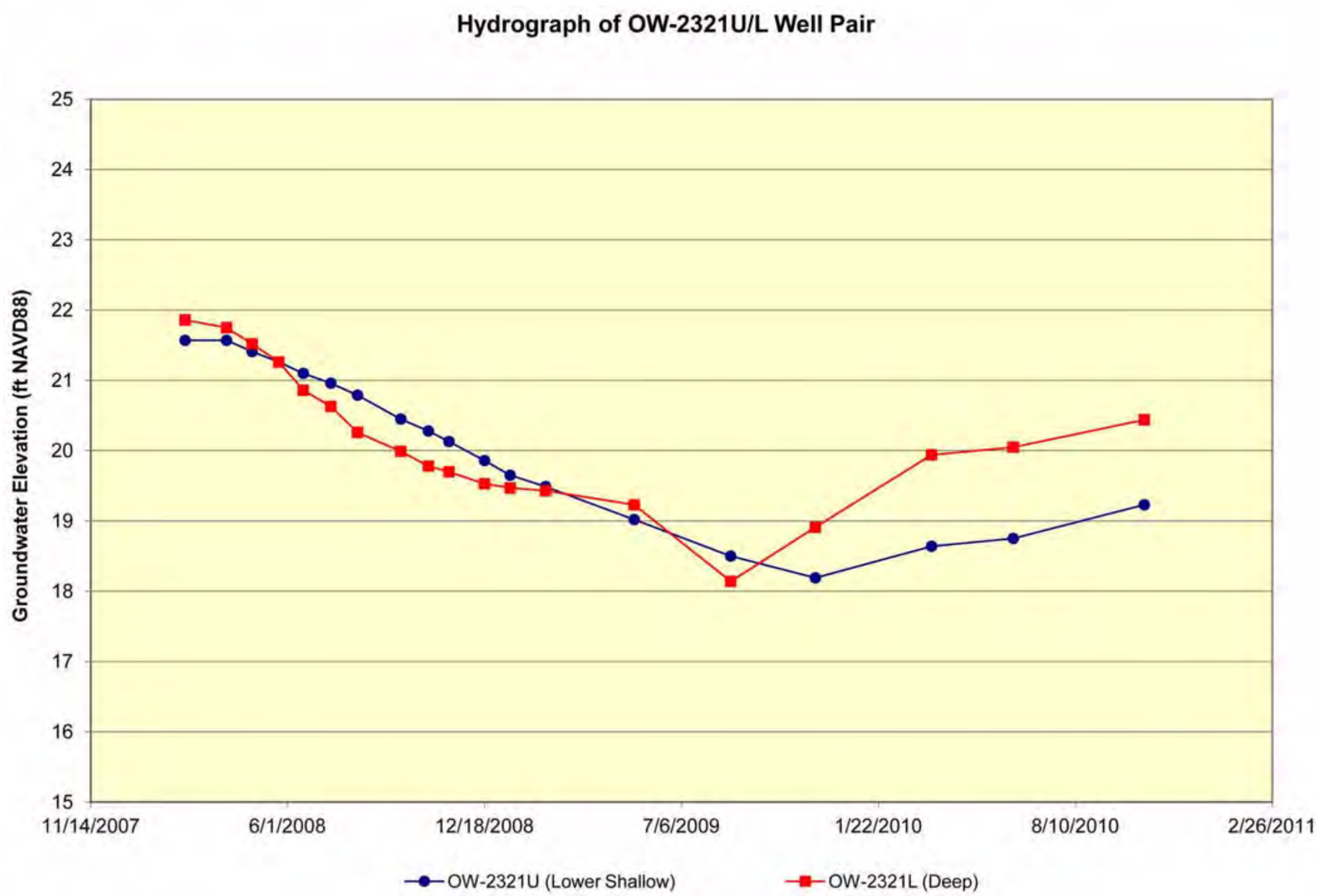


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2321U/L Well Pair (Sheet 24 of 28)

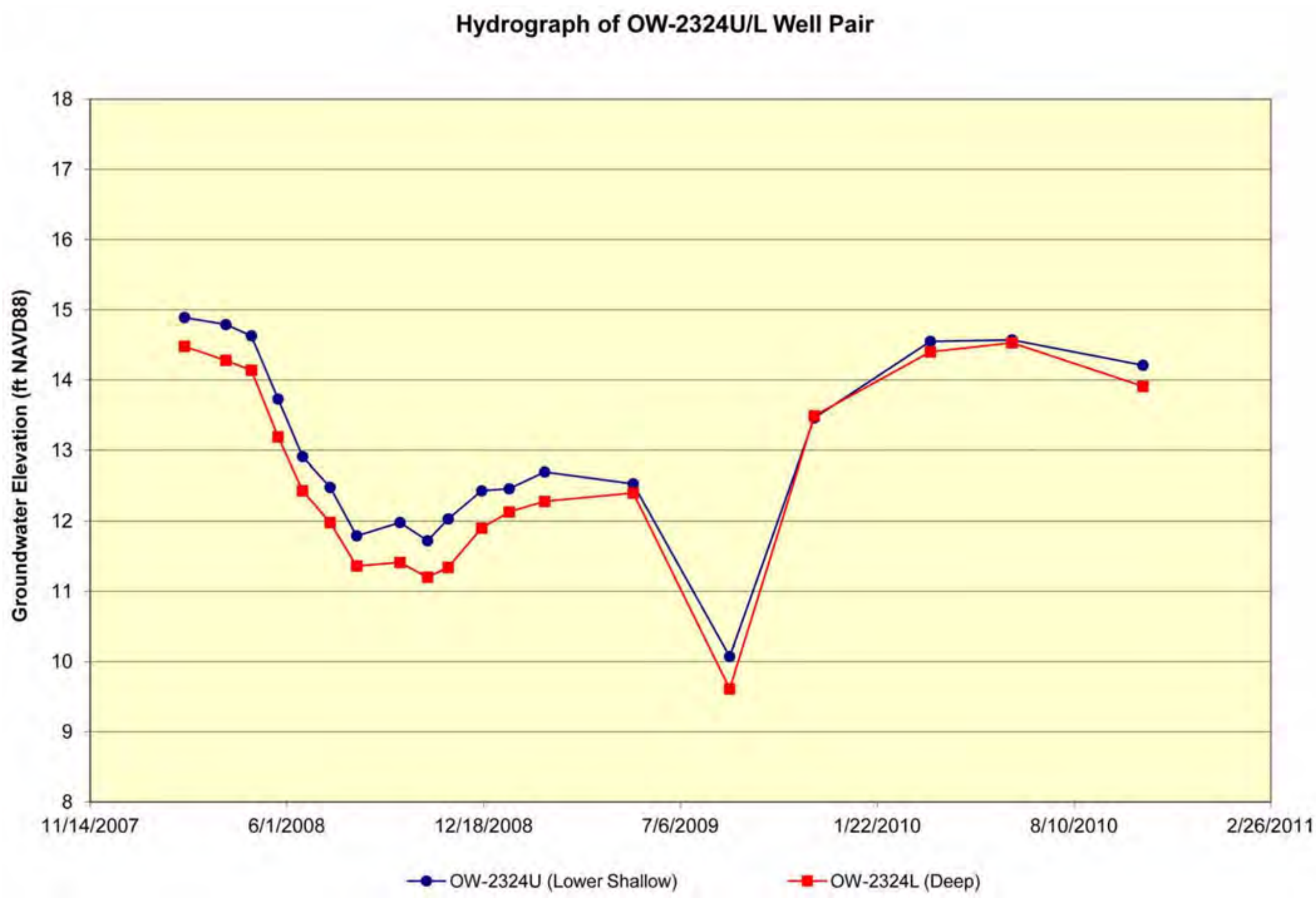


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2324U/L Well Pair (Sheet 25 of 28)

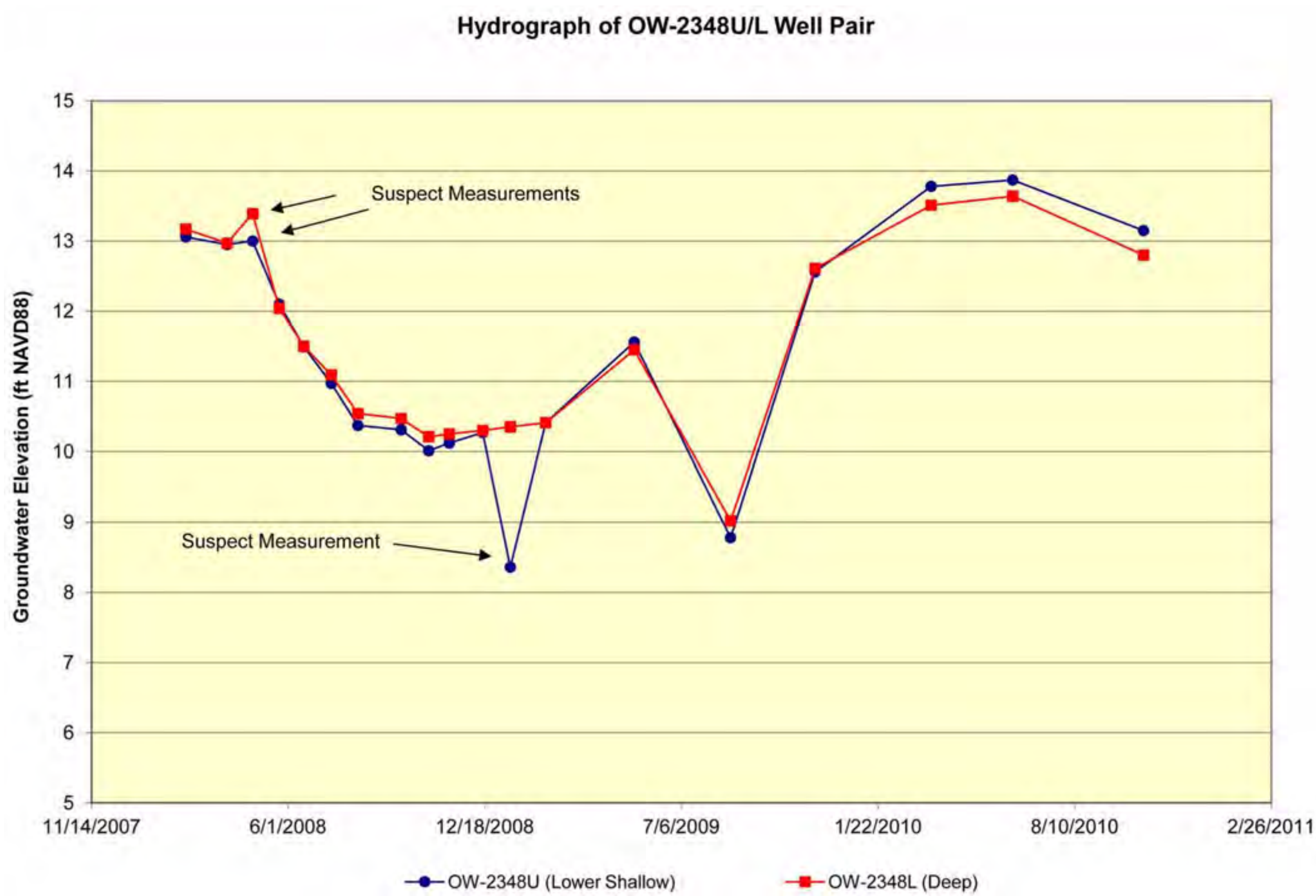


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2348U/L Well Pair (Sheet 26 of 28)

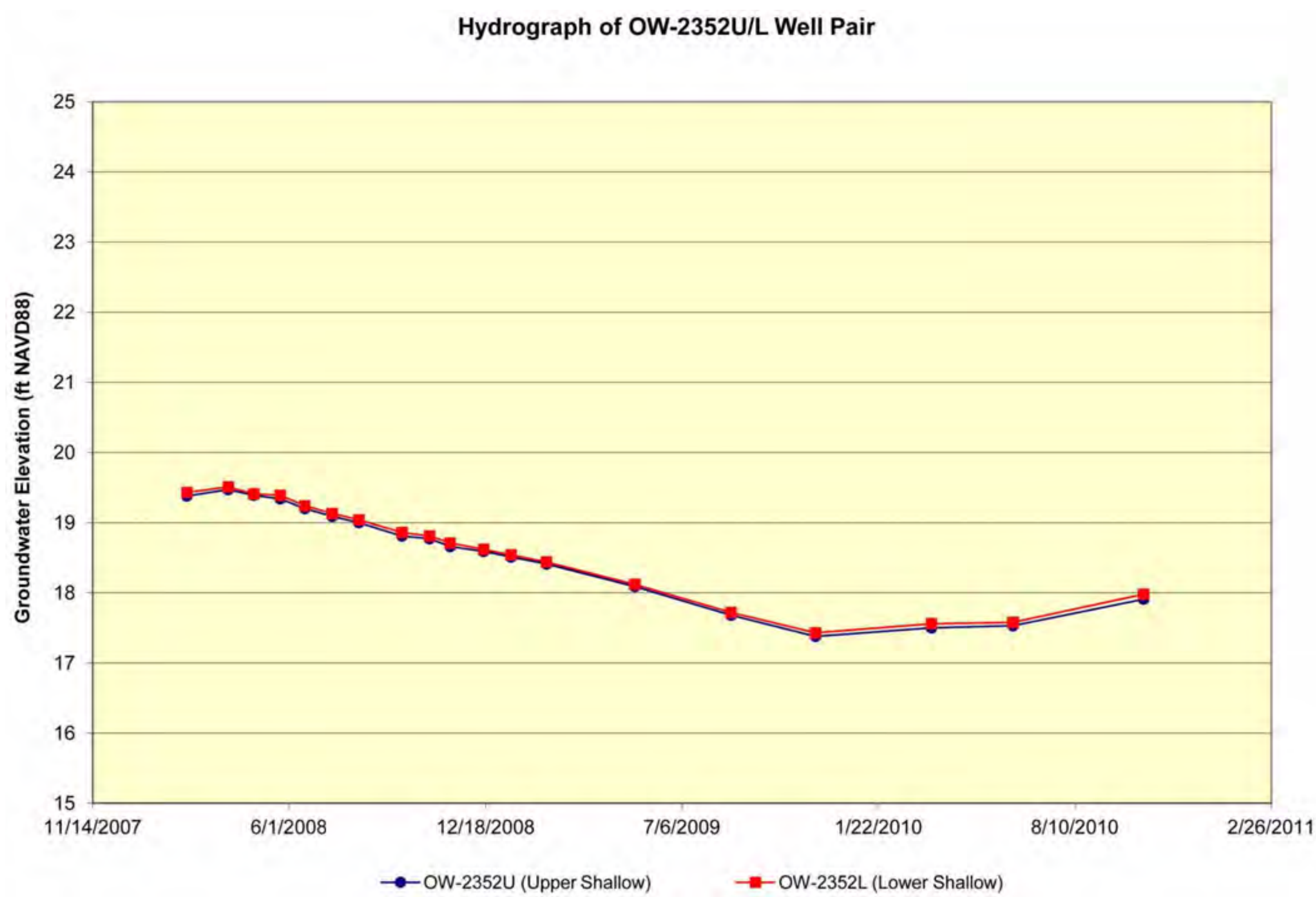


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2352U/L Well Pair (Sheet 27 of 28)

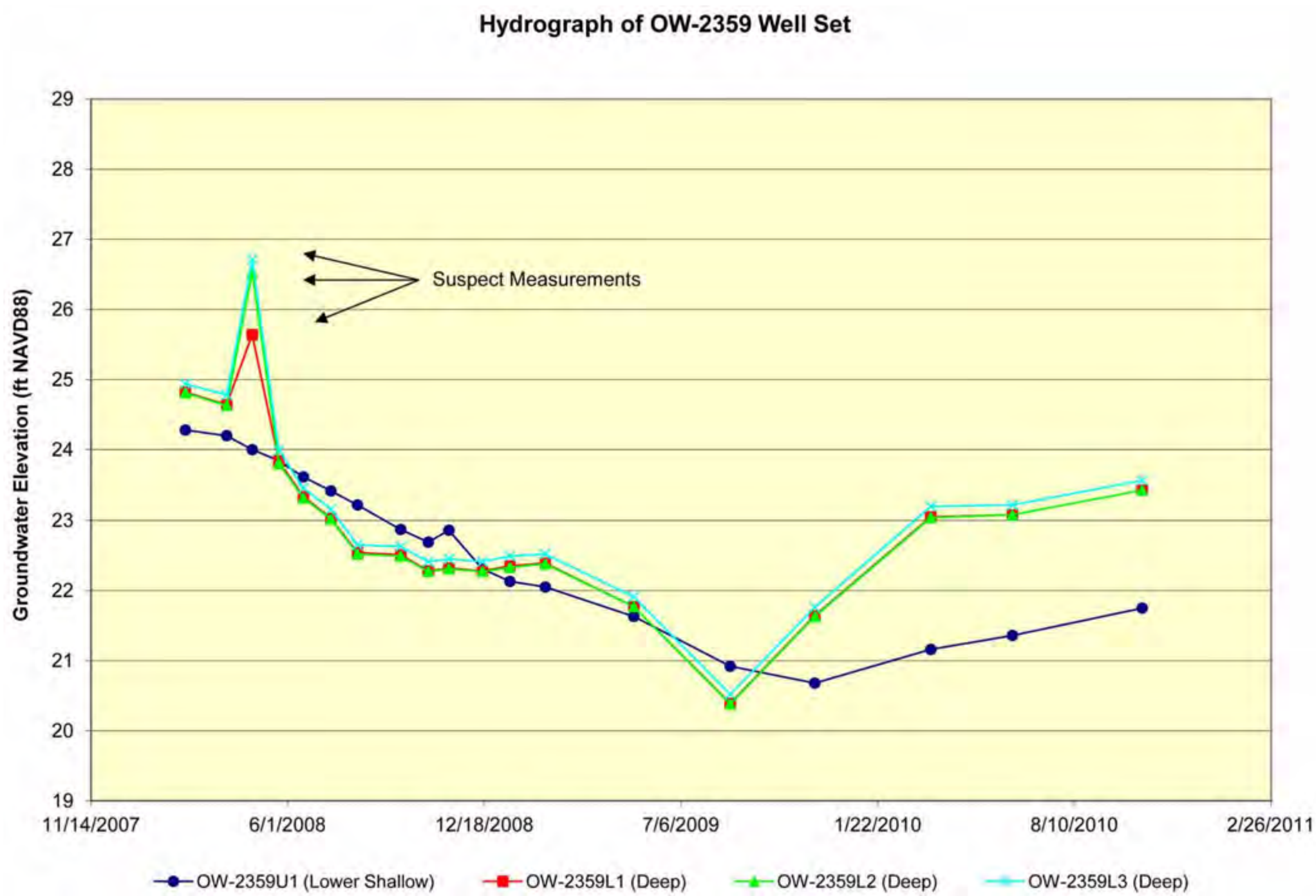


Figure 2.3.1.2-15 VCS Site Hydrographs; OW-2359U/L Well Pair (Sheet 28 of 28)

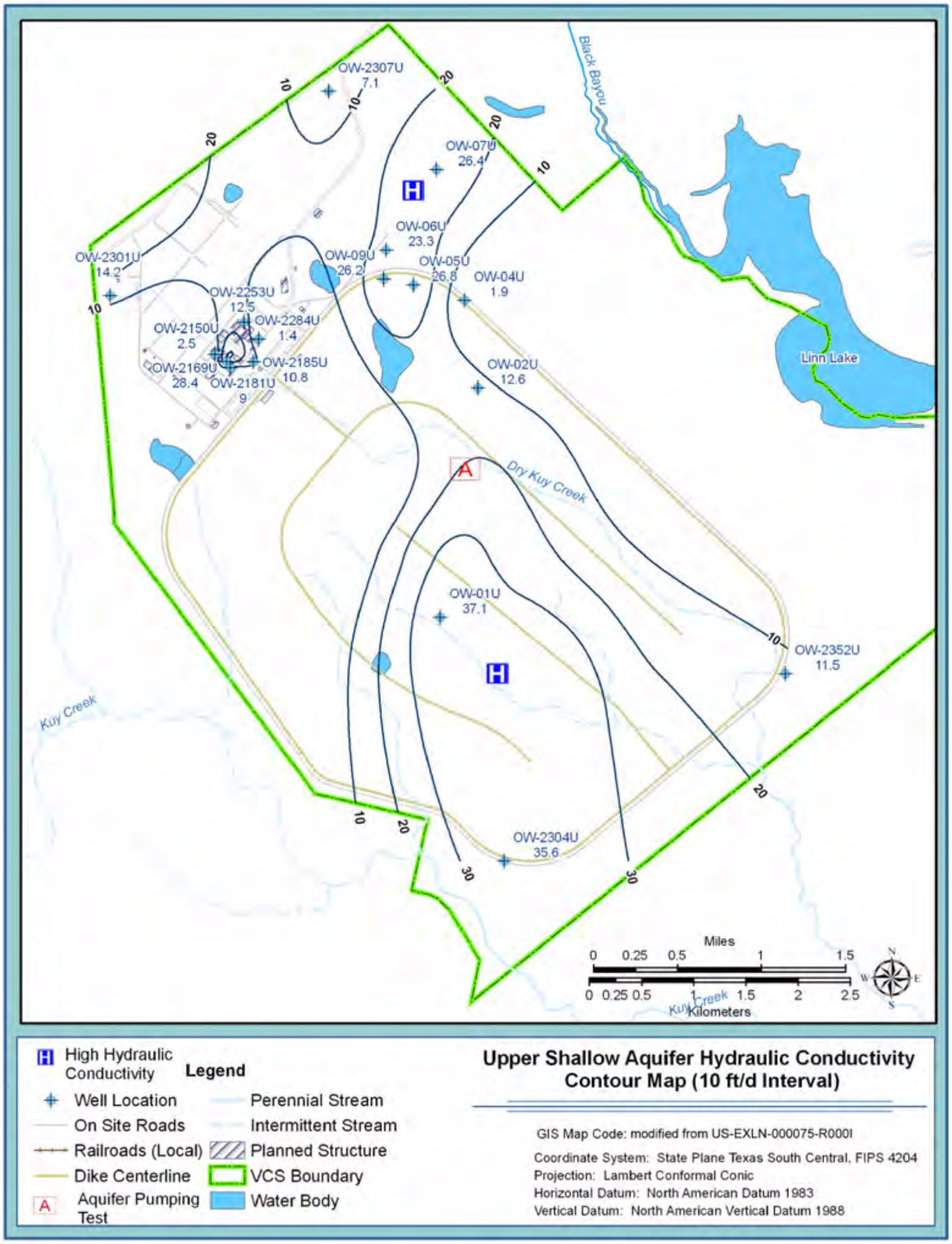


Figure 2.3.1.2-16 Contour Maps of Hydraulic Conductivity from Slug Tests (Sheet 1 of 3)

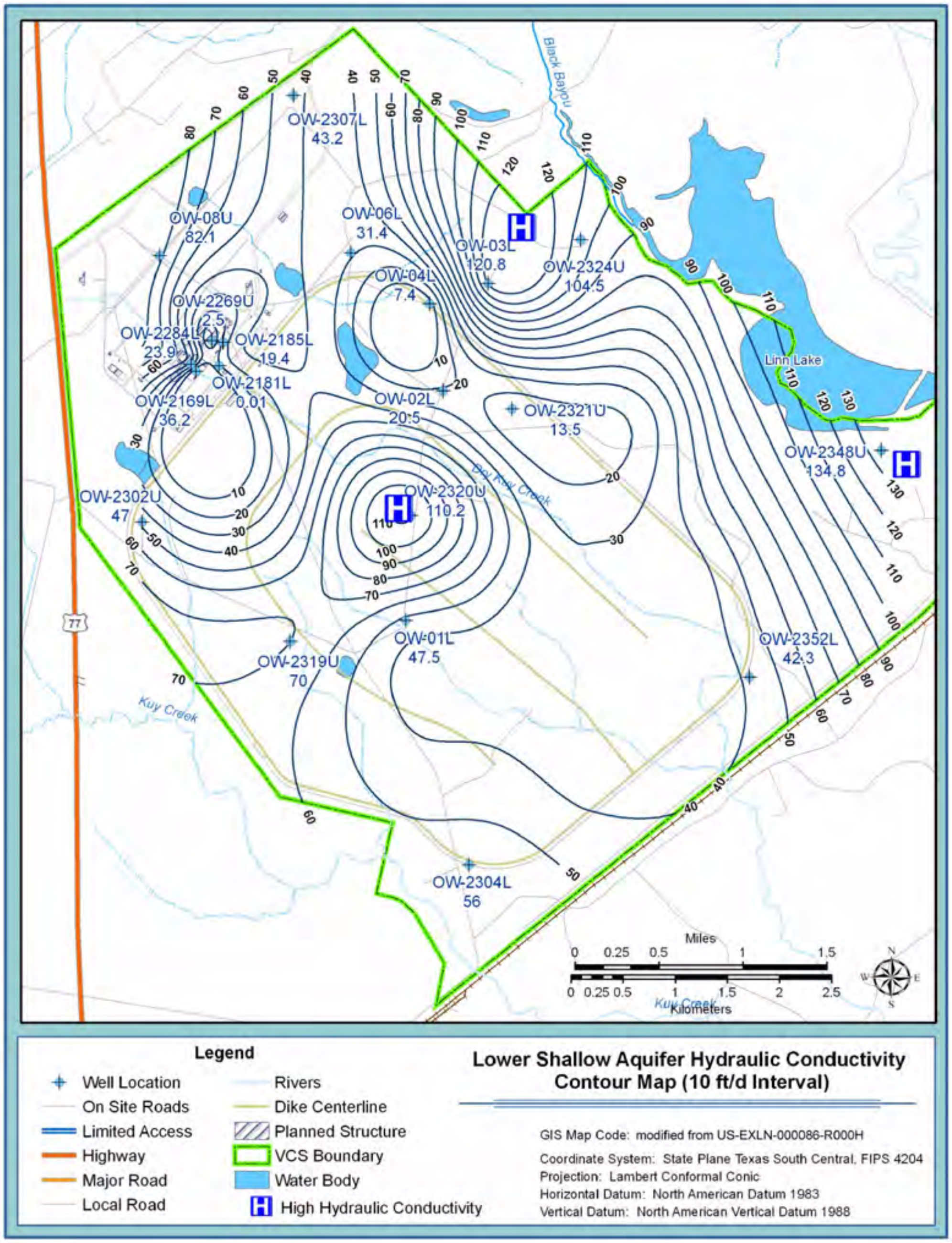


Figure 2.3.1.2-16 Contour Maps of Hydraulic Conductivity from Slug Tests (Sheet 2 of 3)

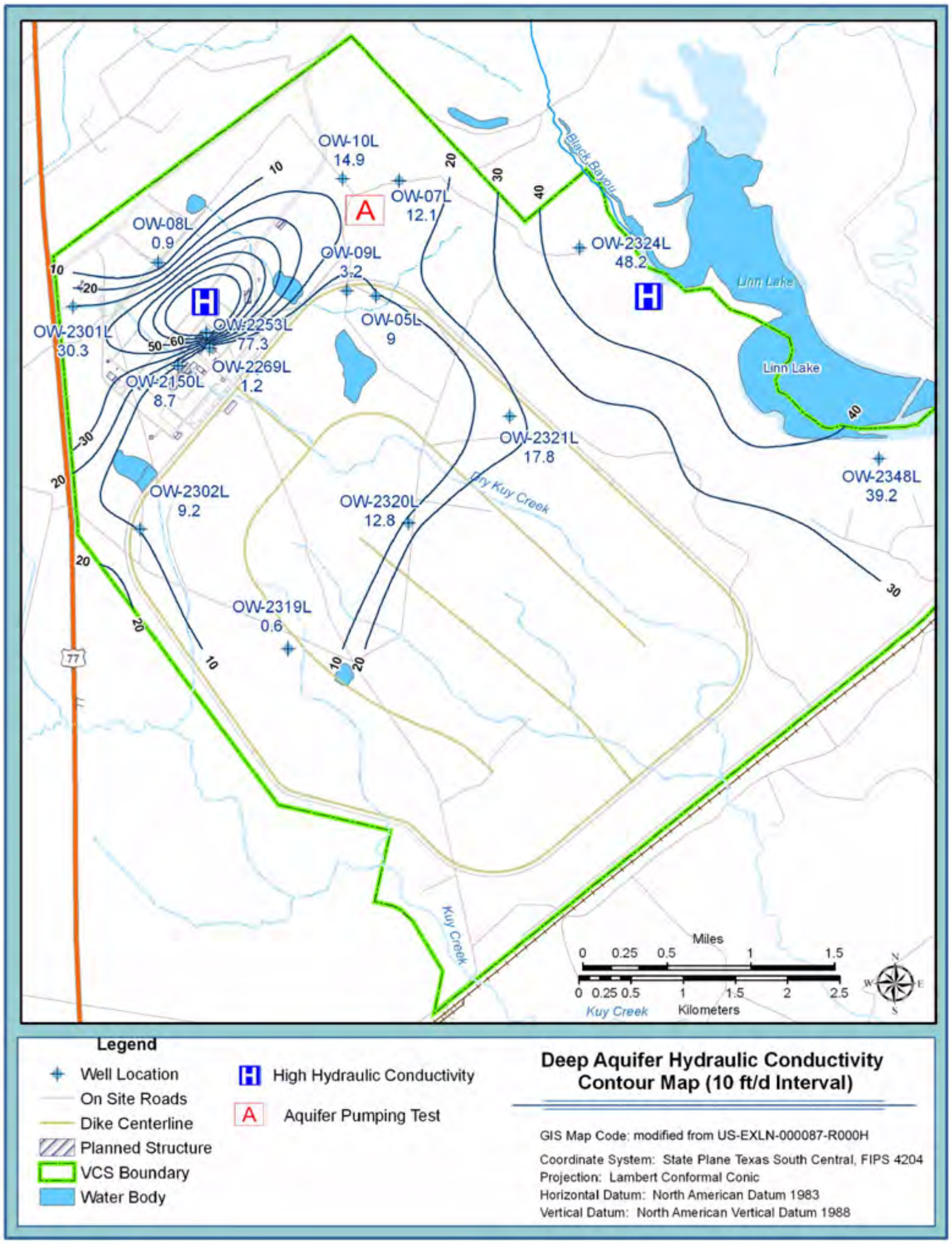
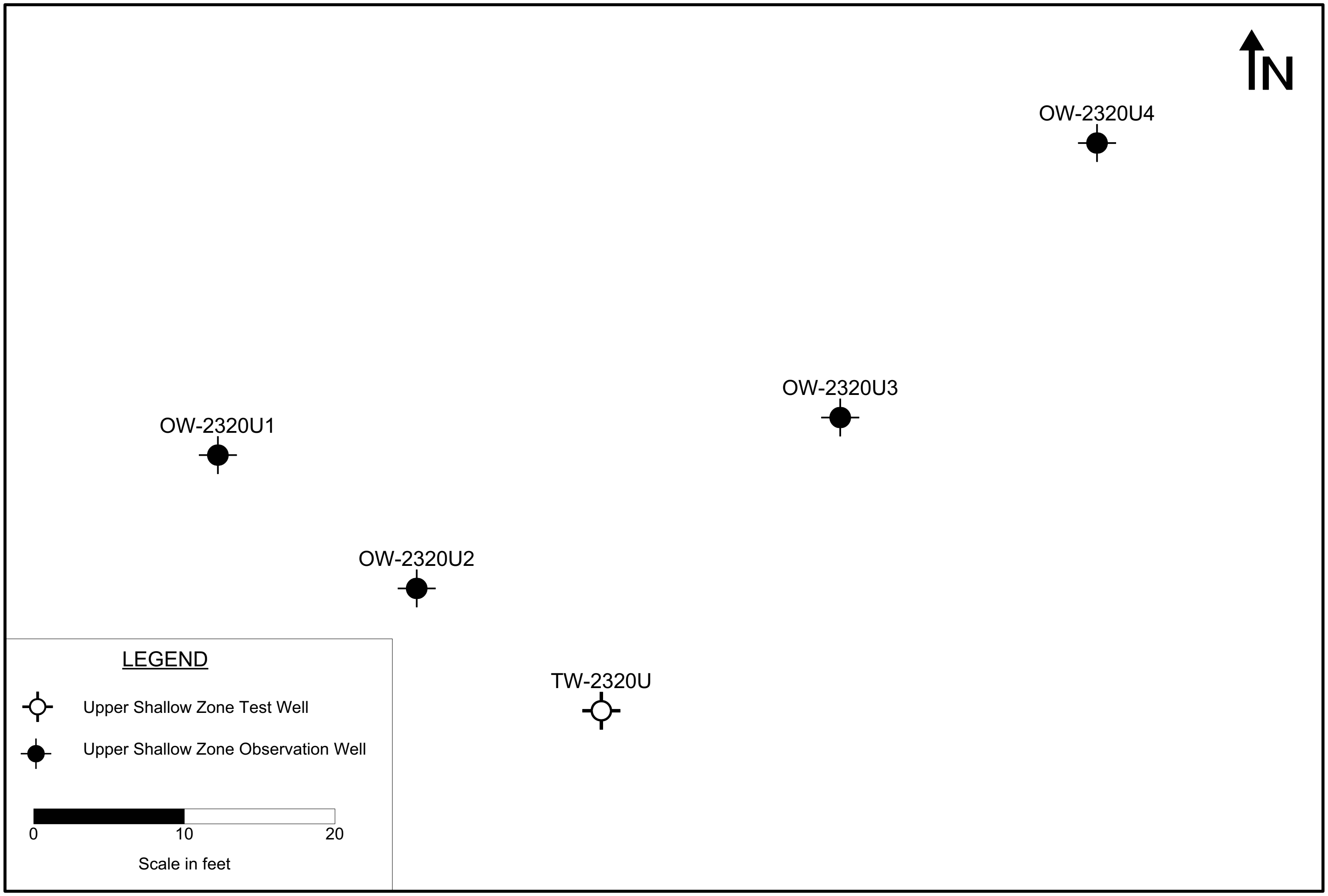
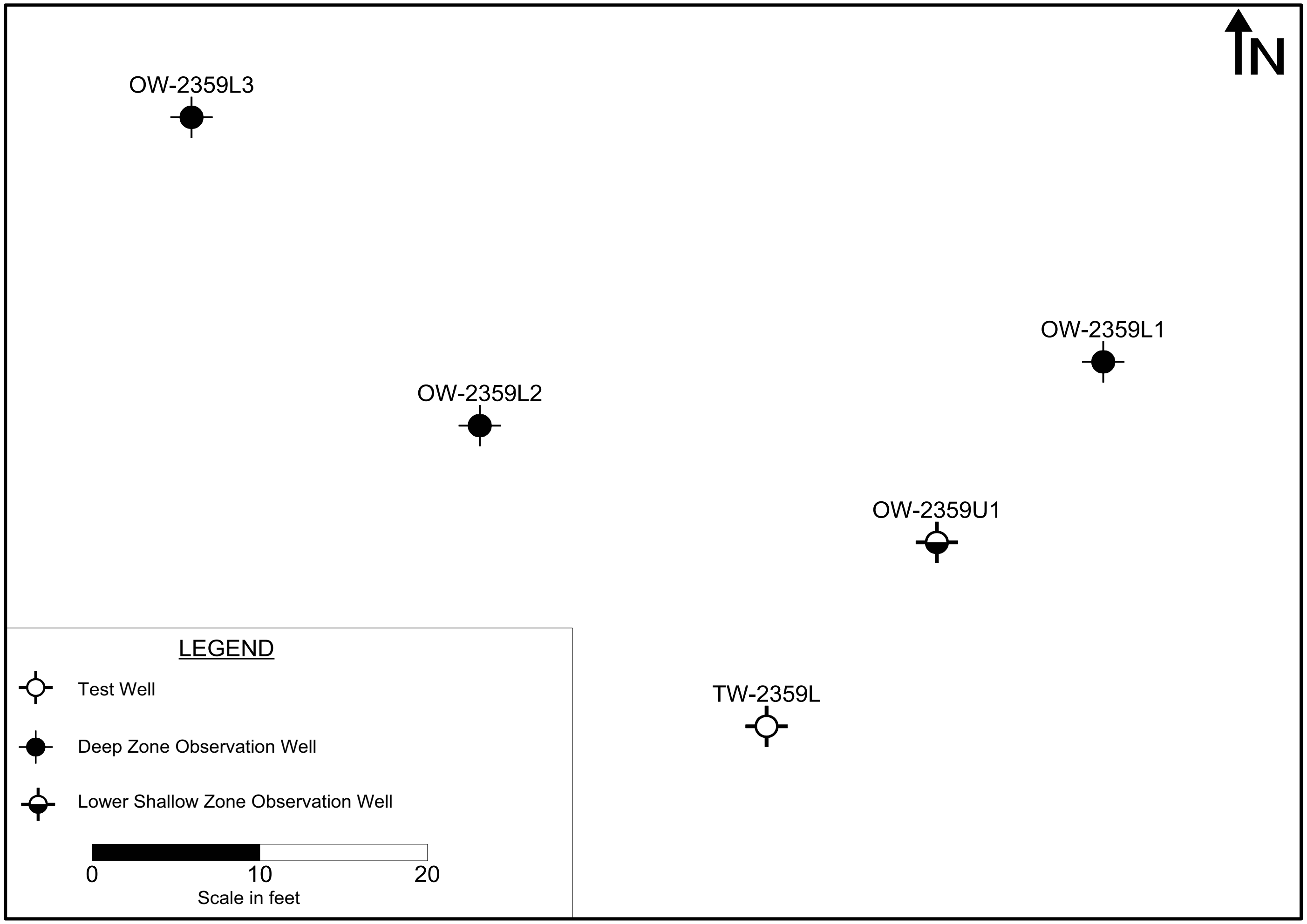


Figure 2.3.1.2-16 Contour Maps of Hydraulic Conductivity from Slug Tests (Sheet 3 of 3)



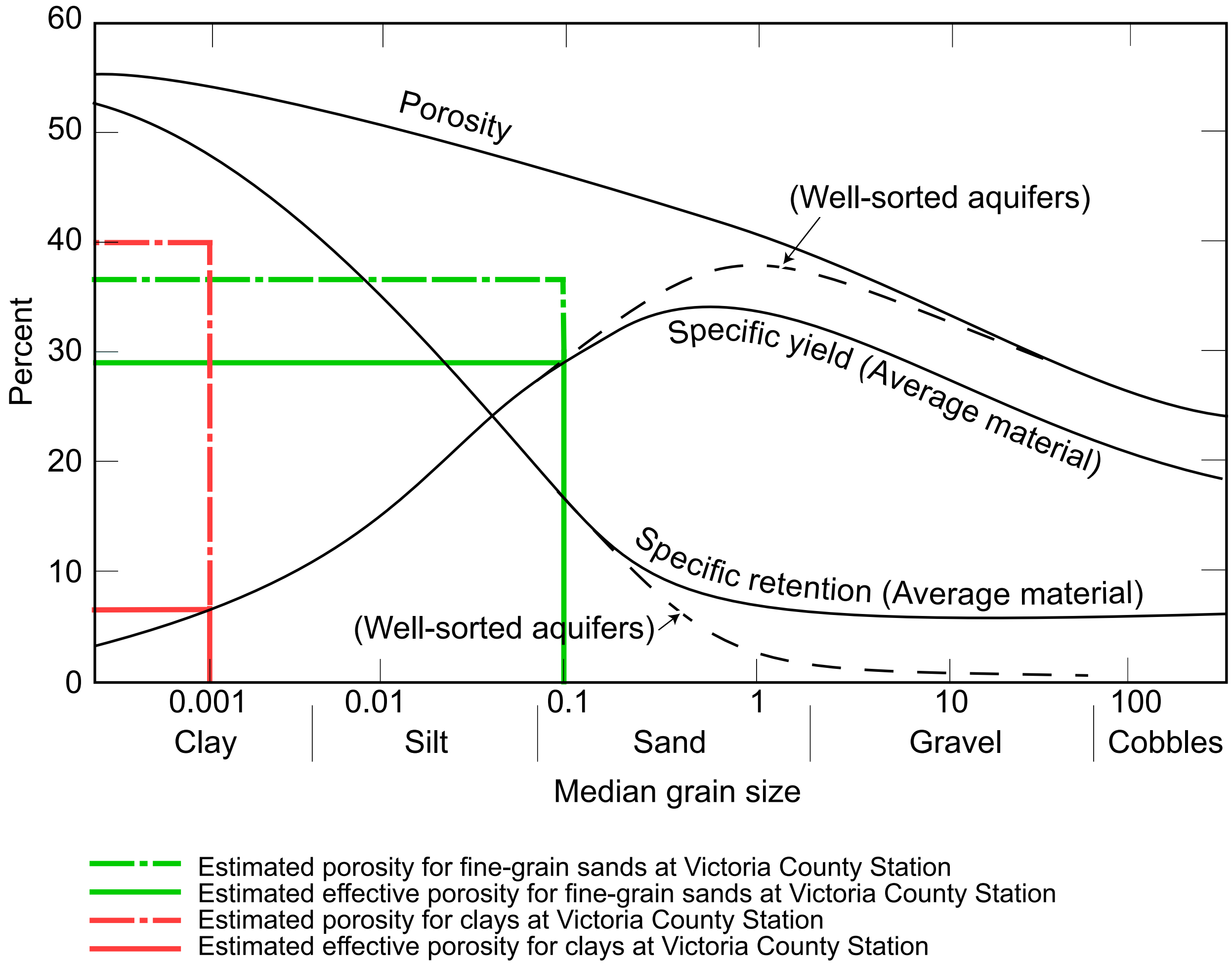
See Figure 2.3.1.2-10 for site location of wells.

Figure 2.3.1.2-17 Well Location Plan for the TW-2320U Aquifer Pumping Test



See Figure 2.3.1.2-10 for site location of wells

Figure 2.3.1.2-18 Well Location Plan for the TW-2359L Aquifer Pumping Test



Source: Table 2.3.1.2-7
Modified from Davis and DeWiest 1966

Figure 2.3.1.2-19 Relationship of Porosity, Specific Yield, and Specific Retention

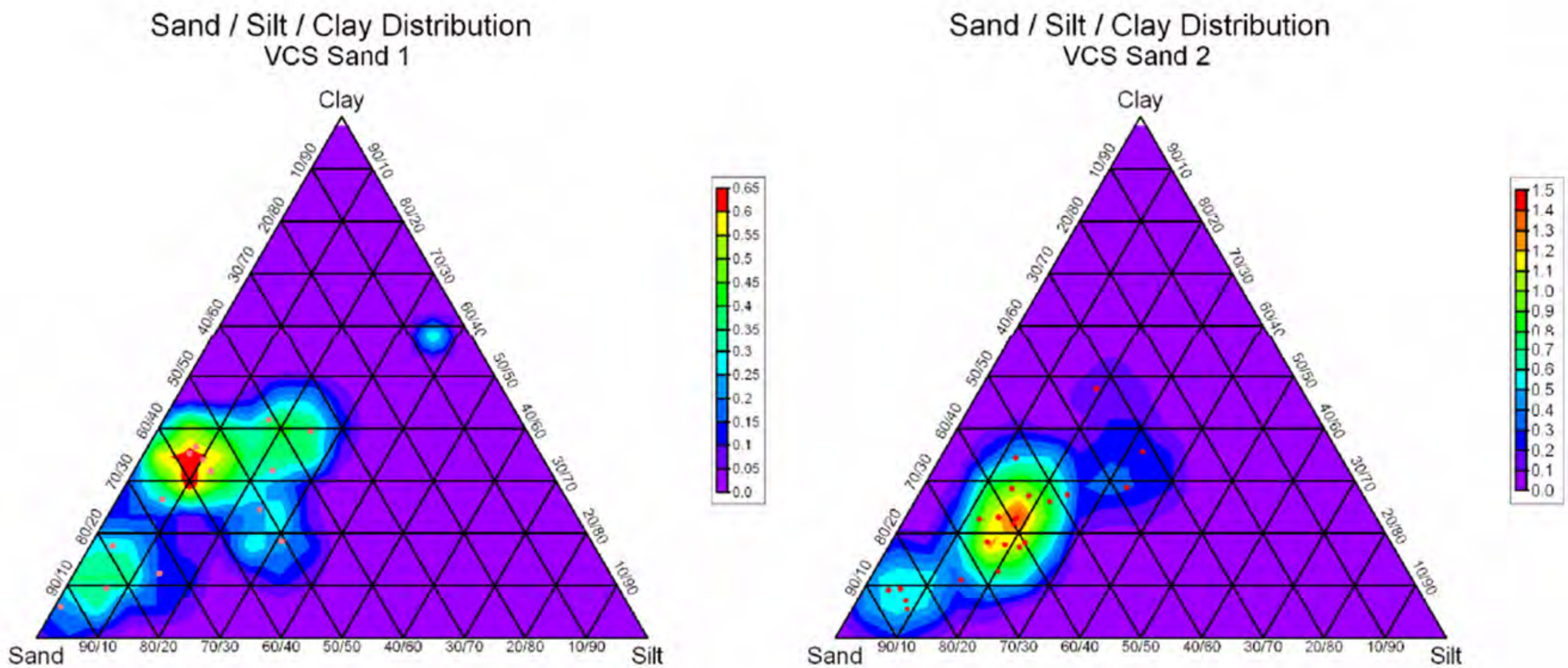


Figure 2.3.1.2-20 Grain Size Ternary Diagrams for VCS (Sheet 1 of 3)

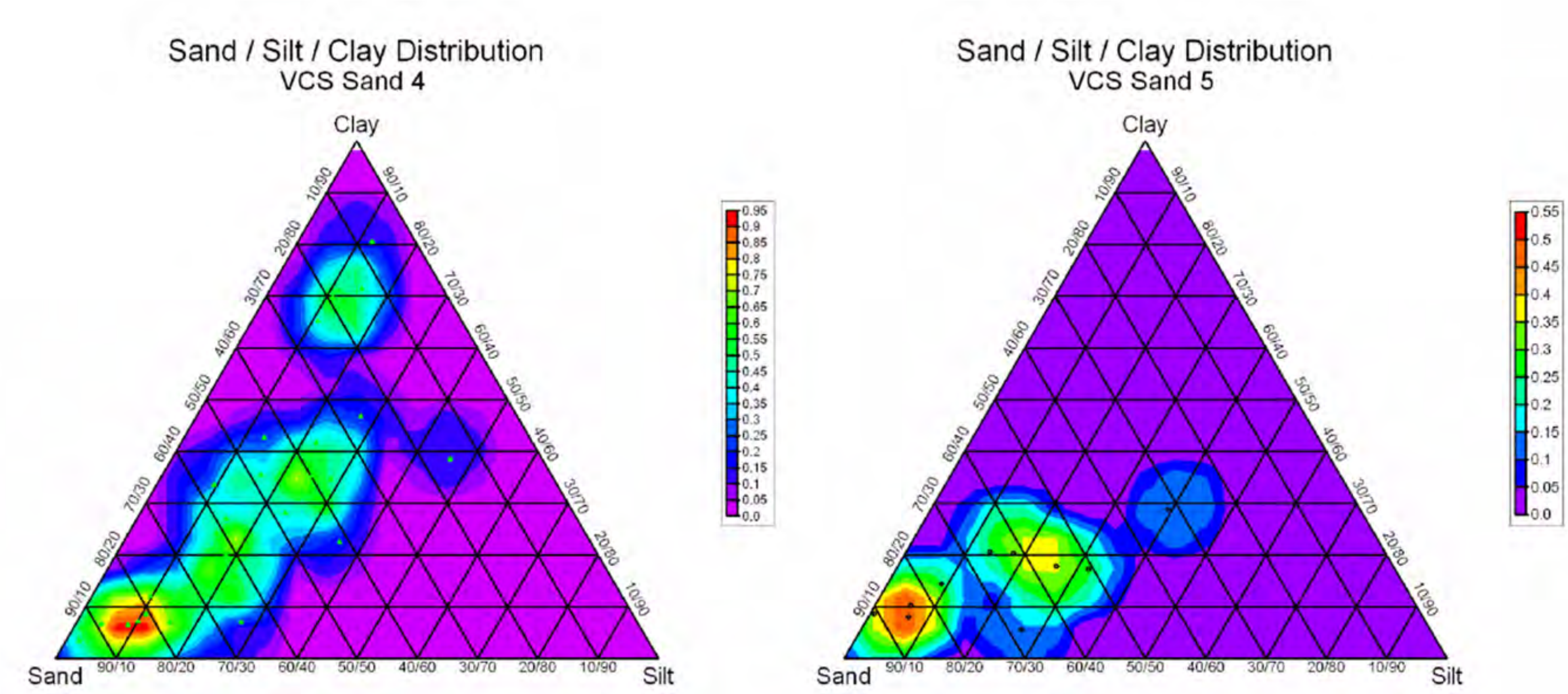


Figure 2.3.1.2-20 Grain Size Ternary Diagrams for VCS (Sheet 2 of 3)

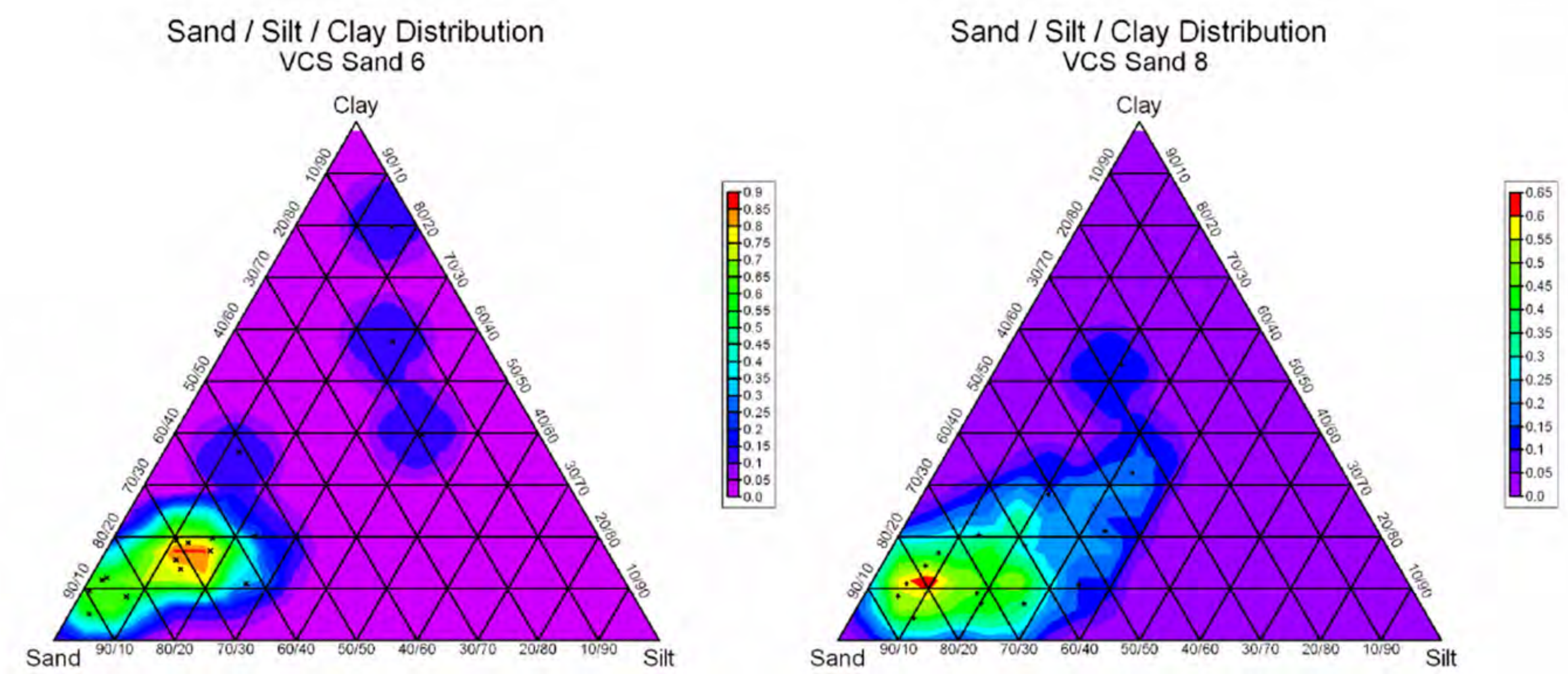


Figure 2.3.1.2-20 Grain Size Ternary Diagrams for VCS (Sheet 3 of 3)

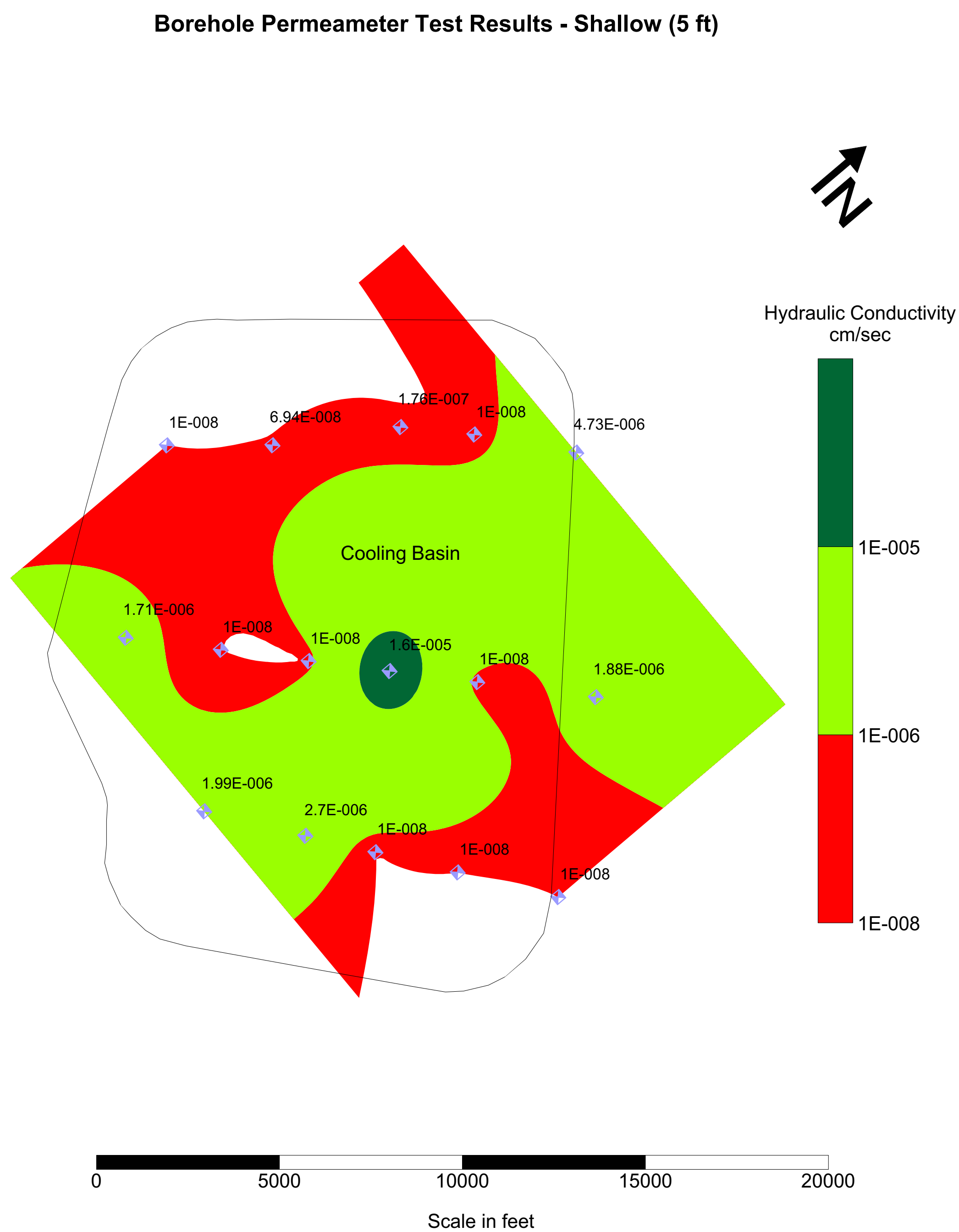


Figure 2.3.1.2-21 Borehole Permeameter Hydraulic Conductivity Contour Map (Sheet 1 of 2)

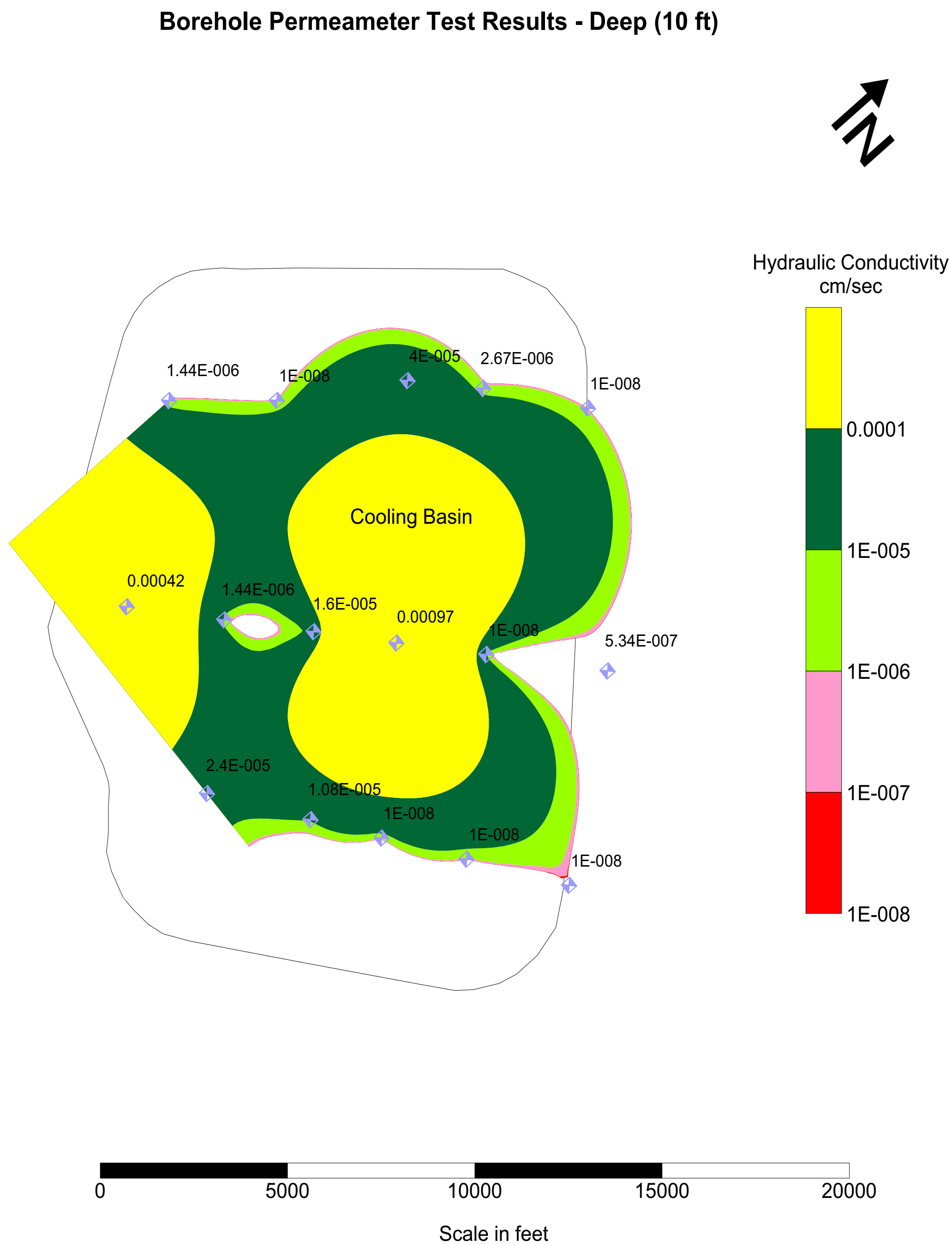
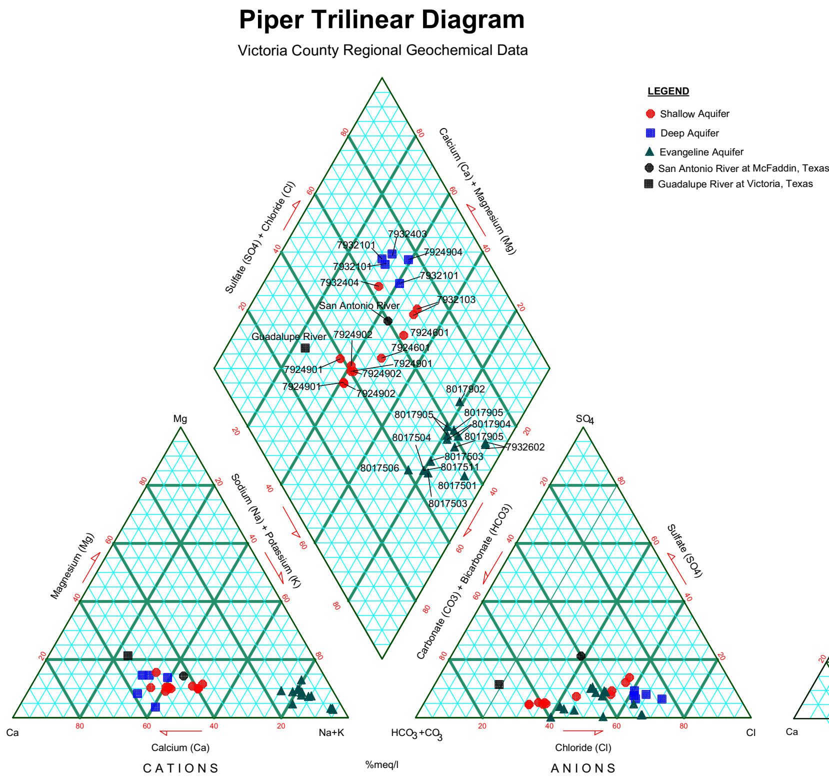


Figure 2.3.1.2-21 Borehole Permeameter Hydraulic Conductivity Contour Map (Sheet 2 of 2)



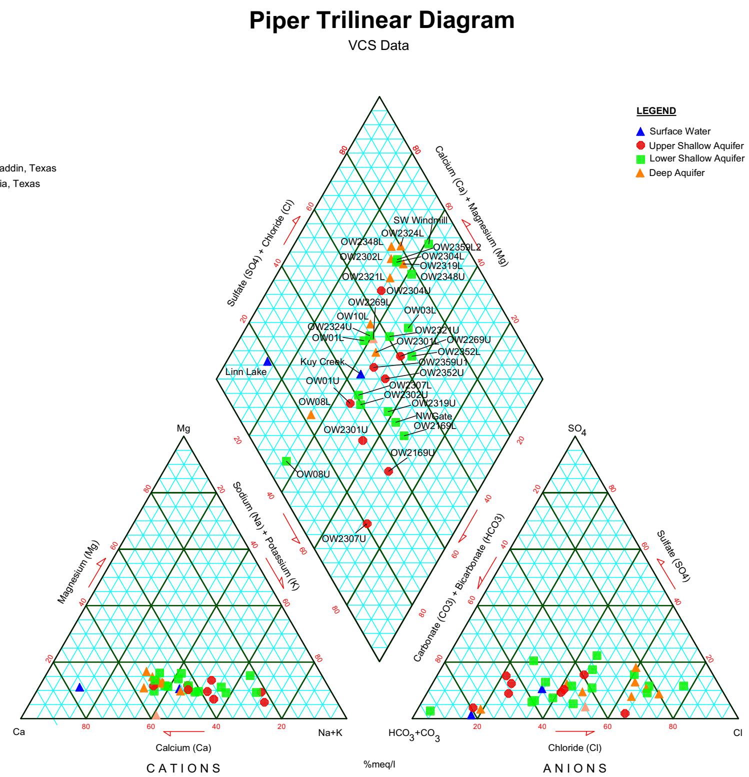
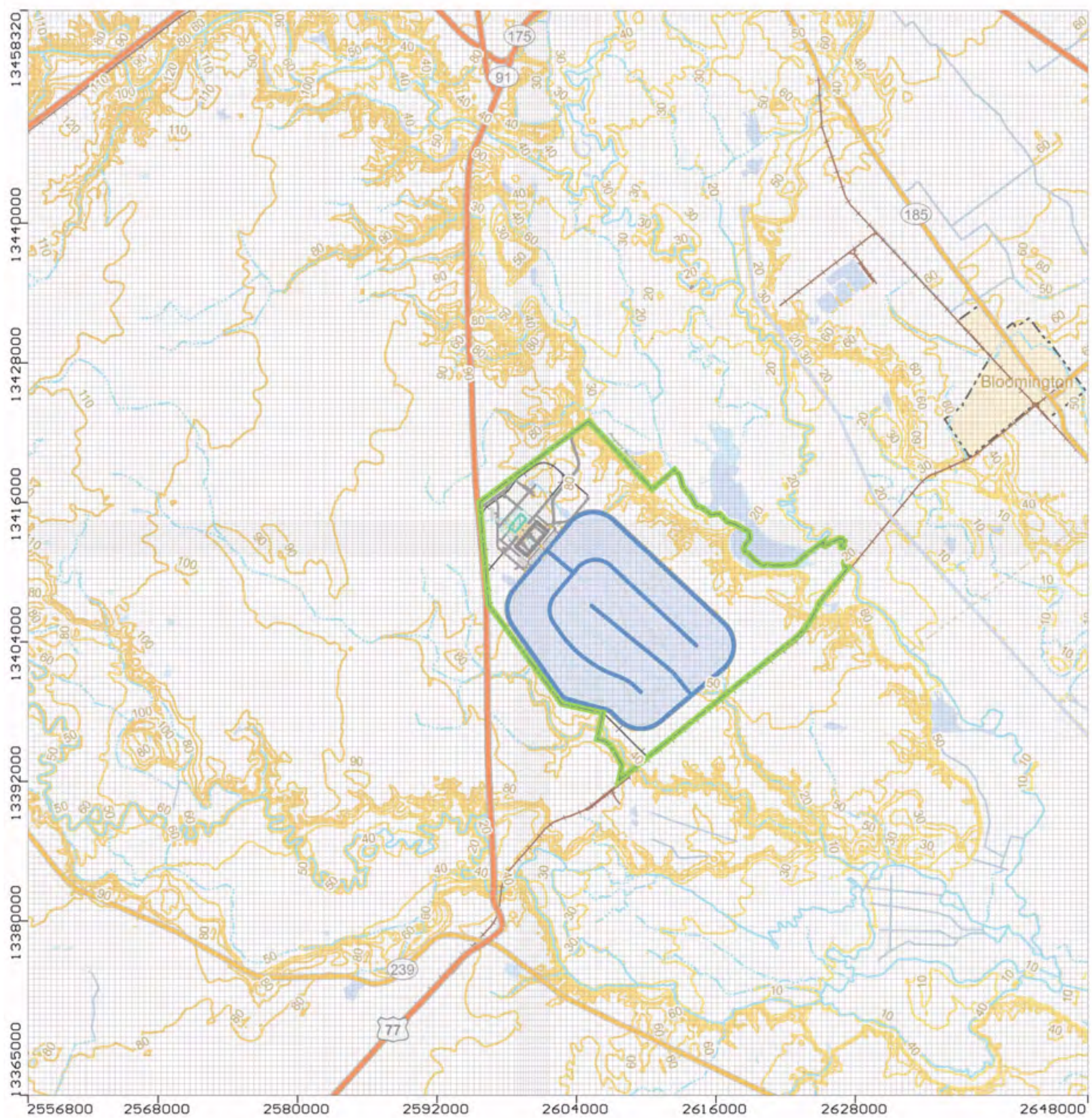
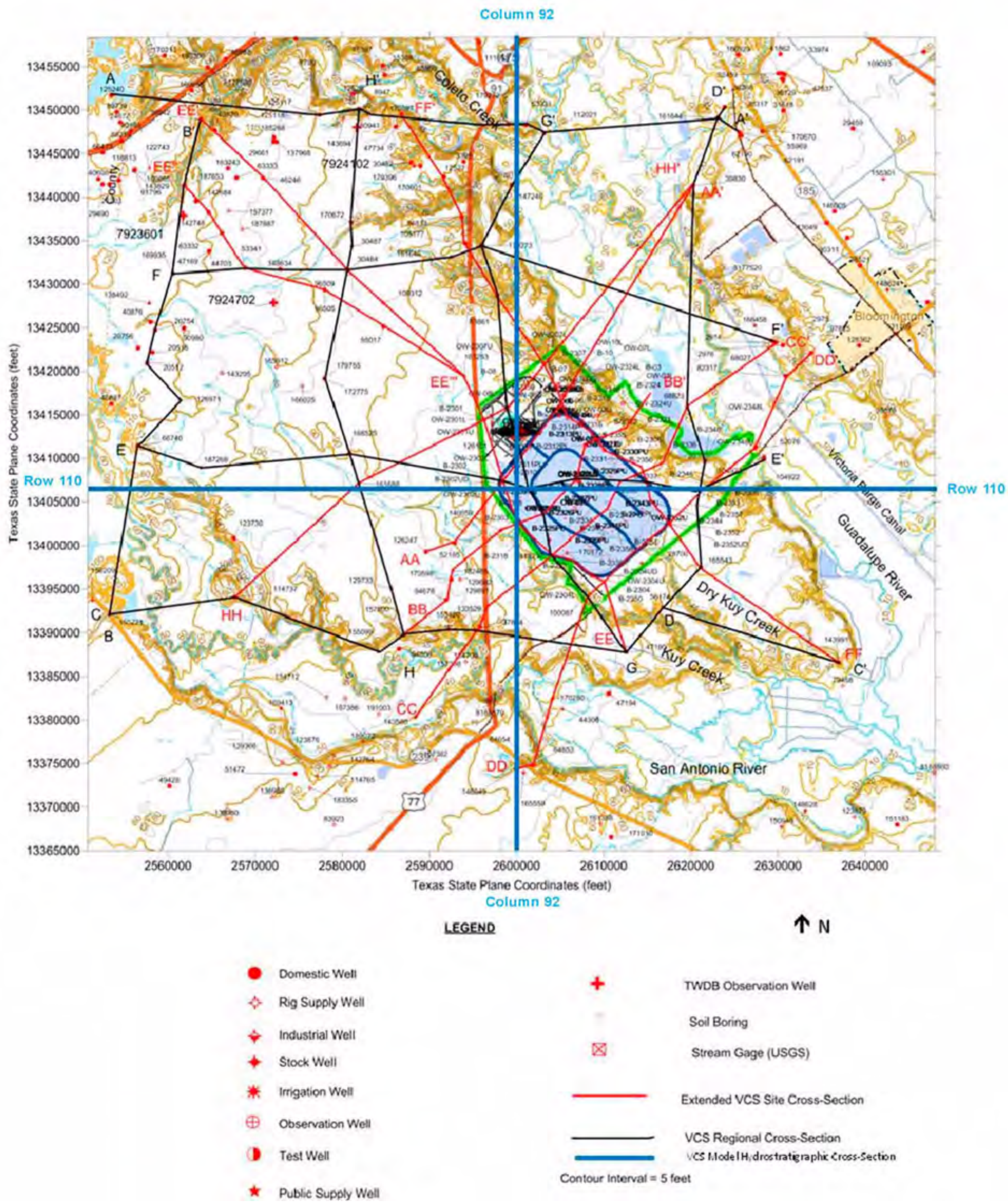


Figure 2.3.1.2-22 Trilinear Diagram of Hydrogeochemical Data



Note: Structures are representative of those that could be located at the site.

Figure 2.3.1.2-23 Plan View of Model Grid



Note: Structures are representative of those that could be located at the site.

Figure 2.3.1.2-24a Plan View Showing Locations of Orthogonal Cross Sections

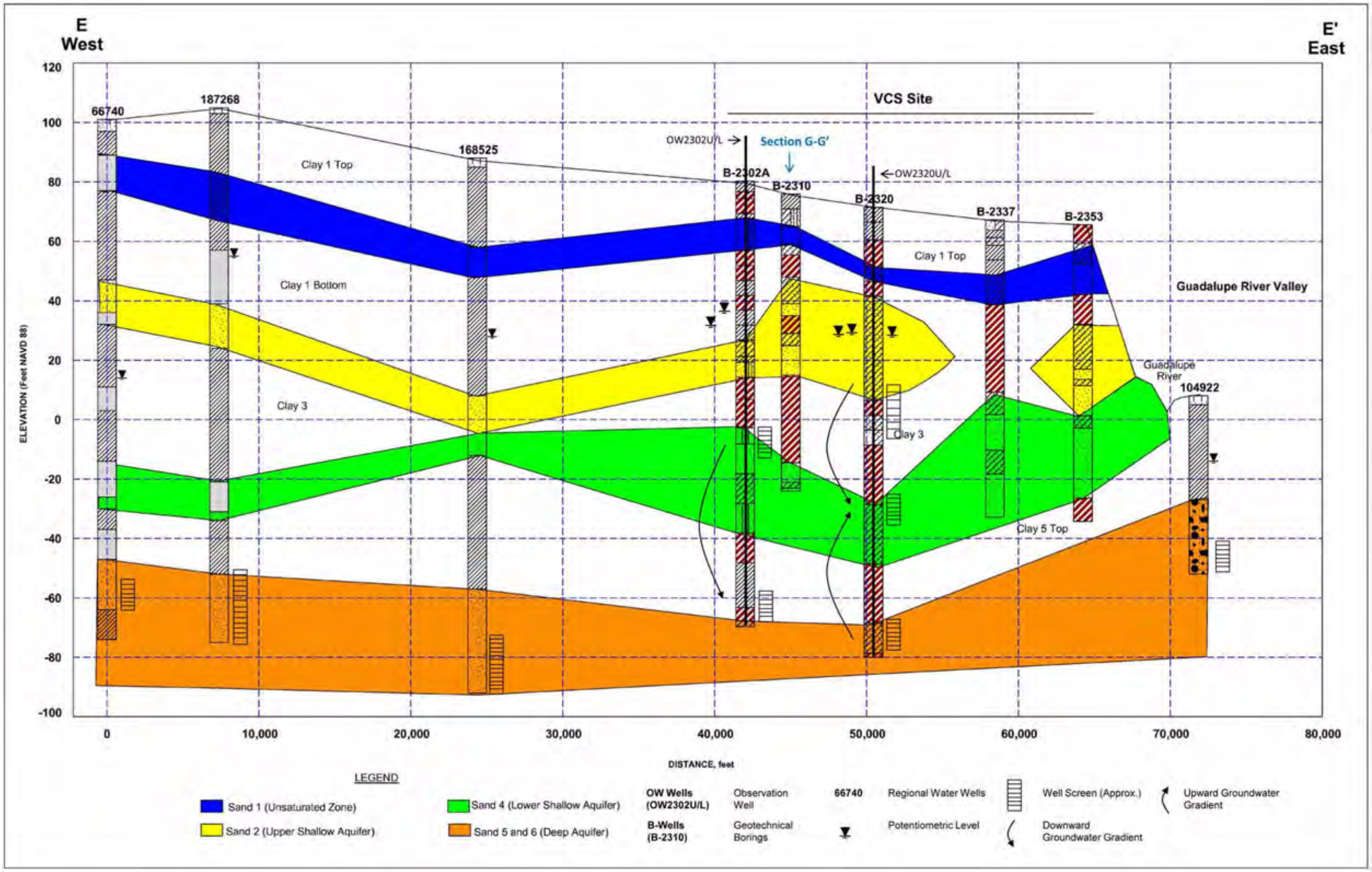


Figure 2.3.1.2-24b Hydrogeologic Cross-Section (E-E')

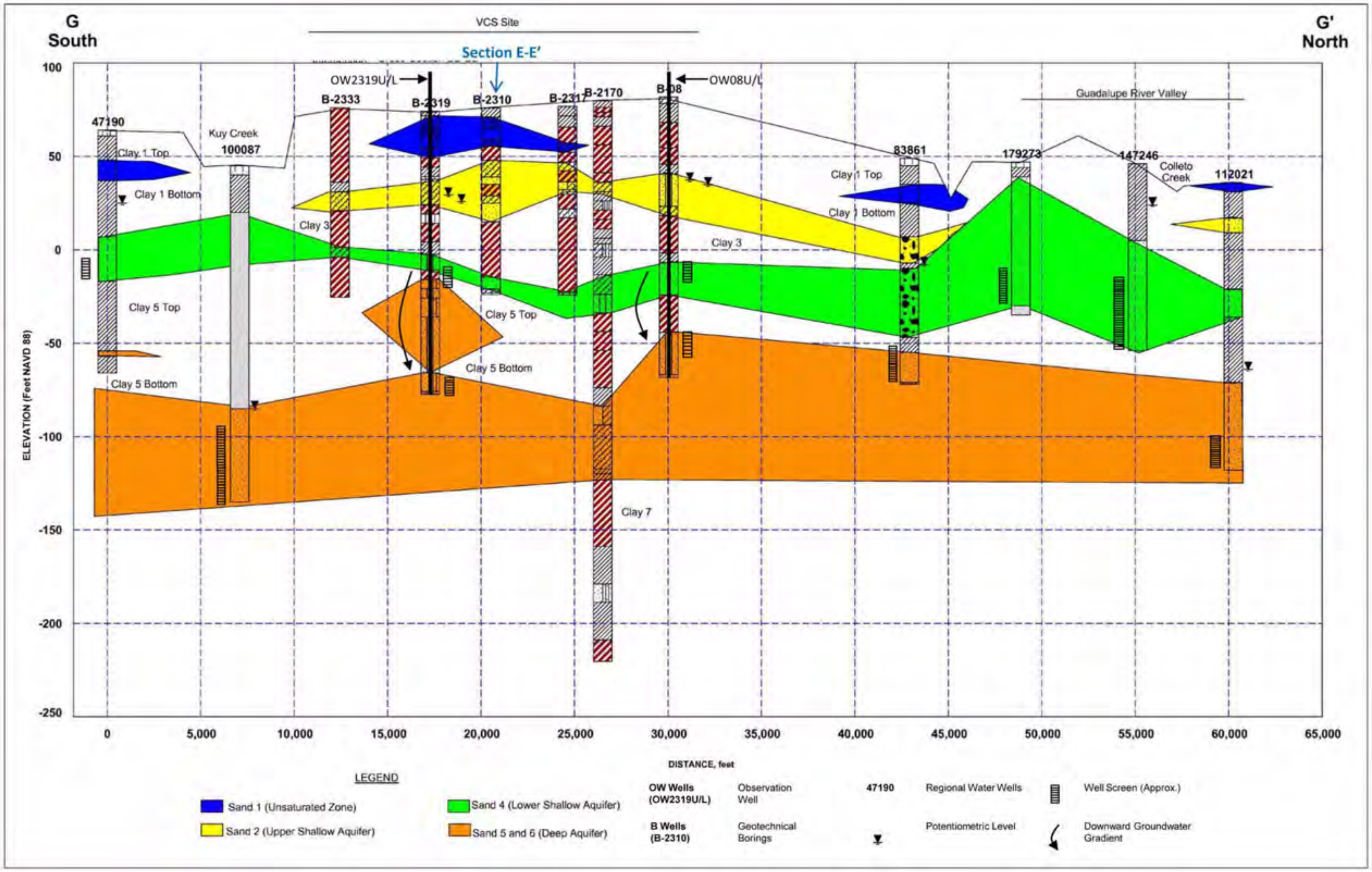


Figure 2.3.1.2-24c Hydrogeologic Cross Section (G-G')

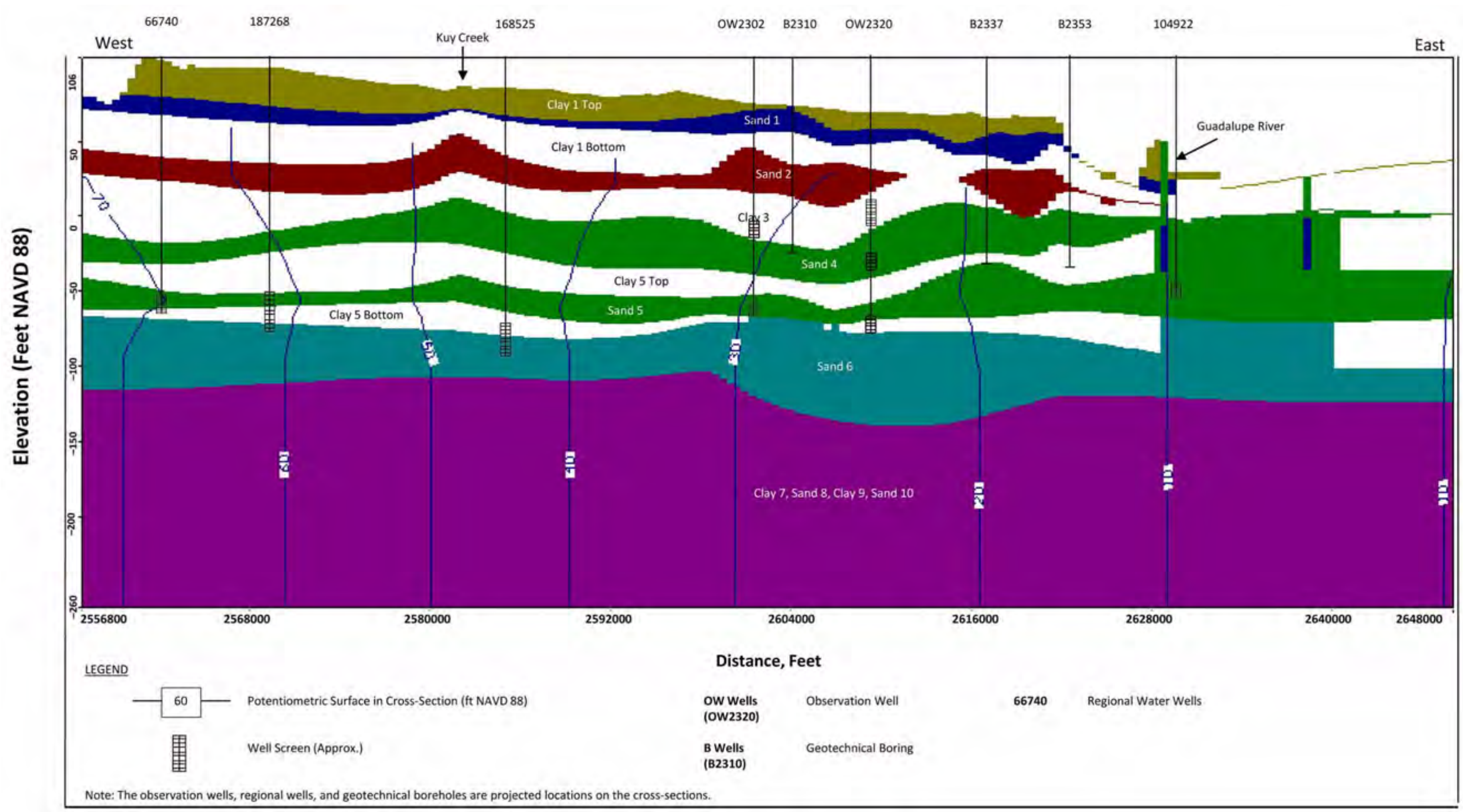


Figure 2.3.1.2-24d Cross-Section along row 110 of Groundwater Model Grid

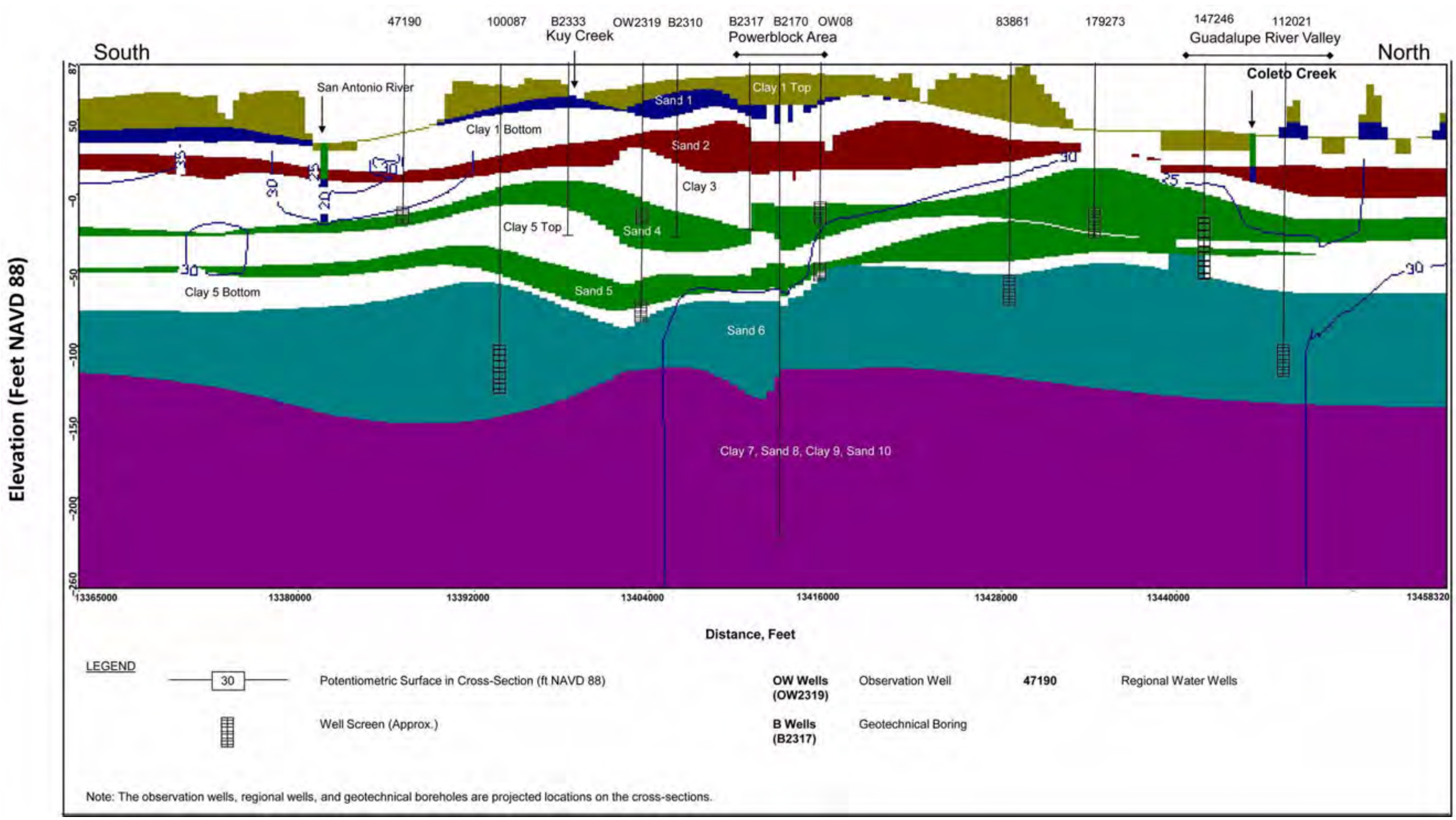
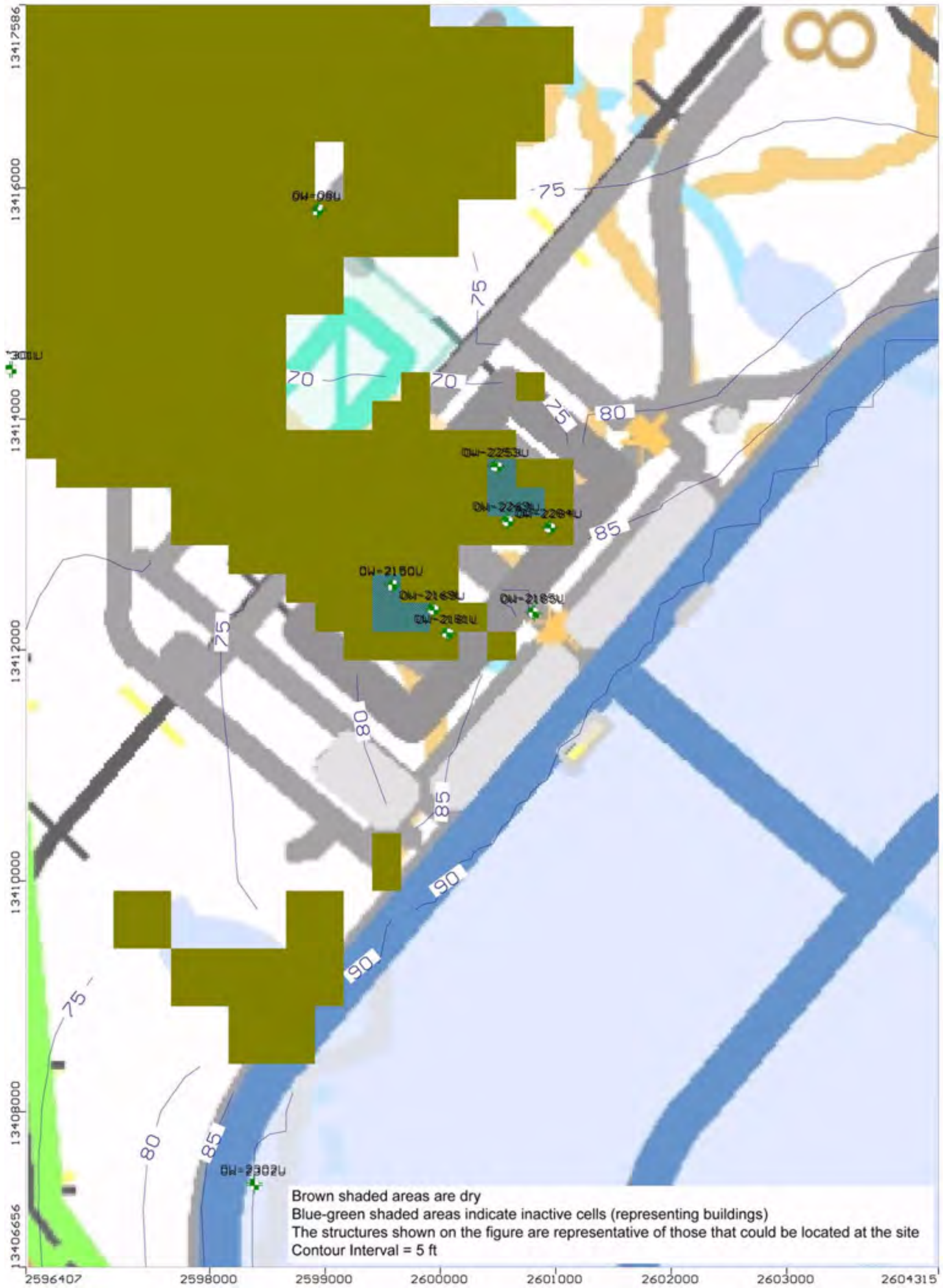
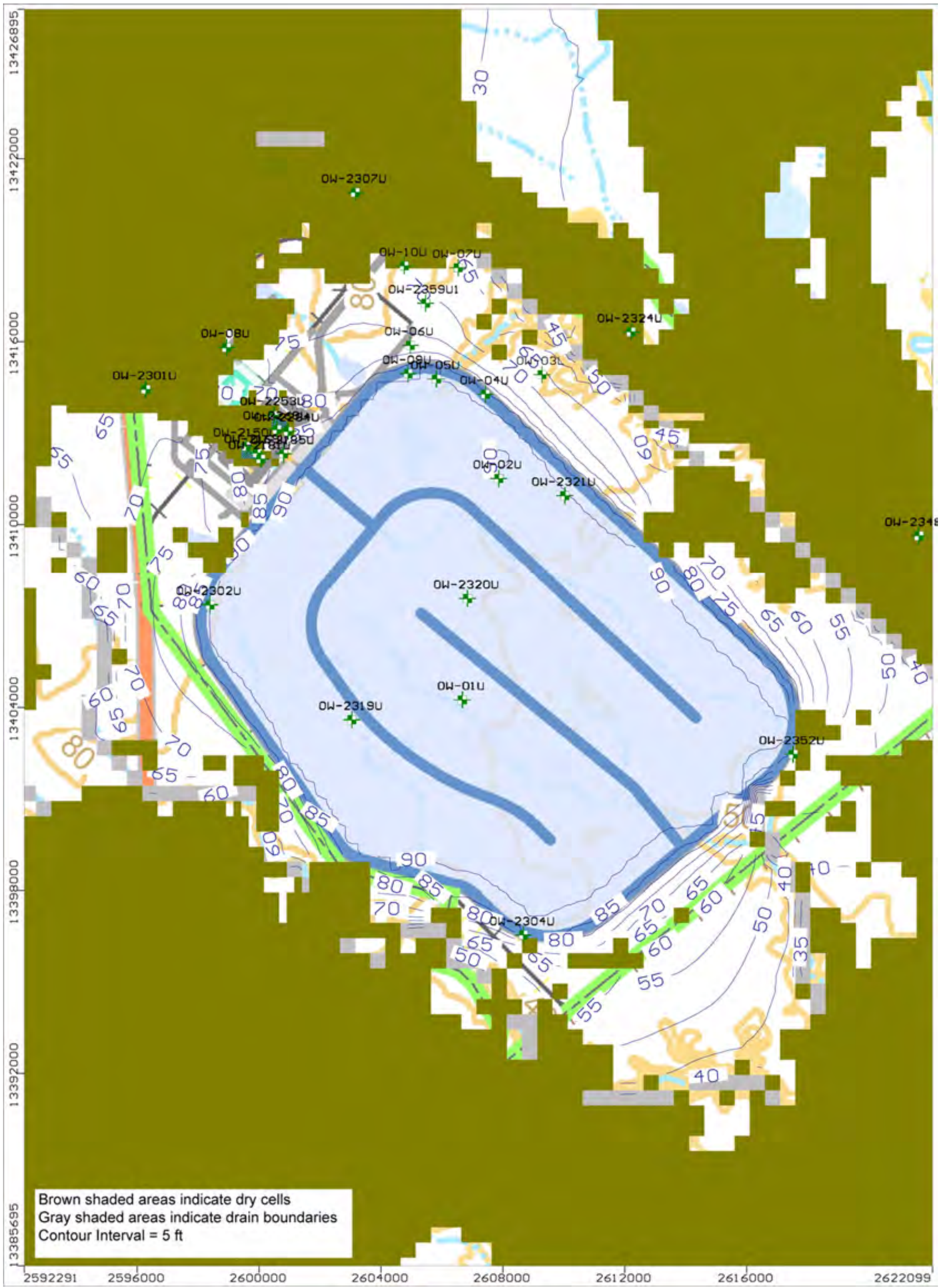


Figure 2.3.1.2-24e Cross-Section Along Column 92 of Groundwater Model Grid



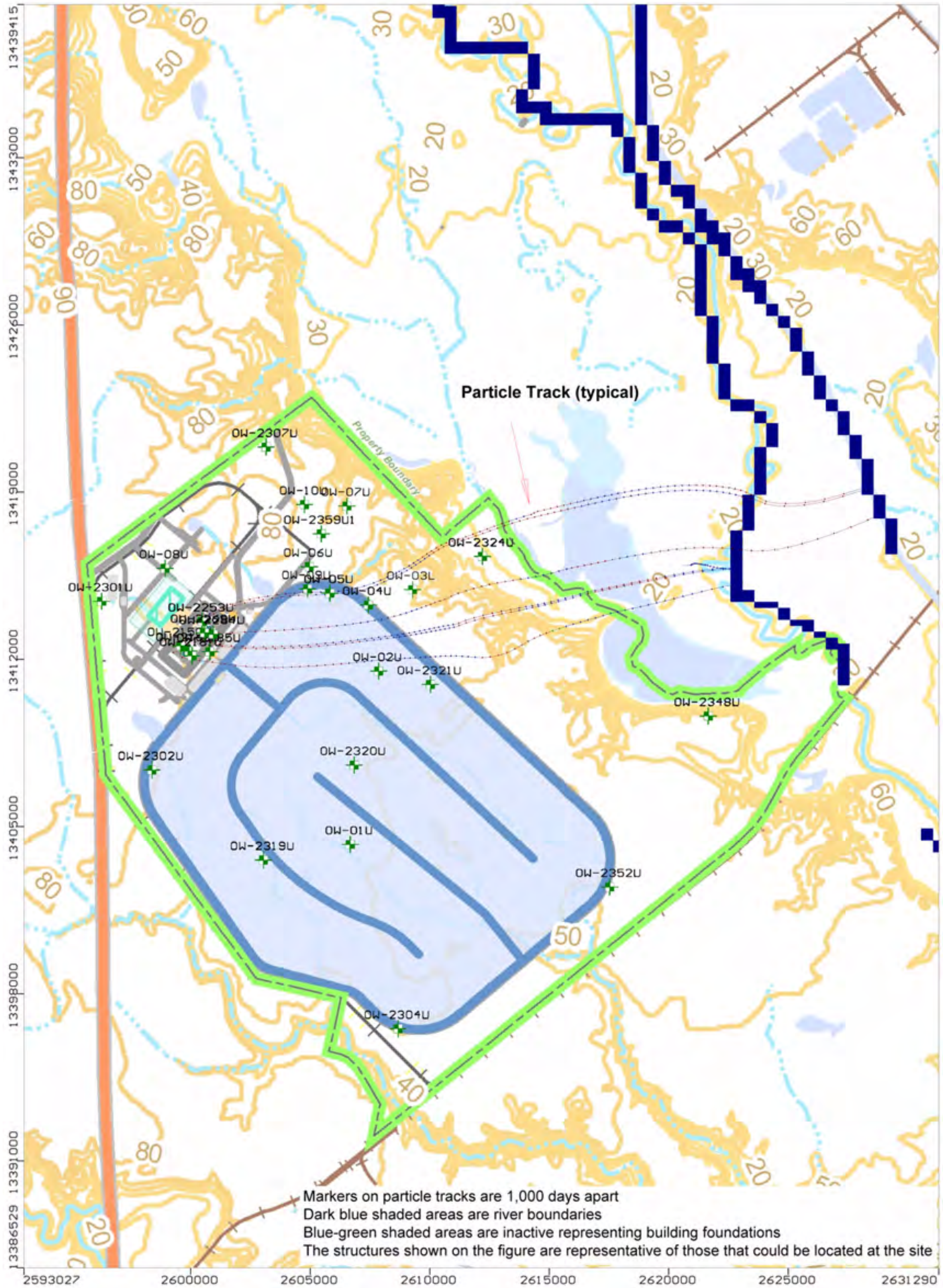
Note: Structures are representative of those that could be located at the site.

Figure 2.3.1.2-25 Simulated Post-Construction Potentiometric Surface at the Power Block in Layer 2



Note: Structures are representative of those that could be located at the site.

Figure 2.3.1.2-26 Simulated Post-Construction Potentiometric Surface at the Cooling Basin in Layer 2



Note: Structures are representative of those that could be located at the site.

Figure 2.3.1.2-27 Particle Tracking Results for Accident Scenario 1 in Layer 6

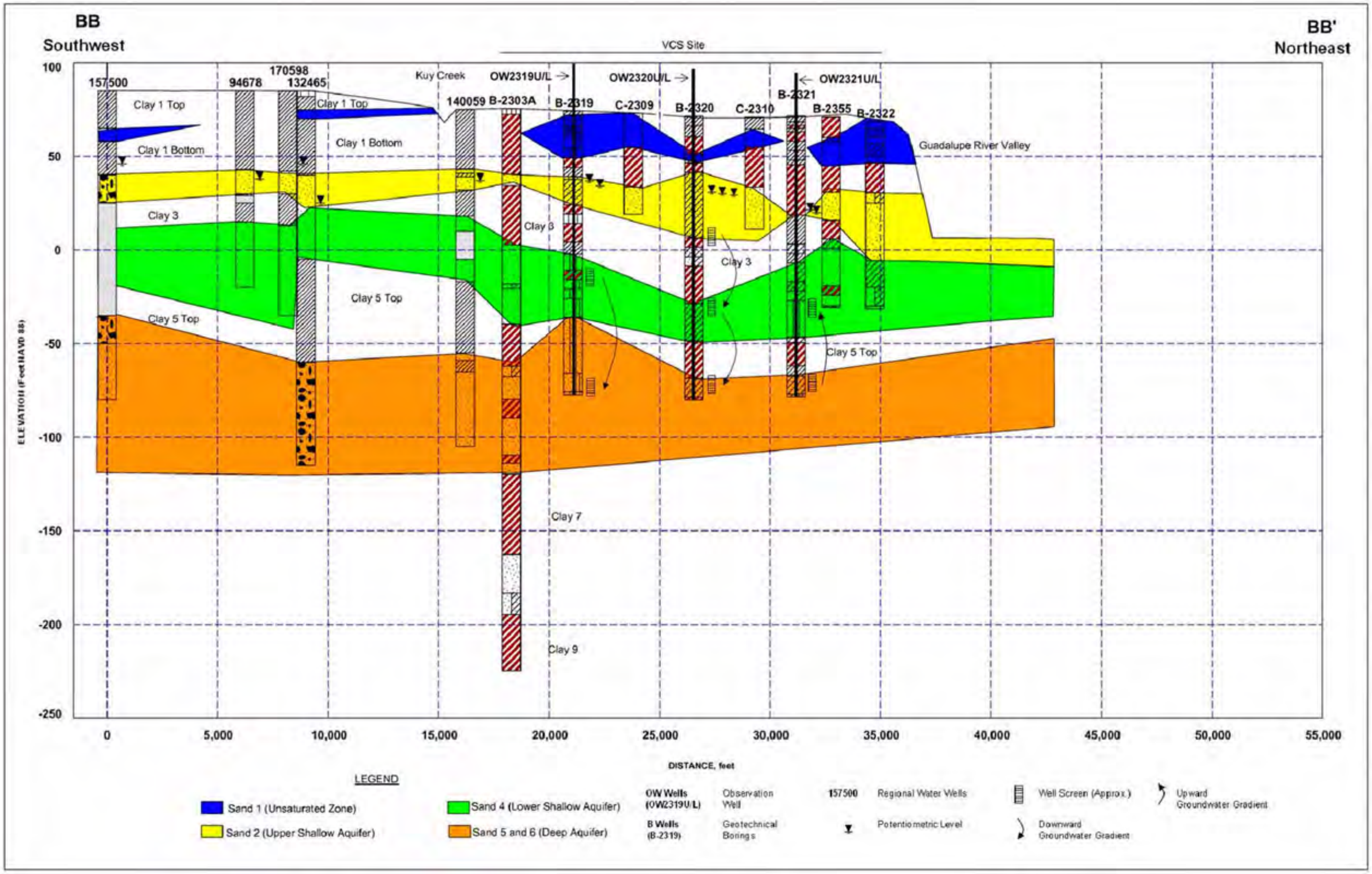


Figure 2.3.1.2-28 Hydrogeologic Cross-Section (BB-BB')

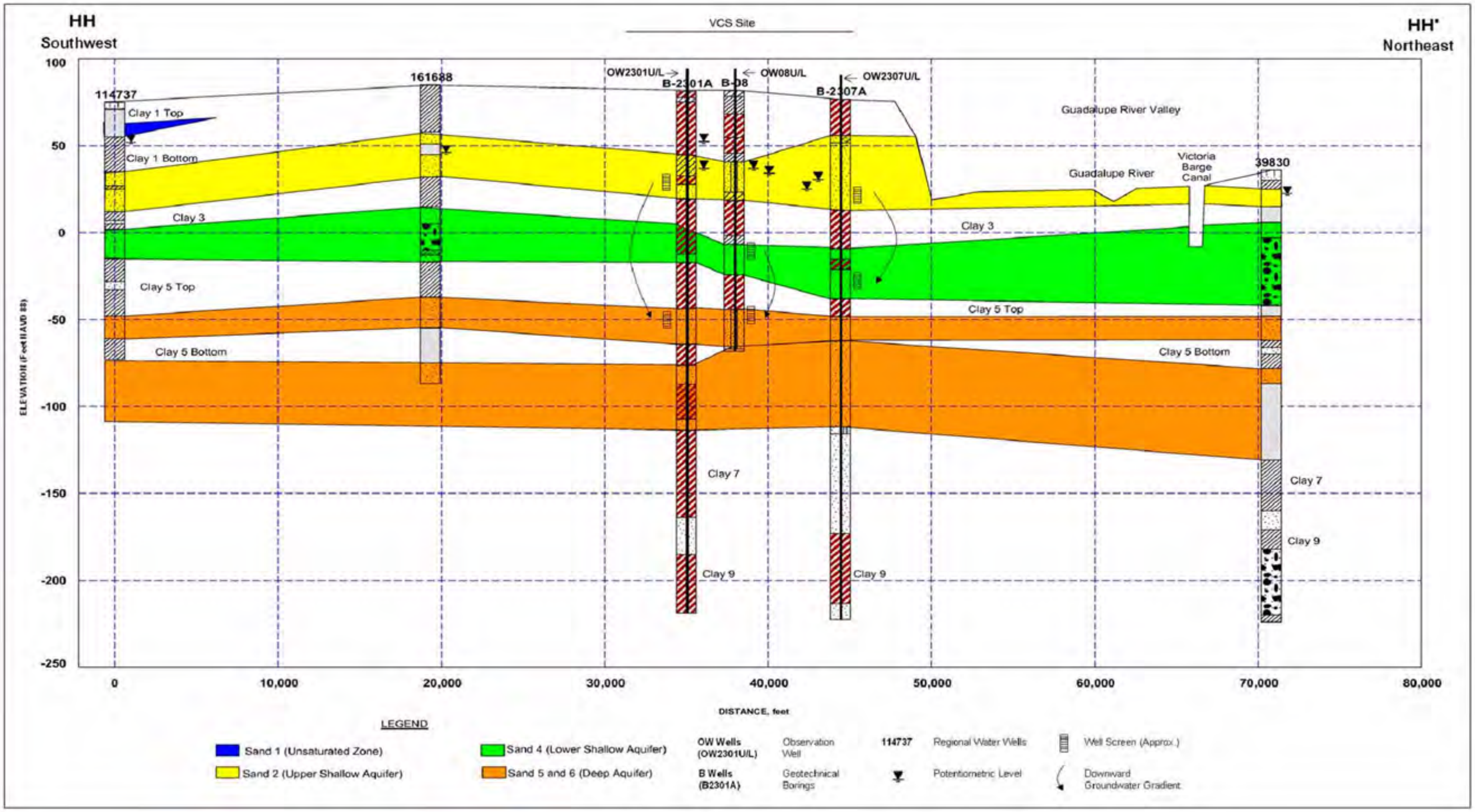


Figure 2.3.1.2-29 Hydrogeologic Cross Section HH-HH'

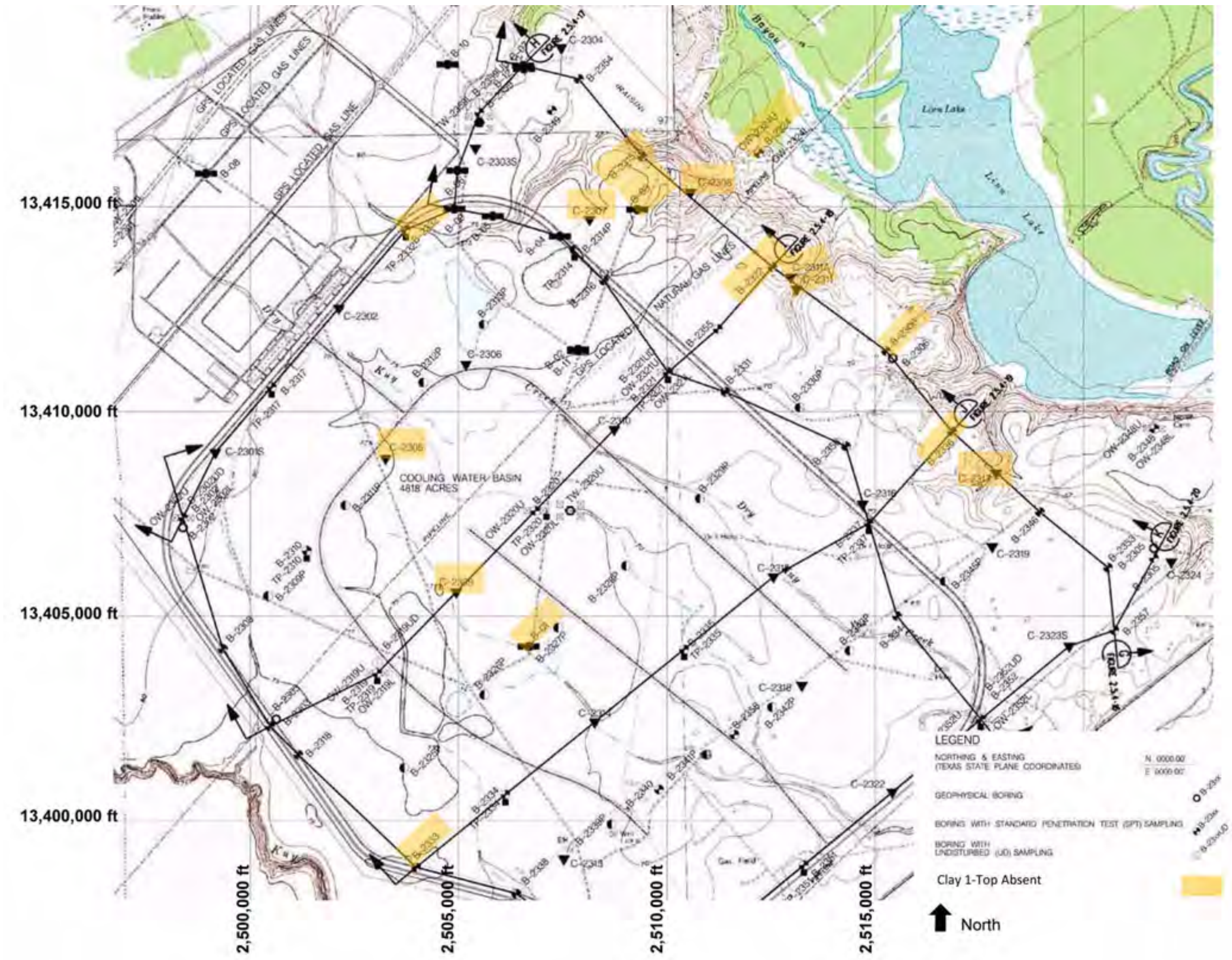


Figure 2.3.1.2-30 Locations Where Clay 1–Top is Absent

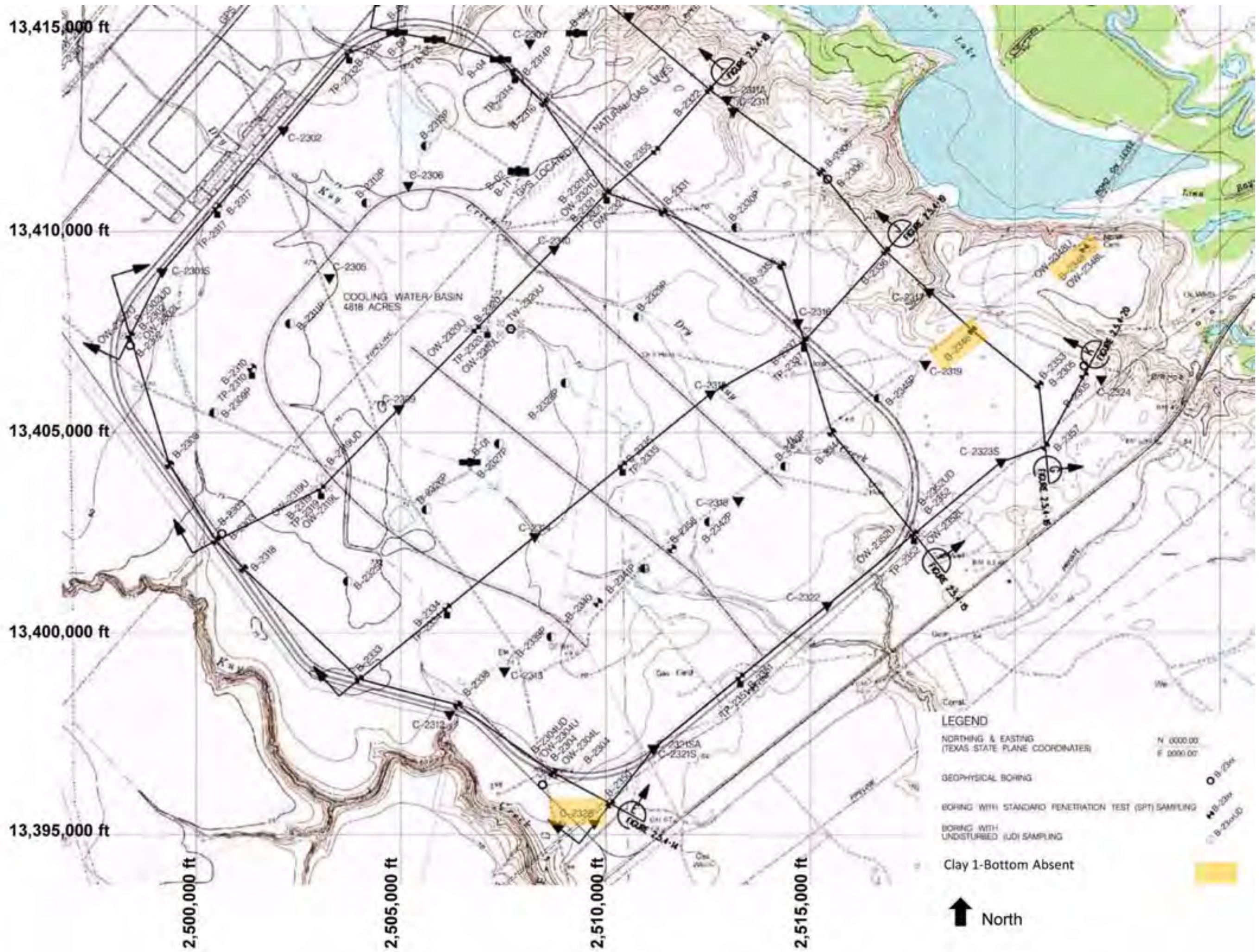


Figure 2.3.1.2-31 Locations Where Clay 1–Bottom is Absent

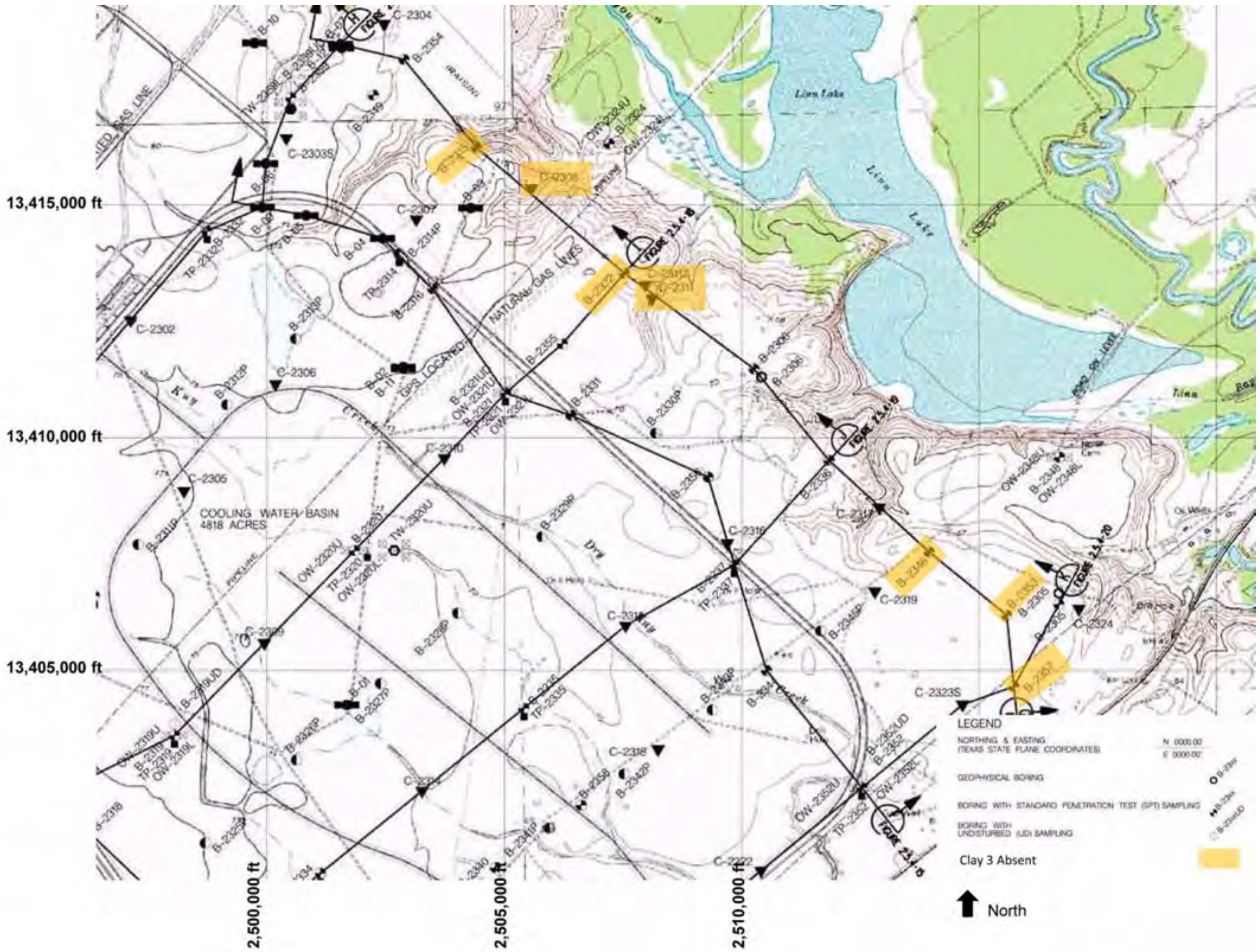


Figure 2.3.1.2-32 Locations Where Clay 3 is Absent

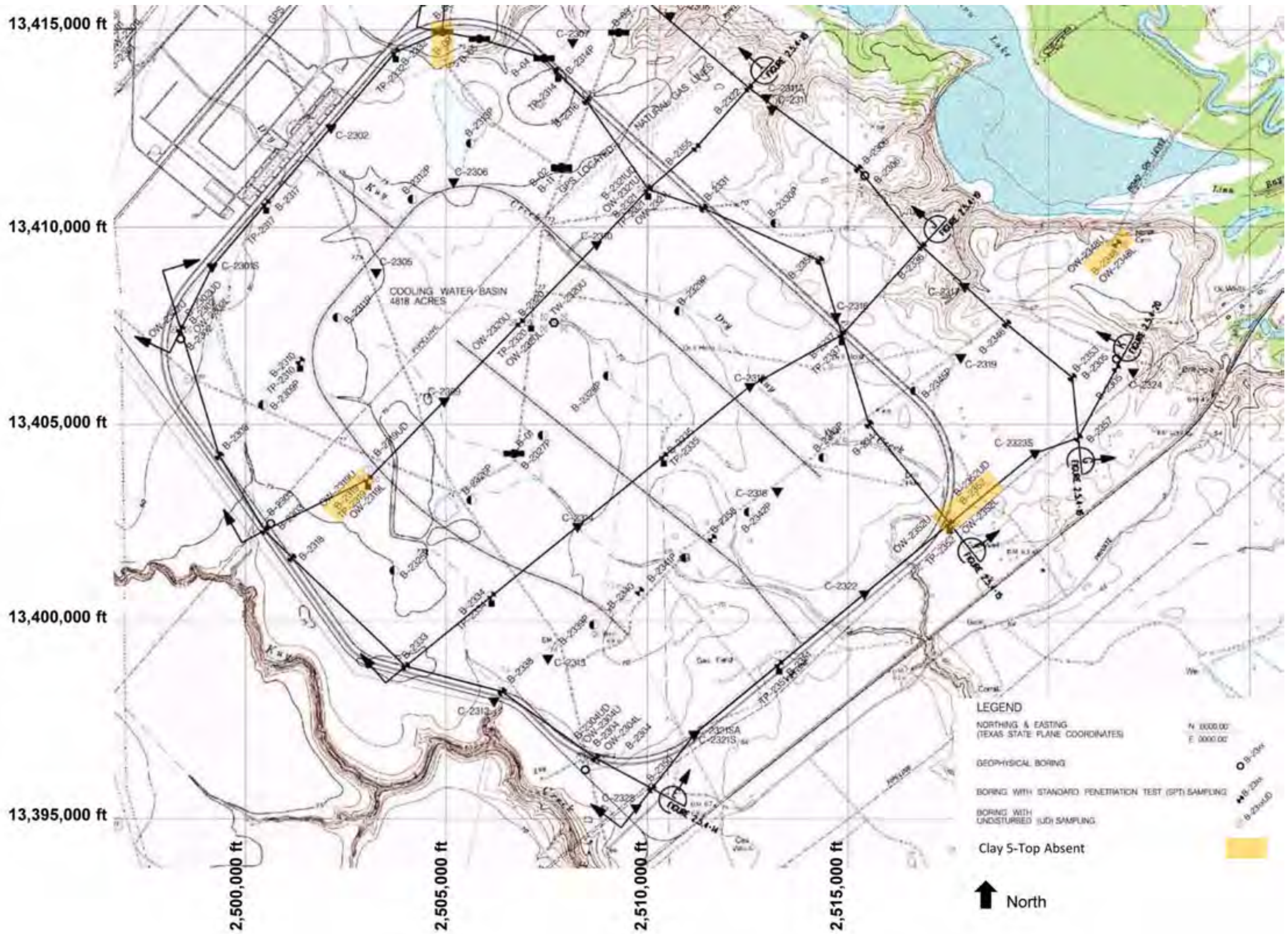


Figure 2.3.1.2-33 Locations Where Clay 5–Top is Absent

Figure 2.3.1-1 Victoria County Station Location Map

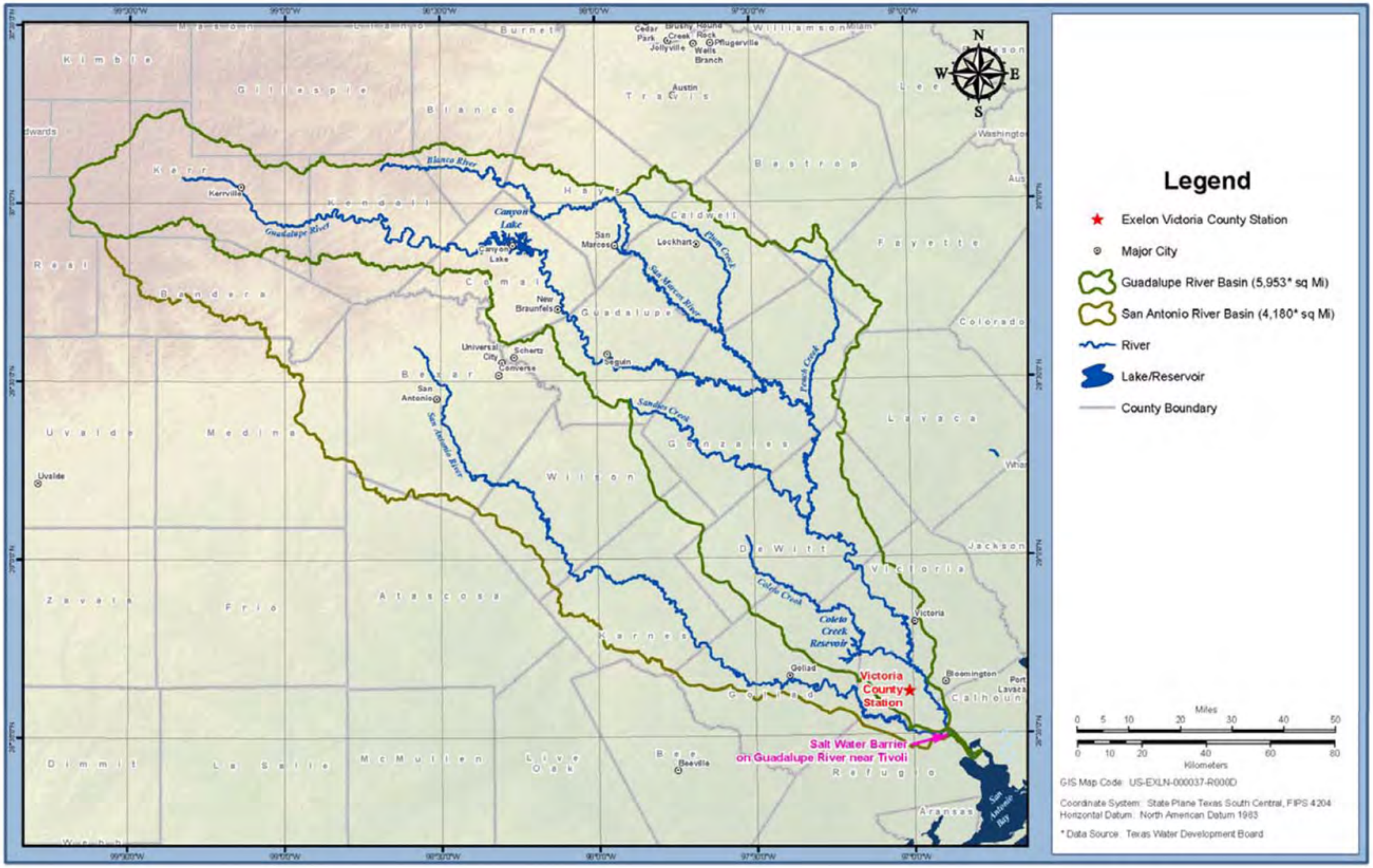


Figure 2.3.1-2 Guadalupe and San Antonio River Basin Watersheds

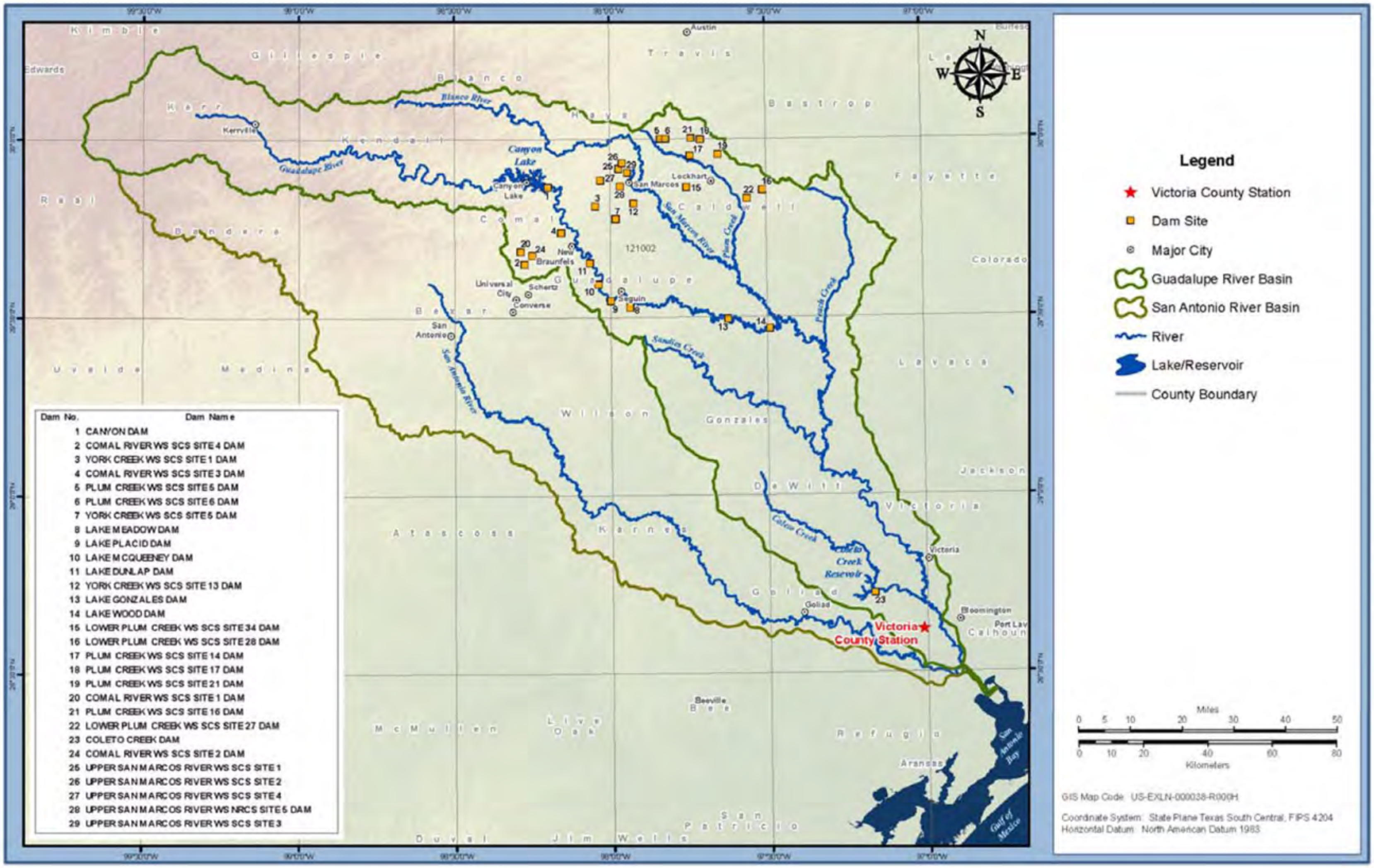


Figure 2.3.1-3 Guadalupe River Basin Dams

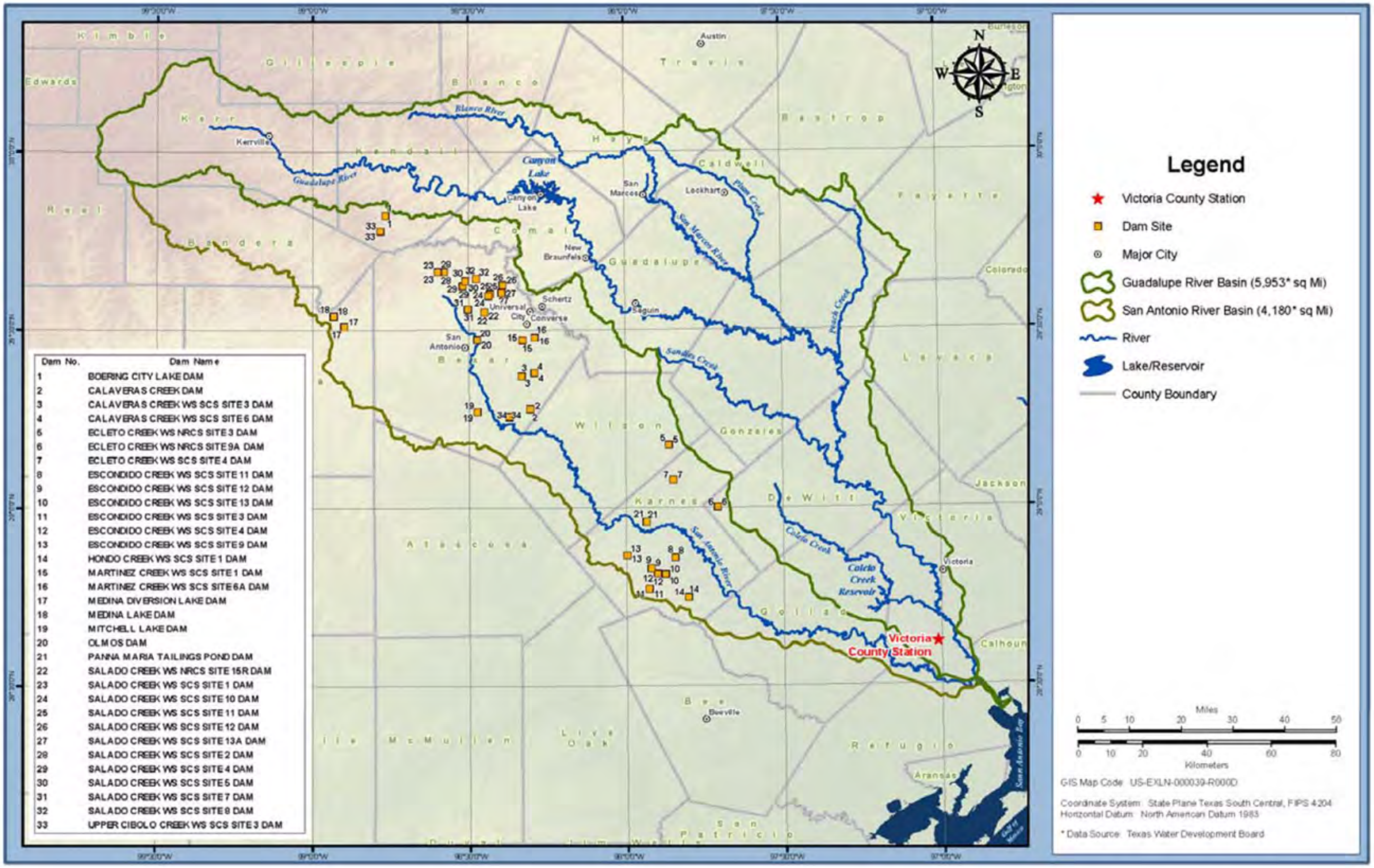


Figure 2.3.1-4 San Antonio River Basin Dams

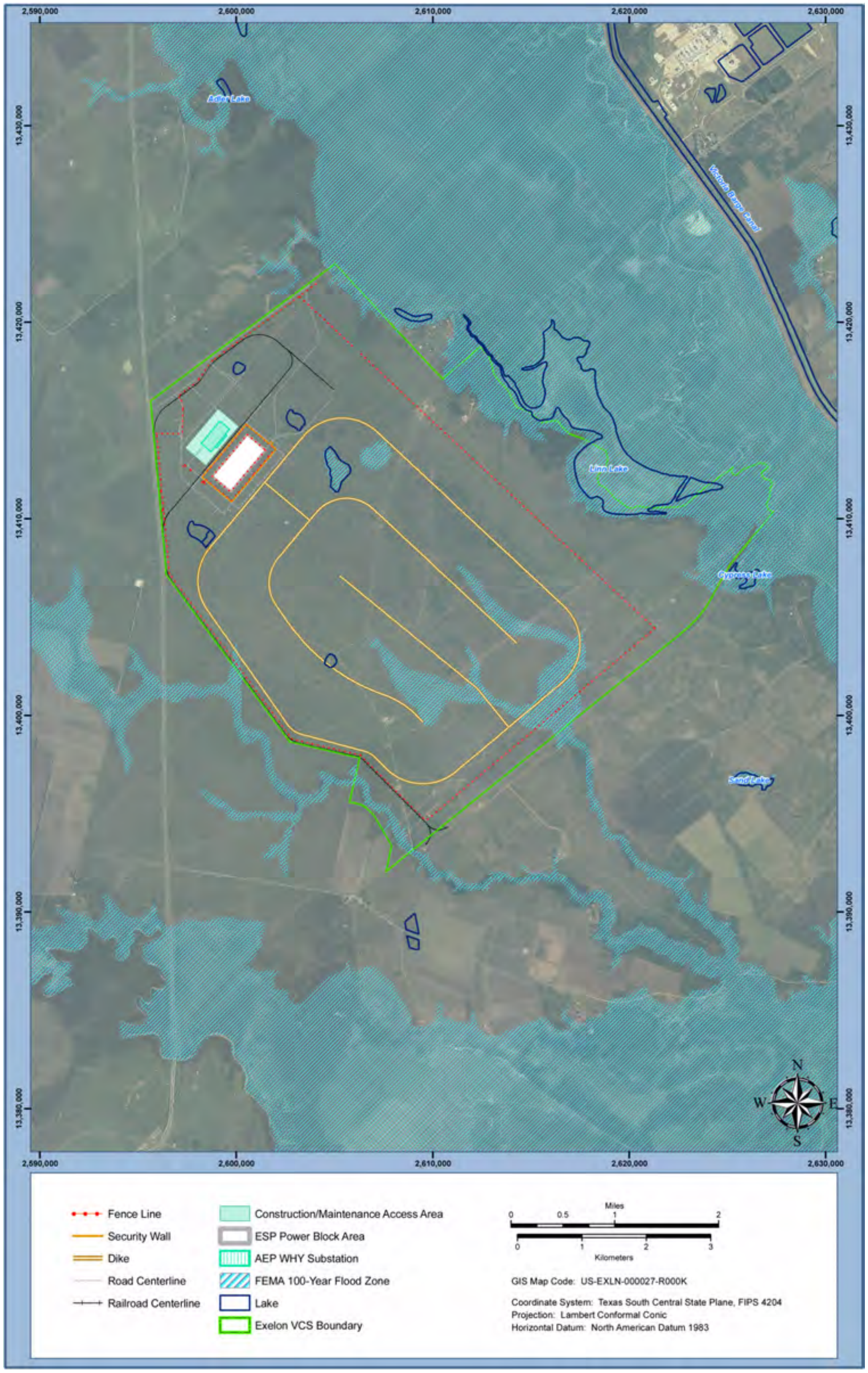


Figure 2.3.1-5 VCS Site Floodplain Map

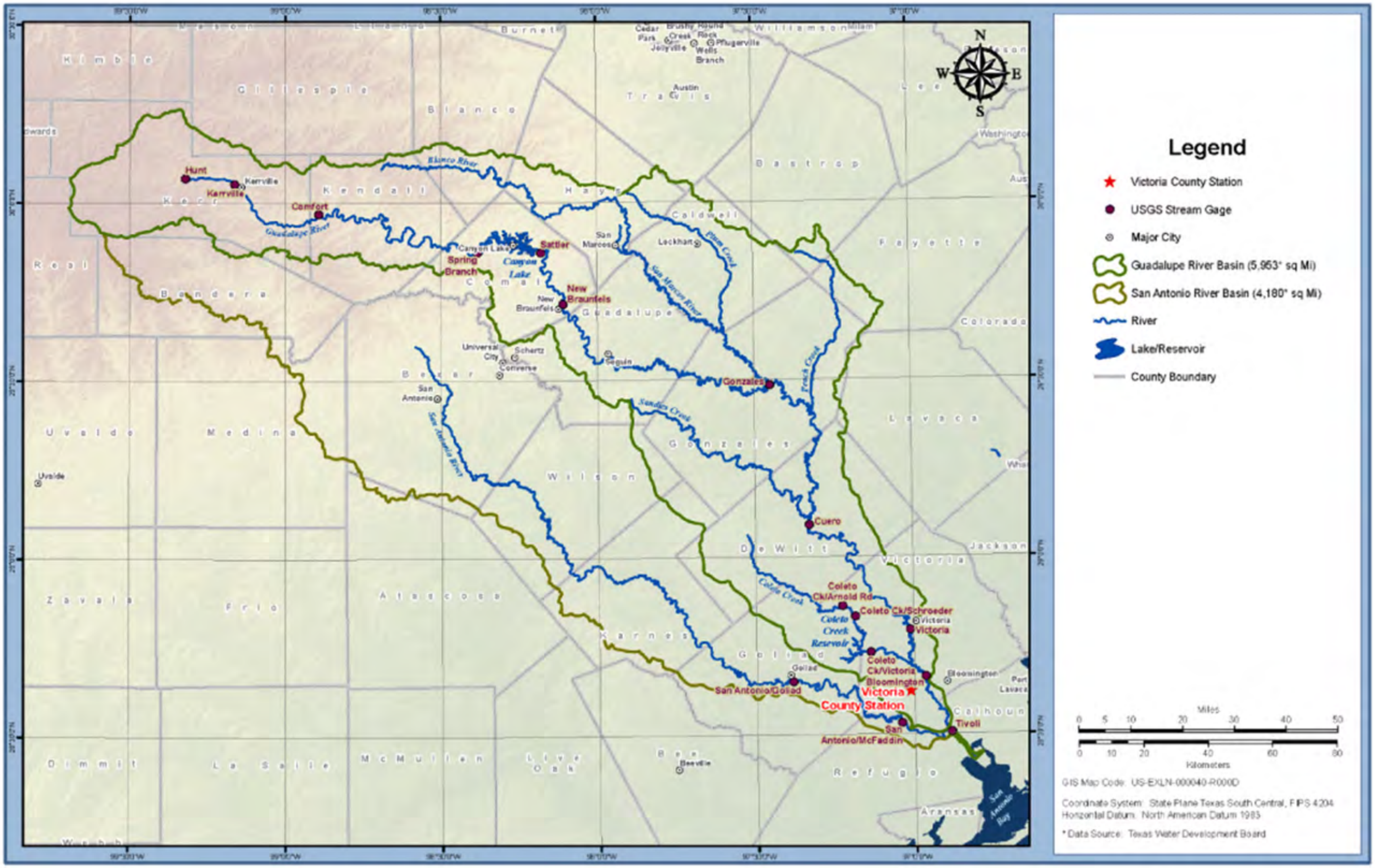


Figure 2.3.1-6 Guadalupe and San Antonio River Basins: Selected Stream Gages

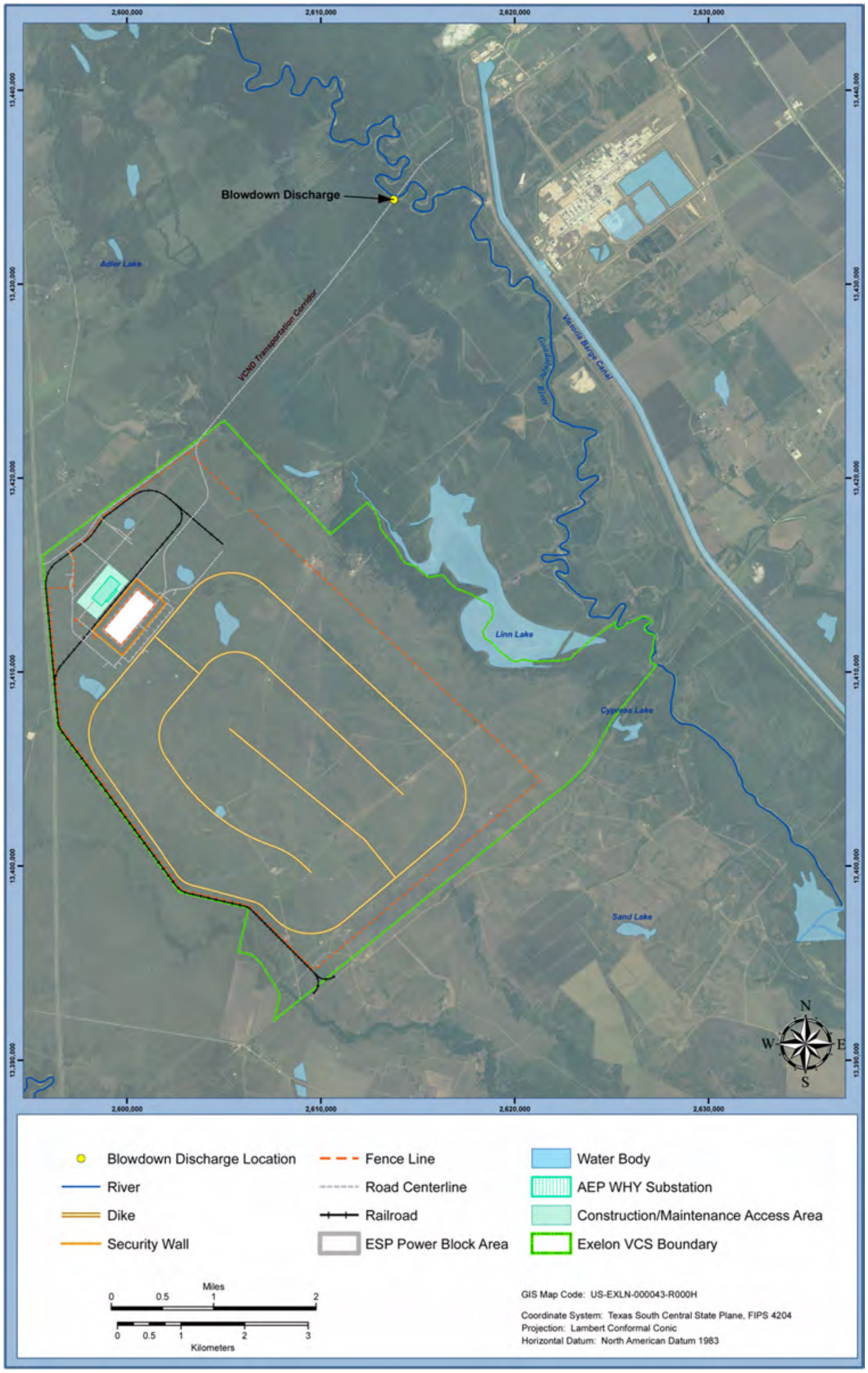


Figure 2.3.1-7 Victoria County Station Blowdown Discharge Location Map

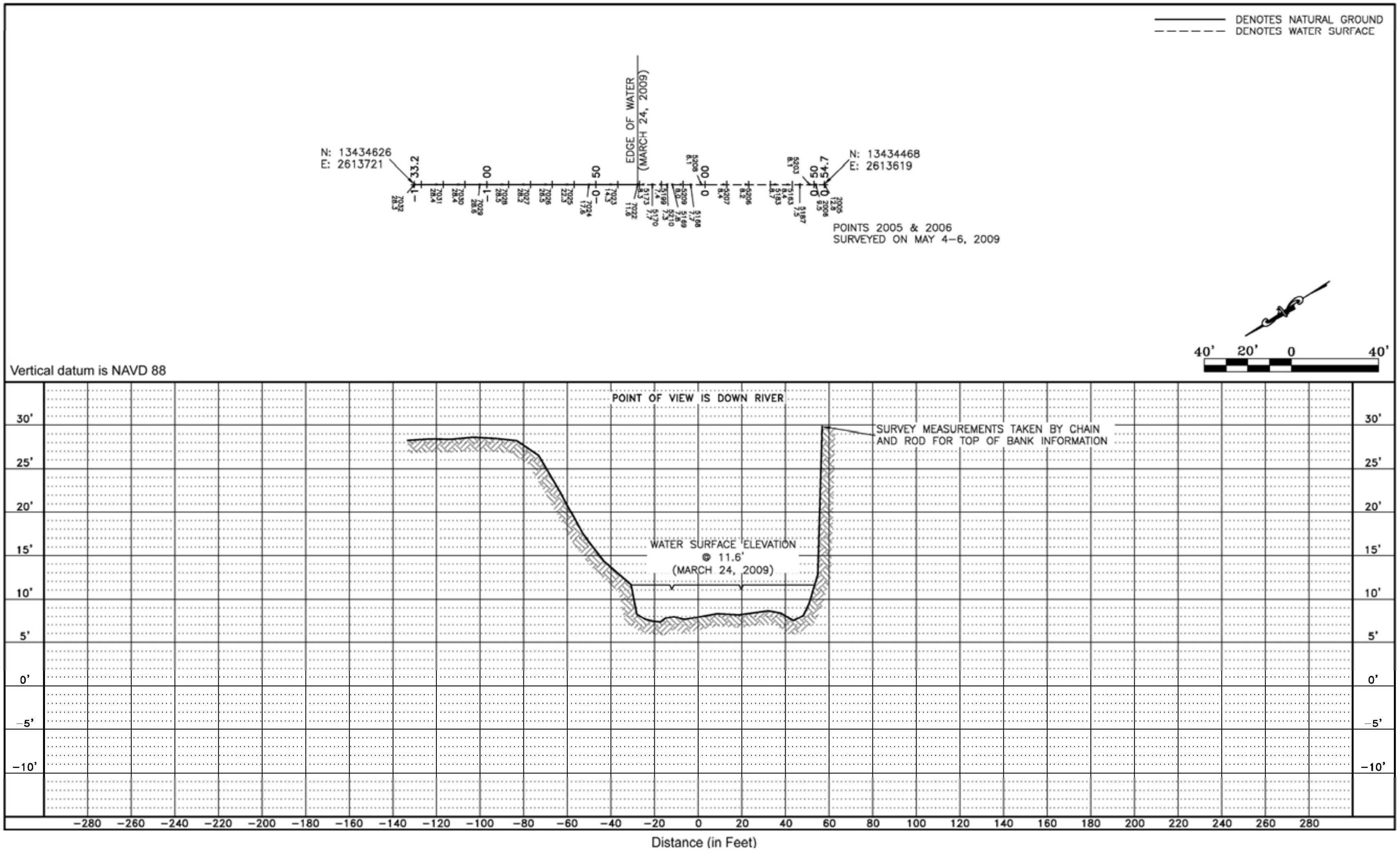


Figure 2.3.1-8 Guadalupe River Bathymetry—200 Feet Upstream of Blowdown Discharge Location

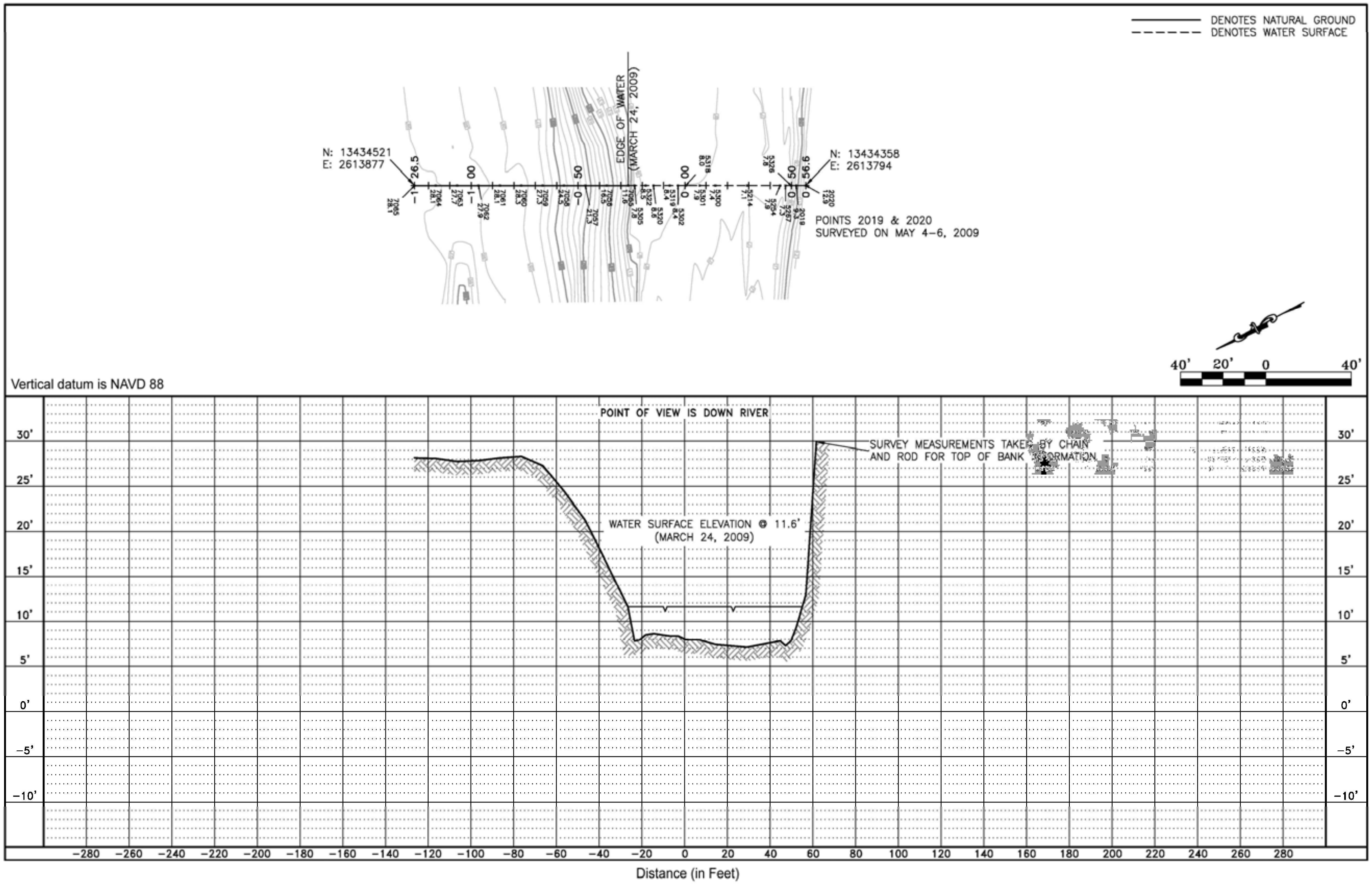


Figure 2.3.1-9 Guadalupe River Bathymetry—Near Blowdown Discharge Location

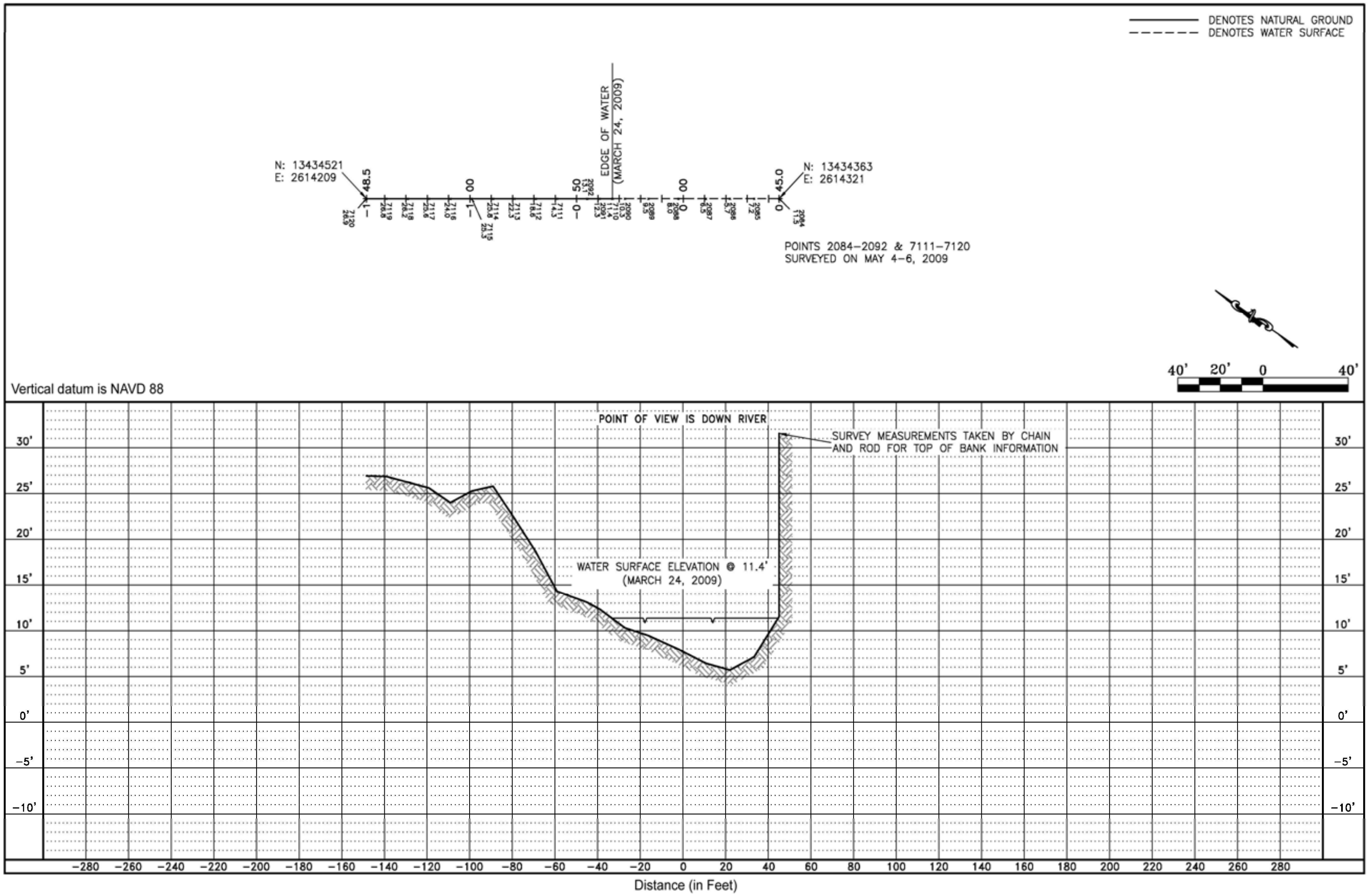


Figure 2.3.1-10 Guadalupe River Bathymetry – 500 Feet Downstream of Blowdown Discharge Location

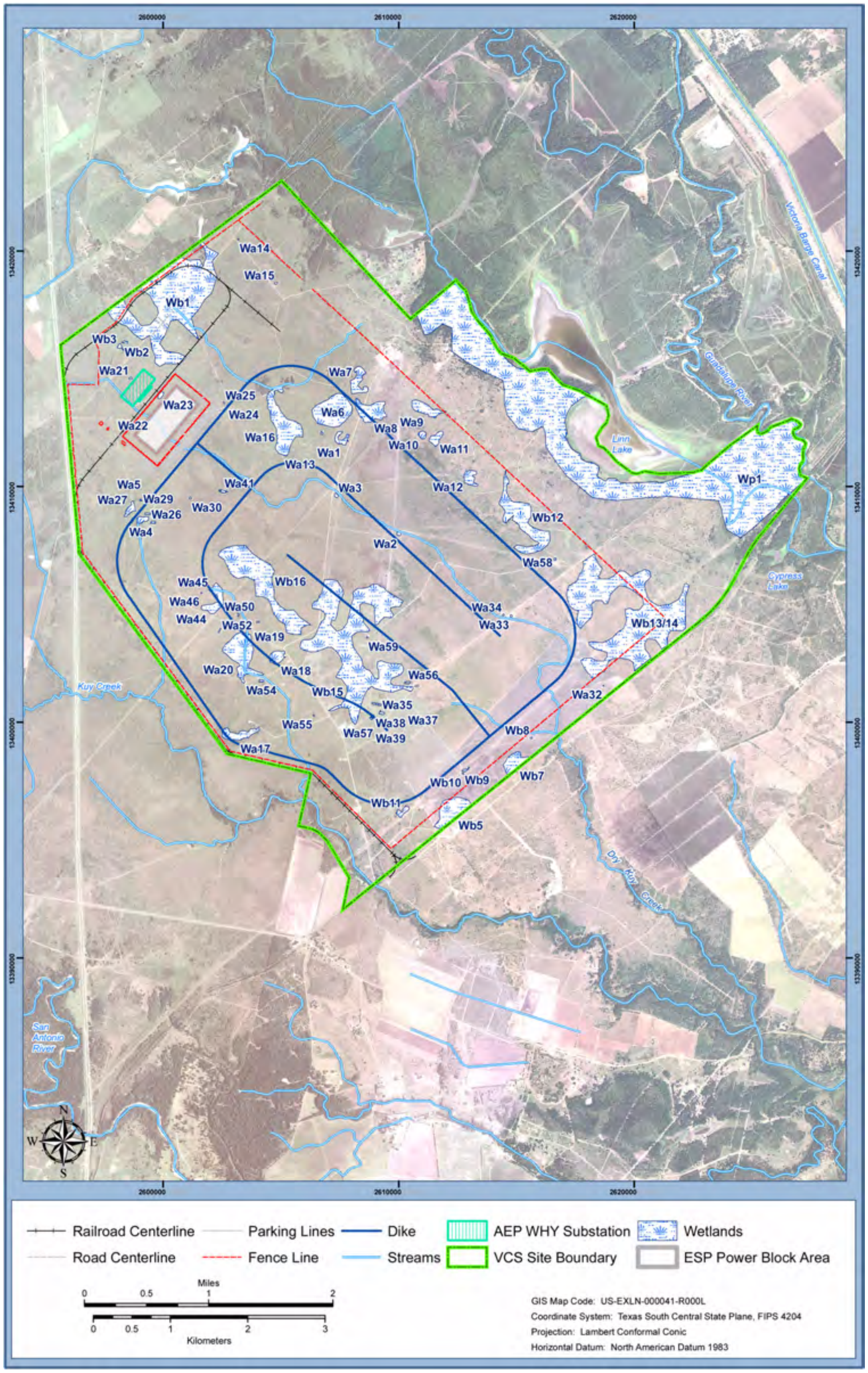


Figure 2.3.1-11 Existing Streams and Wetlands

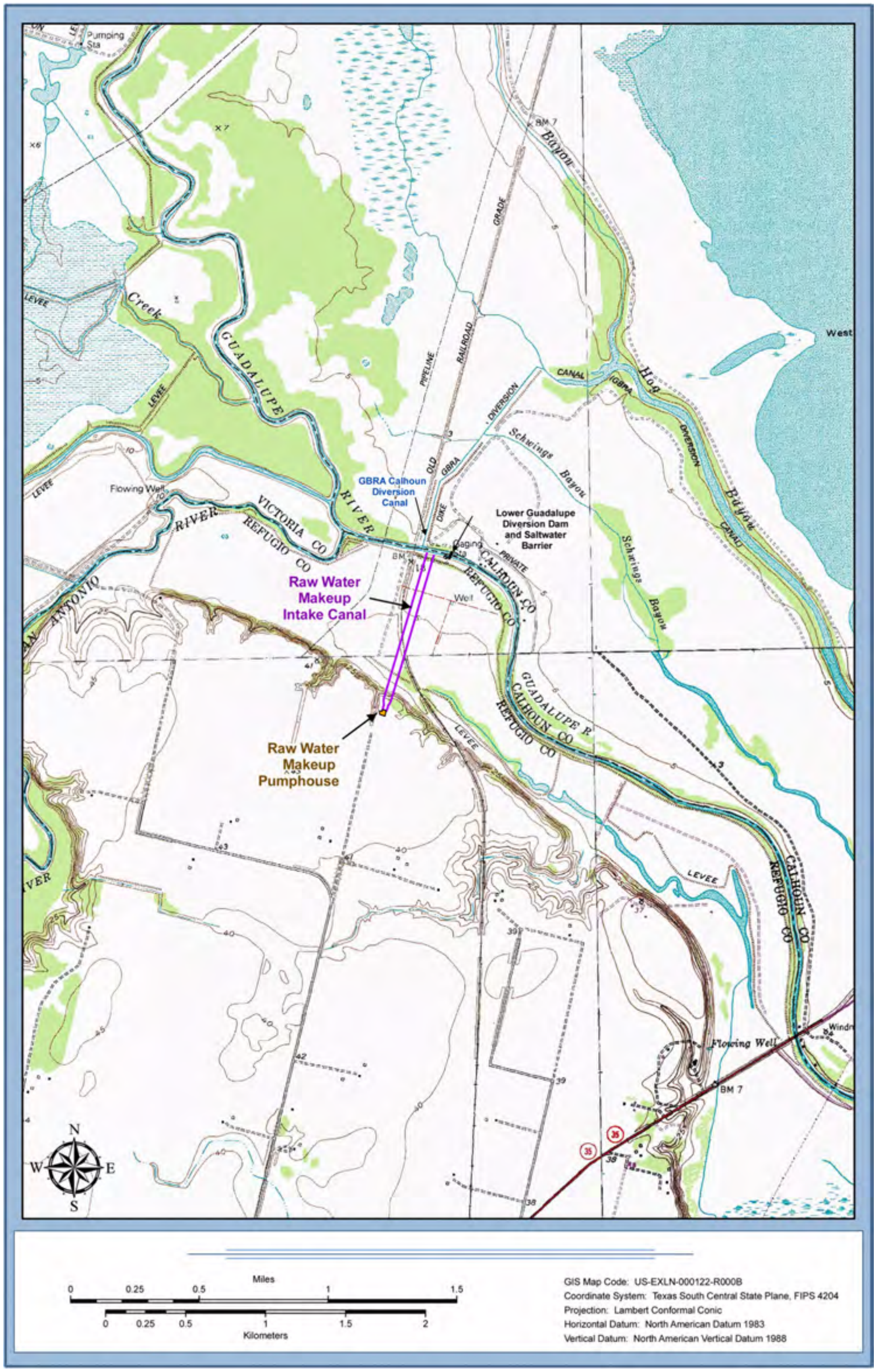


Figure 2.3.1-12 Victoria County Station, Raw Water Makeup (RWMU) System Intake Location Map

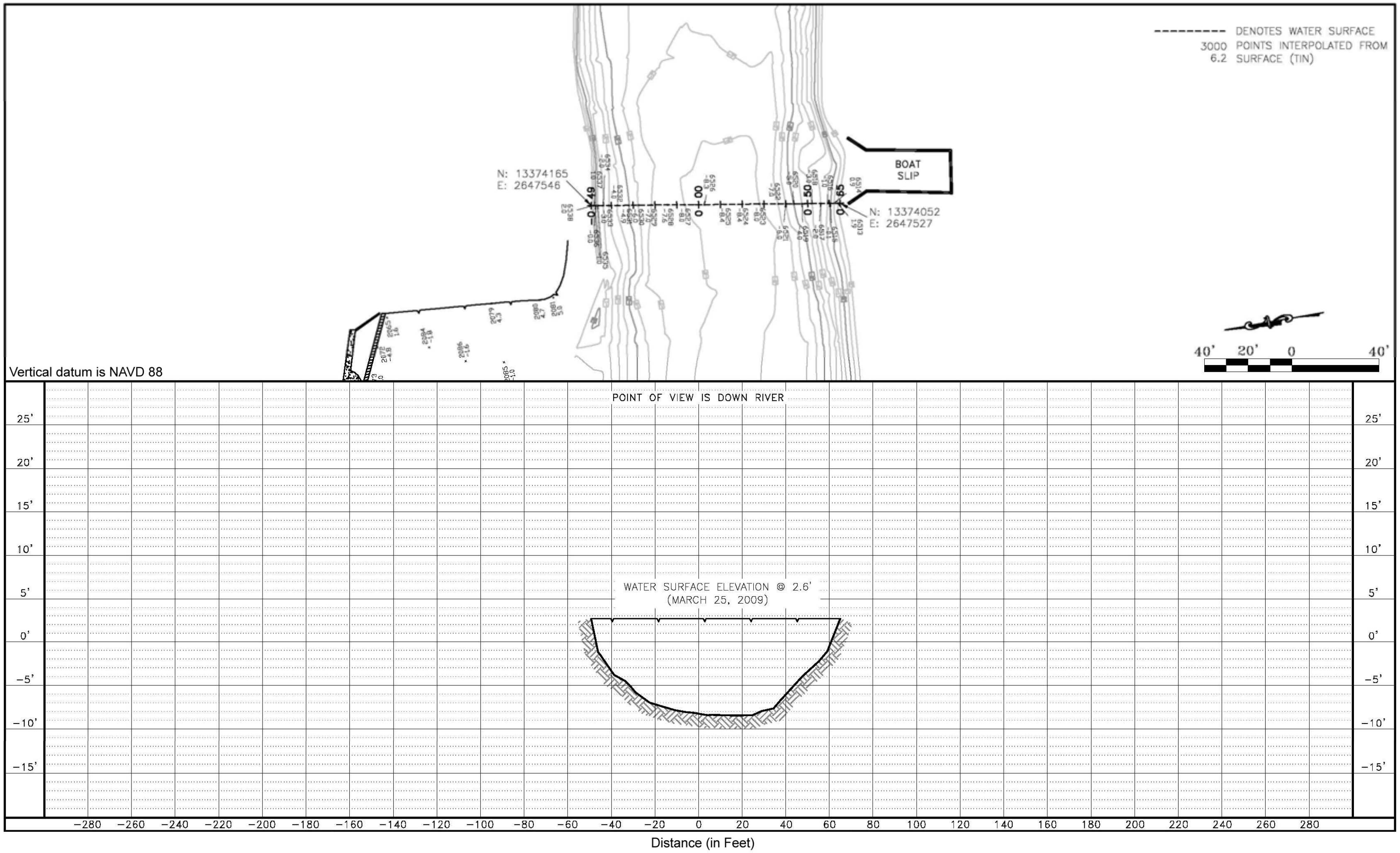


Figure 2.3.1-13 Guadalupe River Bathymetry — Near Raw Water Makeup System Intake Channel Location

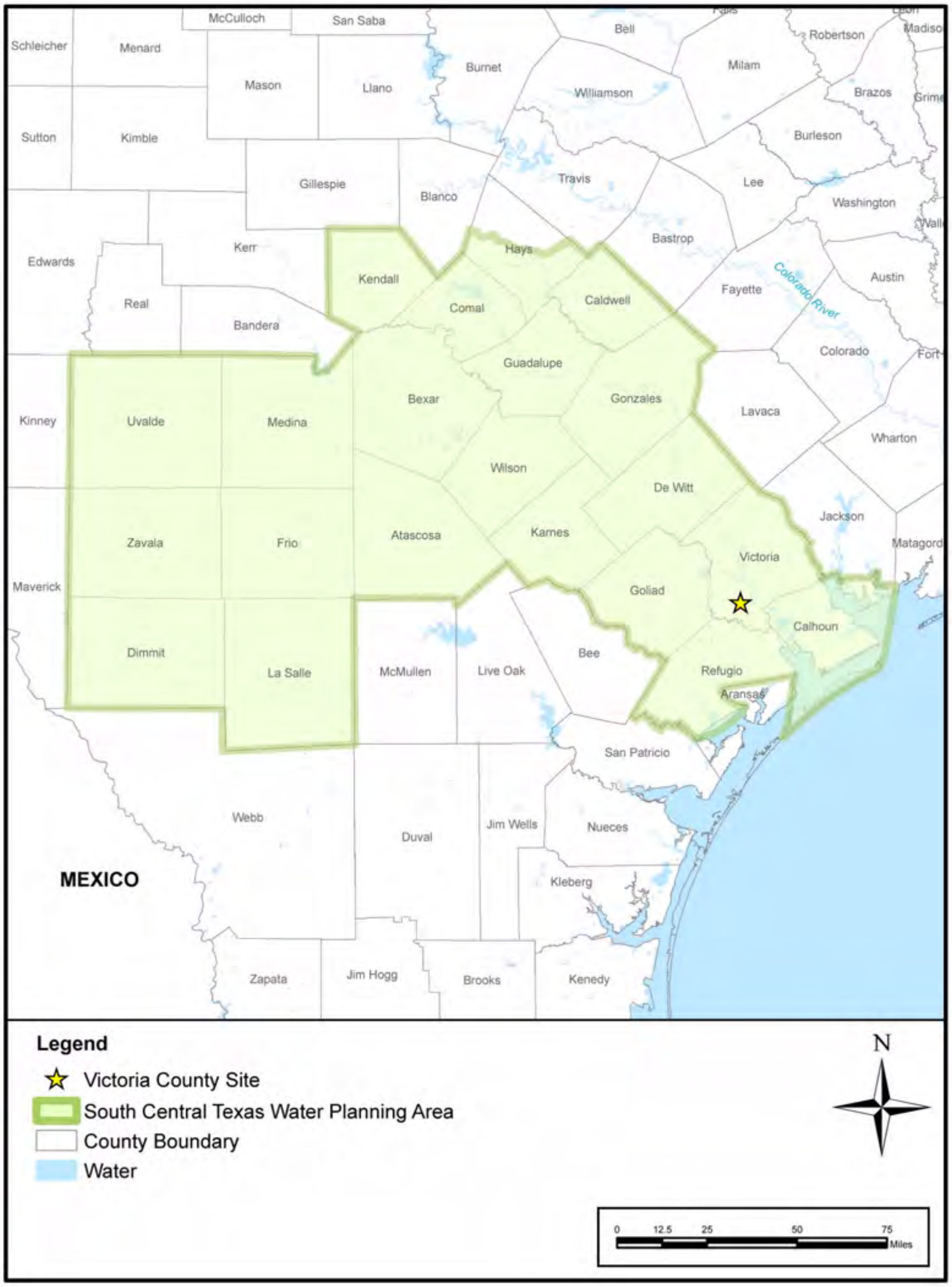


Figure 2.3.2-1 South Central Texas Water Planning Area (Region L)

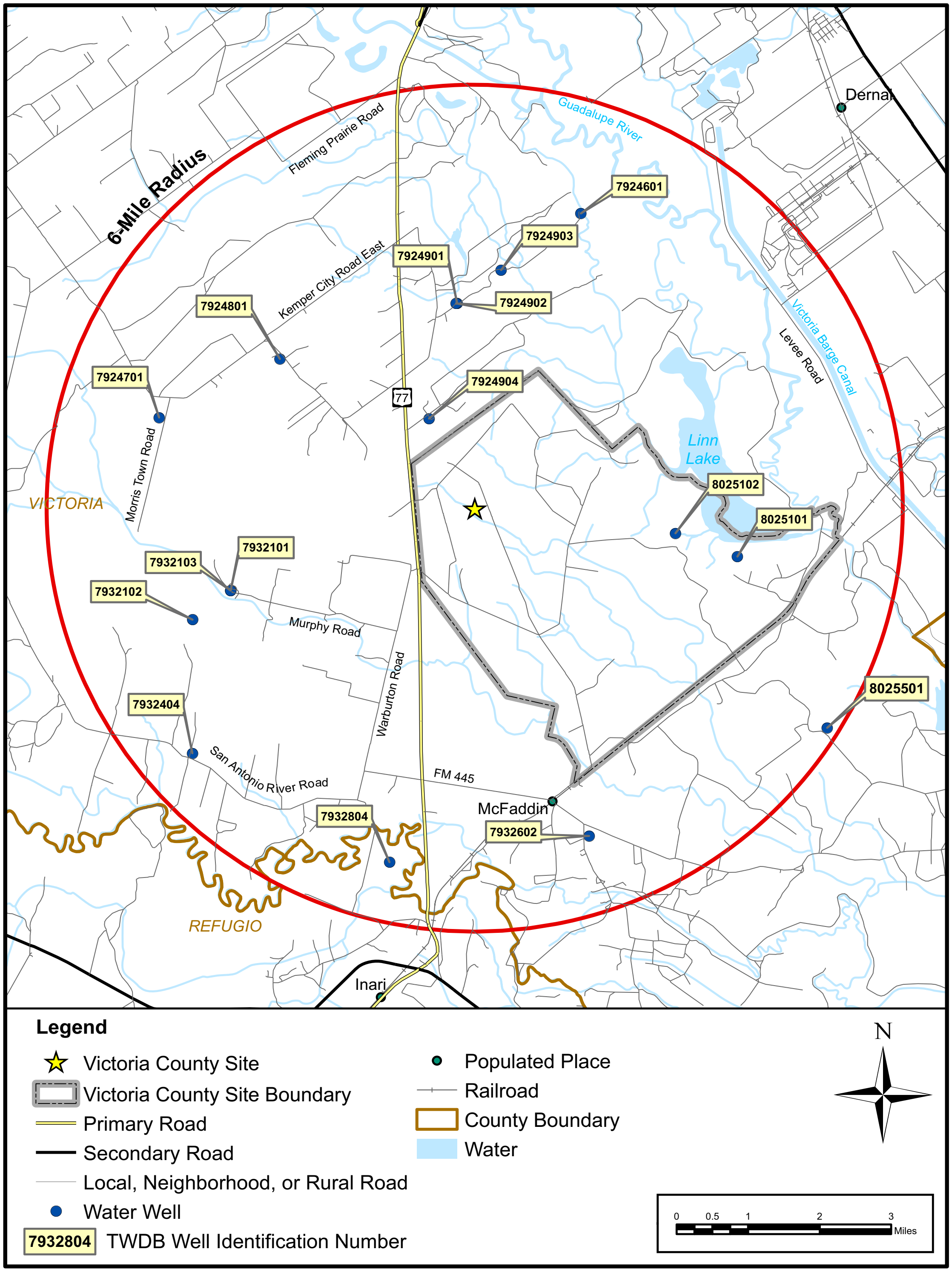


Figure 2.3.2-2 TWDB Well Location Map

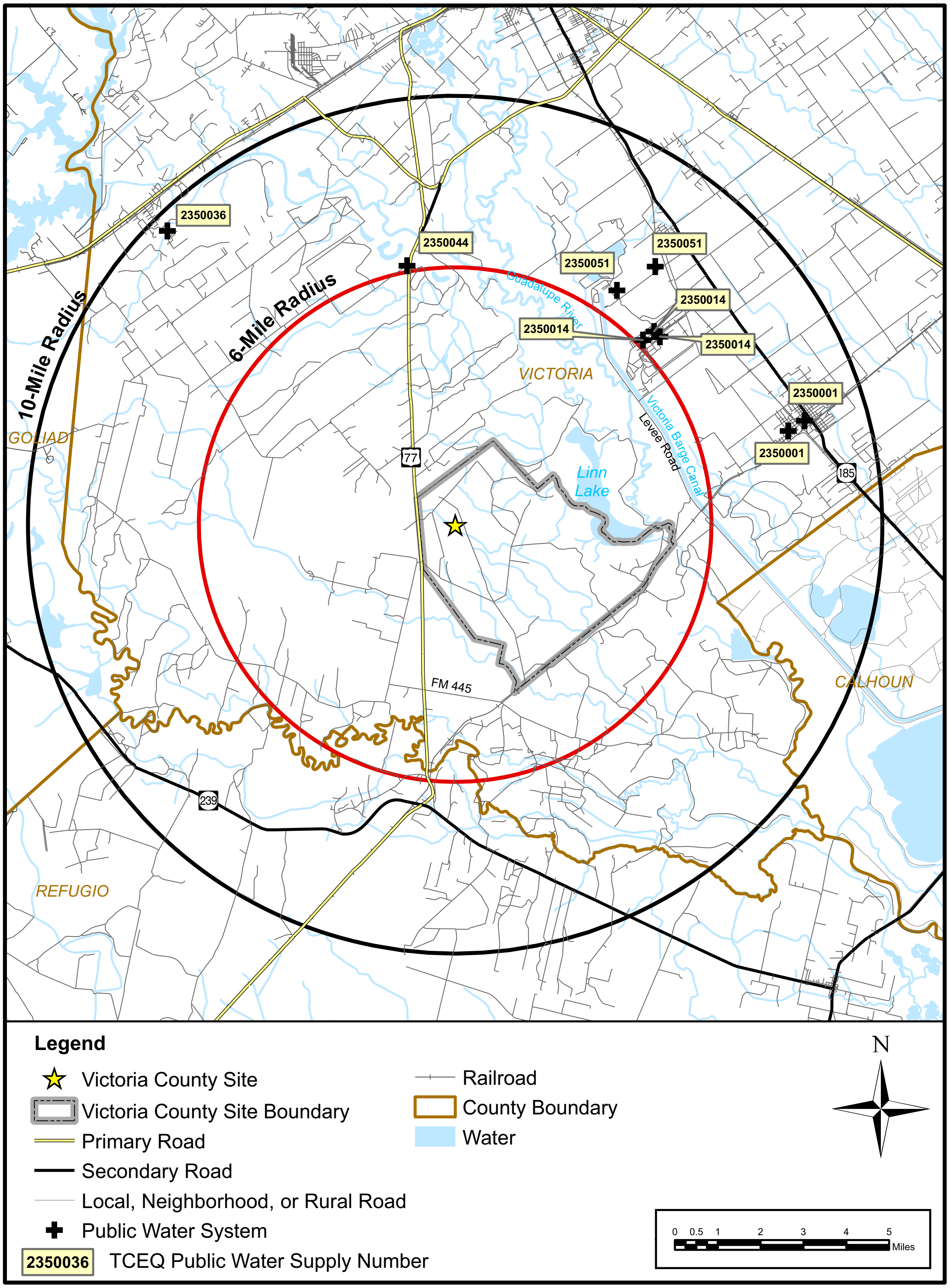


Figure 2.3.2-3 TCEQ Public Water System Wells within 10 Miles

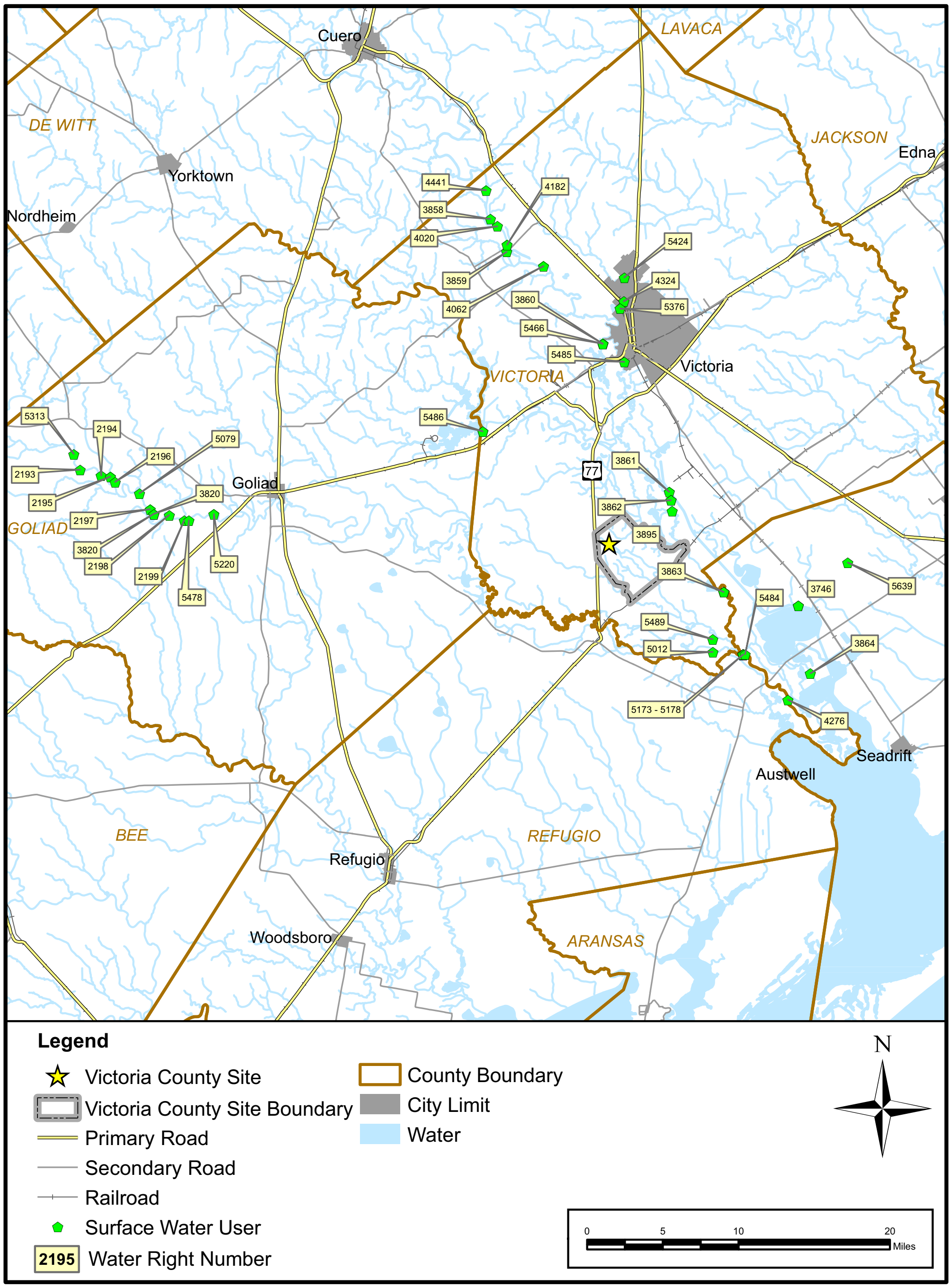


Figure 2.3.2-4 Surface Water Users in the Lower Guadalupe and Lower San Antonio River Basins

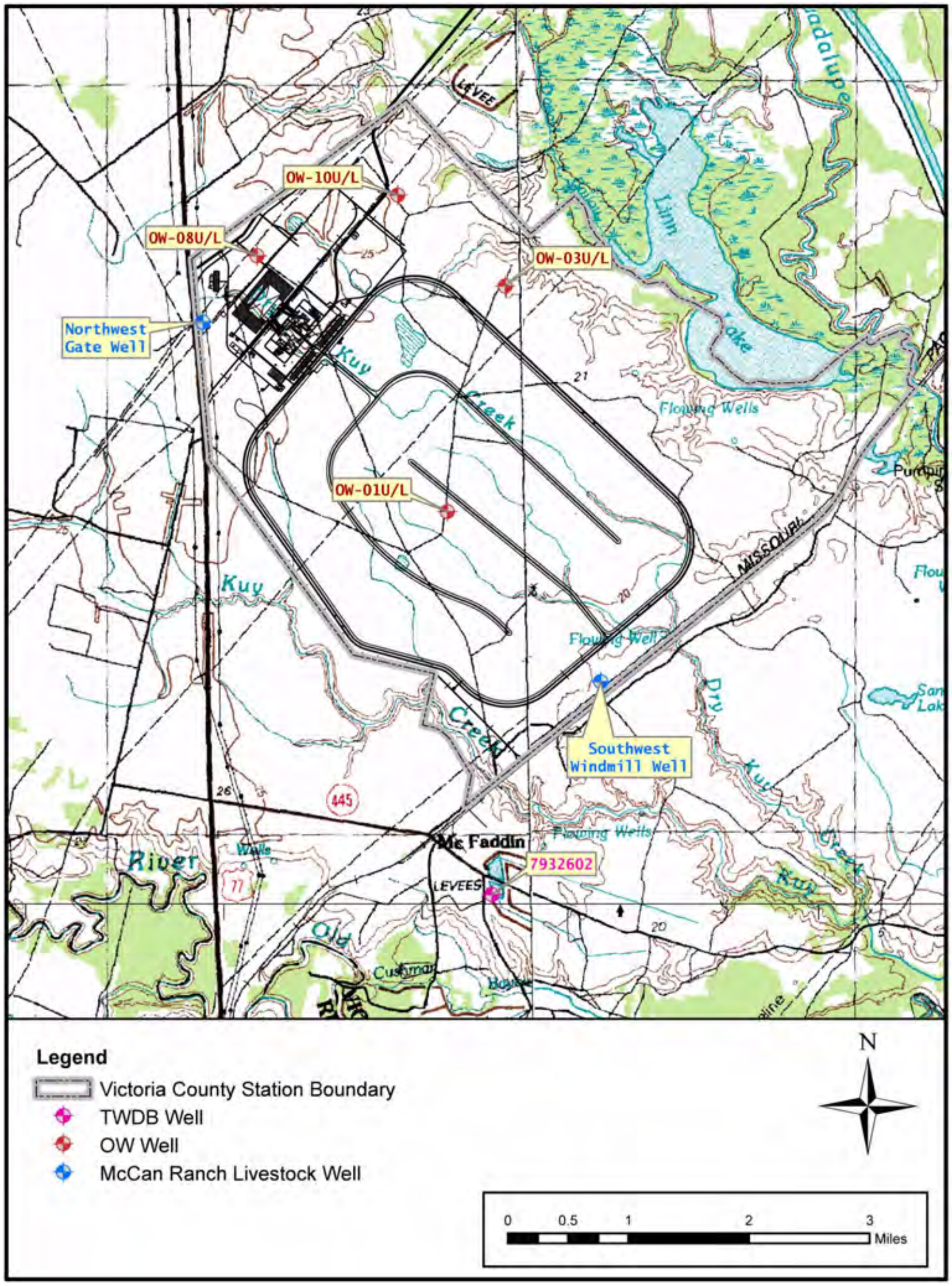


Figure 2.3.3-1 VCS Site Groundwater Well Sample Locations

Figure 2.3.3-2 TCEQ Surface Water Segments in the VCS Site Hydrologic System

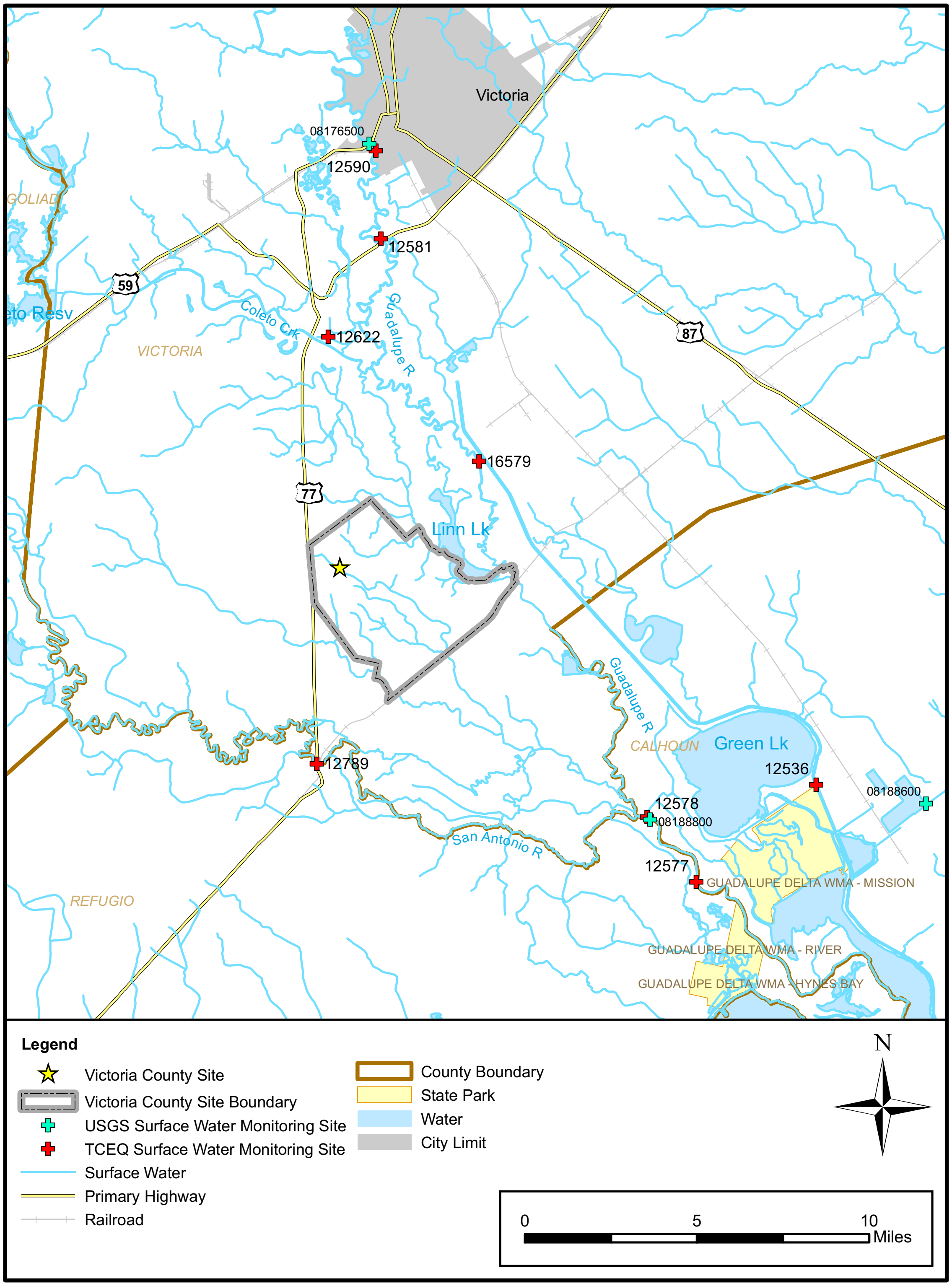


Figure 2.3.3-3 TCEQ and USGS Surface Water Monitoring Station Locations

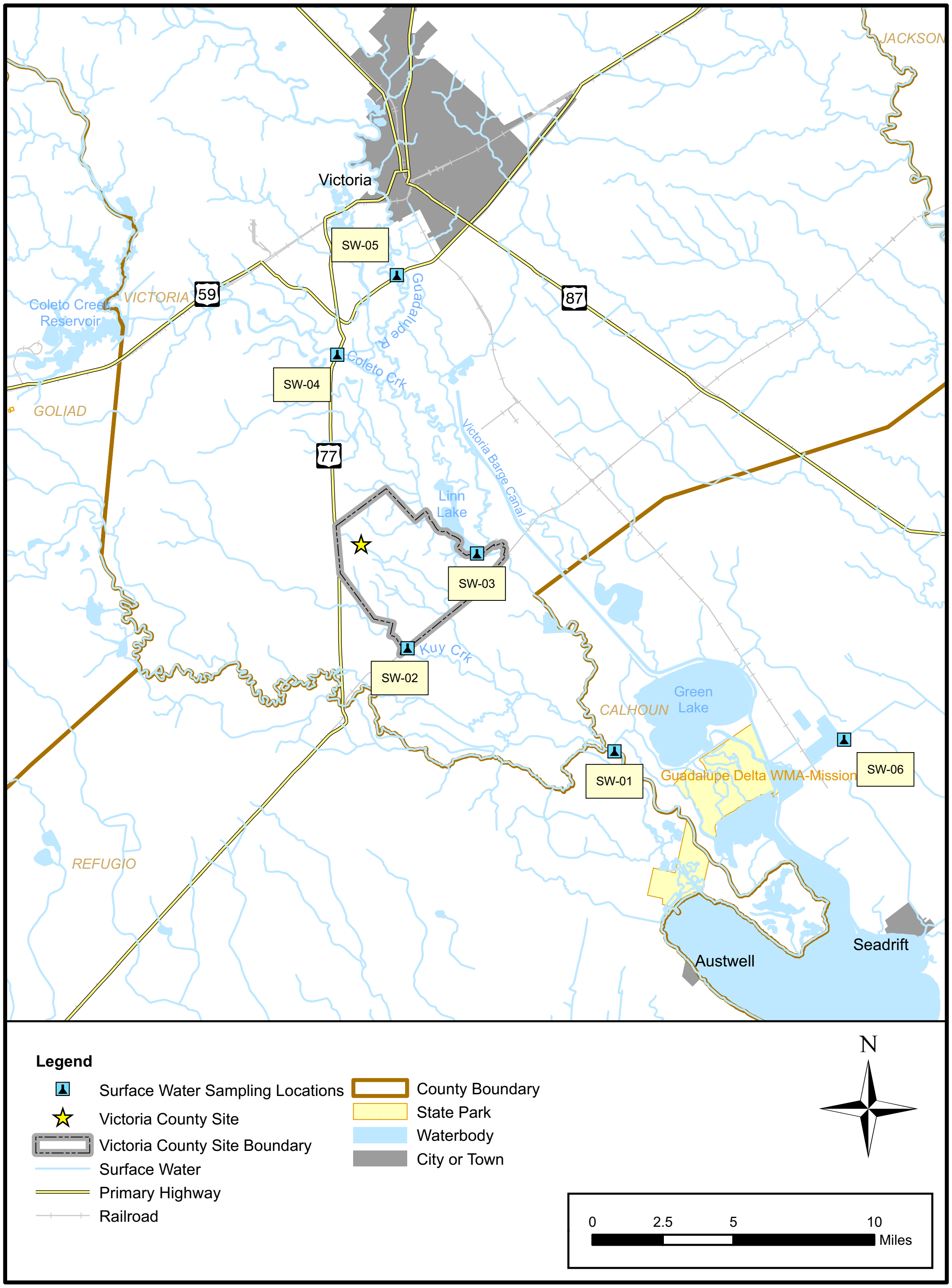


Figure 2.3.3-4 VCS Site Surface Water Sample Locations

Section 2.4 Table of Contents

Section 2.4 List of Tables

Section 2.4 List of Figures

2.4 Ecology

This section addresses resources for the two ecological environments: terrestrial (Subsection 2.4.1) and aquatic (Subsection 2.4.2).

2.4.1 Terrestrial Ecology

2.4.1.1 Regional Landscape

VCS is located within the coastal prairie ecosystem of east Texas, the southernmost tip of the tallgrass prairie system prevalent in the Midwest (USGS 2000). This area is typified by low elevation with native, open prairie grasses interspersed with post oak savannahs or live oak mottes (groves). Most uplands support Bluestem Grasslands, comprised of bushy bluestem (*Andropogon glomeratus*), slender bluestem (*Dichanthium tenue*), little bluestem (*Schizachyrium scoparium*), silver bluestem (*Bothriochloa saccharoides*), three-awn (*Aristida* spp.), buffalograss (*Buchloe dactyloides*), Bermudagrass (*Cynodon dactylon*), brownseed paspalum (*Paspalum plicatulum*), single-spike paspalum (*Paspalum monostachyum*), smutgrass (*Sporobolus poiretti*), sacahuista (*Nolina microcarpa*), windmillgrass (*Chloris cucullata*), southern dewberry (*Rubus trivialis*), live oak (*Quercus virginiana*), mesquite (*Prosopis* spp.), huisache (*Acacia farnesiana*), baccharis (*Baccharis* spp.), and MacCartney rose (*Rosa bracteata*) (McMahan et al. 1984). Much of the original coastal prairie in Victoria County has been converted to croplands or rangeland (TSHA 2001).

Inland freshwater marshes in this region typically support Maidencane-Alligator Weed Marsh vegetation. Commonly associated plants include water hyacinth (*Eichhornia crassipes*), cattail (*Typha* spp.), water-pennywort (*Hydrocotyle ranunculoides*), pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria* spp.), white waterlily (*Nymphaea odorata*), cabomba (*Cabomba furcata*), coontail (*Ceratophyllum demersum*), and duckweed (Family Lemnaceae) (McMahan et al. 1984).

The larger drainages often have bottomland forests. Bottomlands in the Guadalupe River basin commonly support Pecan-Elm Forest, including pecan (*Carya illinoesis*), American elm (*Ulmus americana*), cedar elm (*Ulmus crassifolia*), cottonwood (*Populus deltoides*), sycamore (*Platanus americanus*), black willow (*Salix nigra*), live oak, Carolina ash (*Fraxinus caroliniana*), bald cypress (*Taxodium distichum*), water oak (*Quercus nigra*), hackberry (*Celtis occidentalis*), virgin's bower (*Clematis* spp.), yaupon (*Ilex vomitoria*), greenbrier (*Smilax* spp.), mustang grape (*Vitis mustangensis*), poison oak (*Toxicodendron pubescens*), Johnson-grass (*Sorghum halipense*), Virginia wildrye (*Elymus submuticus*), Canada wildrye (*Elymus canadensis*), rescuegrass (*Bromus catharticus*), frostweed (*Helianthemum* spp.), and western ragweed (*Ambrosia* spp.) (McMahan et al. 1984).

2.4.1.2 General Site Description

The VCS construction landscape, as described in Subsection 2.2, consists of a proposed cooling basin (5785 acres disturbed) and approximately 1350 additional acres for the power block, ancillary facilities, parking, and laydown areas. Associated offsite areas include a cooling basin blowdown line to the Guadalupe River parallel to the transportation corridor, a rail spur, and an approximately 8.5 to 11-mile-long raw water makeup (RWMU) system pipeline between the RWMU pumphouse in Refugio County and VCS (Figures 2.2-4 and 2.2-5). New transmission corridors would be established to connect VCS with the existing power grid, but the exact route of these corridors has yet to be determined (Subsection 2.2.2.1). See also Subsection 2.4.1.7.

The main facility site consists primarily of rangeland (generally Bluestem Grasslands) with scattered oak mottes and encroaching thickets of invasive/nuisance shrubs, predominantly huisache (Figure 2.4-1). This rangeland receives varying levels of use by livestock, as approximately 1100 cattle and 150 horses are rotated among fenced parcels for grazing. Three management strategies are employed on the site to produce good forage for cattle and control the spread of invasive shrubs. Parcels of the property are burned on a 2.5-to-4.0 year rotation. Grazing by livestock is also used to maintain ground cover in an earlier stage of succession. Some portions of this rangeland have not been grazed in 3 to 4 years, and, thus, they can appear as tall “old field vegetation.” Finally, in some areas, encroaching shrubs are removed by mechanical and/or chemical (herbicidal) methods. The presence of livestock, the management of the property for these animals, and the general lack of upper level predators (see below) result in the classification of this landscape as a rangeland/grazing ecosystem. Such systems are dominated by plants and herbivores, and their productivity tends to be driven by climatic factors, primarily annual rainfall.

This rangeland is interspersed with ephemeral/intermittent streams and low-lying depressional wet areas (Figure 2.4-1). The largest ephemeral stream is Dry Kuy Creek, which originates in the northwest corner of the site and exits the south-central site boundary. According to U.S. Geological Survey 7.5-minute topographic maps, Kuy Creek is a perennial stream from north of the VCS site to its confluence with the Guadalupe River; however, based on field observations from October 2007 to July 2008, the portion of Kuy Creek located on the VCS site appears to flow intermittently. Consequently, Kuy Creek is characterized as an "intermittent stream.” Several other un-named ephemeral/intermittent streams occur on the site as tributaries of Dry Kuy Creek, Linn Lake, Black Bayou, and Kuy Creek. The ephemeral/intermittent streams have irregular flows, typically flowing after heavy rainfall events, but maintaining puddles through a portion of the year in low-lying areas near culverts, etc. It should be noted that sustained dry conditions existed in the region during these surveys. Flowing waters were observed in Dry Kuy Creek during only one (March) of five seasonal wildlife surveys. Bands of vegetation, primarily senna bean (*Sesbania drummondii*), border these stream channels. Flowing waters were observed in Kuy Creek during only two of five surveys, with only widely dispersed isolated pools present during the May and July wildlife surveys. Depressional wetlands, as classified primarily by soil type, occur throughout the site and their presence in some locations may be related to roadbeds and other landscape features impeding flows through the natural site topography (Figure 2.4-1). The hydroperiod of these wetlands can be affected by drainage area, vegetative community, their frequency of use by cattle, and rainfall amounts and patterns. Most ephemeral/intermittent streams and/or depressions are typically bordered by senna bean, and a few of the drier depressions have senna bean or grassland vegetation throughout. Many of these wetland areas (classified as such primarily by soil indicators) were indistinguishable from adjacent grassland/brush habitats during field surveys for wildlife. Herbaceous vegetation in both moist soil habitats (ephemeral streams and more hydrologically persistent depressional wetlands) is typified by sedges, switchgrass, delta arrowhead (*Sagittaria platyphylla*), squarestem spikerush (*Eleochairis quadrangulata*), smartweed (*Polygonum spp*.), and brushy bluestem.

The primary open water habitat associated with VCS is Linn Lake, on the eastern boundary of the site (Figure 2.4-1). Linn Lake is a natural oxbow lake fed by Black Bayou and the Guadalupe River and is relatively shallow with highly variable water levels. The only persistent open water habitats on the site are stock watering ponds. There are approximately 24 of these small rectangular ponds scattered across the site. Some ponds are associated with windmill pumps as water sources, whereas others are excavated in natural depressions. Many of these ponds have 4- to 6-foot-tall berms adjacent to them. The berms are typically planted with fast-growing trees like salt cedar (*Tamarix* spp.) and function as windbreaks for livestock.

Potential wetland habitats on the VCS site were examined in 2008 and 2009 employing the routine wetland delineation methods described in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (USACE 2008) to assess for occurrence of hydrophytic vegetation, hydric soils, and wetland hydrology, as indicative that wetlands were present (where differences are noted between the two documents in field approach, the Regional Supplement took precedence over the 1987 manual). Potential wetland habitats examined included wetland areas identified on USFWS National Wetland Inventory (NWI) maps, unmapped potential wetland habitats observed during field efforts, and intermittent/ephemeral stream beds and associated potential wetlands. Site surveys indicated the presence of 1,843 acres of wetlands on the 11,532-acre VCS site. The field evaluation of wetlands occurred during unusually dry conditions, which led to a reliance on soil indicators for wetlands delineation. Because Exelon has not submitted a revised jurisdictional determination request or a permit application to USACE, the USACE has not concurred on the wetlands delineation or determined the extent of federally jurisdictional waters at the site.

The site topography is generally flat, with the terrain becoming more rolling near the eastern boundary before sloping sharply downward to the Guadalupe River basin, specifically the slope in the eastern part of the site. The forest vegetation is dominated by live oak with a dense understory of saw palmetto (*Serenoa repens*). Many of the live oaks are large, greater than 2 feet in diameter at breast height. The forest edge is not abrupt. Scattered live oak trees occur amid the grassland vegetation close to the forest. Little or no grassland vegetation occurs within the closed-canopy forest areas.

At the base of the slope, the upland forest vegetation transitions to bottomland forest (Figure 2.4-1) with a dense tree canopy dominated by black willow and green ash. Occasional bald cypress trees are present. Saw palmetto is largely absent except near the base of the slope. The bottomland forest vegetation extends several hundred feet eastward from the slope to Black Bayou but is present as a narrow band generally less than 500 feet wide along the shore of Linn Lake. A few widely scattered bald cypress trees grow in shallower parts of Linn Lake.

2.4.1.3 Offsite Areas

2.4.1.3.1 Raw Water Makeup System

Raw water would be piped to the VCS cooling basin from the pumping station adjacent to the Guadalupe River in Refugio County. Three possible routes (A, B, and C) for the makeup water pipeline have been surveyed. The pumping station is approximately 0.6 mile southwest of the GBRA Saltwater Barrier on the Guadalupe River (Figure 2.2-5).

Route A extends southwest from the pumping station for approximately 1.4 miles before turning northwest for 8.7 miles (10.1 total miles). This route would cross the San Antonio River, Elm Bayou, Cushman Bayou, Kuy Creek and a tributary of Dry Kuy Creek. Land uses along this route include cropland and pasture (approximately 65 percent), shrub and brush rangeland (17 percent), mixed forestland (13 percent) and deciduous forests (5 percent).

Route B follows Route A from the pumping station for 1.4 miles then extends another 1.2 miles to the southwest. It then extends to the northwest for 3.5 miles and converges with Route A for the remaining 5.2 miles. The total length of Route B is 11.3 miles. This route would cross the San Antonio River and one of its tributaries, Cross Bayou, Cushman Bayou, Kuy Creek, and a tributary of Dry Kuy Creek. Land uses along this route include shrub and brush rangeland (37 percent), cropland and pasture (44 percent), mixed forestland (14 percent) and evergreen forests (5 percent).

Route C extends northwest from the pumping station for 8.5 miles to the VCS. It crosses the San Antonio River, Elm Bayou, Kuy Creek, a tributary of Kuy Creek, and Dry Kuy Creek. Also, this route crosses a Natural Resources Conservation Service Wetlands Reserve Program area between Elm Bayou and Kuy Creek. Land uses along this route include cropland and pasture (41 percent), forested wetlands (35 percent), shrub and brush rangeland (10 percent), and mixed forestland (14 percent).

The primary land covers include cropland and pasture, shrub and brush rangeland, and mixed forests. Vegetation within these land cover types is similar to that described for these land covers on the VCS site. All wetland acreages along the selected route would be subject to field verification. Assessment of impacts to jurisdictional wetlands/waters has yet to be determined (pending delineation and USACE confirmation at the COL stage).

2.4.1.3.2 VCND Transportation Corridor and Cooling Basin Blowdown Line

Independent of the VCS project, the Victoria County Navigation District (VCND) plans to build a transportation corridor to connect the VCND barge facility to the highway system (U.S. Highway 77) adjacent to the VCS, and this corridor would be used to transport the heavy components to the construction site. A heavy haul road (HHR) would be built on VCS property to connect the transportation corridor to the construction site. A 48-inch discharge blowdown line would be installed (buried) within the rights-of-way of the HHR and transportation corridor. Exelon determined that co-locating the transportation corridor and blowdown line would produce fewer impacts than if the corridors were separate (Figure 2.2-4).

The transportation corridor from U.S. Highway 77 to the barge facility would be approximately 6.8 miles long, extending east from the VCS, down gradient to the Guadalupe River floodplain for approximately 3.7 miles. The corridor would cross the Black Bayou, Sand Bayou, an unnamed water course and gullies, and the Guadalupe River. The construction rights-of-way for the combined transportation corridor and blowdown line would be approximately 270 feet wide between the VCS and the Guadalupe River, and approximately 300–310 feet wide from the Guadalupe River to the barge facility. The drivable surface of the road would vary from 80–100 feet in width.

The transportation and blowdown line corridor traverse habitats similar to those described for the bottomland portions of the VCS site, including an overstory of ash and other hardwoods and an understory of saw palmetto in the less disturbed areas. Assessment of impacts to jurisdictional waters has yet to be determined (pending delineation and USACE confirmation at COL stage).

2.4.1.4 Terrestrial Wildlife

2.4.1.4.1 Avifauna

Surveys were conducted seasonally starting from late October 2007 through early October 2008 to document avifauna use of the VCS site, covering late fall, late winter, late spring, late summer, and early fall. The avian monitoring consisted of 2 days (minimum 18 hours) per season of vehicular and pedestrian surveys of the various habitats of the proposed VCS site (see habitats in Figure 2.4-1) to determine seasonal species composition and estimate relative abundance of avian species. One hundred and six avian species were observed on the VCS site during the various surveys (Table 2.4-1). Avian species such as bobwhite quail (*Colinus virginianus*), scissor-tailed flycatcher (*Tyrannus forficatus*), northern cardinal (*Cardinalis cardinalis*), and mockingbird (*Mimus polyglottos*) were considered abundant spring/summer species and likely to nest on the site. Species such as sandhill cranes (*Grus canadensis*) and cliff swallows (*Petrochelidon pyrrhonata*) were abundant in specific seasons and likely responding to favorable environmental conditions. Abundance categories were intuitively based on species encounters within the project area.

Regional data concerning occurrence of birds during the breeding season are derived during the annual North American breeding bird survey, conducted in June of each year. These surveys are 24.5 miles long with 3-minute stops every 0.5 mile to document avian species presence within 0.25 miles (Sauer et al. Jul 2007). The two closest breeding bird surveys to the VCS site are the Schroeder (No. 83014) and Indianola (No. 83013) routes. The Schroeder route lies west-northwest of Victoria, Texas and the Guadalupe River, approximately 20 miles northwest of the VCS site, and contains the following primary habitat types: grassland (35 percent), shrubland (28 percent), deciduous forests (17 percent), and pasture (14 percent) (Sauer et al. Jul 2007). Eighty-one avian species were observed along this route during the latest breeding bird survey. The Indianola route lies east of Green Lake and extends to the marshes below Port Lavaca. The route starts approximately 7.5 miles east-southeast of the VCS site. It contains the following primary habitat types: row crops (53 percent), emergent wetlands (16 percent), pasture (13 percent), and grassland (7 percent) (Sauer et al. Jul 2007). One hundred and nine species were observed during the latest (2007) breeding bird survey along this route. The higher number of species observed compared with the Schroeder route was likely a result of the presence of aquatic habitats and row crops along the Indianola route, which are more conducive to waterbird and waterfowl use. The numbers and types of birds documented for the VCS site in late May 2008 were more similar to the breeding bird survey results for the Schroeder route. This is expected, given the greater similarity in habitat types between the VCS site and the Schroeder breeding bird survey route.

The east coast of Texas, including the VCS site, is located at the terminus of the Central Flyway migration route, resulting in the occurrence of many different species of avifauna during the fall, winter, and spring months (Shackelford et al. Nov 2005). Thousands of migrating birds from the cooler regions of the continent visit or winter in the coastal zone of Texas annually. Other migrants traveling to or from Central and South America use this region of Texas as a stopover point before continuing their travels. Christmas Bird Counts (CBCs) are one measure of avian diversity during the winter period. During these counts, attempts are made to identify and count all birds within a 15-mile-diameter circle on one day during the winter season. The two CBCs nearest to the VCS site are the Guadalupe River Delta/McFaddin Family Ranches (TXGF) and the Victoria (TXVI) counts. TXGF is centered on the northwest corner of nearby Green Lake and the circle boundary extends to the railroad tracks on the southeastern boundary of the VCS site. The circle includes a wide variety of habitats, including Guadalupe River riparian forest, rangeland, marshes, state Wildlife Management Areas, two chemical plants, and portions of Hynes and Guadalupe Bays. The number of avian species observed during the TXGF CBC from 2004 through 2006 ranged from 212 to 225 species (NAS 2007). The number of avian species observed during the TXVI CBC from 2004 through 2006 ranged from 126 to 152 species (NAS 2008).

Another measure of diversity associated with migration is the Great Texas Birding Classic. It is held annually in mid-April during spring migration along the Texas Gulf Coast. VCS, and Victoria County, are in the “central coast” region of this Classic, along with 18 other counties south to, and including, the Corpus Christi area. In 2007, 218 avian species were observed in the central coast region (GCBO 2008).

Avian surveys of the VCS site suggest a reduced avian diversity when compared to the long-term avian studies of this region. However, this is likely because of differences in size and complexity of areas surveyed, with most of the long-term studies covering larger areas with more diverse habitats, and having greater surveying efforts (numbers of observers documenting birds). The findings of the VCS surveys were thus a subset of the other, larger studies.

2.4.1.4.1.1 Mammals

Mammals either observed or indicated by tracks and other signs on the site during seasonal avian surveys include armadillo (*Dasypus novemcinctus*), white-tail deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), wild hog (*Sus scrofa*), bobcat (*Lynx rufus*), opossum (*Didelphiis virginiana*), eastern cottontail (*Silvilagus floridanus*), swamp rabbit (*S. aquaticus*), Attwater’s pocket gopher (*Geomys attwateri*), fox squirrel (*Sciurus niger*), gray squirrel (*S. carolinensis*), and coyote/dog (*Canis spp.*). Specific surveys for mammals were conducted in April/May of 2008. These were one-time surveys during the peak of activity of these species to document species presence and relative abundance. Abundance categories were intuitively based on species encounters within the project area and regional knowledge. Surveys included 800 total trap-nights (Sherman live traps) in the various habitats of the VCS site (for small mammals), with trapping effort apportioned based on habitat abundance (grassland habitats were trapped for 400 trap nights and the remaining four habitat types were trapped for 100 trap nights each) (Figure 2.4-2). Additionally, five remote game cameras were established at scent stations on site to document larger animals. Two of these were set for 25 days each in the grassland habitat, and one each were set in the bottomland, oak forest, and oak motte habitats (cameras could not be set in the wetland habitat type). A single nighttime spotlight survey occurred along the existing site roads, and two mist nets were deployed one night in the bottomland habitats for bats. Sixteen total mammal species were observed on the VCS site during all surveys combined (Table 2.4-2). The greatest diversity of small mammals (N=5 species), based on the Sherman live trap survey, was found in the bluestem grasslands, followed by depressional wetlands (two species) and one species each for the oak forest and oak motte habitats. No small mammals were recorded in the bottomland hardwood areas with the Sherman traps; however, five larger mammal species were documented in bottomland habitat by a game camera. These bottomland hardwood areas are inundated for extended periods after heavy rains and small mammals are likely displaced by these events. Although not documented during the various survey methods, pocket gopher mounds are abundant on the upland portions of the site. These were confirmed to be Attwater's pocket gophers (*Geomys attwaterii*). Mammals considered abundant within the available habitats included Attwater's pocket gopher, white-tailed deer (*Odocoileus virginiana*), raccoon (*Procyon lotor*), fox squirrel (*Sciurus niger*), and cotton rat (*Sigmodon hispidus*). No bats were captured with the mist nets and none were observed during evening hours around aquatic habitats during other surveys.

2.4.1.4.1.2 Herpetofauna

The eastern garter snake (*Thamnophis sirtalis sirtalis*), broad-banded watersnake (*Nerodia fasciata confluens*), western diamondback rattlesnake (*Crotalus horridus*) and alligator (*Alligator mississippiensis*) were the only reptiles observed on site during the seasonal avian surveys. Specific surveys for reptiles and amphibians were conducted in May 2008. These were one-time surveys during the peak of activity of these species to document species presence and relative abundance. Abundance categories were intuitively based on species encounters within the project area and regional knowledge. Herpetological surveys included timed searches of the various habitat types (28 total hours) with searching effort apportioned based on habitat abundance (grassland habitats were searched for 12 hours and the remaining four habitat types were searched for 3 to 5 hours each) (Figure 2.4-2). Other surveying techniques included audible call counts during all surveying efforts, six funnel traps deployed for three nights each in aquatic habitats and a nocturnal road cruise on site roads. A total of 22 herpetological species were observed on the VCS site during all surveys combined, including eight snake, seven frog, three turtle, two lizard and one salamander species, as well as the alligator (Table 2.4-3). The greatest diversity (based on the timed searches) was found in the depressional wetland habitat type. No herpetological species were found within the bluestem grasslands during these timed searches, although a few species were observed in this habitat during the other surveys. Species considered abundant within the available habitats during these surveys included southern leopard frog (*Rana sphenocephala*) and diamondback water snake (*Nerodia rhombifer rhombifer*), with both species found primarily in the site's depressional wetlands.

2.4.1.5 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) is responsible for designating lands as "critical habitat" for federally listed endangered and threatened species. Such lands are protected to aid the recovery of the species and may require special management activities. No area designated by the USFWS as critical habitat is found within or adjacent to the VCS site. The nearest critical habitat is the primary wintering area for federally endangered whooping cranes (*Grus americana*), located approximately 18 miles south of the VCS site in Aransas and Calhoun Counties (CWS & USFWS Mar 2007) (Figure 2.4-3). Wintering habitat for the threatened piping plover (*Charadrius melodus*) is located along the shoreline of Matagorda Island (66 FR 36038-36086), approximately 25 miles south of the VCS site. Portions of the VCS site were included in a Safe Harbor Agreement for Attwater's prairie chicken (*Tympanuchus cupido attwateri*), a federally endangered species that was formerly known in Victoria County, with the landowner agreeing to manage vegetation on this property for this species until 2009 or until the property is sold. Because of this Safe Harbor Agreement and resulting site management activities, as well as the site's proximity to historical (currently unoccupied) breeding grounds, the VCS site lies within a priority management zone for this species (USFWS Sept 2007). However, based on discussions with the USFWS, this species does not reside on the proposed VCS site, and no experimental birds have been released there (the closest release was greater than 7 miles to the west in Goliad County).

Eighteen animal species that are either federally or state-listed as endangered or threatened have been recorded or historically occurred in Victoria County (Table 2.4-4). No federal- or state-listed plants have been recorded for Victoria County. Table 2.4-4 reflects recorded or historical occurrences for federal and state-listed species for counties containing portions of the intake and transmission corridors, which include Calhoun, DeWitt, Goliad, Jackson, Matagorda, Refugio, Victoria, and Wharton. It should be noted that occurrences of federally-listed species on the state and federal Websites occasionally differ. The state Websites include all counties within the historical range of these species and the federal Websites include only counties with recent sightings. As a conservative approach, Exelon has included species in counties from both Websites. Exelon has initiated correspondence with the appropriate federal and state agencies (National Marine Fisheries Service, Texas Parks and Wildlife Department, and USFWS) regarding endangered and threatened species (Appendix A).

The only federally listed species observed on the VCS site during the avian surveys was a single bald eagle (*Haliaeetus leucocephalus*) soaring near Linn Lake in October 2007. Although de-listed under the Endangered Species Act, it remains protected under the Bald and Golden Eagle Protection Act (72 FR 37346-37372). Only two state-listed "threatened" species were observed on the VCS site during the various wildlife surveys. The white-tailed hawk (*Buteo albicaudata*) was observed in low numbers (fewer than five) during all surveys of the VCS site. They typically use shrubby rangeland habitats in eastern Texas, but nesting was not observed on site. The wood stork (*Mycteria americana*) is a large wading bird that is also listed as federally endangered in other portions of their range (southeastern United States). They have bred in Texas occasionally within the past few decades, but most current sightings are presumed to be post-breeding season birds dispersing from populations in Mexico. Wood storks feed in shallow open-water wetlands and the two sightings (one bird each) in May and July on the VCS site were associated with the riverine bottomlands. In addition, a flock of 30 storks was observed flying over Linn Lake in October of 2008.

Whooping cranes (*Grus americana*) are listed as endangered by both federal and state agencies because of population declines first noted in the 1800s. These declines were thought to have been caused by human colonization of the northern Great Plains and subsequent conversion of native prairies and potholes to pasture and crop production (Campbell 2003). The population may have dropped below 30 cranes in the late 1930s, but multinational recovery efforts now estimate a population of over 400 birds. The majority of these cranes nest in the Wood Buffalo National Park in the Northwest Territories, Canada, and winter at the Aransas National Wildlife Refuge (NWR) on the coast of Texas, approximately 18 miles south of the VCS site. The Aransas area is listed as critical wintering habitat for the whooping crane (Figure 2.4-3; CWS & USFWS Mar 2007).

Whooping cranes migrate from their breeding grounds in the fall, generally arriving on the Texas coast between late October and mid December (Campbell 2003). They use an approximately 200-mile-wide migration path en route, then spend almost 6 months on the wintering grounds on and near the Aransas NWR. While on the wintering grounds, they typically forage in brackish bays, marshes, and salt flats, feeding on a variety of food sources including wolfberry fruit (*Lycium Carolinianum*), blue crabs (*Callinectes sapidus*), and other prey. The whooping cranes leave their Texas wintering grounds in late March and early April, returning to Canada. Survival of wintering cranes varies annually.

Despite the overall growth in whooping crane population since the 1940s, several potential threats to whooping cranes and their habitat have been identified. Potential threats include land development in the vicinity of the Aransas Wildlife Refuge, their wintering habitat, that limits expansion of nesting territory as the flock grows. Sea level rise, changes in fresh water inflows, the spread of black mangrove on the wintering grounds, wind energy development, and power lines have also been identified as threats. (WCEP Nov 2009) Several of these threats are discussed in the following paragraphs.

Changes in freshwater inflows into San Antonio Bay may impact blue crab populations (CWS & USFWS Mar 2007). Blue crabs are responsive to salinity levels. Changes in salinity levels potentially resulting from changes in freshwater inflows into the San Antonio Bay system and other factors such as precipitation could result in increased salinities and affect blue crab distribution and numbers. Thus an important food resource for the wintering cranes could be impacted. To further examine the diet, behavior, and habitat of whooping cranes in this region, a series of empirical studies (the SAGES project; Slack *et al.* 2009) were implemented to provide data for computer simulations. Impacts of one aspect investigated include the relationship of variation of freshwater inflows on whooping crane prey and crane use of the bay habitats. Among the many findings of these studies were (1) the diet of cranes is varied and includes wolfberry fruit, blue crabs, clams, snails, insects, fiddler crabs, snakes, and fish; (2) that blue crabs were not always the primary prey item; (3) that wolfberry fruit production is strongly and negatively influenced by salinity levels during summer leaf production (i.e., high salinity = low production); (4) blue crab abundance was influenced by a combination of environmental factors including water levels, windspeeds, water temperature, and salinity; and (5) although salinity was statistically significant and positively correlated with crab abundance in the selected multivariate model, salinity level alone was not a determining factor in crab abundance. The results from these studies were incorporated into computer models. The following relationships were suggested based on computer simulations for the 11-year period from 1997 - 2007: (1) the food supply in the area does not seem limiting, even during lower freshwater inflow conditions within the 11-year period; (2) wolfberry abundance is lower when salinities are higher; (3) blue crab abundance was best explained by a suite of environmental factors that could not be simplified into single-factor predictive models; and (4) the relationship between salinity and whooping crane energetics and/or survival is still uncertain. Given that some of these findings were contrary to those from earlier studies (see comments in Slack *et al*.), additional studies have been proposed to more directly examine the relationship between freshwater inflows, blue crabs, and whooping crane energetics and survival.

The major cause of mortality of the current whooping crane population is collisions with transmission and distribution lines, especially lines within the migratory pathway (CWS & USFWS Mar 2007). Tower guy-wires are also a concern, although to a lesser degree. The USFWS required a transmission company to mark transmission lines with highly visible “aviation balls” within a Texas portion of the whooping crane migratory pathway (AEP 2007). “Spiral markers” are installed on some transmission lines to reduce avian collisions. Another threat to the wintering cranes includes impacts of disturbance (noise, human presence, etc.), a concern resulting from access to the wintering grounds (most areas are public domain) and the continued development along the Texas Coast.

High mortality rates for the Aransas-Wood Buffalo population of whooping cranes during 2008–2009 were documented by the Whooping Crane Eastern Partnership (WCEP), a group of government agencies and non-profit organizations that joined forces to reintroduce a migratory population of whooping cranes to eastern North America. According to WCEP, the majority of losses appear to have occurred during migration. Several possible factors for this mortality level have been identified such as extreme drought which affected food sources and fresh drinking water available in the wintering grounds and disease (e.g., infectious bursal disease (IBD)). Further, chick mortality at Wood Buffalo National Park in Canada was also high, potentially due to higher than average rainfall while the chicks were young. Data from specific analyses (e.g., necropsies, water quality and food source abundance data correlation) was not included in the WCEP assessment. (WCEP Nov 2009)

Due to the fact that only four crane carcasses were recovered, the reports of mortality during the 2008-2009 overwintering period were based primarily on the apparent absence of birds during USFWS aerial census events. These missing birds, which were documented as arriving at Aransas National Wildlife Refuge (ANWR) during earlier aerial censuses, accounted for up to 19 of the 23 suspected mortalities (USFWS 2009a and USFWS 2009b).

During the 2008-2009 overwintering season at ANWR, above-normal upland and water hole use was noted, scattering the cranes over a geographical area beyond their typical territory. As described in the January 2009 USFWS aerial census report, "This makes it very difficult to determine the identity of pairs and family groups and leads to much uncertainty during the census count" (USFWS 2009a). Limited visibility due to weather conditions and smoke from prescribed burns, as well as flight time limitations, were noted on multiple census flights, adding to the difficulty in spotting the widely dispersed cranes (USFWS 2009a). Considering these and other factors, it is possible that the extent of whooping crane mortality during the 2008–2009 overwintering period could be lower than reported.

Given the few carcasses recovered, questions also remain regarding the causes of the reported whooping crane deaths. USFWS reports from the first half of 2009 postulated that the birds absent during the later aerial census counts succumbed to injury, predation, and/or disease resulting primarily from food-related stress (particularly related to small amounts of wolfberries and blue crabs) believed to be brought on by the regional drought conditions (USFWS 2009b). Additionally, the need for the cranes to fly to upland areas to find fresh water to drink was cited as an energy burden that could have further weakened the birds (USFWS 2009b). However, as discussed previously, empirical research indicates that the crane diet is rich and varied, and even when blue crab and wolfberry numbers are low, cranes can meet their daily energy and protein requirements by efficiently foraging on foods such as insects, snails, and razor clams (Slack et al. Aug 2009). As an example, cranes were noted eating fiddler crabs immediately prior to their early departure from ANWR in spring 2009 (USFWS 2009b). Furthermore, the flock departed ANWR relatively early in 2009 (USFWS 2009b). Previous research has indicated that birds will generally migrate earlier than usual when food availability allows for rapid fattening and good physical condition (Studds and Marra 2007).

Additionally, other factors could have contributed to crane mortality. As noted in the USFWS report Whooping Crane Recovery Activities, October 2008–October 2009, the National Wildlife Health Center in Madison, Wisconsin was able to isolate a virus very similar to IBD in a recovered juvenile carcass. One of the symptoms of IBD is emaciation, even when a bird is receiving adequate food. If it turns out the virus is a form of IBD, this would be the first case ever documented in a crane from the Central Flyway (USFWS 2009b). Taking into account the available information, there is uncertainty regarding the specific cause or causes of death for the whooping crane mortalities reported over the 2008-2009 overwintering period at ANWR.

The brown pelican (*Pelecanus occidentalis*) is a large gray-brown bird with a characteristic long bill and pouch, known to forage on fish in coastal areas (Campbell 2003). Historically present in large numbers along the Atlantic and Gulf Coasts, the brown pelican population dropped dramatically by the mid-1970s primarily owing to insecticide (DDT) impacts on egg quality, and it was classified as federally-endangered throughout its range. Around 1900, an estimated 5000 brown pelicans nested on the Texas Coast, but the population declined to less than 10 breeding pairs by 1970, partially as the result of disturbance at their nesting areas by fishermen. Control of insecticide use and other recovery activities (e.g., nesting site protection) have resulted in recovery of segments of the population. In 1985, pelicans along the Atlantic and Florida Coasts had recovered sufficiently to be de-listed, whereas brown pelicans in Louisiana, Texas, and California remain classified as endangered. Currently, the Texas population is at or near historical levels (USFWS 2007a). Primary threats to Texas pelicans are loss of their nesting habitat, typically dredge spoil islands, which are subject to loss during hurricanes, and pollution from either off-shore oil wells or shipping. The closest nesting locations to the VCS site are in Aransas, Calhoun, and Matagorda Counties (USFWS 2007b).

Piping plovers (*Charadrius melodus*) are small stocky shorebirds that nest on shoreline beaches in the northern Great Plains, Great Lakes, and Atlantic Coast areas. All populations are listed as either federally-threatened or endangered. Piping plovers are a migratory species, wintering along the Gulf Coast and other southern locations. Critical wintering habitat for the piping plover is designated along the Texas Gulf Coast, with the closest area to the VCS site located in Matagorda Island bayside habitats in Calhoun County, approximately 25 miles south of the VCS site (Figure 2.4-3).

Five species of sea turtles are federally listed for Calhoun County (Table 2.4-4) including: loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), and the Kemp's Ridley sea turtle (*Lepidochelys kempii*). Three species are known to nest on Texas barrier island beaches (TSTNR 2007), and all five could possibly occur in San Antonio Bay.

Sightings and strandings of endangered West Indian manatees (*Trichechus manatus*) have been recorded over the last 100 years across the entire Texas Coast (Schmidly 2004). A live stranding of a manatee occurred near Galveston, Texas, as recently as 2007 (TMMSN 2007). However, there is no evidence that a breeding population ever existed along the Texas Coast; individuals sighted/stranded in Texas probably represent migrants from Mexico (Schmidly 2004), possibly as the result of cool northern Gulf waters.

Several endangered or threatened species in Table 2.4-4 have become extirpated in the counties associated with the VCS site resulting from the loss of their specific habitats as humans settled the area and altered the natural landscape to a more open and managed agricultural landscape. Once found throughout eastern Texas, the red wolf's (*Canis rufus*) decline was linked to these land use changes, which reduced their more forested habitats and enhanced that of the coyote (*Canis latrans*), resulting in a population overlap. Subsequent interbreeding between the two canine species has effectively resulted in the extirpation of the red wolf from Texas (Schmidly 2004). The ocelot (*Leopardus pardalis*) and jaguarundi (*Felis yagouaroundi cacomitli*) are neotropical cats that typically inhabit large, dense thickets of thorny shrubs. With the loss of vast areas of this habitat by conversion to agricultural lands, both species are now limited to a few isolated areas in more southern portions of Texas (Campbell 2003). The Louisiana black bear (*Ursus americanus luteolus*), one of 16 subspecies of American black bear, was once common in forested areas of eastern Texas. As the result of hunting and habitat loss, this subspecies was presumed to be extirpated from this area by the 1940s, and any recent sightings are thought to be dispersing juveniles from Louisiana (Campbell 2003). Attwater's prairie chickens are medium-sized grouse that historically inhabited Texas coastal tallgrass prairies. With the loss of much of this habitat type to agriculture, pastures, and overgrazing, fewer than 100 of this species are thought to exist in populations in Galveston and Colorado Counties. The Eskimo curlew (*Numenius borealis*), another species affected by the conversion of open and coastal prairie habitats to agriculture and over-hunting, was once an abundant migrant of the Texas prairie that may now be extinct. The last verified sighting of an Eskimo curlew occurred on the "coast of Texas" in 1987 (Campbell 2003).

2.4.1.6 Other Important Species and Habitats

"Important species" are defined in Table 2.4.1-1 of NUREG-1555, the *Standard Review Plan for Environmental Reviews for Nuclear Plants* (U.S. NRC Oct 1999), as those that are federally or state-listed as threatened or endangered, proposed for listing as threatened or endangered, commercially or recreationally valuable, essential to the maintenance or survival of species that are rare or commercially or recreationally valuable, critical to the structure and function of the local terrestrial ecosystem, or that serve as biological indicators. Listed/protected species observed on or near the VCS site include bald eagles, white-tailed hawks, and wood storks. Whooping cranes have not been observed on site, but the main facility and associated corridors lie within their migratory pathway (CWS & USFWS Mar 2007). Game species fall within the "commercially or recreationally valuable" species category. The primary game species observed on the VCS site include white-tail deer, feral pigs, rabbits, northern bobwhites, various species of doves, and waterfowl.

There are an estimated 1000 deer onsite (based on spotlight counts and hunter encounters), and 60 to 90 are harvested annually. One northern bobwhite is estimated to occur per 2 to 3 acres onsite, based on call counts and hunter encounters. No major "travel corridors" for game species are known to cross the VCS site. However, wintering waterfowl use nearby Linn Lake and Black Bayou and may traverse between there and any onsite depressional wetlands that contain water. The only land management activities for wildlife on this property are the burning, grazing, and shrub control practices described above. Nuisance plants observed on the VCS site include huisache, and invasive salt cedar has been planted as windbreaks on some berms on the property. No nuisance animals other than feral hogs have been observed on the site. Although the proposed VCS site hosts such potential disease vectors as ticks and mosquitoes, Exelon is unaware of any vector-borne diseases resulting from them.

Important habitats, as defined under NUREG-1555, include wildlife refuges, sanctuaries, or preserves, habitats identified by federal or state agencies as rare or to be protected, wetlands, floodplains, other resources specifically protected by federal or state regulation, or land areas identified as critical habitat for threatened or endangered species. Ephemeral/intermittent streams and depressional wetlands exist within the boundaries of the VCS site, whereas more persistent waters (Linn Lake and Black Bayou) exist adjacent to the site. The proposed RWMU pipeline corridor and transportation corridor would cross bottomland habitats which may contain jurisdictional wetlands (Figures 2.2-4 and 2.2-5).

The Guadalupe River Delta Wildlife Management Area (WMA) is managed by the Texas Parks and Wildlife Department (TPWD) and is located approximately 11 miles southeast of the proposed site near the junction of Calhoun, Refugio, and Victoria Counties (Figure 2.4-3). The WMA consists of approximately 6200 acres of fresh and brackish water marshes, impoundments, bottomland areas, and bayous, largely fed by freshwater flows from the Guadalupe River. These lands have been used by various state and federal threatened and endangered avian species, migratory waterfowl and neotropical songbirds, and the estuary portions provide valuable spawning and nursery habitat for marine fish, shrimp, and blue crab (TPWD 2007a).

The Aransas NWR is composed of approximately 115,000 acres in five units in Aransas, Calhoun, and Refugio Counties, approximately 18 miles south of the VCS site (USFWS 2008b). A mixture of mainland, bay, and barrier island habitats, much of this refuge is classified as critical wintering habitat for endangered whooping cranes. The refuge hosts a multitude of wildlife species in addition to whooping cranes.

The Welder Flats Coastal Preserve consists of approximately 1500 acres of largely submerged land near the junction of the Victoria Barge Canal and the Gulf Intracoastal Waterway, approximately 26 miles southeast of the proposed site. The preserve is owned by the Texas General Land Office and is managed by the TPWD. The entire preserve is classified as critical wintering habitat for endangered whooping cranes. It contains beds of submerged aquatic vegetation, is used by waterfowl, wading birds and shorebirds, and is a valuable nursery ground for red drum and sea trout. The TPWD uses the shoreline as a stocking location for red drum and sea trout because of its high nursery value (TPWD 2007b).

2.4.1.7 Transmission Line Corridor Habitats and Communities

As described in Subsection 2.2.2, three new transmission corridors would be constructed from VCS to link to the existing transmission system (Figure 2.2-3). One corridor would traverse approximately 20 miles to the northwest and link in with the Coleto Creek substation. This corridor would cross habitat similar to that of the VCS site, largely rangeland and some forested lands, as well as some agricultural fields. A second corridor would connect the VCS site with a proposed Cholla substation approximately 20 miles to the northwest in DeWitt County. The new corridor would co-locate with existing transmission corridors, where practical, but would require additional corridor width. The third corridor would traverse approximately 60 miles between the VCS site and both the Hillje substation in Wharton County and the Blessing substation in Matagorda County. This corridor would also contain an approximately 10-mile connection between VCS and the existing STP-Whitepoint line. The habitat types to be traversed by this corridor would likely be similar to those of the VCS site, with the possible inclusion of agricultural fields and riverine bottomlands.

The routes of the new transmission lines have not been finalized; thus, a macro-corridor approach (3-mile-wide corridor within which the transmission corridors will likely fit) was employed to examine for sensitive habitats (Subsection 2.2.2). This methodology attempts to reduce impacts on human populations and ecological resources by avoiding sensitive areas such as wetlands and towns and using existing corridors (transmission and others) to the extent possible. Several inland water bodies/ drainages within the macro-corridor are artificial (irrigation ponds/ditches/canals, aquaculture impoundments, etc.), but some natural drainages are present in the corridor toward Hillje and Blessing, including the Guadalupe, Lavaca, and Navidad Rivers. Land use within the macro-corridor is listed in Table 2.2-3 and is dominated by rangeland, pasture, and forestland. Thus, most land incorporated in the proposed expansions is already human altered and unlikely to be affected significantly by this activity. No areas designated by the USFWS as critical habitat for endangered or threatened species are crossed by these proposed corridors, nor do they cross any state or federal parks, wildlife refuges or preserves, or wildlife management areas. These corridor expansions likely occur within the migratory pathway of waterfowl and whooping cranes. Potential wetlands within these corridors will be assessed upon finalization of the routes.

Endangered and threatened species known to occur in the counties within the macro-corridors are listed in Table 2.4-4. A species of concern within these counties as the result of the addition/ expansion of transmission corridors is the migratory whooping crane. Cranes and other protected species (for Victoria County) are described in detail in Subsection 2.4.1.5. The list is based on classifications by the USFWS (2008a) and Texas Parks and Wildlife Department (2008). Exelon acknowledges that these lists are based on either recorded occurrences or historical ranges of species.

The transmission line corridors would be constructed and maintained in accordance with the established procedures of the company responsible for these tasks, AEP Texas Central Company.

2.4.2 Aquatic Ecology

The surface water bodies of interest, those that could potentially be affected by construction and operation of new units at VCS are:

- Onsite and near-site streams, wetlands, and ponds (including Linn Lake)
- Guadalupe River
- Guadalupe-Blanco River Authority (GBRA) Calhoun Canal System (an alternate freshwater intake location evaluated in Section 9.4)

Exelon implemented a pre-application monitoring program in January 2008 to characterize the aquatic communities of these water bodies. This monitoring program was the primary source for the descriptions of aquatic communities in Subsection 2.4.2 of the ER and was the basis for the assessment of potential impacts from construction and operation of the proposed facility.

Exelon's pre-application monitoring program encompassed fish and benthic macroinvertebrate surveys of onsite and "near-site" water bodies including several wetlands, a stock pond, permanent and intermittent streams draining the site, and two natural lakes; juvenile and adult fish sampling along approximately 18 miles of the Guadalupe River; ichthyoplankton sampling at the point where water is diverted from the Guadalupe River to the GBRA canal system; juvenile and adult fish sampling at Goff Bayou, which flows into the GBRA canal system; juvenile and adult fish sampling at a station in the GBRA Main Canal; and ichthyoplankton sampling at a station in the GBRA Main Canal. Subsection 2.4.2.1 summarizes the results of these surveys.

Survey results are summarized in the subsections that follow. They form the basis for the discussion of distribution and abundance of important aquatic species and assemblages on which the construction and operation of VCS could have an impact. Consistent with NRC guidance, a full year (January–December 2008) of data was collected, ensuring that seasonal differences in aquatic populations would be reflected.

2.4.2.1 Aquatic Communities

2.4.2.1.1 Onsite and Near-Site Streams, Wetlands, and Ponds

The approximately 11,500-acre VCS site is located on a "bench" or terrace west of the Guadalupe River in southern Victoria County, Texas. The terrain is relatively flat on the western side of the site, sloping gently down toward the eastern side of the site. The northeastern site boundary slopes sharply downward to the Guadalupe River floodplain, more specifically Black Bayou (shown on some maps as McDonald Bayou) and Linn Lake—an oxbow lake into which Black Bayou flows (Figure 2.4-1).

The site is drained by three streams: Black Bayou and its tributaries drain the northern and eastern portion of the site; Dry Kuy Creek and its tributaries drain the central and southeastern portions of the site; and Kuy Creek and its tributaries drain the southwestern portion of the site (Figure 2.4-1). Black Bayou is a perennial stream, while Kuy Creek and Dry Kuy Creek are intermittent/ephemeral streams.

In addition to these drainages, the site contains stock ponds and ephemeral depressional wetlands of varying hydroperiods. Some of the wetland depressions appear to have been created when site roads were constructed many years ago and natural drainages were blocked or dammed. The centers of some of these wetlands have been deepened to provide additional water storage for livestock, creating open water habitats (ponds). Several additional livestock ponds have been created on the site, with most augmented by windmill-driven wells.

Linn Lake, which lies to the east of the site, is an approximately 905-acre oxbow lake. The lake is generally shallow with a muddy bottom. Although access to Linn Lake is limited, some fishermen seek panfish, bass, and catfish in its waters. The Linn Lake fishery is influenced by cycles of drought and flood in the Guadalupe River, with fish populations in the lake periodically replenished when flood waters transport fish into the basin.

The VCS site is currently used primarily for raising livestock (mostly cattle, with a few horses). No crops are cultivated. Thus, there is no regular use of agricultural chemicals. Cattle are typically restricted to small parcels of the property at any given time, while remaining areas are left ungrazed. Many of the dryer portions of the site appear to be in a 2- to 5-year-old successional stage, containing "old field/disturbed area" plants. All portions of the site show signs of livestock use.

Exelon conducted quarterly surveys of the aquatic resources of the VCS site in 2008. Onsite and near-site streams, wetlands, and stock ponds were surveyed in spring (April), summer (July), fall (October), and winter (December) 2008. Twelve sampling stations were established based on a field reconnaissance in 2007 and an examination of topographic maps and aerial photographs. Each of these sampling stations is described in detail in the section that follows.

Station Locations and Descriptions

Station MC-1

Station MC-1 is located on a small, unnamed tributary of Black Bayou that drains a small area in the northern part of the site (Figure 2.4-4). Just downstream of this sampling station, on the adjacent property, this stream has been impounded to form a small fishing pond. Station MC-1 is located in the extreme upper end of this impoundment, at the point at which the stream begins to resemble a pond. This pond was almost entirely covered in floating primrose willow (*Ludwigia peploides*) during all four quarterly surveys. Substrate consists of firm clay with some organic deposition.

Station MC-2

Station MC-2, a small, unnamed, deeply incised intermittent stream that drains the northeastern portion of the site, flows into the Black Bayou/Linn Lake floodplain. In spring 2008 it consisted of several small isolated pools. Substrate in these pools consisted mainly of sand, with small amounts of organic matter. No aquatic vegetation was found in the pools; however, floating primrose willow, swamp smartweed (*Polygonum hydropiperoides*), and a species of millet were found in the streambed between the pools. This station was completely dry in July, October, and December.

Station MC-3

Station MC-3 is a small (0.1-acre) man-made pond in the approximate center of the site that is used to provide water for livestock. Water in the pond is relatively clear. In April, two species of submerged aquatic plants were present—muskgrass (*Chara spp.*) and bushy pondweed (*Najas guadalupensis*). The margins of the pond were dominated by squarestem spikerush (*Eleocharis quadrangulata*), intermixed with sedges (*Cyperus spp.*), floating primrose willow, and cattails (*Typha spp.*). By July, the pond had receded to a shallow puddle covered with floating primrose willow. In October and December, this pond was dry and the station could not be sampled.

Station MC-4

Station MC-4 is a small (0.5-acre) stock pond located directly south of MC-3 in the middle of a wetland depression. In April, the pond was approximately 115 feet by 225 feet with an average depth of 1.5 feet. Livestock activity was very evident around the margins of the pond. As a result, water clarity is low and no submerged aquatic vegetation is present. Floating primrose willow grows around the edges of the pond. By July, the water level had dropped substantially, and the average depth was less than one foot. In October, the pond was reduced to a small mud puddle. In December, the pond was completely dry.

Station MC-5 (Kuy Creek)

Station MC-5 is on Kuy Creek in a riparian woodland near the southern entrance to the site. The channel of the creek is deeply cut, with a soft to moderately firm bottom. Flows and water levels in Kuy Creek vary dramatically depending on the time of year and patterns of precipitation. No submerged aquatic vegetation is present in this section of the creek. During sustained dry periods, as in the summer and fall of 2008, this portion of the creek is reduced to a series of stagnant puddles. Kuy Creek drains the southwestern portion of the VCS site and flows southeast, ultimately meeting the Guadalupe River approximately 10 miles down river of the VCS site (Figure 2.4-4).

Station MC-6 (Dry Kuy Creek)

Station MC-6 is along Dry Kuy Creek, an intermittent/ephemeral tributary of Kuy Creek that flows southeast and drains the middle of the VCS site (Figure 2.4-4). Dry Kuy Creek holds water after sustained or heavy rainfall, but during extended periods of low rainfall it becomes a series of small stagnant pools in channel depressions or is completely dry. Water in these pools is typically turbid due to livestock walking through them. The substrate consists of soft silt and sand, and no aquatic vegetation is present.

Station MC-7 (Black Bayou)

Station MC-7 is on Black Bayou at a pipeline crossing a short distance above its confluence with Linn Lake. Although flows are significantly reduced during dry periods, Black Bayou is considered to be a perennial stream. Water level in Black Bayou was significantly lower in December than April, but the bayou always held water. Water in the bayou is generally turbid. The substrate is composed of moderately firm clay with a layer of organic material and soft silt. Although some filamentous algae may be found along the banks of the bayou, no submerged aquatic vegetation is present. Woody debris in the form of logs and fallen branches lies along the edges of the bayou.

Station MC-8 (Linn Lake)

Station MC-8 is in the upper basin of Linn Lake, a large oxbow lake, near the inflow of Black Bayou. Black Bayou empties into a broad flat of Linn Lake that is extremely shallow during most of the year and may be completely exposed during dry seasons. The substrate is composed of moderately firm clay and soft silt with an abundance of organic deposition. No submerged vegetation is present. This station held less than a foot of water in April and was completely dry in July, October, and December.

Station MC-9 (Linn Lake)

Station MC-9 is in the lower basin of Linn Lake, southeast of and across a large peninsula from MC-8. Linn Lake is shallow in this area with an average depth of <0.5 meters (1.5 feet). This depth is relatively consistent for several hundred meters into the lake. The substrate consists of soft silt and clay; no submerged vegetation is present. This station was a mudflat in July and was completely dry in October and December.

Station MC-10 (Upper Cypress Lake)

Station MC-10 is in the headwaters of Cypress Lake, just upstream of the railroad trestle that marks the site boundary. It includes an expanse of shallow water (swamp) and a creek channel with a maximum depth of approximately 1 meter (3.3 feet). The substrate is moderately firm sand with some silt in quiescent areas. Vegetation along shorelines and islands includes bald cypress, black willow, and box elder. Large bald cypress trees were also present in the swamp and stream channel. No submerged aquatic vegetation is present. This station was completely dry in July, October, and December and could not be sampled.

Station MC-11

Station MC-11 is a stock pond in the approximate center of the VCS site. The surface area of the pond was approximately 0.5 acre in April. Substrate in the pond consisted of loose, silty clays and sand. Water in the pond was very turbid, and there was no evidence of submerged aquatic vegetation. Because the pond is heavily used by livestock, no aquatic vegetation grows along its banks. The water level at this station dropped steadily over the summer and fall, but it was sampled in all four quarters.

Station MC-12

Station MC-12 is a large, ephemeral wetland with the appearance of a freshwater marsh during rainy seasons and a pasture during dry seasons. During the April 2008 sampling effort, one small open area occurred in the middle of the wetland that was approximately 25 meters (84 feet) by 37 meters (120 feet). Water was clear, and substrate was composed of moderately soft soil with abundant organic deposition. The isolated emergent wetland is dominated by squarestem spikerush and rattlebush. Other associated vegetation consisted of American lotus (*Nelumbo lutea*), longbarb arrowhead (*Sagittaria longiloba*), grassy arrowhead (*S. graminea*), spider lily (*Hymenocallis occidentalis*), and swollen bladderwort (*Utricularia vulgaris*). By July 2008, soils at the site were completely dry, and all wetland vegetation had died. It remained dry in October and December.

Fish Sampling

As discussed previously, onsite and nearsite water bodies were sampled quarterly in 2008. Due to the variation in habitats observed at the 12 sites, a variety of sampling methods was employed to efficiently capture resident fishes. Active sampling techniques included backpack electrofishing and seining. Passive sampling techniques included minnow traps, sunfish traps, and gill nets.

Fish were identified to species, measured, weighed, and released, unless it was necessary to retain a voucher specimen. In addition to fish data, detailed notes were taken on the conditions observed at each site. These notes included dominant substrate, aquatic and riparian vegetation, water level/depth, weather conditions, water clarity, and presence of other wildlife.

Onsite fish sampling resulted in the capture of 4215 fish representing 16 families and 36 species (Table 2.4-5). Western mosquitofish (*Gambusia affinis*) was the most abundant species overall, representing 23.5 percent of all fish captured. This species is native to the south-central U.S., north to Indiana and Illinois, west to Texas, south to southern Mexico, and east to the Mobile River system (Vives and Hammerson 2009). Western mosquitofish thrive in hot, shallow waters with dense aquatic vegetation, such as stagnant ponds, ditches, and drainage canals. They are able to withstand dissolved oxygen concentrations less than 1.0 mg/L (Vives and Hammerson 2009), which means they are often the last fish to survive in degraded or disturbed waterbodies. Because of the species' reproductive behavior (e.g., livebearer, parental care, multiple broods) and its ability to tolerate high temperatures, low dissolved oxygen levels, and poor water quality, mosquitofish have a competitive advantage in environments unsuitable for more sensitive species (Etnier and Starnes 1993). This species' prevalence in onsite waterbodies was not surprising, given that several of the stock ponds and wetlands surveyed were small, stagnant pools that provided only marginal fish habitat. Other relatively abundant species were black bullhead (*Ameiurus melas*; 12.6 percent of total), white crappie (*Pomoxis annularis*; 12 percent of total), warmouth (*Lepomis gulosus*; 10.8 percent of total), bluegill (*Lepomis macrochirus*; 9.5 percent of total), and sailfin molly (*Poecilia latipinna*; 8.1 percent of total). These six species dominated collections, making up 76.6 percent of all fish collected from the 12 onsite and near-site waterbodies. With the exception of the sailfin molly, these species are widely distributed across the central U.S. and Gulf Coastal Plain (Lee et al. 1980). The sailfin molly is found in fresh, brackish, and saltwaters along the south Atlantic and Gulf Coasts and has been introduced elsewhere, including Arizona, Nevada, and California (Lee et al. 1980).

At the family level, the sunfishes (*Centrarchidae*) were most abundant, comprising 42.4 percent of all fish captured. The Centrarchids were also the most diverse group, with ten species collected, including seven Lepomis ("bream") species, two Pomoxis (crappie) species, and a single species of black bass, the largemouth bass (*Micropterus salmoides*). The livebearers (family Poecilidae), represented by two species, Western mosquitofish and sailfin molly, were the next most abundant group, making up 31.6 percent of all fish collected.

In addition to being the most abundant species, Western mosquitofish was the most widely distributed, occurring in 11 of the 12 waterbodies surveyed. As discussed previously, the mosquitofish is a hardy species that is able to survive in stagnant pools and ditches that are subject to high temperatures and low levels of dissolved oxygen. Three centrarchids—warmouth, bluegill, and white crappie—were also widely distributed, occurring in 8 of 12 waterbodies surveyed. All three species are habitat generalists able to avail themselves of a range of habitats, from swamps to bayous to big rivers to reservoirs. By contrast, nine species were found in only one of 12 sampling locations: alligator gar (at MC-08), golden shiner (at MC-03), pugnose minnow (at MC-10), flathead catfish (at MC-10), suckermouth armored catfish (at MC-07), striped mullet (at MC-07), sheepshead minnow (at MC-07), black crappie (at MC-07), Rio Grande cichlid (at MC-08). These species are presumed to have more restrictive habitat or water quality requirements that limit their distribution. For example, white crappies were much more common (506 collected) than black crappies (3 collected) in onsite samples, reflecting the fact that white crappies "…tolerate turbid water and soft bottoms better than most other sunfishes, including black crappies" (Marcy et al. 2005).

Golden shiners (*Notemigonus crysoleucas*) were documented in large numbers at MC-03 in April, but were not captured elsewhere. This species' native range included parts of east Texas, but probably did not include the Guadalupe River drainage (Hassan-Williams and Bonner 2009). Golden shiners are often sold by local bait dealers and this species' presence at MC-03 may represent a "bait-bucket introduction." Other introduced or exotic species captured included Rio Grande cichlid (*Cichlasoma cyanoguttatum*), Mexican tetra (*Astyanax mexicanus*), common carp (*Cyprinus carpio*), and suckermouth armored catfish (*Pterygoplichthys anisitsi*). Golden shiners and common carp were the most abundant introduced species.

Species richness was highest at MC-07 (Black Bayou) where 24 species were collected, and MC-10, where 19 species were collected. Species richness was lowest at MC-12 (an ephemeral wetland) where Western mosquitofish was the only species captured. Black Bayou was the only perennial stream surveyed and one of only three stations that held water in all four seasons. Species assemblages in two stock ponds (MC-03 and MC-04) and the single fish pond (MC-01) were indicative of some level of "management" (stocking by fishermen or ranch hands) in the past, as they contained species such as bluegill and white crappie that are often stocked for fishing. The two stations with the highest measures of species richness were both on the east side of the site in the Guadalupe River floodplain, suggesting that these areas are periodically replenished (re-colonized) when the river floods. Stations with lowest measures of species richness were isolated wetlands, stock ponds, and creeks that dried up in the spring and remained dry throughout the summer and fall. These stations tended to be isolated from perennial water sources, thus they were less likely to be colonized (or re-colonized) by fish from the Guadalupe River or one of its tributaries.

No state or federally listed threatened or endangered species was collected during the aquatic survey. Although not listed as threatened or endangered by TPWD or the USFWS, the American eel (*Anguilla rostrata*) is documented as rare within the state. This species spawns in the Atlantic Ocean, and adult females migrate up rivers along the Atlantic and Gulf Coasts to live out the majority of their lives before returning to the sea to spawn. Although none were captured, presence of American eels cannot be ruled out in the larger water bodies which are occasionally connected to the Guadalupe River (i.e, Black Bayou, Linn Lake, Cypress Lake, Kuy Creek).

Not surprisingly, common rough fish were the largest contributors to biomass. Common carp, captured at five stations, ranked first in overall biomass (Table 2.4-6). Other large contributors to overall biomass included spotted gar (*Lepisosteus oculatus*), smallmouth buffalo (Ictiobus bubalus), white crappie, alligator gar (*Atractosteus spatula*), and blue catfish (*Ictalurus furcatus*). Common carp, spotted gar and smallmouth buffalo, which are found in most sluggish Gulf Coast rivers, grow quickly, attain adult sizes in a relatively short time, and may weigh as much as 30 to 40 pounds.

Stations MC-11 and MC-07 exhibited the highest overall biomass, primarily because they were sampled during all four seasons. MC-08 and MC-03 also exhibited high biomass, despite a limited number of collections from these locations. In general, stations with high biomass exhibited high abundance of the large-bodied species described above. Although fish were captured from each station, several stations did not yield individuals large enough to register on the digital scale (sensitivity of 10 g), and thus no weight data is available for these stations. For example, 154 Western mosquitofish were collected at MC-12, but none was heavy enough to register on the scale. Therefore, the total biomass reported for this station was "0."

An extended period of low rainfall in the Victoria County area lowered water levels (or eliminated water altogether) at all onsite sampling locations, and severely hampered the summer (July) sampling effort. Six of the 12 onsite sampling stations (MC-2, MC-6, MC-8, MC-9, MC-10, and MC-12) were completely dry in July. At the other six stations, water levels had dropped dramatically since the April sampling, rendering all but one gear type (beach seine) unusable. Relatively small numbers of fish were collected at these six locations. Two new species—striped mullet (*Mugil cephalus*) and sheepshead minnow (*Cyprinodon variegatus*)—were collected at MC-7 (Black Bayou) in July. Black Bayou was the only onsite or near-site stream that was not reduced by the dry conditions to isolated puddles of water.

Benthic Macroinvertebrate Sampling

Benthic data were collected from all 12 onsite and near-site stations in spring (April) 2008 as part of an initial comprehensive inventory. After the spring sampling, the number of stations was reduced to six (MC-5, MC-6, MC-7, MC-8, MC-9, and MC-10) focusing on down-gradient areas most likely to be affected by site construction. During summer (July), only three of these stations (MC-5, MC-7, and MC-9) had water. In fall (October), only MC-7 had water. In winter (December), only MC-5 and MC-7 had water.

Benthis macroinvertebrates were collected with an Ekman dredge. Three grabs were taken at each sampling location, filtered through a sieve bucket to remove excess silt, and composited into one sample. In the laboratory, samples were sorted and identified to the lowest practical taxon with the aid of a digital zoom stereomicroscope.

Methods for determining Aquatic Life Use (ALU) based on macroinvertebrate samples collected from depositional habitats have not been developed by the Texas Commission on Environmental Quality (TCEQ Jun 2007). However, metrics and scoring criteria for rapid bioassessment protocols associated with Surber samples are available (TCEQ Jun 2007). Therefore, in an attempt to provide some means of comparison between sites, Ekman dredge data were analyzed using this protocol to determine ALU designations. Caution should be taken in interpreting these designations due to inherent differences in sampling technique.

The number of each taxon (group) collected, as well as its percent relative abundance at each sampling location is presented in Table 2.4-7. A total of 441 specimens representing at least 27 families and 45 genera were collected. The number of specimens identified from each station ranged from none at MC-6 to 108 at MC-7. The absence of benthic organisms at MC-6 is not surprising. This station was reduced to a pair of muddy puddles in April and was dry in July, October, and December. Flies and midges (Order Diptera) dominated collections at 11 of 12 sampling stations, and accounted for approximately 79 percent of all specimens collected. Two families of Dipteran midge larvae (Chaoboridae and Chironomidae) were particularly abundant. Midge larvae are considered indicators of poor water quality and are tolerant of pollution (EPA 2007). Other than dipterans, the most abundant taxa were molluscs (Physids and Sphaeriids were most common), freshwater shrimp (family Palaemonidae), and mayflies (Caenidae and Baetidae families).

The aquatic life use classifications calculated for each station are presented below (INT: intermediate, LIM: limited). Most sites were rated for "intermediate" aquatic life use (see below). Only two of the sites, MC-3 and MC-5, were scored as "high" aquatic life use. Both of these stations are characterized by large amounts of organic material either in the waterbody's basin or on its margins, important for benthic organisms. Station MC-3, a shallow pond, has extensive aquatic vegetation and woody debris around its edges. Station MC-5, Dry Kuy Creek, has vegetation growing on its banks and rocks and woody debris in its channel, providing attachment sites and microhabitats for benthic organisms. Sites scored as "limited" (MC-2, MC-6, MC-9, and MC-11) contained little or no aquatic vegetation, and thus had little available organic matter in littoral areas.

Aquatic life use designations based on benthic invertebrates from 12 locations at the Exelon Victoria County Site are presented below:

	MC-1	MC-2	MC-3	MC-4	MC-5	MC-6	MC-7	MC-8	MC-9	MC-10	MC-11	MC-12
Source	25	19	32	29	33	0	27	23	19	27	19	23
ALU	INT	LIM	HIGH	INT	HIGH	LIM	INT	INT	LIM	INT	LIM	INT

The relative scarcity of benthic macroinvertebrates and prevalence of pollution-tolerant forms appears to be substrate-related rather than water quality-related. Rankings appeared to be independent of dissolved oxygen levels, for example. One of the sampling stations ranked as "limited" had the highest dissolved oxygen concentration measured in April. Substrates at stations ranked "limited" tended to be clay or sand and largely devoid of organic material. The aquatic vegetation, leaf litter, and woody material that would allow a more diverse benthic community to develop were almost never present. Only one station, MC-3, contained more than a few pollution-intolerant species, and as noted previously, this station contained a lush growth of aquatic vegetation as well as substantial amounts of woody debris.

As noted previously, in the description of fish sampling, low water levels hampered sampling of aquatic biota in July, October, and December. Six of 12 sampling locations could not be sampled in July. Water bodies that were sampled for benthic macroinvertebrates tended to be stagnant with low dissolved oxygen levels. Benthos sampling results reflected these poor water quality conditions. As discussed previously, only four stations could be sampled for benthic organisms in October, and only three in December.

2.4.2.1.2 Guadalupe River

The Guadalupe River rises in western Kerr County in south-central Texas. It flows southeast for approximately 250 miles before it empties into Guadalupe Bay (the northernmost arm of San Antonio Bay) near Seadrift, Texas (TPWD Sep 1974). The upper Guadalupe River, which flows across the Edwards Plateau, offers steep limestone bluffs, rapids, and stream banks lined with large cypress, oak, and elm trees. It crosses the Balcones Fault Line near New Braunfels (TSHA 2008), at which point it becomes a twisting, turning, slow-moving, coastal river with none of the limestone bluffs and rapids that characterize the upper river (TPWD Sep 1974). TPWD has designated the portion of the Guadalupe River from Farm-to-Market Road 447 in northwest Victoria County to its mouth on Guadalupe Bay as "ecologically significant" because it supports extensive freshwater and estuarine wetlands including the Guadalupe Delta Wildlife Management Area, one of the largest wetland reserves in the United States (TPWD 2008b).

The Guadalupe River's two most important tributaries are the Comal and San Marcos Rivers. Its drainage area is approximately 6070 square miles (TSHA 2008). One major reservoir, 8300-acre

Canyon Reservoir, and many smaller reservoirs have been built on its mainstem. Coleto Creek Reservoir (3100 acres) lies approximately 11 straight-line miles northwest of the VCS site and approximately 20 miles upstream of the proposed VCS discharge on the Guadalupe River. Coleto Creek Power Plant, a 632 MW coal-fired unit, was built on Coleto Creek, a tributary of the Guadalupe River, and went into service in 1980. The power plant uses Coleto Creek Reservoir as its cooling water source. The San Antonio River, another major tributary, merges with the Guadalupe River approximately 11 miles downstream of the Union Pacific railroad trestle, which is a short distance (0.25 miles) from the eastern boundary of the VCS site.

The Guadalupe River, in the vicinity of the VCS site, is characterized by a deeply incised channel and a broad (2- to 4-mile wide) floodplain. Substrates are typically mud and silt and contain a large amount of woody debris. Channel widths range from 32 to 54 meters, and mid-channel depths range from 2.2 to 6.0 meters. Logjams, created when dead and uprooted trees are carried downstream during floods and deposited when flood waters recede, are common. The GBRA periodically removes these logjams, which interfere with normal river flows and impede boat traffic.

Sampling Locations and Descriptions

Exelon conducted an assessment of the aquatic resources of the Guadalupe River over a 12-month period in 2008. Surveys of fish and benthic macroinvertebrates were conducted monthly at five sampling stations, designated GR-01 through GR-05, along an 18-mile reach of river (Figure 2.4-5). The upstream-most station, GR-01, is in the general area of the proposed discharge structure, and is approximately 1 mile southwest of the Invista Victoria Plant. This section of the river also receives effluent from the Invista Victoria Plant. Station GR-02 is immediately downstream of the point at which Linn Bayou empties into the Guadalupe River. Station GR-03 represents a "typical" river reach with no shoreline development and no industrial activity, and is in the approximate center of the 18-mile-long study area. Station GR-04 lies just downstream of the Kuy Creek-Guadalupe River confluence and approximately 0.5 mile upstream of the confluence of the San Antonio River and the Guadalupe River. Station GR-05 is adjacent to the diversion structure/gates of the GBRA Diversion Canal, the point at which water is diverted from the Guadalupe River into the GBRA's Calhoun Canal System. Station GR-05 is also a short distance upstream of the GBRA's Saltwater Barrier, which is used to prevent saltwater intrusion from Guadalupe Bay/San Antonio Bay during periods of drought and low flow in the Guadalupe River. The proposed Raw Water Makeup System pumphouse intake would withdraw makeup water from this reach of the river via a 0.6 mile-long intake canal.

In addition to collecting fish and benthic samples, biologists gathered information on physical characteristics of the river and river bed and took field measurements of water quality in order to characterize habitat quality. Habitats at the five Guadalupe River sites are similar, and are all characterized by a deeply incised channel, a mud and silt substrate, and large amounts of woody debris (sticks, branches, logs), both floating and submerged. The river is normally very turbid, preventing the establishment of submerged aquatic vegetation. Floating aquatic plants, such as water lettuce and water hyacinth, are present but are relatively uncommon in the river.

Fish Sampling

Biologists used boat-mounted electrofishing gear to collect baseline data on Guadalupe River fish at five sampling sites, (each associated with an approximately 650-meter long transect). Electrofishing was employed because it is the least selective sampling method available and efficiently collects fish from most riverine habitats (i.e., runs, shallows, shoals, undercut banks, and backwaters). Barbour et al. (1999) noted that all fish sampling gear is selective to some degree, but "electrofishing has proven to be the most comprehensive and effective single method for collecting stream fishes."

In total, 10,310 fish representing 42 species were collected from the five Guadalupe River sites (Table 2.4-8). Overall, red shiner (*Cyprinella lutrensis*, 48.5 percent of total), gizzard shad (*Dorosoma cepedianum*, 7.3 percent), threadfin shad (*Dorosoma petenense*, 5.8 percent), spotted gar (*Lepisosteus oculatus*, 5.5 percent), and striped mullet (*Mugil cephalus*, 5.4 percent) were the most abundant species, comprising more than 72 percent of all fish collected. No other species made up more than 5 percent of the total.

As indicated in Table 2.4-8, 22 fish species were collected at all five Guadalupe River sampling sites, suggesting widespread distribution in the lower river, although some of these species, like the common carp (*Cyprinus carpio*), the channel catfish (*Ictalurus punctatus*) and the freshwater drum (*Aplodinotus grunniens*), were collected in fairly low numbers. Other species had a more limited distribution. For example, the ribbon shiner (*Lythrurus fumeus*), burrhead chub (*Macrhybopsis marconis*), golden topminnow (*Fundulus chrysotus*), skip jack herring (*Alosa Chrysochloris*), sheepshead minnow (*Cyprinodon variegatus*), redear sunfish (*Lepomis microlophus*) and Southern flounder (*Paralichthys lethostigma*) were all collected at only one station, and only one specimen of each species was captured. Alligator gar (*Atractosteus spatula*) were collected only at station GR-04, and in very small numbers (3 individuals over the 12-month sampling period). Three species were collected only at station GR-05, the downstream-most sampling location: grass carp (*Ctenopharyngodon idella*), golden topminnow (*Fundulus chrysotus*), and sheepshead minnow (*Cyprinodon variegatus*). An American eel (*Anguilla nostrata*) was observed, but not collected at station GR-05.

In summary, 42 species of fish representing 18 families were collected from the Guadalupe River study area over the 12-month sampling period. The family Centrarchidae contributed the most species (11), followed by Cyprinidae (7), Ictaluridae (3), and Lepisosteidae (3). As noted previously, the species most commonly collected were red shiner, gizzard shad, threadfin shad, spotted gar, and striped mullet. These species, which are all well adapted to life in turbid, low-gradient, coastal plain streams like the Guadalupe River, are common residents of streams and bayous along the Texas Coast (Lee et al. 1980, Mettee et al. 1996, Chilton 1997, Hassan-Williams and Bonner 2009, TPWD 2008a).

Although red shiners, gizzard shad, threadfin shad, and striped mullet were numerically dominant in Guadalupe River samples, they constituted a comparatively small proportion of the fish biomass. Four species generally regarded as "rough fish" accounted for 62 percent, by weight, of the fish collected: spotted gar (24.1 percent), smallmouth buffalo (21.9 percent), common carp (8 percent), and longnose gar (8 percent) (Table 2.4-9). By contrast, five popular gamefish (largemouth bass, spotted bass, white crappie, black crappie, and bluegill) collectively made up only 1.7 percent of fish collected, by weight.

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate samples were collected monthly at the five Guadalupe River stations from April 2008 through December 2008. Sampling was conducted with a standard, manually operated Petite Ponar Dredge. Three sediment grabs were taken at each site, one along each bank and one in mid-river, and then composited into one sample. In the laboratory, samples were sorted and identified to the lowest practical taxon with the aid of a digital zoom stereomicroscope.

Methods for determining aquatic life use based on Ponar dredge samples have not been developed by the TCEQ (TCEQ Jun 2007). However, metrics and scoring criteria for rapid bioassessment protocols associated with Surber samples do exist (TCEQ Jun 2007) and were used as surrogates. Therefore, in an attempt to provide some means of comparison between sites, Ponar dredge data were analyzed with this protocol to determine ALU designations. Caution should be taken in interpreting these designations due to inherent differences in sampling technique.

The number of taxa collected, as well as their percent relative abundance at each site is presented in Table 2.4-10. The most abundant invertebrate taxon overall was a gastropod mollusc (*Hydrobiidae*), which was collected in extremely high numbers at several sites. Burrowing mayflies (genus *Hexayonia*) and the invasive bivalve mollusc *Corbicula* were also relatively common at all five sites. Flies, midges (*Chironomidae*), and riffle beetles (*Elmidae*), were less common but widely distributed across the various sites. When applying the benthic metrics and scoring criteria described above, all five river sites received "intermediate" aquatic life use designations.

Two insect species are shown on TPWD's Rare, Threatened, and Endangered Species of Texas database as potentially occurring in the project area: the Texas asaphomyian tabanid fly (*Asaphomyia texensis*) and "a mayfly" (*Tortopus circumfluus*) (TPWD 2009). The Texas tabanid fly, shown on the TPWD database as potentially occurring in Goliad and Victoria Counties, was not collected during the surveys. *Tortopus circumfluus* is only known to occur in Victoria County. *Tortopus* mayfly larvae were collected during the surveys, at stations GR-01 and GR-02. However, there was no way to determine if these larvae were *T. circumfluus* because only adults of the genus Tortopus can be keyed to the species level. Neither of these species has legal protection in Texas but both are rare and considered species of concern in the broadest sense, meaning that TPWD biologists are concerned about their conservation and these concerns are factored into the agency's reviews of proposed projects.

2.4.2.1.3 GBRA Calhoun Canal System

The GBRA operates and maintains a water delivery system in the lower Guadalupe River drainage that conveys fresh water to municipal, industrial, and agricultural customers in the region. The GBRA Calhoun Canal System includes the Lower Guadalupe Diversion Dam and Saltwater Barrier, two smaller saltwater barriers on Hog and Goff Bayous, a pump station operated jointly by Dow Chemical and the GBRA, a separate GBRA-operated pump station for area refineries, and approximately 80 miles of delivery canals and 8 miles of water supply pipeline. The Canal System provides water to rice, pasture and row crop producers, aquaculture ventures, BP Chemicals Company, Seadrift Coke, Dow Chemical, the GBRA Port Lavaca Water Treatment Plant, and Calhoun County Rural Water Supply System, as well as the Aransas National Wildlife Refuge's Whitmire Unit. The Guadalupe River immediately upstream of the GBRA Saltwater Barrier is the source of the fresh water that is distributed to GBRA's agricultural, industrial, and municipal users via the canal system. This system is analyzed as an alternative cooling water supply in Section 9.4.

Goff Bayou

Goff Bayou fish were sampled by electrofishing at a transect immediately upstream of the GBRA's Inverted Siphon (Figure 2.4-5). The Goff Bayou site is considerably shallower than the Guadalupe River sites with a maximum depth of approximately 9.2 feet (2.8 meters). The invasive water hyacinth (*Eichhornia crassipes*) is abundant at the Goff Bayou site. As indicated in Table 2.4-8, electrofishing collections at this site over the 12-month sampling period were numerically dominated by striped mullet (17.5 percent of total), gizzard shad (16.9 percent), Gulf menhadon (9.0 percent), and spotted gar (8.9 percent). These four species accounted for 52 percent of all fish collected at this site. Threadfin shad (7.0 percent), bay anchovy (5.5 percent), smallmouth buffalo (5.3 percent), and western mosquitofish (4.5 percent) were also relatively common. A total of 1298 fish representing 33 species were collected over the 12-month sampling period. The total weight of fish captured at this site over the 12-month sampling period was 355 kilograms, the highest of the sites surveyed (Table 2.4-9). This was approximately 1.6 times the average weight captured at the five Guadalupe River sites (223.4 kilograms) and 15 times the weight of fish collected from the GBRA Main Canal (24 kilograms). The comparatively high biomass of fish collected at Goff Bayou reflects the presence of substantial numbers of large-bodied "rough" fish (e.g., smallmouth buffalo, spotted gar, and common carp), and the high density of striped mullet. The amount of fish biomass at this site is presumed to be related to a habitat factor or factors, such as the lush growth of aquatic weeds that promote growth and survival of the heavier-bodied species and striped mullet. Goff Bayou offers an abundance of forage (small prey species) for the spotted gar and other top-of-the-food-chain predators, dense aquatic vegetation that provides cover and food for a variety of fish species, and a rich, organic bottom substrate with decaying vegetation and invertebrates that provides food for the bottom-feeding species (e.g., smallmouth buffalo, common carp, and striped mullet).

Bluefin killifish (*Lucania goodei*) were captured in both Goff Bayou and the GBRA Main Canal. The presence of this species in the Guadalupe River was first reported in an article published in the February 2008 issue of the Texas Journal of Science (Gallaway et al. Feb 2008). Gallaway et al. (2008) suggest that the species was introduced with wetland vegetation imported from a nursery in Florida to an artificial wetland built on the Invista Victoria Plant. Bluefin killifish were first noted from this wetland in 1998, and have since spread to the Guadalupe River. The presence of bluefin killifish at sampling locations at least 20 miles downstream of the Invista Plant suggests that this species is dispersing throughout the lower river.

GBRA Main Canal

The GBRA Main Canal was sampled by electrofishing at a single transect near the Relift No. 1 Pump Station (Figure 2.4-5). The GBRA Main Canal has a maximum depth of 5.6 feet (1.7 meters) and much less woody debris than the Guadalupe River and Goff Bayou sampling locations. Cover in the canal is limited to vegetation along the edges, consisting mainly of water hyacinth. Collections from the Main Canal were dominated by sunfish (*Centrarchids*) and small-bodied schooling species. Longear sunfish (*Lepomis megalotis*) and warmouth (*Lepomis gulosus*) were the most abundant sunfish, making up 23.5 percent and 8.2 percent, respectively, of all fish collected from this site (Table 2.4-8). Western mosquitofish (*Gambusia affinis*) were also very common, comprising 14.2 percent of fish collection at this site. Minnows (*Cyprinidae*) and minnow-like species, such as the inland silverside (*Menidia beryllina*), were also common at this site. There were noticeably fewer large-bodied species such as gar and catfish at this location. The total weight of fish captured at this site over the 12-month period was only 24 kilograms, as opposed to 355 kilograms at the Goff Bayou site and 223.4 kilograms (on average) at the five Guadalupe River sampling stations (Table 2.4-9).

Although the Guadalupe River and GBRA Calhoun Canal sites were similar in terms of species richness and densities (if not biomass) of fish present, there were obvious differences in the types of fish present. The Guadalupe River fish assemblage was dominated by freshwater species commonly found in freshwater streams across south Texas. Several marine-estuarine species were present, but, with the exception of the striped mullet, they tended to be uncommon in collections. The two GBRA Calhoun Canal sites had relatively more marine-estuarine species and had four marine-estuarine species not collected from the Guadalupe River sites: ladyfish, Gulf menhaden, pinfish, and

Gulf pipefish. The two Calhoun Canal sites typically had higher conductivities during the sampling period than the Guadalupe River sites (station GR-05 was the exception), reflecting their proximity to the high-conductivity (brackish) waters of Guadalupe Bay and San Antonio Bay, and offered water quality conditions slightly more conducive to marine and estuarine fish species. Salinities at all the study sites were low, however, on the order of 0.3 parts per thousand (Stations GR-01, -02, -03, and -04) to 0.7 parts per thousand (station GR-05, Goff Bayou, GBRA Main Canal).

2.4.2.2 Important Aquatic Resources

2.4.2.2.1 Important Aquatic Species

"Important species," including rare species and commercially or recreationally valuable species, have also been considered. Rare species include species listed by the USFWS or National Marine Fisheries Service (NMFS) as threatened or endangered, species proposed for listing by these agencies, species that are candidates for listing by these agencies, and species that are listed as threatened or endangered by the state in which the proposed facilities are located. Although diadromous (migratory) fish are not one of the groups designated as "important," migratory fish have also been considered in the impact assessment.

Rare/Sensitive Species

Construction and operation of proposed new units at the VCS site could potentially impact aquatic populations, including sensitive species, located in onsite and near-site streams, wetlands, and ponds (Victoria County), and the lower Guadalupe River (Calhoun, Refugio, and Victoria Counties). Consequently, TPWD county lists were reviewed to identify sensitive aquatic species in these three counties. Sensitive species in this context are (1) state- or federal-listed species, (2) species that are candidates for federal listing, and (3) species proposed for listing by the USFWS.

Two protected aquatic species, the opossum pipefish (*Microphis brachyurus*) and the smalltooth sawfish (*Pristis pectinata*), are known to occur in these three counties. The opossum pipefish, listed as "threatened" by the state of Texas and designated a "species of concern" by the NMFS, occurs in coastal portions of Calhoun and Refugio Counties, but has not been recorded in Victoria County (TPWD 2005; TPWD 2009). Breeding adult opossum pipefish are found in low-salinity portions of estuaries along the Atlantic Coast of Florida and from the Gulf Coast of Florida to Mexico (NMFS Jan 2009a). Larvae are carried by coastal rivers into higher-salinity (brackish) estuarine waters, where they develop into late-stage larvae and juveniles. Juveniles are normally found in coastal marine and oceanic environments. There, they continue to develop and then migrate as adults back to freshwater tributary streams, generally within 30 miles of the coast (NMFS Jan 2009a). This species is dependent on freshwater streams and marshes along the Gulf Coast habitats that have been replaced by development and degraded by water quality changes and alterations of historic flow regimes. The smalltooth sawfish, the only member of the elasmobranch (sharks, skates, and rays) group that has been afforded protection under the Endangered Species Act, was listed as endangered on April 1, 2003 (68 FR 15674). Once common in shallow waters of the Gulf of Mexico and along the south Atlantic Coast, the U.S. population is now restricted to peninsular Florida with substantial numbers only in the Everglades area (NMFS 2009). Slow to mature and producing only 15-20 young per litter (embryos develop internally, rather than externally, and young are born with adult appearance), the species is extremely vulnerable to overfishing. The sawfish's tendency to become entangled in nets, especially gill nets, is believed to be the main reason for the species' decline. As late as the 1960s, this species was relatively common in the northern and western Gulf of Mexico. Since 1971, however, there have been only three (in 1978, 1979, and 1984) published or museum reports of smalltooth sawfish collected from this region, all from Texas (NMFS Jan 2009b). TPWD has placed the smalltooth sawfish on its lists of rare species for most coastal counties, including Calhoun, Jackson, Matagorda, and Refugio Counties. These listings are clearly based on historical records rather than up-to-date information on the species' range. The American eel (*Anguilla rostrata*), although not listed as threatened or endangered by TPWD or the USFWS, is documented as rare within the state. This species occurs in most coastal counties in Texas, including Calhoun, Refugio, and Victoria Counties.

TPWD county lists have also been reviewed to identify sensitive aquatic species in counties that would be crossed by the proposed RWMU system intake pipeline and transmission line corridors. Seven counties would be affected: Calhoun, Dewitt, Goliad, Jackson, Matagorda, Victoria, and Wharton. Two protected aquatic species, the opossum pipefish and the smallmouth sawfish, are known to occur in these counties. The opossum pipefish has been recorded in coastal portions of Calhoun County (TPWD 2009). As described in the previous paragraph, this species spawns in fresh and low-salinity estuarine waters along the coast of Texas and could be present in lower reaches of rivers and streams flowing into Matagorda and San Antonio Bays (TPWD 2005). The smalltooth sawfish has been recorded in three of the seven counties: Calhoun, Jackson, and Matagorda (TPWD 2009). None of these records is recent, however.

The American eel is believed to occur in six of the seven counties that would be crossed by proposed transmission corridors, with DeWitt the only exception. As noted in the previous subsection, the possibility exists that other unrecorded or recently discovered rare species might occur in the aforementioned counties. Exelon has written the TPWD, the USFWS, and the NMFS seeking information on any state- or federal-listed species that might be affected by construction and operation of VCS.

As described previously, Exelon commissioned baseline aquatic surveys of: (1) the VCS site, (2) an 18-mile-reach of the Guadalupe River, and (3) selected portions of the GBRA's Calhoun Canal system. The goal of the surveys was to establish baseline conditions in these water bodies for purposes of impact assessment and to identify any special status aquatic species that might be present. To date, no state-listed or federally listed species has been collected. A single American eel was observed, but not captured, by biologists electrofishing at Guadalupe River station GR-05 in April. American eels have been documented in the upper Guadalupe River drainage and, therefore, this species' presence in the study area was not unexpected.

Two possible range extensions have been documented as a result of fish community sampling. Bantam sunfish (*Lepomis symmetricus*) have been collected from the Guadalupe River and the GBRA Main Canal, but have not been collected from Goff Bayou. The southwestern boundary of this species' range was previously reported as being the Colorado River in Texas (Hubbs et al. 1991, Thomas et al. 2007). Also, one ribbon shiner (*Lythrurus fumeus*) was collected at GR-01 in January 2008. The southwestern boundary of this species' range was thought to be the Lavaca River drainage. However, given that only one specimen has been collected, this may simply represent a migrant from populations in the nearby Lavaca River and does not necessarily indicate a persistent (breeding) population.

Commercially or Recreationally Important Species

Based on anecdotal reports and casual interviews of local residents, no commercial fishermen are currently working the Guadalupe River in the vicinity of the VCS site. The lower Guadalupe River offers typical Texas coastal plain recreational fishing opportunities, with a variety of centrarchid (e.g., bluegill, warmouth, largemouth bass, spotted bass) and ictalurid (e.g., blue catfish, channel catfish, flathead catfish) species present in good numbers. Other common species, including the smallmouth buffalo and freshwater drum, are regarded as "rough fish" by most sport fishermen, but are prized as food fish by some. Species such as spotted gar and longnose gar, collected frequently during the study from the project area, are occasionally sought by bow fishermen. The TPWD has not conducted creel surveys in the project area to quantify angler effort, harvest, or success. Anecdotal information suggests that blue, flathead, and channel catfish are the most sought-after species, followed by centrarchids such as largemouth bass and panfish (Lepomids, including bluegill, warmouth, and longear sunfish). Limited public access and logjams in this reach of the Guadalupe appear to reduce fishing pressure. The GBRA Diversion Canal and associated creeks and bayous are also used by local fishermen who launch boats at a public boat ramp on Hog Bayou and fish for catfish, bass, and panfish.

In the lowest reaches of the river, especially the Guadalupe Delta area, trotlining for blue, channel, and flathead catfish is a popular activity. Commercial fishing and crabbing are also important in the Guadalupe Delta region. There is also some commercial crabbing in the Guadalupe River from its mouth (point at which it empties into Guadalupe Bay) north to State Highway 35, the state-designated freshwater-saltwater boundary and the legal boundary for commercial crabbing. A portion of Goff Bayou lies north of State Highway 35 and is used by at least one commercial crabber.

Diadromous Species

Based on a literature review and the ongoing surveys, no anadromous fish species ascend the Guadalupe River to spawn upstream or downstream of the VCS site. There are relatively few true anadromous species (e.g., Gulf sturgeon [*Acipenser oxyrinchus desotoi*], Alabama shad [*Alosa alabamae*], and striped bass [*Morone saxatilis*]) in the Gulf of Mexico, and these species spawn in rivers flowing into the Gulf of Mexico further east, in Louisiana, Mississippi, Alabama, and Florida (USFWS undated). One migratory fish species, the American eel, does ascend Gulf Coast streams in Texas, including the Guadalupe River.

The American eel occurs in rivers and streams along the east coast of the United States from Maine to Florida, and along the Gulf Coast from Florida to Texas (Facey and Van Den Avyle 1987). The American eel is catadromous, growing to sexual maturity in fresh water and migrating hundreds of miles into the Atlantic Ocean (the Sargasso Sea) to spawn. Eggs spawned in the Sargasso Sea drift westward and northward with ocean currents and develop into larvae, then nektonic glass eels. The eels swim west across the Continental Shelf and enter Atlantic Coast and Gulf Coast estuaries, where they mature into adults. Small numbers of eel larvae are carried by winds and currents from the Atlantic Ocean into the Gulf of Mexico, almost certainly via the Yucatan Strait. From the Gulf of Mexico, young eels "wander" into Gulf Coast and Central American estuaries and rivers (Nedeau 2005). American eels are uncommon in Texas. In 30 years of sampling coastal waters, the Coastal Fisheries Division of the TPWD encountered only seven eels, in Matagorda Bay, San Antonio Bay, and Corpus Christi Bay (three in 1984, one in 1986, one in 1988, and two in 2001). The Inland Fisheries Division of the TPWD encountered only 15 eels in 20 years of sampling in freshwater reservoirs and streams, two in the 1980s, ten in 1990, and three in 2003 to 2004, (NatureServe 2008).

In response to a petition received in November 2004, the USFWS announced (on July 6, 2005) in a 90-day finding that it was initiating a status review to determine if listing the American eel was warranted (70 FR 38849). The discussion of population status indicated that population declines have been most dramatic in Canada and New England, and that populations may be stable in the southeastern United States. On February 2, 2007, the USFWS published its findings on a Petition to List the American eel (72 FR 4967), summarized as follows: "After a thorough review of all available scientific information, we find that listing the American eel as either threatened or endangered is not warranted at this time."

As noted previously in this section, a single American eel was observed by Exelon’s biologists at station GR-05 on the Guadalupe River in April 2008, but they were not able to capture it or photograph it. This species has no official status or legal protection in Texas; however, it is rare and considered a species of concern in the broadest sense, meaning that TPWD biologists are concerned about its conservation and these concerns are factored into the agency's reviews of proposed projects.

2.4.2.2.2 Important Aquatic Habitats

Many marine and estuarine fishes that are managed by the Gulf of Mexico Fishery Management Council (GMFMC) rely on coastal bays and tidal rivers during part of their lives. The tidally influenced sections of the Guadalupe River and its tributaries, as well as Guadalupe and San Antonio Bays, have been designated essential fish habitat (EFH), which is defined as those waters and substrate necessary to fish or shellfish for spawning, breeding, feeding, or growth to maturity (GMFMC Oct 1998). Virtually every estuary in Texas has been similarly designated. Discussion of EFH is in §600.10 of the regulations implementing the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; P.L. 104-297). The GMFMC and NMFS are responsible for designating EFH for each life stage of federally managed marine fish species.

The generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the GMFMC (GMFMC Oct 1998) prescribes EFH for federally managed species, including shrimp, red drum, reef fish, and coastal migratory pelagic species. Riverine systems, such as the Guadalupe River, are considered important to EFH because the quantity, quality and timing of the stream discharge into estuaries affects the supply of nutrients, maintains the salinity gradients, flushes pollutants, and provides other functional value. The boundaries of estuarine EFH follow those identified in the Cooperative Gulf of Mexico Estuarine Inventory conducted in each state. The landward boundary of estuarine EFH is the limit of permanent freshwater bottom; seaward limits are the coastal barrier islands. Thus, in the San Antonio Bay, EFH is all waters and substrates (mud, sand, shell, rock and associated biological communities) within the estuarine boundaries, up to the permanent freshwater bottom of the Guadalupe River (GMFMC Oct 1998). The GBRA’s Saltwater Barrier is therefore the landward boundary of EFH in the Guadalupe River–San Antonio Bay system.

Habitats in the lower Guadalupe River and San Antonio Bay near the VCS site include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, and seagrasses. Managed species that are considered important with respect to this ER include shrimp and red drum (GSMFC 2005). EFH has been designated for all life stages (egg, larvae, post-larvae, juvenile, and adult) of these species. The NOAA has prepared maps showing EFH for the various species and life stages (NOAA undated).

Categories of EFH in the lower Guadalupe River and San Antonio Bay that could be impacted by the project include estuarine water column, estuarine mud and sand bottoms (unvegetated estuarine benthic habitats), estuarine shell substrate (oyster reefs and shell substrate), estuarine emergent wetlands, and seagrasses. Detailed information on EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the GMFMC. In addition to providing EFH for the federally managed species listed above, the San Antonio Bay estuary provides nursery and rearing habitat for other important estuarine species as well as for non-harvested forage species that support the harvested species.

2.4.2.3 Nuisance Species

The Asiatic clam, *Corbicula fluminea*, is a problematic invasive mollusk from southeastern Asia. It is a small bivalve that is typically found at high densities and has a relatively high growth rate (GSMFC 2005). Because of its tolerance of a wide variety of aquatic conditions and its high reproductive rate, it has developed into a pest that clogs ditches and interferes with pipes and heat exchangers of power plants. The first reported collection of *Corbicula* in Texas occurred in the Neches River in 1958 (Karatayev et al. Aug 2005). *Corbicula* were next discovered near El Paso in 1964, suggesting that the species was invading Texas from both east and west. From 1970 through 1979, Corbicula spread throughout much of Texas and during this period was first discovered in the Guadalupe and Blanco River systems (Karatayev et al. Aug 2005). By 2005, *Corbicula* had been reported from 162 lotic and 174 lentic waterbodies in Texas. Based on the surveys conducted to date (Subsection 2.4.2.1.2), *Corbicula* appear to be a major component of the benthos in the reach of the Guadalupe River that adjoins the VCS site. They are less evident in the GBRA canal system, perhaps because the canals are more steep sided than the river and lack the river's sandbars and sandbanks. Although present in low densities in the GBRA Calhoun Canal system, *Corbicula* have never created any operational problems, such as clogging pipes or damaging pumps, for the GBRA.

The water hyacinth (*Eichoria crassipes*), a free-floating perennial plant, was introduced into the United States (Florida) from South America in the 1880s and has since spread throughout the southeastern and southwestern United States and into parts of the mid-Atlantic and Pacific Northwest (FDEP undated, CAIP 2001). A serious problem for water system managers in the southern United States, water hyacinth grows rapidly and can take over a waterway in a matter of days when conditions are favorable for its growth. This plant is found throughout the GBRA canal and diversion system, including Goff Bayou. Clumps of water hyacinth are occasionally seen floating in the Guadalupe River.

Water lettuce (*Pistia stratiotes*), a species regarded as nonnative by some botanical authorities (who believe it was introduced from the Caribbean during the Colonial era) and indigenous to the United States by others (it was recorded by pioneer naturalists in Florida in the 18th century), is a floating perennial plant that under certain conditions forms "vast mats that disrupt submersed plant and animal communities and interfere with water movement and navigation" (Langeland and Burks 2006). This species is also found throughout the GBRA canal and diversion system, including Goff

Bayou, and is presumed to occur in backwaters of the Guadalupe River. It is generally less abundant than water hyacinth, and to date it has not presented any operational problems for the GBRA.

Hydrilla (*Hydrilla verticillata*), a nonnative plant from Asia, has been found in 100 water bodies in Texas (LCRA 2003). It is a fast-growing, nuisance species that quickly establishes itself and produces dense mats of vegetation that can clog pipes and ditches and otherwise restrict water flow. It was first recorded in Texas in 1969 and has since spread through much of the state, from north-central to eastern Texas and south to the Rio Grande (LCRA 2003; Jacono and Richerson Dec 2003). Although present in the upper and middle reaches of the Guadalupe River, and a problem in several GBRA reservoirs, it is present in limited backwater areas of the lower river and the GBRA canal system, if at all.

2.4.2.4 Preexisting Environmental Stresses

Environmental or man-induced stresses include thermal and chemical pollutants (discharges), which are regulated by the TCEQ under the Texas Pollutant Discharge Elimination System (TPDES) program. The TCEQ is required, under Section 303(d) of the Clean Water Act, to identify water bodies for which effluent limitations are not stringent enough to satisfy water quality standards. In every even-numbered year, the TCEQ publishes a "Texas Water Quality Inventory and 303(d) List" that identifies freshwater streams, impoundments, tidal streams, and coastal bays that are impaired for one or more pollutants and therefore do not meet one or more water quality standards (TCEQ 2008). Stream segments in the vicinity of the VCS site that could potentially be affected by construction or operation of the new units are listed in Table 2.3.3-4 of Subsection 2.3.3 and shown in Figure 2.3.3-2.

Segment 1803 of the Guadalupe River, which lies adjacent to the VCS site and would receive effluent from the proposed new units, did not appear on 2004, 2006, or 2008 TCEQ lists of impaired waters. Segment 1802, the short segment of the Guadalupe River between its confluence with the San Antonio River and the Saltwater Barrier, likewise did not appear on 2004, 2006, or 2008 lists. Segment 1801, the tidal portion of the Guadalupe River (from the GBRA Saltwater Barrier to Guadalupe Bay), appeared on the 2004 list as impaired for low dissolved oxygen but met state water quality standards in the last two assessments. (TCEQ 2004, 2006, 2008)

Bay Segment 2462, Guadalupe/Hynes/San Antonio Bay, was listed as impaired for bacteria (oyster waters) in 2004, 2006, and 2008 (TCEQ 2004, 2006, 2008). Fecal coliform is the indicator bacterium used by the TCEQ to determine if bay and gulf waters are suitable for shellfish harvesting. Assessment of oyster waters is coordinated with the Seafood Safety Division of the Texas Department of State Health Services, which is responsible for monitoring and classifying shellfish waters into four categories for harvesting: approved, conditionally approved, restricted, and prohibited. Bay segments are classified and mapped, with maps available for viewing on the Texas

Department of State Health Services Website. The map currently displayed on the Website, dated November 1, 2008, shows Guadalupe Bay as a Restricted Area, Hynes Bay as a Conditionally Approved Area, and San Antonio Bay as an Approved Area for shellfish harvesting (TDSHS Nov 2008).

2.4.2.5 References

AEP 2007. American Electrical Power, *Corporate Citizenship*, available at http://www.aep.com/citizenship/crreport/GRI/EN12.asp, accessed August 10, 2007.

CAIP 2001. Center for Aquatic and Invasive Plants University of Florida, *Eichornia crassipes*, available at http://aquat1.ifas.ufl.edu/seagrant/eiccra2.html, accessed April 24, 2008.

Campbell 2003. Texas Parks and Wildlife Department, Campbell, L, *Endangered and Threatened Animals of Texas: Their Life History and Management*, 2003.

Chilton 1997. Chilton, E. W., *Freshwater Fishes of Texas*, 1997, Texas Parks and Wildlife Press.

CWS & USFWS Mar 2007. Canadian Wildlife Service and U.S. Fish and Wildlife Service, *International Recovery Plan for the Whooping Crane 2006*, March 2007.

Davis, et al. 1994. Davis, W.B. and D.J. Schmidly, *The Mammals of Texas*, Texas Parks and Wildlife Press, Austin, 283 pp., 1994.

Dixon 2000. *Amphibians and Reptiles of Texas, 2nd Edition* Dixon, J.R., Texas A&M Press, College Station, 2000.

EPA 2007. United States Environmental Protection Agency, *Midge Flies*, available at http://www.epa.gov/bioiweb1/html/midgeflies.html, accessed July 22, 2008.

Etnier and Starnes 1993. Etnier, D. A. and W. C. Starnes, *The Fishes of Tennessee*. The University of Tennessee Press, Knoxville.

Facey and Van Den Avyle 1987. Facey, D. E. and M. J. Van Den Avyle, *Species Profile: Life History And Environmental Requirements Of Coastal Fishes And Invertebrates* — American Eel, U.S. Fish and Wildlife Service Biological Report 82(11.74), 1987.

FDEP Undated. Florida Department of Environmental Protection Bureau of Plant Management, *Weed Alert: Water-hyacinth (Eichornia crassipes)*, available at http://www.dep.state.fl.us/lands/invaspec/2ndlevpgs/pdfs/hyacinth.pdf, accessed April 24, 2008.

Gallaway et al. Feb 2008. Gallaway, B.J., R.G. Fechhelm, and R.G. Howells, "Introduction of the bluefin killifish *(Lucania goodei)* in Texas," Texas Journal of Science 60(1), February 2008.

GCBO 2008. Gulf Coast Bird Observatory,. *2007 Central Coast Results*, available at http://www.gcbo.org/, accessed April 13, 2008.

GMFMC Oct 1998. Gulf of Mexico Fishery Management Council, *Generic Amendment for Addressing Habitat Requirements in the following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Waters, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic, Stone Crab Fishery of the Gulf of Mexico, Spiny Lobster in the Gulf of Mexico and South Atlantic*, Coral and Coral Reefs of the Gulf of Mexico, October 1998.

GSMFC 2005. Gulf States Marine Fisheries Commission, *Fact sheet for Corbicula fluminea (Muller, 1774)*, available at http://nis.gsmfc.org/nis_factsheet.php?toc_id=128, accessed April 24, 2008.

Hassan-Williams and Bonner 2009. Texas State University-San Marcos Department of Biology, Hassan-Williams, C., and T. H. Bonner, *Texas Freshwater Fishes*, available at http://www.bio.txstate.edu/~tbonner/txfishes/, accessed May 1, 2009.

Hubbs et al. 1991. Hubbs, C., R. J. Edwards, and G. P. Garrett, An Annotated Checklist of the Freshwater Fishes of Texas, *With Keys to Identification of Species*, The Texas Journal of Science 43(4): Supplement, 1991.

Jacono and Richerson Dec 2003. U.S. Geological Survey, Jacono, C. C. and M. M. Richerson, *Hydrilla verticillata*, revised December 18, 2003, available at http://nas.er.usgs.gov/taxgroup/plants/docs/hy_verti.html, accessed April 24, 2008.

Karatayev et al. Aug 2005. Karatayev, A. Y., R. G. Howells, L. E. Burlakova, and B. D. Sewell, *History of spread and current distribution of Corbicula fluminea in Texas*, Journal of Shellfisheries Research, August 2005.

Langeland and Burks 2006. University of Florida Center for Aquatic and Invasive Plants, Langeland, K. A. and K. C. Burks, *Identification & Biology of Non-Native Plants in Florida's Natural Areas*, available at http://aquat1.ifas.ufl.edu/identif.html, accessed April 24, 2008.

LCRA 2003. Lower Colorado River Association, *Hydrilla Fact Sheet: Questions and Answers about a Nuisance Aquatic Plant*, available at http://www.lcra.org/featurestory/2003/hydrilla_factsheet_2003.html, accessed April 24, 2008.

Lee et al. 1980. Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McCallister, and J. R. Stauffer, *Atlas of North American Freshwater Fishes*, 1980, North Carolina State Museum of Natural History.

Marcy et al. 2005. Marcy, B.C., D. E. Fletcher, F. D. Martin, M. H. Paller, and M. J. M. Reichert, *Fishes of the Middle Savannah River Basin*. The University of Georgia Press, Athens.

McMahan et al. 1984. Texas Parks and Wildlife Department, McMahan, C.A., R.G. Frye, and K.L. Brown, *The Vegetation Types of Texas, Including Cropland*, 1984.

Mettee et al. 1996. Mettee, M. F., P. E. O'Neil, and J. M. Pierson, *Fishes of Alabama and the Mobile Basin*, Oxmoor House, Inc.

NAS 2007. National Audubon Society, *Christmas Bird Count (CBC) Results: Count Data by Count Circle, Guadalupe River Delta – MacFaddin Family Ranches [TXGF]*, available at http://audubon2.org/cbchist/, accessed October 31, 2007.

NAS 2008. National Audubon Society, *Christmas Bird Count (CBC) Results: Count Data by Count Circle, Victoria [TXVI]*, available at http://audubon2.org/cbchist/count_table_display.jsp, accessed April 14, 2008.

NatureServe 2008. NatureServe, *Anguilla rostrata*, American Eel, available at http://www.natureserve.org/explorer/servlet/NatureServe?searchName=ANGUILLA+ROSTRATA, accessed April 28, 2008.

Nedeau 2005. Nedeau, E., *Where Have All The Eels Gone?*, Gulf of Maine Times, Volume 9, Number 2 (Summer), available at http://www.gulfofmaine.org/times/summer2005/eel.html, accessed April 28, 2008.

NMFS 2009. National Marine Fisheries Service, *Smalltooth Sawfish (Pristis pectinata),* species account prepared by Office of Protected Resources, NOAA Fisheries, available at http://www.nmfs.noaa.gov/pr/species/fish/smalltoothsawfish.htm, accessed May 8, 2009.

NMFS Jan 2009a. National Marine Fisheries Service, *Species of Concern: Opossum pipefish, Microphis brachyurus lineatus*, available at http://www.nmfs.noaa.gov/pr/pdfs/species/opossumpipefish_detailed.pdf, January 16, 2009, accessed May 20, 2009.

NMFS Jan 2009b. National Marine Fisheries Service, *Smalltooth Sawfish Recovery Plan (Pristis pectinata)*, prepared by the Smalltooth Sawfish Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland, January 2009.

NOAA undated. NOAA Fisheries Service, Galveston Laboratory, *Relative Abundance*, available at http://galveston.ssp.nmfs.gov/research/fisheryecology/EFH/Relative/index.html, accessed July 22, 2008.

Sauer et al. Jul 2007. USGS Patuxent Wildlife Research Center, Sauer, J.R., J.E. Hines, and J. Fallon, *The North American Breeding Bird Survey Results and Analysis 1966-2006*, Version 7.23.2007, available at http://www.mbr-pwrc.usgs.gov/bbs/bbs.html, accessed September 10, 2007.

Schmidly 2004. Schmidly, D.J., *The Mammals of Texas, 6th Edition*, 2004.

Shackelford et al. Nov 2005. Texas Parks and Wildlife Department, Shackelford, C.E., E.R. Rozenburg, W.C. Hunter, and M.W. Lockwood, *Migration and Migratory Birds of Texas: Who Are They and Where Are They Going, 4th Edition*, PWD BK W7000-511, November 2005.

Slack *et al*. 2009. Slack, R.D., W.E. Grant, S.E. Davis III, T.M. Swannack, J. Wosniak, D.M. Greer, and A.G. Snelgrove, *Linking Freshwater Inflows and Marsh Community Dynamics in San Antonio Bay to Whooping Cranes*, SAGES (San Antonio Estuarine System) Final Project Report to the Guadalupe-Blanco River Authority and the San Antonio River Authority, Texas A&M AgriLIFE, April 2009.

Studds and Marra 2007. Studds, C. E., and P.P. Marra. Linking fluctuations in rainfall to nonbreeding season performance in a long-distance migratory bird, *Setophaga ruticilla*. Climate Research 35:115-122, December 31, 2007. Available at http://www.int-res.com/articles/cr_oa/c035p115.pdf., accessed June 6, 2010.

TCEQ 2004. Texas Commission on Environmental Quality, *2004 Texas Water Quality Inventory and 303d List*, available at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/04twqi/twqi04.html, accessed May 5, 2008.

TCEQ 2006. Texas Commission on Environmental Quality, *2006 Texas Water Quality Inventory and 303d List*, available at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/06twqi/twqi06.html, accessed May 5, 2008.

TCEQ Jun 2007. Texas Commission on Environmental Quality, *Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data*, Report No. RG-416, June 2007.

TCEQ 2008. Texas Commission on Environmental Quality, *2008 Texas Water Quality Inventory and 303(d) List*, available at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html#y2008, accessed May 8, 2009.

TDSHS Nov 2008. Texas Department of State Health Services, *Shellfish Classification of Harvesting Areas Maps: San Antonio, Espiritu Santo Bays*, November 1, 2008, available at http://www.dshs.state.tx.us/seafood/classification.shtm#maps, accessed May 20, 2009.

Tennant 1984. *The Texas Snakes*, Tennant, A., 1984, Texas Monthly Press, Austin.

Tennant 1985. *A Field Guide to Texas Snakes,* Tennant, A., Gulf Publishing Company, Houston, 1985.

Tennant 2006. *Lone Star Field Guide: Texas Snakes,* Tennant, A., Taylor Trade Publishing, Boulder, 2006.

Thomas et al. 2007. Thomas, C., T. H. Bonner, and B. G. Whiteside, *Freshwater Fishes of Texas: A Field Guide, 2007*, Texas A&M University Press.

TMMSN 2007. Texas Marine Mammal Stranding Network, *TMMSN Rescues and Rehabilitations*, available at http://www.tmmsn.org/rescue_rehab/rescue_ rehab.htm, accessed August 21, 2007.

TPWD Sep 1974. Texas Parks and Wildlife Department, *An Analysis of Texas Waterways. A Report on the Physical Characteristics of Rivers, Streams, and Bayous in Texas, September 1974*. Central Texas Waterways, Guadalupe River, available at http://www.tpwd.state.tx.us/publications/pwdpubs/pwd_rp_t3200_1047/index.phtml, accessed April 27, 2008.

TPWD 2005. Texas Parks and Wildlife Department, *Rare, Threatened, and Endangered Species of Texas: Opossum pipefish (Microphis brachyurus)*, available at http://gis.tpwd.state.tx.us/TpwEndangeredSpecies/DesktopDefault.aspx?tabindex=0&tabid=9&type=wildcardc&parm=pipefish, accessed April 22, 2008.

TPWD 2007a. Texas Parks and Wildlife Department, *Guadalupe Delta Wildlife Management Area*, available at http://tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/list/?id=37, accessed April 21, 2008.

TPWD 2007b. Texas Parks and Wildlife Department, *Welder Flats Wildlife Management Area*, available at http://tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/list/?id=43, accessed April 13, 2008.

TPWD 2008a. Texas Parks and Wildlife Department, *Wildlife Fact Sheets*, available at http://www.tpwdstate.tx.us/huntwild/wild/species/, accessed April 12, 2008.

TPWD 2008b. Texas Parks and Wildlife Department, *Ecologically Significant Stream Segments: Region L (South Central)*, available at http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/, accessed April 27, 2008.

TPWD 2009. Texas Parks and Wildlife Department, *Rare, Threatened and Endangered Species of Texas: By County*, available http://gis.Tpwd.state.tx.us/TpwEndangeredSpecies/DesktopDefault.aspx, accessed May 21, 2009.

TSHA 2001. Texas State Historical Association, Handbook of Texas Online Victoria County, available at http://www.tsha.utexas.edu/handbook/online/articles/VV/hcv3_print.html, accessed August 28, 2007.

TSHA 2008. Texas State Historical Association, *Guadalupe River from the Handbook of Texas Online*, at http://www.tshaonline.org/handbook/online/articles/GG/rng1.html, accessed April 28, 2008.

TSTNR 2007. Texas Sea Turtle Nesting Report, *2007 Nest Count*, available at http://texasturtlenest.blogspot.com/2007/07/late-newsflash-juvenile-release.html, accessed September 14, 2007.

USACE 2008. U.S. Army Corps of Engineers, *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region*, eds. J.S. Wakely, R.W. Lichvar, and C.V. Noble, ERDC/EL TR-08-30. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

USFWS Undated. U.S. Fish and Wildlife Service, *Gulf Coast Fisheries Coordination Office — Station Facts*, available at http://www.fws.gov/southeast/gulfcoast/, accessed May 5, 2008.

USFWS Sept 2007. U.S. Fish and Wildlife Service, *Attwater's Prairie-Chicken* (*Typamnuchus cupido attwateri*) *Draft Recovery Plan*, *2nd Edition*, 2007.

USFWS 2007a. U.S. Fish and Wildlife Service, *Texas Colonial Waterbird Census: Most Recent Database*, available at http://www.fws.gov/texascoastalprogram /TCWC.html, accessed September 6, 2007.

USFWS 2007b. U.S. Fish and Wildlife Service, *Listed Distinct Population Segment of the Brown Pelican (Pelecanus occidentalis) 5-Year Review: Summary and Evaluation,* 2007.

USFWS 2008a. U.S. Fish and Wildlife Service, *List of Endangered Species by County for Texas*, available at http://www.fws.gov/southwest/es/Endangered Species/ lists/ListSpecies.cfm, accessed April 21, 2008.

USFWS 2008b. U.S. Fish and Wildlife Service, *Aransas National Wildlife Refuge Complex*, available at http://www.fws.gov/southwest/REFUGES/texas/aransas, accessed April 12, 2008.

USFWS 2009a. January 2009 to April 2009 ANWR Migration-Population Status Reports. U. S. Fish and Wildlife Service, Aransas National Wildlife Refuge, Austwell, Texas, USA. Available at http://www.ccbirding.com/twc/, accessed June 6, 2010.

USFWS 2009b. Whooping crane recovery activities, October 2008-October 2009. Prepared by Tom Stehn. U. S. Fish and Wildlife Service, Aransas National Wildlife Refuge, Austwell, Texas, USA. Available at http://www.ccbirding.com/twc/ 2009/09_10-2008_to_10-2009_WCRA.pdf, accessed June 6, 2010.

USGS 2000. U.S. Geological Survey, *Fact Sheet: Coastal Prairie*, USGS FS-019-00, 2000.

U.S. NRC Oct 1999. U.S. Nuclear Regulatory Commission, *Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants*, NUREG-1555, October 1999.

Vives and Hammerson 2009. Vives, S.P. and G. Hammerson, *Gambusia affinis (Baird and Girard, 1853) — Western mosquitofish*. From NatureServe Explorer, An Online Encyclopedia of Life, available at http://www.natureserve.org/explorer/servlet/NatureServe?searchName=Gambusia%20affinis, accessed May 18, 2009.

WCEP Nov 2009. Whooping Crane Eastern Partnership, *Whooping Crane Recovery Activities October 2008-October 2009*, available at http://www.bringbackthecranes.org/recovery/recv2009.html, last updated November 17, 2009,

Table 2.4-1 (Sheet 1 of 5)
Avian Species Observed During Wildlife Surveys[(a)] of the Proposed VCS Site[(b)] in Victoria County, Texas: 2007–2008

Avian Group	Species	Abundance[(c)] Oct 07	Mar 08	May 08	Jul 08	Oct 08
Wading Birds	Roseate spoonbill (*Ajaia ajaja*)	Uncom	Uncom	Uncom	Com	—
	Great egret (*Ardea alba*)	Com	Com	Uncom	Com	Uncom
	Great blue heron (*Ardea herodias*)	Com	Com	Uncom	Uncom	Uncom
	American bittern (*Botaurus lentiginosus*)[(d)]	—	—	—	—	—
	Cattle egret (*Bubulcus ibis*)	—	—	Com	Uncom	—
	Green heron (*Butorides virescens*)[(d)]	—	—	—	—	—
	Little blue heron (*Egretta caerulea*)	Uncom	Uncom	Uncom	Uncom	Uncom
	Snowy egret (*Egretta thula*)	Uncom	—	Uncom	—	—
	Tricolored heron (*Egretta tricolor*)	Uncom	—	Uncom	—	—
	White ibis (*Eudocimus albus*)	Com	Com	Com	Com	Uncom
	Least bittern (*Ixobrychus exilis*)[(d)]	—	—	—	—	—
	Wood stork (*Mycteria americana*)	—	—	—	Uncom	Com
	Yellow-crowned night-heron (*Nyctanassa violacea*)	—	Uncom	Uncom	—	—
	Black-crowned night-heron (*Nycticorax nyctocorax*)[(d)]	—	—	—	Uncom	—
	Whitefaced or glossy ibis (*Plegadis chihi or falcinellus*)	—	Com	—	Uncom	—
Shoredbirds	Spotted sandpiper (*Actits macularia*)[(d)]	—	—	—	—	—
	Western sandpiper (*Calidris mauri*)[(d)]	—	—	—	—	—
	Least sandpipier (*Calidris pusillus*)[(d)]	—	—	—	—	—
	Mountain plover (*Charafrius montanus*)	—	Uncom	—	—	—
	Killdeer (*Charadrius vocifeous*)	Com	Com	Uncom	—	Com
	Black-necked stilts (*Himantopus mexicanus*)[(d)]	—	—	—	—	—
	Short-billed dowitcher (*Limnodromus griseus*)[(d)]	—	—	—	—	—
	Long-billed dowitcher (*Limnodromus scolopaceus*)[(d)]	—	—	—	—	—
	Stilt sandpiper (*Micropalma himantopus*)[(d)]	—	—	—	—	—

Table 2.4-1 (Sheet 2 of 5)
Avian Species Observed During Wildlife Surveys[(a)] of the Proposed VCS Site[(b)] in Victoria County, Texas: 2007–2008

Avian Group	Species	Abundance[(c)]				
		Oct 07	Mar 08	May 08	Jul 08	Oct 08
Shoredbirds (cont.)	American avocet (*Recurviristra americana*)	Uncom	—	—	—	—
	Lesser yellowlegs (*Tringa flavipes*)[(d)]	—	—	—	—	—
	Greater yellowlegs (*Tringa melanocleuca*)	—	Uncom	—	—	Uncom
	Solitary sandpiper (*Tringa solitaria*)[(d)]	—	—	—	—	—
Other Waterbirds	Wood duck (*Aix sponsa*)[(d)]	—	—	—	—	—
	Northern shoveler (*Anas clypeata*)	—	Uncom	—	—	—
	Blue-winged teal (*Anas discors*)[(d)]	—	—	—	—	Uncom
	Mottled duck (*Anas fulvigula*)[(d)]	—	—	—	—	—
	Anhinga (*Anhinga anhinga*)	Com	Com	—	—	—
	Yellow rail (*Coturnicops novaboracensis*)[(d)]	—	—	—	—	—
	Black-bellied whistling duck (*Dendrocygna autumnalis*)	—	—	Uncom	Uncom	—
	Fulvous whistling duck (*Dendrocygna bicolor*)	Uncom	—	—	—	—
	White pelican (*Pelecanus erythrorhynchos*)	Com	Com	Uncom	—	—
	American coot (*Fulicia americana*)	—	Uncom	—	—	—
	Sora (*Porzana carolina*)[(d)]	—	—	—	—	—
	Cormorant spp. (*Phalacrocorax sp*)	Uncom	Uncom	—	—	—
Upland Game Birds	Northern bobwhite quail (*Colinus virginianus*)	Uncom	Uncom	Abun	Abun	Uncom
	Common ground dove (*Columbina passerina*)	—	—	Uncom	Uncom	Uncom
	Sandhill crane (*Grus canadensis*)	Com	Abun	—	—	—
	Wild turkey (*Meleagris gallapavo*)	Uncom	Uncom	Uncom	—	—
	Mourning dove (*Zenaida macroura*)	Com	Com	Abun	Com	Abun

Table 2.4-1 (Sheet 3 of 5)
Avian Species Observed During Wildlife Surveys[(a)] of the Proposed VCS Site[(b)] in Victoria County, Texas: 2007–2008

Avian Group	Species	Abundance[(c)] Oct 07	Mar 08	May 08	Jul 08	Oct 08
Passerines & Other Birds	Red-winged blackbird (*Agelaius phoeniceus*)	—	Uncom	Com	Uncom	—
	Ruby-throated hummingbird (*Archilochus colubris*)	—	—	—	Uncom	—
	Tufted titmouse (*Baeolophus bicolor*)	—	Uncom	Uncom	Uncom	Uncom
	Great horned owl (*Bubo virginiana*)[(d)]	—	—	—	—	—
	Northern cardinal (*Cardinalis cardinalis*)	Com	Com	Abun	Abun	Com
	Chimney swift (*Chaetura pelagica*)[(d)]	—	—	—	—	—
	Lark sparrow (*Chondestes grammacus*)[(d)]	—	—	—	—	—
	Yellow-billed cuckoo (*Coccyzus americanus*)	—	—	Uncom	Uncom	—
	Northern flicker (*Colaptes auratus*)	—	Uncom	—	—	—
	Eastern wood pewee (*Contopus virens*)	—	—	—	—	Uncom
	American crow (*Corvus brachyrhynchos*)	—	Uncom	Uncom	Uncom	Com
	Yellow-rumped warbler (*Dendroica coronata*)	—	Uncom	—	—	—
	Yellow-throated warbler (*Dendroica dominica*)[(d)]	—	—	—	—	—
	Palm warbler (*Dendroica palmarum*)	—	—	—	—	Uncom
	Pileated woodpecker (*Dryocopus pileatus*)	—	—	—	Uncom	—
	Gray catbird (*Dumetella caroleninsis*)	—	—	—	—	Uncom
	Blue grosbeak (*Guiraca caerulea*)	—	—	—	Uncom	—
	Barn swallow (*Hirundo rustica*)	Com	—	—	—	Abun
	Loggerhead shrike (*Lanius ludovicianus*)	Com	Com	—	Uncom	Com
	Red-bellied woodpecker (*Melanerpes carolin*us)	—	Uncom	Uncom	Uncom	Uncom
	Song sparrow (*Melospiza melodia*)	—	Com	—	—	—
	Mockingbird (*Mimus polyglottos*)	Com	Com	Abun	Com	Com
	Black-and-white warbler (*Mniotitla varia*)	—	—	—	Uncom	—
	Brown-headed cowbird (*Molothrus ater)*	—	Uncom	Com	Uncom	—
	Great crested flycatcher (*Myiarchus crinitus*)	—	—	Uncom	—	—

Table 2.4-1 (Sheet 4 of 5)
Avian Species Observed During Wildlife Surveys[a] of the Proposed VCS Site[b] in Victoria County, Texas: 2007–2008

Avian Group	Species	Abundance[c] Oct 07	Mar 08	May 08	Jul 08	Oct 08
Passerines & Other Birds (cont.)	Ladder-backed woodpecker (*Picoides scalaris*)	—	—	Uncom	—	Uncom
	Painted bunting (*Passerina ciris*)	—	—	Uncom	Uncom	—
	Indigo bunting (*Passerina cyanea*)[d]	—	—	—	—	—
	Savannah sparrow (*Passerculus sandwichensis*)	—	Com	—	—	Uncom
	Cliff swallow (*Petrochelidon pyrrhonata*)	—	—	Com	Abun	Com
	Vesper sparrow (*Pooecetes gramineus*)[d]	—	—	—	—	—
	Carolina chickadee (*Poecile carolinensis*)	—	Uncom	Uncom	Uncom	Uncom
	Blue-gray gnatcatcher (*Poliotila caerula*)	—	Uncom	—	—	Uncom
	Prothonotary warbler (*Prothonotaria citrea*)[d]	—	—	—	—	—
	Great-tailed grackle (*Quiscalus mexicanus*)	—	—	—	Uncom	—
	Common grackle (*Quiscalus quiscala*)	—	Uncom	—	—	—
	Eastern phoebe (*Sayornis phoebe*)	—	Com	—	—	—
	Eastern bluebird (*Siala sialis*)	—	Uncom	—	—	—
	Yellow-bellied sapsucker (*Sphyrapicus varius*)	—	—	—	—	Uncom
	Dickcissel (*Spiza americana*)	—	—	Uncom	—	—
	Field sparrow (*Spizella pusilla*)	—	Uncom	—	—	—
	Northern rough-winged swallow (*Stelgidopteryx serripannis*)	—	—	—	—	Uncom
	Barred owl (*Strix varia*)	—	Uncom	Uncom	Uncom	Uncom
	Eastern meadowlark (*Sturnella magna*)	Com	Com	Uncom	Abun	Uncom
	Tree swallow (*Tachycineta bicolor*)	Com	Uncom	—	—	—
	Bewick's wren (*Theyomanes bewickii*)	—	—	Uncom	—	—
	Scissor-tailed flycatcher (*Tyrannus forficatus*)	Uncom	—	Abun	Com	Com
	Eastern kingbird (*Tyrannus tyrannus*)[d]	—	—	—	—	—
	Orange-crowned warbler (*Vermivora celata*)	—	—	—	—	Uncom
	White-eyed vireo (*Vireo griseus*)	—	Com	Com	Com	—

Table 2.4-1 (Sheet 5 of 5)
Avian Species Observed During Wildlife Surveys[(a)] of the Proposed VCS Site[(b)] in Victoria County, Texas: 2007–2008

Avian Group	Species	Abundance[(c)] Oct 07	Mar 08	May 08	Jul 08	Oct 08
Passerines & Other Birds (cont.)	Red-eyed vireo (*Vireo olivaceus*)[(d)]	—	—	—	—	—
Birds of Prey/Soaring Birds	White-tailed hawk (*Buteo albicaudatus*)	Uncom	Uncom	Uncom	Uncom	Uncom
	Red-tailed hawk (*Buteo jamaicensis*)	Com	Com	Uncom	Uncom	Uncom
	Red-shouldered hawk (*Buteo lineatus*)	—	Uncom	Uncom	Uncom	Uncom
	Crested caracara (*Caracara plancus*)	Uncom	Com	Uncom	Uncom	Uncom
	Turkey vulture (*Cathartes aura*)	Com	Com	Com	Abun	Abun
	Northern harrier *Circus cyaneus*)	—	Uncom	—	—	—
	Black vulture (*Coragyps atratus*)	Uncom	Uncom	Uncom	Uncom	Uncom
	Merlin (*Falco columbarius*)	Uncom	—	—	—	—
	Kestrel (*Falco sparverius*)	Com	Com	—	—	Com
	Bald eagle (*Haliaeetus leucocephalus*)	Uncom	—	—	—	Uncom

(a) Survey periods were October 22–24, 2007; March 11–13, 2008, May 28–29, 2008, July 15–16, 2008, and October 7–8, 2008.
(b) The site includes the VCS site, Black Bayou, and Linn Lake.
(c) Estimated abundances (within expected habitats) were classified as Abun = Abundant; Com = Common; and Uncom = Uncommon/Rare. "—" indicate birds were not observed during the specified survey and thus relative abundance was not determined. Abundance classifications were intuitively based on species encounters within the project area.
(d) These species were not observed during the five seasonal surveys but were observed during other site visits/surveys.

Table 2.4-2 (Sheet 1 of 2)
Mammals of Potential Occurrence[a] at VCS and Abundance Estimates of Those Observed in the Spring Surveys of 2008

Common Name	Scientific Name	General Habitat[b]	Observed/ Abundance[c]
Northern pygmy mouse	*Baiomys taylori*	G	O
Ringtail	*Bassariscus astutus*	B, F, M	—
Coyote	*Canis latrans*	G, F	U
American beaver	*Castor canadensis*	I	—
Hispid pocket mouse	*Chaetodipus hispidus*	G	—
Least shrew	*Cryptotis parva*	G, F	—
Nine-banded armadillo	*Dasypus novemcinctus*	G, F	C
Virginia opossum	*Didelphis virginiana*	G, B, F, I	C
Big brown bat	*Eptesicus fuscus*	G, B, F, I	—
Attwater's pocket gopher	*Geomys attwateri*	G	A
Southern flying squirrel	*Glaucomys volans*	B, F, M	—
Silver-haired bat	*Lasionycteris noctivagans*	G, B, F, I	—
Red bat	*Lasiurus borealis*	G, B, F, I	—
Hoary bat	*Lasiurus cinereus*	G, B, F, I	—
Northern yellow bat	*Lasiurus intermedius*	G, B, F, I	—
Seminole bat	*Lasiurus seminolus*	G, B, F, I	—
Black-tailed jackrabbit	*Lepus californicus*	G	—
Northern river otter	*Lontra canadensis*	G, B, F	—
Bobcat	*Lynx rufus*	G, F, M	O
Striped skunk	*Mephitis mephitis*	G, F	—
Long-tailed weasel	*Mustela frenata*	G, B, F	—
Cave Myotis	*Myotis velifer*	G, B, F, I	—
White-nosed coati	*Nasua narica*	B, F, M	—
Eastern woodrat	*Neotoma floridana*	G, F	—
Crawford's gray shrew	*Notiosorex crawfordi*	G	—
Evening bat	*Nycticeius humeralis*	G, B, F, I	—
Big free-tailed bat	*Nyctinomops macrotis*	G, I	—
White-tailed deer	*Odocoileus virginiana*	G, B, F, M	A
Northern grasshopper mouse	*Onychomys leucogaster*	G	—
Marsh rice rat	*Oryzomys palustris*	I	O
Collared peccary	*Pecari tajacu*	G, F	—
White-footed mouse	*Peromyscus leucopus*	G, F	O
Deer mouse	*Peromyscus maniculatus*	G, B, F, M	—
Eastern Perimyotis	*Pipistrellus subflavus*	G, B, F, I	—
Northern raccoon	*Procyon lotor*	B, F, I	A

Table 2.4-2 (Sheet 2 of 2)
Mammals of Potential Occurrence[a] at VCS and Abundance Estimates of Those Observed in the Spring Surveys of 2008

Common Name	Scientific Name	General Habitat[b]	Observed/ Abundance[c]
Cougar	*Puma concolor*	G, F	—
Fulvous harvest mouse	*Reithrodontomys fulvescens*	G	U
Plains harvest mouse	*Reithrodontomys montanus*	G	—
Eastern mole	*Scalopus aquaticus*	G, F	—
Eastern gray squirrel	*Sciurus carolinensis*	B, F, M	O
Eastern fox squirrel	*Sciurus niger*	B, F, M	A
Hispid cotton rat	*Sigmodon hispidus*	G, I	A
Mexican ground squirrel	*Spermophilus mexicanus*	G	—
Thirteen-lined jackrabbit	*Spermophilus tridecemlineatus*	G	—
Eastern spotted skunk	*Spilogale putorius*	G, B, F	—
Feral hog	*Sus scrofa*	G, B, F, M	C
Swamp rabbit	*Sylvilagus aquaticus*	I	—
Eastern cottontail	*Sylvilagus floridanus*	G, F	C
Brazilian free-tailed bat	*Tadarida brasiliensis*	G, I	—
American badger	*Taxidea taxus*	G	—
Common gray fox	*Urocyon cinereoargenteus*	G, F	—
Red fox	*Vulpes vulpes*	G, F	—

(a) According to Schmidly (2004).
(b) General habitats: G = bluestem grassland, B = bottomland hardwood forest, F = live oak forest, M = live oak motte, I = depressional wetland.
(c) Abundance categories were intuitively based on species encounters within the project area and regional knowledge: A = abundant, C = common, U = uncommon, O = occasional, R = rare, — = not observed.

Table 2.4-3 (Sheet 1 of 3)
Amphibians and Reptiles of Potential Occurrence[(a)] at VCS and Abundance Estimates of Those Observed in the Spring Surveys of 2008

Common Name	Scientific Name	General Habitat[(b)]	Observed/ Abundance[(c)]
Frogs			
Blanchard's cricket frog	*Acris crepitans blanchardi*	B, F, M, I	C
Eastern green toad	*Bufo debilis*	G, I	—
Texas toad	*Bufo speciosus*	G, I	—
Gulf coast toad	*Bufo valliceps*	G, I	C
Woodhouse's toad	*Bufo woodhousii woodhousii*	G, I	—
Eastern narrowmouth toad	*Gastrophryne carolinensis*	B, F, M, I	O
Great plains narrowmouth toad	*Gastrophryne olivacea*	B, F, M, I	—
Cope's gray treefrog	*Hyla chrysoscelis*	B, F, M, I	—
Green treefrog	*Hyla cinerea*	B, F, M, I	C
Squirrel treefrog	*Hyla squirella*	B, F, M, I	O
Gray treefrog	*Hyla versicolor*	B, F, M, I	—
Spotted chorus frog	*Pseudacris clarkii*	B, F, M, I	—
Strecker's chorus frog	*Pseudacris streckeri*	B, F, M, I	—
Western chorus frog	*Pseudacris triseriata*	B, F, M, I	—
Bullfrog	*Rana catesbeiana*	I	C
Southern leopard frog	*Rana sphenocephala*	I	A
Hurter's spadefoot	*Scaphiopus hurterii*	G, I	—
Salamanders			
Smallmouth salamander	*Ambystoma texanum*	I	—
Eastern newt	*Notophthalmus viridescens*	I	—
Slimy salamander	*Plethodon glutinosus complex*	I	—
Southern redback salamander	*Plethodon serratus*	I	—
Western lesser siren	*Siren intermedia nettingi*	I	C
Crocodilians			
American alligator	*Alligator mississippiensis*	I	C
Lizards			
Green anole	*Anolis carolinensis*	B, F, M, I	—
Texas spotted whiptail	*Cnemidophorus gularis*	G	—
Marbled whiptail	*Cnemidophorus marmoratus*	G	—
Six-lined racerunner	*Cnemidophorus sexlineatus sexlineatus*	G	—
Five-lined skink	*Eumeces fasciatus*	B, F, M	C
Broadhead skink	*Eumeces laticeps*	B, F, M	—
Mediterranean gecko	*Hemidactlus turcicus turcicus*	B, F	—

Table 2.4-3 (Sheet 2 of 3)
Amphibians and Reptiles of Potential Occurrence[a] at VCS and Abundance Estimates of Those Observed in the Spring Surveys of 2008

Common Name	Scientific Name	General Habitat[b]	Observed/ Abundance[c]
Keeled Earless lizard	*Holbrookia propinqua propinqua*	G	—
Western slender glass lizard	*Ophisaurus attenuatus*	G	—
Texas horned lizard	*Phrynosoma cornutum*	G	—
Texas spiny lizard	*Sceloporus olivaceus*	G, F	—
Southern prairie skink	*Sceloporus septentrionalis obtusirostris*	G, F	—
Northern fence/Prairie lizard	*Sceloporus undulatus hyacinthinus*	G, F	—
Ground skink	*Scincella lateralis*	B, F, M	C
Snakes			
Broad-banded copperhead	*Agkistrodon contortrix laticinctus*	B, F, M	—
Western cottonmouth	*Agkistrodon piscivorus leucostoma*	I	U
Texas glossy snake	*Arizona elegans arenicola*	G	—
Eastern yellow-bellied racer	*Coluber constrictor flaviventris*	G	—
Western diamondback rattlesnake	*Crotalus atrox*	G, F	—
Canebrake rattlesnake	*Crotalus horridus atricaudatus*	B, F, M	—
Great plains rat snake	*Elaphe emoryi*	G, F	—
Southwestern rat snake	*Elaphe guttata meahllmorum*	G, F	—
Texas rat snake	*Elaphe obsoleta lindheimeri*	G, F	C
Mud snake	*Farancia abacura*	I	—
Eastern hognose snake	*Heterodon platirhinos*	G	—
Texas night snake	*Hypsiglena torquata jani*	G	—
Prairie king snake	*Lampropeltis calligaster calligaster*	G	O
Speckled king snake	*Lampropeltis getula splendida*	G	O
Louisiana milk snake	*Lampropeltis triangulum amaura*	B, F, M	—
Texas blind snake	*Leptotyphlops dulcis*	B, F, M	—
Eastern coachwhip	*Masticophis flagellum flagellum*	G	C
Texas coral snake	*Micrurus fulvius tenere*	B, F, M	—
Blotched water snake	*Nerodia erythrogaster transversa*	I	—
Broad-banded water snake	*Nerodia fasciata confluens*	I	C
Diamondback water snake	*Nerodia rhombifer rhombifer*	I	A
Rough green snake	*Opheodrys aestivus*	B, F, M	—
Bull snake	*Pituophis catenifer sayi*	G	—
Graham’s crayfish snake	*Regina grahamii*	I	—
Western massasauga	*Sistrurus catenatus tergeminus*	G, F	—
Western pygmy rattlesnake	*Sistrurus miliarius streckeri*	G, F	—

Table 2.4-3 (Sheet 3 of 3)
Amphibians and Reptiles of Potential Occurrence[a] at VCS and Abundance Estimates of Those Observed in the Spring Surveys of 2008

Common Name	Scientific Name	General Habitat[b]	Observed/ Abundance[c]
Marsh brown snake	*Storeria dekayi limnetes*	B, F, M, I	—
Flathead snake	*Tantilla gracilis*	B, F, M	—
Plains black-headed snake	*Tantilla nigriceps nigriceps*	B, F, M	—
Checkered garter snake	*Thamnophis marcianus marcianus*	G, I	—
Gulf coast ribbon snake	*Thamnophis proximus orarius*	G, I	—
Eastern garter snake	*Thamnophis sirtalis sirtalis*	G, I	—
Texas lined snake	*Tropidoclonion lineatum texanum*	G, I	—
Ground snake	*Virginia striatula*	B, F, M, I	U
Rough earth snake	*Virginia striatula*	B, F, M	—
Turtles			
Spiny softshell	*Apalone spinifera*	I	U
Common snapping turtle	*Chelydra serpentina*	I	U
Texas tortoise	*Gopherus berlandieri*	G	—
Cagle’s map turtle	*Graptemys caglei*	I	—
Yellow mud turtle	*Kinosternon flavescens*	I	—
Mississippi mud turtle	*Kinosternon subrubrum hoppocrepis*	I	—
Texas river cooter	*Pseudemys texana*	I	—
Common mush turtle	*Sternotherus odoratus*	I	—
Eastern box turtle	*Terrapene carolina*	G, F	—
Ornate box turtle	*Terrapene ornata*	G	—
Red-eared slider	*Trachemys scripta*	I	C

(a) According to Tennant (1984, 1985, 2006), and Dixon (2000).
(b) General habitats: G = bluestem grassland, B = bottomland hardwood forest, F = live oak forest, M = live oak motte, I = depressional wetland.
(c) Abundance categories were intuitively based on species encounters within the project area and regional knowledge: A = abundant, C = common, U = uncommon, O = occasional, R = rare, — = not observed.

Table 2.4-4 (Sheet 1 of 2)
Protected Species In Counties Associated with the VCS Site

Common Name	Scientific Name	Federal Status[a]	State Status[a]	Counties[b]
Amphibians				
Sheep Frog	*Hypopachus variolosus*	—	T	Cal, Gol, Ref
Black-spotted newt	*Notopthalmus meridionalis*	—	T	Cal, Gol, Ref, Vic
Birds				
White-tailed hawk	*Buteo albicaudatus*	—	T	All
Piping plover	*Charadrius melodus*	LT	T	Cal, Mat, Ref
Reddish egret	*Egretta rufescens*	—	T	Cal, Jac, Mat, Ref, Vic
Northern Aplomado falcon	*Falco femoralis septentrionalis*	LE	E	Ref
Peregrine falcon	*Falco peregrinus anatum*	DL	T	All
Arctic peregrine falcon	*Falco peregrinus tundrius*	DL	T	All
Whooping crane	*Grus Americana*	LE	E	All
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Cal, DeW, Gol, Jac, Mat, Ref, Vic, Wha
Wood stork	*Mycteria Americana*	—	T	All
Eskimo curlew	*Numenius borealis*	LE	E	Cal, Mat
Brown pelican	*Pelecanus occidentalis*	LE-PDL	E	Jac, Mat, Ref, Vic
White-faced ibis	*Plegadis chihi*	—	T	All
Interior least tern	*Sterna antillarum athalassos*	LE	E	Gol, Jac, Vic, Wha
Sooty tern	*Sterna fuscata*	—	T	Cal, Jac, Mat, Ref
Attwater’s prairie chicken	*Tympanuchus cupido attwateri*	LE	E	Ref, Vic, Wha
Fishes				
Smalltooth sawfish	*Pristis pectinata*	LE	E	Cal, Jac, Mat, Ref
Oppossum pipefish	*Microphis brachyurus*	—	T	Cal
Mammals				
Red wolf	*Canis rufus*	LE	L	All
Jaguarundi	*Herpailurus yaguarondi*	LE	E	Cal
Ocelot	*Leopardus pardalis*	LE	E	Cal, Gol, Mat, Ref
White-nosed coati	*Nasua narica*	—	T	Ref, Vic
West Indian manatee	*Trichechus manatus*	LE	E	Cal, Mat, Ref
Black bear	*Ursus americana*	T/SA	T	Cal
Louisiana black bear	*Ursus americanus luteolus*	LT	T	Jac, Mat, Ref, Vic, Wha
Plants				
Black lace cactus	*Echinocereus reichenbachii var. albertii*	LE	E	Ref

Table 2.4-4 (Sheet 2 of 2)
Protected Species In Counties Associated with the VCS Site

Common Name	Scientific Name	Federal Status[(a)]	State Status[(a)]	Counties[(b)]
Reptiles				
Loggerhead sea turtle	*Caretta caretta*	LT	T	Cal, Jac, Mat, Ref
Texas scarlet snake	*Cemophora coccinea lineri*	—	T	Cal, Jac, Mat, Ref
Green sea turtle	*Chelonia mydas*	LT	T	Cal, Mat, Ref
Timber/canebrake rattlesnake	Crotalus horridus	—	T	Cal, DeW, Gol, Jac, Mat, Ref, Vic, Wha
Leatherback sea turtle	Dermochelys coriacea	LE	E	Cal, Mat, Ref
Indigo snake	Drymarchon corais	—	T	Gol, Ref
Atlantic hawksbill sea turtle	Eretmochelys imbricata	LE	E	Cal, Mat, Ref
Texas tortoise	Gopherus berlandieri	—	T	Cal, DeW, Jac, Gol, Mat, Ref, Vic
Cagle’s map turtle	Graptemys caglei	—	T	DeW, Vic
Kemp’s ridley sea turtle	Lepidochelys kempii	LE	E	Cal, Mat, Ref
Smooth green snake	Liochlorophis vernalis	—	T	Mat
Texas horned lizard	Phrynosoma cornutum	—	T	Cal, DeW, Gol, Jac, Mat, Ref

Sources: TPWD 2009, USFWS 2008a

(a) LE/E = Endangered; LT/T = Threatened; C = Candidate; **-** = Not listed; DL = delisted taxon, recovered, monitored for first five years post delisting; PDL = proposed for delisting; SA = listed due to similarity of appearance with a threatened species

(b) Counties containing the proposed Exelon facilities, intake corridor and transmission lines where protected species are listed [All = listed for all counties: Cal = Calhoun, DeW = DeWitt, Gol = Goliad, Jac = Jackson, Mat = Matagorda, Ref = Refugio, Vic = Victoria, & Wha = Wharton]. The main facility site is in Victoria County and the intake corridor originates in Refugio County. New and existing transmission corridors to be upgraded will occur in seven counties (excluding Refugio).

Table 2.4-5 (Sheet 1 of 2)
Number Collected (#) and Percent Relative Abundance (%) of Fish Captured at 12 Locations on the Exelon Victoria County Site in 2008

Family	Common Name	Scientific Name	MC-1		MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8		MC-9		MC-10		MC-11		MC-12		Total	
			#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Lepisosteidae																												
	Alligator gar	*Atractosteus spatula*															5	**7.4**									5	**0.1**
	Spotted gar	*Lepisosteus oculatus*							2	**0.4**					20	**2.9**	1	**1.5**					11	**1.9**			34	**0.8**
Clupeidae																												
	Gizzard shad	*Dorosoma cepedianum*													14	**2.0**	3	**4.4**			2	**1.0**	20	**3.5**			39	**0.9**
	Threadfin shad	*Dorosoma petenense*													69	**10.1**			9	**69.2**	2	**1.0**					80	**1.9**
Cyprinidae																												
	Golden shiner	*Notemigonus crysoleucas*[(a)]					65	**14.2**																			65	**1.5**
	Red shiner	*Cyprinella lutrensis*																			6	**3.0**					6	**0.1**
	Common carp	*Cyprinus carpio*[(a)]					25	**5.5**	18	**3.6**	1	**0.6**			1	**0.1**			2	**15.4**			16	**2.8**			63	**1.5**
	Pugnose minnow	*Opsopoeodus emiliae*																			1	**0.5**					1	**0.0**
	Bullhead minnow	*Pimephales vigilax*													5	**0.7**	1	**1.5**			12	**5.9**					18	**0.4**
Catostomidae																												
	Smallmouth buffalo	*Ictiobus bubalus*									1	**0.6**			3	**0.4**	1	**1.5**					7	**1.2**			12	**0.3**
Characidae																												
	Mexican tetra	*Astyanax mexicanus*[(a)]									4	**2.2**			17	**2.5**					1	**0.5**					22	**0.5**
Ictaluridae																												
	Black bullhead	*Ameiurus melas*	515	**44.9**	3	**1.5**	1	**0.2**			1	**0.6**											11	**1.9**			5,31	**12.6**
	Yellow bullhead	*Ameiurus natalis*					19	**4.2**	15	**3.0**	10	**5.6**											4	**0.7**			48	**1.1**
	Blue catfish	*Ictalurus furcatus*													1	**0.1**	5	**7.4**	1	**7.7**	1	**0.5**					8	**0.2**
	Channel catfish	*Ictalurus punctatus*													1	**0.1**					18	**8.9**					19	**0.5**
	Flathead catfish	*Pylodictis olivaris*																			1	**0.5**					1	**0.0**
Loricariidae																												
	Suckermouth armored catfish	*Pterygoplichthys anisitsi*[(a)]													5	**0.7**											5	**0.1**
Mugilidae																												
	Striped mullet	*Mugil cephalus*													19	**2.8**											19	**0.5**
Atherinopsidae																												
	Inland silverside	*Menidia beryllina*													29	**4.2**	2	**2.9**			4	**2.0**					35	**0.8**
Fundulidae																												

Table 2.4-5 (Sheet 2 of 2)
Number Collected (#) and Percent Relative Abundance (%) of Fish Captured at 12 Locations on the Exelon Victoria County Site in 2008

			MC-1		MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8		MC-9		MC-10		MC-11		MC-12		Total	
Family	**Common Name**	**Scientific Name**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
	Golden topminnow	*Fundulus chrysotus*	42	**3.7**											1	**0.1**											43	**1.0**
Poeciliidae																												
	Western mosquitofish	*Gambusia affinis*	223	**19.4**	185	**90.7**	32	**7.0**	162	**32.7**	113	**63.5**	31	**68.9**	77	**11.3**	2	**2.9**			6	**3.0**	6	**1.1**	154	**100.0**	991	**23.5**
	Sailfin molly	*Poecilia latipinna*					30	**6.6**	205	**41.3**					77	**11.3**	22	**32.4**			9	**4.5**					343	**8.1**
Cyprinodontidae																												
	Sheepshead minnow	*Cyprinodon variegatus*													34	**5.0**											34	**0.8**
Moronidae																												
	White bass	*Morone chrysops*													3	**0.4**	1	**1.5**									4	**0.1**
Centrarchidae																												
	Green sunfish	*Lepomis cyanellus*			5	**2.5**	127	**27.8**	15	**3.0**	4	**2.2**															151	**3.6**
	Warmouth	*Lepomis gulosus*	137	**11.9**	11	**5.4**	146	**31.9**	49	**9.9**	37	**20.8**			44	**6.4**					21	**10.4**	12	**2.1**			457	**10.8**
	Orangespotted sunfish	*Lepomis humilis*																			2	**1.0**	108	**19.0**			110	**2.6**
	Bluegill	*Lepomis macrochirus*	39	**3.4**			3	**0.7**	16	**3.2**	7	**3.9**			200	**29.3**	23	**33.8**			67	**33.2**	46	**8.1**			401	**9.5**
	Longear sunfish	*Lepomis megalotis*													2	**0.3**					11	**5.4**					13	**0.3**
	Redear sunfish	*Lepomis microlophus*	4	**0.3**											14	**2.0**					2	**1.0**					20	**0.5**
	Bantam sunfish	*Lepomis symmetricus*	79	**6.9**					8	**1.6**					23	**3.4**					1	**0.5**					111	**2.6**
	Largemouth bass	*Micropterus salmoides*	8	**0.7**					1	**0.2**													5	**0.9**			14	**0.3**
	White crappie	*Pomoxis annularis*	100	**8.7**			9	**2.0**	5	**1.0**			14	**31.1**	21	**3.1**	1	**1.5**			35	**17.3**	321	**56.5**			506	**12.0**
	Black crappie	*Pomoxis nigromaculatus*													3	**0.4**											3	**0.1**
Sciaenidae																												
	Freshwater drum	*Aplodinotus grunniens*																	1	**7.7**			1	**0.2**			2	**0.0**
Cichlidae																												
	Rio Grande cichlid	*Cichlasoma cyanoguttatum*[(a)]															1	**1.5**									1	**0.0**
Total			1147		204		457		496		178		45		683		68		13		202		568		154		4215	

(a) Exotic or introduced species

Table 2.4-6 (Sheet 1 of 2)
Combined Weight (g) and Percent of Total Weight (%) for Each Species Based on Data Collected from 537 Individuals at 12 Locations on the Exelon Victoria County Site in 2008[(a)]

		MC-1		MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8		MC-9		MC-10		MC-11		MC-12		Total	
Common Name	**Scientific Name**	**g**	**%**	**g)**	**%**	**g**	**%**	**gg**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**
Alligator gar	*Atractosteus spatula*															7,470	**47.1**									7,470	**6.9**
Spotted gar	*Lepisosteus oculatus*							230	**3.6**					18,490	**66.4**							5,780	**14.5**			24,500	**22.6**
Gizzard shad	*Dorosoma cepedianum*													30	**0.1**					20	**0.9**	550	**1.4**			600	**0.6**
Golden Shiner	*Notemigonus crysoleucas*[(b)]					730	**5.1**																			730	**0.7**
Common carp	*Cyprinus carpio*[(a)]					7,560	**53.2**	2,450	**38.6**	160	**23.2**			770	**2.8**							16,000	**40.2**			26,940	**24.8**
Smallmouth buffalo	*Ictiobus bubalus*													630	**2.3**	2,500	**15.8**					9,080	**22.8**			12,210	**11.3**
Black bullhead Catfish	*Ameiurus melas*					1,030	**7.2**			20	**2.9**											330	**0.8**			1,380	**1.3**
Yellow bullhead catfish	*Ameiurus natalis*					1,040	**7.3**	420	**6.6**	50	**7.2**											440	**1.1**			1,950	**1.8**
Blue catfish	*Ictalurus furcatus*													670	**2.4**	4,890	**30.8**			1,130	**50.0**					6,690	**6.2**
Channel catfish	*Ictalurus punctatus*													900	**3.2**					20	**0.9**					920	**0.8**
Flathead catfish	*Pylodictis olivaris*																			20	**0.9**					20	**0.0**
Suckermouth armored catfish	*Pterygoplichthys anisitsi*[(a)]													730	**2.6**											730	**0.7**
Striped mullet	*Mugil cephalus*													2,437	**8.7**											2,437	**2.2**
Sailfin molly	*Poecilia latipinna*					40	**0.3**																			40	**0.0**
White bass	*Morone chrysops*															900	**5.7**									900	**0.8**

Table 2.4-6 (Sheet 2 of 2)
Combined Weight (g) and Percent of Total Weight (%) for Each Species Based on Data Collected from 537 Individuals at 12 Locations on the Exelon Victoria County Site in 2008(a)

		MC-1		MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8		MC-9		MC-10		MC-11		MC-12		Total	
Common Name	**Scientific Name**	**g**	**%**	**g)**	**%**	**g**	**%**	**gg**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**	**g**	**%**
Green sunfish	*Lepomis cyanellus*					370	**2.6**	590	**9.3**	10	**1.4**															970	**0.9**
Warmouth	*Lepomis gulosus*					2,800	**19.7**	1,490	**23.5**	410	**59.4**			120	**0.4**					50	**2.2**					4,870	**4.5**
Bluegill	*Lepomis macrochirus*	15	**1.0**			70	**0.5**	430	**6.8**	40	**5.8**			280	**1.0**					20	**0.9**					855	**0.8**
Longear sunfish	*Lepomis megalotis*																			50	**2.2**					50	**0.0**
Redear sunfish	*Lepomis microlophus*	10	**0.7**											40	**0.1**											50	**0.0**
Largemouth bass	*Micropterus salmoides*	20	**1.4**					300	**4.7**													5,640	**14.2**			5,960	**5.5**
White crappie	*Pomoxis annularis*	1,406	**96.9**			570	**4.0**	430	**6.8**					2,530	**9.1**	110	**0.7**			950	**42.0**	1,850	**4.7**			7,846	**7.2**
Black crappie	*Pomoxis nigromaculatus*													230	**0.8**											230	**0.2**
Freshwater drum	*Aplodinotus grunniens*																					110	**0.3**			110	**0.1**
Total		1,451		0		14,210		6,340		690		0		27,857		15,870		0		2,260		39,780		0		108,458	

(a) Weight was not recorded for specimens less than 10 grams.
(b) Exotic or introduced species

Table 2.4-7 (Sheet 1 of 2)
Macroinvertebrates in Benthic Samples from 12 Locations on the Exelon Victoria County Site in 2008

			MC-1		MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8		MC-9		MC-10		MC-11		MC-12		Total	
Common Name	**Family**	**Genus**	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Mayflies	**Caenidae**	*Caenis*					8	27.6	3	30.0					1	0.9			1	1.3							13	2.9
	Baetidae	*Fallceon*													1	0.9											1	0.2
Dragonflies/ Damselflies	**Libellulidae**	*Perithemis*					1	3.4																			1	0.2
	Gomphidae	*Aphylla*	2	2.4							2	4.7															4	0.9
Water boatmen	**Corixidae**	*Trichocorixa*													1	0.9							1	14.3	1	6.3	3	0.7
Caddisflies	**Hydroptilidae**	*Orthotrichia pupa*					1	3.4																			1	0.2
Beetles	**Hydrophilidae**	*Berosus*													1	0.9	1	25.0	2	2.7							4	0.9
	Elmidae	*Dubiraphia*																			1	16.7					1	0.2
	Scarabidae																		1	1.3							1	0.2
	Haliplidae	*Haliplus*					4	13.8																			4	0.9
		Peltodytes					1	3.4							1	0.9											2	0.5
	Curculionidae						1	3.4																			1	0.2
	Chrysomelidae										1	2.3															1	0.2
Flies and midges	**Suborder: Brachycerca**										3	7.0															3	0.7
	Ephydridae																		6	8.0							6	1.4
	Tabanidae	*Chrysops*					3	10.3																	1	6.3	4	0.9
	Ceratopogonidae	*Ceratopogon*	2	2.4					3	30.0	2	4.7			14	13.0	2	50.0	13	17.3	1	16.7					37	8.4
		Culicoides	1	1.2							1	2.3			2	1.9			9	12.0	2	33.3					15	3.4
		Probezzia	2	2.4											1	0.9											3	0.7
		Serromyia	1	1.2																							1	0.2
		Sphaeromias	1	1.2					1	10.0					2	1.9									2	12.5	6	1.4
	Chaoboridae	*Chaoborus*			42	72.4																					42	9.5
	Chironomidae	*Procladius*	25	29.4	10	17.2					3	7.0			20	18.5							1	14.3	2	12.5	61	13.8
		Clinotanypus	16	18.8							1	2.3															17	3.9
		Tanypus									1	2.3			15	13.9			30	40.0	1	16.7					47	10.7
		Rheotanytarsus	16	18.8					1	10.0							1	25.0	3	4.0							21	4.8
		Cryptochironomus	1	1.2											3	2.8							2	28.6			6	1.4
		Dicrotendipes									1	2.3							1	1.3							2	0.5
		Parachironomus	8	9.4					1	10.0																	9	2.0
		Polypedilum	4	4.7											1	0.9											5	1.1
		Chironomus									2	4.7			25	23.1							1	14.3	1	6.3	29	6.6

Table 2.4-7 (Sheet 2 of 2)
Macroinvertebrates in Benthic Samples from 12 Locations on the Exelon Victoria County Site in 2008

			MC-1		MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8		MC-9		MC-10		MC-11		MC-12		Total	
Common Name	**Family**	**Genus**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Flies and midges (cont.)	**Chironomidae (cont.)**	*Tanytarsus*													1	**0.9**			1	**1.3**							2	**0.5**
		Coelotanypus													2	**1.9**			8	**10.7**							10	**2.3**
		Microchironomus													2	**1.9**											2	**0.5**
Mosquitoes	**Culicidae**	*Aedes*									19	**44.2**															19	**4.3**
Molluscs	**Physidae**		4	**4.7**	1	**1.7**	2	**6.9**	1	**10.0**															3	**18.8**	11	**2.5**
	Planorbidae						2	**6.9**																			2	**0.5**
	Ancylidae	*A*																							1	**6.3**	1	**0.2**
		B																							1	**6.3**	1	**0.2**
	Sphaeriidae	*A*	1	**1.2**			6	**20.7**			1	**2.3**			3	**2.8**					1	**16.7**					12	**2.7**
		B	1	**1.2**							3	**7.0**			3	**2.8**											7	**1.6**
	Unionidae														1	**0.9**											1	**0.2**
		Toxolasma texasiensis																					1	**14.3**			1	**0.2**
Crustaceans	**Palaemonidae**	*Palaemonetes*													8	**7.4**							1	**14.3**	4	**25.0**	13	**2.9**
	Cambaridae				5	**8.6**					3	**7.0**															8	**1.8**
Segmented Worms	**Phylum: Annelida**				P						P				P		P				P		P				P	
Totals			85		58		29		10		43		0		108		4		75		6		7		16		441	

P = present

Table 2.4-8 (Sheet 1 of 2)
Number Collected (#) and Percent Relative Abundance (%) of Fishes Collected from the Guadalupe River, Goff Bayou, and the GBRA Main Canal, January–December 2008

			GR-01		GR-02		GR-03		GR-04		GR-05		GR-All		Goff		Canal		Total	
Family	Common Name	Scientific Name	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Lepisosteidae	Alligator gar	*Atractosteus spatula*							3	0.2			3	0.0					3	0.0
	Spotted gar	*Lepisosteus oculatus*	147	2.7	71	4.7	61	6.2	195	15.9	91	7.7	565	5.5	116	8.9	15	1.2	696	5.4
	Longnose gar	*Lepisosteus osseus*	39	0.7	27	1.8	35	3.6	36	2.9	34	2.9	171	1.7	10	0.8			181	1.4
Elopidae	Ladyfish	*Elops saurus*													1	0.1			1	0.0
Anguillidae	American eel	*Anguilla rostrata*[(a)]									1	0.1	1	0.0					1	0.0
Clupeidae	Skipjack herring	*Alosa chrysochloris*			1	0.1							1	0.0					1	0.0
	Gulf menhaden	*Brevoortia patronus*													117	9.0	2	0.2	119	0.9
	Gizzard shad	*Dorosoma cepedianum*	273	5.1	168	11.1	47	4.8	130	10.6	137	11.5	755	7.3	219	16.9	21	1.6	995	7.7
	Threadfin shad	*Dorosoma petenense*	554	10.3	5	0.3	2	0.2	19	1.5	14	1.2	594	5.8	91	7.0	4	0.3	689	5.3
Engraulidae	Bay anchovy	*Anchoa mitchilli*							3	0.2	2	0.2	5	0.0	72	5.5	31	2.4	108	0.8
Cyprinidae	Grass carp	*Ctenopharyngodon idella*[(b)]									2	0.2	2	0.0					2	0.0
	Red shiner	*Cyprinella lutrensis*	3,419	63.4	760	50.0	444	45.1	195	15.9	178	15.0	4,996	48.5	18	1.4	43	3.3	5,057	39.2
	Common carp	*Cyprinus carpio*[(b)]	3	0.1	1	0.1	6	0.6	22	1.8	20	1.7	52	0.5	50	3.9	13	1.0	115	0.9
	Ribbon shiner	*Lythrurus fumeus*	1	0.0									1	0.0					1	0.0
	Burrhead chub	*Macrhybopsis marconis*	1	0.0									1	0.0					1	0.0
	Pugnose minnow	*Opsopoeodus emiliae*	7	0.1	9	0.6			49	4.0	18	1.5	83	0.8	7	0.5	83	6.4	173	1.3
	Bullhead minnow	*Pimephales vigilax*	117	2.2	76	5.0	60	6.1	25	2.0	42	3.5	320	3.1	14	1.1	57	4.4	391	3.0
Catostomidae	Smallmouth buffalo	*Ictiobus bubalus*	18	0.3	17	1.1	37	3.8	18	1.5	33	2.8	123	1.2	69	5.3	12	0.9	204	1.6
	Gray redhorse	*Moxostoma congestum*															1	0.1	1	0.0
Characidae	Mexican tetra	*Astyanax mexicanus*[(b)]	127	2.4	36	2.4	40	4.1	65	5.3	53	4.5	321	3.1	15	1.2	23	1.8	359	2.8
Ictaluridae	Yellow bullhead	*Ameiurus natalis*															1	0.1	1	0.0
	Blue catfish	*Ictalurus furcatus*	31	0.6	18	1.2	21	2.1	8	0.7	19	1.6	97	0.9	24	1.8			121	0.9
	Channel catfish	*Ictalurus punctatus*	1	0.0	9	0.6	25	2.5	11	0.9	16	1.3	62	0.6	3	0.2	1	0.1	66	0.5
	Tadpole madtom	*Noturus gyrinus*															6	0.5	6	0.0
	Flathead catfish	*Pylodictis olivaris*			6	0.4	19	1.9	5	0.4	3	0.3	33	0.3	6	0.5			39	0.3
Loricariidae	Suckermouth armored catfish	*Pterygoplichthys anisitsi*[(b)]					1	0.1	3	0.2	5	0.4	9	0.1	3	0.2	10	0.8	22	0.2
Mugilidae	Striped mullet	*Mugil cephalus*	191	3.5	7	0.5	14	1.4	77	6.3	265	22.3	554	5.4	227	17.5			781	6.1
Atherinopsidae	Inland silverside	*Menidia beryllina*	180	3.3	6	0.4	1	0.1	46	3.7	35	2.9	268	2.6	37	2.9	102	7.9	407	3.2
Fundulidae	Golden topminnow	*Fundulus chrysotus*									1	0.1	1	0.0					1	0.0
	Bluefin killifish	*Lucania goodei*[(b)]													3	0.2	2	0.2	5	0.0
Cyprinodontidae	Sheepshead minnow	*Cyprinodon variegatus*									1	0.1	1	0.0					1	0.0
Syngnathidae	Gulf pipefish	*Syngnathus scovelli*															2	0.2	2	0.0

Table 2.4-8 (Sheet 2 of 2)
Number Collected (#) and Percent Relative Abundance (%) of Fishes Collected from the Guadalupe River, Goff Bayou, and the GBRA Main Canal, January–December 2008

Family	Common Name	Scientific Name	GR-01		GR-02		GR-03		GR-04		GR-05		GR-All		Goff		Canal		Total	
			#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Poeciliidae	Western mosquitofish	*Gambusia affinis*	71	**1.3**	50	**3.3**	19	**1.9**	71	**5.8**	52	**4.4**	263	**2.6**	59	**4.5**	184	**14.2**	506	**3.9**
	Sailfin molly	*Poecilia latipinna*	15	**0.3**	6	**0.4**	2	**0.2**	39	**3.2**	23	**1.9**	85	**0.8**	9	**0.7**	62	**4.8**	156	**1.2**
Moronidae	White bass	*Morone chrysops*	1	**0.0**							3	**0.3**	4	**0.0**	2	**0.2**			6	**0.0**
Centrarchidae	Green sunfish	*Lepomis cyanellus*			1	**0.1**	2	**0.2**					3	**0.0**					3	**0.0**
	Warmouth	*Lepomis gulosus*	11	**0.2**	21	**1.4**	6	**0.6**	40	**3.3**	27	**2.3**	105	**1.0**	8	**0.6**	106	**8.2**	219	**1.7**
	Orangespotted sunfish	*Lepomis humilis*	14	**0.3**	1	**0.1**	2	**0.2**					17	**0.2**			1	**0.1**	18	**0.1**
	Bluegill	*Lepomis macrochirus*	42	**0.8**	61	**4.0**	34	**3.5**	72	**5.9**	42	**3.5**	251	**2.4**	56	**4.3**	90	**6.9**	397	**3.1**
	Longear sunfish	*Lepomis megalotis*	85	**1.6**	98	**6.5**	43	**4.4**	26	**2.1**	21	**1.8**	273	**2.6**	26	**2.0**	304	**23.5**	603	**4.7**
	Redear sunfish	*Lepomis microlophus*					1	**0.1**					1	**0.0**					1	**0.0**
	Bantam sunfish	*Lepomis symmetricus*							1	**0.1**	2	**0.2**	3	**0.0**			3	**0.2**	6	**0.0**
	Spotted bass	*Micropterus punctulatus*	9	**0.2**	19	**1.3**	26	**2.6**	28	**2.3**	7	**0.6**	89	**0.9**	2	**0.2**	2	**0.2**	93	**0.7**
	Largemouth bass	*Micropterus salmoides*	2	**0.0**					1	**0.1**	1	**0.1**	4	**0.0**	13	**1.0**	2	**0.2**	19	**0.1**
	White crappie	*Pomoxis annularis*	3	**0.1**	5	**0.3**			15	**1.2**	11	**0.9**	34	**0.3**	6	**0.5**	6	**0.5**	46	**0.4**
	Black crappie	*Pomoxis nigromaculatus*	5	**0.1**	5	**0.3**	1	**0.1**	15	**1.2**	17	**1.4**	43	**0.4**	9	**0.7**	1	**0.1**	53	**0.4**
Sparidae	Pinfish	*Lagodon rhomboides*															1	**0.1**	1	**0.0**
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*	7	**0.1**	7	**0.5**	4	**0.4**	6	**0.5**	8	**0.7**	32	**0.3**	4	**0.3**			36	**0.3**
Cichlidae	Rio Grande cichlid	*Cichlasoma cyanoguttatum*[(b)]	15	**0.3**	28	**1.8**	32	**3.2**	5	**0.4**	3	**0.3**	83	**0.8**	1	**0.1**	104	**8.0**	188	**1.5**
Paralichthyidae	Southern flounder	*Paralichthys lethostigma*													1	**0.1**			1	**0.0**
Achiridae	Hogchoker	*Trinectes maculatus*							1	**0.1**			1	**0.0**					1	**0.0**
Total			5,389		1,519		985		1,230		1,187		10,310		1,298		1,295		12,903	

(a) Observed but not collected
(b) Exotic or introduced species

Table 2.4-9
Combined Weight (kg) and Percent of Total Weight (%) of Fish Data Collected (2,949 Individuals) from the Guadalupe River, Goff Bayou, and the GBRA Main Canal, January–December 2008[a]

		GR-01		GR-02		GR-03		GR-04		GR-05		GR-All		Goff		Canal		Total	
Common Name	**Scientific Name**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**kg**	**%**
Alligator gar	*Atractosteus spatula*							8	**3.2**			8	**0.7**					8	**0.6**
Spotted gar	*Lepisosteus oculatus*	73	**25.2**	26	**25.4**	30	**16.5**	99	**37.5**	41	**14.6**	269	**24.1**	46	**12.8**	7	**28.1**	321	**21.5**
Longnose gar	*Lepisosteus osseus*	26	**8.9**	9	**8.4**	28	**15.3**	10	**3.7**	17	**6.1**	89	**8.0**	9	**2.5**			98	**6.5**
Ladyfish	*Elops saurus*													<1	**0.0**			<1	**0.0**
Skipjack herring	*Alosa chrysochloris*			<1	**0.2**							<1	**0.0**					<1	**0.0**
Gulf menhaden	*Brevoortia patronus*													<1	**0.0**			<1	**0.0**
Gizzard shad	*Dorosoma cepedianum*	28	**9.4**	20	**20.0**	9	**4.7**	15	**5.9**	14	**5.0**	86	**7.7**	9	**2.5**	<1	**0.5**	95	**6.4**
Threadfin shad	*Dorosoma petenense*	<1	**0.0**	<1	**0.0**							<1	**0.0**					<1	**0.0**
Grass carp	*Ctenopharyngodon idella*[b]									28	**10.2**	28	**2.5**					28	**1.9**
Common carp	*Cyprinus carpio*[a]	2	**0.5**	<1	**0.4**	6	**3.3**	48	**18.2**	33	**11.9**	89	**8.0**	44	**12.4**	7	**29.6**	140	**9.4**
Smallmouth buffalo	*Ictiobus bubalus*	38	**13.0**	21	**21.0**	77	**42.4**	35	**13.2**	73	**26.1**	244	**21.9**	113	**31.7**	6	**25.1**	363	**24.2**
Gray redhorse	*Moxostoma congestum*															<1	**0.5**	<1	**0.0**
Mexican tetra	*Astyanax mexicanus*[a]			<1	**0.0**	<1	**0.0**			<1	**0.0**	<1	**0.0**					<1	**0.0**
Blue catfish	*Ictalurus furcatus*	58	**20.0**	13	**12.4**	15	**8.4**	6	**2.4**	10	**3.5**	102	**9.2**	14	**3.8**			116	**7.8**
Channel catfish	*Ictalurus punctatus*	<1	**0.2**	1	**1.1**	1	**0.3**	2	**0.7**	4	**1.3**	8	**0.7**	3	**0.8**			10	**0.7**
Flathead catfish	*Pylodictis olivaris*			3	**3.2**	4	**2.2**	5	**1.8**	2	**0.9**	14	**1.3**	17	**4.8**			32	**2.1**
Suckermouth armored catfish	*Pterygoplichthys anisitsi*[a]					<1	**0.0**	<1	**0.2**	1	**0.3**	1	**0.1**	1	**0.3**			2	**0.2**
Striped mullet	*Mugil cephalus*	56	**19.2**	2	**1.7**	7	**3.8**	25	**9.7**	46	**16.7**	137	**12.2**	90	**25.2**			226	**15.1**
White bass	*Morone chrysops*	<1	**0.1**							1	**0.4**	2	**0.1**	1	**0.2**			2	**0.1**
Warmouth	*Lepomis gulosus*	<1	**0.0**	<1	**0.1**	<1	**0.0**	1	**0.4**	<1	**0.2**	2	**0.2**	<1	**0.0**	1	**2.9**	3	**0.2**
Bluegill	*Lepomis macrochirus*	<1	**0.1**	1	**0.6**	<1	**0.1**	1	**0.2**	1	**0.4**	3	**0.2**	1	**0.2**	<1	**1.2**	4	**0.2**
Longear sunfish	*Lepomis megalotis*	<1	**0.1**	<1	**0.3**	<1	**0.1**	<1	**0.1**	<1	**0.0**	1	**0.1**	<1	**0.0**	<1	**1.2**	1	**0.1**
Spotted bass	*Micropterus punctulatus*	1	**0.3**	1	**1.3**	1	**0.6**	4	**1.5**	1	**0.3**	8	**0.7**	1	**0.2**	<1	**0.7**	9	**0.6**
Largemouth bass	*Micropterus salmoides*	1	**0.2**					<1	**0.1**	<1	**0.1**	1	**0.1**	6	**1.6**	1	**5.3**	8	**0.5**
White crappie	*Pomoxis annularis*	<1	**0.1**	<1	**0.2**			1	**0.4**	1	**0.2**	2	**0.2**	1	**0.2**	1	**2.8**	3	**0.2**
Black crappie	*Pomoxis nigromaculatus*	1	**0.3**	1	**0.9**	<1	**0.0**	1	**0.5**	2	**0.7**	5	**0.5**	1	**0.2**	<1	**0.4**	6	**0.4**
Freshwater drum	*Aplodinotus grunniens*	7	**2.3**	2	**2.4**	3	**1.8**	1	**0.5**	4	**1.3**	17	**1.6**	<1	**0.1**			18	**1.2**
Rio Grande Cichlid	*Cichlasoma cyanoguttatum*[a]	<1	**0.0**	<1	**0.3**	1	**0.5**					1	**0.1**			<1	**1.8**	2	**0.1**
Southern flounder	*Paralichthys lethostigma*													1	**0.3**			1	**0.1**
Total		292		102		182		263		278		1116		355		24		1495	

(a) Weight was not recorded for specimens less than 10 grams.
(b) Exotic or introduced species

Table 2.4-10 (Sheet 1 of 2)
Benthic Macroinvertebrates Collected at Five Stations on the Guadalupe River, April–December 2008

Common Name	Family	Genus	GR-01		GR-02		GR-03		GR-04		GR-05		Total	
			#	%	#	%	#	%	#	%	#	%	#	%
Mayflies	Ephemeridae	*Hexagenia*	94	**20.5**	99	**9.7**	19	**0.5**	26	**11.4**	24	**20.0**	262	**4.8**
	Polymitarcyidae	*Tortopus*	6	**1.3**	1	**0.1**							7	**0.1**
		Campsurus			3	**0.3**	1	**0.0**	1	**0.4**			5	**0.1**
	Caenidae	*Cercobrachys*	2	**0.4**			1	**0.0**					6	**0.1**
		Caenis	1	**0.2**			7	**0.2**			1	**0.8**	9	**0.2**
		Brachycercus	8	**1.7**	1	**0.1**							9	**0.2**
	Palingeniidae	*Pentagenia vittegera*	5	**1.1**					4	**1.7**	1	**0.8**	10	**0.2**
	Baetidae	*Apobaetis*	1	**0.2**									1	**0.0**
Stoneflies	Perlidae		1	**0.2**									1	**0.0**
Caddisflies	Leptoceridae	*Oecetis*	2	**0.4**	4	**0.4**	2	**0.1**	2	**0.9**			10	**0.2**
		Nectopsyche			2	**0.2**	1	**0.0**					3	**0.1**
	Polycentropodidae	*Neureclipsis*					1	**0.0**					1	**0.0**
		Cyrnellus			1	**0.1**	3	**0.1**					4	**0.1**
	Hydroptilidae	*Hydroptila*					1	**0.0**			1	**0.8**	2	**0.0**
		Neotrichia					3	**0.1**					1	**0.0**
Dragonflies/ Damselflies	Gomphidae	*Gomphus*	5	**1.1**	1	**0.1**	2	**0.1**			4	**3.3**	12	**0.2**
		Dromogomphus			1	**0.1**							1	**0.0**
		Stylurus			2	**0.2**			2	**0.9**	2	**1.7**	6	**0.1**
	Coenagrionidae				1	**0.1**							1	**0.0**
		Argia			1	**0.1**							1	**0.0**
	Macromiidae	*Macromia*					1	**0.0**	1	**0.4**			2	**0.0**
Beetles	Scarabaeidae								1	**0.4**			1	**0.0**
	Elmidae	*Stenelmis*	6	**1.3**	11	**1.1**	13	**0.4**	4	**1.7**	6	**5.0**	40	**0.7**
		Dubiraphia	2	**0.4**	1	**0.1**			1	**0.4**	2	**1.7**	1	**0.0**
		Heterelmis	2	**0.4**			5	**0.1**					7	**0.1**
		Hexacylloepus			1	**0.1**					1	**0.8**	2	**0.0**
	Chrysomelidae				1	**0.1**							1	**0.0**
	Dryopidae	*Helichus*	1	**0.2**									1	**0.0**
Flies and midges	Ceratopogonidae	*Probezzia*	4	**0.9**			2	**0.1**					6	**0.1**
		Sphaeromias	8	**1.7**	10	**1.0**	7	**0.2**	14	**6.1**	6	**5.0**	45	**0.8**
		Culicoides									2	**1.7**	2	**0.0**
	Chironomidae	*Procladius*					1	**0.0**					1	**0.0**
		Ablabesmyia	1	**0.2**			3	**0.1**					4	**0.1**
		Microspectra	7	**1.5**									7	**0.1**
		Cryptochironomus	12	**2.6**	4	**0.4**	21	**0.6**	12	**5.2**	17	**14.2**	66	**1.2**
		Cryptotendipes							7	**3.1**			7	**0.1**
		Dicrotendipes			4	**0.4**			2	**0.9**	7	**5.8**	13	**0.2**
		Fissimentum			1	**0.1**							1	**0.0**
		Stelenchomyia									1	**0.8**	1	**0.0**
		Paracladopelma	1	**0.2**			1	**0.0**					2	**0.0**
		Polypedilum			12	**1.2**	6	**0.2**	7	**3.1**	2	**1.7**	27	**0.5**
		Chironomus			24	**2.4**	5	**0.1**					29	**0.5**
		Microchironomus			2	**0.2**	1	**0.0**					3	**0.1**
		Axarus	2	**0.4**			1	**0.0**	1	**0.4**	2	**1.7**	6	**0.1**
		Eukiefferiella			1	**0.1**							1	**0.0**
		Endochironomus	1	**0.2**									1	**0.0**
		Stictochironomus	2	**0.4**	7	**0.7**	2	**0.1**	5	**2.2**	2	**1.7**	18	**0.3**

Table 2.4-10 (Sheet 2 of 2)
Benthic Macroinvertebrates Collected at Five Stations on the Guadalupe River, April–December 2008

Common Name	Family	Genus	GR-01		GR-02		GR-03		GR-04		GR-05		Total	
			#	%	#	%	#	%	#	%	#	%	#	%
		Xestochironomus					3	**0.1**					3	**0.1**
		Epoicocladius			2	**0.2**							2	**0.0**
		Rheocricotopus					1	**0.0**					1	**0.0**
		Cardiocladius							1	**0.4**			1	**0.0**
		Larsia	3	**0.7**									3	**0.1**
		Ablabesmyia			3	**0.3**	1	**0.0**	1	**0.4**			5	**0.1**
		Tanypus			7	**0.7**			2	**0.9**	1	**0.8**	10	**0.2**
		Coelotanypus			5	**0.5**	1	**0.0**	9	**3.9**	2	**1.7**	17	**0.3**
		Paramerina	1	**0.2**	6	**0.6**	5	**0.1**	3	**1.3**	3	**2.5**	18	**0.3**
		Tanytarsus					1	**0.0**	1	**0.4**			2	**0.0**
		Cladotanytarsus							3	**1.3**			3	**0.1**
Molluscs	Corbiculidae		20	**4.4**	17	**1.7**	24	**0.7**	16	**7.0**	5	**4.2**	82	**1.5**
	Hydrobiidae		253	**55.1**	752	**73.9**	3412	**95.4**	96	**41.9**	23	**19.2**	4536	**84.0**
	Ancylidae				4	**0.4**							4	**0.1**
	Planorbidae	*Menetus*			1	**0.1**							1	**0.0**
	Unionidae		1	**0.2**	1	**0.1**	1	**0.0**					3	**0.1**
	Physidae		1	**0.2**	3	**0.3**	2	**0.1**	1	**0.4**			7	**0.1**
	Sphaeriidae		1	**0.2**	12	**1.2**	5	**0.1**	3	**1.3**			21	**0.4**
	Marine Gastropod								1	**0.4**			1	**0.0**
Leeches	*Subclass: Hirudinea*				2	**0.2**	4	**0.1**	1	**0.4**	1	**0.8**	8	**0.1**
Flatworms	Planariidae										1	**0.8**	1	**0.0**
Crustaceans	Palaemonidae	*Palaemonetes*	5	**1.1**	6	**0.6**			1	**0.4**			12	**0.2**
	Gammaridae	*Gammarus*					5	**0.1**			3	**2.5**	8	**0.1**
	Order: Podocopida				1	**0.1**	1	**0.0**					2	**0.0**
	Class: Branchiura						1	**0.0**					1	**0.0**
Segmented worms	*Phylum: Annelida*		P		P		P		P		P		P	
Totals			459		1018		3577		229		120		5403	

P = present

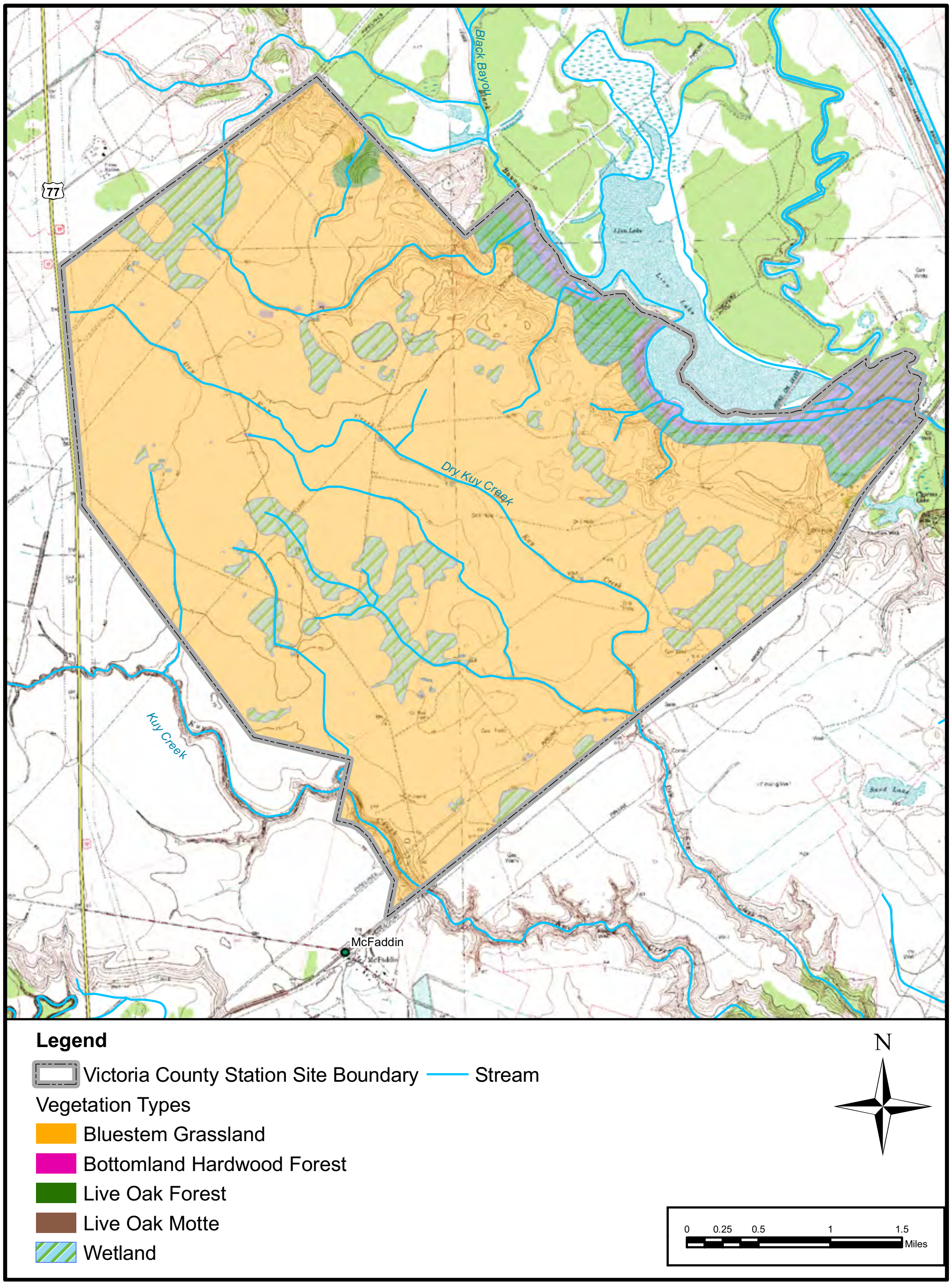


Figure 2.4-1 Habitat Types on the VCS Site

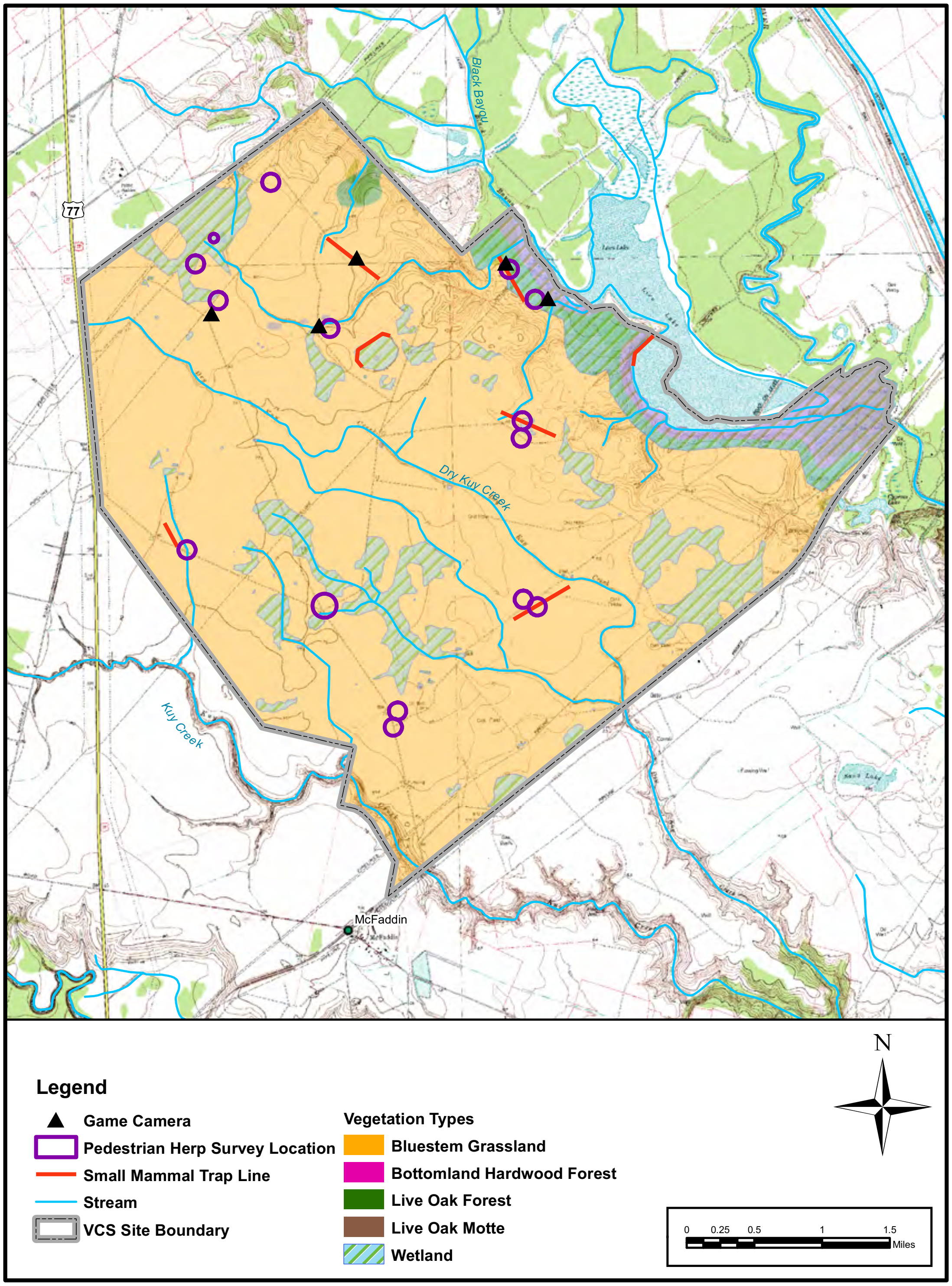


Figure 2.4-2 Locations of Herpetological and Mammal Surveys on the VCS Site

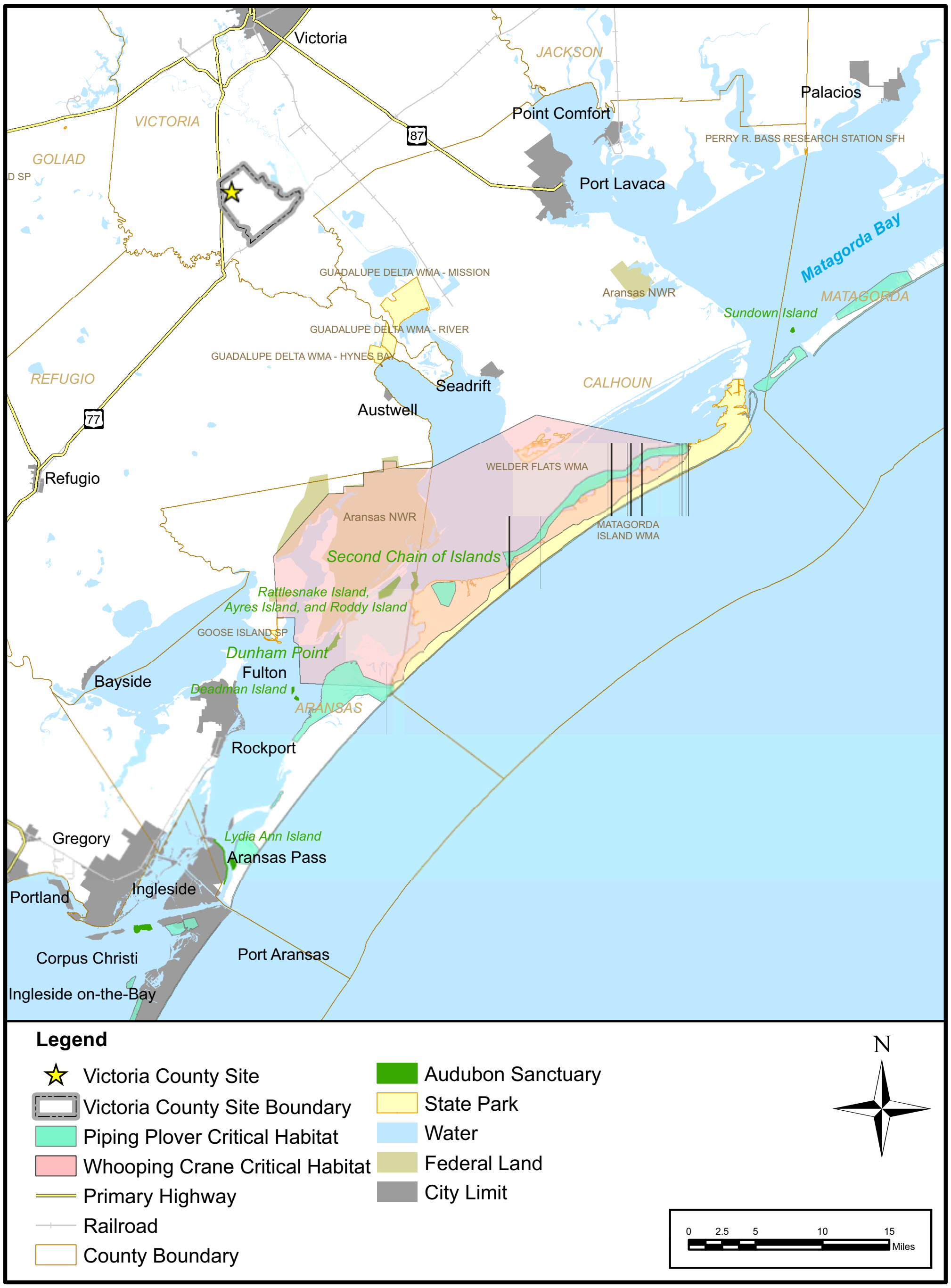


Figure 2.4-3 Critical Habitats, Parks, and Refuges Near the VCS Site

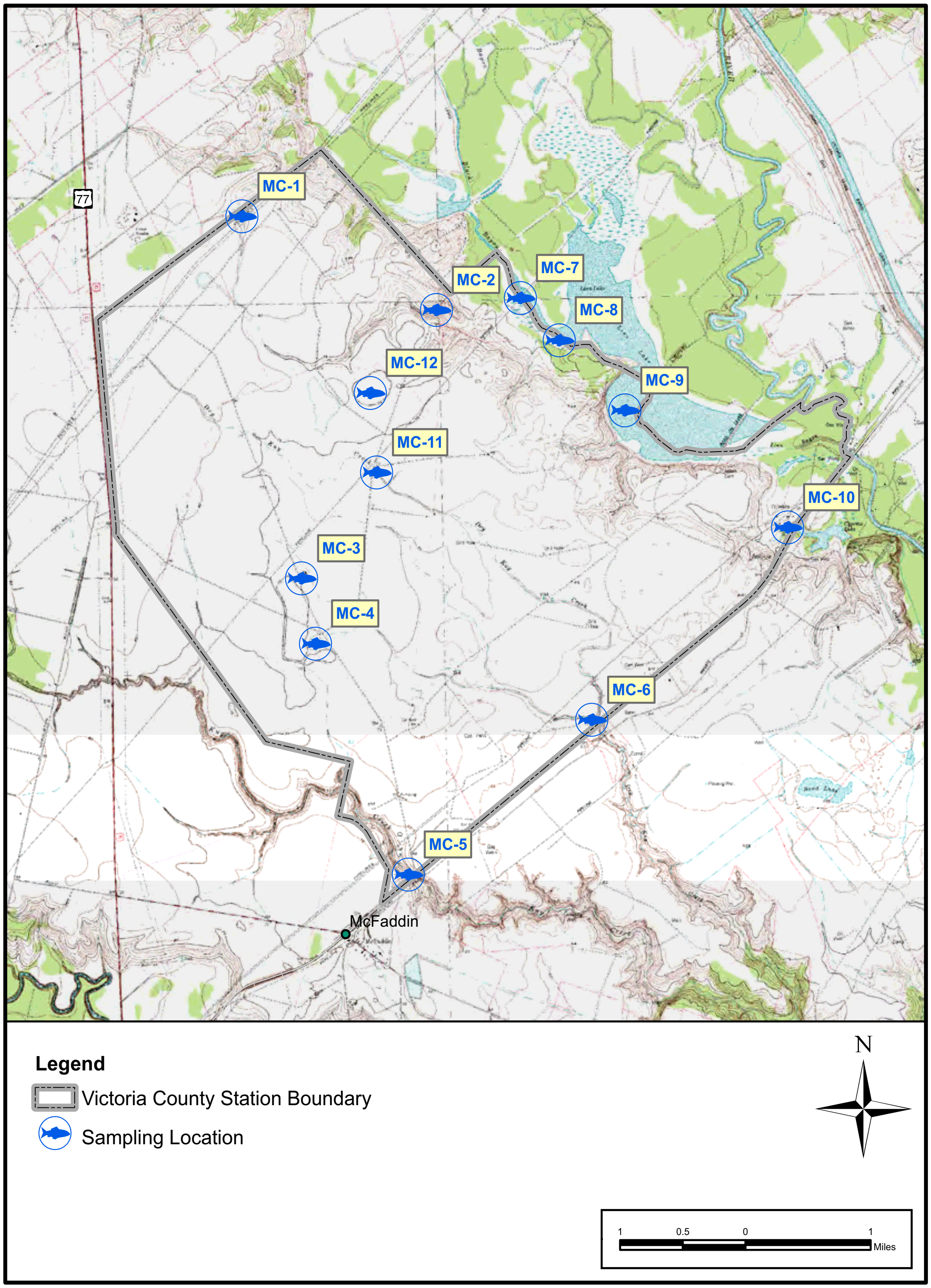


Figure 2.4-4 Onsite/Near-Site Fish Sampling Locations

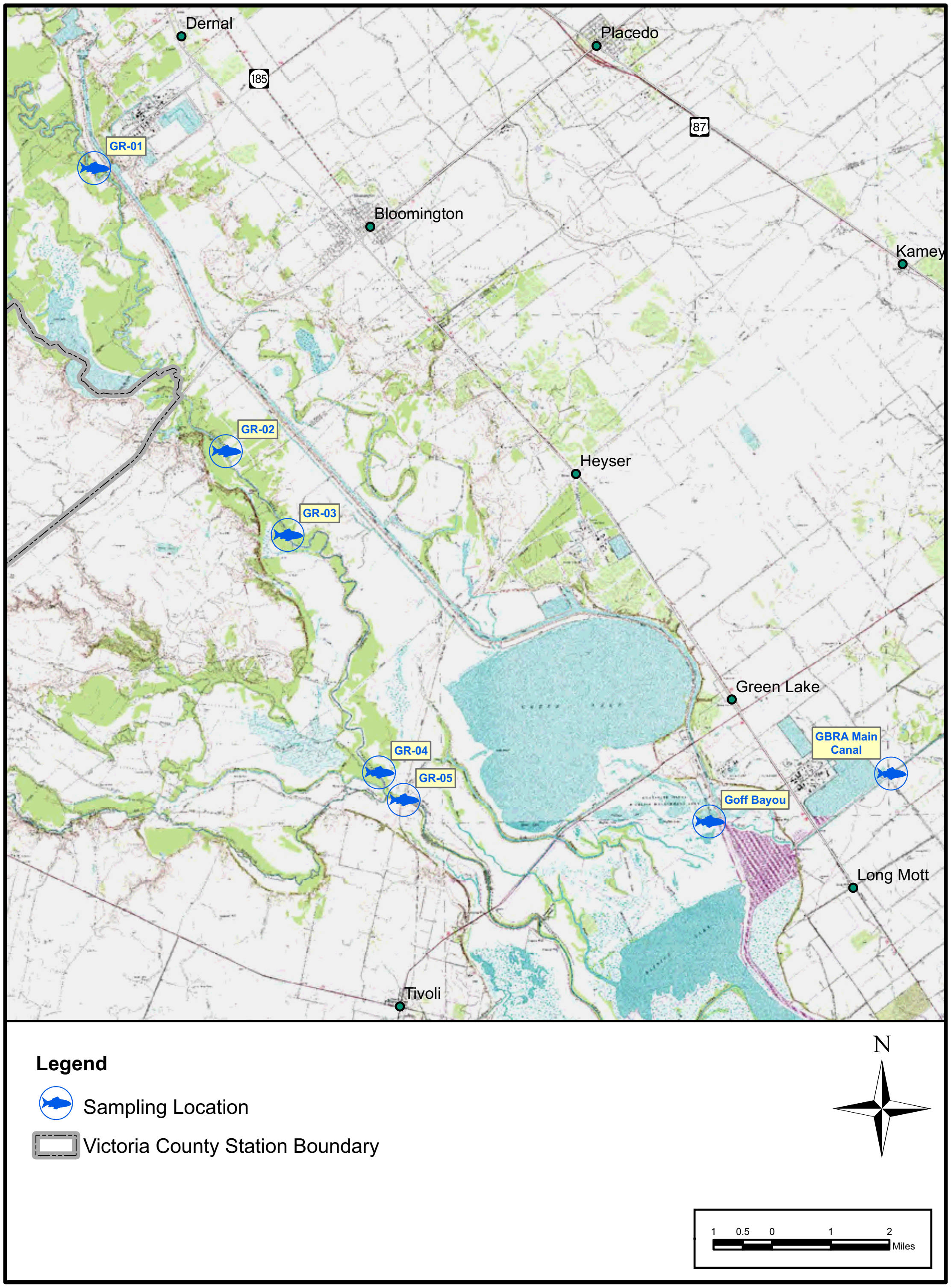


Figure 2.4-5 Guadalupe River and GBRA Canal System Sampling Locations

Section 2.5 Table of Contents

Section 2.5 List of Tables

List of Tables (Cont.)

Section 2.5 List of Figures

2.5 Socioeconomics

This section describes the socioeconomic resources that have the potential to be impacted by the construction and operation of nuclear power units at the VCS site and is divided into four subsections: demographics, community characteristics, historic properties, and environmental justice. These subsections include descriptions of spatial and temporal considerations, where appropriate.

For purposes of socioeconomic analysis, Exelon has collected and analyzed regional socioeconomic data, including the transit of workers between Victoria County and its neighboring counties, to determine the appropriate socioeconomic region of influence. Based on this analysis, Exelon determined that the socioeconomic region of influence for this project includes Victoria County and the following counties bordering it: Calhoun, DeWitt, Goliad, Jackson, and Refugio. Because the socioeconomic effects would be most evident in these counties, their socioeconomic characteristics are analyzed.

2.5.1 Demography

This subsection describes the following demographic characteristics: population data by sector, population data by political jurisdiction, and transient populations. Migrant populations are characterized in Subsection 2.5.4, Environmental Justice.

2.5.1.1 Population Data by Sector

The population surrounding the proposed site, up to 50 miles, was estimated based on the 2000 U.S. Census Bureau (USCB) decennial census data. The population distribution was estimated in 16 directional sectors, each direction consisting of 22.5 degrees, and in 10 concentric bands, measured from the power block reference point (Section 2.1): 0 to 1 mile, 1 to 2 miles, 2 to 3 miles, 3 to 4 miles, 4 to 5 miles, 5 to 10 miles, 10 to 20 miles, 20 to 30 miles, 30 to 40 miles, and 40 to 50 miles. Population estimates were projected using an exponential growth rate calculated from state population projections in 10-year increments from 2010 to 2080. This period covers the period of construction through 40 years of operations plus 20 years of license renewal.

The population distribution within 50 miles of the proposed site was computed by overlaying the 2000 census block point data (the smallest unit of census data) on the grids shown in Figures 2.5.1-1 and 2.5.1-2.

SECPOP2000, a code developed for the NRC by Sandia National Laboratories to calculate population by emergency planning zone sectors, was used to determine the 2000 resident population by sector[1]. The transient population for 0 to 10 miles was added to the 2000 resident population for use in the projections, and is reflected in Table 2.5.1-1. The population projections for radii of more than 10 miles include only residents.

Once the 2000 population (resident and transient, as appropriate) was determined for each sector, projections were made for the 10-year increments from 2010 to 2080.

Growth rates were calculated for each county based on projections obtained from the Texas State Data Center. Projections provided by the Texas State Data Center include four scenarios: Zero Migration Scenario, 1990–2000 Migration Scenario, One-Half 1990–2000 Migration Scenario, and 2000–2004 Migration Scenario. These scenarios assume the same set of mortality and fertility assumptions, but differ in their net migration assumptions. The Texas State Data Center suggests using the One-Half 1990–2000 Migration Scenario for most counties for long-term planning because migration is expected, but the 1990–2000 rate is not expected to be maintained over the coming years[2]. The 2000–2004 Migration Scenario was based on post-2000 population trends (estimates) and represents too few years on which to base a meaningful long-term trend. Therefore, Exelon used the One-Half 1990–2000 migration scenario for this analysis. Once county growth rates were determined, geographic information system software (ArcGIS® 9.2) was used to determine the total land area within a sector and the percentage of the land area in each sector occupied by a particular county. The population in a sector was assumed to be evenly distributed. In any sector spanning more than one county, the percentage of land area attributed to each county was multiplied by the sector population to determine each county's portion of the sector population. Then, each county's growth rate was applied to its respective population number to determine the projected population of that portion of the sector population. The projected populations of all portions in a sector were summed to determine the total projected population of that sector. Table 2.5.1-1 presents the population projections to 2080 by sector.

Regional population density and use characteristics of the site environs, including the exclusion area, low population zone, and population center distance are presented in Subsection 2.1.3 of the Site Safety Analysis Report in Part 2 of this application.

1. The latest decennial census (2000) data was used as the basis for population projections by radius and sector. While more recent population estimates are available from the U.S. Census Bureau (USCB), these estimates are either too general (by county), or are not spatially complete (by city or town). In order to get appropriate projections, SECPOP2000 uses USCB census block data to distribute the 2000 population by sector and radius. Populations for future years are then projected from the 2000 base data. State data is not used because it is based on the USCB data and has the same formats.

2.5.1.2 Population Data by Political Jurisdiction

Exelon has also included population data by political jurisdiction to facilitate analyses in the socioeconomic sections of this Environmental Report. The area defined by a 50-mile radius from the the power block reference point (Figure 2.5.1-1) includes all or part of 16 counties in Texas (Table 2.5.1-2 and Figure 2.5.1-1).

The proposed VCS site is located approximately 13.3 miles south of Victoria, Texas, 4.3 miles northwest of McFaddin, and adjacent to Linn Lake (Figure 2.5.1-2). The site is not located within a township. The closest population center with more than 25,000 residents is the city of Victoria (Figure 2.5.1-2). The city of Victoria had a 2000 population of 60,603 and a 2006 population estimate of 62,169 (USCB 2000a; USCB 2007b). The larger municipalities in the 50-mile radius (those with populations of 5000 or greater), their 2000 populations and 2006 estimates, and locations relative to the proposed site are presented in Table 2.5.1-3.

The 50-mile vicinity includes: the Victoria, Texas metropolitan statistical area (MSA) in its entirety; portions of the Corpus Christi, Texas, MSA; and portions of the Bay City, El Campo, and Beeville micropolitan statistical areas (MiSAs) (USCB 2003a).

---

2. The State Demographer's Office reported, “(f)rom our analyses of these projection scenarios, we believe that the 0.5 scenario is the most appropriate scenario for most counties for use in long-term planning. This recommendation is suggested for several reasons. First, the 1990-2000 period was a period of expansive growth in the Texas economy. There has been a general slowdown in the U.S. and Texas economies since 2000 that is likely to slow population growth. Although a recovery is occurring, it is uncertain at this time when it will be complete. At the same time, we believe that the substantial changes shown for 2000-2004 for many areas are unlikely to prevail over the long run in most areas, thus its use for long term projections such as those produced here seems ill advised. The 0.5 scenario produces a statewide annual rate of growth of approximately 1.5 percent slower than 1990-2000 but still substantial growth, given the 2000 population base. It thus represents a rate of growth more moderate than the rapid growth of the 1990s but one that produces substantial population growth in the State... Second, the 2000 Census count showed a substantially larger U.S. and Texas population than was anticipated. Although the Census Bureau has not fully determined the reasons for this, it is likely that the 2000 count included persons who were missed in 1990. Since residual migration measures classify such persons as 1990-2000 migrants and three of the scenarios are based on 1990-2000 migration patterns, it is possible that the migration rates for some groups, for some periods, for some counties are too high suggesting the use of a more moderate rate of growth scenario. Third, although the scenarios use trends in births and deaths, they assume constant levels of migration. Such an assumption is used because of the lack of historical data of sufficient specificity to trend these rates over time. Our analyses of such rates suggest that it is unlikely that such trends (especially in some key groups) will continue at the level of the 1990s. At the same time, the overall direction of trends and differences among racial/ethnic groups seem likely to continue suggesting the need for the use of a scenario that is based on 1990-2000 trends in migration but shows slower growth--the 0.5 scenario. Finally, higher than expected birth rates and elderly survival rates from 2000 to 2004 resulted in an alteration of projected fertility and mortality rates so that larger populations are projected under the 0.0, 0.5 and 1.0 scenarios. Because all four projection scenarios use the same fertility and mortality projections, the projected values for the three scenarios used in the previous (2004) projections are higher in this (2006) set of projections than in the previous projections. As a result, the rates of growth shown for the 1.0 scenario have become even higher and even more difficult to sustain over the projection period. This serves as an additional factor further recommending the use of the 0.5 scenario for long-term planning purposes... As noted above, we recommend the 0.5 scenario for the long-term planning purposes for which these projections are produced. However, for those who intend to use the projections for relatively short-term (i.e., 3-10 year) planning purposes or who believe the 2000-2004 period is indicative of long-term trends, the 2000-2004 scenario may be preferable.” (TOSD 2006)

- The Victoria, Texas MSA had a 2000 population of 111,663 (USCB 2003a). It was the 305th largest MSA in the United States (out of 362). From 1990 to 2000, it grew 12.3 percent (USCB 2003a). The 2006 population estimate was 114,088 (USCB 2007b).
- The Corpus Christi, Texas MSA had a 2000 population of 403,280 (USCB 2003a). It was the 111th largest MSA in the United States (out of 362). From 1990 to 2000, it grew 9.7 percent (USCB 2003a). The 2006 population estimate was 415,810 (USCB 2007b).
- The Bay City, Texas MiSA is characterized as primarily rural, with a 2000 population of 37,957 (USCB 2003a). It was the 352nd largest MiSA in the United States (out of 560). From 1990 to 2000, it grew 2.8 percent (USCB 2003a). The 2006 population estimate was 37,824 (USCB 2007b).
- The El Campo, Texas MiSA had a 2000 population of 41,188 (USCB 2003a). It was the 303rd largest MiSA in the United States (out of 560). From 1990 to 2000, it grew 3.1 percent (USCB 2003a). The 2006 population estimate was 41,475 (USCB 2007b).
- The Beeville, Texas MiSA had a 2000 population of 32,359 (USCB 2003a). It was the 428th largest MiSA in the United States (out of 560). From 1990 to 2000, it grew 28.7 percent (USCB 2003a). The 2006 population estimate was 33,176 (USCB 2007b).

Table 2.5.1-4 presents historical and projected population and growth rate data for the counties in the region of influence and for the region of influence as a whole. For the purpose of comparison, population data for the state of Texas is included in this table. From 1990 to 2000, the populations of the six counties grew at average annual growth rates ranging from –0.2 percent in Refugio County to 1.5 percent in Goliad County. The region of influence population grew at an average annual rate of 1.0 percent. For the same period, the state of Texas population grew at an average annual rate of 2.1 percent. The 2006 population estimates for the counties in the region of influence are as follows: Calhoun County, 20,705; DeWitt County, 20,167; Goliad County, 7192; Jackson County, 14,249; Refugio County, 7596; and Victoria County, 86,191 (USCB 2007a).

Population projections are provided by the Texas State Population Estimates and Projections Program. The program's projections of the population of Texas and of each county in Texas were prepared by the Office of the State Demographer and the Texas State Data Center in the Institute for Demographic and Socioeconomic Research at the University of Texas at San Antonio (TOSD 2006).

The population projections were completed using a cohort-component projection technique. Figure 2.5.1-3 provides a brief explanation of the technique, as provided by the Office of the State Demographer. Between 2010 and 2040 (the latest year for which data is provided), the average annual growth rates of all six counties and the state of Texas are projected to slow. By 2040, both

Goliad and Refugio Counties are projected to begin decreasing in population. The average annual growth rate for the region of influence is projected to slow to 0.4 percent.

Table 2.5.1-5 lists the age distributions of the populations in each of the six counties, and the region of influence as a whole, in 2000 and compares them to the age distribution of the population in the state of Texas.

2.5.1.3 Transient Populations

NRC RG 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, Section C.4 defines transient populations as people (other than those just passing through the area) who work, reside part-time, or engage in recreational activities in a given area, but are not permanent residents of the area (U.S. NRC Apr 1998)[3]. Under this definition, transients include people in:

- Workplaces
- Places where people reside part-time, such as hotels and motels and seasonal housing
- Recreational areas or at special events

Transient information is presented in two formats: quantitatively within the 0- to 10-mile radius and qualitatively within the 10- to 50-mile radius. The transient population within 10 miles was estimated to be 1470, based on major employers, overnight accommodations (including hotels, motels, and seasonal housing), and major recreation areas. These transient populations are included in Table 2.5.1-1. Transients within the 10- to 50-mile radius are not included in Table 2.5.1-1 but are described qualitatively in this subsection and throughout Section 2.5. Because most transient data is available by political boundaries and not by radii, the transient discussion encompasses Aransas, Bee, Calhoun, DeWitt, Jackson, Goliad, Refugio, and Victoria Counties because they are the counties whose boundaries are primarily within the 50-mile radius. For the transient description, they will be called the "eight-county region," not to be confused with the six-county socioeconomic region of influence.

A method for measuring the number of transient workers entering an area is to use worker flows in and out of counties. The USCB tracks this data, and Table 2.5.1-6 identifies the number of workers that traveled into the eight-county region for work in 2000. Workers traveling from one county to another in the eight-county region are not counted as transients. According to the data, about 7850 workers traveled into the eight-county region for work in 2000. Migrant populations are described in Subsection 2.5.4.2.

3. People living in institutional settings, such as correctional institutions and nursing homes, and non-institutional settings, such as college dormitories and military quarters, are considered, by the USCB, as permanent residents and are included in the decennial census.

Table 2.5.1-7 presents hotel and motel data for the eight-county region. Within all eight counties, in the first quarter of 2007, there were 72 hotels or motels with 313,500 room nights available and an occupancy rate of 51.7 percent. Table 2.5.1-8 quantifies seasonal housing in the eight counties. In 2000, there were 5806 vacant housing units that were designated for seasonal, recreational, or occasional use. Most seasonal housing is located along the coast, so seasonal population fluctuations are more apparent in places such as Port O'Connor, Seadrift, Olivia, Port Alto, and Port Lavaca. In the "resort-style" towns, the population drops in the "off season" and swells to several times the "off season" size in the "high season." Visitors to the area come to rent homes near the beach, go fishing and boating, and engage in wildlife observation activities.

Recreational facilities and major special events in the 50-mile region are described in Section 2.5.2.5.

2.5.1.4 References

TOG 2007. Texas Office of the Governor, *Regional Hotel Reports*, available at http://www.travel.state.tx.us/HotelReports.aspx, accessed December 13, 2007.

TOSD 2006. Texas Office of the State Demographer, *Projections of the Population of Texas and Counties in Texas by Age, Sex, and Race/Ethnicity for 2000-2004*, available at http://txsdc.utsa.edu/tpepp/2006projections/, accessed December 10, 2007.

USCB 2000a. U.S. Census Bureau, *P1 Total Population [1] --Universe: Total Population Data Set: Census 2000 Summary File 1 (SF1) 100 Percent Data,* available at http://factfinder.census.gov, accessed January 9, 2008.

USCB 2000b. U.S. Census Bureau, *DP-1 Profile of General Demographic Characteristics: 2000 Data Set: Census 2000 Summary File 1 (SF 1) 100 Percent Data*, available at http://factfinder.census.gov, accessed December 6 and 13, 2007.

USCB 2003a. U.S. Census Bureau, *Table 3b. Population in Metropolitan and Micropolitan Statistical Areas Ranked Separately by 2000 Population for the United States and Puerto Rico: 1990 and 2000*, available at http://www.census.gov, accessed December 6, 2007.

USCB 2003b. U.S. Census Bureau, *County-To-County Worker Flow Files*, available at http://www.census.gov, accessed January 21, 2008.

USCB 2007a. U.S. Census Bureau. *Subcounty Population Datasets,* available at http://www.census.gov, accessed March 24, 2008.

USCB 2007b. U.S. Census Bureau. *Metropolitan and Micropolitan Statistical Area Estimates,* available at http://www.census.gov, accessed March 24, 2008.

U.S. NRC Apr 1998. U.S. Nuclear Regulatory Commission, *Regulatory Guide 4.7 — General Site Suitability Criteria for Nuclear Power Stations*, DG-4004, April 1998.

Table 2.5.1-1 (Sheet 1 of 6)
Current Populations and Projections, by Sector, to 2080

Radii/Distance (miles)

Sectors	Year	0–1	1–2	2–3[a]	3–4	4–5	5–10	0–10[a]	10–20	20–30	30–40	40–50	0–50[a]
N	2000	0	1	0	9	0	141	151	37,290	1,792	681	8,007	47,921
	2010	0	1	0	10	0	154	165	40,646	1,946	695	8,030	51,482
	2020	0	1	0	11	0	168	180	44,375	2,119	714	8,064	55,452
	2030	0	1	0	12	0	183	196	48,477	2,307	730	8,086	59,796
	2040	0	1	0	13	0	200	214	52,952	2,513	753	8,189	64,621
	2050	0	2	0	14	0	219	235	57,799	2,735	770	8,212	69,751
	2060	0	2	0	15	0	238	255	63,020	2,975	792	8,246	75,288
	2070	0	2	0	17	0	259	278	68,614	3,232	814	8,280	81,218
	2080	0	2	0	18	0	283	303	74,953	3,523	839	8,314	87,932
NNE	2000	0	0	0	35	0	503	538	28,296	1,151	694	327	31,006
	2010	0	0	0	38	0	548	586	30,843	1,249	725	335	33,738
	2020	0	0	0	42	0	599	641	33,672	1,358	761	344	36,776
	2030	0	0	0	45	0	654	699	36,785	1,477	798	354	40,113
	2040	0	0	0	50	0	714	764	40,180	1,606	836	365	43,751
	2050	0	0	0	54	0	780	834	43,859	1,747	879	376	47,695
	2060	0	0	0	59	0	850	909	47,820	1,898	922	388	51,937
	2070	0	0	0	64	0	926	990	52,065	2,059	965	399	56,478
	2080	0	0	0	70	0	1,011	1,081	56,875	2,241	1,015	411	61,623
NE	2000	0	0	100	0	0	1,312	1,412	1,263	1,203	7,433	3,217	14,528
	2010	0	0	100	0	0	1,430	1,530	1,377	1,286	7,805	3,378	15,376
	2020	0	0	100	0	0	1,561	1,661	1,503	1,380	8,251	3,571	16,366
	2030	0	0	100	0	0	1,706	1,806	1,642	1,480	8,697	3,764	17,389
	2040	0	0	100	0	0	1,863	1,963	1,793	1,586	9,143	3,964	18,449
	2050	0	0	100	0	0	2,034	2,134	1,958	1,704	9,663	4,189	19,648
	2060	0	0	100	0	0	2,217	2,317	2,134	1,827	10,183	4,414	20,875
	2070	0	0	100	0	0	2,414	2,514	2,324	1,956	10,704	4,639	22,137
	2080	0	0	100	0	0	2,637	2,737	2,539	2,102	11,298	4,897	23,573

Table 2.5.1-1 (Sheet 2 of 6)
Current Populations and Projections, by Sector, to 2080

Radii/Distance (miles)

Sectors	Year	0–1	1–2	2–3[(a)]	3–4	4–5	5–10	0–10[(a)]	10–20	20–30	30–40	40–50	0–50[(a)]
ENE	2000	0	0	100	0	0	2,881	2,981	1,222	800	1,549	655	7,207
	2010	0	0	100	0	0	3,140	3,240	1,331	851	1,627	690	7,739
	2020	0	0	100	0	0	3,428	3,528	1,453	909	1,720	731	8,341
	2030	0	0	100	0	0	3,745	3,845	1,586	970	1,814	773	8,988
	2040	0	0	100	0	0	4,091	4,191	1,732	1,034	1,907	816	9,680
	2050	0	0	100	0	0	4,466	4,566	1,889	1,105	2,016	864	10,440
	2060	0	0	100	0	0	4,869	4,969	2,059	1,179	2,125	914	11,246
	2070	0	0	100	0	0	5,401	5,401	2,241	1,256	2,234	964	12,096
	2080	0	0	100	0	0	5,791	5,891	2,447	1,343	2,359	1021	13,061
E	2000	0	0	0	0	0	58	58	262	262	262	262	1,106
	2010	0	0	0	0	0	63	63	281	281	281	281	1,187
	2020	0	0	0	0	0	68	68	297	297	297	297	1,256
	2030	0	0	0	0	0	74	74	318	318	318	318	1,346
	2040	0	0	0	0	0	80	80	339	339	339	339	1,436
	2050	0	0	0	0	0	87	87	360	360	360	360	1,527
	2060	0	0	0	0	0	94	94	384	384	384	384	1,630
	2070	0	0	0	0	0	101	101	409	409	409	409	1,737
	2080	0	0	0	0	0	110	110	438	438	438	438	1,862
ESE	2000	0	0	0	0	0	0	0	360	626	1,108	0	2,094
	2010	0	0	0	0	0	0	0	385	670	1,186	0	2,241
	2020	0	0	0	0	0	0	0	407	707	1,252	0	2,366
	2030	0	0	0	0	0	0	0	436	757	1,341	0	2,534
	2040	0	0	0	0	0	0	0	464	808	1,429	0	2,701
	2050	0	0	0	0	0	0	0	493	858	1,518	0	2,869
	2060	0	0	0	0	0	0	0	526	914	1,618	0	3,058
	2070	0	0	0	0	0	0	0	558	970	1,717	0	3,245
	2080	0	0	0	0	0	0	0	598	1,039	1,839	0	3,476

Table 2.5.1-1 (Sheet 3 of 6)
Current Populations and Projections, by Sector, to 2080

Radii/Distance (miles)

Sectors	Year	0–1	1–2	2–3[a]	3–4	4–5	5–10	0–10[a]	10–20	20–30	30–40	40–50	0–50[a]
SE	2000	0	0	0	0	0	12	12	1,007	1,607	2	0	2,628
	2010	0	0	0	0	0	13	13	1,053	1,695	2	0	2,763
	2020	0	0	0	0	0	14	14	1,096	1,774	2	0	2,886
	2030	0	0	0	0	0	16	16	1,146	1,872	2	0	3,036
	2040	0	0	0	0	0	17	17	1,197	1,970	3	0	3,187
	2050	0	0	0	0	0	19	19	1,248	2,069	3	0	3,339
	2060	0	0	0	0	0	20	20	1,310	2,183	3	0	3,516
	2070	0	0	0	0	0	22	22	1,365	2,292	3	0	3,682
	2080	0	0	0	0	0	24	24	1,434	2,426	3	0	3,887
SSE	2000	0	0	0	0	55	104	159	43	17	0	0	219
	2010	0	0	0	0	60	111	171	44	18	0	0	233
	2020	0	0	0	0	65	118	183	46	19	0	0	248
	2030	0	0	0	0	72	126	198	47	19	0	0	264
	2040	0	0	0	0	78	134	212	48	20	0	0	280
	2050	0	0	0	0	85	143	228	49	21	0	0	298
	2060	0	0	0	0	93	153	246	51	22	0	0	319
	2070	0	0	0	0	101	164	265	52	23	0	0	340
	2080	0	0	0	0	111	176	287	54	24	0	0	365
S	2000	0	0	0	0	0	33	33	13	122	10,397	18,948	29,513
	2010	0	0	0	0	0	34	34	13	127	10,878	20,268	31,320
	2020	0	0	0	0	0	35	35	14	132	11,359	21,650	33,190
	2030	0	0	0	0	0	37	37	14	138	11,924	23,314	35,427
	2040	0	0	0	0	0	38	38	15	144	12,489	25,103	37,789
	2050	0	0	0	0	0	39	39	15	149	13,055	27,016	40,274
	2060	0	0	0	0	0	41	41	15	156	13,639	29,083	42,934
	2070	0	0	0	0	0	43	43	16	162	14,289	31,527	46,037
	2080	0	0	0	0	0	44	44	16	169	14,958	34,157	49,344

Table 2.5.1-1 (Sheet 4 of 6)
Current Populations and Projections, by Sector, to 2080

Radii/Distance (miles)

Sectors	Year	0–1	1–2	2–3[(a)]	3–4	4–5	5–10	0–10[(a)]	10–20	20–30	30–40	40–50	0–50[(a)]
SSW	2000	0	0	0	0	0	34	34	17	232	1,100	6,491	7,874
	2010	0	0	0	0	0	35	35	18	239	1,147	7,530	8,969
	2020	0	0	0	0	0	36	36	18	246	1,196	8,688	10,184
	2030	0	0	0	0	0	38	38	19	253	1,248	10,089	11,647
	2040	0	0	0	0	0	39	39	19	260	1,305	11,729	13,352
	2050	0	0	0	0	0	40	40	20	267	1,365	13,606	15,298
	2060	0	0	0	0	0	42	42	20	276	1,440	15,782	17,560
	2070	0	0	0	0	0	43	43	21	283	1,512	18,380	20,239
	2080	0	0	0	0	0	45	45	21	293	1,600	21,336	23,295
SW	2000	0	0	3	0	0	18	21	21	3,697	1,825	7,802	13,366
	2010	0	0	3	0	0	19	22	22	3,815	1,894	8,577	14,330
	2020	0	0	4	0	0	20	24	22	3,935	1,964	9,417	15,362
	2030	0	0	4	0	0	21	25	23	4,056	2,033	10,390	16,527
	2040	0	0	4	0	0	22	26	24	4,177	2,109	11,534	17,870
	2050	0	0	5	0	0	23	28	24	4,298	2,179	12,772	19,301
	2060	0	0	5	0	0	24	29	25	4,456	2,273	14,259	21,042
	2070	0	0	6	0	0	25	31	26	4,580	2,350	15,933	22,920
	2080	0	0	6	0	0	26	32	27	4,741	2,445	17,850	25,095
WSW	2000	0	0	0	0	31	58	89	14	161	108	27,560	27,932
	2010	0	0	0	0	34	62	96	14	166	113	28,938	29,327
	2020	0	0	0	0	37	67	104	15	173	118	30,316	30,726
	2030	0	0	0	0	40	72	112	16	179	124	31,694	32,125
	2040	0	0	0	0	44	77	121	16	184	130	33,348	33,799
	2050	0	0	0	0	48	82	130	17	191	135	34,726	35,199
	2060	0	0	0	0	52	88	140	17	197	142	36,655	37,151
	2070	0	0	0	0	57	95	152	18	204	148	38,308	38,830
	2080	0	0	0	0	62	102	164	18	212	155	40,238	40,787

Table 2.5.1-1 (Sheet 5 of 6)
Current Populations and Projections, by Sector, to 2080

Radii/Distance (miles)

Sectors	Year	0–1	1–2	2–3[(a)]	3–4	4–5	5–10	0–10[(a)]	10–20	20–30	30–40	40–50	0–50[(a)]
W	2000	0	0	0	33	0	13	46	241	2,609	493	1,649	5,038
	2010	0	0	0	36	0	14	50	248	2,687	508	1,717	5,210
	2020	0	0	0	39	0	15	54	258	2,792	528	1,789	5,421
	2030	0	0	0	43	0	16	59	268	2,896	548	1,860	5,631
	2040	0	0	0	47	0	18	65	275	2,974	563	1,942	5,819
	2050	0	0	0	51	0	19	70	284	3,079	583	2,013	6,029
	2060	0	0	0	56	0	21	77	294	3,183	603	2,107	6,264
	2070	0	0	0	61	0	22	83	304	3,287	623	2,188	6,485
	2080	0	0	0	66	0	24	90	316	3,418	648	2,285	6,757
WNW	2000	0	4	0	0	2	52	58	643	1,147	475	2,287	4,610
	2010	0	4	0	0	2	56	62	662	1,181	488	2,350	4,743
	2020	0	5	0	0	2	61	68	688	1,227	505	2,418	4,906
	2030	0	5	0	0	3	67	75	714	1,273	520	2,481	5,063
	2040	0	6	0	0	3	72	81	733	1,308	535	2,566	5,223
	2050	0	6	0	0	3	79	88	759	1,353	551	2,629	5,380
	2060	0	7	0	0	3	85	95	785	1,399	568	2,715	5,562
	2070	0	7	0	0	4	92	103	811	1,445	585	2,783	5,727
	2080	0	8	0	0	4	101	113	843	1,503	605	2,869	5,933
NW	2000	0	0	6	16	4	814	840	1,867	916	3,525	765	7,913
	2010	0	0	7	17	4	887	915	1,945	947	3,598	783	8,188
	2020	0	0	7	19	5	969	1,000	2,042	988	3,706	808	8,544
	2030	0	0	8	21	5	1,058	1,092	2,143	1,026	3,782	827	8,870
	2040	0	0	9	23	6	1,156	1,194	2,233	1,064	3,887	853	9,231
	2050	0	0	9	25	6	1,262	1,302	2,341	1,105	3,963	872	9,583
	2060	0	0	10	27	7	1,376	1,420	2,453	1,150	4,071	899	9,993
	2070	0	0	11	29	7	1,498	1,545	2,569	1,197	4,179	926	10,416
	2080	0	0	12	32	8	1,636	1,688	2,707	1,250	4,290	953	10,888

Table 2.5.1-1 (Sheet 6 of 6)
Current Populations and Projections, by Sector, to 2080

Radii/Distance (miles)

Sectors	Year	0–1	1–2	2–3[(a)]	3–4	4–5	5–10	0–10[(a)]	10–20	20–30	30–40	40–50	0–50[(a)]
NNW	2000	0	0	4	0	0	192	196	4,680	1,616	9,705	1,206	17,403
	2010	0	0	4	0	0	209	213	5,100	1,703	9,899	1,231	18,146
	2020	0	0	5	0	0	228	233	5,567	1,807	10,190	1,268	19,065
	2030	0	0	5	0	0	250	255	6,081	1,910	10,384	1,293	19,923
	2040	0	0	6	0	0	273	279	6,641	2,029	10,675	1,329	20,953
	2050	0	0	6	0	0	298	304	7,247	2,148	10,870	1,355	21,924
	2060	0	0	7	0	0	324	331	7,901	2,283	11,161	1,392	23,068
	2070	0	0	7	0	0	353	360	8,601	2,425	11,452	1,429	24,267
	2080	0	0	8	0	0	386	394	9,394	2,584	11,743	1,466	25,581
TOTAL	2000	0	5	213	93	92	6,225	6,628	77,239	33,257	39,870	82,417	239,411
	2010	0	5	214	101	100	6,775	7,195	83,982	35,230	41,393	87,537	255,337
	2020	0	6	216	111	109	7,387	7,829	91,473	37,150	43,140	93,004	272,596
	2030	0	6	217	121	120	8,063	8,527	99,715	39,442	44,880	99,107	291,671
	2040	0	7	219	133	131	8,794	9,284	108,661	41,751	46,760	106,182	312,638
	2050	0	8	220	144	142	9,590	10,104	118,362	44,148	48,607	113,346	334,567
	2060	0	9	222	157	155	10,442	10,985	128,814	46,817	50,666	121,867	359,149
	2070	0	9	224	171	169	11,358	11,931	139,994	49,491	52,769	131,066	385,251
	2080	0	10	226	186	185	12,396	13,003	152,680	52,699	55,075	141,445	414,902

(a) Transients in ring 2 to 3 miles for the NE sector (100 people) and the ENE sector (100 people) were not escalated over time because of the finite capacity of the development.

Table 2.5.1-2
Counties Completely or Partially within the 50-Mile Region

Aransas	Karnes[(a)]
Bee	Lavaca[(a)]
Calhoun	Matagorda[(a)]
Colorado[(a)]	Nueces[(a)]
DeWitt	Refugio
Goliad	San Patricio[(a)]
Gonzales[(a)]	Victoria
Jackson	Wharton[(a)]

Source: Figure 2.5.1-1

(a) Less than approximately 50% of this county falls within the 50-mile radius

Table 2.5.1-3
Larger[(a)] Municipalities in the 50-Mile Region

Municipality	County	2006 Population	2000 Population	Distance from Proposed Site (air-miles)	Direction
Victoria	Victoria	62,169	60,603	13.3	N
Port Lavaca	Calhoun	11,696	12,035	24.5	E
Cuero	DeWitt	6,632	6,571	36.6	NNW
Edna	Jackson	5,867	5,899	34.4	NE
Yoakum	DeWitt	5,677	5,731	47.2	N

Sources: USCB 2000a; USCB 2007a; and Figures 2.5.1-1 and 2.5.1-2

(a) Municipalities with populations greater than 5000

Table 2.5.1-4
Population Data, 1970 to 2040

Year	Calhoun Population	Calhoun Average Annual Percent Growth	DeWitt Population	DeWitt Average Annual Percent Growth	Goliad Population	Goliad Average Annual Percent Growth	Jackson Population	Jackson Average Annual Percent Growth
1970	17,831	N/A	18,660	N/A	4,869	N/A	12,975	N/A
1980	19,574	0.9%	18,903	0.1%	5,193	0.6%	13,352	0.3%
1990	19,053	–0.3%	18,840	0.0%	5,980	1.4%	13,039	–0.2%
2000	20,647	0.8%	20,013	0.6%	6,928	1.5%	14,391	1.0%
2010	22,684	0.9%	20,832	0.4%	7,416	0.7%	15,571	0.8%
2020	24,427	0.7%	21,538	0.3%	7,798	0.5%	16,745	0.7%
2030	25,732	0.5%	21,902	0.2%	7,963	0.2%	17,432	0.4%
2040	26,571	0.3%	21,987	0.0%	7,921	–0.1%	17,759	0.2%

Year	Refugio Population	Refugio Average Annual Percent Growth	Victoria Population	Victoria Average Annual Percent Growth	Region of Influence Population	Region of Influence Average Annual Percent Growth	Texas Population	Texas Average Annual Percent Growth
1970	9,494	N/A	53,766	N/A	117,595	N/A	11,196,730	N/A
1980	9,289	–0.2%	68,807	2.5%	135,118	1.4%	14,229,191	2.4%
1990	7,976	–1.5%	74,361	0.8%	139,249	0.3%	16,986,510	1.8%
2000	7,828	–0.2%	84,088	1.2%	153,895	1.0%	20,851,820	2.1%
2010	8,365	0.7%	94,143	1.1%	169,011	0.9%	24,330,612	1.6%
2020	8,660	0.3%	104,236	1.0%	183,404	0.8%	28,005,788	1.4%
2030	8,793	0.2%	112,380	0.8%	194,202	0.6%	31,830,589	1.3%
2040	8,783	0.0%	119,276	0.6%	202,297	0.4%	35,761,201	1.2%

Sources: USCB 1995; USCB 2000g; TOSD 2006
N/A – Not applicable, base year.

Table 2.5.1-5
Age Distribution, 2000

Age Group	Calhoun		DeWitt		Goliad		Jackson	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Under 5 years	1,616	7.8	1,093	5.5	399	5.8	1,022	7.1
5 to 9 years	1,714	8.3	1,263	6.3	481	6.9	1,001	7
10 to 14 years	1,621	7.9	1,453	7.3	530	7.7	1,125	7.8
15 to 19 years	1,524	7.4	1,424	7.1	555	8	1,227	8.5
20 to 24 years	1,197	5.8	924	4.6	276	4	752	5.2
25 to 34 years	2,556	12.4	2,188	10.9	690	10	1,631	11.3
35 to 44 years	3,077	14.9	3,229	16.1	1,043	15.1	2,123	14.8
45 to 54 years	2,598	12.6	2,727	13.6	996	14.4	1,927	13.4
55 to 59 years	1,096	5.6	1,036	5.2	397	5.7	676	4.7
60 to 64 years	909	4.4	895	4.5	353	5.1	612	4.3
65 to 74 years	1,705	8.3	1,887	9.4	659	9.5	1,194	8.3
75 to 84 years	804	3.9	1,319	6.6	400	5.8	780	5.4
85 years and over	230	1.1	575	2.9	152	2.2	321	2.2
TOTAL	20,647	100	20,013	100	6,928	100	14,391	100
Median age (years)	35.3		40.1		40.2		37.3	

Age Group	Refugio		Victoria		Region of Influence		Texas	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Under 5 years	466	6	6,431	7.6	11,027	7.2	1,624,628	7.8
5 to 9 years	566	7.2	6,682	7.9	11,707	7.6	1,654,184	7.9
10 to 14 years	626	8	7,051	8.4	12,406	8.1	1,631,192	7.8
15 to 19 years	616	7.9	6,925	8.2	12,271	8.0	1,636,232	7.8
20 to 24 years	346	4.4	5,167	6.1	8,662	5.6	1,536,404	7.4
25 to 34 years	875	11.2	10,745	12.8	18,685	12.1	3,162,083	15.2
35 to 44 years	1,155	14.8	12,911	15.4	23,538	15.3	3,322,238	15.9
45 to 54 years	1,029	13.1	11,109	13.2	20,386	12.2	2,611,137	12.5
55 to 59 years	423	5.4	3,884	4.6	7,509	4.9	896,521	4.3
60 to 64 years	425	5.4	3,124	3.7	6,318	4.1	107,669	3.4
65 to 74 years	689	8.8	5,557	6.6	11,691	7.6	1,142,608	5.5
75 to 84 years	438	5.6	3,346	4	7,087	4.6	691,984	3.3
85 years and over	174	22	1,156	1.4	2,608	1.7	237,940	1.1
TOTAL	7,828	100	84,088	100	153,895	100	20,851,820	100
Median age (years)	38.6		34.2		N/A		32.3	

Source: USCB 2000g

Note: Age stratification data at this level of detail is not available in 2006 estimates. Therefore, the 2000 data is the most current.

Table 2.5.1-6
Worker Flows into the Eight-County Region, 2000

Number of workers residing outside of the eight-county region but traveling into the eight-county region for work	Workplace County
1,248	Aransas
1,216	Bee
1,503	Calhoun
1,369	DeWitt
109	Goliad
502	Jackson
261	Refugio
1,644	Victoria
7,852	Eight-County In-Migrating Worker Total

Source: USCB 2003b

Table 2.5.1-7
Hotel/Motel Data, 2007, First Quarter, Eight-County Region[(a)]

City/Town/Place	Rate (Dollars)	Number of Hotels	Room Nights Available (in thousands)[(b)]	Percent Occupancy
Aransas Pass	0–39.99	1	4.1	27.1
Beeville	0–39.99	2	5.9	53.3
	40–49.99	1	4.9	43.6
	50–59.99	1	5.4	79.6
	80–89.99	1	5.5	80.3
Cuero	0–39.99	2	5.4	39.0
	70–79.99	1	2.8	78.4
Edna	40–49.99	2	5.7	49.1
Fulton	60–69.99	2	7.0	50.2
	70–79.99	1	6.6	48.0
	80–89.99	1	4.0	54.8
Goliad	0–39.99	2	5.3	55.4
Port Aransas	110–120	1	4.1	76.4
Port Lavaca	0–39.99	2	7.5	39.2
	40–49.99	1	4.8	46.9
	50–59.99	2	13.6	48.8
	80–89.99	1	4.5	73.2
Port O’Connor	40–49.99	1	3.2	19.0
	60–69.99	2	4.7	48.2
	80–89.99	1	0.7	29.2
	90–99.99	1	4.5	10.2
Refugio	0–39.99	1	1.5	36.3
	40–49.99	1	4.0	38.9
	70–79.99	1	1.4	38.3
Rockport	0–39.99	3	7.7	32.8
	40–49.99	1	5.4	45.4
	50–59.99	3	9.9	33.7
	60–69.99	2	4.2	42.5
	70–79.99	3	20.1	41.5
	80–89.99	1	4.5	55.7
	100–110	2	8.1	38.0
	120–130	2	1.6	31.0
	130+	1	7.0	46.7
Seadrift	40–49.99	2	4.3	42.2
	60–69.99	1	1.1	27.5
	80–89.99	1	1.1	55.6
Victoria	0–39.99	7	41	51.5
	40–49.99	1	7.2	76.1
	50–59.99	1	9.0	51.3
	60–69.99	5	45.1	61.1
	80–89.99	1	5.8	76.3
	90–99.99	2	11.0	79.8
Yoakum	60–69.99	1	2.3	69.5
Eight-County Total		72	313.5	51.7

Source: TOG 2007

(a) Only properties with revenues exceeding $18,000 in the current quarter.
(b) Room Nights Available — the number of rooms in a hotel multiplied by the number of nights in the current quarter.

Table 2.5.1-8
Seasonal Housing Data 2000, Eight-County Region

County	Vacant Housing for Seasonal, Recreational, or Occasional Use
Aransas	2,461
Bee	215
Calhoun	1,751
DeWitt	318
Goliad	385
Jackson	228
Refugio	187
Victoria	261
8-County Total	5,806

Source: USCB 2000b

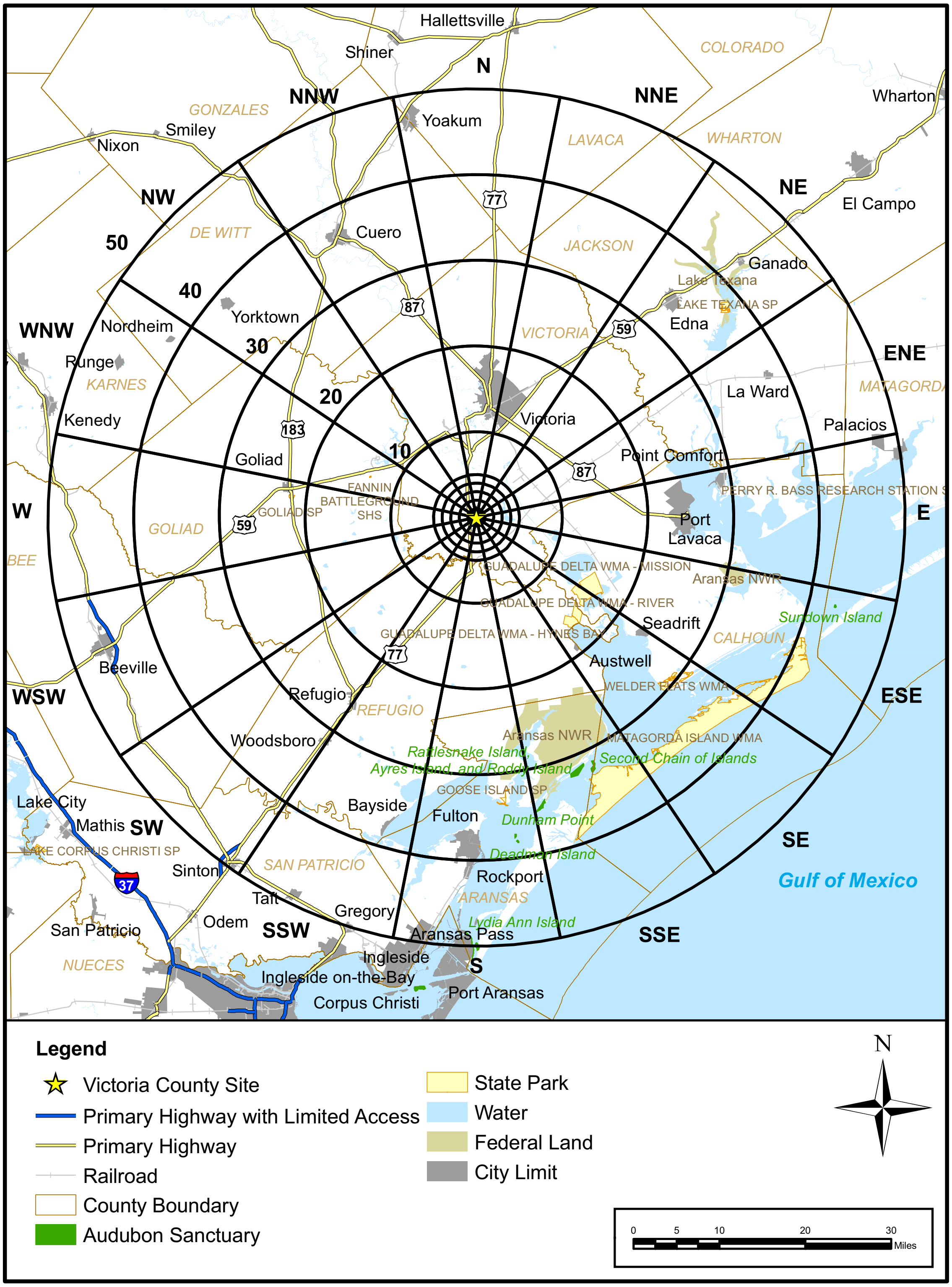


Figure 2.5.1-1 50-Mile Vicinity with Direction Sectors

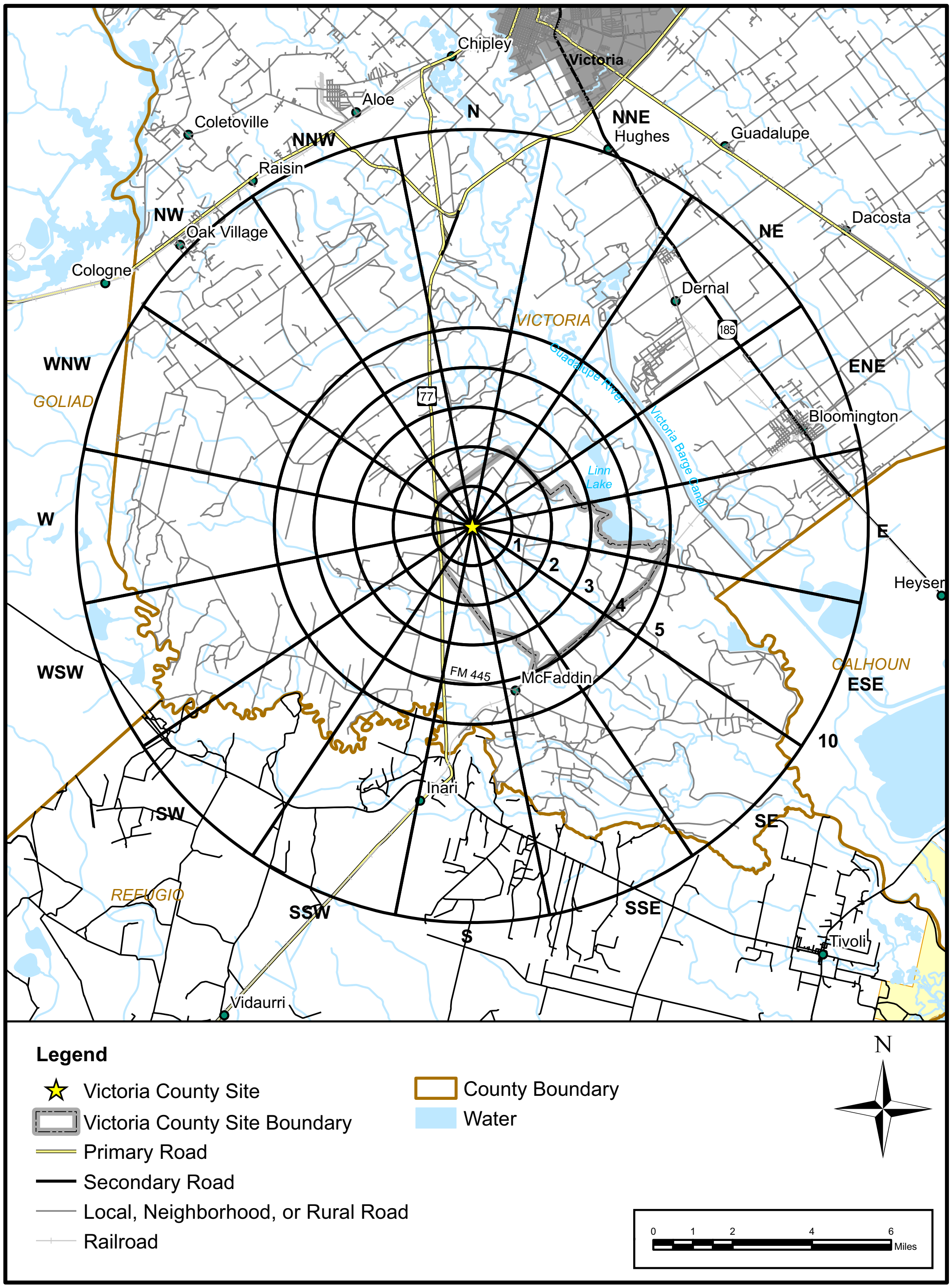


Figure 2.5.1-2 10-Mile Vicinity with Direction Sectors

The basic characteristics of this technique are the use of separate cohorts — persons with one or more common characteristics — and the separate projection of each of the major components of population change — fertility, mortality, and migration — for each of the cohorts. These projections of components for each cohort are then combined in a demographic equation as follows:

$P_{t2} = P_{t1} + B_{t1-t2} - D_{t1-t2} + M_{t1-t2}$

Where :

P_{t1} = the population projected at some future data $t_1 - t_2$
P_{t1} = the population at the base year t_1
B_{t1-t2} = the number of births that occur during the interval $t_1 - t_2$
D_{t1-t2} = the number of deaths that occur during the interval $t_1 - t_2$
M_{t1-t2} = the number of net migration that takes place during the interval $t_1 - t_2$

When several cohorts are used, P_{t2} may be seen as:

$$P_{t2} = \sum_{i=1}^{n} P_{ci,t2}$$

Where:

Pt2 is as in the equation above
Pci,t2 = population of a given cohort at time t2 and
$P_{ci,t2}$ = $P_{ci,t1} + B_{ci,t1-t2} - D_{ci,t1} + M_{ci,t1}$

Where :

all terms are as noted above but are specific to given cohorts ci
In this, as in any other use of the cohort-component technique at least four major steps must be completed:

1. The selection of a baseline set of cohorts for the projections area or areas of interest for the baseline time period (usually the last census and for other dates for which detailed base data are available);
2. The determination of appropriate baseline migration, mortality, and fertility measures for each cohort for the baseline time period;
3. The determine of a method for projecting trends in fertility, mortality and migration rates over the projection period;
4. The selection of a computational procedure for applying the rates to the baseline cohorts to project the population for the projection period.

Source: TOSD 2006
Note: In performing their projection analyses, the State Demographer’s Office provided projections based on four different scenarios, which produce four alternative sets of population values. These scenarios assume the same set of mortality and fertility assumptions in each scenario but differ in their assumptions relative to net migration. The net migration assumptions made for three scenarios are derived from 1990-2000 patterns which have been altered relative to expected future population trends. This is done by systematically and uniformly altering the adjusted (as noted above) 1990-2000 net migration rates by age, sex and race/ethnicity. The scenarios so produced are referred to as the zero migration (0.0) scenario, the one-half 1990-2000 (0.5) scenario, and the 1990-2000 (1.0) scenario. The fourth scenario uses 2000 to 2004 estimates of net migration with 2004 population values being taken from the Texas State Data Center age, sex, and race/ethnicity estimates.

Exelon selected the one-half 1990-2000 (0.5) scenario because it is the scenario recommended by the State Demographer’s Office for long term planning. This scenario was prepared as an approximate average of the zero (0.0) and 1990-2000 (1.0) scenarios. It assumes rates of net migration one-half of those of the 1990s. The reason for including this scenario is that many counties in the State are unlikely to continue to experience the overall levels of relative extensive growth of the 1990s. This scenario suggests slower than 1990-2000, but steady, growth.

Figure 2.5.1-3 Population Projection Methodology

2.5.2 Community Characteristics

The VCS site is a greenfield site; therefore, Exelon cannot use the residential distributions of an existing nuclear plant workforce at that location as a surrogate for the residential distributions of the new plant workforce, as utilities have done when proposing new reactors on existing sites. Instead, to establish the most likely counties that would be affected by the new workforce, Exelon reviewed data from several governmental agencies, including the U.S. Census Bureau (USCB), the U.S. Department of Commerce, the Bureau of Economic Analysis (BEA), the U.S. Department of Labor, and the Bureau of Labor Statistics (BLS), to develop a model and then arrive at a determination of which counties within 50 miles of the proposed site have strong economic linkages to the proposed project's host county, Victoria. Exelon analyzed regional socioeconomic data including, but not limited to, county populations, the location of population centers, location and sizes of overall and construction labor forces, and worker commuting patterns among counties surrounding the VCS site. Generally, counties are linked economically and share economic benefits if (1) there is a relationship between one county's labor force (size, availability, skill mix) and the use of that labor force in another county and (2) there are commuting routes of relative ease between the counties (particularly between the population centers). These factors were used to objectively determine the region of influence (ROI) analyzed in this document. Based on this analysis, Exelon has concluded that the proposed action has the potential to impact socioeconomic variables (employment, population, income, housing, infrastructure, and community services) in six counties (Calhoun, DeWitt, Goliad, Jackson, Refugio, and Victoria).

This subsection addresses the following community characteristics for the ROI: economy, taxes, transportation, land use, housing, community infrastructure and public services, and education. Subsection 2.5.2.5, Aesthetics and Recreation, contains data for the entire 50-mile radius around the site because most of the potential socioeconomic impacts to these resources should be experienced in that area. Subsection 2.5.2.8, Schools, contains data for colleges and universities within a 50-mile region for the same reason.

Throughout socioeconomics, data is presented for the most current year available. Depending on the source of the data, the most current year may vary.

2.5.2.1 Economy

The proposed VCS site is in Victoria County, near the central Texas Gulf Coast. In the ROI, Victoria, Goliad, and Calhoun Counties comprise the Victoria, Texas Metropolitan Statistical Area (MSA) (OMB Dec 2006). In addition, five of the six ROI counties (excluding Refugio County), along with Gonzales and Lavaca Counties to the north and east, comprise the seven-county Golden Crescent Regional Planning Commission (GCRPC) (GCRPC Undated) and the Texas Workforce Commission's Golden Crescent Local Workforce Development Region (TWC 2007).

The ROI's principal economic centers include the six county seats: Port Lavaca (Calhoun County); Cuero (DeWitt County); Goliad (Goliad County); Edna (Jackson County); Refugio (Refugio County); and Victoria (Victoria County) (TWC 2007). Victoria is by far the largest city in the ROI; as of the 2000 Census, its population of 60,603 was more than double the combined population of the other five county seats (USCB 2000a).

The area within 10 miles of the proposed VCS site is generally rural farmland, primarily pastureland used for livestock ranching with some crop production. The ROI as a whole is also predominantly rural, with an economy based primarily on cattle ranching, crop production (rice, cotton, sorghum, and corn), oil and natural gas production, oil refining, petrochemical production, and commercial fishing (TSHA Jun 2001a; TSHA Jun 2001b; TSHA Jun 2001c; TSHA Jan 2006a; TSHA Jan 2006b; TSHA Jan 2008a; TWC 2007).

Table 2.5.2-1 details labor force, employment, and unemployment trends in the ROI, as reported by the BLS. In 2006, the ROI labor force totaled 78,157 people, representing less than 1.0 percent of the total Texas labor force (BLS 2007a). The ROI labor force increased at an average annual rate of 0.4 percent between 1996 and 2006, while the state's labor force grew at an average annual rate of 1.7 percent over the same period (BLS 2007a). As shown in Figure 2.5.2-1, the ROI labor force is concentrated in Victoria County, with 59 percent of the ROI total, followed by Calhoun and DeWitt Counties with 12 percent each (BLS 2007a). In 2006, 3391 people in the ROI were unemployed, a decline of 1.3 percent since 1996. The 2006 annual unemployment rate in the ROI was 4.3 percent, and the unemployment rate in its individual counties ranged from 4.1 percent to 4.9 percent, compared to 4.9 percent for Texas and 4.6 percent for the United States (BLS 2007a).

The BEA reports employment data by industrial sector (as defined by the North American Industrial Classification System [NAICS]) and other subcategories. The Service sector (which includes Information; Professional and Technical Services; Management of Companies and Enterprises; Administrative and Waste Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment and Recreation; Accommodation and Food Services; and other services except Public Administration) is the largest source of employment in the ROI, accounting for 28.4 percent of jobs, compared to 39.6 percent for Texas. Local government provides 12.2 percent of jobs in the ROI, while the retail sector provides 11.4 percent. Manufacturing and construction each provide approximately 8 percent, and the finance, insurance, and real estate sectors together account for 6.5 percent. The rural nature of the ROI is reflected in the number of jobs in farm employment, 7.4 percent for the ROI compared to 2.2 percent for Texas (BEA 2008). Table 2.5.2-2 summarizes regional employment by industrial category and shows detailed industry sector employment by county, for the ROI, and for Texas. Figure 2.5.2-2 illustrates employment by industrial sector in the ROI as a whole.

Table 2.5.2-3 lists the ROI's major employers. The largest employers are concentrated in Victoria and Calhoun Counties, with one large plastics company located in Jackson County. The largest public employers tend to be the independent school districts (ISDs) (e.g., Victoria ISD has more than 2100 employees) and county governments. The largest private employers are in the chemical/plastics industry and the health care sector (CCEDC Undated; CDC Jul 2006; Victoria Undated b, Yoakum Undated a, TWC 2007, JCCC Oct 2007, VEDC 2007a). According to the Texas Workforce Commission, as of 2004, the ROI contained 1264 establishments with 10 or more employees. Less than 1 percent of these firms had more than 1000 employees, and 84 percent had fewer than 50 employees (TWC 2007).

In its Quarterly Census of Employment and Wages, the BLS collects employment and wage data by NAICS industrial sectors. Table 2.5.2-4 presents data for 2001 through 2006 for workers in all industry sectors and in NAICS Sector 23, Construction; Sector 237, Heavy and Civil Engineering Construction; Sector 22, Utilities; and Sector 221113, Nuclear Electric Power Generation. As the table shows, the 2006 average annual wages for the total of all sectors and subsectors vary widely among the ROI counties, ranging from $26,506 in DeWitt County to $49,933 in Calhoun County. Generally, wages tend to rise as industry specialization increases. Average ROI wages in 2006 for Sector 23, Construction, ranged from $26,207 in DeWitt County to $51,233 in Goliad County. Wages for Sector 237, Heavy and Civil Engineering Construction, ranged from $33,150 in DeWitt County to $51,390 in Calhoun County, compared to $48,466 for Texas and $52,617 for the United States (BLS 2007b). Average annual wages in 2006 were not disclosed for Sector 237 in Goliad and Refugio Counties[1]. In the ROI, wages in this sector grew between 2001 and 2006 (not adjusted for inflation) and the growth rates also varied widely, ranging from 0.2 percent in DeWitt County to 6.8 percent in Victoria County, compared to 4.9 percent for Texas and 4.1 percent nationally (BLS 2007b; BLS 2007c). Figure 2.5.2-3 illustrates wage growth for Sector 237 in the ROI counties. Construction wages are discussed more fully in Subsection 4.4.2.

Table 2.5.2-4 also presents average annual wages in Sector 22, Utilities, for the ROI counties, although five of the six counties have wages that were not disclosed, along with Texas and the United States. In 2006 in this sector, Goliad County had the highest annual wages among the three ROI counties where wages were disclosed, at $70,386, followed by Victoria County with $62,337. The table shows only U.S. wages for Section 221113, Nuclear Electric Power Generation; wages for Texas were not disclosed, and this sector is currently not present in the ROI. Operations wages are discussed in more detail in Subsection 5.8.2.

1. County or other small area data may not be disclosed when data do not meet BLS or state agency disclosure standards regarding confidentiality or data quality (BLS Dec 2006). For example, if there are few firms in an area, data users could determine or approximate a firm's total payroll, hours worked, and other information that a firm may not want known to its competitors.

BLS also collects occupational employment data by state and by selected MSAs. Occupational categories are determined by a worker's skills and job duties, regardless of the industrial sector in which the worker is employed. Table 2.5.2-5 shows 2006 employment in the Department of Labor category of Construction and Extraction Occupations was 5390 jobs for the Victoria MSA, representing 1 percent of Texas employment (513,910) for that category. In the Victoria MSA, employment in the Construction and Extraction Occupation category accounts for 11.2 percent of total employment in the MSA, while these occupations provide only 5.3 percent of total employment in Texas as a whole (BLS May 2006).

Texas is a "right-to-work" state; workers are not required to join labor unions as a condition of employment. Approximately 5 percent of the Texas workforce is unionized, with the greatest concentration of unionized workers in the governmental (public) sector (BLS Jan 2008).

Per capita personal income (PCI) provides a useful means of comparing income among regions. The BEA calculates PCI by dividing the total personal income in an area by the area population. The ROI counties have lower PCI values than those for Texas and the United States. In 2005, the ROI's PCI was $27,983, representing 81 percent of the national PCI ($34,471) and 86 percent of the Texas PCI ($32,460). Victoria County's PCI of $30,667 was the highest in the ROI, while Goliad County, with $23,353, was the lowest (BEA 2008). Incomes for the ROI, Texas, and the United States are shown in Table 2.5.2-6, which also presents the percent change between 1995 and 2005, both adjusted and unadjusted for inflation[2]. During that period, the PCI in the overall ROI increased by 13.8 percent when adjusted for inflation, while Texas PCI increased by 20.6 percent and that of the United States by 16.6 percent (BEA 2008; BLS 2007c).

2.5.2.2 Transportation

The 50-mile region surrounding the proposed VCS site is served by a transportation network of U.S. highways and state and county roads providing access to major north-south and east-west routes, rail terminals (cargo service only), 13 public airports (including one with commercial passenger service), and three navigable waterways.

2.5.2.2.1 Roads

Roads in the region consist of U.S. highways, state routes (SR), county roads, and county farm-to-market (FM) roads. Figure 2.5.2-4 shows the road and highway transportation system in the 50-mile region.

2. The BLS inflation calculator (BLS 2007c) was used to adjust 1995 dollars to 2005 dollars before calculating the percent change between the two years, in order to provide the "real" increase ("real" meaning that a value has been adjusted for inflation). The adjustment factor between 1995 and 2005 was 1.28 (i.e., the 1995 dollars were multiplied by 1.28 to adjust to 2005 values).

Most roads in Texas are owned and maintained by the counties, rather than by the state or municipalities. The state of Texas owns 79,648 miles of roadway (26.2 percent of the total), individual counties own 144,685 miles (47.6 percent), local governments own 78,848 miles (25.9 percent), other jurisdictional agencies own 159 miles (0.05 percent), and the federal government is responsible for 831 miles (0.3 percent) of roadways in federal parks, forests or reservations that are not part of the state and local highway systems (BTS 2005). Primary access to the proposed site would be via Highway 77.

In the ROI, there are four U.S. highways: Highway 59, which runs northeast-southwest connecting Jackson, Victoria, Goliad and Bee Counties; Highway 77 which runs north-south-southwest connecting Lavaca, Victoria, and Refugio Counties; Highway 87, which runs northwest-southeast connecting DeWitt, Victoria and Calhoun Counties; and Highway 183, which runs north-south connecting DeWitt, Goliad and Refugio Counties. A number of state routes intersect these U.S. highways and connect to the towns in the counties, providing outlying areas access to the U.S. highway system.

Most roadways in the region are secondary roads and feed from primary highways. The proposed VCS site is located in a rural area and most of the roads in the vicinity are paved, two-lane roadways. Table 2.5.2-7 presents road characteristics and traffic statistics, including average annual daily traffic counts, for the primary road segments that would be used by the construction and operations workforces to reach the site. Figure 2.5.2-5 identifies the road segments. Vehicle volumes on the roads, as measured by average annual daily traffic counts within a 24-hour period, reflect the rural character of the area. There are no Transportation Research Board Level of Service determinations for these roads (TXDOT Oct 2007).

Highway 77 would provide the only access to and from the proposed site for commuting workers and truck deliveries. Deliveries from the Houston metro area would likely use Highway 59 to reach Highway 77 south to the site entrance. Workers arriving from the north would likely take Highway 77 to the site entrance. Those arriving from the east would likely take SR 35 west to SR 239, then follow Highway 239 west to Highway 77 north. Workers arriving from the south would likely take Highway 77 north, or take SR 35 to SR 239 west to Highway 77. Workers arriving from the west would likely take Highway 59 east to Highway 77 south, SR 239 east to Highway 77 north, or SR 202 east to Highway 77 north. Potential commuting routes are shown in Figure 2.5.2-5.

Roads in Victoria County surrounding the proposed site do not traverse any parks, national forests, or other federally, state, or locally protected areas. The portion of SR 35 that connects Port Lavaca and the town of Tivoli in Calhoun County, approximately 14 miles southeast of the proposed site, serves as the northern boundary of the Guadalupe Delta Wildlife Management Area (WMA) and provides access to the WMA's headquarters. The Guadalupe Delta WMA provides important habitat for wetland-dependent wildlife, especially waterfowl.

2.5.2.2.2 Railroads

Figure 2.5.2-4 shows the railroad lines within 50 miles of the VCS site. These railroad lines within this radius are owned and operated by Union Pacific; however, Tex-Mex/Kansas City Southern, Burlington Northern Santa Fe, and Port Comfort & Northern have track rights allowing them to operate on the Union Pacific rail lines (VEDC 2007b).

The Union Pacific railroad system runs east-west across Matagorda, Jackson, Victoria, and Refugio Counties, and north-south across DeWitt, Victoria, and Calhoun Counties (UP Undated). There is no passenger rail service within the 50-mile region. The nearest passenger rail (Amtrak) service is from Houston to San Antonio, north of the proposed site and outside of the 50-mile region (NRPC Undated).

2.5.2.2.3 Navigable Waterways and Ports

Figure 2.5.2-5 shows the navigable waterways within 50 miles of the proposed site. These are the San Antonio River, Guadalupe River, and Victoria Barge Canal. The site is not located on a waterway, but lies west of the Guadalupe River (approximately 4.1 miles), west-southwest of the Victoria Barge Canal (approximately 5.2 miles), and west-northwest of the San Antonio River (approximately 5.5 miles).

The 35-mile-long Victoria Barge Canal connects Victoria and Calhoun Counties to the San Antonio Bay, the Gulf Intracoastal Waterway and nearby deepwater ports on the Gulf of Mexico. The Canal begins at its intersection with the Gulf Intracoastal Waterway near Seadrift in Calhoun County, and terminates at the Port of Victoria, south of the city of Victoria. The canal provides transportation of large equipment and products for the chemical, construction and steel fabrication, and agribusiness industries in the area. Constructed in 1968, the canal was expanded in 2002 to a width of 125 feet and a depth of 12 feet to match the dimensions of the Gulf Intracoastal Waterway and allow access to larger cargo loads (VEDC Undated). Because of its size limitations, the canal cannot accommodate ocean going ships; it primarily serves commercial barges and small boat traffic, because the clearance at the railroad bridge is approximately 73 feet.

The U.S. Army Corps of Engineers (USACE) Navigation Data Center tracks waterways and waterborne traffic in America's inland water system. In 2005, the Corps reported an average of 100 barge trips per week along the Victoria Barge Canal. The number of trips has declined since 2002 (USACE 2001; USACE 2002; USACE 2003; USACE 2004; USACE 2005). Table 2.5.2-8 shows the number of inbound and outbound trips between 2001 and 2005. According to the Navigation Data Center, there are 11 docks along the Canal (USACE 2008a), as listed in Table 2.5.2-9.

The Port of Victoria is a shallow water port serviced by the Victoria Barge Canal, with a 400-acre turning basin area. The port serves as an intermodal point of cargo transfer to air, rail, and truck networks. The Port of Victoria Industrial Park, with varied industrial customers, surrounds the turning basin (VEDC Undated). The port's freight tonnage declined between 2000 and 2005, but rebounded in 2006, when the port was ranked 96th out of 150, among principal ports in the United States (USACE 2008a; USACE 2008b). Table 2.5.2-10 shows freight tonnage for the port between 1992 and 2006 and the port's rankings between 2002 and 2006.

2.5.2.2.4 Airports

Thirteen public airports are within or near the 50-mile region. Airport information is presented in Table 2.5.2-11, and Figure 2.5.2-6 shows the locations of the airports. Restricted or private-use airports, unused airstrips, and abandoned military runways are not included.

The only airport in the region offering commercial passenger service is Victoria Regional Airport, located in the city of Victoria. The Federal Aviation Administration (FAA) collects passenger boarding data for commercial airports. The FAA reported 9113 boardings at the Victoria Regional Airport for 2006, a decline of 41.7 percent since 2001. Table 2.5.2-12 presents the annual data for 2001 through 2006. According to the Victoria Regional Airport manager, the decline is due to reduced service from six commercial flights per day to two. The airport employs 20 workers. (VRA Mar 2008)

2.5.2.2.5 Evacuation Routes

The proposed site is approximately 36 miles inland from the Gulf of Mexico. Hurricane evacuation routes serving the area include Interstate 37; Highways 59, 77, 87, 181, and 183; and SRs 35, 239, 111, and 185. These routes cross the counties within 50 miles (TEP 2007; TDPS Jun 2002).

2.5.2.3 Taxes

Several tax revenue categories would be affected by the construction and operation of VCS. These include franchise taxes on corporate profits, sales and use taxes on construction- and operations-related purchases and purchases made by project-related workers; real property taxes related to the construction and operation of the plant; and real property taxes paid by incoming workers. The following subsections describe each type of tax and its application in the ROI counties, and discuss revenues and expenditures by category for local jurisdictions.

2.5.2.3.1 Personal Income and Corporate Franchise Taxes

Texas does not have a personal income tax (FTA JAN 2007). It does, however, have a corporate franchise tax.

According to the website for the Texas Comptroller of Public Accounts, the franchise tax is the state's primary business tax (GT Jun 2006). In 2007, the state of Texas received $3.1 billion (4.1 percent of its total net revenue of $77.2 billion) from franchise taxes (TCPA 2008a). The Texas franchise tax is imposed on each taxable entity that is chartered and/or organized in Texas or is "doing business in Texas" (TCPA 2008b). The Texas Legislature recently made significant revisions to the Texas franchise tax in House Bill 3 (passed during the 79th Third Called Session) and House Bill 3928 (passed during the 80th Regular Session), which extended the franchise tax to partnerships (general, limited, and limited liability), corporations, limited liability companies, business trusts, professional associations, business associations, joint ventures, and most other legal entities. The tax will be based on the taxable entity's margin (defined by the company's revenues and expenses in Texas). To determine the margin for each taxable entity, the least of three calculations will be used: (1) total revenue minus cost of goods sold, (2) total revenue minus compensation, or (3) 70 percent of total revenue. The tax rate is 1.0 percent for most taxable entities and 0.5 percent for entities engaged primarily in retail and wholesale trade. These revisions became effective January 1, 2008 (TCPA 2008b).

2.5.2.3.2 Sales and Use Taxes

Texas state sales and use tax is imposed on retail sales, leases and rentals of most goods, and some services. The state sales tax rate is 6.25 percent of the sale price of taxable goods and services (TCPA 2008c). Texas received $20.3 billion (26.3 percent of its revenue) from sales tax collections in 2007 (TCPA 2008a).

Regulations governing sales and use tax for Texas are found in the Texas Administrative Code, Title 34, Part 1, Chapter 3, Tax Administration: §295, taxation of natural gas and electricity; §306, taxation of mobile homes; §344, taxation of telecommunications; and §481, taxation of manufactured housing (other than mobile homes) (TAC 2007). The total sales and use tax (sales tax) imposed on most taxable goods and services consists of the state sales tax and, where applicable, a local sales tax (TCPA 2008c).

Collecting sellers remit state sales tax revenues directly to the state. While these funds are not returned directly to county or city governments for their use, the state uses sales tax and other revenues throughout the state to support a variety of services. In 2006, the state government spent a total of $71.5 billion for the 254 counties that comprise Texas. State expenditures in the ROI counties totaled approximately $470 million, accounting for less than 1.0 percent of the state total. Of the ROI expenditures, 38.4 percent was for public assistance, while intergovernmental payments accounted for 27.4 percent (TCPA 2007). Table 2.5.2-13 summarizes the state's expenditures in the ROI, and Figure 2.5.2-7 illustrates the allocation of expenditures by category.

Local jurisdictions, including cities, counties, transit authorities, and some special purpose districts, may also impose a local sales tax. (A special purpose district is a voter-approved district governed by an elected board that provides infrastructure and public services such as water, health, community colleges, or economic development). According to the "Overview of Local Taxes in Texas," published by the Research Division of the Texas Legislative Council, the imposition of a local sales tax must be approved by the voters residing in the jurisdiction in which the sales tax is to be imposed. Local sales tax revenues may be used for a variety of purposes, including general funds, property tax relief, health care for the indigent, crime control, economic development, support of public libraries, emergency services, street maintenance, and support of public transit (TLC Nov 2002).

The sum of all local sales taxes may not exceed 2 percent anywhere in the state, and thus, the maximum allowable sales tax in Texas is 8.25 percent. Cities, counties, and special purpose districts each have the authority to levy a local sales tax of up to 2 percent, while transit authorities may levy a local sales tax of up to 1 percent. The state has the authority to govern taxation by local jurisdictions and to ensure that the sum of local sales taxes does not exceed the 2 percent cap (TLC Nov 2002).

Voters in about half of the counties in Texas have approved the levy of a county sales tax (up to 0.5 percent for counties with a city territory, and up to 1 percent for counties without a city territory) for property tax relief (TLC Nov 2002). In the ROI, Calhoun, Jackson, and Victoria Counties each levy a 0.5 percent sales tax (TCPA 2008d). Table 2.5.2-14 shows county and city sales tax rates in the ROI.

Cities in Texas may also impose additional sales tax, up to the maximum of 2 percent, for the following purposes:

- General fund (1 percent)
- Property tax reduction (up to 0.5 percent)
- Street maintenance (0.25 percent)
- Industrial and economic development (up to 0.5 percent)
- Sports and community venues (up to 0.5 percent) (TCPA 2008c)

As shown in Table 2.5.2-14, several cities in the ROI impose sales taxes ranging from 1 percent to 2 percent, with Cuero, Yoakum, Goliad (city), and Refugio (city) imposing the maximum tax of 2 percent. The city of Victoria, the largest retail center in the ROI, imposes a 1.5 percent sales tax.

Since Victoria County also imposes a 0.5 percent sales tax, shoppers in the city of Victoria pay the maximum of 8.25 percent (TCPA 2008d).

Some items are exempt from state sales tax but may be taxed locally. For example, natural gas and electricity for residential and agricultural use are exempt from state sales tax (TAC 2007). Although local jurisdictions have the authority to levy sales tax on these items (TLC Nov 2002), none of the cities in the ROI do so (TCPA 2008e).

All telecommunications (including cellular phone services) are subject to the state sales tax. Local jurisdictions may impose taxes for intrastate services only (calls between locations in Texas). Services are billed by the caller's residence or the call's place of origin, depending on billing arrangements (TAC 2007). In the ROI, the cities of Goliad, Edna, and Victoria currently impose the 2 percent sales tax on telecommunications services (TCPA 2008f).

2.5.2.3.3 Other Sales and use-Related Taxes

The state of Texas currently imposes a 6 percent hotel occupancy tax on rooms or space in a hotel with rates of at least $15 per day. Stays of 30 consecutive days or more are exempt from the tax (TLC Nov 2002). Texas received $341 million (0.4 percent of its revenue) from the hotel occupancy tax in 2007 (TCPA 2008a).

All cities, and some counties, are eligible to adopt a hotel occupancy tax on rooms with a rate of at least $2 per day. According to the "Overview of Local Taxes in Texas," hotel occupancy tax revenues must be used to directly promote tourism and the convention and hotel industry. Specifically, hotel tax revenues should be used for a convention center, tourism advertising and promotion, programs to enhance the arts, and historic preservation projects that promote tourism. These revenues may not be used for general revenue purposes or for activities not directly related to promoting tourism (TLC Nov 2002). The Texas Tax Code, §352.002, lists criteria under which a county may impose this tax. However, Provision (d) prohibits collection of the county hotel occupancy tax within municipalities (TTC 2007). The city of Victoria imposes a 7 percent sales tax on eligible hotel rooms in addition to the state's 6 percent hotel tax, for a total of 13 percent (VEDC 2007c).

Manufacturers of manufactured homes or industrialized housing who conduct business in Texas must apply for a permit to collect manufactured housing sales tax. This tax is imposed by the state at a current rate of 3.25 percent of the sales price. Additionally, manufactured homes purchased outside of Texas for use in the state are subject to a use tax imposed at the same rate of 3.25 percent. Manufactured homes purchased in Texas for use in another state are not subject to the tax (TAC 2007).

2.5.2.3.4 Property Taxes — Counties and Special Districts

According to the "Overview of Local Taxes in Texas," all privately owned real property in Texas is subject to property taxation by the county, city, special district(s) (such as junior college districts and groundwater districts), and school district(s) in which it is located, unless specifically exempted by the Texas constitution (TLC Nov 2002).

The "Overview of Local Taxes in Texas" notes that county appraisal districts determine the value of properties, and local taxing jurisdictions set the tax rates. Each county appraisal district sets property values and sends those values to the local taxing jurisdictions in that county. The governing body of each local jurisdiction sets its tax rates, which are applied to property values to generate the needed property tax revenues. Tax rates are stated as an amount per $100 of assessed value. The annual property tax levy in any jurisdiction is derived by multiplying the total taxable value divided by 100 in the jurisdiction by the total tax rate per $100 of value. The total tax rate may include a rate for day-to-day maintenance and operations (M&O rate) and a rate for debt service payments (often called the "I&S rate" or Interest and Sinking Fund rate). Some special districts with other revenue sources do not levy a maintenance and operations tax (TLC Nov 2002).

Texas counties collect real property taxes (sometimes referred to in Texas law as *ad valorem* taxes (TLC Nov 2002), based on assessed valuations, from the property owners within their boundaries. These taxes are used for county operations. As stated previously, the appraised value of a property, as determined by each county's appraisal district, is used to calculate property tax assessments for all taxing jurisdictions in the county. Generally, taxpayers make consolidated payments to the county tax assessor, who distributes the funds to the other taxing jurisdictions in the county.

As provided by the Texas constitution, each county may levy as many as three individual tax rates for funds dedicated to specific purposes. Those three funds include the General Fund, a Special Road and Bridge Fund, and Farm-to-Market Roads & Flood Control. All Texas counties impose a tax for the General Fund. In 2005, that levy totaled $4.6 billion statewide. For the 2005 tax year, 118 counties reported levying the Farm-to-Market Roads & Flood Control tax, raising $134.7 million, while 71 counties reported levying the Special Road and Bridge Fund tax, resulting in $63.2 million in revenue (TCPA Dec 2006). Victoria County collects property taxes for its General Fund and Special Road and Bridge Fund (VCTX 2007).

Texas tax rates are stated in dollars per $100 of assessed value.[3] The 2006 total county property tax rates for the counties in the ROI range from 0.3986 (Victoria County) to 0.7224 (DeWitt County) dollars per $100 of assessed value, and are shown in Table 2.5.2-15 (TAOC 2007a). Between 2000 and 2006, Victoria County annual property tax levies rose steadily, from $11.3 to $16.9 million (TAOC

3. For example, a tax rate of 0.3986 on a property with a taxable assessed value of $100,000 would yield a tax levy of $398.60 [0.3986 times (100,000 divided by 100)].

2007b), although the tax rate remained constant between 2003 and 2006 (TAOC 2007a). Table 2.5.2-16 shows the market value and taxable value of Victoria County property and the total property taxes collected by the county.

In addition to county property taxes, most private property owners in Texas pay property taxes to cities, local special districts such as junior college districts and groundwater districts, and school districts. Property taxes are a major source of tax revenue for counties, cities, special purpose districts, and school districts. Property owners within each district's boundaries pay taxes to the districts in addition to those taxes paid to the county, at the standard millage rates assigned by the taxing districts each year (TLC Nov 2002). Table 2.5.2-17 shows real property taxes for ROI cities, and Table 2.5.2-18 provides information on the special taxing districts in the ROI counties. The affected school districts are discussed in the following section.

The VCS site consists of 11 separate parcels, listed in Table 2.5.2-19. The parcels lie within the boundaries of Victoria County, three additional special taxing districts, and two school districts (discussed in the following section). The proposed site is not within any city boundaries. Table 2.5.2-20 shows the total 2006 and 2007 property tax payments, by taxing entity, for the 11 parcels comprising the VCS site.

According to the website for the Victoria Economic Development Corporation, the city of Victoria and Victoria County have established guidelines for the creation of reinvestment zones and granting tax abatements, for which manufacturing and other types of businesses are eligible to apply. Economic qualifications include an increase to appraised value of the property equal to or in excess of $500,000 and creation of a minimum of 10 full-time positions. Abatements can be granted for up to eight years (VEDC Undated).

2.5.2.3.5 Property Taxes — Independent School Districts

Property taxes are the sole local source of tax revenue for school districts in Texas (TLC Nov 2002). According to the Texas Education Agency, Texas uses a wealth equalization process to determine funding for each independent school district (ISD), which is generally summarized as follows. The state provides funds to ISDs according to district wealth, which is determined by the assessed valuation of property. After a county appraisal district sets a district's total assessed valuation, and it is validated by the State Property Tax Board, the district's total assessed valuation is divided by the total number of students (weighted average daily attendance) to determine its wealth per student. Each year, the Texas Legislature establishes a wealth benchmark to determine if a school district is to be designated as a "property-wealthy" or "property-poor" district, according to the guidelines of Texas Education Code Title 2 (Public Education), Chapter 41 or Chapter 42. Districts with a wealth per student value at or above the benchmark fall under Chapter 41 and are designated as "property-wealthy" school districts. Districts with a wealth per student value below the benchmark are designated as "property-poor" school districts and are governed by the provisions of Chapter 42. The state's funding formula is applied to each district. The state requires Chapter 41 (Equalized Wealth Level) school districts to send a share of their local tax monies to the state as a part of the equalization of wealth stipulated by law. Chapter 42 (Foundation School Program) school districts receive funding from the state (TEA Oct 2007).

ISDs may only tax properties within their boundaries. Although Victoria County is home to several ISDs, 9 of the 11 parcels comprising the proposed VCS site lie in the Refugio ISD and 2 of the 11 parcels are in the Victoria ISD (Table 2.5.2-19).

The Refugio ISD is a relatively small district with a 2007–2008 enrollment of 735 students (RISD Apr 2008). It is headquartered in the city of Refugio, and includes non-contiguous portions in Refugio and Victoria Counties. The Victoria County portion is bordered by the Victoria, Bloomington, Calhoun County, and Austwell-Tivoli ISDs (TEA Jul 2007) (Figure 2.5.2-16).

The Refugio ISD's property values between 2001 and 2007 are shown in Table 2.5.2-21. The substantial fluctuations during those years primarily reflect changes in oil and gas production, which makes up a large portion of the assessed value of property in the ISD (RISD Feb 2008). Figure 2.5.2-8 illustrates these fluctuations. As shown in Table 2.5.2-21, for 2007 the ISD's total assessed value of property was $480,471,469, which represented a very small decline (–0.6 percent) from the previous year (RISD Feb 2008). The predominance of the oil and gas industry is shown by the ISD's major taxpayers. The top five taxpayers in the Refugio County portion of the Refugio ISD were Hilcorp Energy Co., CDM Resource Management LTD, Acock/Anaqua Operating Co. LP, Kinder Morgan Tejas Pipeline, and Primrose Operating Company. In the Victoria County portion of the Refugio ISD, the top five taxpayers were Apache Corp., Future Petroleum Co., LLC, Union Pacific Railroad, Kinder Morgan Tejas Pipeline, and C K McCan, Jr. et al. (RISD Feb 2008).

The Refugio ISD was first designated a "property-wealthy" (Chapter 41) school district in the 2007-2008 school year, and was previously a "property-poor" (Chapter 42) district (RISD Feb 2008). Consequently, the ISD must now send part of its local tax collections to the state for redistribution to "property-poor" districts. District taxpayers submit their entire payments directly to the Refugio ISD, which then distributes the required portion to the state of Texas. For the 2007-2008 school year, the ISD's total revenues were $4,846,993, with only $320,707 (6.62 percent) in "excess" collections remitted to the state (RISD Feb 2008). Table 2.5.2-22 shows the Refugio ISD's revenues for 2001-2002 through 2007-2008 and the state submittal for 2007-2008.

As noted previously, the proposed VCS site consists of 11 parcels, 9 of which are taxed by the Refugio ISD and 2 of which are taxed by the Victoria ISD. Table 2.5.2-23 shows the assessed value and tax payments to each ISD for 2006 and 2007. In 2006, the current owner's payments of $12,487 to the Refugio ISD represented 0.20 percent of that ISD's total revenues. In 2007, the payment of $10,300 was 0.23 percent of the total.

2.5.2.3.6 Local Revenues and Expenditures

As noted previously, the proposed VCS would primarily affect Victoria County through county real property taxes. According to the Victoria Economic Development Corporation (VEDC 2007c), Victoria County had $1.7 million in retail sales in 2005 (compared to Calhoun County's $206,684 and Jackson County's $145,644), thus making Victoria County (especially its main population center, the city of Victoria) the predominant retail center in the ROI. Victoria County and the city of Victoria would thus be most affected by project and worker expenditures and consequent sales tax collections. For this reason, only Victoria County and the city of Victoria are discussed in this section.

Victoria County

In 2006, the Victoria County government had $28.9 million in total revenues. The county received two-thirds of its revenues from property (ad valorem) and sales taxes. Other large revenue sources were intergovernmental payments (15.3 percent), fees (6.5 percent), and fines and forfeitures (5.3 percent). Figure 2.5.2-9 illustrates the proportion from each revenue source. Table 2.5.2-24 provides revenue details.

The county's expenditures for 2006 totaled $26.3 million, as shown in Table 2.5.2-25. General government accounted for 54 percent of expenses. Public safety, accounting for 40.1 percent, included expenses for the fire marshal, sheriff, constables, and the Emergency Management City/County Interlocal Agreement. Culture and Recreation, which included parks and recreation, extension services, and the Victoria Public Library accounted for 4.9 percent. Figure 2.5.2-10 shows the expense breakout. Table 2.5.2-26 provides a recap of revenues and expenses, showing that the Victoria County government had a surplus of $2.6 million in 2006.

As noted previously, Victoria County imposes a sales tax of 0.5 percent on eligible goods and services. Table 2.5.2-27 shows that sales tax revenues for Victoria County increased every year between 1997 and 2007 except one (2002), with an annual average growth rate of 5.8 percent on non-inflation-adjusted values. To obtain an inflation-adjusted, annual, average growth rate, the revenues were converted to 2007 dollars[4], yielding an adjusted rate of 3.2 percent. Sales tax allocations were $7.2 million for the county in 2007 (TCPA 2008g).

4. Conversions were made from nominal dollars to 2007 dollars using the Bureau of Labor Statistics Inflation Calculator (BLS 2007c).

City of Victoria

For Fiscal Year (FY) 2006-2007, the Victoria municipal government budgeted $38 million in revenues (Table 2.5.2-28). Major revenue sources were taxes (62.7 percent) and franchise fees (12.2 percent) (Victoria 2007). Other sources accounted for the remaining revenues. Figure 2.5.2-11 illustrates the revenue sources.

Table 2.5.2-29 summarizes Victoria's FY 2006-2007 expenditures by category. Its expenditures were budgeted at $37.8 million, with more than one-half allocated to public safety (Victoria 2007). The next highest category of expenses (23.6 percent) was development, including planning, engineering, building and environmental inspections, code enforcement, street maintenance and operation, and traffic control. Recreation, including parks and recreation and library, accounted for 12.6 percent of expenditures (Victoria 2007). Figure 2.5.2-12 illustrates the expenditure proportions. Table 2.5.2-30 provides a recap of revenues and expenses, showing that the city of Victoria government had a surplus of $283,600 in FY 2006-2007.

Victoria imposes a sales tax of 1.5 percent on eligible goods and services. Table 2.5.2-31 presents Victoria sales tax revenues from 1997 to 2007. Like the County's revenues, Victoria's revenues increased every year (except 2002), with an annual average growth rate of 5.5 percent when not adjusted for inflation, and an inflation-adjusted average annual rate of 2.8 percent. Sales tax allocations were $19.6 million for the city in 2007 (TCPA 2008g). Figure 2.5.2-13 compares sales tax revenues (adjusted for inflation) for Victoria County and the city of Victoria for the past decade.

2.5.2.4 Land Use

The proposed site is in south-central Victoria County, approximately 13.3 miles south of the city of Victoria, 17 miles northwest of San Antonio Bay, 33 miles west of Matagorda Bay, and is adjacent to Linn Lake. The site is located adjacent to Highway 77 to the west. The Union Pacific Rail Line, used by the Burlington Northern Santa Fe railroad, is just south of the site (Figure 2.5.2-4). The site consists of 11,532 acres of land. Section 2.2, Land Use, provides tables and maps displaying land use categories and breakdowns for the proposed site vicinity and the 50-mile radius.

The ROI counties, except Refugio, are part of the Golden Crescent Regional Planning Commission (GCRPC), along with Gonzales and Lavaca Counties. The GCRPC provides planning services for the region and provides assistance to local governments in carrying out regional plans and recommendations including those related to solid waste management, water issues, land use issues, and rural transportation. (GCRPC Undated)

Calhoun County

Calhoun County is on the Gulf Coast between Houston and Corpus Christi. In 2000, the county had a land area of 512.3 square miles (327,878 acres) (USCB 2008). Calhoun County is bordered by Victoria and Jackson Counties on the north, Matagorda Island and the Gulf of Mexico on the south, Refugio County on the west, and Matagorda County on the east. Port Lavaca is its largest city and the county seat. Calhoun County is located in the Coastal Prairie, and its elevation ranges from sea level to 50 feet above sea level, resulting in terrain that is flat. The county is drained by the Guadalupe River and Chocolate Bayou. Green Lake, one of the largest freshwater lakes in Texas at approximately 10,000 acres (TSHA Jan 2008b), is in Calhoun County.

Incorporated communities in Calhoun County include Point Comfort, Port Lavaca, and Seadrift. The county is served by the Union Pacific railroad, as well as by Highway 87 and SRs 35 and 185 (TSHA Jan 2006a).

In 2002, there were 328 farms and ranches covering 247,827 acres, of which, 59 percent were in pasture and 38 percent in crops (USDA 2002). Between 21 percent and 30 percent of the land was considered "prime farmland" (TSHA Jan 2006a). Within the boundaries of the county, land coverage and use is classified as being approximately 1 percent urban or built-up land, 18 percent agricultural land, 18 percent rangeland, 3 percent forest land, 51 percent water, 8 percent wetland, and 1 percent barren land. Matagorda Island State Park and Wildlife Management Area, Calhoun County's principal state park, covers 7325 acres (TSHA Jan 2006a).

The unincorporated portion of Calhoun County is not zoned but does have subdivision regulations "to protect the health, safety, and welfare of the citizens of Calhoun County" (Calhoun County Dec 2007). Calhoun County has some commercial development and concentrations of residential development, primarily in Port Lavaca.

The county's main population center, Port Lavaca, is not zoned (Port Lavaca 2008). However, it does have a subdivision ordinance to guide "sound community growth" (Port Lavaca May 2007) within the city boundaries and the extraterritorial jurisdiction adjacent to the city (Port Lavaca May 2007).

DeWitt County

DeWitt County is on the Gulf Coast Plain in southeastern Texas about 45 miles inland from Copano Bay. It is bounded by Victoria, Goliad, Karnes, Gonzales, and Lavaca Counties. Cuero, the county's largest town, serves as the county seat (TSHA Jan 2006b). In 2000, the county had a land area of 909.2 square miles (581,875 acres) (USCB 2008). Most of the land is nearly level to sloping, with the areas of greatest elevation mostly in the northwest. The elevation ranges from about 150 feet above sea level in the east corner to more than 540 feet above sea level in the southwest. Most of the county is drained by the Guadalupe River and its tributaries. Small areas in the northern part of the county are drained by the Lavaca River, and a small area in the southern portion is drained by the San Antonio River (TSHA Jan 2006b).

In 2002, there were 1786 farms and ranches covering 576,896 acres, of which 64 percent was in pasture and 29 percent in crops (USDA 2002). More than 336,700 barrels of oil and 16,322,000 cubic feet of gas-well gas were produced in the county in 2004 (TSHA Jan 2006b). Within the boundaries of the county, land coverage and use is classified as being approximately 1 percent urban or built-up land, 55 percent agricultural land, 8 percent rangeland, 36 percent forest land, less than 1 percent water, less than 1 percent wetland, and 1 percent barren land. The principal towns in the county are Cuero, Yoakum, and Yorktown (TSHA Jan 2006b).

The unincorporated portion of DeWitt County is not zoned and has no county-wide land use plans. There are only small areas of commercial development and concentrations of residential development in the county.

The county's main population center, Cuero, has adopted land use regulations in Title XV of its City of Cuero, Texas Code of Ordinances (Cuero May 2005). The land use regulations include subdivision regulations (Chapter 154) and zoning (Chapter 158). The purpose of the subdivision regulations is to, "(p)romote and develop the utilization of the land in a manner to assure the best possible community environment" (Cuero May 2005).

Goliad County

Goliad County is on the Coastal Plain 25 miles inland from Copano Bay in southeast Texas. It is bounded by Bee, DeWitt, Karnes, Refugio, and Victoria Counties. Goliad is the county seat and largest town (TSHA Jun 2001a). In 2000, the county had a land area of 853.5 square miles (546,253 acres) (USCB 2008), most of which is nearly level to gently rolling. The elevation ranges from 100 to 250 feet above sea level. The northeastern half of the county is drained primarily by the San Antonio River and its tributaries. Coleto Creek Reservoir is an industrial reservoir on the Goliad-Victoria county line (TSHA Jun 2001a).

In 2002, there were 984 farms and ranches covering 506,019 acres, of which 70 percent was in pasture and 22 percent in crops (USDA 2002). Oil and gas production and agriculture represent much of the county's land use. Within the boundaries of the county, land coverage and use is classified as being approximately 1 percent urban or built-up land, 26 percent agricultural land, 24 percent rangeland, 49 percent forest land, less than 1 percent water, less than 1 percent wetland, and less than 1 percent barren land. The county is served by a variety of paved farm and ranch roads and by three major highways: Highway 59 to Houston and Laredo, Highway 183 to Austin, and SR 239, which joins Highway 181 to San Antonio (TSHA Jun 2001a).

Despite the increasing urbanization of surrounding counties, Goliad County has remained rural. The unincorporated portion of Goliad County is not zoned but does have subdivision regulations. The subdivision regulations were "established for the orderly growth of Goliad County" (Goliad County May 2005). There are only small areas of commercial development and concentrations of residential development in the county.

The city of Goliad, the county's main population center, is located at the head of the navigable portion of the San Antonio River. Goliad is the only incorporated community in the county (TSHA Jun 2001a) and is zoned (Goliad 2004).

Jackson County

Jackson County is southwest of Houston on Highway 59, in the Coastal Prairies region of the Coastal Plain. It is bordered by both Lavaca Bay and Carancahua Bay. It is bounded by Calhoun, Victoria, Lavaca, Colorado, Wharton, and Matagorda Counties. Edna, the county's largest town, is the county seat. Elevation ranges from sea level to 150 feet above sea level (TSHA Jun 2001b). In 2000, the county had a land area of 829.5 square miles (530,874 acres) (USCB 2008).

In the early 1990s, 90 percent of the county was used for farming and ranching (TSHA Jun 2001b). In 2002, there were 917 farms and ranches covering 470,500 acres (USDA 2002). Between 41 percent and 50 percent of Jackson County land is deemed "prime farmland" (TSHA Jun 2001b) Within the boundaries of the county, land coverage and use is classified as being approximately 3 percent urban or built-up land, 63 percent agricultural land, 9 percent rangeland, 23 percent forestland, 2 percent water, 2 percent wetland, and less than 1 percent barren land.

The unincorporated portion of Jackson County is not zoned. However, it is guided by subdivision regulations (Jackson County Mar 2008). There are only small areas of commercial development and concentrations of residential development in the county.

The county population center, Edna, adopted a land use management ordinance (Ordinance 2004-24), that is "in accordance with a comprehensive plan for the purpose of promoting the health, safety, morals, and general welfare of the city; …to prevent the overcrowding of land, to provide undue concentration of population" (Edna Jan 2005). *The Comprehensive Plan for the City of Edna Jackson County, Texas* is applicable to the area within the city limits and the area of extraterritorial jurisdiction, or 1 mile beyond the city limits. The Plan provides for "adequate space and efficient, convenient arrangement of all types of community land uses, which should include residential, commercial, industrial, transportation, educational, civic, and cultural uses while at the same time following a harmonious plan of preserving the open space for drainage and recreation" (Edna May 1972).

Refugio County

Refugio County is on the lower Texas Gulf Coast in the Coastal Prairies region of the Coastal Plain, bounded on the south by San Patricio County, on the west by Bee and Goliad counties, on the north by Victoria and Calhoun Counties, and on the east by Aransas County and by Hynes Bay and Copano Bay (TSHA Jun 2001c). The county had 770.2 square miles of land area in 2000 (492,934 acres) (USCB 2008). The town of Refugio, the county's seat of government and its largest population center, is 35 miles north of Corpus Christi. The county is generally flat land. Elevations range from sea level to 100 feet above sea level in the northwest section. The county is drained by the Aransas River, which forms its southern border, and by the converging Guadalupe and San Antonio Rivers, which form its northern boundary. Refugio County is joined to the rest of Texas by Highway 77, which runs southwesterly across the western part of the county, and by SR 35, which runs north to south across the eastern section. (TSHA Jun 2001c).

Since the early 1990s, agriculture has been the leading source of income. In 2002, there were 274 farms and ranches covering 505,954 acres, of which 75 percent was in pasture and 21 percent in crops (USDA 2002). Within the boundaries of the county, land coverage and use is classified as being approximately 5 percent urban or built-up land, 21 percent agricultural land, 45 percent rangeland, 19 percent forestland, 6 percent water, 5 percent wetland, and less than 1 percent barren land.

There is currently no formal land use planning or zoning at the county, city, or town level in Refugio County. There are only small areas of commercial development and concentrations of residential development in the county. Refugio County's main population center is Refugio.

Victoria County

Victoria County is in southeastern Texas on the Coastal Plain, midway on the Texas Gulf Coast. Victoria, the county's largest city, is the county seat. Victoria is approximately 120 miles from Houston, 100 miles from San Antonio, 110 miles from Austin, and 75 miles from Corpus Christi (TSHA Jan 2008a). In 2000, Victoria County was comprised of 882.5 square miles of land area (564,800 acres) (USCB 2008). The county has a nearly level to gently rolling terrain. The elevation ranges from sea level in the southeast to 300 feet above sea level near Mission Valley in the northwest. The northeastern section of the county drains into Lavaca Bay, and the southwestern area is drained by the Guadalupe and San Antonio River systems (TSHA Jan 2008a). The Guadalupe River is important because of its navigability to Kemper's Bluff and Victoria, a distance of about 78 miles from the river's mouth (TSHA Jan 2008a).

In 2002, there were 1286 farms and ranches covering 513,828 acres, of which 64 percent was in pasture and 32 percent in crops (USDA 2002). Within the boundaries of the county, land use and coverage is classified as being approximately 5 percent urban or built-up land, 39 percent agricultural land, 28 percent rangeland, 25 percent forestland, less than 1 percent water, 2 percent wetland, and 1 percent barren land.

The unincorporated portion of Victoria County is not zoned. The city of Victoria has a comprehensive land use plan, *Victoria 2020: Remembering the Past, Preparing for the Future* (Victoria Nov 2001). The Plan provides the basis for Victoria's subdivision regulations and other development-related regulations. The stated purpose of the Plan's development guidelines is, "to maintain and stabilize the value of property, to reduce fire hazards, improve public safety, and safeguard the public health; to decrease traffic congestion and its accompanying hazards; to prevent the concentration of population; and to create a comprehensive and stable pattern of land uses upon which to plan for transportation, water supply, sewerage, schools, parks, public utilities, and other facilities" (Victoria Nov 2001). The purpose of the subdivision and development ordinance is, "to insure the development and maintenance of a healthy, attractive and efficient community that provides for the conservation and protection of its human and natural resources. It is the purpose of this ordinance to implement the goals, objectives and policies of the city comprehensive planning process to promote orderly growth and development" (Victoria Jul 2007). The Plan was commissioned "to help position the community for the future while maintaining Victoria's unique quality of life and environment." The Plan was designed, "permitting flexibility for new developments, allowing market forces to be the primary driving force that determines future land uses. The city of Victoria has historically taken a conservative approach to planning and land use management. It remains the second largest city in the State of Texas that does not utilize zoning laws" (Victoria Nov 2001). Constraints on the city's growth, including residential development, include the large floodplain along the Guadalupe River, railroad lines, as well as scattered oil and natural gas fields (Victoria Nov 2001). Victoria County has a well recognized commercial district, as well as a more sprawling commercial creep and concentrations of residential development.

2.5.2.5 Aesthetics and Recreation

This subsection characterizes the aesthetics and recreational facilities and opportunities in the 50-mile region.

2.5.2.5.1 Aesthetics

Victoria County is in the coastal plain ecosystem of east Texas. The county is primarily surfaced with dark clay loams and clays that support bluestems and tall grasses, oak forest, huisache, mesquite, prickly pear, and other vegetation (TSHA Jan 2008a).

The topography of the proposed site is fairly flat with the elevation ranging from 12 feet to 85 feet above MSL. The area in which the plant facilities would be constructed is currently at an elevation of approximately 80 feet. The proposed site is currently used for rangeland for cattle and horses on the surface. There is also limited oil and gas production in the subsurface of the proposed site. The major land uses within a 6-mile radius are rangeland and forest land. Within the 50-mile region, the major land uses are agricultural, forest land, rangeland, and water.

No sensitive visual resources, such as residential subdivisions or public lands, have been identified in the proposed VCS area or in the vicinity of the proposed site. Highway 77 provides the best opportunity for the public to view the site. Since the topography surrounding the site is relatively flat and sparsely populated with trees, there is little to no screen for the proposed facilities from area roadways.

2.5.2.5.2 Recreation

There are federal, state, local, and private recreational facilities and opportunities within 50 miles of the proposed site. Table 2.5.2-32 lists locations, acreages, and other information for the wildlife management areas (WMAs), national wildlife refuges (NWRs), and state parks within the 50-mile region. Table 2.5.2-33 lists county and city parks within the 50-mile region. Figure 2.5.2-14 shows the WMAs, NWRs, state parks, and Audubon sanctuaries within 50 miles of the site.

Federal and State Facilities and Opportunities

Of the 172 million acres in Texas, 5.7 percent (approximately 9,872,800 acres) are public lands; approximately 2.5 percent of the 172 million acres are in parks, forests, and refuges, and 0.6 percent of the public lands are managed by the Texas Parks and Wildlife Department. In addition, 9.1 percent of the private land in Texas is under wildlife management (TPWD 2001). Most of these lands are available for recreational use.

The Matagorda Island WMA, an offshore barrier island and bayside marsh, is jointly owned by the Texas General Land Office and the U.S. Fish and Wildlife Service (TPWD Feb 2007a).

The Guadalupe Delta WMA, spread across Victoria, Refugio, and Calhoun Counties, approximately 14 miles southeast of the proposed site, consists of freshwater marshes in the delta of the Guadalupe River. Lands in the Guadalupe Delta WMA have traditionally provided habitat for wetland-dependent wildlife, especially migratory waterfowl. Public hunting is permitted for waterfowl and migratory shore birds, alligators, and other wetland wildlife. Other uses include birding and nature observation. (TPWD Feb 2007b)

The Welder Flats WMA is south of Seadrift in Calhoun County, approximately 29 miles from the proposed VCS site. It has 1480 acres of submerged coastal wetlands that are used to stock the San Antonio Bay with red drum and spotted sea trout. Public use is allowed with permission. (TPWD Feb 2007c)

The Aransas NWR is near Rockport in Aransas and Calhoun Counties, and its Lamar unit is approximately 22 miles from the proposed site. The Aransas NWR consists of approximately 115,000 acres and provides resting, feeding, wintering, and nesting grounds for migratory birds and native Texas wildlife. The refuge is known for hosting the largest wild flock of endangered whooping cranes each winter. (USFWS 2008)

Goliad State Park serves as a hub for visiting Mission Espiritu Santo State Historic Site (in the park), Presidio La Bahia, Ignacio Zaragoza Birthplace State Historic Site, Fannin Battleground State Historic Site, Goliad Historic District, and Mission Rosario State Historic Site (TPWD Feb 2007d). Other nearby state parks are Lake Texana State Park in Jackson County, approximately 37 miles from the proposed site, and Goose Island State Park in Aransas County, approximately 32 miles from the proposed site. Lake Texana State Park provides a swimming area, boating, fishing piers, birding, and canoeing (TPWD Jan 2008). The "Big Tree," a Coastal Live Oak (Quercus virginiana) in Goose Island State Park, is thought to be one of the largest trees in the nation. Estimated to be over 1000 years old, the "Big Tree" trunk has a circumference of 35 feet (TPWD Oct 2007).

Table 2.5.2-32 presents acreage, location, annual visitor, and capacity information about WMAs, NWRs, and state parks within 50 miles of VCS.

The Texas Independence Trail follows SR 35 from east of Palacios to west of Port Lavaca and passes within 9 miles of the VCS site. Two points of interest along the trail are in Palacios and near Port Lavaca. A half-scale, seaworthy replica of French explorer La Salle's ship, the Belle, is being constructed at the Port of Palacios. South of Port Lavaca, in Indianola, there is a 25-foot granite statue of La Salle (THC Undated).

Birding is a major recreational activity in the region. The Coastal Birding Trail is a 500-mile trail that stretches along the Texas Gulf Coast from north of Beaumont to the Rio Grande Valley. The trail establishes viewing areas at feeding, roosting, and nesting points for both migrating and endemic bird species. Established in October 1994, the Central Texas Coast section of the trail encompasses 95 of the 308 distinct wildlife viewing sites. Approximately 40 wildlife viewing sites are located within 50 miles of the proposed site (TPWD Feb 2007e).

Recreational fishing, sailing, and boating opportunities are available on area bays and rivers, such as the Matagorda and San Antonio Bays and the Guadalupe and San Antonio Rivers. These bodies of water offer fishing for redfish, shark, trout, flounder, pompano, gafftop, whiting, croaker, sheephead, drum, jack crevalle, Spanish mackerel, and tarpon (USACE May 2007).

County and City Facilities and Opportunities

The counties and cities in the 50-mile region provide numerous public recreational facilities.

Sixteen counties—Aransas, Bee, Calhoun, Colorado, DeWitt, Goliad, Gonzales, Jackson, Karnes, Lavaca, Matagorda, Nueces, Refugio, San Patricio, Victoria, and Wharton Counties—are wholly or partially within the 50-mile region. Six of these, Colorado, Gonzales, Karnes, Lavaca, Nueces, and Wharton Counties, do not have any recreational facilities located within 50 miles of VCS. Table 2.5.2-33 lists the county and city parks within or near the 50-mile region, their locations, and acreages.

Aransas County offers several city parks, a public beach, fishing piers, birding, a community aquatic and skate park, hiking and biking trails, and a freshwater pond. Events held in Aransas Pass include the annual Shrimporee and a lighted boat parade during December (APCC Undated).

Bee County contains nine recreational parks in or near Beeville. These parks include a pool, basketball courts, baseball fields, soccer/football fields, merry-go-rounds, tennis courts, a bowling alley, and nature trails. The county is geographically located in three biological zones, which provide a variety of habitats for bird species. In Beeville County, dove and quail hunting is popular. Events held in Beeville include an annual Chamber of Commerce parade, Western Week Celebration, Junior Livestock Show and Rodeo, and the Diez y Seiz Festival (City of Beeville Mar 2008, CBT Jun 2008).

Calhoun County has a number of public park facilities. Lighthouse Beach and Bird Sanctuary in Port Lavaca offers an elevated walkway stretching over coastal wetlands and a tidal exchange basin. In Port Lavaca, recreational offerings include the Pier Park, a campground, a boardwalk, and a boat ramp. Beyond the Port Lavaca area, the towns of Port O'Connor, Magnolia Beach, and Indianola also offer recreational opportunities, such as the Port O'Connor Kingfisher Beach and Park (PLCCCC Undated). Events in Port Lavaca include a St. Patrick's Day Fun Run/Walk, Seafood Market Days Annual Palm Sunday Barbeque, and the Annual Festival of Lights Night Parade (PLCC Undated). In the town of Seadrift, the only city on San Antonio Bay, events include a Halloween Parade and Shrimpfest (SCC Undated).

DeWitt County is considered the "Wildflower Capital of Texas" (Yorktown Undated). In the county are several parks, including those in Cuero and Yoakum. Cuero Municipal Park offers an 8.5-acre lake with a lighted fishing pier, a walking trail, ball fields, a rodeo arena, and a swimming pool. There is also a 9-hole golf course and an amphitheater (Cuero Mar 2008). Events in Cuero include an annual Turkeyfest, the Texas River Marathon (a canoe race), and a youth rodeo (CCCA Undated). Yoakum opportunities include the Land of Leather days and Chili Cook-off plus the Tom-Tom Festival, a festival based on the tomato heritage of Yoakum (YACC Undated). The city of Yorktown has the Annual Yorktown Western Days Festival (Yorktown Undated).

Goliad County offers several recreational facilities such as parks, area lakes, public golf courses, and tennis courts. Annual events include the Goliad Market Days, a county fair and rodeo with a parade, a bike ride, and the Hunter's Ball (Goliad Undated).

Jackson County has five public parks. One of them, Brackenridge Plantation Park and Campground, is situated on Lake Texana. It provides fishing, camping, hiking trails, bike trails, birding, an equestrian trail, a nature trail, and a day-use area (BPPC Undated). Brackenridge Plantation Park and Campground is located near Edna, approximately 37 miles from the site. Annual recreational events in the county include the Texana Chili Spill, Go Texas Barbecue, and Christmas in the Outback (JCCCA Undated).

Matagorda County provides several public park facilities within the 50-mile region, all located in Palacios. The city offers playgrounds and shelters available for rent. The port of Palacios also provides boating and fishing opportunities (Palacios Undated). The city of Palacios has events including the Valentine Parade and Ball, Shrimp-o-ree Festival, and the Texas Fishermen's Seafood Festival (PCC Undated).

Refugio County operates two parks. Lions/Shelly Park is situated on the Mission River and has a playground, covered pavilion, picnic tables, nature trails, and a fishing pier. This park is also one of the stations on the Great Texas Coastal Birding Trail. Refugio RV Park is located just two blocks west of Highway 77 at the south end of the city of Refugio (RCCCEDF Undated a). Refugio County annual events include the Refugio County Fair (CF Undated).

In San Patricio County, there are two municipalities located within or just outside of the 50-mile region: Sinton and Ingleside. Sinton provides a butterfly garden, Welder Park, Grace Coin Park, a wildlife foundation, and golf tournaments. Ingleside provides a skate park, eco-nature tours, birding, cycling, hiking, swimming and water sports, fishing, disc golf, and basketball courts (TCB Undated). Events in Sinton and Ingleside include an Annual Golf Tournament, Annual "Cruise Your Ride to Ingleside" Fly-in/Car Show, Roundup Days Festival and Parade, and the Enchanted Forest Renaissance Faire (ICC Undated; SICC Undated).

Victoria County has 15 recreational facilities, all in the city of Victoria. The parks are owned and maintained by the city of Victoria. The parks include ball fields, tennis courts, basketball courts, a swimming pool, a zoo, and a fishing pond. The city of Victoria provides annual events such as Market Days, Holiday Lighted Parade, and Christmas in the Park. (Victoria Undated a)

The closest county or city recreational facility to the proposed site is Martin L. King, Jr. Park, in Victoria County, approximately 11 miles away. (Victoria May 2008).

The Texas Water Safari is a canoe race on the Guadalupe River from Gonzales to the mouth of the river at San Antonio Bay. Approximately 115 teams enter the race each year and the event attracts thousands of spectators (TWS 2008). The location of the Guadalupe River relative to the VCS site is shown in Figure 2.1-1.

There is a privately owned approximately 2200-acre hunting facility between the VCS site and the Guadalupe River.

2.5.2.6 Housing

2.5.2.6.1 Permanent Housing

In the ROI, residential areas are found in cities, towns, and smaller communities. Most of the housing is concentrated in Victoria County, particularly in and around the city of Victoria. Victoria County has the largest housing stock.

Table 2.5.2-34 provides the number of housing units and housing unit vacancies for Calhoun, DeWitt, Goliad, Jackson, Refugio, and Victoria Counties. In 2006, there were 68,083 housing units in the ROI (USCB 2008), an increase of 3.8 percent (2504 units) from 2000 (USCB 2000b). Approximately 50 percent of the units were in Victoria County and 16 percent in Calhoun County. The majority of all housing in the ROI (52.3 percent) has been built since 1970. Victoria County has the greatest percentage of housing stock built since 1970 at 58.4 percent. Refugio County has the smallest percentage of housing inventory built since 1970 at 36.3 percent (USCB 2000c). Of the 65,579 total units in the ROI in 2000, 15 percent were vacant (9894 units). Vacancy rates for homeowners varied from 1.6 percent in Victoria County to 3.1 percent in Refugio County. Vacancy rates among rental units were substantially higher. They ranged from 6.5 percent in Refugio and DeWitt Counties to 16.0 percent in Calhoun County (USCB 2000b).

Of the 32,945 housing units in Victoria County in 2000, 3431 were mobile homes (approximately 10.4 percent of the total units). Of the other ROI counties, Calhoun had 10,238 units, of which 1640 were mobile homes (16.0 percent of the county's housing units); DeWitt had 8756 housing units, of which 1345 were mobile homes (15.4 percent of the county's housing units); Goliad had 3426 housing units, of which 828 were mobile homes (24.2 percent of the county's housing units); Jackson had 6545 housing units, of which 1080 were mobile homes (16.5 percent of the county's housing units); and Refugio had 3669 housing units, of which 501 were mobile homes (13.7 percent of the housing units) (USCB 2000c).

Table 2.5.2-35 presents 2000 data on occupied and vacant housing, by occupant characteristics, for the population center of each ROI county (USCB 2000b).

- Port Lavaca (Calhoun County) had 4791 units, of which 602 were vacant (12.6 percent)
- Cuero (DeWitt County) had 2867 units, of which 367 were vacant (12.8 percent)
- Goliad (Goliad County) had 877 units, of which 128 were vacant (14.6 percent)

- Edna (Jackson County) had 2609 units, of which 382 were vacant (14.6 percent)
- Refugio (Refugio County) had 1312 units, of which 184 were vacant (14.0 percent)
- Victoria (Victoria County) had 24,192 units, of which 2063 were vacant (8.5 percent) (USCB 2000b)

The six population centers had a weighted, average vacancy rate of 10.2 percent.

Counties in the ROI have experienced growth in their single-family housing inventory since the last decennial census. From January 1, 2000 to December 31, 2006, Calhoun County issued 721 single-family dwelling unit permits, DeWitt County issued 48, Jackson County issued 145, Refugio County issued 46, and Victoria County issued 1044. The number of permits issued in Goliad County is not available. In 2006, the average value of the permitted housing units ranged from $127,200 in DeWitt County to $196,300 in Refugio County (TAMU Jan 2008). The counties do not distinguish seasonal/recreational housing from permanent housing when permits are issued.

2.5.2.6.2 Seasonal Housing

In 2000, there were 3130 vacant housing units for seasonal, recreational, or occasional use in the ROI. Fifty-six percent of the vacant seasonal housing units in the ROI, 1751 units, were in Calhoun County (USCB 2000b). Hurricane Carla, a Category 5 tropical storm, made landfall between Port O'Connor and Port Lavaca in September 1961. The storm destroyed or damaged most of the housing in the coastal area of Calhoun County. Approximately 25 percent of the current housing in Calhoun County was built or re-built during the decade following Hurricane Carla (USCB 2000c).

2.5.2.6.3 Recreational Vehicle Parks with Hook-ups

There are numerous year-round recreational vehicle (RV) parks or campgrounds, with full hookups (water, sewer, and electricity) for private recreational vehicles in the ROI. There are at least 33 RV parks: 22 in Calhoun County (CBT Undated a), four in Victoria County (CBT Undated b), three in Goliad County (PPA 2008, Woodall’s Undated), two in Jackson County (JCCCA Undated), one in Refugio County (RCCCEDF Undated b), and one in DeWitt County (CBT Undated c). Monthly rates in late 2007 generally ranged from $300 to $400 per site (TC Undated).

2.5.2.6.4 Hotels and Motels

Hotel/motel data for each county in the ROI is presented in Table 2.5.2-36. In the first quarter of 2007, there were 43 hotels and motels in the ROI. Of those, Victoria County had 17 and Calhoun County had 15. There were nearly 90,100 unoccupied room-nights available in the ROI during the first quarter of 2007. Occupancy rates varied from 37.7 percent in Refugio County to 60.4 percent in

Victoria County (TOG Undated), with an average occupancy rate in the ROI of 54.4 percent. Two new hotels are slated to open in Victoria County in 2008. The new hotels would add 158 rooms to the area inventory (VA Oct 2007).

2.5.2.6.5 Housing Values

A 2000 real estate inventory for each county in the ROI, by value of owner-occupied units, is presented in Table 2.5.2-37. In five counties (Calhoun, DeWitt, Goliad, Jackson, and Refugio) the largest portion of their housing inventory was in the category of "less than $50,000." The median price of all owner-occupied housing was $56,400 in Calhoun County, $47,100 in DeWitt County, $57,400 in Goliad County, $52,700 in Jackson County, and $42,600 in Refugio County. The largest portion of housing inventory in Victoria County was in the category of "$50,000 and $99,999." The median value of all owner-occupied units in Victoria County was $73,300. In 2000, approximately 75 percent of the housing in Victoria County was valued at less than $100,000. (USCB 2000c)

2.5.2.7 Public Services and Community Infrastructure

Public services and community infrastructure include public water supply and wastewater treatment systems, police and fire departments, medical facilities, and schools. Schools are described in Subsection 2.5.2.8. The remaining services are described below.

2.5.2.7.1 Public Water Supply and Wastewater Treatment Systems

The discussion of public water supply systems includes the six counties comprising the ROI; however, water assessment and planning are performed on a regional basis in Texas, as shown in Figure 2.5.2-15. Therefore, these counties are discussed within the context of their respective regions. Table 2.5.2-38 details public water suppliers in the ROI, their current capacities, and their average daily production. Table 2.5.2-39 details wastewater treatment facilities in the ROI. Currently, there is excess capacity in all of the major water supply facilities and in most of the wastewater treatment facilities.

2.5.2.7.1.1 Public Water Supply

In 1957, in response to the drought of the 1950s, the Texas legislature created the Texas Water Development Board (TWDB) to develop water supplies and prepare plans to meet the state's future water needs. In 1997, the legislature established a water planning process to address water supply issues in light of Texas' population growth trends. (TWDB Undated)

The TWDB divides Texas into 16 water planning regions: Region A through Region P (Figure 2.5.2-15). Each region is represented by a Regional Water Planning Group that prepares a regional water plan for its region. Regional Water Planning Groups are composed of representatives from a variety of interests, including agricultural, industrial, environmental, public, municipal, business, water district, river authority, water utility, county, and power generation. Their plans have engineering, socioeconomic, hydrological, environmental, legal, and institutional components. They include direction for water conservation strategies, meeting future water supply needs, and responding to future droughts. (TWDB Undated)

The six counties comprising the ROI are located in Regions L and P. Calhoun, DeWitt, Goliad, Refugio, and Victoria counties are in Region L, and Jackson County is in Region P. The larger population centers in the Region L portion of the ROI are Port Lavaca and Seadrift in Calhoun County; Cuero, Yoakum, and Yorktown in DeWitt County; Goliad in Goliad County; Refugio and Woodsboro in Refugio County; and Victoria in Victoria County. The larger population centers in the Region P portion of the ROI are Edna and Ganado in Jackson County. A summary of Regions L and P water demand and supply is provided below, as presented in the 2007 State Water Plan (TWDB Nov 2006).

Region L — Demand, Supply, Additional Water Needs, and Water Management Strategies

Region L contains all or part of 21 counties, including five of the counties in the ROI. Region L contains all or portions of nine river and coastal basins, the Guadalupe Estuary and San Antonio Bay. The largest cities in Region L are San Antonio, Victoria, San Marcos, and New Braunfels.

Between 2010 and 2060, Region L population is projected to increase by almost 75 percent. Water demands, however, are projected to increase less significantly. The region's total water demand is projected to increase by 29 percent, from 985,237 acre-feet in 2010 to 1,273,003 acre-feet in 2060 (Table 2.5.2-40). After 2020, municipal water use makes up the largest share of these demands in all decades and is projected to experience the greatest increase over the planning period, from 369,694 acre-feet in 2010 to 597,619 acre-feet in 2060, a 62 percent increase. However, this increase in demand will be somewhat offset by a decrease in the demand from agricultural irrigation water, which is projected to decline 20 percent, from 379,026 acre-feet in 2010 to 301,679 acre-feet in 2060. Steam electric demand will increase 118 percent from 50,427 acre-feet to 109,776 acre-feet. (TWDB Nov 2006)

Major water supply sources in Region L are summarized in Table 2.5.2-41. This data indicates a decrease in regional water supplies from groundwater, surface water, and water reuse, from 1,049,769 acre-feet in 2010 to 1,018,410 acre-feet in 2060.

Water needs for Victoria and Calhoun Counties are discussed in Subsection 2.3.2. Tables 2.3.2-2 and 2.3.2-3 provide a summary of the 2010 through 2060 projected available and unallocated groundwater supplies for Victoria and Calhoun Counties. Table 2.3.2-14 provides a summary of projected surface water demands, supplies, and needs for Victoria and Calhoun Counties from 2000 through 2060. Goliad County's projected water needs for steam electric is projected to increase to 4842 acre-feet in 2060. Victoria County's water needs for manufacturing are projected to increase to 6566 acre-feet in 2060. Water needs for DeWitt and Refugio Counties are not projected to increase during the period from 2010 through 2060. (TWDB Nov 2006)

Water management strategies for the Region L Plan include, but are not limited to, a more coordinated use of surface water and groundwater, reuse, groundwater and seawater desalination, and conservation. In total, these strategies will provide 732,779 acre-feet per year of additional water supply by the year 2060, at a total capital cost of approximately $5.2 billion. (TWDB Nov 2006)

Conservation strategies represent 15 percent of the total amount of water resulting from all recommended water management strategies. Water conservation is included as a strategy for every municipal and non-municipal water user group. (TWDB Nov 2006)

The VCS site does not currently obtain potable water through public water supplies. There are stock wells at the VCS site and a domestic well at the McCan Ranch house.

Region P — Demand, Supply, Additional Water Needs, and Water Management Strategies

Region P contains all or part of three counties, one of which (Jackson County) is located in the ROI. Most of Region P lies inside the Lavaca River Basin, which is the primary source of surface water for the region. Groundwater from the Gulf Coast Aquifer supplies most of the water for the region.

Table 2.5.2-42 provides projected water demand data for Region P. Projected water demands for Region P indicate a slight reduction, from 225,561 acre-feet in 2010 to 206,908 acre-feet in 2060. (TWDB Nov 2006)

Table 2.5.2-43 provides water supply data for Region P. In 2010, surface water is projected to provide less than 1 percent of the total supply, with groundwater providing the balance. The principal surface water supply source is Lake Texana, the only reservoir in the region. The Gulf Coast Aquifer provides groundwater in the region. The total surface water and groundwater supply is estimated to remain constant at 209,431 acre-feet per year from 2010 to 2060. (TWDB Nov 2006)

Water user groups in Region P are anticipated to need 50,655 acre-feet of additional water in 2010, under drought conditions, and 31,979 acre-feet by 2060, all of which can be met by pumping additional groundwater during irrigation season and then allowing water levels to recover prior to the next planting season. Irrigation is the only water use group for this region that has a need for additional water from 2010 to 2060, although the level of need is estimated to decline because of a projected decrease in irrigated acreage in the region. Irrigation water needs for Jackson County are projected to increase slightly from 15,735 acre-feet in 2010 to 15,834 acre-feet in 2060, which is less than a 1 percent increase. (TWDB Nov 2006)

The Region P water management strategy is water conservation for municipal users only. Region P planners state that water conservation is not the most cost-effective method to meet irrigation needs, which are the only projected additional water needs in the region. Planners recommend the continued use of good agricultural practices, and state and federal programs that provide financial and technical assistance to agricultural producers, to achieve irrigation efficiency and overall water conservation. Region P water policy recommendations include establishing fees for groundwater export from the region, basing groundwater availability on an aquifer's sustainable yield, and subjecting regional groundwater used outside of the region to the same protections as the basin of origin for surface water. (TWDB Nov 2006)

2.5.2.7.1.2 Wastewater Treatment Systems

Wastewater is the domestic sewage from homes, communities, farms, businesses, and manufacturing facilities. It also includes industrial waste from manufacturing sources. Wastewater treatment in the region is provided by local jurisdictions and primarily regulated by the Texas Commission on Environmental Quality. Wastewater treatment capacity depends on two factors: water supply and the availability of infrastructure. As stated previously, there is currently excess capacity in most of the wastewater treatment systems in counties in the ROI.

Capacity for Wastewater Treatment

Table 2.5.2-39 details public wastewater treatment facilities, the average flow rates for their plant designs, and their average monthly processing. The rural areas of each county, including the proposed VCS site, are on septic systems.

Infrastructure for Wastewater Treatment

In the event that capacity limits may be approached or exceeded, Texas Administrative Code Title 30 Section 305.126(a) directs that:

> Whenever flow measurements for any sewage treatment plant facility in the state reach 75 percent of the permitted average daily or annual average flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the wastewater treatment and/or collection facilities. Whenever the average daily or annual average flow reaches 90 percent of the permitted average daily flow for three consecutive months, the permittee shall obtain necessary authorization from the commission to commence construction of the necessary additional treatment and/or collection facilities.

However, this requirement can be waived if the facility can show that the population served or the expected waste to be processed will not exceed facility design limitations.

An evaluation of the data listed in Table 2.5.2-39 indicates that the wastewater systems for the city of Port Lavaca, Jackson County Water Control and Improvement District (WCID) No. 2, and Victoria County WCID No. 2 are already in excess of the 75 percent flow value discussed above.

2.5.2.7.2 Law Enforcement, Fire Protection Services, and Emergency Management

Law Enforcement

Table 2.5.2-44 provides 2005 law enforcement data for the ROI counties. Table 2.5.2-46 provides approximate ratios of residents to law enforcement officers (sworn officers). In the ROI as a whole, the current ratio of residents per officer is approximately 482 to 1. In 2005, the national average was 417 residents per officer. (FBI Sep 2006)

Fire Protection Services

Table 2.5.2-45 provides 2007 fire protection personnel data for the departments for the counties in the ROI. Most firefighters are volunteers, with the exception of the city of Victoria and Port Lavaca fire departments where most are paid. Table 2.5.2-46 provides approximate ratios of residents to active firefighters. In the ROI, the current ratio of residents per active firefighter is approximately 245 to 1. In 2006, the estimated number of firefighters in the nation was 1,140,900 (USFA 2008) and the USCB population estimate for the nation was 299,398,484 (USCB 2006), resulting in a residents per active firefighter ratio of 262 to 1.

Additionally, in 1998, the state of Texas adopted the Public Protection Classification system (TDI Sep 2007). It is a national system used by the Insurance Services Office (ISO) to reflect a community's local fire protection for property insurance rating purposes. The ISO is an advisory organization that serves the property and casualty insurance industry by providing inspection services, insurance coverage for development, and statistical services. The public fire protection of a city, town, or area is graded using the ISO Fire Suppression Rating Schedule. ISO classifies communities from 1 (the highest rating) to 10 (the lowest rating). Communities are graded on water distribution, fire department equipment and manpower, and fire alarm facilities, among other things (TDI Sep 2007). Table 2.5.2-47 provides Public Protection Classification ratings for the ROI communities that have populations large enough to be counted in the U.S. Census.

Emergency Management

The Governor is responsible for homeland security and emergency management in the state of Texas. The Governor's Division of Emergency Management is responsible for carrying out a comprehensive all-hazard emergency management program for the state and assisting cities, counties, and state agencies in implementing their own emergency management programs. The

Governor's Division of Emergency Management, like other state agencies, is also responsible for supporting development and implementation of the Governor's Homeland Security Strategy (TDPS Undated).

A number of other councils and committees, including the state Emergency Management and Homeland Security Council, assist the Governor in matters relating to disaster mitigation, emergency preparedness, disaster response, and recovery (TDPS Undated).

Texas is divided into Disaster Districts, which are the state's regional emergency management organizations. They serve as the initial source of state emergency assistance for local governments. With the exception of Refugio County, the ROI counties are in District 17, the Victoria District. Refugio County is part of District 20, the Corpus Christi District (TDPS Undated).

On the local level, mayors and county judges have responsibility for emergency preparedness and response in their jurisdictions. Local emergency management and homeland security organizations may be organized at the city level, at the county level, or as inter-jurisdictional programs that include one or more counties and cities. Local emergency management organizations may be organized as part of the mayor or county judge's staff, as a separate office or agency, as part of the local fire department or law enforcement agency, etc. Local emergency management and homeland security agencies may be identified as emergency management offices or agencies, homeland security offices or agencies, or some combination of the two. (TDPS Undated)

The mayors and county judges may appoint an Emergency Management Coordinator to manage day-to-day program activities (TDPS Undated). Each of the ROI counties has an Emergency Management Coordinator (TDPS Jan 2008).

2.5.2.7.3 Medical

Table 2.5.2-48 presents hospital use in 2006 and medical practitioner data by county in 2007. As a whole, the ROI has 273 physicians, eight hospitals (four of which are in Victoria County), and 808 staffed beds. The 2006 ROI hospital census shows that the average number of in-patients receiving care each day was 369. A comparison of the number of staffed beds to the hospital census yields a use rate of approximately 46 percent.

2.5.2.8 Schools

2.5.2.8.1 Public Pre-Kindergarten through Grade 12

This subsection discusses the enrollment, capacity, and facilities of public schools in the ROI. The public school systems in Texas are organized into Independent School Districts (ISDs). For the 2007-2008 school year, the ISDs in the ROI (in whole or in part) have a total enrollment of 31,571 students. The public school systems in the ROI have space available for an additional 14,728 students including the seating of the schools that are planned or under construction. Table 2.5.2-49 provides information on the number and type of public schools in each county. Table 2.5.2-50 summarizes the information on student population and available capacity (including the capacity of schools under construction and the planned new schools) for each ISD. Figure 2.5.2-16 shows the boundaries of each ISD and the location of each campus.

2.5.2.8.1.1 Calhoun County

Calhoun County has one ISD, the Calhoun County ISD, and the ISDs boundaries encompass most of the county (the Seadrift community is a part of the Austwell-Tivoli ISD). The ISD is described below.

Calhoun County ISD

The Calhoun County ISD had a pre-kindergarten through grade 12 total enrollment of 4290 students in November 2007 (Table 2.5.2-50). The 2006-2007 school year enrollment was approximately 4331 students. The existing ISD infrastructure could support approximately 5600 students. Additionally, a new elementary school campus is currently being built and one of the high schools is currently being expanded to include a separate structure for the 9th grade. Upon completion, these projects will expand capacity by an additional 632 students in the ISD. (CCISD Nov 2007, CCISD Apr 2008)

For the 2005-2006 school year, the Calhoun County ISD received 85.23 percent of its revenue from local property taxes, 3.41 percent from other local and intermediate taxes (as a result of services rendered to other school districts), 10.75 percent from state funding, and 0.61 percent from federal funding (TEA 2007).

2.5.2.8.1.2 DeWitt County

DeWitt County has six ISDs with a pre-kindergarten through grade 12 enrollment of 4405 students in November 2007 (Table 2.5.2-50). The six ISDs in the county can collectively support an additional 1240 public school students (Table 2.5.2-50). Each school district is described below.

Cuero ISD

The Cuero ISD, which partially extends into Gonzales County, had a kindergarten through grade 12 enrollment of 1950 students in November 2007, which is unchanged from the 2006-2007 school year. A junior high school and a high school were recently built, increasing the student capacity of the ISD to 2700. (CISD Nov 2007)

For the 2005-2006 school year, the Cuero ISD received 28.58 percent of its revenue from local property taxes, 3.37 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 68.05 percent from state funding. The ISD received no federal funding. (TEA 2007)

Meyersville ISD

The Meyersville ISD, which extends into Victoria County, had a kindergarten through grade 8 enrollment of 125 students in November 2007. The ISD has a total capacity of 160 students. During the 2006-2007 school year, the district had an enrollment of 130 students. No expansion plans are scheduled. (MISD Nov 2007)

For the 2005-2006 school year, the Meyersville ISD received 63.01 percent of its revenue from local property taxes, 2.86 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 34.14 percent from state funding. The ISD received no federal funding. (TEA 2007)

Nordheim ISD

The Nordheim ISD, which extends into Karnes County, had a 2007–2008 pre-kindergarten through grade 12 enrollment of 82 students on a single campus. The 2006–2007 school year enrollment was 80 students. With the existing infrastructure, the total capacity is 175 students. The Nordheim ISD has no current plans to expand. (NISD Nov 2007)

During the 2005-2006 school year, the Nordheim ISD received 79.74 percent of its revenue from local property taxes, 1.05 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 19.22 percent from state funding. The ISD received no federal funding. (TEA 2007)

Westhoff ISD

The Westhoff ISD, which is completely contained in DeWitt County, has a 2007–2008 school year pre-kindergarten through grade 8 enrollment of 48 students. High school students attend school in the Cuero ISD. In the 2006–2007 school year, enrollment was also 48 students. Although the district could support 160 students, enrollment has never been more than 70 students. No expansion plans are scheduled. (WISD Nov 2007)

For the 2005–2006 school year, the Westhoff ISD received 35.15 percent of its revenue from local property taxes, 2.75 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 62.11 percent from state funding. The ISD received no federal funding. (TEA 2007)

Yoakum ISD

The Yoakum ISD, which extends into Gonzales and Lavaca Counties, had a 2007–2008 school year enrollment in pre-kindergarten through grade 12 of 1550 students. The enrollment in 2006–2007 was 1560 students. The Yoakum ISD schools are currently functioning at capacity. If enrollment increases, the existing infrastructure would not be sufficient. Although there are no plans for expansion, the district acknowledges that it will expand if enrollment increases. (YISD Nov 2007)

For the 2005-2006 school year, the Yoakum ISD received 41.75 percent of its revenue from local property taxes, 1.39 percent from other local and intermediate taxes (a result of services rendered to other school districts), 56.45 percent from state funding, and 0.41 percent from federal funding (TEA 2007).

Yorktown ISD

The Yorktown ISD, which is completely contained in DeWitt County, had a 2007–2008 school year pre-kindergarten through grade 12 enrollment of 650 students. Enrollment during the 2006–2007 school year was 675 students. The existing infrastructure at Yorktown ISD could support a total of 900 students. The Yorktown ISD has no current plans to expand. (YORKISD Nov 2007)

For the 2005-2006 school year, the Yorktown ISD received 29.29 percent of its revenue from local property taxes, 1.14 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 69.57 percent from state funding. The ISD received no federal funding. (TEA 2007)

2.5.2.8.1.3 Goliad County

Goliad County has one ISD, the Goliad ISD. The ISD is contained within the county boundary and is described below.

Goliad ISD

The Goliad ISD had a 2007–2008 school year pre-kindergarten through grade 12 total enrollment of 1312 students. Enrollment during the 2006–2007 school year was approximately 1332 students. With the existing infrastructure, the Goliad ISD is at capacity. No expansion plans are scheduled. (GISD Nov 2007)

For the 2005–2006 school year, the Goliad ISD received 89.80 percent of its revenue from local property taxes, 1.35 percent from other local and intermediate taxes (as a result of services rendered to other school districts), 8.58 percent from state funding, and 0.27 percent from federal funding (TEA 2007).

2.5.2.8.1.4 Jackson County

Jackson County has three ISDs wholly contained within the county and portions of the Palacios ISD (Matagorda County) and the Hallettsville ISD (Lavaca County). During the 2007-2008 school year, the five ISDs had a pre-kindergarten through grade 12 enrollment of 5560 students (Table 2.5.2-50). Currently, the county has space available for an additional 940 students. Each school district is described below.

Edna ISD

The Edna ISD had a 2007–2008 school year enrollment of 1450 students in pre-kindergarten through grade 12. During the 2006–2007 school year, the ISD had an enrollment of 1450 students. A new elementary school will open in the spring of 2008, increasing the capacity of the district to 1800 students. (EISD Oct 2007, EISD Apr 2008)

For the 2005-2006 school year, the Edna ISD received 44.10 percent of its revenue from local property taxes, 1.73 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 54.18 percent from state funding. The ISD received no federal funding. (TEA 2007)

Ganado ISD

The Ganado ISD had a 2007–2008 school year pre-kindergarten through grade 12 enrollment of 640 students. Enrollment for the 2006–2007 school year was 650 students. With the existing infrastructure at the Ganado ISD, the district could support approximately 700 students, or an additional 60 students. Currently, the ISD has no plans for expanding. (GANISD Nov 2007)

For the 2005–2006 school year, the Ganado ISD received 35.49 percent of its revenue from local property taxes, 1.24 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 63.27 percent from state funding. The ISD received no federal funding. (TEA 2007)

Hallettsville ISD

The Hallettsville ISD is primarily located in Lavaca County, although a very small portion of it is in Jackson County. The ISD has a 2007–2008 kindergarten through grade 12 enrollment of 887 students. Enrollment during the 2006–2007 school year was 940 students. The Hallettsville ISD has capacity for 1050 students. No expansion plans are scheduled. (HISD Nov 2007)

For the 2005–2006 school year, the Hallettsville ISD received 89.53 percent of its revenue from local property taxes, 1.14 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 9.33 percent from state funding. The ISD received no federal funding. (TEA 2007)

Industrial ISD

The Industrial ISD, which also extends into Victoria County, had a 2007–2008 school year pre-kindergarten through grade 12 enrollment of 1060 students. The 2006–2007 school year enrollment was 1030 students. The ISD's existing infrastructure could support a total of 1150 students. The ISD is adding classrooms to the two existing elementary schools, but this will not affect enrollment capacity (IISD Nov 2007, IISD Apr 2008).

For the 2005–2006 school year, the Industrial ISD received 85.22 percent of its revenue from local property taxes, 2.72 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 12.06 percent from state funding. The ISD received no federal funding. (TEA 2007)

Palacios ISD

The Palacios ISD is primarily located in Matagorda County, though a portion of it is in Jackson County. The ISD had a pre-kindergarten through grade 12 enrollment of 1574 students in the 2006–2007 school year and a 2007–2008 enrollment of 1523 students. The existing infrastructure can support a total of 1800 students. No classroom expansions are currently planned. (PISD Sep 2007)

For the 2005–2006 school year, the Palacios ISD received 79.91 percent of its revenue from local property taxes, 3.61 percent from other local and intermediate taxes (a result of services rendered to other school districts), 16.32 percent from state funding, and 0.15 percent from federal funding. (TEA 2007)

2.5.2.8.1.5 Refugio County

Refugio County has three ISDs with a pre-kindergarten through grade 12 enrollment of 1436 students in the 2007-2008 school year (Table 2.5.2-50). There is space available for an additional 1164 students (Table 2.5.2-50). Each school district is described below.

Austwell-Tivoli ISD

The Austwell-Tivoli ISD, which is primarily in Refugio County but extends into Calhoun County, has a pre-kindergarten through grade 12 enrollment of 155 students in the 2007–2008 school year. During the 2006–2007 school year, the district had an enrollment of 160 students. With the existing infrastructure, the Austwell-Tivoli ISD could support an additional 345 students. Currently, the Austwell-Tivoli ISD has no expansion plans. (ATISD Nov 2007)

For the 2005–2006 school year, the Austwell-Tivoli ISD received 84.79 percent of its revenue from local property taxes, 6.41 percent from other local and intermediate taxes (as a result of services rendered to other school districts), 7.58 percent from state funding, and 1.22 percent from federal funding (TEA 2007).

Refugio ISD

The Refugio ISD is primarily located in Refugio County, with a noncontiguous portion in Victoria County; the Victoria County portion of this ISD includes most of the proposed VCS site. The ISD has a pre-kindergarten through grade 12 enrollment of 735 students in November 2007. Enrollment for the 2006-2007 school year was 725 students. The existing infrastructure can support approximately 1000 students. The ISD is currently building a separate campus for middle school students, which will expand capacity by an additional 500 students (RISD Nov 2007, RISD Apr 2008).

For the 2005–2006 school year, the Refugio ISD received 87.45 percent of its revenue from local property taxes, 1.39 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 11.17 percent from state funding. The ISD received no federal funding. (TEA 2007)

Woodsboro ISD

The Woodsboro ISD had a pre-kindergarten through grade 12 enrollment of 579 students in November 2006. The 2007–2008 enrollment was approximately 546 students. The existing infrastructure can support a total of approximately 600 students. The district does not have expansion plans. (WOISD Nov 2007)

For the 2005–2006 school year, the Woodsboro ISD received 34.42 percent of its revenue from local property taxes, 3.18 percent from other local and intermediate taxes (a result of services rendered to other school districts), 62.39 percent from state funding, and 0.02 percent from federal funding (TEA 2007).

2.5.2.8.1.6 Victoria County

Victoria County has three ISDs plus portions of the Industrial ISD (Jackson County), the Meyersville ISD (DeWitt County), and the Refugio ISD (Refugio County). In the three ISDs completely within Victoria County, pre-kindergarten through grade 12 enrollment was 14,568 students in the 2007–2008 school year (Table 2.5.2-50). The school systems in the county could accommodate an additional 10,042 students, after the schools planned and under construction are completed and the reliance on mobile units is reduced. Each school district is described below.

Bloomington ISD

The Bloomington ISD has a 2007–2008 pre-kindergarten through grade 12 enrollment of 908 students. The 2006-2007 school year enrollment was 921 students. With the existing infrastructure, the capacity is 1050 students. As of 2007, the ISD has no plans for expansion. (BISD Nov 2007)

For the 2005-2006 school year, the Bloomington ISD received 26.58 percent of its revenue from local property taxes, 0.93 percent from other local and intermediate taxes (a result of services rendered to other school districts), 72.19 percent from state funding, and 0.30 percent from federal funding (TEA 2007).

Nursery ISD

The Nursery ISD has a pre-kindergarten through grade 5 total enrollment of 110 students in November 2007. The 2006–2007 school year also had an enrollment of 110 students. Currently, the school within Nursery ISD is at capacity, however, the ISD is building a new facility to replace the existing structure. The new school will support about 210 students (NUISD Nov 2007, NUISD Apr 2008).

For the 2004–2005 school year, the Nursery ISD received 91.66 percent of its revenue from local property taxes, 0.91 percent from other local and intermediate taxes (a result of services rendered to other school districts), and 7.42 percent from state funding. The ISD received no federal funding. (TEA 2007)

Victoria ISD

Two tax parcels of the proposed VCS site lie within the Victoria ISD, which has a pre-kindergarten through grade 12 total enrollment of 13,550 students in November 2007. Enrollment for the 2006–2007 school year was 13,838 students. With the existing facilities, the Victoria ISD could support another 4450 students. The Victoria ISD is currently building five new schools (two elementary, one middle/intermediate/junior, and two high schools), adding space for a net additional 5350 students. The ISD will reduce its reliance on mobile classroom units when the new schools are completed. (VISD Nov 2007, VISD Apr 2008)

For the 2005–2006 school year, the Victoria ISD received 60.44 percent of its revenue from local property taxes, 1.25 percent from other local and intermediate taxes (a result of services rendered to other school districts), 37.88 percent from state funding, and 0.42 percent from federal funding (TEA 2007).

2.5.2.8.2 Post-Secondary Institutions

There are five post-secondary institutions–three colleges or universities and two vocational schools–within 50 miles of the proposed VCS site. Victoria College is located approximately 13 miles from the proposed site, in the city of Victoria. The college is accredited to award Associate Degrees. In the fall of 2007, Victoria College had an enrollment of 4297 students (VC Oct 2007). The University of Houston — Victoria (UHV) is located approximately 13 miles from the proposed site and is accredited to award both Baccalaureate and Masters Degrees. In the fall of 2007, UHV had an enrollment of 2784 students (UHV Oct 2007). UHV has articulation agreements to allow students from Wharton County Junior College (in nearby Wharton County) or from Victoria College to transfer credits toward earning a Baccalaureate or Masters Degree at UHV (UHV Undated). Coastal Bend College, in Beeville, is located approximately 48 miles from the proposed site. It is accredited to award Associate Degrees. In the fall of 2007, Coastal Bend College had an enrollment of 925 students at the Beeville campus (CBC Jan 2008). In the city of Victoria, there are two vocational schools: the Texas Vocational School and the Victoria Beauty College. The Texas Vocational School has a current total enrollment of 74 students, and the Victoria Beauty College has a current enrollment of 115 students (NCES May 2008). In addition, there is a Texas State Technical College (TSTC) system but there is no campus within 50 miles of the VCS site. However, the college provides a service called "Corporate College" that provides specialized training for businesses and industries on a contractual basis (TSTC Jun 2008). Exelon has had general discussions with TSTC regarding how it might support Exelon's needs in the future should the proposed project proceed to construction.

2.5.2.9 References

AHA 2006. American Hospital Association, *2007 AHA Guide*, September 2006.

AMA 2005. American Medical Association, *Physician-Related Data Resources*, 2005, available at http://www.ama-assn.org/ama/pub/category/2676.html, accessed December 27, 2007.

AN Feb 2008a. AirNav.Com, *Airport Information, KRKP Aransas County Airport*, February 2008, available at http://www.airnav.com/airport/KRKP, accessed March 13, 2008.

AN Feb 2008b. AirNav.Com, *Airport Information, KPKV Calhoun County Airport*, February 2008, available at http://www.airnav.com/airport/KPKV, accessed March 13, 2008.

AN Feb 2008c. AirNav.Com, *Airport Information, 26R Jackson County Airport*, February 2008, available at http://www.airnav.com/airport/26R, accessed March 13, 2008.

AN Feb 2008d. AirNav.Com, *Airport Information, T85 Yoakum Municipal Airport*, February 2008, available at http://www.airnav.com/airport/T85, accessed March 13, 2008.

AN Feb 2008e. AirNav.Com, *Airport Information, KPSX Palacios Airport*, February 2008, available at http://www.airnav.com/airport/KPSX, accessed March 13, 2008.

AN Feb 2008f. AirNav.Com, *Airport Information, RFG Rooke Field [Refugio]*, February 2008, available at http://www.airnav.com/airport/RFG, accessed March 13, 2008.

AN Feb 2008g. AirNav.Com, *Airport Information, VCT Victoria Airport*, February 2008, available at http://www.airnav.com/airport/VCT, accessed March 13, 2008.

AN July 2008a. AirNav.com, KTFP T. P.McCampbell Airport, July 2008, available at http://www .airnav.com/airport/KTFP, accessed July 31, 2008.

AN July 2008b. AirNav.com, KBEA Beeville Municipal Airport, July 2008, available at http://www. airnav.com/airport/7T3, accessed July 31, 2008.

AN July 2008c. AirNav.com, 7T3 Goliad County Industrial Airport, July 2008, available at http://www. airnav.com/airport/KTFP, accessed July 31, 2008.

AN July 2008d. AirNav.com, T71 Cuero Municipal Airport, July 2008, available at http://www. airnav.com/airport/T71, accessed July 31, 2008.

AN July 2008e. AirNav.com, T69 Alfred C. "Bubba" Thomas Airport, July 2008, available at http://www.airnav.com/airport/T69, accessed July 31, 2008.

AN July 2008f. AirNav.com, 2R9 Kames County Airport, July 2008, available at http://www.airnav. com/airport/2R9, accessed July 31, 2008.

APCC Undated. Aransas Pass Chamber of Commerce, *Calendar of Events*, available at http://www. aransaspass.org, accessed March 26, 2008.

Aransas Pass 2008. City of Aransas Pass, *Parks Department*, available at http://www.aransaspasstx. gov/parks-department.php, accessed March 25, 2008.

Aransas Pass May 2008. Aransas Pass, *Park Usage or Capacity, Park Master Plan, Park Acreage: Population Standard*, Phone call from R. Henderson-Tetra Tech to A. Lirmann-Aransas Pass on May 22, 2008.

ATISD Nov 2007. Austwell-Tivoli Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to M. Kelso-Austwell-Tivoli ISD on November 5, 2007.

BEA 2008. U.S. Department of Commerce Bureau of Economic Analysis, *Regional Economic Accounts, Local Area Personal Income: Table CA25N — Total full-time and part-time employment by NAICS industry*, available at http://www.bea.gov/bea/regional/reis, accessed February 18, 2008.

BISD Nov 2007. Bloomington Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to D. Warnell-Bloomington ISD on November 9, 2007.

BLS May 2006. U.S. Department of Labor Bureau of Labor Statistics, *Occupational Employment Statistics: May 2006 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates, Victoria, Texas Metropolitan Statistical Area; Texas Statewide*, May 2006, available at http://stats.bls.gov/oes/, accessed October 30, 2007 and January 31, 2008.

BLS Dec 2006. U.S. Department of Labor Bureau of Labor Statistics, *Bureau of Labor Statistics Report to the Office of Management and Budget On Implementation of The Confidential Information Protection and Statistical Efficiency Act of 2002*, December 2002–December 2006, available at http://www.bls.gov/bls/cipseareport.pdf, accessed January 17, 2008.

BLS 2007a. U.S. Department of Labor Bureau of Labor Statistics, *Local Area Unemployment Statistics. Labor Force, Employment, and Unemployment Data*, available at http://data.bls.gov, accessed October 23, 2007.

BLS 2007b. U.S. Department of Labor Bureau of Labor Statistics, *Quarterly Census of Employment and Wages*, available at http://data.bls.gov/PDQ/outside.jsp?survey=en, accessed October 30, 2007.

BLS 2007c. U.S. Department of Labor Bureau of Labor Statistics, *Inflation Calculator*, available at http://www.bls.gov/cpi/, accessed October 30, 2007.

BLS Jan 2008. U.S. Department of Labor Bureau of Labor Statistics, *Union Affiliation of employed wage and salaried workers by state, 2006*, available at http://www.bls.gov/news.release/union2.t05.htm, accessed July 7, 2008.

BPPC Undated. Brackenridge Plantation, *Welcome to Brackenridge Plantation Park and Campground*, available at http://www.brackenridgepark.com, accessed March 31, 2008.

BTS 2005. U.S. Department of Transportation Bureau of Transportation Statistics, Table 1-2: *Public Road Length, Miles by Ownership: 2005*, available at http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2006/html/table_01_02.html, accessed January 30, 2008.

Calhoun County Dec 2007. Calhoun County Texas, *Property Development-Subdivision Regulations for Calhoun County*, December 13, 2007.

CBC Jan 2008. Coastal Bend College, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to A. Ulloa-Coastal Bend College on January 16, 2008.

CBT Jun 2008. Coastal Bend Texas. *Texas Coastal Bend Coastal Communities: Beeville*, available at http://www.coastalbendtexas.com, accessed June16, 2008.

CBT Undated a. Coastal Bend Texas. *Texas Coastal Bend Coastal Communities: Calhoun County*, available at http://www.coastalbendtexas.com, accessed March 22, 2008.

CBT Undated b. Coastal Bend Texas. *Texas Coastal Bend Inland Communities: Victoria*, available at http://www.coastalbendtexas.com, accessed March 22, 2008

CBT Undated c. Coastal Bend Texas. *Texas Coastal Bend Inland Communities: Cuero*, available at http://www.coastalbendtexas.com, accessed March 22, 2008.

CCCA Undated. Cuero Chamber of Commerce and Agriculture, *Welcome to Cuero.org*, available at http://www.cuero.org, accessed March 26, 2008.

CCEDC Undated. Calhoun County Economic Development Corporation, *County Profile: Top Ten Employers in Calhoun County*, available at http://www.calhounedc.org/county_profile.php, accessed October 29, 2007.

CCISD Nov 2007. Calhoun County Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to S. Hunt-Calhoun County ISD on November 5, 2007.

CCISD Apr 2008. Calhoun County Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to P. Mickel-Calhoun County ISD on April 4, 2008.

CDC Jul 2006. Cuero Development Corporation, *Demographics: Top Ten Major Area Employers — Cuero,* available at http://www.cuerodc.com/demographics.php, accessed October 30, 2007.

CF Undated. County Fairgrounds, USA!, *Texas and the 254 Counties*, available at http://www.county fairgrounds.net/texas/texas.html, accessed March 26, 2008.

CISD Nov 2007. Cuero Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to H. Lind-Cuero ISD on November 7, 2007.

City of Beeville Mar 2008. City of Beeville, *Beeville, Texas*, available at www.beeville.net, accessed March 24, 2008.

Coleto Creek Park June 2008. GBRA Coleto Creek Park, *Visitors Statistics*, Phone call from R. Henderson-Tetra Tech to W. Korth-Coleto Creek Park on June 16, 2008.

Cuero May 2005. City of Cuero Texas, *City of Cuero, Texas Code of Ordinances: Title XV Land Usage*, May 2005.

Cuero Mar 2008. City of Cuero, Texas, *Cuero Public Parks*, available at http://www.cityofcuero.com/parkrulesandfees.php, accessed January 28, 2008.

Cuero May 2008. City of Cuero, *Park Usage or Capacity, Park Master Plan, Park Acreage: Population Standard*, Phone call from R. Henderson-Tetra Tech to D. Danish- City of Cuero on May 23, 2008.

Edna May 1972. City of Edna Texas, *Comprehensive Plan for City of Edna Jackson County, Texas*, May 1972.

Edna Jan 2005. City of Edna Texas, *Land Use Management Regulations and Districts*, Ordinance No. 74-04, as amended by Ordinance No. 2004-24, January 2005.

EISD Oct 2007. Edna Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to B. Wells-Edna ISD on October 29, 2007.

EISD Apr 2008. Edna Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to B. Wells-Edna ISD on April 11, 2008.

FBI Sep 2006. Federal Bureau of Investigation, *Crime in the United States 2005*, available at http://www.fbi.gov/ucr/05cius, accessed December 28, 2007.

FTA Jan 2007. Federation of Tax Administrators, *State Individual Income Taxes: Tax Rates For Tax Year 2007 — As Of January 1, 2007*, available at http://www.taxadmin.org/FTA/rate/ind_inc.html, accessed February 2008.

GANISD Nov 2007. Ganado Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to T. Walch-Ganado ISD on November 6, 2007.

GBRA Jun 2008. Guadalupe-Blanco River Authority, *Coleto Creek Park*, available at http://www.gbra.org/Recreation/ColetoCreek/Default.aspx, accessed June 16, 2008.

GCRPC Undated. Golden Crescent Regional Planning Commission, *Home Page Information — Map of Counties Included in GCRPC,* available at http://www.gcrpc.org, accessed October 30, 2007.

GISD Nov 2007. Goliad Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to S. Bell-Goliad ISD on November 8, 2007.

Goliad 2004. City of Goliad Texas, *2004 City of Goliad Zoning Districts*, available at http://www.goliadtx.net/images/Zoning.pdf, accessed November 16, 2007.

Goliad County May 2005. Goliad County Texas, *Goliad County Subdivision Regulations*, May 9, 2005.

Goliad Undated. City of Goliad Texas, *Recreation and Area Attractions*, available at http://www.goliadtx.net/cityliving_parks.asp, accessed January 28, 2008.

GT Jun 2006. Greenberg Traurig, LLP, *The New Texas Franchise Tax*, June 2006.

HISD Nov 2007. Hallettsville Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to S. Brandenberger-Hallettsville ISD on November 8, 2007.

ICC Undated. Ingleside Chamber of Commerce, *Ingleside Calendar of Events*, available at http://inglesidetxchamber.com, accessed March 26, 2008.

IISD Nov 2007. Industrial Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to T. Williams-Industrial ISD on November 5, 2007.

IISD Apr 2008. Industrial Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to T. Williams-Industrial ISD on April 11, 2008.

Jackson County Mar 2008. *Jackson County Texas, Subdivision Regulations for Jackson County Texas*, March 2008.

JCCC Oct 2007. Jackson County Chamber of Commerce, *Major Employers in Jackson County*, E-mail to K. Sutherlin-Tetra Tech from Jackson County Chamber of Commerce (j.chamber@att.net) on October 29, 2007.

JCCCA Undated. Jackson County Chamber of Commerce and Agriculture. *Parks & Campgrounds in Jackson County*, available at http://www.ykc.com/jccc/parks.htm, accessed March 23, 2008.

MISD Nov 2007. Meyersville Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to L. Whitson-Meyersville ISD on November 6, 2007.

NCES May 2008. U.S. Department of Education National Center for Educational Statistics, *Search for Schools, Colleges, and Libraries*, available at http://nces.ed.gov/globallocator/, accessed May 8, 2008

NISD Nov 2007. Nordheim Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to S. Little-Nordheim ISD on November 8, 2007.

NRPC Undated. National Railroad Passenger Corporation, *Interactive Route Atlas*, available at http://www.amtrak.com/servlet/ContentServer?pagename=Amtrak/am2Copy/Title_Image_Copy_Page&c=am2Copy&cid=1093554048998&ssid=10872, accessed November 13, 2007.

NUISD Nov 2007. Nursery Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to S. Bell-Nursery ISD on November 9, 2007.

NUISD Apr 2008. Nursery Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to S. Bell-Nursery ISD on April 4, 2008.

OMB Dec 2006. Office of Management and Budget, *Update of Statistical Area Definitions and Guidance on Their Uses*, OMB BULLETIN NO. 07-01, December 2006.

Palacios Undated. City of Palacios Texas, *Palacios, Texas City by the Sea*, available at http://www.cityofpalacios.org, accessed March 25, 2008.

PCC Undated. Palacios Chamber of Commerce, *Palacios Chamber of Commerce The City by the Sea*, available at http://www.palacioschamber.com, accessed March 26, 2008.

PISD Sep 2007. Palacios Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to P. Smith-Palacios ISD on September 26, 2007.

PLCC Undated. Port Lavaca Chamber of Commerce, *Community Events*, available at http://www.plchamber.com/index.htm, accessed March 26, 2008.

PLCCCC Undated. Port Lavaca Calhoun County Chamber of Commerce, *Area Features*, available at http://www.portlavacainfo.com/plcc_features_.html, accessed January 28, 2008.

Port Lavaca May 2007. City of Port Lavaca Texas, *Ordinance Charter 2007: Subdivision Ordinance*, May 14, 2007.

Port Lavaca 2008. City of Port Lavaca Texas, *Zoning*, Phone call from P. Baxter-Tetra Tech to C. Aguirre-City of Port Lavaca on February 28, 2008.

Port Lavaca Undated. City of Port Lavaca, *Lighthouse Beach and Bird Sanctuary*, available at http://www.portlavaca.org, accessed January 28, 2008.

PPA 2008. Passport-America, *Campgrounds*, available at http://www.passport-america.com, accessed March 23, 2008.

RCCCEDF Undated a. Refugio County Chamber of Commerce, *Refugio Area Recreation*, available at http://www.refugiocountytx.org/Recreation/recreation.html, accessed January 28, 2008.

RCCCEDF Undated b. Refugio County Chamber of Commerce and Economic Development Foundation. *Refugio Community Development*, available at http://www.refugiocountytx.org, accessed March 22, 2008.

Refugio County May 2008. Refugio County, *Park Usage or Capacity, Park Master Plan, Park Acreage: Population Standard*, Phone call from R. Henderson-Tetra Tech to P. Lewis- Refugio County on May 22, 2008.

RISD Nov 2007. Refugio Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to M. Beuershausen-Refugio ISD on November 6, 2007.

RISD Feb 2008. Refugio Independent School District, *Information and Spreadsheet*, E-mail to K. Sutherlin-Tetra Tech from W. Pursell-RISD Business Manager on February 11, 2008.

RISD Apr 2008. Refugio Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to B. Azam-Refugio ISD on April 14, 2008.

Rockport Undated. City of Rockport, *Parks and Leisure Department*, available at http://www.cityofr ockport.com, accessed March 25, 2008.

SCC Undated. Seadrift Chamber of Commerce, *Welcome to Seadrift, Texas*, available at http://www. seadriftchamber.com/, accessed March 26, 2008.

SICC Undated. Sinton Chamber of Commerce, *Event*, available at http://www.sintontexas.org/ events.html, accessed March 26, 2008.

TAC 2007. *Texas Administrative Code*, available at http://info.sos.state.tx.us/pls/pub/readtac$ ext.ViewTAC?tac_view=4&ti=34&pt=1&ch=3, accessed November 2007.

TAMU Jan 2008. Texas A & M University, *Texas County Building Permit Activity*, available at http://recenter.tamu.edu/Data/bpc, accessed January 17, 2008.

TAOC 2007a. Texas Association of Counties-County Information Project, *County Tax Rates*, available at http://www.county.org/resources/countydata/products.asp, accessed November 2007.

TAOC 2007b. Texas Association of Counties-County Information Project, *Property Tax Information for Victoria County*, available at http://www.txcip.org/tac/census/taxes.php?FIPS=48469, accessed November 2007.

TC Undated. Texas Campgrounds, *Camping Across the Beautiful State of Texas*, available at http://www.texascampgrounds.com/, accessed November 12, 2007 and February 21, 2008.

TCB Undated. Texas Coastal Bend, *Explore the Texas Coastal Bend*, available at http://www.txcoastalbend.org, accessed March 25, 2008.

TCEQ 2007. Texas Commission on Environmental Quality, *Water Utility Database*, available at http://www3.tceq.state.tx.us/iwud/, accessed October 31, 2007 and November 1, 2007.

TCEQ Nov 2007. Texas Commission on Environmental Quality, *Wastewater Treatment Plant Data*, E-mail to G. Gunter-Tetra Tech from M. Beatty-TCEQ Enforcement Division Program Specialist on November 14, 2007.

TCEQ Dec 2007. Texas Commission on Environmental Quality, *Wastewater Treatment Plant Data*, E-mail to G. Gunter-Tetra Tech from M. Beatty-TCEQ Enforcement Division Program Specialist on December 19, 2007.

TCPA Dec 2006. Texas Comptroller of Public Accounts, *Annual Property Tax Report, Tax Year 2005*, December 2006.

TCPA 2007. Texas Comptroller of Public Accounts, *Texas State Expenditures by County*, 2006, available at http://www.window.state.tx.us/taxbud/expbyco06/counties/, accessed October 2007.

TCPA 2008a. Texas Comptroller of Public Accounts, *Texas Net Revenue by Source — Fiscal 2007*, available at http://www.window.state.tx.us/taxbud/revenue.html, accessed January 2008.

TCPA 2008b. Texas Comptroller of Public Accounts. *Revised Texas Franchise Tax*, available at http://www.window.state.tx.us/taxinfo/franchise/ft_revised.html, accessed February 2008.

TCPA 2008c. Texas Comptroller of Public Accounts, *Sales and Use Tax*, available at http://www.window.state.tx.us/taxinfo/sales/index.html, accessed February 2008.

TCPA 2008d. Texas Comptroller of Public Accounts, *Texas Sales and Use Tax Rates*, January 2008.

TCPA 2008e. Texas Comptroller of Public Accounts, *Local Sales and Use Tax on Residential Use of Gas and Electricity*, available at http://www.window.state.tx.us/taxinfo/utility/reflist.html, accessed February 2008.

TCPA 2008f. Texas Comptroller of Public Accounts, *Jurisdictions that Impose Local Sales Tax on Telecommunications Services*, January 1, 2008, available at http://www.window.state.tx.us/taxinfo/taxpubs/tx96_339.html, accessed January 2008.

TCPA 2008g. Texas Comptroller of Public Accounts, *Local Sales and Use Tax*, Allocation Historical Summary, available at http://ecpa.cpa.state.tx.us/allocation/AllocHistResults.jsp;jsessionid=0000tCl7FHkFTlzjVjW_Ygf0jrn:-1, accessed January 2008.

TDI Sep 2007. Texas Department of Insurance, *Public Protection Classification (PPC) Oversigh*t, available at http://www.tdi.state.tx.us/fire/fmppcfaq.html#250095, accessed January 9, 2008.

TDI Jan 2008. Texas Department of Insurance, *Requested County PPC Listing*, E-mail to N. Hill-Tetra Tech from J. Williams - PPC Oversight Officer, State Fire Marshall's Office, on January 9, 2007.

TDPS Jun 2002. Texas Department of Public Safety, *Inland Evacuation Map, Matagorda Study Area*, June 2002, available at http://www.txdps.state.tx.us/dem/Hurricanemaps/MatagordaInland EvacuationMap.pdf, accessed May 2, 2008.

TDPS Jan 2008. Texas Department of Public Safety, *Emergency Management Coordinators*, E-mail to N. Hill-Tetra Tech from J. Miller — WIPP/Radiological Planner, Texas Department of Public Safety, on January 7, 2008.

TDPS Undated. Texas Department of Public Safety, *State Local Emergency Officials Organizations*, at http://www.txdps.state.tx.us/dem/pages/statelocalemergencymgmt.htm, accessed January 7, 2008.

TEA 2007. Texas Education Agency, *2005–2006 Budgeted Financial Data*, available at http://www.tea.state.tx.us/school.finance/forecasting/financial_ reports/FinRep_index.html, accessed September 26, 2007.

TEA Jul 2007. Texas Education Agency, *School District Locator*, available at http://deleon.tea.state.tx.us/SDL/Forms/#, accessed January 2008.

TEA Oct 2007. Texas Education Agency, School Finance Website, *Manual for Districts Subject to Wealth Equalization*, 2007-2008 School Year, October 17, 2007, available at http://www.tea.state.tx.us/school.finance/, accessed December 2007.

TEP 2007. Texas Emergency Portal, *Major Hurricane Evacuation Routes*, available at http://www.state.tx.us/emergency/eng/evacuating.html#maps, accessed October 30, 2007.

THC Undated. Texas Historical Commission, *Texas Independence Trail Region*, available at http://www.thc.state.tx.us/heritagetourism/htindetrail.shtml, accessed January 28, 2008.

TLC Nov 2002. Texas Legislative Council Research Division, *Overview of Local Taxes in Texas, Prepared for the Senate Committee on Finance*, November 2002.

TOG Undated. Texas Office of the Governor, *Regional Hotel Tables*, available at http://www.travel.state.tx.us/asp/customreports.aspx, accessed November 8, 2007.

TPWD 2001. Texas Parks and Wildlife Department. *Texas Parks and Wildlife for the 21st Century*, at http://www.tpwd.state.tx.us/publications/nonpwdpubs/media/tpwd_21st_century.pdf, accessed April 17, 2008.

TPWD Feb 2007a. Texas Parks and Wildlife Department, *Matagorda Island WMA*, available at http://www.tpwd.state.tx.us, accessed September 19, 2007.

TPWD Feb 2007b. Texas Parks and Wildlife Department, *Guadalupe Delta WMA*, available at http://www.tpwd.state.tx.us, accessed September 19, 2007.

TPWD Feb 2007c. Texas Parks and Wildlife Department, *Welder Flats WMA*, available at http://www.tpwd.state.tx.us, accessed March 31, 2008.

TPWD Feb 2007d. Texas Parks and Wildlife Department, *Goliad State Park*, available at http://www.tpwd.state.tx.us, accessed November 11, 2007.

TPWD Feb 2007e. Texas Parks and Wildlife Department, *Great Texas Coastal Birding Trail*, available at http://www.tpwd.state.tx.us, accessed March 19, 2008.

TPWD Oct 2007. Texas Parks and Wildlife Department, *Goose Island State Park*, available at http://www.tpwd.state.tx.us, accessed November 11, 2007.

TPWD Jan 2008. Texas Parks and Wildlife Department, *Lake Texana State Park*, available at http://www.tpwd.state.tx.us, accessed January 2, 2008.

TPWD May 2008a. Texas Parks and Wildlife, *Visitor Statistics*, Phone call from R. Henderson-Tetra Tech to M. Nelson-TPWD on May 7, 2008.

TPWD May 2008b. Texas Parks and Wildlife, *Visitor Statistics*, Phone call from R. Henderson-Tetra Tech to J. Sunder-TPWD on May 7, 2008.

TSHA Jun 2001a. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Goliad County*, June 6, 2001, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed December 06, 2007.

TSHA Jun 2001b. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Jackson County*, June 6, 2001, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed December 06, 2007.

TSHA Jun 2001c. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Refugio County*, June 6, 2001, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed December 06, 2007.

TSHA Jan 2006a. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Calhoun County*, January 19, 2006, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed December 06, 2007.

TSHA Jan 2006b. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Dewitt County*, January 27, 2006, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed December 06, 2007.

TSHA Jan 2008a. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Victoria County*, January 10, 2008, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed January 29, 2008.

TSHA Jan 2008b. Texas State Historical Association, *Handbook of Texas Online: A Digital Gateway to Texas History: Green Lake*, January 17, 2008, available at http://www.tsha.utexas.edu/handbook/online/articles/, accessed November 14, 2007.

TSTC Jun 2008. Texas State Technical College, *Corporate College*, available at http://corpcollege.tstc.edu/business.asp, accessed June 11, 2008.

TTC 2007. Texas Tax Code, Chapter 352, County Hotel Occupancy Taxes, available at http://tlo2.tlc.state.tx.us/statutes/docs/TX/content/htm/tx.003.00.000352.00.htm, accessed October 2007.

TWC 2007. Texas Workforce Commission, *County Narrative Profiles, combined report on ROI counties and individual reports for Calhoun, DeWitt, Goliad, Jackson, Refugio, and Victoria Counties*, available at http://www.texasindustryprofiles.com/apps/cnp/index_single.asp, accessed October 3, 2007, updated January 25, 2008.

TWDB Nov 2006. Texas Water Development Board, *2007 State Water Plan*, Document No. GP-8-1, November 14, 2006.

TWDB Undated. Texas Water Development Board, *SB 1 Water Planning*, available at http://www.twdb.state.tx.us/RWPG/what-is-rwp.asp, accessed December 6, 2007.

TWS 2008. Texas Water Safari, *Texas Water Safari Questions*, E-mail from G. Cochran-Texas Water Safari to R. Henderson-Tetra Tech on April 3, 2008.

TXDOT Mar 1993a. Texas Department of Transportation, *Rural Functional Classification Map*, Yoakum District, March 31, 1993.

TXDOT Mar 1993b. Texas Department of Transportation, *Rural Functional Classification Map*, Yoakum District, March 31, 1993.

TXDOT Dec 1998a. Texas Department of Transportation, *Rural Functional Classification Map*, Corpus Christi District, December 22, 1998.

TXDOT Dec 1998b. Texas Department of Transportation, *Rural Functional Classification Map*, Corpus Christi District, December 22, 1998.

TXDOT Sep 2001. Texas Department of Transportation, *Traffic Data and Analysis Manual*. September 2001.

TXDOT Sep 2007a. Texas Department of Transportation, *Corpus Christi Urban Traffic Map*, Inset 29. September 24, 2007.

TXDOT Sep 2007b. Texas Department of Transportation, *Corpus Christi Urban Traffic Map*, Inset 33. September 24, 2007.

TXDOT Sep 2007c. Texas Department of Transportation, *Yoakum Urban Traffic Map*, Inset 1. September 24, 2007.

TXDOT Sep 2007d. Texas Department of Transportation, *Yoakum Urban Traffic Map*, Inset 3. September 24, 2007.

TXDOT Sep 2007e. Texas Department of Transportation, *Yoakum Urban Traffic Map*, Inset 4. September 24, 2007.

TXDOT Oct 2007. Texas Department of Transportation, *LOS for Texas Roadways*, Phone call from B. Twigg-Tetra Tech to Julie Pollard-TXDOT Transportation Planning and Programming Division on October 30, 2007.

TXDOT 2007. Texas Department of Transportation, *Texas Airport Directory*, available at http://www.dot.state.tx.us/services/aviation/airport_directory.htm#bb, accessed November 5, 2007.

TXDOT Mar 2008. Texas Department of Transportation, *Open Records on Highway Capacity*, E-mail from R. Branecky-Texas Department of Transportation to B. Twigg-Tetra Tech on March 14, 2008. March 14, 2008.

UHV Oct 2007. University of Houston Victoria, *Enrollment and Accreditation*, Phone call from R. Henderson-Tetra Tech to T. Wortham-University of Houston Victoria on October 12, 2007.

UHV Undated. University of Houston Victoria, *Admissions and Records*, available at http://www.uhv.edu, accessed September 28, 2007.

UP Undated. Union Pacific Railroad, Texas Services, *Commodities, and Customers Map*, available at http://www.uprr.com/aboutup/usguide/tx.shtml, accessed November 13, 2007.

USACE 2001. U.S. Army Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 2001, Part 2-Waterways and Harbors, Gulf Coast, *Mississippi River System, and Antilles*, IWR-WCUS-01-2, at http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusmvgc01.pdf, accessed March 10, 2008.

USACE 2002. U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, Calendar Year 2002, Part 2-Waterways and Harbors, Gulf Coast, Mississippi River System, and Antilles, IWR-WCUS-02-2, at http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusmvgc02.pdf, accessed March 10, 2008.

USACE 2003. U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, Calendar Year 2003, Part 2-Waterways and Harbors, Gulf Coast, Mississippi River System, and Antilles, IWR-WCUS-03-2, at http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusmvgc03.pdf, accessed March 10, 2008.

USACE 2004. U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, Calendar Year 2004, Part 2-Waterways and Harbors, Gulf Coast, Mississippi River System, and Antilles, IWR-WCUS-04-2, at http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusmvgc04.pdf, accessed March 10, 2008.

USACE 2005. U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, Calendar Year 2005, Part 2-Waterways and Harbors, Gulf Coast, Mississippi River System, and Antilles, IWR-WCUS-05-2, at http://www.iwr.usace.army.mil/ndc/wcsc/pdf/wcusmvgc05.pdf, accessed March 10, 2008.

USACE May 2007. U.S. Army Corps of Engineers, *Draft Environmental Impact Statement for Calhoun County Navigation District's Proposed Matagorda Ship Channel Improvement Project.* Matagorda and Calhoun Counties. May 2007.

USACE 2008a. U.S. Army Corps of Engineers, *U.S. Waterway Data, Port and Waterway Facilities*, available at http://www.iwr.usace.army.mil/ndc/data/datapwd.htm, accessed March 12, 2008.

USACE 2008b. U.S. Army Corps of Engineers, *Tonnage for Selected U.S. Ports for 2001 to 2006*, available at http://www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm, accessed March 11, 2008.

USCB 2000a. U.S. Census Bureau, *Census 2000 Redistricting Data (Public Law 94-171) Summary File, Texas Places*, available at http://factfinder.census.gov, accessed July 30, 2007.

USCB 2000b. U.S. Census Bureau, *DP-1 Profile of General Demographic Characteristics: 2000 Data Set: Census 2000 Summary File 1 (SF 1)*, available at http://factfinder.census.gov/, accessed November 1, 2007 and January 24, 2008.

USCB 2000c. U.S. Census Bureau, *DP-4 Profile of Selected Housing Characteristics: 2000 Data Set: Census 2000 Summary File 3 (SF 3)*, available at http://factfinder.census.gov/, accessed January 28, 2008, February 5, 2008.

USCB 2006. U.S. Census Bureau, *T1. Population Estimates [9]. Data Set: 2006 Population Estimates*, available at http://quickfacts.census.gov/, accessed January 24, 2008.

USCB 2008. U.S. Census Bureau, *State & County Quick Facts*, available at http://quickfacts.census.gov/, accessed January 24, 2008.

USDA 2002. U.S. Department of Agriculture, *2002 Census of Agriculture: Texas State and County Profiles*, available at http://www.nass.usda.gov/census/census02/profiles/tx/index.htm, accessed November 26, 2007.

USEPA 2007. U.S. Environmental Protection Agency, *Safe Drinking Water Information System*, available at http://www.epa.gov/enviro/html/sdwis/sdwis_query.html, accessed October 30, 2007 and November 1, 2007.

USFA 2007. U.S. Fire Administration, *National Fire Department Census*, available at http://www.usfa.dhs.gov/applications/census/, accessed December 28, 2007.

USFA 2008. U.S. Fire Administration, *Firefighters*, available at http://www.usfa.dhs.gov/statistics/firefighters/index.shtm, accessed May 19, 2008.

USFWS 2008. U.S. Fish and Wildlife Service, *Official Site of the Aransas National Wildlife Refuge Complex*, available at http://www.fws.gov/southwest/refuges/texas/aransas/, accessed January 28, 2008.

USFWS May 2008. U.S. Fish and Wildlife Service, *Aransas National Wildlife Refuge visitor Statistics*, Phone call from R. Henderson-Tetra Tech to Troy Litrell-U.S. Fish and Wildlife Service on May 2008.

VA Oct 2007. Victoria Advocate, A. Miles, *Victoria Gets Two New Retailers*, October 10, 2007.

VC Oct 2007. Victoria College, *Enrollment and Accreditation*, Phone call from R. Henderson-Tetra Tech to B. Willemin-Victoria College on October 12, 2007.

VCA Jun 2007. Victoria County Auditor, *County of Victoria Texas Comprehensive Annual Financial Report Year Ended December 31, 2006*, June 19, 2007.

VCTX 2007. Victoria County, Victoria County Tax Information Online, *Victoria County Tax Info.- Public Access*, available at http://www.victoriacountytx.org/departments/tax/property.htm, accessed December 2007.

VEDC 2007a. Victoria Economic Development Corporation, *A Regional Partnership: Major Employers in the Golden Crescent Region*, available at http://www.victoriaedc.com/content/category/2/8/31, accessed October 29, 2007.

VEDC 2007b. Victoria Economic Development Corporation, *Railroads*, available at http://www.victoriaedc.com/content/category/6/35/93/, accessed November 13, 2007.

VEDC 2007c. Victoria Economic Development Corporation, *Victoria, Texas: A Community Profile*, available at http://www.victoriaedc.com/images/stories/victoria_community_profile.pdf, accessed November 2007.

VEDC Undated. Victoria Economic Development Corporation, *Victoria Barge Canal*, available at http://www.victoriaedc.com/content/view/46/91/, accessed March 10, 2008.

Victoria Nov 2001. Victoria, Texas, *Victoria 2020: Remembering the Past, Preparing for the Future*, November 26, 2001.

Victoria 2007. Victoria, Texas, City of Victoria, Texas, *Fiscal Year 2006-2007, General Fund*, available at http://www.victoriatx.org/finance/budget/General%20Fund%2007.pdf, accessed January 2008.

Victoria Jul 2007. Victoria Texas, *City of Victoria Code of Ordinances, Ordinance 2007-10, Chapter 21*, "Subdivision and Development," July 17, 2007.

Victoria May 2008. Victoria, Texas. *Park Master Plan*, E-mail from D. Cochran-City of Victoria to R. Henderson-Tetra Tech On May 22, 2008.

Victoria Undated a. Victoria, Texas, *Parks and Recreation*, available at http://victoriatx.org/pio/pdfs/parksrec.pdf, accessed March 26, 2008.

Victoria Undated b. Victoria, Texas, *Demographics: Top Ten Employers in Victoria County*, available at http://www.victoriatx.org/planning/demographics.asp, accessed October 25, 2007.

VISD Nov 2007. Victoria Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to R. Leach-Victoria ISD on November 6, 2007.

VISD Apr 2008. Victoria Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to R. Leach-Victoria ISD on April 11, 2008.

VRA Mar 2008. Victoria Regional Airport, *Information About Airport*, E-mail to K. Sutherlin-Tetra Tech from L. Blackwell-Victoria Regional Airport on March 10, 2008.

WISD Nov 2007. Westhoff Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to D. Garrison-Westhoff ISD on November 9, 2007.

WOISD Nov 2007. Woodsboro Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to B. Mundine-Woodsboro ISD on November 7, 2007.

Woodall's Undated. RV Parks, *Resorts and Campgrounds in Texas*, available at http://www.woodalls.com, accessed March 23, 2008.

YACC Undated. Yoakum Area Chamber of Commerce, *Welcome to the Yoakum Area Chamber of Commerce*, available at http://www.yoakumareachamber.com, accessed March 25, 2008.

YISD Nov 2007. Yoakum Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to C. Gasch-Yoakum ISD on November 9, 2007.

Yoakum Undated a. City of Yoakum, Businesses. *Major Employers in City of Yoakum*, available at http://www.yoakumusa.com/Businesses/businesses.html, accessed November 1, 2007.

Yoakum Undated b. City of Yoakum, *Civic Activities/Festivals*, available at www.cityofyoakum.org, accessed March 24, 2008.

YORKISD Nov 2007. Yorktown Independent School District, *Enrollment and Capacity*, Phone call from R. Henderson-Tetra Tech to D. Kneese-Yorktown ISD on November 7, 2007.

Yorktown Undated. City of Yorktown, *Yorktown, Texas*, available at http://www.yorktowntx.com/, accessed March 26, 2008.

Table 2.5.2-1
Employment Trends 1996-2006

	Labor Force			Employment			Unemployment			Unemployment Rate	
Area	**1996**	**2006**	**Average Annual Percent Change**	**1996**	**2006**	**Average Annual Percent Change**	**1996**	**2006**	**Average Annual Percent Change**	**1996**	**2006**
United States	133,943,000	151,428,000	1.2%	126,708,000	144,427,000	1.3%	7,236,000	7,001,000	–0.3%	5.4%	4.6%
Texas	9,736,646	11,487,496	1.7%	9,175,983	10,921,673	1.8%	560,663	565,823	0.1%	5.8%	4.9%
Calhoun County	9,786	9,557	–0.2%	9,059	9,084	0.0%	727	473	–4.2%	7.4%	4.9%
DeWitt County	8,094	9,617	1.7%	7,722	9,190	1.8%	372	427	1.4%	4.6%	4.4%
Goliad County	2,680	3,480	2.6%	2,549	3,337	2.7%	131	143	0.9%	4.9%	4.1%
Jackson County	9,143	6,573	–3.2%	8,808	6,266	–3.3%	335	307	–0.9%	3.7%	4.7%
Refugio County	3,009	3,827	2.4%	2,860	3,645	2.5%	149	182	2.0%	5.0%	4.8%
Victoria County	42,103	45,103	0.7%	39,934	43,244	0.8%	2,169	1,859	–1.5%	5.2%	4.1%
ROI	74,815	78,157	0.4%	70,932	74,766	0.5%	3,883	3,391	–1.3%	5.2%	4.3%
ROI as percent of Texas	0.8%	0.7%		0.8%	0.7%		0.7%	0.6%			

Source: BLS 2007a

Table 2.5.2-2 (Sheet 1 of 2)
Employment by Industry 2005

	ROI		Texas	
Summary by Major Industry Sector	**Number of Workers**	**Percent of Total**	**Number of Workers**	**Percent of Total**
Total employment	90,404	100.0%	13,088,946	100.0%
Farm Employment	6,658	7.4%	281,727	2.2%
Mining	3,665	4.1%	244,837	1.9%
Construction	7,037	7.8%	899,172	6.9%
Manufacturing	7,240	8.0%	951,778	7.3%
Wholesale Trade	2,370	2.6%	530,192	4.1%
Retail Trade	10,330	11.4%	1,417,748	10.8%
Transportation and Warehousing	1,687	1.9%	469,746	3.6%
Finance, Insurance, and Real Estate[a]	5,881	6.5%	1,156,780	8.8%
Services[b]	25,660	28.4%	5,189,665	39.6%
Federal and State Government[c]	1,789	2.0%	680,081	5.2%
Local Government	11,019	12.2%	1,147,922	8.8%
Other	7,068	7.8%	119,298	0.9%

Unit Industry	**Calhoun**	**DeWitt**	**Goliad**	**Jackson**	**Refugio**	**Victoria**	**ROI Total**	**Texas**
Total employment	12,787	12,399	3,281	7,823	3,391	50,723	90,404	13,088,946
Wage and salary employment	9,935	7,559	1,617	5,433	2,304	39,792	66,640	10,269,066
Proprietors employment	2,852	4,840	1,664	2,390	1,087	10,931	23,764	2,819,880
Farm proprietors employment	322	1,843	967	1,020	303	1,364	5,819	236,886
Nonfarm proprietors employment	2,530	2,997	697	1,370	784	9,567	17,945	2,582,994
Farm employment	409	2,001	1,076	1,273	421	1,478	6,658	281,727
Nonfarm employment	12,378	10,398	2,205	6,550	2,970	49,245	83,746	12,807,219
Private employment	10,851	8,055	1,697	5,423	2,259	42,653	70,938	10,979,216
Forestry, fishing, related activities, and other	422	(D)	(D)	185	(D)	269	876	68,253
Mining	141	234	(D)	(D)	273	3,017	3,665	244,837
Utilities	(D)	63	(D)	63	14	334	474	51,045
Construction	1,854	680	135	781	(D)	3,587	7,037	899,172

Table 2.5.2-2 (Sheet 2 of 2)
Employment by Industry 2005

Unit Industry (continued)	Calhoun	DeWitt	Goliad	Jackson	Refugio	Victoria	ROI Total	Texas
Manufacturing	3,215	1,258	85	(D)	(D)	2,682	7,240	951,778
Wholesale trade	(D)	212	91	273	42	1,752	2,370	530,192
Retail trade	1,165	1,093	208	670	351	6,843	10,330	1,417,748
Transportation and warehousing	200	179	(D)	100	50	1,158	1,687	469,746
Information	74	58	(D)	88	(D)	659	879	262,195
Finance and insurance	425	534	72	242	121	1,783	3,177	631,849
Real estate and rental and leasing	309	365	63	166	45	1,756	2,704	524,931
Professional and technical services	444	334	86	270	75	2,011	3,220	828,786
Management of companies and enterprises	(D)	(D)	0	0	0	111	111	69,896
Administrative and waste services	(D)	(D)	85	138	65	2,861	3,149	843,486
Educational services	(D)	(D)	(L)	14	(D)	538	552	178,321
Health care and social assistance	(D)	(D)	174	336	(D)	6,240	6,750	1,168,205
Arts, entertainment, and recreation	88	95	29	31	(D)	672	915	200,551
Accommodation and food services	779	479	159	(D)	(D)	3,233	4,650	879,593
Other services, except public administration	548	844	203	414	278	3,147	5,434	758,632
Government and government enterprises	1,527	2,343	508	1,127	711	6,592	12,808	1,828,003
Federal, civilian	42	43	20	34	52	242	433	181,107
Military	94	46	16	32	17	195	400	161,205
State and local	1,391	2,254	472	1,061	642	6,155	11,975	1,485,691
State government	80	506	39	45	28	258	956	337,769
Local government	1,311	1,748	433	1,016	614	5,897	11,019	1,147,922

Source: BEA 2008

(a) In summary area, "Finance, Insurance, and Real Estate" includes the following sectors: Finance and insurance, and Real estate and rental and leasing.

(b) In summary area, "Services" includes the following sectors: Information; Professional and technical services; Management of companies and enterprises; Administrative and waste services; Educational services; Health care and social assistance; Arts, entertainment, and recreation, Accommodation and food services; and Other services, except public administration.

(c) In summary area, "Federal and State Government" includes the following sectors: Federal, Civilian; Military; and State government.

Note (D): As reported by the U.S. Bureau of Economic Analysis, "not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals." For this reason, columns may not sum to the totals shown.

Note (L): Less than 10 jobs, but the estimates for this item are included in the totals.

Table 2.5.2-3
Major Employers in ROI

Employer	Owner	Type	Number	County
Victoria Independent School District	Public	Public school district	2114	Victoria
The Inteplast Group, Ltd.	Private	Chemical	1700	Calhoun
The Inteplast Group, Ltd.	Private	Plastic film	1600	Jackson
Formosa Plastics	Private	Chemical	1500	Calhoun
Citizens Medical Center	Public	Health care	1027	Victoria
DeTar Healthcare System	Private	Health care	872	Victoria
Dow Chemical – Seadrift Operations	Private	Chemical	660	Calhoun
Alcoa	Private	Chemical	630	Calhoun
County of Victoria	Public	Local government	616	Victoria
Calhoun County Independent School District	Public	Public school district	613	Calhoun
DuPont INVISTA	Private	Fiber/polymer manufacturing	610	Victoria
City of Victoria	Public	Local government	606	Victoria
Tandy Brands Accessories, Inc.	Private	Leather/hunting accessories manufacturing	578	DeWitt
Wal-Mart Supercenter	Private	Retail	468	Victoria
University of Houston - Victoria	Public	Education	436	Victoria
First Victoria National Bank	Private	Financial	425	Victoria
Cuero Community Hospital	Public	Health care	420	DeWitt
Cuero Independent School District	Public	Public school district	400	DeWitt
Covalence Plastics	Private	Plastics manufacturing	372	Victoria
King Fisher Marine Service	Private	Service	330	Calhoun
Eddy Packing	Private	Smoked meats	329	DeWitt
Texas Department of Criminal Justice	Public	Correctional facility	315	DeWitt
HEB Grocery	Private	Grocery	275	Calhoun
Mount Vernon Mills, Brentex Division	Private	Textiles	244	DeWitt
Yoakum Independent School District	Public	Public school district	235	DeWitt

Sources CCEDC Undated, CDC Jul 2006, Victoria Undated b, Yoakum Undated a, JCCC Oct 2007, TWC 2007, VEDC 2007a

Table 2.5.2-4 (Sheet 1 of 2)
Average Annual Wage Trends[a], 2001-2006, ROI and Comparison Areas

Sector/Area	2001	2002	2003	2004	2005	2006	Average Annual Growth Rate
Total, All Industry Sector Wages							
U.S.	$36,157	$36,539	$37,508	$39,134	$40,505	$42,414	3.2%
Texas	$36,794	$36,766	$37,442	$39,100	$40,880	$43,276	3.3%
Calhoun County	$42,734	$44,345	$42,654	$45,488	$47,998	$49,933	3.2%
DeWitt County	$22,244	$22,569	$22,598	$23,859	$27,807	$26,506	3.6%
Goliad County	$23,477	$24,087	$25,715	$25,779	$28,189	$29,836	4.9%
Jackson County	$26,150	$26,131	$27,114	$28,631	$28,747	$31,200	2.4%
Refugio County	$23,082	$22,842	$23,414	$24,397	$25,080	$28,754	2.1%
Victoria County	$29,235	$29,213	$29,808	$31,343	$32,032	$34,704	3.5%
Sector 23, Construction Sector Wages							
U.S.	$38,412	$39,027	$39,509	$40,521	$42,100	$44,496	4.3%
Texas	$36,145	$36,516	$37,301	$38,349	$40,565	$44,551	5.3%
Calhoun County	$34,519	$35,241	$35,198	$37,808	$38,984	$44,614	5.3%
DeWitt County	$23,585	$23,343	$24,223	$23,946	$24,696	$26,207	2.1%
Goliad County	(ND)	(ND)	$28,545	$29,668	$41,400	$51,233	[b]
Jackson County	$28,521	$27,359	$28,753	$31,595	$34,254	$35,095	4.2%
Refugio County	$24,423	$24,034	(ND)	(ND)	(ND)	(ND)	[b]
Victoria County	$42,022	$37,628	$35,786	$37,900	$40,997	$43,240	0.6%
Sector 237, Heavy and Civil Engineering Construction Sector Wages							
U.S.	$43,099	$44,298	$45,417	$47,027	$49,399	$52,617	4.1%
Texas	$38,125	$38,466	$39,905	$40,490	$43,371	$48,466	4.9%
Calhoun County	$41,347	$43,342	$40,057	$39,631	$48,382	$51,390	4.4%
DeWitt County	$32,900	$29,225	$29,194	$31,639	$33,371	$33,150	0.2%
Goliad County	(ND)	(ND)	(ND)	(ND)	(ND)	(ND)	[b]
Jackson County	$27,580	$28,761	$32,413	$32,136	(ND)	$36,709	5.9%
Refugio County	(ND)	(ND)	(ND)	$33,461	$34,401	(ND)	[b]
Victoria County	$30,756	$33,093	$33,904	$34,472	$36,172	$42,677	6.8%
Sector 22, Utilities							
U.S.	$65,561	$67,374	$68,651	$72,403	$75,208	$78,341	3.6%
Texas	$76,319	$72,674	$68,589	$72,949	$76,102	$82,032	1.5%
Calhoun County	$62,267	$61,137	$73,571	(ND)	(ND)	(ND)	[b]
DeWitt County	$41,671	(ND)	(ND)	(ND)	$44,688	$45,774	1.9%

Table 2.5.2-4 (Sheet 2 of 2)
Average Annual Wage Trends[a], 2001-2006, ROI and Comparison Areas

Sector/Area	2001	2002	2003	2004	2005	2006	Average Annual Growth Rate
Sector 22, Utilities (continued)							
Goliad County	(ND)	(ND)	(ND)	$69,166	(ND)	$70,386	[b]
Jackson County[c]	$35,546	$35,313	$39,064	$39,962	$46,524	(ND)	7.0%
Refugio County[c]	$37,221	$38,232	$58,736	$60,195	$60,938	(ND)	13.1%
Victoria County	$48,547	$52,377	$59,299	$57,463	$61,280	$62,337	5.1%
Sector 221113, Nuclear electric power generation[d]							
U.S.	$74,294	$77,076	$83,627	$89,590	$91,732	$95,927	5.2%

Source: BLS 2007b

(a) Information reflects privately owned firms and all establishment sizes. Dollars are not adjusted for inflation.
(b) Unable to calculate growth rate due to insufficient data.
(c) Average annual growth rate is from 2001 to 2005, as data are not available for 2006.
(d) Information was not disclosed by the BLS for Texas or the ROI counties for NAICS 221113.

Note: (ND) = "Not Disclosable — data do not meet BLS or State agency disclosure standards."

Table 2.5.2-5
Employment in Construction and Extraction Occupations

	Employment		
Area	**Total Employment**	**Construction and Extraction Occupations**	**Construction and Extraction as Percent of Total Employment**
Texas	9,760,960	513,910	5.3%
Victoria MSA[a]	48,020	5,390	11.2%
Victoria MSA as percent of Texas	0.5%	1.0%	

Source: BLS May 2006

(a) Victoria MSA = Victoria, Goliad, and Calhoun Counties.
Note: MSA is a U.S. Census Bureau description of a Metropolitan Statistical Area.

Table 2.5.2-6
Per Capita Personal Income 1995-2005

Area	1995	2005	1995–2005 Percent Change Not Adjusted for Inflation	1995–2005 Percent Change Adjusted for Inflation[a]	2005 PCI as Percent of Texas	2005 PCI as Percent of U.S.
United States	$23,076	$34,471	49.4%	16.6%	106.2%	100.0%
Texas	$21,003	$32,460	54.5%	20.6%	100.0%	94.2%
Calhoun	$17,312	$24,561	41.9%	10.7%	75.7%	71.3%
DeWitt	$15,641	$24,281	55.2%	21.1%	74.8%	70.4%
Goliad	$14,794	$23,353	57.9%	23.2%	71.9%	67.7%
Jackson	$20,412	$23,743	16.3%	–9.2%	73.1%	68.9%
Refugio	$21,487	$29,195	35.9%	6.0%	89.9%	84.7%
Victoria	$20,441	$30,667	50.0%	17.1%	94.5%	89.0%
ROI	$19,185	$27,983	45.9%	13.8%	86.2%	81.2%

Sources: BEA 2008, BLS 2007c

(a) Inflation calculator from Bureau of Labor Statistics (BLS 2007c).

Table 2.5.2-7 (Sheet 1 of 2)
Road Characteristics and Traffic Statistics

Location Number on Figure 2.5.2-5	Route Segment	Number of Lanes	Type	TXDOT Road Classification	Avg Annual Daily Traffic for 2007 (vehicles per 24-hour)	Threshold Capacity (passenger cars per hour)[a]
1	Hwy 59 (From Beeville to Berclair)	2[b]	Undivided	Other Rural Principal Arterial	5,800	4,200[c]
2	Hwy 59 (From Berclair to Goliad)	2[b]	Undivided	Other Rural Principal Arterial	4,800	4,200[c]
3	Hwy 59 (From Goliad to Victoria County Line)	4	Undivided	Other Rural Principal Arterial	10,100	10,300[c]
4	Hwy 59 to Hwy 77(via Hwy 59 loop south of Victoria)	4	Divided	Other Rural Principal Arterial	6,100	11,800[c]
5	Hwy 77 S to Hwy 77 (intersection of Hwy 59 and Hwy 77)	4	Undivided	Rural Major Arterial	1,850	27,000
6	Hwy 59 loop to Hwy 87	4	Divided	Other Rural Principal Arterial	19,900	11,800[c]
7	Hwy 87 (south from Victoria to Placedo)	4	Divided	Rural Minor Arterial	9,700	11,800[c]
8	Hwy 87 (south from Placedo to State Route 35)	4	Divided	Rural Minor Arterial	7,800	11,800[c]
9	State Route 185 (south from Victoria to Bloomington)	2	Undivided	Rural Major Collector	26,000	2,300
10	State Route 185 (Bloomington to State Route 35)	2	Undivided	Rural Major Collector	5,100	2,300
11	County Road 616 (LaSalle to Placedo)	2	Undivided	Rural Major Collector	600	2,300
12	County Road 616 (Placedo to Bloomington	2	Undivided	Rural Major Collector	900	2,300
13	State Route 35 (Port Lavaca to Green Lake)	2	Undivided	Rural Minor Arterial	5,000	4,200[c]
14	State Route 35 (State Route 185 to Refugio County Line)	2	Undivided	Rural Minor Arterial	3,100	4,200[c]
15	State Route 35 (from Refugio County line to County Road 774)	2	Undivided	Rural Minor Arterial	4,000	4,200[c]
16	State Route 239 (Tivoli to Hwy 77)	2	Undivided	Rural Major Collector	3,300	2,300
17	Hwy 77 (Hwy 59 loop south to Refugio County Line)	4	Divided	Other Rural Principal Arterial	16,300	11,800[c]
18	Hwy 77 (Refugio County line south to Refugio)	4	Divided	Other Rural Principal Arterial	16,000	11,800[c]
19	State Route 239 (Hwy 77 to Goliad)	2	Undivided	Rural Major Collector	720	2,300

Table 2.5.2-7 (Sheet 2 of 2)
Road Characteristics and Traffic Statistics

Location Number on Figure 2.5.2-5	Route Segment	Number of Lanes	Type	TXDOT Road Classification	Avg Annual Daily Traffic for 2007 (vehicles per 24-hour)	Threshold Capacity (passenger cars per hour)[(a)]
20	State Route 202 (Refugio to County Road 2441)	2	Undivided	Rural Major Collector	1,150	2,300
21	State Route 202 (County Road 2441 to Beeville)	2	Undivided	Rural Major Collector	4,100	2,300

Sources: TXDOT Sep 2007a, TXDOT Sep 2007b, TXDOT Sep 2007c, TXDOT Sep 2007d, TXDOT Sep 2007e, TXDOT Mar 1993a, TXDOT Mar 1993b, TXDOT Dec 1998a, TXDOT Dec 1998b, TXDOT Sep 2001, TXDOT Mar 2008

(a) Capacity used in travel demand modeling by TXDOT, metropolitan planning organizations, and local governments. The capacity is typically based on level of service C (stable flow) based on the Transportation Research Board Highway Capacity Manual. Level of service A or B (free flow to reasonably free flow) may also be used as the threshold capacity level in less congested urban areas (TXDOT Sep 2001)

(b) Just completed "Super 2" passing lanes.

(c) TXDOT does not provide a threshold capacity for these functional classes in rural areas. The suburban fringe area estimate was used to approximate rural areas.

Table 2.5.2-8
Victoria Barge Canal, Number of Trips, 2001-2005

Year	Inbound	Outbound	Total	Average per week
2001	3863	3886	7749	149
2002	4058	4057	8115	156
2003	3770	3846	7616	146
2004	3258	3229	6487	125
2005	2576	2599	5175	100

Sources: USACE 2001, USACE 2002, USACE 2003, USACE 2004, USACE 2005

Table 2.5.2-9
Victoria Barge Canal Docks

Name	Location	Town (County)	Mile	Bank	Owner
Dow Seadrift Operations Slip	At head of private channel extending east from Mile 14.3 Victoria Barge Canal, approx. 3 miles below SR 35 Bridge, Seadrift	Seadrift (Calhoun)	14	East	Union Carbide Corp., a subsidiary of The Dow Chemical Co.
Seadrift Coke, Hydrocarbon Dock	Mile 15.6 Victoria Barge Canal, approximately 1.5 miles below SR 35 Bridge, Seadrift	Seadrift (Calhoun)	15	East	Seadrift Coke, LP
Seadrift Coke, Coke Loading Dock	Mile 15.6, Victoria Barge Canal, approximately 1.5 miles below SR 35 Bridge, Seadrift	Seadrift (Calhoun)	15	East	Seadrift Coke, LP
BP Chemicals Corp., Green Lake Plant Wharf	Mile 20.6, Victoria Barge Canal, approximately 3.5 miles above SR 35 Bridge, Green Lake	Green Lake (Calhoun)	20	East	BP Chemicals Corp
DuPont INVISTA Victoria Plant, Petrochemical Division, Dock No. 6	Mile 32.9, Victoria Barge Canal, lower portion of rectangular slip; approximately 2 miles below Pickering Turning Basin, Bloomington	Bloomington (Victoria)	32	East	DuPont INVISTA
DuPont INVISTA Victoria Plant, Petrochemical Division, Dock No. 5	Mile 32.9, Victoria Barge Canal, lower portion of rectangular slip; approximately 2 miles below Pickering Turning Basin, Bloomington	Bloomington (Victoria)	32	East	DuPont INVISTA
DuPont INVISTA Victoria Plant, Petrochemical Division, Dock No. 3	Mile 32.9, Victoria Barge Canal, lower portion of rectangular slip; approximately 2 miles below Pickering Turning Basin, Bloomington	Bloomington (Victoria)	32	East	DuPont INVISTA
DuPont INVISTA Victoria Plant, Petrochemical Division, Dock No. 1	Mile 33.0, Victoria Barge Canal, lower portion of rectangular slip; approximately 2 miles below Pickering Turning Basin, Bloomington.	Bloomington (Victoria)	33	East	DuPont INVISTA
Fordyce, Parker Dock	Mile 34.7, Victoria Barge Canal, below Pickering Turning Basin, Bloomington	Bloomington (Victoria)	34	East	Fordyce, Ltd.
Fordyce, Briggs Dock	Mile 35.0, Victoria Barge Canal, northeast portion of Pickering Turning Basin, Bloomington	Bloomington (Victoria)	35	North	Fordyce, Ltd.
Victoria County Navigation District, Barge Dock	Mile 35.0, Victoria Barge Canal, northwest portion of Pickering Turning Basin, Bloomington	Bloomington (Victoria)	35	North	Victoria Co. Navigation District

Source: USACE 2008a

Table 2.5.2-10
Port of Victoria, Freight Tonnage, 1992-2006

Year	Thousands of Short Tons	Rank Among U.S. Ports
1992	4265	—
1993	3937	—
1994	4567	—
1995	4624	—
1996	4351	—
1997	5000	—
1998	5298	—
1999	5522	—
2000	5104	—
2001	4733	—
2002	4734	77
2003	4750	81
2004	3712	91
2005	3224	98
2006	3556	96

Sources: USACE 2001, USACE 2002, USACE 2003,
USACE 2004, USACE 2005, USACE 2008b

Table 2.5.2-11
Characteristics of Public Airports within or near 50 Miles of Proposed VCS Site

Name (FAA Designation)	Location	Owner	Average Daily Operations	Number of Aircraft Based at Field	Military Use	Commercial Passenger Service
Aransas County Airport (KRKP)	Rockport, Aransas County	Aransas County	225	70	40%	No
Calhoun County Airport (KPKV)	Port Lavaca, Calhoun County	Calhoun County	18	18	23%	No
Jackson County Airport (26R)	Edna, Jackson County	Jackson County	106	18	2%	No
Yoakum Municipal (T85)	Lavaca County	City of Yoakum	3.3	4	—	No
Palacios Municipal (KPSX)	Palacios, Matagorda County	City of Palacios	8.1	5	49%	No
Rooke Field (KRFG)	City of Refugio, Refugio County	Refugio County	12.3	21	—	No
Victoria Regional (VCT)	City of Victoria, Victoria County	Victoria County	111	50	44%	Yes
T. P. McCampbell (KTFP)	Ingleside, San Patricio County	San Patricio County	30	37	—	No
Beeville Municipal Airport (KBEA)	Beeville, Bee County	City of Beeville	13	15	—	No
Goliad County Industrial Airpark (7T3)	Berclair, Goliad County	Goliad County	Not Available	2	—	No
Cuero Municipal Airport (T71)	Cuero, DeWitt County	City of Cuero	5	6	—	No
Alfred C. "Bubba" Thomas Airport (T69)	Sinton, San Patricio County	San Patricio County	28	39	—	No
Kames County Airport (2R9)	Kenedy, Karnes County	City of Kenedy	6	7	—	No

Sources: AN Feb 2008a, AN Feb 2008b, AN Feb 2008c, AN Feb 2008d, AN Feb 2008e, AN Feb 2008f, AN Feb 2008g, AN Jul 2008a, AN Jul 2008b, AN Jul 2008c, AN Jul 2008d, AN Jul 2008e, AN Jul 2008f, TXDOT 2007

Table 2.5.2-12
Victoria Regional Airport Passenger Boardings, 2001–2006

Year	Total Passenger Boardings
2001	15,638
2002	13,758
2003	11,853
2004	10,763
2005	10,932
2006	9,113
Percent Change, 2001–2006	–41.7%

Table 2.5.2-13
Texas State Expenditures in ROI Counties, 2006

Area	Total	Intergovernmental Payments	Labor Costs	Public Assistance	Highway Construction/ Maintenance	Operating Expenses	Capital Outlays	Misc.
Texas Total	$71,542,126,874	$19,356,701,100	$17,479,332,269	$24,189,679,738	$5,574,037,267	$1,757,367,816	$311,885,587	$2,873,123,097
Calhoun County	49,731,763	8,001,686	7,527,359	16,973,826	13,695,354	938,913	1,476,981	1,117,643
DeWitt County	73,531,924	28,366,284	10,111,328	22,693,439	10,687,138	1,526,465	0	147,270
Goliad County	34,227,763	4,120,994	6,467,162	5,786,077	16,756,016	969,131	0	128,385
Jackson County	33,920,498	10,582,716	2,385,020	11,686,702	5,997,933	561,157	21,803	2,685,168
Refugio County	23,178,337	5,131,056	4,112,508	8,147,255	5,187,484	375,332	0	224,700
Victoria County	255,328,884	72,566,221	40,585,476	114,971,104	15,232,342	3,820,748	1,645,286	6,507,706
ROI Total	$469,919,169	$128,768,957	$71,188,853	$180,258,403	$67,556,267	$8,191,746	$3,144,070	$10,810,872
ROI as Percent of State Total	0.7%	0.7%	0.4%	0.7%	1.2%	0.5%	1.0%	0.4%
Percent by Category		27.4%	15.1%	38.4%	14.4%	1.7%	0.7%	2.3%

Source: TCPA 2007

Table 2.5.2-14
County and City Sales Tax Rates ROI 2008

Taxing Unit[a]	Tax Rates			
	State	County	City	Total
Calhoun County	6.25%	0.5%	—	6.75%
Port Lavaca	6.25%	0.5%	1.5%	8.25%
Seadrift	6.25%	0.5%	1.5%	8.25%
DeWitt County	6.25%	—	—	6.25%
Cuero	6.25%	—	2.0%	8.25%
Nordheim	6.25%	—	1.0%	7.25%
Yoakum	6.25%	—	2.0%	8.25%
Yorktown	6.25%	—	1.5%	7.75%
Goliad County	6.25%	—	—	6.25%
Goliad (city)	6.25%	—	2.0%	8.25%
Jackson County	6.25%	0.5%	—	6.75%
Edna	6.25%	0.5%	1.5%	8.25%
Ganado	6.25%	0.5%	1.5%	8.25%
LaWard	6.25%	0.5%	1.0%	7.75%
Refugio County	6.25%	—	—	6.25%
Austwell	6.25%	—	1.0%	7.25%
Bayside	6.25%	—	1.0%	7.25%
Refugio (city)	6.25%	—	2.0%	8.25%
Woodsboro	6.25%	—	1.0%	7.25%
Victoria County	6.25%	0.5%	—	6.75%
Victoria (city)	6.25%	0.5%	1.5%	8.25%

Source: TCPA 2008d

(a) Only communities with a local sales tax are shown in the table.
Note: — Entity does not tax

Table 2.5.2-15
Total Real Property Tax Rates ROI Counties 2000 - 2006[a]

County	2000	2001	2002	2003	2004	2005	2006
Calhoun County	0.3750	0.3750	0.4244	0.5210	0.5210	0.5210	0.4900
DeWitt County	0.5466	0.5272	0.6072	0.6823	0.6930	0.6317	0.7224
Goliad County	0.7645	0.6840	0.7820	0.7840	0.6847	0.6671	0.5554
Jackson County	0.5450	0.5076	0.6186	0.6186	0.6334	0.6233	0.5387
Refugio County	0.6277	0.6169	0.6386	0.6218	0.5375	0.4625	0.3998
Victoria County	0.3410	0.3485	0.3601	0.3986	0.3986	0.3986	0.3986

Source: TAOC 2007a

(a) Property tax rates shown as dollars per $100 of taxable value.

Table 2.5.2-16
Total Real Property Taxes, Victoria County 2001-2006

	Total Market Value		Total Taxable Value	Total Levies	
	With Exempt[a]	Without Exempt[b]	General Fund[c]	General Fund Levy[d]	Total County Levy[e]
2000	$4,057,724,176	$3,842,560,406	$3,324,392,653	$9,507,762	$11,336,177
2001	4,218,514,902	3,985,262,147	3,528,394,928	10,708,678	12,296,455
2002	4,263,350,440	4,019,870,328	3,555,123,916	11,379,951	12,802,000
2003	4,301,873,415	4,053,129,665	3,548,119,389	12,546,150	14,142,803
2004	4,519,428,703	4,266,076,342	3,707,127,542	13,108,403	14,776,610
2005	4,745,388,483	4,485,528,573	3,941,782,441	13,741,054	15,711,945
2006	5,515,968,648	5,245,209,808	4,237,939,605	14,561,561	16,892,428

Source: TAOC 2007b

(a) Total Market Value, With Exempt: Total market value before 10% cap on homestead appraisals. Includes the value of all totally exempt properties.

(b) Total Market Value, Without Exempt: Total market value of taxable property prior to adjustments for partial exemptions or the 10% cap on residence homesteads. Does not include totally exempt properties.

(c) Total Taxable Value, General Fund: Total taxable value for county tax purposes. Used with both the General Fund and Special Road & Bridge Fund tax rates to determine the levies for those funds.

(d) Totals, General Fund Levy: Actual total county tax levy for General Fund.

(e) Totals, Total County Levy: Actual total county tax levy. It includes the General Fund, Special Road & Bridge Fund, and the Farm-to-Market/Flood Control Fund.

Table 2.5.2-17
Real Property Taxes for Cities in the ROI 2005

County/City	Percent Homestead Exemption	Taxable Value	Tax Rate[(a)]	2005 Tax Levy
Calhoun County				
Point Comfort	20%	$56,717,894	0.5429	$307,921
Port Lavaca	0%	354,308,927	0.7200	2,551,024
Seadrift	20%	32,453,573	0.4154	134,812
DeWitt County				
Cuero	0%	$170,989,570	0.2883	$493,031
Nordheim	0%	5,100,640	0.4600	23,463
Yoakum	0%	161,288,980	0.0942	151,950
Yorktown	0%	42,420,970	0.5591	237,171
Goliad County				
Goliad [City]	0%	$48,381,542	0.5271	$255,020
Jackson County				
Edna	0%	$137,590,564	0.3885	$534,539
Ganado	0%	47,797,512	0.6308	301,507
Refugio County				
Austwell	0%	$3,715,950	0.4931	$18,324
Bayside	0%	8,319,410	0.9215	76,664
Refugio [City]	0%	56,685,520	0.7966	451,557
Woodsboro	0%	22,551,860	0.8620	194,937
Victoria County				
Victoria [City]	0%	$2,337,399,369	0.6900	$16,128,056

Source: TCPA Dec 2006

(a) Tax Rates are shown as dollars per $100 of taxable value.

Table 2.5.2-18 (Sheet 1 of 2)
Special Taxing Districts in ROI 2005

County/Special District	Market Value	Taxable Value	Total Tax Rate[(a)]	Tax Levy
Calhoun County				
Port O'Connor MUD	$200,221,578	$184,462,966	0.20000	$368,926
Calhoun County Drainage District #6	4,838,632	4,520,810	0.52600	2378
Calhoun County Navigation District	2,897,120,880	2,041,437,408	0.00430	87,781
Calhoun County WCID #1	536,254,010	527,847,463	0.04260	224,863
Calhoun County Drainage District #11	9,643,986	9,639,954	0.14850	14,315
Calhoun County Drainage District #10	63,326,170	63,006,483	0.24500	154,366
Calhoun County Drainage District	6,495,539	6,489,909	0.29050	18,853
DeWitt County				
Pecan Valley Water District	$1,305,635,170	$775,112,660	0.01500	$116,281
DeWitt Drainage District #1	184,732,670	168,724,110	0.06135	103,512
DeWitt Medical District #1	687,494,230	419,497,670	0.11899	499,163
Yoakum Hospital District	281,300,920	162,407,740	0.22000	357,324
Ecleto Creek Watershed District	8,081,200	1,218,810	0.00960	117
Goliad County				
San Antonio River Authority	$1,195,937,653	$738,686,310	0.016425	$121,329
Goliad County Ground WCD	1,195,937,653	724,800,977	0.0098	71,031
Jackson County				
Jackson County FCD	$1,313,816,862	$928,709,959	0.1054	$978,860
Jackson County WCID #1	11,535,160	10,498,922	0.1416	14,866
Jackson County ESD	527,303,050	441,118,378	0.0298	131,453
Jackson County Hospital District	1,333,000,040	991,416,449	0.2661	2,638,159
Jackson County WCID #2	5,967,843	5,780,087	0.02396	13,849
Refugio County				
Refugio Ground WCD	$1,183,857,000	$979,942,630	0.0200	$195,982
Refugio County Drainage District #1	528,808,460	471,897,210	0.0837	394,978
Refugio Co Memorial Hospital District	1,183,857,000	979,942,630	0.2475	2,425,366
Refugio County WCID #1	6,494,990	6,387,000	0.5222	33,353
Refugio County WCID #2	1,177,362,010	974,543,200	0.0012	11,691
Victoria County				
Quail Creek MUD	$52,777,170	$52,039,202	0.1840	$99,752
Victoria County WCID #1	27,186,829	26,052,492	0.4947	128,882
Victoria County Drainage District #2	102,620,393	90,090,457	0.1240	111,712
Victoria Junior College District	4,761,445,489	3,954,923,444	0.1416	5,600,173
Victoria County Navigation District	4,501,408,692	4,060,836,063	0.0369	1,498,449
Victoria County WCID #2	10,089,981	10,014,909	0.9016	90,294

Table 2.5.2-18 (Sheet 2 of 2)
Special Taxing Districts in ROI 2005

County/Special District	Market Value	Taxable Value	Total Tax Rate[(a)]	Tax Levy
Victoria County (continued)				
Victoria County Drainage District #3	1,146,102,044	1,093,018,647	0.046	502,789

Source: TCPA Dec 2006

(a) Tax Rates are shown as dollars per $100 of taxable value.

Table 2.5.2-19
Proposed VCS Site, Parcels and Assessed Value 2007

Parcel ID	Acreage[(a)]	Total Taxable Value, 2007	Property Location	ISD
R29444	4,007	$298,320	McFaddin Rail Rd	Refugio ISD
R31903	364	29,070	US Hwy 77	Victoria ISD
R32186	2,600	178,040	US Hwy 77	Refugio ISD
R32742	4,397	329,780	McFaddin Rail Rd	Refugio ISD
R34801	215	15,760	McFaddin Rail Rd	Refugio ISD
R36939	13	960	McFaddin Rail Rd	Victoria ISD
R36987[(b)]	17	26,200	US Hwy 77	Refugio ISD
R37008	58	4,340	US Hwy 77	Refugio ISD
R81237	8	600	McFaddin Rail Rd	Refugio ISD
R81437	162	12,120	McFaddin Rail Rd	Refugio ISD
R81480	30	2,230	McFaddin Rail Rd	Refugio ISD
Total	11,870	$897,420		

Source: VCTX 2007

(a) Values are based on tax records and do not sum to exactly match the surveyed acreage.
(b) This 17-acre parcel lies partially within the VCS site. It is counted as wholly within the site for this analysis.

Table 2.5.2-20
Total Property Taxes on Proposed VCS Site, Victoria County and Special Districts: 2006–2007

Taxing Entity/Year		Assessed	Taxable	Rate	Tax
County of Victoria General Fund					
	2007	$17,794,640	$897,420	0.3436	$3084
	2006	$17,794,640	$897,420	0.3436	$3084
County of Victoria Special Road and Bridge Fund					
	2007	$17,794,640	$897,420	0.0550	$494
	2006	$17,794,640	$897,420	0.0550	$494
Victoria Junior College District					
	2007	$17,794,640	$897,420	0.1445	$1297
	2006	$17,794,640	$897,420	0.1416	$1271
Victoria County Navigation District					
	2007	$17,794,640	$897,420	0.0317	$284
	2006	$17,794,640	$897,420	0.0335	$301
UWD Victoria County Groundwater District					
	2007	$17,794,640	$897,420	0.0100	$90
	2006	$17,794,640	$897,420	0.0100	$90
2007 Total					$5248
2006 Total					$5238
2006 Payment, as Percent of Victoria County's Total 2006 Tax Revenues = 0.03%					

Source: VCTX 2007
Note: Data before 2006 is not available.

Table 2.5.2-21
Refugio ISD Property Values 2001–2007

Year	Total Property Value	Percent Change from Previous Year
2001	$439,463,325	—
2002	292,697,938	–33.4%
2003	310,933,757	6.2%
2004	387,192,158	24.5%
2005	414,065,232	6.9%
2006	483,358,975	16.7%
2007	480,471,469	–0.6%

Source: RISD Feb 2008

Table 2.5.2-22
Refugio ISD District Revenues 2001–2002 to 2007–2008 School Years

School Year	Total District Revenue	Excess Percent (Goes to State)[(a)]	Revenue Remaining in District	Percent Change in Total Revenue from Previous Year
2001–2002	$5,285,864	0.00%	$5,285,864	
2002–2003	4,258,754	0.00%	4,258,754	–19.4%
2003–2004	4,524,086	0.00%	4,524,086	6.2%
2004–2005	5,445,857	0.00%	5,445,857	20.4%
2005–2006	5,863,991	0.00%	5,863,991	7.7%
2006–2007	6,359,442	0.00%	6,359,442	8.4%
2007–2008	4,846,993	6.62%	4,526,286	–23.8%

Source: RISD Feb 2008

(a) Refugio ISD became a Chapter 41 (“property-wealthy”) district in the 2007–2008 school year.

Table 2.5.2-23
ISD Property Taxes Paid on Proposed VCS Site ISDs 2006–2007

Taxing Entity/Year	Assessed	Taxable	Rate[a]	Tax
Refugio ISD (9 of 11 parcels)				
2007	$17,239,110	$867,390	1.1875	$10,300
Pct of Refugio ISD revenues				0.23%
2006	$17,239,110	$867,390	1.4396	$12,487
Pct of Refugio ISD revenues				0.20%
Victoria ISD (2 of 11 parcels)				
2007	$555,530	$30,030	1.2337	$370
2006	$555,530	$30,030	1.4285	$429

(a) Tax rates are shown as dollars per $100 of taxable value.

Table 2.5.2-24
Victoria County Revenues 2006

Revenues	Actual Dollars	Percent of Total
Taxes — ad valorem (property)	12,469,394	—
Taxes — Sales	6,980,525	—
Total Taxes	$19,449,919	67.3%
Fees	1,868,725	6.5%
Intergovernmental	4,425,115	15.3%
Fines & forfeitures	1,543,819	5.3%
Interest	807,628	2.8%
Licenses & permits	36,065	0.1%
Contributions	5,884	0.0%
Miscellaneous	760,805	2.6%
Total	$28,897,960	100.0%

Source: VCA Jun 2007

Table 2.5.2-25 (Sheet 1 of 2)
Victoria County Expenditures 2006

Expenditure Item	Actual Amounts	Subtotal	Percent of Total
General Government			
County Judge	$186,987	—	—
Commissioners' Court	81,125	—	—
Records management	20,926	—	—
County clerk	551,006	—	—
Veterans Service officer	50,592	—	—
Heritage Director	50,623	—	—
Non-departmental	2,153,247	—	—
County courts at law (two)	434,557	—	—
District court	779,513	—	—
District clerk	578,485	—	—
Justices of the peace (four)	604,621	—	—
Criminal district attorney	862,640	—	—
Election administrator	243,077	—	—
County auditor	388,340	—	—
County treasurer	249,038	—	—
Tax assessor-collector	602,600	—	—
Administrative services	211,493	—	—
Information technology	2,137,276	—	—
Building maintenance	1,198,943	—	—
Adult probation department	7960	—	—
Juvenile detention facility	2,699,441	—	—
Juvenile board	90,935	—	—
Total general government		$14,183,425	54.0%
Public Safety			
Fire marshal	303,581	—	—
Sheriff	9,664,983	—	—
Constables (four)	117,916	—	—
Non-departmental	428,984	—	—
Total public safety		10,515,464	40.1%
Culture and Recreation			
Parks and recreation	106,151	—	—
Extension service	254,541	—	—
Non-departmental (library)	932,307	—	—
Total culture and recreation		1,292,999	4.9%
Public health – Total		107,761	0.4%

Table 2.5.2-25 (Sheet 2 of 2)
Victoria County Expenditures 2006

Expenditure Item	Actual Amounts	Subtotal	Percent of Total
Culture and Recreation (continued)			
Capital outlay		155,250	0.6%
Total expenditures		$26,254,899	5.9%

Source: VCA Jun 2007

Table 2.5.2-26
Recap of Victoria County Revenues and Expenditures, 2006

Item	Amount	Difference
Total Revenues[(a)]	$28,897,960	
Total Expenditures[(b)]	26,254,899	
Surplus		$2,643,061

Source: VCA Jun 2007

(a) Table 2.5.2-24
(b) Table 2.5.2-25

Table 2.5.2-27
Sales Tax Allocations, Victoria County 1997–2007

	Not Adjusted for Inflation		Adjusted for Inflation[(a)]	
Year	Sales Tax Allocations (nominal dollars)	Percent Change from Previous Year	Sales Tax Allocations (2007 dollars)	Percent Change from Previous Year
1997	$4,074,421.63	—	$5,263,543.96	—
1998	4,382,895.57	7.6%	5,575,205.05	5.9%
1999	4,503,100.82	2.7%	5,604,333.54	0.5%
2000	4,729,825.28	5.0%	5,695,072.20	1.6%
2001	4,992,319.53	5.5%	5,844,819.95	4.3%
2002	4,858,298.12	–2.7%	5,599,384.24	–4.2%
2003	4,921,322.62	1.3%	5,474,615.35	–2.2%
2004	5,546,860.42	12.7%	6,088,391.39	11.2%
2005	5,883,458.11	6.1%	6,246,226.06	2.6%
2006	6,918,442.97	17.6%	7,115,495.05	13.9%
2007	7,179,369.90	3.8%	7,179,369.90	0.9%
10-yr increase	76.2%		36.4%	
Average annual increase	5.8%		3.2%	

Source: TCPA 2008g

(a) Inflation calculator from BLS 2007c (dollars converted to 2007 dollars).

Table 2.5.2-28
City of Victoria Budgeted Revenues, FY 2006–2007

Function	Budgeted Amount	Percent of Total
Taxes	$23,853,036	62.7%
Franchise Fees	4,625,000	12.2%
Fines and Forfeitures	1,270,000	3.3%
Licenses and Permits	539,825	1.4%
Charges for Services	1,545,100	4.1%
Intergovernmental	2,217,493	5.8%
Miscellaneous	659,925	1.7%
Other Financing Sources	3,324,989	8.7%
Total	$38,035,368	100.0%

Table 2.5.2-29
City of Victoria Budgeted Expenditures FY 2006-2007

Function	Amount	Percent of Total
General Administration	$2,406,974	6.4%
Public Safety	19,666,245	52.1%
Development	8,892,393	23.6%
Building Services	669,359	1.8%
Recreation	4,768,563	12.6%
Non-departmental	1,348,234	3.6%
Total	$37,751,768	100.0%

Source: Victoria 2007

Table 2.5.2-30
Recap of City of Victoria Revenues and Expenditures FY 2006

Item	Amount	Difference
Total Budgeted Revenues[a]	$38,035,368	
Total Budgeted Expenditures[b]	37,751,768	
Surplus		$283,600

Source: Victoria 2007

(a) Table 2.5.2-28
(b) Table 2.5.2-29

**Table 2.5.2-31
Sales Taxes, City of Victoria 1997–2007**

Year	Sales Tax Allocations (current dollars)	Percent Change from Previous Year	Sales Tax[(a)] Allocations (2007 dollars)	Percent Change from Previous Year
1997	$11,537,600	—	$14,905,000	—
1998	12,371,500	5.6%	15,737,600	5.6%
1999	12,963,800	2.5%	16,134,300	2.5%
2000	13,462,500	0.5%	16,209,300	0.5%
2001	14,576,000	5.8%	17,065,000	5.8%
2002	13,953,100	–5.8%	16,081,000	–5.8%
2003	14,271,500	0.0%	16,082,500	0.0%
2004	15,285,300	4.3%	16,777,300	4.3%
2005	16,590,100	5.0%	17,612,900	5.0%
2006	18,696,700	9.2%	19,229,500	9.2%
2007	19,615,200	2.0%	19,615,200	2.0%
10-yr increase	70.0%		31.6%	
Average annual increase	5.5%		2.8%	

Source: TCPA 2008g

(a) Inflation calculator: BLS 2007c (dollars converted to 2007 dollars).

Table 2.5.2-32
Wildlife Management Areas, National Wildlife Refuges, and State Parks within 50 Miles of the VCS Site[(a)]

Name	Acreage	Location	Annual Visitors	Peak Daily Visitors
Matagorda Island WMA[(b),(c)]	56,688	Calhoun County	1,100	—
Guadalupe Delta WMA[(b)]	7,411	Northeast of Tivoli in Victoria, Refugio, and Calhoun Counties	3,500	—
Welder Flats WMA[(b),(d)]	1,480	Southeast of Seadrift in Calhoun County	—	—
Aransas National Wildlife Refuge	115,670	Aransas, Refugio, and Calhoun Counties (some areas non-contiguous, see Figure 2.5.2-14)	65,000	600
Goliad State Park[(e)]	188	South of Goliad in Goliad County	23,973	412
Goose Island State Park[(e)]	321	North of Rockport in Aransas County	90,033	2,405
Lake Texana State Park[(e)]	575	East of Edna in central Jackson County	48,821	560
Fannin Battleground State Historic Site[(f)]	14	Goliad County	—[(g)]	—

Sources: TPWD May 2008a, TPWD May 2008b USFWS 2008, USFWS May 2008

(a) TPWD acknowledges that there is a basic lack of user and nonuser information on local and state parks.
(b) Visitor information has not been collected since 2004 at WMAs. Data listed is for 2004.
(c) Matagorda Island WMA is partially owned by the General Land Office and Fish and Wildlife Services, thus not all visitors are counted. Visitors listed were counted by TPWD.
(d) Information is not available for Welder Flats WMA since it is submerged
(e) Visitor information is for the fiscal year 2007.
(f) Fannin Battleground State Historic Site is a historic site operated by the Texas Historical Commission.
(g) TPWD stated that visitor information is included in Goliad State Park due to close proximity.

Table 2.5.2-33 (Sheet 1 of 3)
County and City Parks within or near the 50-Mile Region[a]

Name	Location	Acres	Recommended Park Acres/ Population
Community Park	Aransas County	—	—
Newbury Park	Aransas County	—	—
Rockport Beach Park	Aransas County	44.0	14.5/1000
Community Aquatic and Skate Park	Aransas County	12.3	14.5/1000
Magnolia Park	Aransas County	1.9	Variable
Mathis Park	Aransas County	1.0	1.25/1000
Memorial Park	Aransas County	52.0	14.5/1000
Spencer Park	Aransas County	0.7	1.25/1000
Triangle Park	Aransas County	0.4	0.35/1000
Tule Park	Aransas County	2.0	1.25/1000
Wetland Park	Aransas County	5.0	Variable
Zachary Taylor Park	Aransas County	0.5	0.35/1000
Veterans Park	Bee County	—	—
Koehler Park	Bee County	—	—
Klipstein Park	Bee County	—	—
Flournoy Park	Bee County	—	—
Poesta Park	Bee County	—	—
Trevino Park	Bee County	—	—
Carlos Reyes Park	Bee County	—	—
Moore Park	Bee County	—	—
Martin Luther King Park/City Pool	Bee County	—	—
Lighthouse Beach and Bird Sanctuary	Calhoun County	—	—
Formosa Wetlands Walkway and Alcoa Bird Tower	Calhoun County	—	—
Port O'Connor Kingfisher Beach and Park	Calhoun County	—	—
Pier Park	Calhoun County	0.68	10/1000
Tilley Park	Calhoun County	10.1	10/1000
Wilson Park	Calhoun County	101.9	10/1000
George Adams Park	Calhoun County	1.68	10/1000
Bayfront Park	Calhoun County	41.3	10/1000
Old City Hall Park	Calhoun County	—	10/1000
Sulton Park	Calhoun County	3.6	10/1000
Little Chocolate Bayou Park and Community Garden	Calhoun County	41.0	10/1000
Bauer Community Center	Calhoun County	4.5	10/1000

Table 2.5.2-33 (Sheet 2 of 3)
County and City Parks within or near the 50-Mile Region[(a)]

Name	Location	Acres	Recommended Park Acres/ Population
Swan Point Park	Calhoun County	—	—
Cuero Municipal Park	DeWitt County	—	—
Daule Park	DeWitt County	—	—
Alexander Park	DeWitt County	—	—
Municipal Park	DeWitt County	—	—
Hub City RV Park	DeWitt County	—	—
Mack Jamison Park	DeWitt County	—	—
Centennial Park	DeWitt County	—	—
Coleto Creek Park and Reservoir	Goliad County	190	4000 visitors per day
Fannin Plaza	Goliad County	—	—
Brackenridge Plantation Park and Campground	Jackson County	—	—
Shady Oaks RV Resort	Jackson County	—	—
Bennet Park	Jackson County	—	—
Devers Creek Park	Jackson County	—	—
Shelby Park	Jackson County	—	—
East Bay Park	Matagorda County	7.35	10/1000
South Bay Park	Matagorda County	18.35	10/1000
Downtown Park	Matagorda County	1.50	10/1000
Railroad Park	Matagorda County	29.19	10/1000
Rorem Street Park	Matagorda County	1.65	10/1000
Texas Street Park	Matagorda County	2.89	10/1000
Swimming Pool	Matagorda County	1.28	1/20000
Golf Course — 9 holes	Matagorda County	103.60	1/25000
Foley Reserve Park	Matagorda County	6.00	10/1000
Tanner Flats Park	Matagorda County	5.58	10/1000
Old Landfill Park	Matagorda County	6.31	10/1000
Lions/Shelly Park	Refugio County	—	—
Refugio RV Park	Refugio County	—	—
Skate Park	San Patricio County	—	—
Cove park	San Patricio County	—	—
N.O. Simmons park	San Patricio County	—	—
Faith Park	San Patricio County	—	—
Lake Whitney	San Patricio County	—	—
Live Oak Park	San Patricio County	—	—
Oak Park	San Patricio County	—	—

Table 2.5.2-33 (Sheet 3 of 3)
County and City Parks within or near the 50-Mile Region[(a)]

Name	Location	Acres	Recommended Park Acres/ Population
Rob and Bessie Welder park	San Patricio County	—	—
Welder Park	San Patricio County	—	—
Speck Eakin Park	San Patricio County	—	—
Butterfly garden	San Patricio County	—	—
Grace Coin park	San Patricio County	—	—
Liberty Square Mural	San Patricio County	—	—
DeLeon Plaza	Victoria County	1.8	Variable
Ethel Lee Tracy Park	Victoria County	30.5	10,000 – 50,000
Green Belt Park	Victoria County	12.9	2,000 – 10,000
Hopkins Park	Victoria County	11.6	2,000 –10,000
Memorial Park	Victoria County	1.2	2,000 –10,000
Pine Street Community Park	Victoria County	3.3	2,000 –10,000
Queen City Park	Victoria County	2.1	2,000 –10,000
Riverside Park	Victoria County	565.1	Entire urban area
Ted B. Reed Park	Victoria County	10.0	2,000 –10,000
Will Rogers Park	Victoria County	1.9	2,000 –10,000
Boulevard Park	Victoria County	1.4	2,000 –10,000
Brownson Park	Victoria County	0.9	2,000 –10,000
Community Center Park	Victoria County	73.2	10,000 – 50,000
Martin Luther King, Jr. Park	Victoria County	1.7	2,000 –10,000
Meadowlane Park	Victoria County	1.2	2,000 –10,000

Sources: Aransas Pass 2008, Aransas Pass May 2008, City of Beeville Mar 2008, City of Beeville May 2008, City of Cuero May 2008, City of Indianola May 2008, City of Ingleside Jun 2008, City of Ingleside May 2008, City of Palacios May 2008, City of Port Lavaca May 2008, City of Sinton June 2008, City of Victoria May 2008, City of Yoakum May 2008, Coleto Creek Park June 2008, Cuero Mar 2008, Cuero May 2008, GBRA Jun 2008, JCCCA Undated, PLCCCC Undated, Port Lavaca Undated, RCCCEDF Undated a, Refugio County May 2008, Rockport Undated, Yoakum Undated b

(a) TPWD acknowledges that there is a basic lack of user and non-user information on local and state parks.

Table 2.5.2-34
ROI Housing

County	2006 Housing Units(a)	Percent of 2006 ROI Total	2000 Housing Units(b)	2000 to 2006 Growth	2000 Occupied Units(b)	2000 Owner Occupied Units(b)	2000 Rental Occupied Units(b)	2000 Vacant Units(b)	2000 Homeowner Vacancy Rate(b)	2000 Rental Vacancy Rate(b)	2000 Median Value Owner-Occupied Housing(a)
Calhoun	10,882	16.0%	10,238	6.3%	7,442	5,417	2,025	2,796	2.1%	16.0%	$56,400
DeWitt	8,949	13.1%	8,756	2.2%	7,207	5,514	1,693	1,549	2.6%	6.5%	$47,100
Goliad	3,556	5.2%	3,426	3.8%	2,644	2,116	528	782	3.0%	7.2%	$57,400
Jackson	6,656	9.8%	6,545	1.7%	5,336	3,936	1,400	1,209	1.7%	15.5%	$52,700
Refugio	3,727	5.5%	3,669	1.6%	2,985	2,236	749	684	3.1%	6.5%	$42,600
Victoria	34,313	50.4%	32,945	4.2%	30,071	20,265	9,807	2,874	1.6%	11.2%	$73,300
ROI Total	68,083	100.0%	65,579	3.8%	55,685	39,484	16,202	9,894	—	—	—

(a) USCB 2008
(b) USCB 2000b

Table 2.5.2-35
ROI Population Center Housing

County Population Center	2000 Housing Units(a)	2000 Occupied Units(a)	2000 Owner-Occupied Units(a)	2000 Rental-Occupied Units(a)	2000 Vacant Units(a)	2000 Percent Vacant(a)	2000 Homeowner Vacancy Rate(a)	2000 Rental Vacancy Rate(a)	2000 Median Value Owner-Occupied Housing(b)
Port Lavaca (Calhoun)	4,791	4,189	2,743	1,446	602	12.6%	1.6%	15.6%	$56,600
Cuero (DeWitt)	2,867	2,500	1,751	749	367	12.8%	2.9%	6.0%	$43,200
Goliad (Goliad)	877	749	505	244	128	14.6%	5.4%	8.6%	$58,000
Edna (Jackson)	2,609	2,227	1,397	830	382	14.6%	2.3%	18.5%	$49,600
Refugio (Refugio)	1,312	1,128	806	322	184	14.0%	3.5%	6.9%	$41,400
Victoria (Victoria)	24,192	22,129	13,461	8,668	2,063	8.5%	1.4%	11.3%	$72,600
Totals	36,648	32,922	20,663	12,259	3,726	10.2%	–-	–-	–-

(a) USCB 2000b
(b) USCB 2008

**Table 2.5.2-36 (Sheet 1 of 2)
Hotel/Motel Data, First Quarter, 2007**

City/Town/Place	Rate	Number of Hotels[a]	Room Nights Available[b]	Revenue (dollars)	Percent Occupancy	Room Nights Sold
Calhoun County						
Port Lavaca	$0–39.99	2	7,500	98,000	39.2	2,900
	$40–49.99	1	4,800	109,000	46.9	2,200
	$50–59.99	2	13,600	335,000	48.8	6,600
	$80–89.99	1	4,500	272,000	73.2	3,300
Port O Connor	$40–49.99	1	3,200	24,000	19	600
	$60–69.99	2	4,700	146,000	48.2	2,300
	$80–89.99	1	700	18,000	29.2	200
	$90–99.99	1	4,500	42,000	10.2	500
Seadrift	$40–49.99	2	4,300	82,000	42.2	1,800
	$60–69.99	1	1,100	19,000	27.5	300
	$80–89.99	1	1,100	54,000	55.6	600
Total		15	50,000	1,199,000	42.6	21,300
DeWitt County						
Cuero	$0–39.99	2	5,400	54,000	39	2,100
	$70–79.99	1	2,800	161,000	78.4	2,200
Yoakum	$60–69.99	1	2,300	99,000	69.5	1,600
Total		4	10,500	314,000	56.2	5,900
Goliad County						
Goliad	$0–39.99	2	5,300	104,000	55.4	2,900
Total		2	5,300	104,000	54.7	2,900
Jackson County						
Edna	$40–49.99	2	5,700	123,000	49.1	2,800
Total		2	5,700	123,000	49.1	2,800

Table 2.5.2-36 (Sheet 2 of 2)
Hotel/Motel Data, First Quarter, 2007

City/Town/Place	Rate	Number of Hotels[a]	Room Nights Available[b]	Revenue (dollars)	Percent Occupancy	Room Nights Sold
Refugio County						
Refugio	$0–39.99	1	1,500	14,000	36.3	600
	$40–49.99	1	4,000	76,000	38.9	1,500
	$70–79.99	1	1,400	39,000	38.3	500
Total		3	6,900	129,000	37.7	2,600
Victoria County						
Victoria	$0–39.99	7	41,000	622,000	51.5	21,100
	$40–49.99	1	7,200	244,000	76.1	5,500
	$50–59.99	1	9,000	255,000	51.3	4,600
	$60–69.99	5	45,100	1,803,000	61.1	27,500
	$80–89.99	1	5,800	380,000	76.3	4,400
	$90–99.99	2	11,000	845,000	79.8	8,800
Total		17	119,100	4,149,000	60.4	71,900
6-County						
ROI Total		43	197,500	6,018,000	54.4	107,400

Source: TOG Undated

(a) Only properties with revenues exceeding $18,000 in the current quarter.
(b) Room Nights Available – the number of rooms in a hotel multiplied by the number of nights in the current quarter.

Table 2.5.2-37
ROI Housing Inventory by Price Range, 2000(a)

	Calhoun County		DeWitt County		Goliad County		Jackson County		Refugio County		Victoria County		ROI	
Value	**Number of Units**	**%**	**Number of Units**	**%**	**Number of Units**	**%**	**Number of Units**	**%**	**Number of Units**	**%**	**Number of Units**	**%**	**Number of Units**	**%**
Less than $50,000	1,766	43.3	1,849	53.8	426	43.7	1,232	46.8	1,050	60.7	4,304	26.8	10,627	36.8
$50,000 to $99,999	1,697	41.6	1,141	33.2	333	34.2	1,021	38.8	507	29.3	7,685	47.9	12,384	42.9
$100,000 to $149,999	391	9.6	288	8.4	146	15	222	8.4	123	7.1	2,329	14.5	3,499	12.1
$150,000 to $199,999	163	4	106	3.1	49	5	115	4.4	24	1.4	1,060	6.6	1,517	5.2
$200,000 to $299,999	63	1.5	25	0.7	16	1.6	36	1.4	10	0.6	444	2.8	594	2.1
$300,000 to $499,999	0	0	5	0.1	2	0.2	4	0.2	2	0.1	181	1.1	194	0.7
$500,000 to $999,999	0	0	15	0.4	2	0.2	0	0	0	0	37	0.2	54	0.2
$1,000,000 or more	0	0	5	0.1	0	0	0	0	15	0.9	11	0.1	31	0.1
Total Units	4,080	100.0	3,434	100.0	974	100.0	2,630	100.0	1,731	100.0	16,051	100.0	28,900	100.0
Median Value	$56,400		$47,100		$57,400		$52,700		$42,600		$73,300		N/A	

Source: USCB 2000c

(a) Owner-occupied units with a mortgage.

Note: N/A - Not available

Table 2.5.2-38 (Sheet 1 of 2)
Major Water Suppliers in the ROI

System Name	Population Served[(a),(b)]	Primary Water Source[(c)]	Total Production Capability (MGD)[(c)]	Max Purchased Capacity (MGD)[(c)]	Average Daily Consumption (MGD)[(c)]	Percent Utilized Capacity	Percent Available Capacity
Calhoun County							
Calhoun County Rural Water System	7,041	Purchased Surface Water	2.26	N/A	0.205	9.1	90.9
City of Point Comfort	1,296	Surface Water	1.152	N/A	0.136	11.8	88.2
City of Port Lavaca	12,000	Purchased Surface Water	N/A	N/A	1.210	N/A	100.0
City of Seadrift	4,338	Groundwater	2.304	N/A	0.104	4.5	95.5
Port O'Connor MUD	3,810	Purchased Groundwater	1.044	N/A	N/A	N/A	–-
County Subtotal	28,485	–-	6.76	–-	1.655	24.5	75.5
DeWitt County							
City of Cuero	6,571	Groundwater	7.740	N/A	1.680	21.7	78.3
City of Yoakum	5,731	Groundwater	4.212	7.920	0.771	18.3	81.7
City of Yorktown	2,207	Groundwater	2.030	N/A	0.265	13.1	86.9
County Subtotal	14,509	–-	13.982	–-	2.716	19.4	80.6
Goliad County							
City of Goliad	2,018	Groundwater	1.656	N/A	0.376	22.7	77.3
County Subtotal	2,018	–-	1.656	–-	0.376	22.7	77.3
Jackson County							
City of Edna	5,999	Groundwater	3.300	1.656	0.594	18.0	82.0
City of Ganado	2,376	Groundwater	2.660	1.296	0.195	7.3	92.7
Jackson County WCID 1	700	Groundwater	0.403	N/A	0.058	14.4	85.6
Jackson County WCID 2	600	Groundwater	0.324	N/A	0.050	15.4	84.6
County Subtotal	9,675	–-	6.687	–-	0.897	13.4	86.6

Table 2.5.2-38 (Sheet 2 of 2)
Major Water Suppliers in the ROI

System Name	Population Served[(a),(b)]	Primary Water Source[(c)]	Total Production Capability (MGD)[(c)]	Max Purchased Capacity (MGD)[(c)]	Average Daily Consumption (MGD)[(c)]	Percent Utilized Capacity	Percent Available Capacity
Refugio County							
City of Bayside	714	Groundwater	0.165	N/A	N/A	–-	–-
City of Refugio	2,941	Groundwater	2.736	N/A	0.524	19.2	80.8
City of Woodsboro	1,750	Groundwater	1.188	N/A	0.203	17.1	82.9
County Subtotal	5,405	–-	4.089	–-	0.727	17.8	82.2
Victoria County							
City of Victoria	61,055	Surface Water	36.657	N/A	9.920	27.1	72.9
Quail Creek MUD	1,533	Groundwater	2.261	0.720	0.148	6.5	93.5
Victoria County WCID 1	2,800	Groundwater	0.994	N/A	0.245	24.6	75.4
Victoria County WCID 2	696	Groundwater	0.288	N/A	0.060	20.8	79.2
County Subtotal	66,084	–-	40.2	–-	10.373	25.8	74.2
ROI Total	126,176	–-	73.374	–-	16.744	22.8	77.2

(a) USEPA 2007
(b) TCEQ 2007
(c) Data selected based on major populations served per county. Year of data not provided. Data extracted from TCEQ database that is updated continuously.
Notes: WCID = Water Control and Improvement District
MUD = Municipal Utilities Department
N/A = Not Available
MGD = Millions of gallons per day

Table 2.5.2-39 (Sheet 1 of 3)
Wastewater Treatment Systems in the ROI

System Name (TPDES #)[(a)]	Plant Designed Average Flow (MGD)[(b)]	Wastewater Processed (MGD)[(a)]	Period[(a)]
Calhoun County			
City of Point Comfort (10599001)	0.2	Monthly Avg. Min. 0.029 Monthly Avg. Max. 0.126 Monthly Avg. 0.057	September 2006 – August 2007
City of Port Lavaca (10251001)	1.5	Monthly Avg. Min. 1.14 Monthly Avg. Max. 1.39 Monthly Avg. 1.24	October 2006 – September 2007
City of Seadrift (0822001)	0.3	Monthly Avg. Min. 0.08 Monthly Avg. Max. 0.34 Monthly Avg. 0.15	September 2006 – August 2007
Port O'Connor MUD (13693001)	0.6	Monthly Avg. Min. 0.070 Monthly Avg. Max. 0.277 Monthly Avg. 0.110	September 2006 – August 2007
Guadalupe-Blanco River Authority (13954001)	0.03	Monthly Avg. Min. 0.004 Monthly Avg. Max. 0.017 Monthly Avg. 0.009	September 2006 – August 2007
South-Central Calhoun County W. (13774001)	0.075	Monthly Avg. Min. 0.013 Monthly Avg. Max. 0.03 Monthly Avg. 0.021	August 2006 – July 2007
DeWitt County			
City of Cuero (10403002)	1.5	Monthly Avg. Min. 0.484 Monthly Avg. Max. 0.963 Monthly Avg. 0.900	August 2006 – July 2007
City of Yoakum (10463001)	0.95	Monthly Avg. Min. 0.468 Monthly Avg. Max. 1.142 Monthly Avg. 0.647	October 2006 – September 2007
City of Yorktown (10323001)	0.26	Monthly Avg. Min. 0.105 Monthly Avg. Max. 0.211 Monthly Avg. 0.152	September 2006 – August 2007
Goliad County			
City of Goliad (10458001)	0.35	Monthly Avg. Min. 0.159 Monthly Avg. Max. 0.400 Monthly Avg. 0.240	September 2006 – August 2007
Jackson County			
City of Edna (10164001)	1.8	Monthly Avg. Min. 0.575 Monthly Avg. Max. 1.13 Monthly Avg. 0.713	September 2006 – August 2007
City of Ganado (10010001)	0.35	Monthly Avg. Min. 0.147 Monthly Avg. Max. 0.385 Monthly Avg. 0.201	September 2006 – August 2007

Table 2.5.2-39 (Sheet 2 of 3)
Wastewater Treatment Systems in the ROI

System Name (TPDES #)[(a)]	Plant Designed Average Flow (MGD)[(b)]	Wastewater Processed (MGD)[(a)]	Period[(a)]
Jackson County (cont.)			
City of La Ward (13479001)	0.013	Monthly Avg. Min. 0.0002 Monthly Avg. Max. 0.0039 Monthly Avg. 0.0017	September 2006 – August 2007
Jackson County WCID No. 1 (10911001)	0.062	Monthly Avg. Min. 0.021 Monthly Avg. Max. 0.261 Monthly Avg. 0.042	August 2006 – July 2007
Jackson County WCID No. 2 (10196001)	0.045	Monthly Avg. Min. 0.023 Monthly Avg. Max. 0.163 Monthly Avg. 0.045	October 2006 – September 2007
Refugio County			
City of Austwell (11117001)	0.06	Monthly Avg. Min. 0.005 Monthly Avg. Max. 0.033 Monthly Avg. 0.010	September 2006 – August 2007
Refugio County WCID No. 1 (10256001)	0.075	Monthly Avg. Min. 0.034 Monthly Avg. Max. 0.079 Monthly Avg. 0.046	August 2006 – July 2007
Town of Bayside (13892001)	N/A	Monthly Avg. Min. 0.003 Monthly Avg. Max. 0.040 Monthly Avg. 0.009	September 2006 – August 2007
Town of Refugio (10255001)	0.576	Monthly Avg. Min. 0.210 Monthly Avg. Max. 0.544 Monthly Avg. 0.284	September 2006 – August 2007
Town of Woodsboro (10156001)	0.25	Monthly Avg. Min. 0.083 Monthly Avg. Max. 0.100 Monthly Avg. 0.091	September 2006 – August 2007
Victoria County			
Aqua Utilities, Inc. (10742001)	0.05	Monthly Avg. Min. 0.020 Monthly Avg. Max. 0.040 Monthly Avg. 0.026	September 2006 – August 2007
City of Victoria & Guadalupe (10466001)	2.5	Monthly Avg. Min. 0.9 Monthly Avg. Max. 1.1 Monthly Avg. 0.98	October 2006 – September 2007
Guadalupe-Blanco River Authority (11078001)	9.6	Monthly Avg. Min. 5.7 Monthly Avg. Max. 7.7 Monthly Avg. 6.5	October 2006 – September 2007
Quail Creek MUD (12226001)	0.22	Monthly Avg. Min. 0.100 Monthly Avg. Max. 0.157 Monthly Avg. 0.118	September 2006 – August 2007
Victoria County WCID No. 2 (12743001)	0.072	Monthly Avg. Min. 0.036 Monthly Avg. Max. 0.113 Monthly Avg. 0.069	November 2006 – October 2007

Table 2.5.2-39 (Sheet 3 of 3)
Wastewater Treatment Systems in the ROI

System Name (TPDES #)[a]	Plant Designed Average Flow (MGD)[b]	Wastewater Processed (MGD)[a]	Period[a]
Victoria County (cont.)			
Victoria County WCID No. 1 (10513002)	N/A	Monthly Avg. Min. 0.172 Monthly Avg. Max. 0.324 Monthly Avg. 0.217	August 2006 – July 2007
ROI Total	21.438	Monthly Avg. 12.9	–

(a) TCEQ Nov 2007
(b) TCEQ Dec 2007
Notes: WCID = Water Control and Improvement District
MUD = Municipal Utilities Department
N/A = Not available
MGD = Millions of gallons per day

Table 2.5.2-40
Region L - Projected Water Demands for 2010 and 2060

Category	2010 (acre-feet)	2060 (acre-feet)	Percent change in demand 2010–2060	Percent of overall demand in 2010	Percent change in relative share of overall demand 2010–2060
Municipal	369,694	597,619	+62	38	+9
County-other	26,302	39,616	+51	3	0
Manufacturing	119,310	179,715	+51	12	+2
Mining	14,524	18,644	+28	1	0
Irrigation	379,026	301,679	–20	38	–15
Steam-electric	50,427	109,776	+118	5	+4
Livestock	25,954	25,954	0	3	–1
Region L total	985,237	1,273,003	+29	—	—

Source: TWDB Nov 2006

Table 2.5.2-41
Region L - Existing Major Water Supply Sources

Water Supply Source	2010 (acre-feet)	2060 (acre-feet)
Surface water		
Guadalupe River run-of-river	123,328	123,328
Canyon Lake	59,820	55,153
Calaveras Lake	36,900	36,900
Lake Texana	32,604	32,604
Guadalupe River Combined run-of-river irrigation	18,184	18,184
Livestock Local Supply	13,230	13,150
Coleto Creek Lake	12,500	12,500
Victor Braunig Lake	12,000	12,000
Other Surface Water	25,414	25,414
Surface water subtotal	333,980	329,233
Groundwater		
Edwards (Balcones Fault Zone) Aquifer	343,799	343,799
Carrizo-Wilcox Aquifer	256,735	235,072
Gulf Coast Aquifer	58,926	55,580
Queen City Aquifer	12,742	11,111
Other groundwater	12,934	11,842
Groundwater subtotal	685,136	657,404
Reuse		
Direct Reuse	30,653	31,773
Reuse subtotal	30,653	31,773
Region L Total	1,049,769	1,018,410

Source: TWDB Nov 2006

Note: Water supply sources are listed individually if 10,000 acre-feet per year or greater in 2010. Values include only water supplies that are physically and legally available to users during a drought of record.

Table 2.5.2-42
Region P- Projected Water Demands for 2010 and 2060

Category	2010 (acre-feet)	2060 (acre-feet)	Percent change in demand 2010–2060	Percent of overall demand in 2010	Percent change in relative share of overall demand 2010–2060
Municipal	4,765	4,445	–7	2	0
County-other	2,406	2,096	–13	1	0
Manufacturing	1,089	1,425	+31	0	0
Mining	164	192	+17	0	0
Irrigation	213,638	195,251	–9	95	0
Steam-electric	0	0	0	0	0
Livestock	3,499	3,499	0	2	0
Region P Total	225,561	206,908	–8	–	–

Source: TWDB Nov 2006

Table 2.5.2-43
Region P - Existing Major Water Supply Sources

Water Supply Source	2010 (acre-feet)	2060 (acre-feet)
Surface water		
Lake Texana	1,832	1,832
Surface water subtotal	1,832	1,832
Groundwater		
Gulf Coast Aquifer	207,599	207,599
Groundwater subtotal	207,599	207,599
Region P Total	209,431	209,431

Source: TWDB Nov 2006
Note: Water supply sources are listed individually if 10,000 acre-feet per year or greater in 2010. Values include only water supplies that are physically and legally available to users during a drought of record.

Table 2.5.2-44
Law Enforcement Personnel, 2005

Political Jurisdiction	Total Law Enforcement Employees	Total Police Officers[(a)]	Total Civilians[(b)]
Calhoun County and City Personnel			
Calhoun County	56	22	34
Point Comfort	1	1	0
Port Lavaca	25	19	6
Seadrift	2	2	0
Total	84	44	40
DeWitt County and City Personnel			
DeWitt County	28	10	18
Cuero	14	13	1
Yoakum	17	10	7
Yorktown	4	4	0
Total	63	37	26
Goliad County and City Personnel			
Goliad County	25	10	15
Total	25	10	15
Jackson County and City Personnel			
Jackson County	24	14	10
Edna	11	9	2
Ganado	4	3	1
Total	39	26	13
Refugio County and City Personnel			
Refugio County	32	10	22
Refugio	13	9	4
Total	45	19	26
Victoria County and City Personnel			
Victoria County	155	88	67
Victoria	132	95	37
Total	287	183	104
Total ROI (All Counties)	543	319	224

Source: FBI Sep 2006

(a) Individuals who ordinarily carry a badge and a firearm and have full arrest powers.
(b) Personnel such as clerks, radio dispatchers, stenographers, jailers, and mechanics.

Table 2.5.2-45 (Sheet 1 of 3)
Fire Protection Personnel, 2007[(a)]

Fire Dept Name	Dept Type	Organization Type	Number Of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non-Firefighting (Civilian)	Non-Firefighting (Volunteer)
Calhoun County								
Magnolia Beach Volunteer Fire Department	Volunteer	Local	1	0	11	0	0	2
Olivia-Port Alto Volunteer Fire Department	Volunteer	Local	1	0	20	0	0	0
Port Lavaca Fire Department	Mostly Career	Local	2	16	11	0	1	0
Port O'Connor Volunteer Fire Department	Volunteer	Local	1	0	20	0	0	10
Seadrift Volunteer Fire Department	Volunteer	Local	1	0	15	0	0	2
Thomaston Volunteer Fire Department	Volunteer	Non-governmental VFD	1	0	8	0	0	12
DeWitt County								
Cuero Fire Department	Mostly Volunteer	Local	1	6	45	0	0	0
Meyersville Volunteer Fire Department	Volunteer	Local	1	0	20	0	0	0
Westhoff Volunteer Fire Department	Volunteer	Local	1	0	15	0	0	10
Goliad County								
Ander-Weser Volunteer Fire Department	Volunteer	Local	1	0	20	0	0	25
Goliad Volunteer Fire Department	Volunteer	Local	1	0	25	0	0	0
Weesatche Volunteer Fire Department	Volunteer	Local	1	0	25	0	0	1

Table 2.5.2-45 (Sheet 2 of 3)
Fire Protection Personnel, 2007[(a)]

Fire Dept Name	Dept Type	Organization Type	Number Of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non-Firefighting (Civilian)	Non-Firefighting (Volunteer)
Jackson County								
Edna Fire Department	Mostly Volunteer	Local	1	8	22	0	1	0
Ganado Volunteer Fire Department	Volunteer	Local	1	0	0	26	0	0
La Ward Volunteer Fire Department	Volunteer	Local	1	0	15	0	0	3
Refugio County								
Bayside Volunteer Fire Department	Volunteer	Local	1	0	15	0	0	0
Refugio Volunteer Fire Department	Volunteer	Local	1	0	25	0	0	0
Tivoli Volunteer Fire Department	Volunteer	Local	1	0	20	0	0	0
Woodsboro Fire Department	Volunteer	Contract fire department	1	0	28	0	0	1
Victoria County								
Bloomington Volunteer Fire Department, Inc.	Volunteer	Local	1	0	22	0	0	12
Lone Tree Volunteer Fire Department	Volunteer	Local	1	0	10	0	0	80
Nursery Volunteer Fire Department	Volunteer	Local	1	0	14	0	0	0
Placedo Volunteer Fire Department	Volunteer	Local	1	0	18	0	0	4
Quail Creek Volunteer Fire Department	Volunteer	Local	1	0	20	0	0	14

Table 2.5.2-45 (Sheet 3 of 3)
Fire Protection Personnel, 2007[(a)]

Fire Dept Name	Dept Type	Organization Type	Number Of Stations	Active Firefighters (Career)	Active Firefighters (Volunteer)	Active Firefighters (Paid per Call)	Non-Firefighting (Civilian)	Non-Firefighting (Volunteer)
Victoria County (continued)								
Raisin Volunteer Fire Department	Volunteer	Local	4	0	15	0	0	20
Telferner Volunteer Fire Department	Volunteer	Local	1	0	6	0	0	3
Victoria Fire Department	Career	Local	4	107	0	0	3	0
Total – ROI (All Counties)			34	137	465	26	5	199

Source: USFA 2007

(a) Data is obtained from the U. S. Fire Administration's (USFA) National Fire Department Census. Responses to this census are voluntary and the USFA estimates that, as of 2006, approximately 81 percent of the nation's fire departments have responded (USFA 2007).

Table 2.5.2-46
Police and Fire Protection Ratios

County	Total Population (2000)	Sworn Officers (2005)	Ratio of Residents per Officer[(a)]	Active Firefighters (career, volunteer, and paid per call) (2007)	Ratio of Residents per Active Firefighter[(b)]
Calhoun	20,647	44	469:1	101	204:1
DeWitt	20,013	37	541:1	86	233:1
Goliad	6,928	10	693:1	70	99:1
Jackson	14,391	26	554:1	71	203:1
Refugio	7,828	19	412:1	88	89:1
Victoria	84,088	183	459:1	212	397:1
ROI	153,895	319	482:1	628	245:1

Sources: Tables 2.5.1-4, 2.5.2-44, 2.5.2-45

(a) Total population in 2000 divided by sworn officers in 2005.
(b) Total population in 2000 divided by active firefighters in 2007.

Table 2.5.2-47 (Sheet 1 of 2)
Public Protection Classification Ratings in the ROI

City/Town/Community/Fire Department	County	Zip Code	Public Protection Classification[a]
Point Comfort Fire Department	Calhoun	77978	5
Point Comfort Outside of Point Comfort Fire Department protection area	Calhoun	77978	5/9
Port Lavaca Fire Department	Calhoun	77972	4
Port Lavaca Fire Department	Calhoun	77979	4
Port Lavaca Outside of Port Lavaca Fire Department protection area	Calhoun	77979	4/9
Port O'Connor Fire Department	Calhoun	77982	8
Seadrift Fire Department	Calhoun	77983	7
Cuero Fire Department	DeWitt	77954	5
Hochheim Fire Department	DeWitt	77967	10
Nordheim Fire Department	DeWitt	78141	8
Weesatche Volunteer Fire Department	DeWitt	78164	9/10
Westhoff Fire Department	DeWitt	77994	10
Yoakum Fire Department	DeWitt	77995	5
Yorktown Fire Department	DeWitt	78164	7
Berclair Fire Department	Goliad	78107	10
Fannin Fire Department	Goliad	77960	10
Goliad Fire Department	Goliad	77963	7
Raisin Volunteer Fire Department	Goliad	77960	10
Weesatche Volunteer Fire Department	Goliad	77993	9/10
Caranacuhua Volunteer Fire Department	Jackson	77465	10
Edna Fire Department	Jackson	77957	6
Francitas Volunteer Fire Department	Jackson	77961	9/10
Ganado Fire Department	Jackson	77962	7
La Salle Fire Department	Jackson	77969	10
La Ward Fire Department	Jackson	77970	9/10
La Ward Volunteer Fire Department	Jackson	77970	9/10
Lolita Fire Department	Jackson	77971	7/9
Lolita Volunteer Fire Department	Jackson	77971	7/9
Vanderbilt Volunteer Fire Department	Jackson	77991	7/9
Austwell Fire Department	Refugio	77950	10
Bayside Fire Department	Refugio	78340	7/9
Bayside Fire Department	Refugio	78340	7/9
Refugio Fire Department	Refugio	78377	5

Table 2.5.2-47 (Sheet 2 of 2)
Public Protection Classification Ratings in the ROI

City/Town/Community/Fire Department	County	Zip Code	Public Protection Classification[a]
Refugio — Outside of Refugio Fire Department protection area	Refugio	78377	9/10
Tivoli Fire Department	Refugio	77990	10
Woodsboro Fire Department	Refugio	78393	7
Bloomington Fire Department	Victoria	77951	9/10
Bloomington Volunteer Fire Department	Victoria	77951	9/10
Crescent Valley Fire Department	Victoria	77905	9/10
Crescent Valley Volunteer Fire Department	Victoria	77905	9/10
Inez Fire Department	Victoria	77968	10
Lone Tree Volunteer Fire Department	Victoria	77977	9/10
Mcfaddin Fire Department	Victoria	77973	10
Mcfaddin Volunteer Fire Department	Victoria	77973	10
Placedo Fire Department	Victoria	77977	10
Quail Creek Volunteer Fire Department	Victoria	77905	5/8B[b]
Raisin Volunteer Fire Department	Victoria	77901	10
Telferner Volunteer Fire Department	Victoria	77988	9/10
Victoria Fire Department	Victoria	77901	4
Victoria Fire Department	Victoria	77904	4
Victoria Fire Department	Victoria	77905	4
Victoria — Outside of Victoria Fire Department protection area	Victoria	77905	9/10

Source: TDI Jan 2008

(a) For Public Protection Classifications with two numbers, the first number is the Public Protection Classification for buildings within 1000 feet of a fire hydrant and 5 road miles of a recognized fire department. The second number is for buildings more than 1000 feet from a fire hydrant but within 5 road miles of a recognized fire department (TDI Sep 2007).

(b) 8B = the rating is actually between 8 and 9.

Table 2.5.2-48
2006 Hospital Data and 2007 Physician Data

Facility Name	Staffed Beds	Admissions[a]	Daily Census[b]	Outpatient Visits[a]	Personnel[c]	No. of Physicians
Calhoun County						
Memorial Medical Center	25	1385	13	29,674	188	NA
County Total	25	1385	13	29,674	188	20
DeWitt County						
Cuero Community Hospital	60	2706	27	142,077	349	NA
County Total	60	2706	27	142,077	349	14
Goliad County						
County Total	0	0	0	0	0	3
Jackson County						
Jackson County Hospital District	54	403	32	NA	108	NA
County Total	54	403	32	NA	108	4
Refugio County						
Refugio County Memorial Hospital	20	303	3	31,283	99	NA
County Total	20	303	3	31,283	99	2
Victoria County						
Citizens Medical Center	296	11,557	150	95,958	1027	NA
DeTar Health Care System	308	9385	116	84,106	872	NA
Triumph Hospital of Victoria	23	223	15	0	58	NA
Victoria Warm Springs Hospital	22	260	13	5136	73	NA
County Total	649	21,425	294	185,200	2030	230
ROI						
ROI Total	808	26,222	369	388,234	2774	273

Sources: AHA 2006, AMA 2005

(a) Total during most recent 12-month period for which data was collected.
(b) Average daily census during most recent 12-month period for which data was collected.
(c) Hospital personnel list does not include doctors that serve patients in the hospital, but are not employed by the hospital.
Note:N/A – Not Available

Table 2.5.2-49
Public School Campuses in the ROI, 2007–2008 Academic Year

	Primary/Elementary		Middle/Intermediate/Junior High		High School		Alternative/ Magnet	Total	
ISD	Current	Proposed	Current	Proposed	Current	Proposed		Current[e]	Proposed
Calhoun County									
Calhoun County	5	1	2	0	2	1	1	10	2
DeWitt County									
Cuero	2	0	2	0	1	0	1	6	0
Meyersville	1	0	1	0	0	0	0	1	0
Nordheim	1	0	1	0	1	0	0	1	0
Westhoff	1	0	1	0	0	0	0	1	0
Yoakum	3	0	1	0	1	0	0	5	0
Yorktown	1	0	1	0	1	0	1	4	0
Goliad County									
Goliad	1	0	2	0	1	0	0	4	0
Jackson County									
Edna	1	1[a]	1	0	1	0	0	3	1
Ganado	1	0	1	0	1	0	0	3	0
Hallettsville	1	0	1	0	1	0	0	3	0
Industrial	2	2[b]	1	0	1	0	1	4	2
Palacios	1	0	2	0	1	0	1	5	0
Refugio County									
Austwell-Tivoli	1	0	1[d]	0	1	0	0	2	0
Refugio	1	0	0	1	1	0	0	2	1
Woodsboro	1	0	1[d]	0	1	0	0	2	0
Victoria County									
Bloomington	2	0	1	0	1	0	0	4	0
Nursery	1	1[c]	0	0	0	0	0	1	1
Victoria	15	2	3	1	3	2	1	22	5

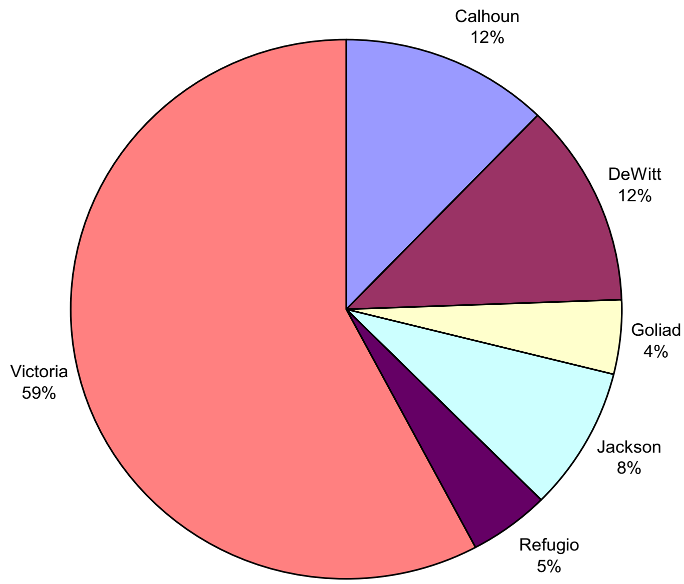
(a) New school to replace existing school.
(b) Additional classrooms in two existing buildings.
(c) New school will replace existing school
(d) Middle school is combined with high school.
(e) Numbers of campuses may not sum to the total.

Table 2.5.2-50
2007–2008 Enrollment and Capacities of Public Schools in the ROI

ISD	Current Enrollment/Percent of Capacity	Enrollment Capacity	Available Student Capacity
Calhoun County			
Calhoun County ISD	4290 (76%)	5,632	1342 (24%)
County-wide Total	4290 (76%)	5,632	1342 (24%)
DeWitt County			
Cuero ISD	1950 (72%)	2,700	750 (28%)
Meyersville ISD	125 (78%)	160	35 (22%)
Nordheim ISD	82 (47%)	175	93 (53%)
Westhoff ISD	48 (30%)	160	112 (70%)
Yoakum ISD	1550 (100%)	1,550	0 (0%)
Yorktown ISD	650 (72%)	900	250 (28%)
County-wide Total	4405 (78%)	5,645	1240 (22%)
Goliad County			
Goliad ISD	1312 (100%)	1,312	0 (0%)
County-wide Total	1312 (100%)	1,312	0 (0%)
Jackson County			
Edna ISD	1450 (81%)	1,800	350 (19%)
Ganado ISD	640 (91%)	700	60 (9%)
Hallettsville ISD	887 (85%)	1,050	163 (15%)
Industrial ISD	1060 (92%)	1,150	90 (8%)
Palacios ISD	1523 (85%)	1,800	277 (15%)
County-wide Total	5560 (86%)	6,500	940 (14%)
Refugio County			
Austwell-Tivoli ISD	155 (31%)	500	345 (69%)
Refugio ISD	735 (49%)	1,500	765 (51%)
Woodsboro ISD	546 (91%)	600	54 (9%)
County-wide Total	1436 (55%)	2,600	1164 (45%)
Victoria County			
Bloomington ISD	908 (86%)	1,050	142 (14%)
Nursery ISD	110 (52%)	210	100 (48%)
Victoria ISD[a]	13,550 (58%)	23,350	9800 (42%)
County-wide Total	14,568 (59%)	24,610	10,042 (41%)
Total for ROI	31,571 (68%)	46,299	14,728 (32%)

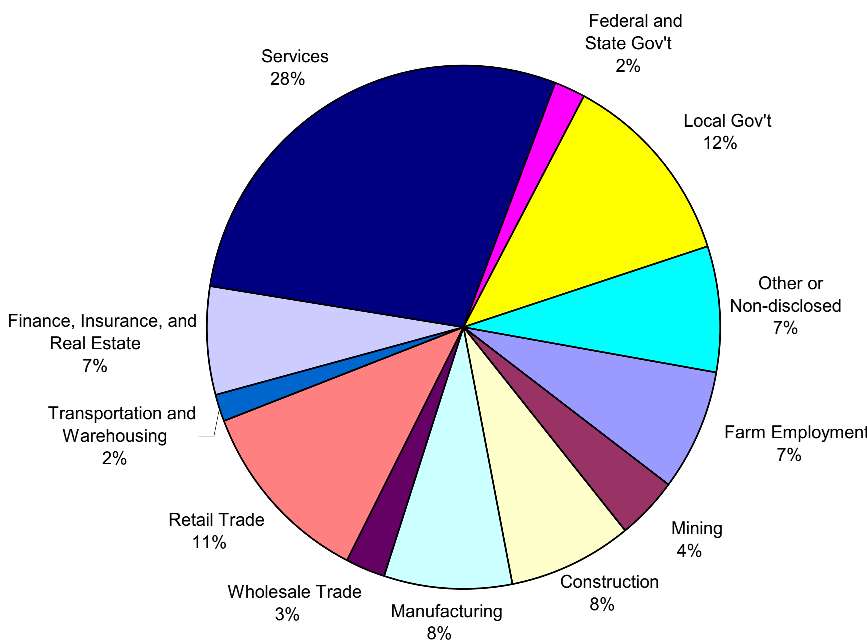
(a) Victoria ISD will decrease its current reliance on mobile classroom units when new schools are completed.

Note: If an ISD is located in more than one county, then the enrollment was only included in the primary county the ISD is located in with the exception of Hallettsville ISD and Palacios ISD. These ISDs were included in the county that is in the ROI since the primary county is outside the ROI.



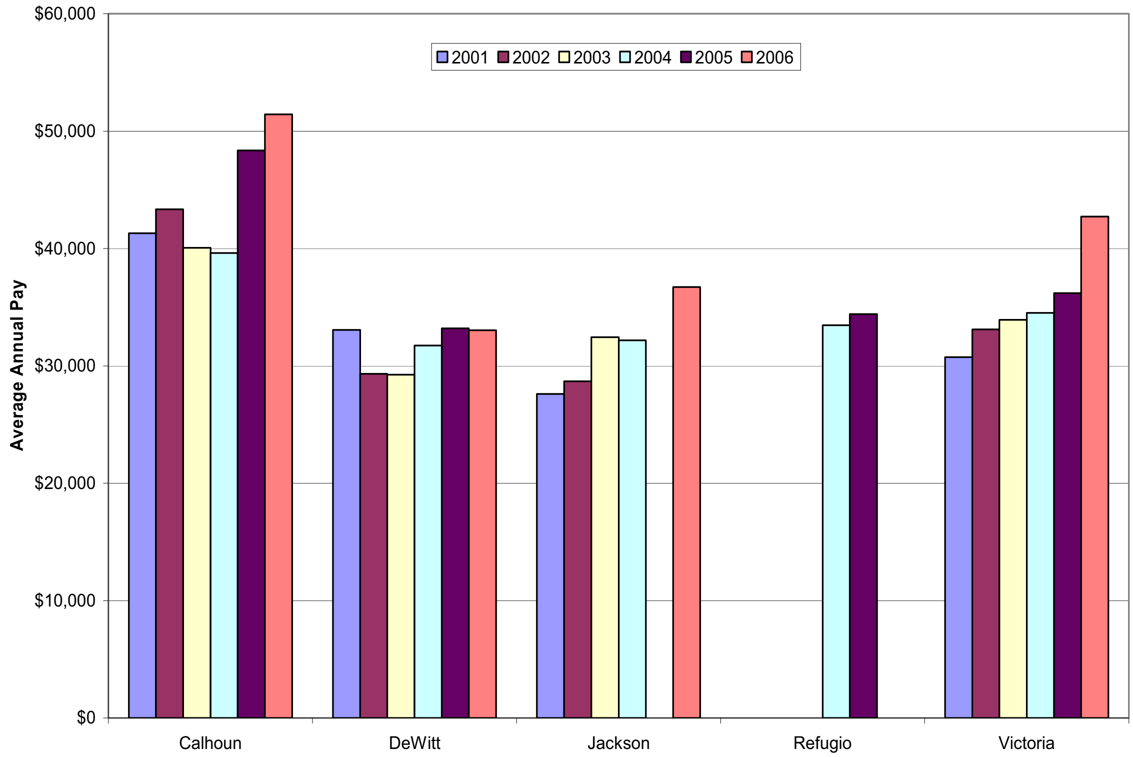
Source: BLS 2007a

Figure 2.5.2-1 ROI Labor Force Distribution, 2006



Source: BEA 2008

Figure 2.5.2-2 Major Employment Sectors, ROI, 2005



Source: BLS 2007b
Note: Data non-disclosed in all years for Goliad County, and in 2001–2003 and 2006 for Refugio County

Figure 2.5.2-3 Average Annual Earnings, NAICS Sector 237, Heavy and Civil Engineering Construction, 2001-2006

Figure 2.5.2-4 Transportation System in the 50-Mile Region

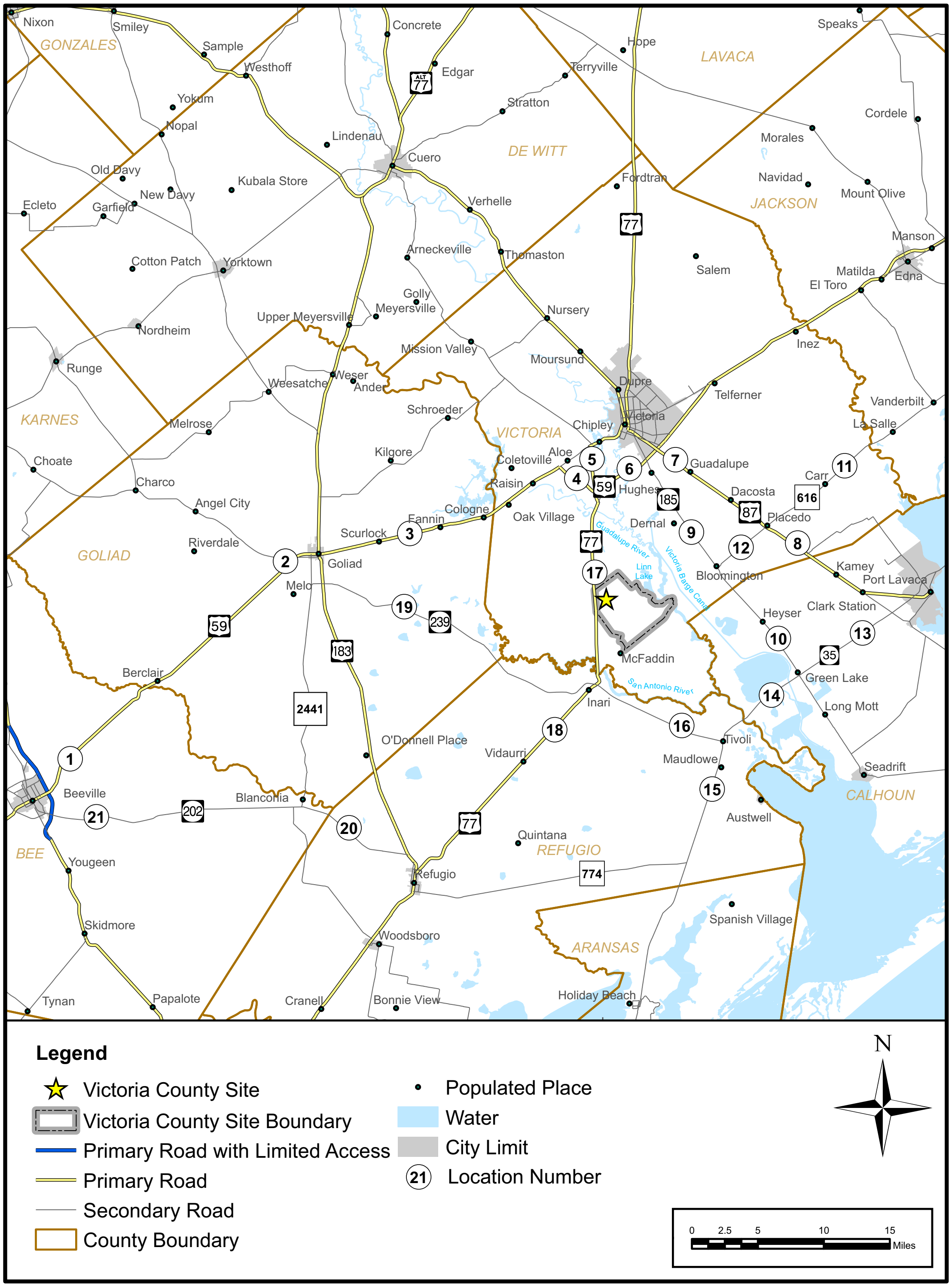


Figure 2.5.2-5 Transportation Routes to the Victoria County Station Site

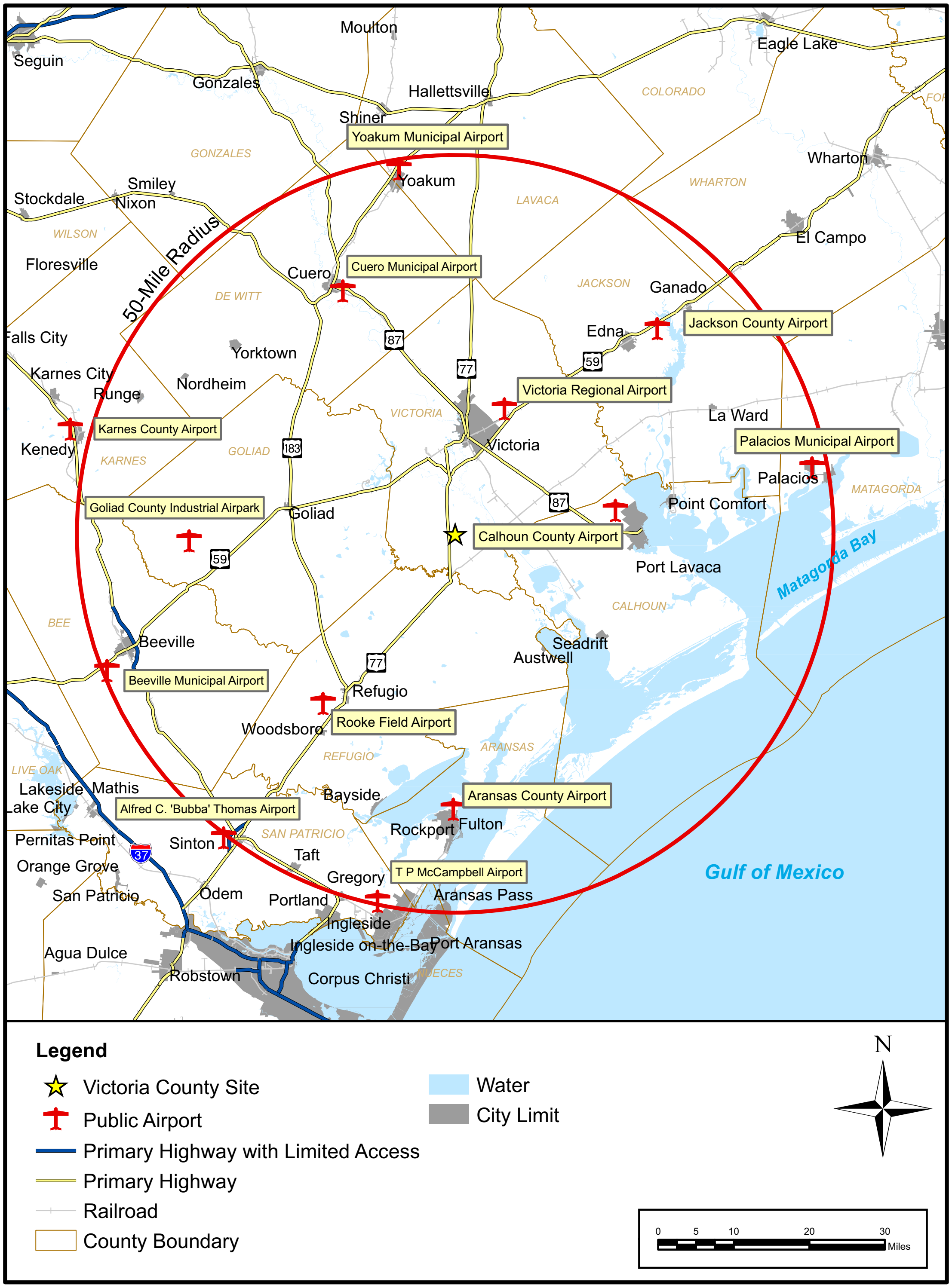
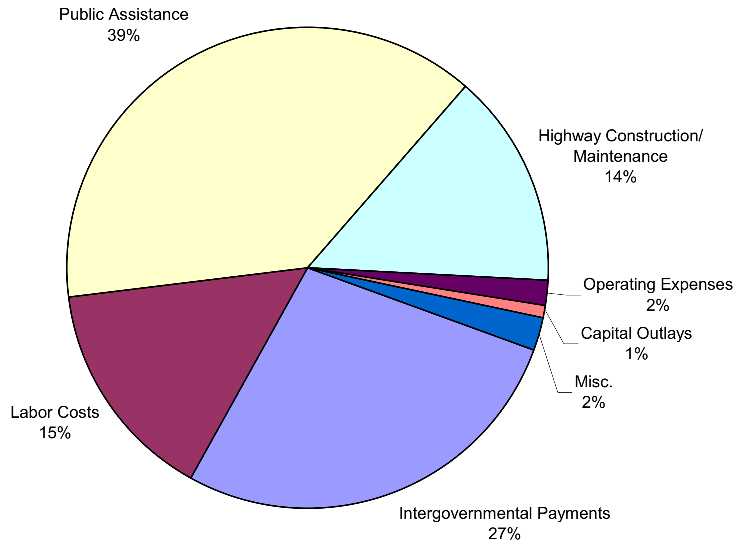


Figure 2.5.2-6 Airports in the 50–Mile Region

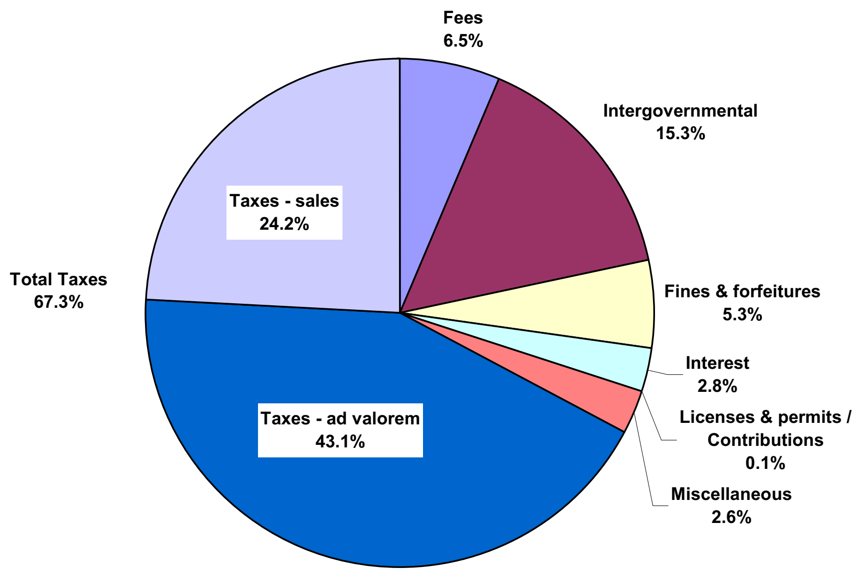


Source: TCPA 2007

Figure 2.5.2-7 State Expenditures by Category in ROI Counties, 2006

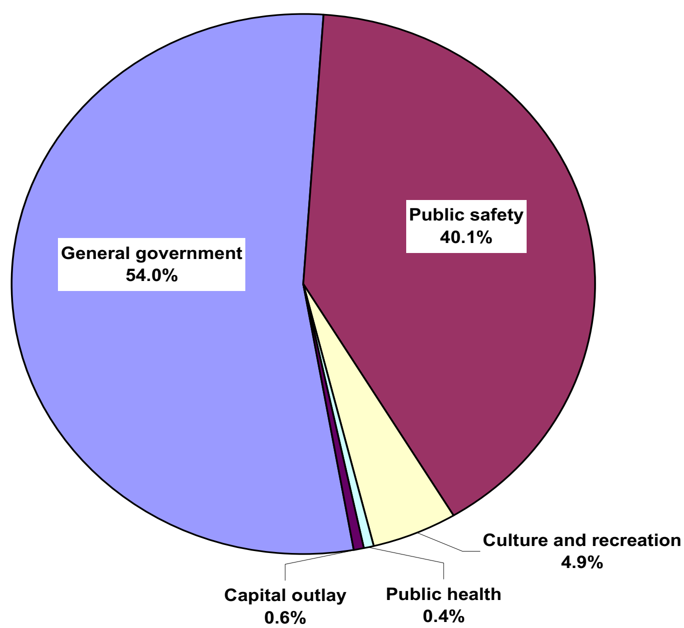
Source: RISD Feb 2008

Figure 2.5.2-8 Refugio ISD, Changes from Previous Year in Property Values and Revenues, 2001–2007



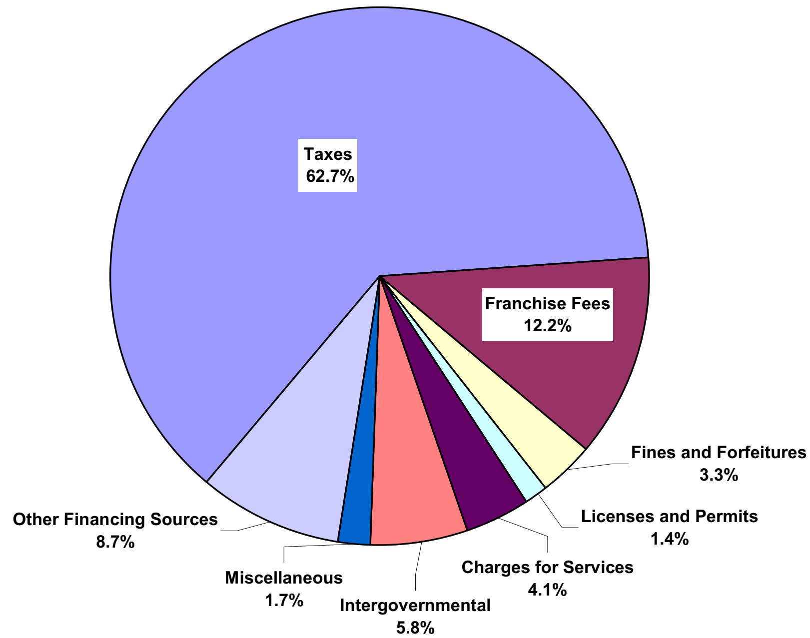
Source: VCA Jun 2007

Figure 2.5.2-9 Victoria County Revenues, 2006



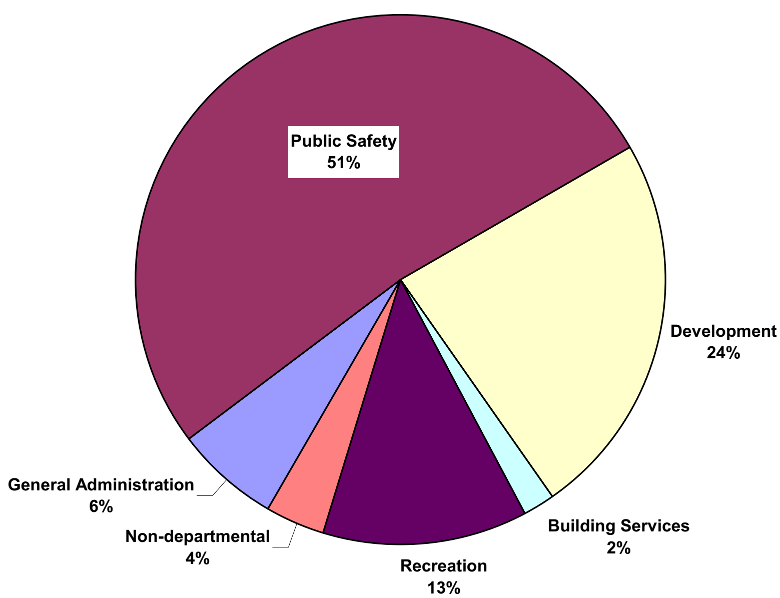
Source: VCA Jun 2007

Figure 2.5.2-10 Victoria County Expenditures, 2006



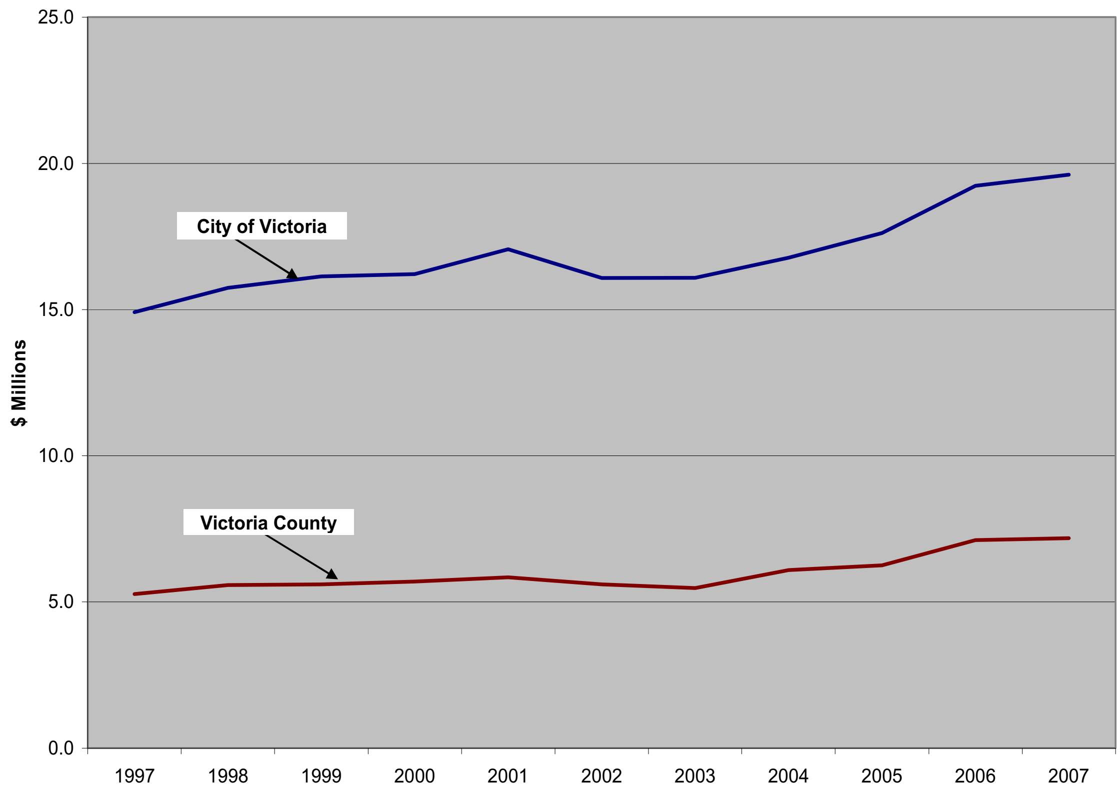
Source: Victoria 2007

Figure 2.5.2-11 City of Victoria Budgeted Revenues, 2006–2007



Source: Victoria 2007

Figure 2.5.2-12 City of Victoria Budgeted Expenditures, 2006–2007



Source: TCPA 2008g

Figure 2.5.2-13 Sales Taxes, Victoria County and City of Victoria, 1997–2007 (Adjusted for Inflation; Values are in 2007 Dollars)

Figure 2.5.2-14 Federal and State Recreational Areas within the 50-Mile Radius

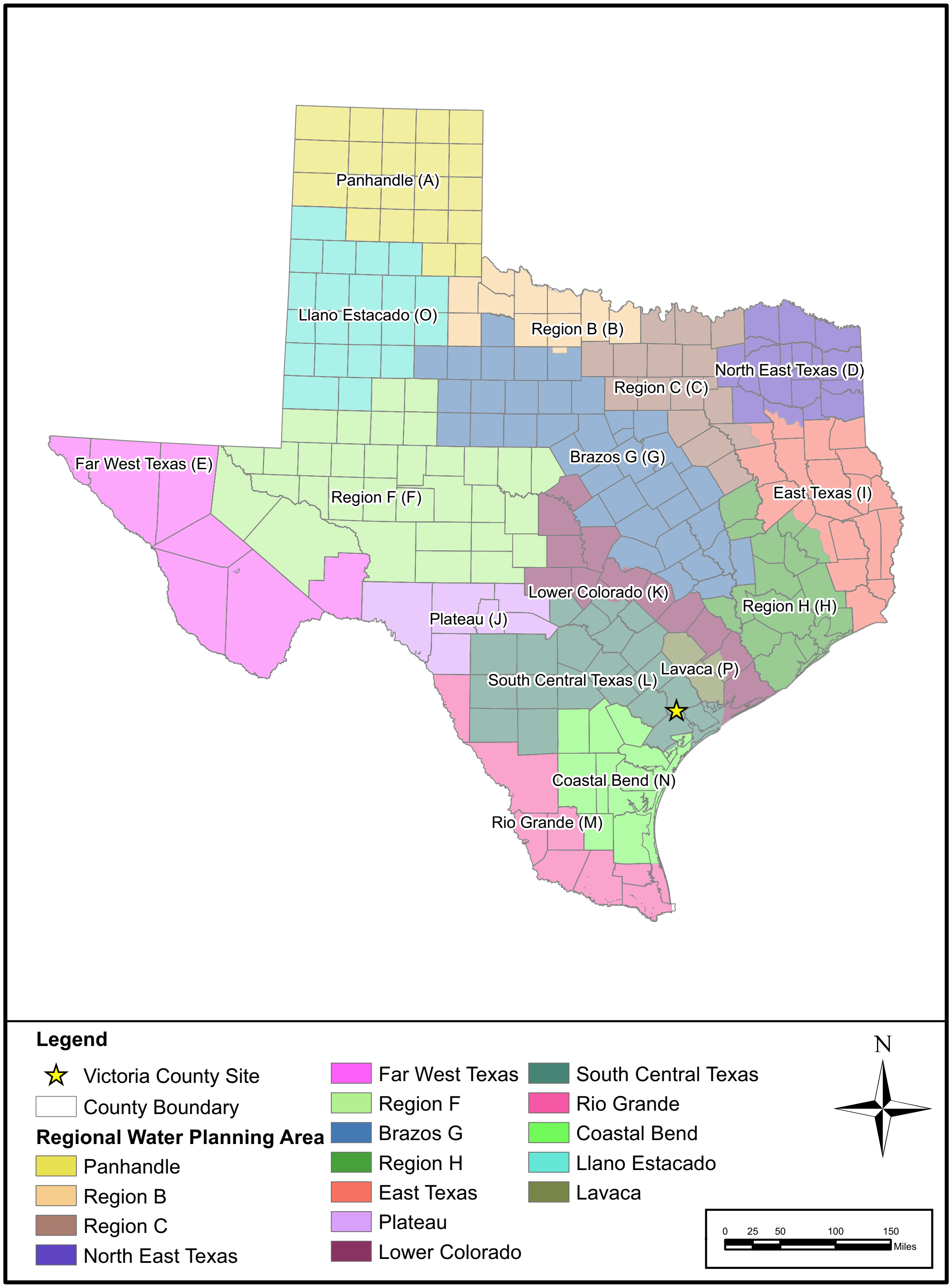


Figure 2.5.2-15 Regional Water Planning Areas

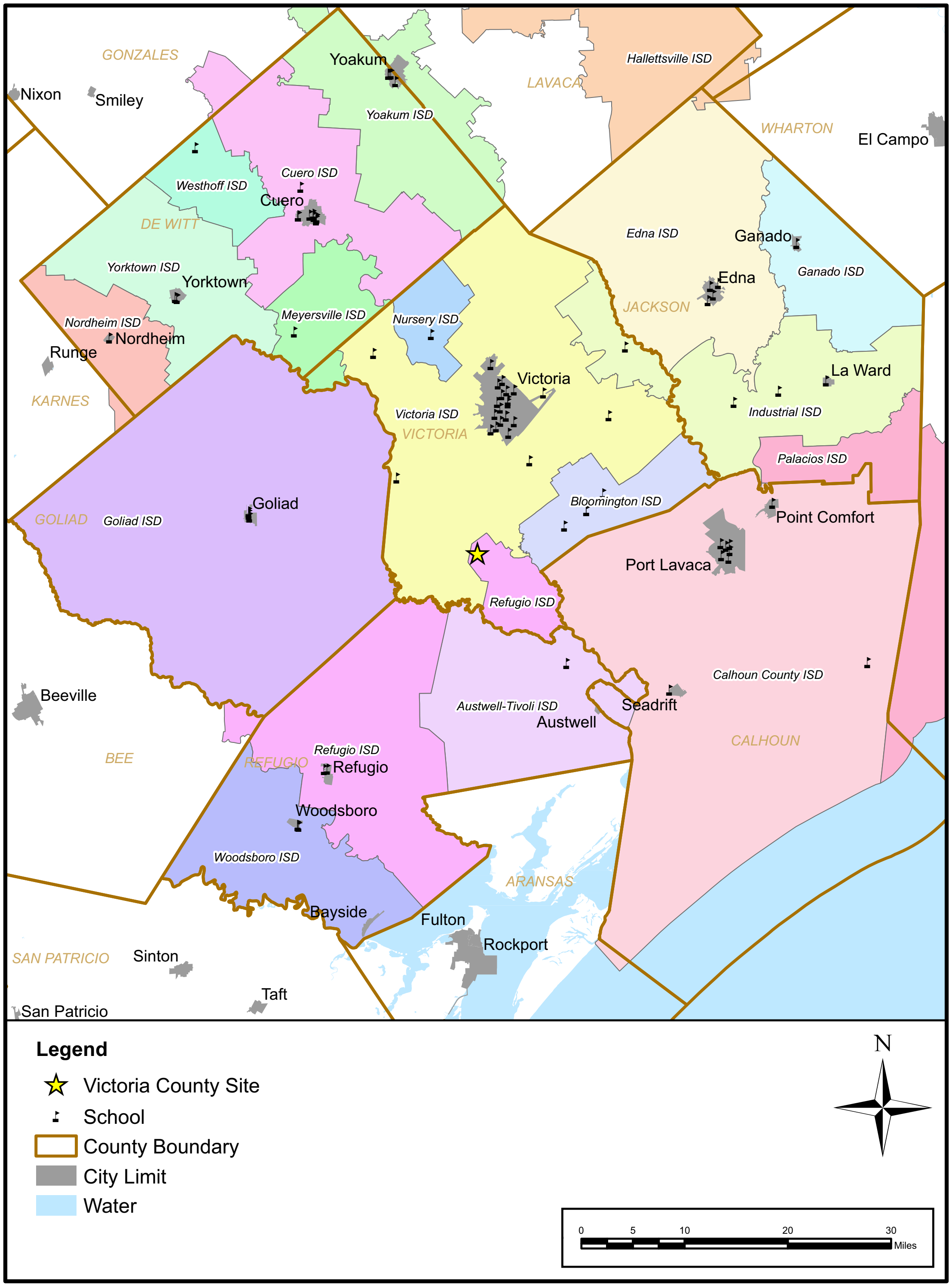


Figure 2.5.2-16 Public Schools and Independent School Districts

2.5.3 Historic Properties

2.5.3.1 Applicable Federal and State Historic Preservation Regulations

The NRC, a federal agency, would issue the early site permit for the VCS site; thus, the project is subject to review and consultation under the National Historic Preservation Act (16 U.S.C. § 470 et seq.). In particular, Section 106 of the Act applies, along with the section's implementing regulations, 36 CFR Part 800. These regulations apply to resources determined potentially eligible or eligible for listing on the National Register of Historic Places. The state of Texas' Government Code, Title 4, Chapter 442, Texas Historical Commission, Subsection 442.006(f) protects recorded Texas historic landmarks. State archeological landmarks are protected under the state of Texas' Natural Resources Code Title 9, Chapter 191, Antiquities Code. Historic Texas Cemeteries do not have specific protection. However, burials at any historic cemetery (dated post-1700) located on state, municipal, or private lands are protected by the Texas Health and Safety Code, Title 8, Chapters 694–715. Prehistoric burials located on state, municipal, or private lands do not have any additional protection, other than as an archaeological site, as addressed through the Antiquities Code.

The project currently does not include any federal land. If the transmission line corridor is routed in such a way that federal land is included in the right-of-way, then additional cultural resource regulations would pertain to cultural resources located on the federally owned land in the right-of-way. These regulations include the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 et seq.), Archaeological Resources Protection Act (16 U.S.C. 470aa–mm), American Indian Religious Freedom Act (42 U.S.C. 1996), and Archaeological and Historic Preservation Act (16 U.S.C. 469).

2.5.3.2 Consultation with the Texas Historical Commission

Exelon has consulted with the Texas Historical Commission (THC) and the Texas State Historic Preservation Officer regarding the project and cultural resource investigations associated with land selected for VCS and their results. Exelon held an initial meeting with the THC in December 2007 to introduce the site and to consult on planned Phase Ia investigations. The Phase Ia investigations would help define the areas of potential effect (APEs) for the project, and determine the follow-on Phase Ib (intensive inventory and initial evaluation) methodology for identifying historic properties (as defined in 36 CFR Part 800) and assessing the potential impact of the project on historic properties within the defined APEs. A copy of the Phase Ia report was provided to the THC in April 2008 for their review. Exelon then met with the THC to discuss the Phase Ia results and the proposed APEs and Phase Ib methodology. In May 2008, Exelon submitted a letter to the THC officially describing the proposed project APEs and Phase Ib investigation methodology (see A). The THC responded with a letter on May 8, 2008, concurring with the determination of the APEs and Phase Ib methodology (see A). The THC responded on May 29, 2008, with concurrence on the methodologies and findings presented in the Phase Ia report (see A). Exelon provided copies of the Phase Ib report and its recommendations concerning historic property identification and assessment of effect to the THC for review and consultation on February 13, 2009 (see A). As requested by the THC, additional copies were provided on April 1, 2009. The SHPO responded on April 30, 2009 with their comments. Exelon revised the Phase Ib report in accordance with the SHPO comments. The decision to include additional technologies in the plant parameter envelope necessitated additional investigations to reassess visual effects to historic properties. Exelon consulted with the THC in October 2009 regarding the methodology to reassess potential effects. The Phase Ib report was revised to include the new assessment and will resubmitted to the THC for review.

2.5.3.3 Cultural Resource Investigations

2.5.3.3.1 Phase Ia Investigations for the VCS Site and the Definition of the Site APEs and Phase Ib Methodology

In consultation with the THC, Exelon conducted Phase Ia investigations to help define the APEs and determine Phase Ib methodologies to identify historic properties and assess potential impacts. The Phase Ia investigations were conducted by Geo-Marine, Inc. personnel who meet and exceed the professional qualifications stipulated in the Secretary of the Interior’s *Standards and Guidelines for Archeology and Historic Preservation* (36 CFR Part 61) (48 FR 44716 – 44742). The Phase Ia investigations were overseen by Tetra Tech, Inc. personnel who also meet and exceed the professional qualifications stipulated in the Secretary of the Interior’s *Standards and Guidelines for Archeology and Historic Preservation.*

The Phase Ia investigations addressed the 11,532-acre VCS site and the vicinity within 10 miles surrounding the site. The Phase Ia investigations included background research, geoarchaeological investigations, line-of-sight analysis, and a windshield survey. Background research was conducted to identify previously recorded cultural resources located on and near the VCS site, to develop prehistoric and historic cultural contexts, to define the cultural landscape initially, and to identify areas as having low, moderate, or high potential to contain prehistoric and historic archaeological resources. A review of pertinent archaeological and historical resources records was conducted, which included the Texas Archeological Sites Atlas and Texas Historic Sites Atlas. A review was also conducted of primary sources such as historic maps and historic pictorial publications, and secondary sources such as published archaeological and historic research concerning the region, county histories, research monographs, and previous cultural resource investigations. Knowledgeable people from the area, including the McCan ranch owner, ranch workers, the Coastal Bend Museum in Victoria, a THC-designated site steward, and the head of the Victoria County Historical Commission were contacted for their insights into possible historical resources located in the APEs. Geoarchaeological investigations were conducted through excavation of backhoe trenches located across the VCS site and analysis of exposed soil profiles to identify soil structures with the potential to contain archaeological resources, specifically with a focus on dynamic Holocene-aged depositional environments. The area surrounding the site, in which historic properties could have a view of the VCS structures, was determined by a line-of-sight analysis that was conducted using GIS and considered site topography, distance, and proposed structures. A windshield survey to locate historic structural resources was conducted in the area within 10 miles of the site to further clarify potential line-of-sight with regard to topography, vegetation, and orientation, and to perform initial identification of historic-age (i.e., greater than 50 years) properties.

Two APEs for historic properties were identified by the Phase Ia investigations that could potentially be affected by the construction of VCS: (1) the APE for physical disturbances and (2) the APE for visual effects (Figure 2.5.3-1). The APE for physical disturbances was estimated to be about 9,431 acres on site based on the anticipated location and extent of areas required for all VCS construction activities within the 11,532-acre site. A buffer area along the cooling basin's east side was included in this APE to capture additional area that could potentially receive indirect impacts during construction activities.

The Phase Ia report recommended a strategy for the Phase Ib archaeological survey of the APE for physical disturbances. The Phase Ia investigations determined that much of the site is located on a Pleistocene terrace, where the antiquity and relative geological stability of the formation tend to result in low potential for buried or intact surface archaeological resources. The strategy included a 10 percent sample survey of these uplands (806 acres), with one shovel test measuring approximately 1 foot in diameter and 2.6 feet deep excavated every 2 acres. A more intensive survey was recommended around a wetland area (248 acres) and along the lower, deeply incised portion of Dry Kuy Creek (248 acres), with shovel testing in a 30-meter grid. An intensive archaeological survey was also recommended for four valley margin locations (248 acres) where background research had indicated the presence of historic homesteads. These four locations would include shovel testing in a standard 30-meter grid and metal detector surveys over the areas. All of these areas (a total of 1550 acres) are in the APE for physical disturbances (Figure 2.5.3-2). Finally, the Guadalupe River valley margin along the eastern side of the site was identified in the Phase Ia investigations as an area with significant potential for buried cultural material. Based upon its designation as a high potential area, an intensive survey strategy, including shovel testing in a 30-meter grid and targeted backhoe trenching, was recommended for this area. Only the western portion of the valley margin area included in the Phase Ia investigations was included in the APE for physical disturbances.

The APE for visual effects to historic property settings extends 10 miles beyond the VCS facilities, including the power block structures and the dikes surrounding the cooling water basin. This 10-mile radius APE was recommended in the Phase Ia report based on investigations using GIS line-of-sight analysis, complemented by field visits to identify topography, orientation, vegetation, and distance factors. It was found that by 10 miles, potential visibility of proposed VCS structures would be diminished because of changes in elevation gradient, back slopes, and land cover. The Phase Ia report recommended a Phase Ib strategy of intensive windshield survey covering all accessible roads in the APE to identify potentially eligible architectural properties and to assess visual impact. The Phase Ia report also recommended recording and evaluating the rural historic landscape as a resource. The strategy recommended for this study included archival research, field survey, and ethnographic interviews.

Exelon provided the Phase Ia investigations report to the THC for review, and met with the THC in April 2008 to discuss the results and the proposed Phase Ib methodology. Exelon submitted a letter to the THC formally proposing the two APEs and the Phase Ib methodology. The THC responded with a letter on May 8, 2008, concurring with the determination of the APEs and Phase Ib methodology. The THC responded on May 29, 2008, with concurrence on the methodologies and findings included in the Phase Ia report.

2.5.3.3.2 Phase Ib Investigations for the VCS Site

Exelon conducted the Phase Ib investigations of the VCS site from May 12 to June 17 of 2008. The methodology implemented complied with the methodology proposed in the Phase Ia report, which was concurred with by the THC and is described in Subsection 2.5.3.3.1. Exelon provided copies of the Phase Ib report and its recommendations concerning historic property identification and assessment of effect to the THC for review and consultation on February 13, 2009 (see A). Per THC's request, additional copies were provided on April 1, 2009. The SHPO responded on April 30, 2009 with their comments. Exelon revised the Phase Ib report in accordance with the SHPO comments. The decision to include additional technologies in the plant parameter envelope necessitated additional investigations to reassess visual effects to historic properties. Exelon consulted with the THC in October 2009 regarding the methodology to reassess potential effects. The Phase Ib report was revised to include the new assessment and will be resubmitted to the THC for review.

2.5.3.3.3 Definition of APEs and Phase Methodologies for Offsite Areas

Phase 1 investigation activities for offsite corridors will be conducted at the COL stage. Exelon will consult with the THC regarding the APEs and investigation methodologies after the corridors for the cooling basin blowdown pipeline and RWMU pipeline have been identified or confirmed.

2.5.3.3.4 Transmission Line Study Area

Identification of cultural resources in the transmission line corridor is considered separately from other offsite areas described above in Subsection 2.5.3.3.3. The specific location of the transmission line right-of-way has not yet been determined. Once a location has been determined by the Public Utility Commission of Texas, and before initiation of construction activities, cultural resource investigations would be conducted by the transmission service provider to identify historic properties and assess the effects to these properties from constructing the transmission line in the vicinity.

A study was conducted for the transmission line area to identify known cultural resources. The study included research in the National Register of Historic Places, county architecture survey files, historic architecture reports on file at the THC, Texas Historic Sites Atlas, and Texas Archaeological Sites Atlas. Results are reported below in Subsection 2.5.3.9.

2.5.3.4 Cultural Resources in the Two VCS Site APEs

2.5.3.4.1 Resources in the APE for Physical Disturbances

The archaeological survey and shovel testing of the upland, wetland, and Dry Kuy Creek areas of the VCS site did not reveal prehistoric or historic cultural materials. All excavated shovel tests were able to reach subsoil, thus deep trenching via backhoe was not necessary.

The archaeological survey within the Guadalupe River valley margin and the four historic homestead areas of the VCS site resulted in discovery of three prehistoric sites, two historic sites, and three prehistoric localities. A site was defined when materials were recovered from two or more shovel tests or, for surface material, when five or more artifacts were found within a 20-meter square area. Artifact clusters not meeting the criteria for site were given the designation “locality.” All eight of the identified resources were recommended as not eligible for the National Register of Historic Places due to lack of integrity, lack of intact features, and/or low artifact density. The eight resources are listed in Table 2.5.3-1.The SHPO concurred with the findings of the archaeological survey and agreed that all eight resources are not eligible for listing on the National Register of Historic Places (A).

2.5.3.4.2 Resources in the APE for Visual Effects

The survey of the visual effects APE, which is a 10-mile radius surrounding the VCS site, recorded 468 historic resources, including individual buildings and structures, farmsteads, and homesteads. Of the 468 historic resources, 53 are recommended as eligible for listing on the National Register of Historic Places. These eligible historic properties are clustered in the locations of McFaddin, Tivoli, Guadalupe, and Victoria. They include 34 domestic dwellings, 9 agricultural outbuildings, 3 businesses, 1 cemetery, 3 churches, 1 school, 1 bridge, and 1 post office. Thirty-six of the 53 historic properties comprise a proposed Town of McFaddin Historic District.

2.5.3.4.3 Rural Historic Landscape

The Phase Ib investigations included identifying, recording, and evaluating the McFaddin Ranch Rural Historic Landscape. This landscape includes the entire physical disturbances APE. The

McFaddin Ranch is recommended as eligible for listing on the National Register of Historic Places under Criteria A and B for its associations with the cattle ranching and petroleum industries and with James A. McFaddin and Claude K. McCan, Sr. The period of significance extends from 1878, when James McFaddin established the ranch, to 1968, when the Victoria cattle breed received official recognition. The resource is comprised of the natural landscape and many ranching and petroleum industry features located on the ranch, including the road network, windmills, cisterns, water troughs, water features, creeks, culverts, bridges, gates, fences, cattle guards, well heads, and pipelines. A total of 96 such features date to the period of significance and are considered contributing features to the historical significance of this rural historic landscape.

The full results of the Phase Ib investigations will be provided for NRC review upon THC concurrence, after the submission of this ESP application.

2.5.3.5 Cultural Resources in the Offsite Areas

The results of the Phase I investigations in the offsite areas will be incorporated at the COL stage. The full results of the Phase I investigations in the VCS offsite areas will be provided as part of the COL application.

2.5.3.6 Native American Consultation

Exelon consulted with the THC to identify Native American groups who consider themselves to be culturally affiliated with the area that encompasses the VCS site and offsite areas. The information provided by the THC led to the identification of six groups with potential cultural concerns within the VCS site and offsite project areas. These groups include the Alabama-Coushatta Tribe of Texas, Comanche Tribe of Oklahoma, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, Tonkawa Tribe of Oklahoma, and the Wichita and affiliated tribes.

2.5.3.7 Significant Cultural Resources within 10 Miles of the VCS Site

There are five types of designations in Texas to recognize and protect significant historic and prehistoric properties—two are federal and three are state designations. The National Park Service designates areas as National Historic Landmarks and properties listed on the National Register of Historic Places. The THC offers three designations: recorded Texas historic landmark, state archeological landmark, and historic Texas cemetery. Each of the four counties within 10 miles of the site (Victoria, Goliad, Refugio, and Calhoun) has a County Historical Commission, but they do not have their own designations, nor do they maintain a separate listing of important cultural properties.

A search of records maintained by the National Park Service, THC, and Texas Archeological Research Laboratory was conducted to identify significant cultural resources located within 10 miles of the site. Forty-six such resources were identified and are described below.

The National Register, which is maintained by the National Park Service, is the official list of national historic landmarks and National Register properties. There are no National Historic Landmarks or National Register-listed properties within 10 miles of the VCS site (NPS 2008a and 2008b).

The Texas Historic Sites Atlas, which is maintained by the THC, contains the lists of recorded Texas historic landmarks and historic Texas cemeteries located in Victoria, Refugio, Calhoun, and Goliad counties (THC 2008a, 2008b, 2008c, and 2008d). There are no designated Historic Texas Cemeteries within 10 miles of the VCS site. There are four landmarks within the 10 miles. These four properties are listed in Table 2.5.3-2.

The Texas Archeological Research Laboratory is located at the University of Texas at Austin. This facility maintains the records of state archeological landmarks and records of all previously recorded archeological sites located in the state. There are no state archeological landmarks within 10 miles of the VCS site. There are 42 previously recorded archaeological sites located within 10 miles of the site. These sites are listed in Table 2.5.3-3.

2.5.3.8 Significant Cultural Resources within 1.2 Miles of the Offsite Areas

A search of records maintained by the National Park Service, THC, and Texas Archeological Research Laboratory was conducted to identify significant cultural resources located within 1.2 miles of the offsite areas, including the cooling basin blowdown pipeline and RWMU pipeline. There are no national historic landmarks, National Register-listed properties, recorded Texas historic landmarks, historic Texas cemeteries, or state archeological landmarks within a 1.2-mile radius of the offsite areas (NPS 2008a and 2008b; THC 2008a, 2008b, 2008c, and 2008d).

There are no previously recorded archaeological sites located within 1.2 miles of the RWMU pipeline Routes A or B. There is one previously recorded site within 1.2 miles of Route C, site 41VT88, which is a prehistoric lithic scatter. There are two previously recorded sites within 1.2 miles of the cooling basin blowdown pipeline. Site 41VT99 is a prehistoric camp and quarry, and site 41VT102 is a prehistoric lithic scatter.

2.5.3.9 Cultural Resources in the Transmission Line Study Area

The research of previously recorded cultural resources in the transmission line study area identified 121 historic architectural resources, 44 cemeteries, 45 recorded Texas historic landmarks, and 241 archaeological sites, of which 30 are state archeological landmarks. The more recently added transmission line from VCS to the Cholla substation, 20 miles north of VCS, was addressed as a separate study area, and that study area is discussed at the end of this section.

The 121 historic architectural resources were identified during a series of county-wide surveys conducted under the supervision of the THC. Generally, these county-wide building surveys represent a non-systematic attempt to document what were considered to be historically and architecturally significant structures. Thus, each of the architectural resources examined is listed on the National Register of Historic Places. The resources include mostly homes, but also courthouses, religious buildings (churches, temples), commercial buildings, a school, a windmill, and four historic districts. The resources are located in the towns of Victoria (111), Goliad (9), and Edna (1).

The 44 cemeteries are located in the counties of Victoria (9), Goliad (3), Jackson (26), Matagorda (5), and Wharton (1).

The 45 Recorded Texas Historic Landmarks include some of the historic architectural resources and cemeteries discussed above, plus others. The landmarks include homes, cemeteries, religious buildings, townsites, places of important events such as duels and battles, and community buildings.

The 241 archaeological sites come from both the historic and prehistoric periods. There are a total of 72 sites pertaining to the historic period, 16 to both the prehistoric and historic periods, and 153 to the prehistoric period. Of the 153 prehistoric sites identified, 43 were either potentially eligible for the National Register, already listed on the National Register, or recommended for further work to clarify their eligibility for the National Register. Seventy-nine sites have no recommendation at all. The remaining 31 sites were either recommended for no further work or not eligible for inclusion on the National Register. Many of the sites were identified and excavated in the 1960s and 1970s during the early days of compliance with the National Historic Preservation Act. Accordingly, the National Register assessments for these sites are often problematic because they are rarely clearly defined, if defined at all. Prehistoric site types represented include occupation or campsites, shell middens, lithic or other artifact scatters, and quarries. These prehistoric archaeological sites are located in Victoria (36), Goliad (27), and Jackson (90) Counties.

Historic archaeological sites consist of artifact scatters, house sites, cemeteries, a kiln, a fort, a battlefield, a shipwreck, and a bridge. Of the 72 historic sites identified, 32 were either potentially eligible for the National Register, already listed on the National Register, or recommended for further work to clarify their eligibility for the National Register. Nineteen of the sites have no recommendation at all. The remaining 21 sites were either recommended for no further work or not eligible for inclusion on the National Register. These historic archaeological sites are located in the counties of Victoria (9), Goliad (1), and Jackson (62).

The 16 combination prehistoric/historic sites include prehistoric and historic artifact scatters, historic houses, and a historic cemetery. Eleven of the sites are either recommended for further work or potentially eligible for the National Register. Three had no recommendation at all, and two were recommended for no further work. These archaeological sites are located in the counties of Victoria (3), Goliad (1), and Jackson (12).

Of the 241 archaeological sites located in the transmission corridor study area, 30 were deemed to be sufficiently significant to be listed as state archeological landmarks. However, of these 30 landmarks, only two are listed on the National Register and only two others are recommended for further work to clarify their National Register status. Of the remaining 26, four have a recommendation of “no further work” while the remaining 22 have no National Register recommendation. The landmarks consist of 26 prehistoric sites, three historic sites, and a combination prehistoric/historic site. The landmarks include prehistoric lithic scatters, shell middens, campsites, historic houses, cemeteries, artifact scatters, a fort, and a steamboat. The state archeological landmarks are located in the counties of Goliad (19), Jackson (1) and Victoria (10).

The VCS to Cholla study area contains no historic structures, 12 cemeteries, and 96 archaeological sites. The archaeological sites are spread between the counties of DeWitt (13), Goliad (13), and Victoria (70).

The distribution of archaeological sites within the transmission corridor study area is skewed because only a small portion of the study area has been surveyed, resulting in incomplete survey coverage and data. Approximately 12 percent fall in Goliad County, another 35 percent fall in Victoria County, 4 percent are in DeWitt County, and the remaining 49 percent fall in Jackson County. Although incomplete coverage may skew the site distribution, some general patterns have been observed in the distribution of sites. Prehistoric sites tend to cluster near water sources, such as river floodplains, and natural resources, like chert outcroppings, while historic archaeological sites will group around transportation centers, like railroads and bridges. However, agricultural sites associated with the historic period can be more widely spread. Sites from both the prehistoric and historic periods are prevalent on high, level land within a short distance to a reliable water source.

A smaller recommended corridor, approximately 3 miles wide, was delineated in the study area in response to environmental resource location data, including the locations of the cultural resources described above for the study area. This smaller corridor avoids most of the known cultural resources described above by avoiding high resource concentration areas around Coleto Creek Reservoir and Lake Texana. This corridor also minimizes drainage crossings, which is important for cultural resources because, in this region, drainage crossings tend to have a high potential for archaeological sites. Finally, the smaller corridor also minimizes the proximity to developed areas such as towns. This is important for cultural resources because developed areas are where important architectural resources are likely to be located.

2.5.3.10 References

NPS 2008a. National Park Service, *National Historic Landmarks Survey, Listing of National Historic Landmarks by State, Texas (46)*, available at http://www.nps.gov/history/nhl/designations/listsofNHLs.htm, accessed April 9, 2008.

NPS 2008b. National Park Service, *National Register of Historic Places, Victoria County, Goliad County, Calhoun County, and Refugio County*, available at http://www.nr.nps.gov/iwisapi/explorer.dll/x2_3anr4_3aNRIS1/script/report.iws, accessed April 7, 2008.

THC 2008a. Texas Historical Commission, *Texas Historic Sites Atlas, Victoria County*, available at http://atlas.thc.state.tx.us, accessed April 7, 2008.

THC 2008b. Texas Historical Commission, *Texas Historic Sites Atlas, Refugio County*, available at http://atlas.thc.state.tx.us, accessed April 7, 2008.

THC 2008c. Texas Historical Commission, *Texas Historic Sites Atlas, Calhoun County*, available at http://atlas.thc.state.tx.us, accessed April 7, 2008.

THC 2008d. Texas Historical Commission, *Texas Historic Sites Atlas, Goliad County*, available at http://atlas.thc.state.tx.us, accessed April 7, 2008.

Table 2.5.3-1
Recorded Archaeological Resources on the VCS Site

Resource Identifier	Size (m^2)	Temporal Affiliation	NRHP Eligibility
VCS-001	7,225	Historic 19th century	Not eligible
VCS-002	2,700	Historic 19th century	Not eligible
VCS-003	10	Unspecified prehistoric	Not eligible
VCS-004	100	Unspecified prehistoric	Not eligible
VCS-005	200	Unspecified prehistoric	Not eligible
Locality 1	10	Unspecified prehistoric	Not eligible
Locality 2	10	Unspecified prehistoric	Not eligible
Locality 3	20	Unspecified prehistoric	Not eligible

Table 2.5.3-2
Recorded Texas Historic Landmarks Within 10 Miles of the VCS Site

Resource Name	Description	Location	Approximate Distance to Site
McFaddin Mercantile	1910 board-and-batten building	McFaddin	½ mile S
McFaddin Post Office	1913 board-and-batten building	McFaddin	½ mile S
Infant Jesus of Prague Catholic Church	1916 redwood church	McFaddin	½ mile S
T-C Ranch House	1874 ranch house	US 77, 25 miles north of Refugio	5 miles SW

Sources: THC 2008a, 2008b

Table 2.5.3-3 (Sheet 1 of 2)
Previously Recorded Archaeological Sites within 10 Miles of the VCS Site

Site Number	Description	County
41CL59	Archaic shell midden, lithic scatter	Calhoun
41CL60	Archaic shell midden, artifact scatter	Calhoun
41CL61	Archaic shell midden	Calhoun
41CL62	Archaic shell midden, scatter of lithic, bone, and ceramic artifacts	Calhoun
41CL63	Archaic shell midden, lithic scatter	Calhoun
41CL75	prehistoric shell midden	Calhoun
41CL76	prehistoric shell midden	Calhoun
41CL77	prehistoric shell midden, scatter of lithic, ceramic, and historic artifacts	Calhoun
41CL80	prehistoric shell midden	Calhoun
41GD136	prehistoric camp, lithic and bone scatter	Goliad
41GD137	Early Archaic camp, lithic scatter	Goliad
41GD138	prehistoric camp, lithic and bone scatter	Goliad
41RF15	prehistoric lithic scatter, 19th century homestead	Refugio
41RF17	prehistoric lithic scatter	Refugio
41VT9	prehistoric burials, artifact scatter	Victoria
41VT12	unknown	Victoria
41VT65	de la Garza homestead	Victoria
41VT78	prehistoric burial	Victoria
41VT79	prehistoric camp, artifact scatter	Victoria
41VT80	Eagles Roost, prehistoric shell midden, lithic scatter	Victoria
41VT81	prehistoric habitation, artifact scatter	Victoria
41VT82	prehistoric bone and lithic scatter	Victoria
41VT83	prehistoric artifact scatter	Victoria
41VT84	prehistoric shell midden	Victoria
41VT85	prehistoric shell midden, Clovis point	Victoria
41VT86	prehistoric shell midden, artifact scatter	Victoria
41VT87	prehistoric shell midden	Victoria
41VT88	prehistoric lithic scatter	Victoria
41VT89	unknown	Victoria
41VT94	Blue Bayou, prehistoric cemetery, prehistoric to historic habitation	Victoria
41VT95	prehistoric quarry	Victoria
41VT98	Archaic cemetery and habitation	Victoria
41VT99	prehistoric camp, quarry	Victoria
41VT101	prehistoric lithic scatter	Victoria
41VT102	prehistoric lithic scatter	Victoria
41VT103	prehistoric lithic scatter	Victoria
41VT113	Dalton Bridge	Victoria

Table 2.5.3-3 (Sheet 2 of 2)
Previously Recorded Archaeological Sites within 10 Miles of the VCS Site

Site Number	Description	County
41VT115	prehistoric lithic scatter	Victoria
41VT116	unknown	Victoria
41VT117	prehistoric lithic scatter	Victoria
41VT118	Civil War-era homestead	Victoria
41VT119	prehistoric shell midden, lithic scatter	Victoria

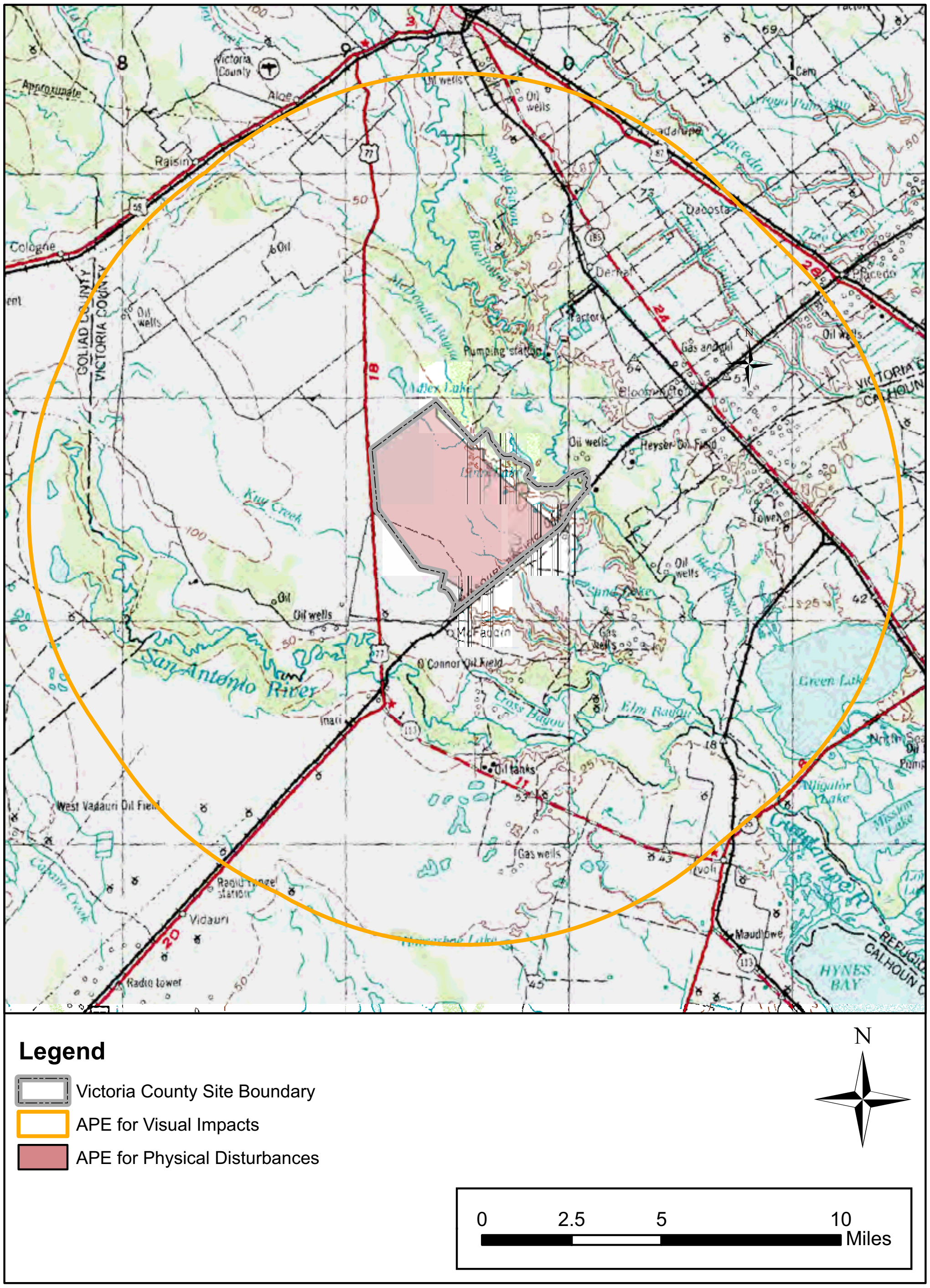


Figure 2.5.3-1 Areas of Potential Effect (APE)

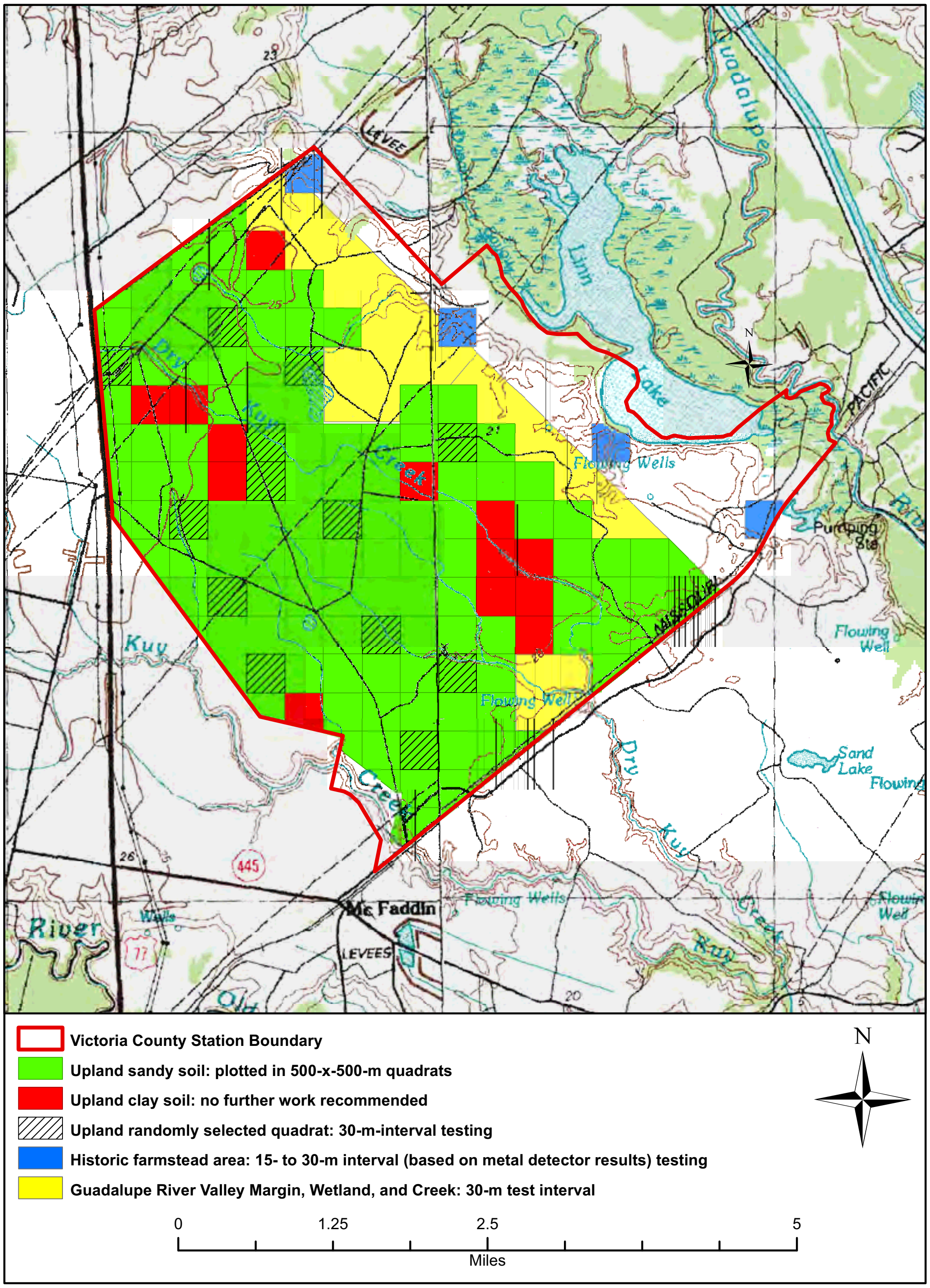


Figure 2.5.3-2 Location of Phase Ib Archaeological Survey Areas

2.5.4 Environmental Justice

2.5.4.1 Methodology

Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (U.S. EPA Feb 2008). Concern that minority and/or low-income populations might be bearing a disproportionate share of adverse health and environmental impacts led President Clinton to issue Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." This order directs federal agencies to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ Dec 1997). The NRC has also issued guidance on environmental justice analysis in "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" (U.S. NRC May 2004). Exelon used NRC guidance in determining the minority and low-income composition in the environmental impact area.

The NRC previously concluded that a 50-mile radius could reasonably be expected to contain the area of potential impact and that the state was appropriate as the geographic area for comparative analysis. The NRC's methodology identifies minority and low-income populations within the 50-mile region and then determines if these populations could receive disproportionately high adverse impacts from the proposed action. Exelon has adopted this approach for identifying the minority and low-income populations and associated impacts that could be caused by the proposed action. While this subsection identifies the locations of minority and low-income populations in the area surrounding the site, the potential adverse impacts to these groups from construction and operations are identified and discussed in Chapters 4 and 5, respectively.

Exelon used ArcGIS®[5] 9.2 software and U.S. Census Bureau (USCB) 2000 census data to determine minority and low-income characteristics by block group within 50 miles of the proposed VCS site (i.e., the environmental impact area). A census block group is a geographic unit used by the USCB, which is between the census tract and the census block. There are, on average, about 39 blocks in a block group. Exelon included a block group if any part of its occupied area fell within 50 miles of the proposed site. A total of 216 block groups were identified within the 50-mile area. Consistent with NRC guidance, Exelon defined the geographic area for comparative analysis as the state of Texas.

5. ®ArcGIS is a trademark of Environmental Systems Research Institute, Inc.

2.5.4.2 Minority Populations

The NRC's "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" defines minority categories as: American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black races, and Hispanic ethnicity (U.S. NRC May 2004). Additionally, the guidance states that "other" may be considered a separate category and requires that the multiracial and aggregate minority categories be analyzed separately. The guidance also indicates that a significant minority population exists if either of these two conditions exists:

- The minority population of the block group or environmental impact area exceeds 50 percent.
- The minority population percentage of the environmental impact area is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for comparative analysis.

Exelon calculated the percentage of the block group's population represented by each minority category for each of the 216 block groups within the 50-mile radius (the environmental impact area), using the USCB 2000 census data, and calculated the percentage in each minority category for the state. If the percentage of any block group minority category exceeded 50 percent of the total block group population or exceeded its corresponding state percentage by more than 20 percent, it was identified as containing a significant minority population.

Census data for Texas characterizes 11.5 percent of the population as Black or African American, 0.6 percent as American Indian or Alaskan Native, 2.7 percent as Asian, 0.1 percent as Native Hawaiian or other Pacific Islander, 11.7 percent as Other, 2.5 percent as multiracial (two or more races), 29.0 percent as aggregate of minority races, and 32.0 percent as Hispanic ethnicity (USCB 2000a).

Table 2.5.4-1 and Figures 2.5.4-1 through 2.5.4-5 present the results of the analysis. Three census block groups within the 50-mile radius have significant Black or African American populations. However, as shown in Figure 2.5.4-1, none of these block groups are located in Victoria County. One block group, located in Matagorda County, has a significant Asian minority population (Figure 2.5.4-2). Twelve block groups have a significant "Other" race population. As shown in Figure 2.5.4-3, the closest block groups for this category are located directly east of the site in Victoria County and in the city of Victoria.

Nine block groups within the 50-mile radius have significant aggregate minority population percentages (Figure 2.5.4-4). The closest of these are located directly east of the site and in the city of Victoria. Sixty-eight census block groups within the 50-mile radius have significant Hispanic ethnicity populations. Figure 2.5.4-5 shows the location of these block groups, many of which are located in Victoria County. Based on the two criteria established previously, no significant American

Indian or Alaskan Native, Native Hawaiian or other Pacific Islander, or multiracial minorities exist in the geographic area. In addition, there are no American Indian reservations within 50 miles of the Victoria County site.

Seasonal agricultural (migrant) workers may make up a portion of the minority population within the 50-mile radius. While migrant worker population counts are not available from USCB, the U.S. Department of Agriculture has collected information on farms that employ migrant labor. Farms in the following Texas counties, which fall wholly or partially within the 50-mile radius, employ migrant labor: Calhoun (2), Colorado (29), DeWitt (10), Goliad (1), Gonzales (7), Jackson (1), Lavaca (11), Matagorda (72), Nueces (13), Refugio (6), San Patricio (21), and Wharton (40). Aransas, Bee, Karnes, and Victoria counties did not report any farms employing migrant labor (USDA Jun 2004).

2.5.4.3 Low-Income Populations

The NRC guidance defines low-income households based on statistical poverty thresholds (U.S. NRC May 2004). A block group is considered low-income if either of the following two conditions is met:

- The low-income population in the census block group or the environmental impact site exceeds 50 percent.
- The percentage of households below the poverty level in an environmental impact site is significantly greater (typically at least 20 percentage points) than the low-income population percentage in the geographic area chosen for comparative analysis.

Exelon divided USCB low-income households in each census block group by the total number of households for that block group to obtain the percentage of low-income households per block group. Using the state of Texas as the geographical area for comparative analysis, Exelon determined that 14.0 percent of households are low-income in the state (USCB 2000b). Fourteen census block groups within the 50-mile radius have a significant percentage of low-income households. Table 2.5.4-1 identifies and Figure 2.5.4-6 locates the low-income block groups, none of which are in Victoria County.

2.5.4.4 Potential for Disproportionate Impacts

Exelon contacted local government officials and the staff of social welfare agencies concerning unusual resource dependencies or practices that could result in potentially disproportionate impacts to minority and low-income populations. Contact with multiple agencies in Calhoun, DeWitt, Jackson, Refugio, and Victoria counties was attempted. No appropriate agencies in Goliad County were identified. Many agencies had no information concerning activities and health issues of minority populations. Successful interviews were conducted with the Calhoun County Health Department, the

U.S. Department of Agriculture in Calhoun County, the DeWitt County Commerce and Health Department, Family Promise of Victoria, the Health Department of Victoria County, the Neighborhood Services Program in Victoria County, and the United Way of Victoria County. No agency reported dependencies or practices, such as subsistence agriculture, hunting, or fishing, or preexisting health conditions through which the populations could be disproportionately adversely affected by the construction project.

As Figure 2.5.4-2 shows, the area surrounding Palacios has an unusually high percentage of Asian Americans because it is home to a large community of Vietnamese immigrants and their families. Tens of thousands of Vietnamese settled along the Gulf and Atlantic coasts around 1978 to shrimp, crab, fish, and work in seafood processing and wholesaling (Tang Aug 2003). While many in the Vietnamese community make their living by catching seafood, the seafood is generally sold commercially rather than for personal sustenance. No unique preexisting health conditions were identified for this particular community.

2.5.4.5 References

CEQ Dec 1997. Council on Environmental Quality, *Environmental Justice Guidance Under the National Environmental Policy Act*, December 1997, Executive Office of the President.

Tang Aug 2003. I. Tang, *Still Shrimping: Vietnamese American Shrimpers 25 Years After the Second Wave*, August 29, 2003, Asian Week.

USCB 2000a. U.S. Census Bureau, *Census 2000 Redistricting Data (Public Law 94-171) Summary File, Texas Places*, available at http://factfinder.census.gov, accessed July 30, 2007.

USCB 2000b. U.S. Census Bureau, *DP-1 Profile of General Demographic Characteristics: 2000 Data Set: Census 2000 Summary File 1 (SF 1)*, available at http://factfinder.census.gov/, accessed November 1, 2007.

USDA Jun 2004. U.S. Department of Agriculture, *Texas State and County Data, 2002 Census of Agriculture, Volume 1, Geographic Area Series*, Part 43A, AC-02-A-43A, June 2004, National Agricultural Statistics Service.

U.S. EPA Feb 2008. U.S. Environmental Protection Agency, *Environmental Justice*. Available at http://www.epa.gov/compliance/environmentaljustice/index.html, accessed March 4, 2008.

U.S. NRC May 2004. U.S. Nuclear Regulatory Commission, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues*, NRR Office Instruction No. LIC-203, Revision 1, May 2004.

Table 2.5.4-1
Block Groups within 50 Miles of the Victoria County Station Site with Significant Minority or Low-Income Populations

County Name	Number of Block Groups	Black	American Indian or Alaskan Native	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial	Aggregate	Hispanic	Low-Income Households
Aransas	19	0	0	0	0	0	0	0	0	2
Bee	25	1	0	0	0	1	0	1	18	6
Calhoun	17	0	0	0	0	0	0	0	6	0
Colorado	1	0	0	0	0	0	0	0	0	0
De Witt	18	0	0	0	0	0	0	1	1	1
Goliad	6	0	0	0	0	0	0	0	2	0
Gonzales	2	0	0	0	0	0	0	0	0	0
Jackson	11	1	0	0	0	0	0	1	0	0
Karnes	6	1	0	0	0	0	0	1	3	0
Lavaca	7	0	0	0	0	0	0	0	0	0
Matagorda	8	0	0	1	0	2	0	1	2	0
Nueces	1	0	0	0	0	0	0	0	0	0
Refugio	9	0	0	0	0	0	0	0	2	1
San Patricio	21	0	0	0	0	2	0	0	11	4
Victoria	62	0	0	0	0	7	0	4	23	0
Wharton	3	0	0	0	0	0	0	0	0	0
TOTALS:	216	3	0	1	0	12	0	9	68	14

	Black	American Indian or Alaskan Native	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial	Aggregate	Hispanic	Low-Income Households
Texas Percentages	11.53	0.57	2.70	0.07	11.69	2.47	29.03	31.99	13.98

Note: Highlighted counties are completely contained within the 50-mile radius.

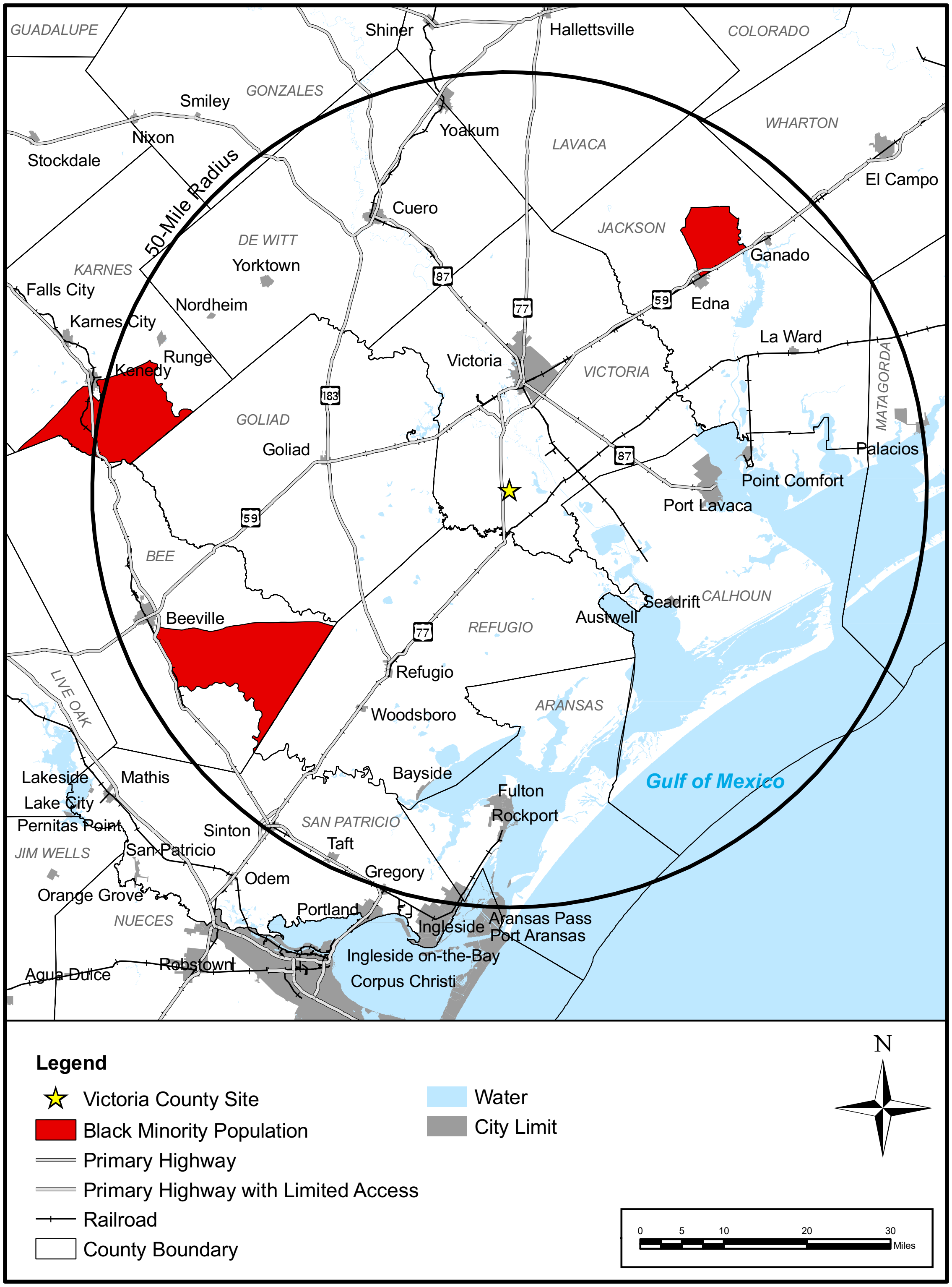


Figure 2.5.4-1 Black Population within the 50-Mile Region

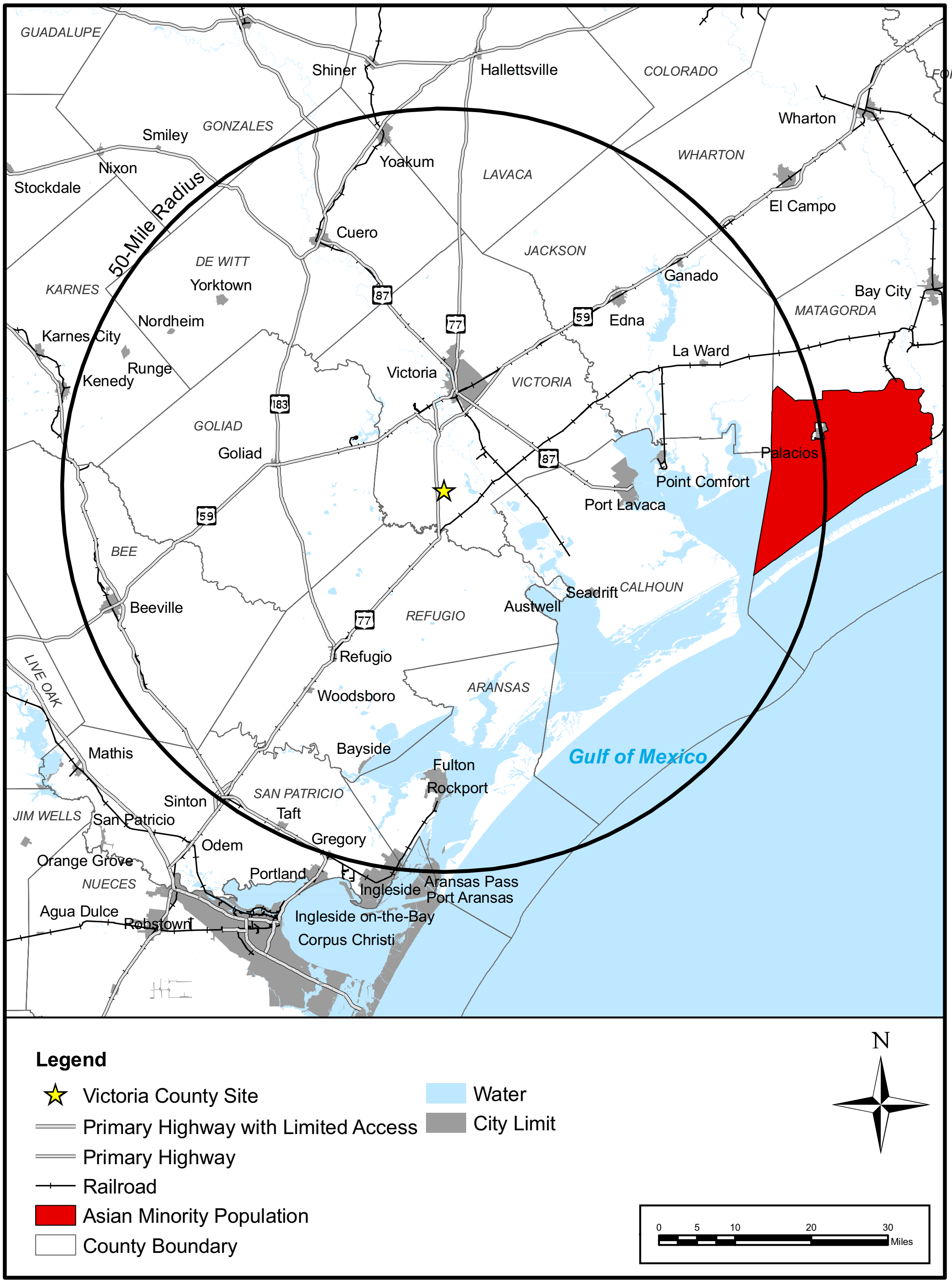


Figure 2.5.4-2 Asian Minority Population within the 50-Mile Region

Figure 2.5.4-3 Other Minority Population within the 50-Mile Region

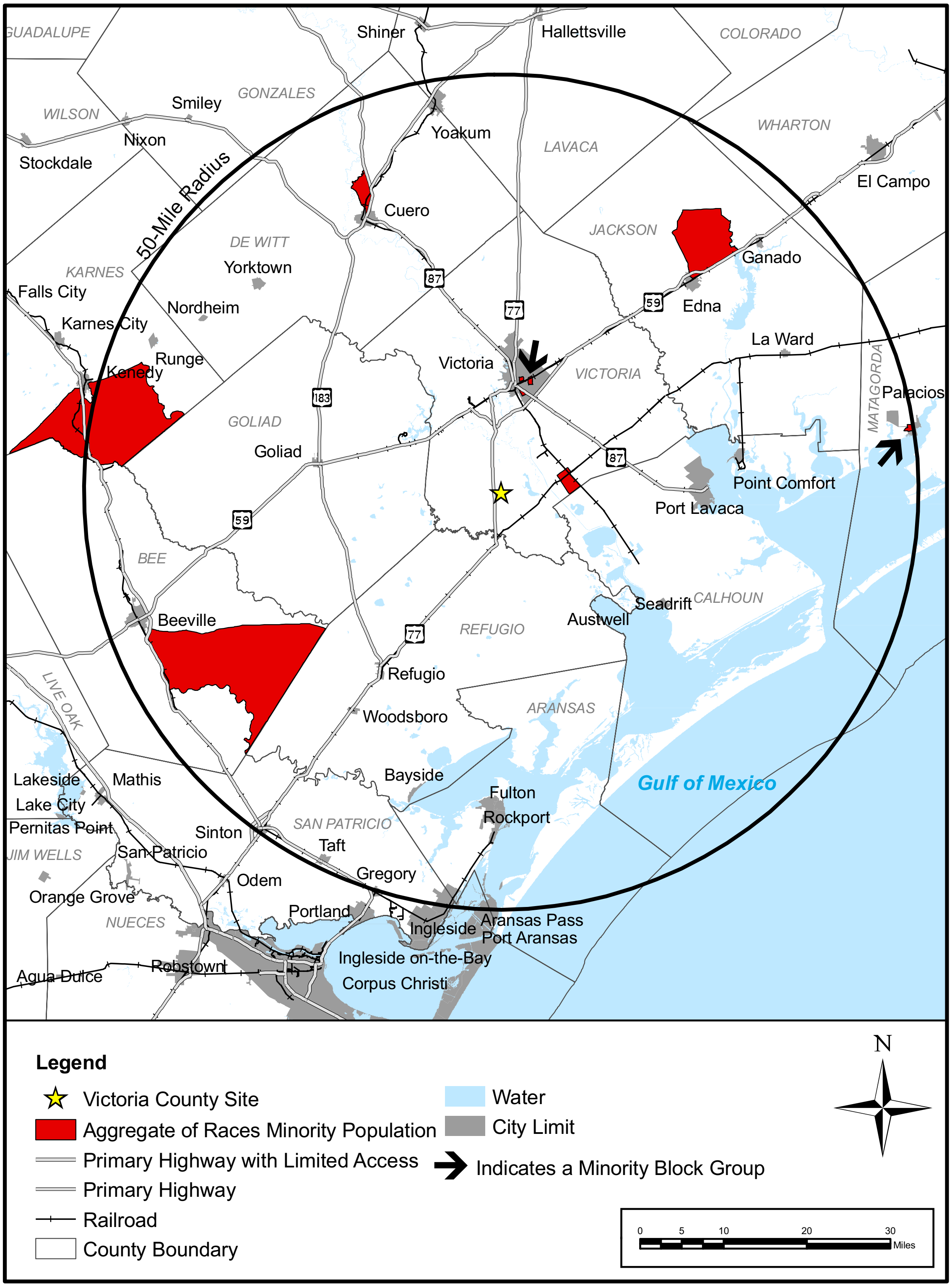


Figure 2.5.4-4 Aggregate of Races Minority Population within the 50-Mile Region

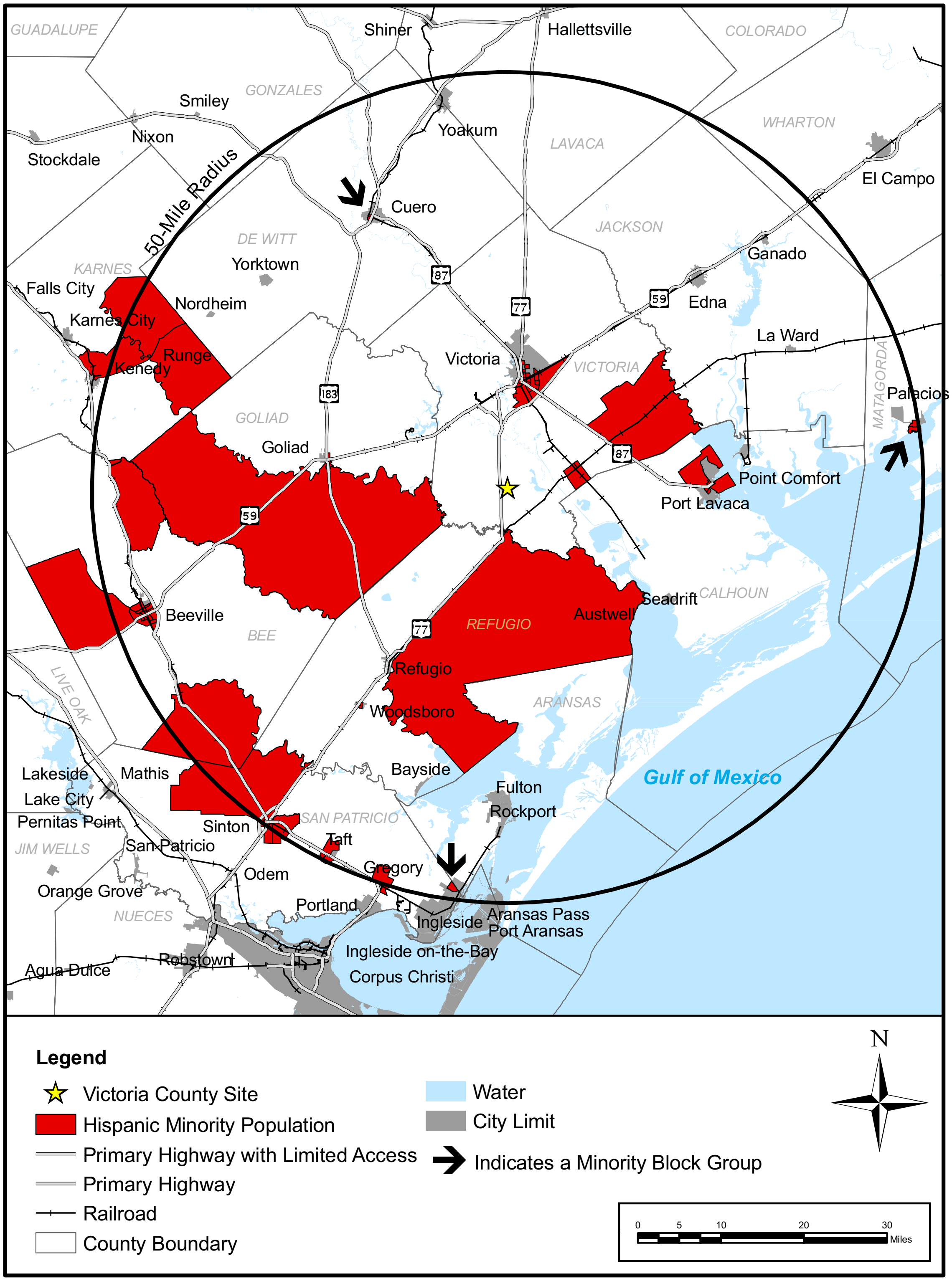


Figure 2.5.4-5 Hispanic Minority Population within the 50-Mile Region

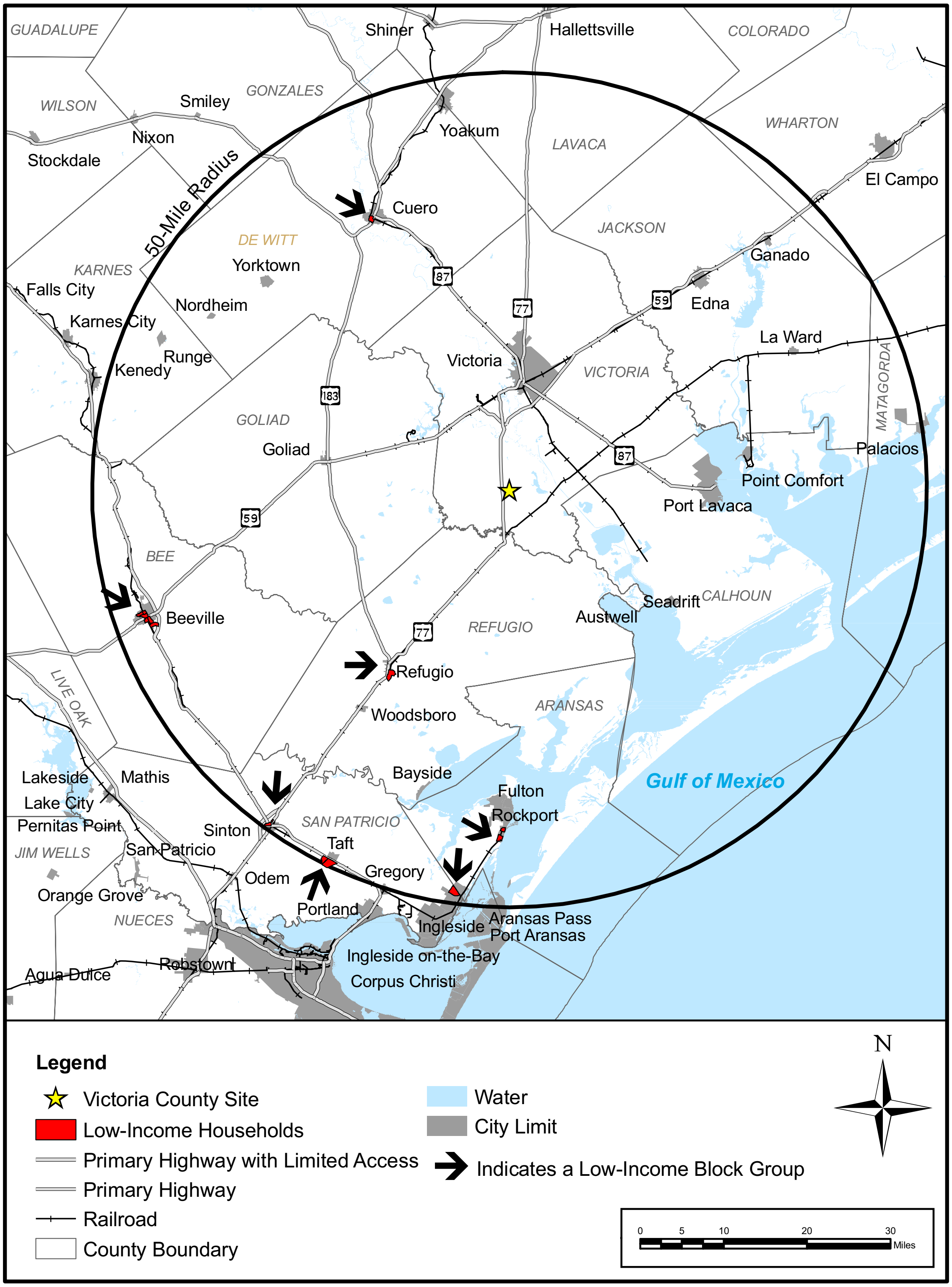


Figure 2.5.4-6 Low-Income Populations within the 50-Mile Region

Section 2.6 Table of Contents

Section 2.6 List of Figures

2.6 Geology

This section summarizes the geological conditions at the VCS site. The site information is subdivided into two categories: physiography and stratigraphy. An evaluation of how plant construction and operations activities or infrastructure could interact with the geological features at the site to produce adverse environmental impacts is also provided. The information provided in these sections has been developed in accordance with the guidance provided in Regulatory Guide 4.2, *Preparation of Environmental Reports for Nuclear Power Stations.*

The geological information in this section is based on the information contained in SSAR Subsection 2.5.1, *Basic Geologic and Seismic Information*.

2.6.1 Geological Conditions

2.6.1.1 Physiography

The VCS site covers an area of approximately 11,500 acres (46.5 km^2) and is located in Victoria County in southern Texas. The site area is located within the Gulf Coastal Plains physiographic province (Figure 2.6-1) (Texas Bureau of Economic Geology 1996). Topography in the vicinity of the VCS site is characteristic of the Gulf Coastal Plains with gently rolling terrain. The ground elevations at the site, before preconstruction and construction activities, range from approximately 85 feet (26 meters) North American Vertical Datum of 1988 (NAVD 88) in the north to about 65 feet (20 meters NAVD 88) in the south to slightly above 15 feet (4.6 meters NAVD 88) in the southeast where it borders the Guadalupe River.

The site is drained by ephemeral streams that form a dendritic drainage pattern. The longest stream on the site is Dry Kuy Creek, which has headwaters near the northwest corner of the site. It flows for more than 5 miles (8 km) and joins Kuy Creek about a half-mile south of the site boundary. This creek is an ephemeral tributary of the Guadalupe River; the Guadalupe River discharges into the San Antonio Bay about 7 miles (11 km) southeast of the confluence of the San Antonio and Guadalupe Rivers (Figure 2.6-2).

The eastern edge of the site is bounded by the Guadalupe River floodplain. The Union Pacific Railway right-of-way forms the southern boundary and Kuy Creek and U.S. Highway 77 forms the western boundary. The northern boundary is identified by a gravel ranch road about a half-mile north of the north gate to the VCS site. The VCS site is generally covered with grass, low-lying brush, or woodlands. The site is easily accessible by foot or standard vehicle.

The VCS units will be constructed at a present grade elevation of approximately 80 feet (24 meters). Engineered fill will be used to raise the plant grade elevation to a final grade elevation of approximately 95 feet (29 meters) NAVD 88 at the power block area.

2.6.1.2 Stratigraphy

The VCS site is underlain by Paleocene to Holocene age Coastal Plains sediments which are, in turn, underlain by about 21,000 feet (4 miles or 6.4 km) of Mesozoic age sediments above extended, thin continental basement. The Cenozoic age sediments are estimated to be over 20,000 feet (3.8 miles or 6 km). The only borings that have been advanced into the Cenozoic and Mesozoic sediments in the area are those drilled for petroleum exploration purposes. These borings are generally limited to depths of around 6000 feet below the ground surface. Figures 2.6-3 and 2.6-4 are generalized stratigraphic columns for the site and vicinity taken from published data. The site stratigraphy is described in more detail in SSAR Subsection 2.5.1.

The long-term southward migration of the Gulf shoreline has been overprinted in late Cenozoic time with relatively minor marine regressions and transgressions associated with sea level changes during glacial and interglacial periods. Within the site vicinity, some of these glacial cycles are recorded in the deposition of the Beaumont and Lissie formations (the major Pleistocene formations). Both formations were deposited during interglacial transgressions as facies of alluvial fan-delta systems.

The near-surface sediments in the Victoria County region belong to the Beaumont Formation. From the Louisiana/Texas border to the Rio Grande, the Beaumont Formation is recognized as a series of multiple, cross-cutting and/or superimposed incised stream channel fills and over-bank deposits formed during glacio-eustatic cycles (Blum and Aslan 2006). The Beaumont Formation is composed of poorly bedded, marly, reddish-brown clay interbedded with lenses of sand (Barnes 1992); its thickness beneath the VCS site is between 100–200 feet (30–61 meters) (Blum and Price 1998).

The older Lissie Formation crops out in the site vicinity as levee deposits, distributary sands, and flood basin mud with a combined thickness of roughly 200 feet (61 meters) (Barnes 1987). The formation was deposited in low energy depositional environments, resulting in clay-rich surfaces. The sub-aerially exposed Lissie surface is morphologically subdued and has a relatively uniform seaward dip of 4.4–6.6 feet per mile (0.8–1.3 meters per km). Where exposed at the ground surface, the distinct gradient of the Lissie Formation surface allows it to be easily distinguished from stratigraphically higher and chronologically younger units like the Beaumont Formation. The age of the top of the Lissie Formation is estimated to be about 700 thousand years (ka) (Winker 1979).

2.6.2 Geological Impacts

Based on the geological conditions at the VCS site (SSAR Subsections 2.5.1 and 2.5.3), there are no known geological conditions that could result in plant construction or operation adversely impacting the environment. This conclusion is based on the following:

- The absence of capable tectonic sources (SSAR Subsections 2.5.1.2 and 2.5.3) at the VCS site eliminates the possibility of seismological impacts, namely design exceedence ground shaking and surface fault rupture. Non-tectonic growth faults may be present at the site within the Cenozoic and Mesozoic age sediments. Surface faulting is not expected to occur as a result of construction or operation of the proposed facility.
- Surface settlement, as a result of facility construction, is expected to be insignificant. If settlement does occur, it can be mitigated by regrading the site during construction.
- The geologic strata are not subject to dissolution.
- Permanent dewatering during operations will not be required at the VCS site because the static water table is deep enough that further reduction is not necessary.
- Water supply wells at the site will supply groundwater to the plant for other than process cooling purposes. The wells will be constructed at depths of between about 500–700 feet (150–210 meters) below the ground surface. This may result in subsidence of the sediments underlying the plant. The amount of potential subsidence is related to change in piezometric head and the amount of clay underlying the site. A 1992 study performed by Camp Dresser & McKee estimates that the land surface subsidence in Victoria County would be 0.3 feet using unit-compaction coefficients derived for the Chicot and Evangeline aquifers in the Houston area. This estimate is consistent with the Texas Water Development Board regional study of subsidence (Ratzlaff 1982) estimate of less than 6 inches based on 1973 data. The 1982 value is attributed to production of oil and gas rather than groundwater withdrawal.
- There are no natural slopes proximal to the VCS construction site that could be adversely impacted by foundation excavation, loading resulting from construction of the proposed structures, or infiltration of precipitation as a result of surface modifications. The slopes associated with construction of the cooling basin will be considered in the design and construction of the cooling basin.
- Potentially adverse impacts that could result from the placement of fill at the VCS construction site plant area will be mitigated by earthwork design.

Some short-term geological conditions that could impact the environment associated with construction and operation of the plant are described below.

- Disposal of excavated material will likely be required either on site or offsite. Generally accepted methods will be used to mitigate the potential for erosion of this material at the disposal site.
- Temporary dewatering of foundation excavations may impact groundwater levels in the water table aquifer. These impacts are described in Subsection 4.2.1.2.

2.6.3 References

Barnes, 1987. Barnes, V.E., *Geologic Atlas of Texas Beeville-Bay City Sheet*, Bureau of Economic Geology, University of Texas, 1987.

Barnes, 1992. Barnes, V.E., *Geologic Map of Texas*, Bureau of Economic Geology, University of Texas, 1992.

Blum and Aslan, 2006. Blum, M. D., and Aslan, A., *Signatures of Climate vs. Sea-Level Change within Incised Valley-Fill Successions: Quaternary Examples from the Texas Gulf Coast, Sedimentary Geology*, v. 190, p. 177-211, 2006.

Blum and Price, 1998. Blum, M., and Price, D.M., *Quaternary Alluvial Plain Construction in Response to Glacio-Eustatic and Climatic Controls, Texas Gulf Coastal Plain, Relative Role of Eustacy, Climate, and Tectonism in Continental Rocks*, Special Publication 59, p. 31-48, Society for Sedimentary Geology, 1998.

Camp Dresser & McKee, 1992. Camp Dresser & McKee, *Regional Water Supply Plan for the City and county of Victoria*, Texas Water Development Board Contracted Report 91483588, 1992.

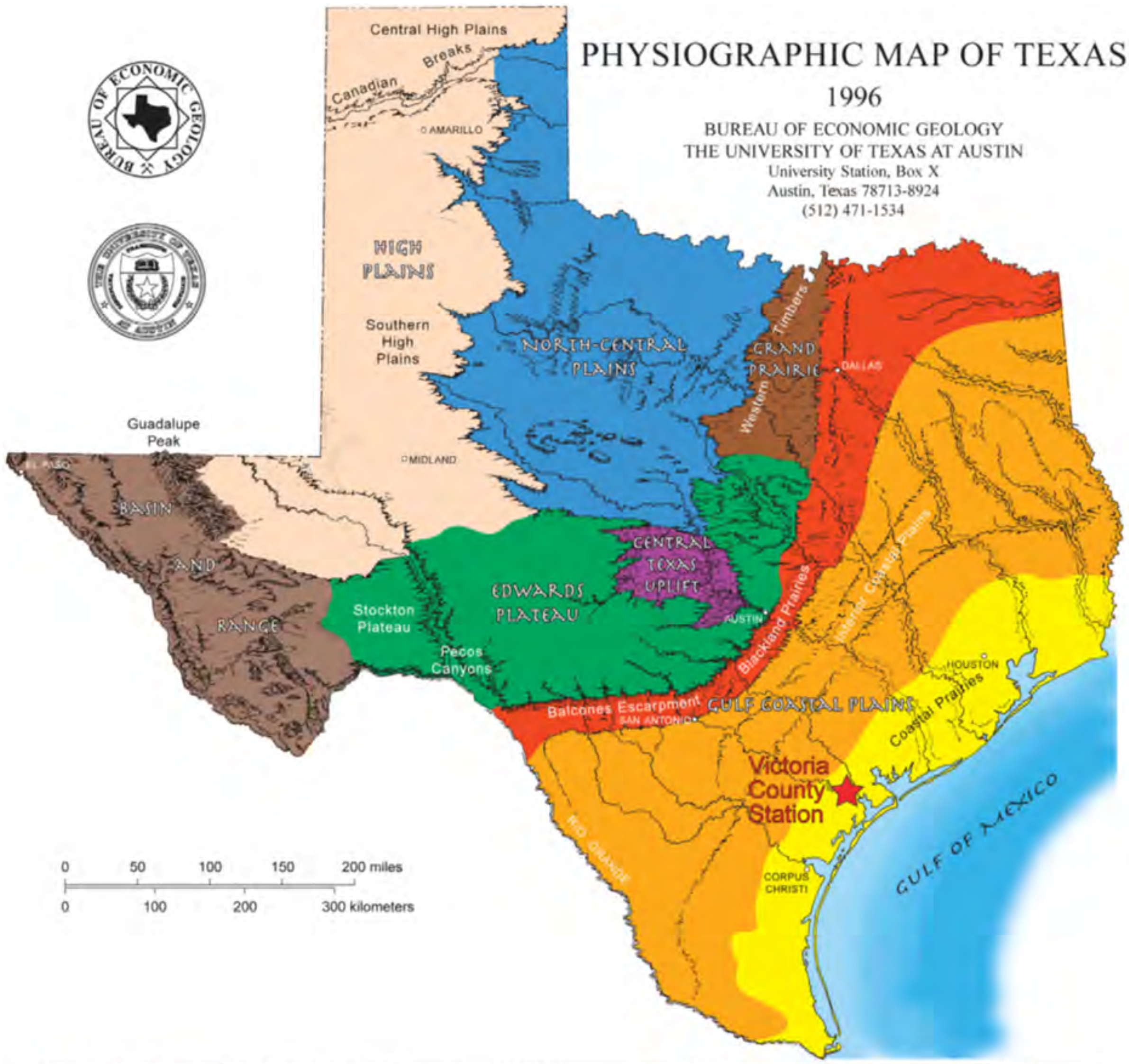
Ratzlaff 1982. Ratzlaff, K.W. *Land Surface Subsidence in the Texas Coastal Region, Texas Department of Water Resources, Report 272*, 1982.

Texas Bureau of Economic Geology, 1996. Texas Bureau of Economic Geology, *Physiographic Map of Texas*, University of Texas, 1996.

USGS, 1978. USGS, Quadrangle Topographic Map of Beevile (1:250,000), 1978.

USGS, 1975. USGS, Quadrangle Topographic Map of Seguin (1:250,000), 1975.

Winker, 1979. Winker, C.D., *Late Pleistocene Fluvial-Deltaic Deposition: Texas Coastal Plain and Shelf* [MA thesis], University of Texas, 1979.



PROVINCE	MAX. ELEV. (ft)	MIN. ELEV. (ft)	TOPOGRAPHY	GEOLOGIC STRUCTURE	BEDROCK TYPES
Gulf Coastal Plains					
Coastal Prairies	300	0	Nearly flat prairie, <1 ft/mi to Gulf	Nearly flat strata	Deltaic sands and muds
Interior Coastal Plains	800	300	Parallel ridges (questas) and valleys	Beds tilted toward Gulf	Unconsolidated sands and muds
Blackland Prairies	1000	450	Low rolling terrain	Beds tilted south and east	Chalks and marls
Grand Prairie	1250	450	Low stairstep hills west; plains east	Strata dip east	Calcareous east; sandy west
Edwards Plateau					
Principal	3000	450	Flat upper surface with box canyons	Beds dip south; normal faulted	Limestones and dolomites
Pecos Canyons	2000	1200	Steep-walled canyons		Limestones and dolomites
Stockton Plateau	4200	1700	Mesa-formed terrain; highs to west	Unfaulted, near-horizontal beds	Carbonates and alluvial sediments
Central Texas Uplift	2000	800	Knobby plain; surrounded by questas	Centripetal dips, strongly faulted	Granites; metamorphics; sediments
North-Central Plains	3000	900	Low north-south ridges (questas)	West dip; minor faults	Limestones; sandstones; shales
High Plains					
Central	4750	2900	Flat prairies slope east and south	Slight dips east and south	Eolian silts and fine sands
Canadian Breaks	3800	2350	Highly dissected; local solution valleys		
Southern	3800	2200	Flat; many playas; local dune fields		
Basin and Range	8750	1700	North-south mountains and basins	Some complex folding and faulting	Igneous; metamorphics; sediments

Source: Texas Bureau of Economic Geology, 1996

Figure 2.6-1 Map of Physiographic Provinces

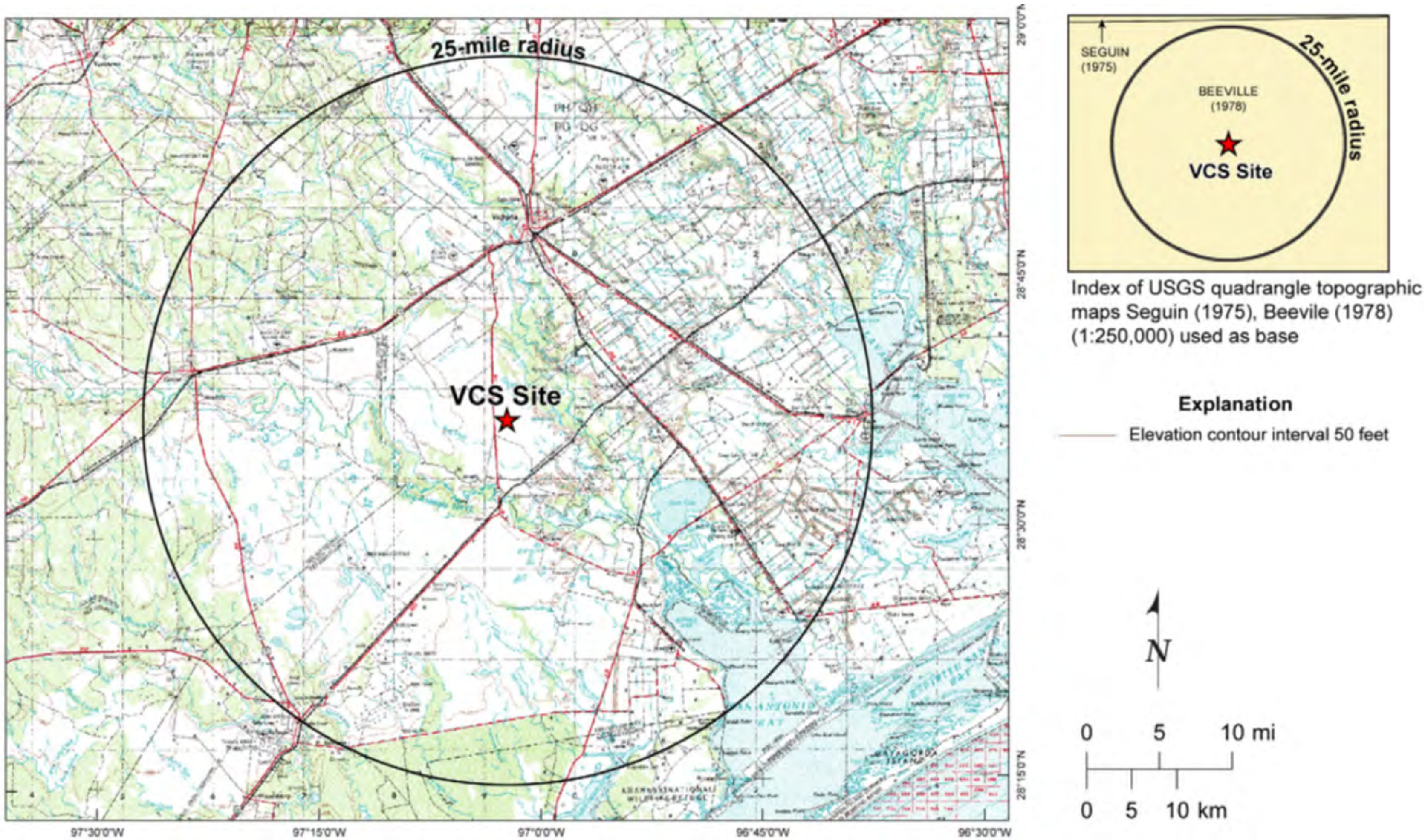


Figure 2.6-2 Topographic Map (25-Mile Radius)

ERATHEM	SYSTEM	SERIES	STAGE	GROUP	AGE mya	FORMATION	MEMBER	LITHOLOGY	THICKNESS (ft)
MESOZOIC	CRETACEOUS	Upper Cretaceous		Navarro Gp.		Escondido Fm		claystone, marl	1050
						Olmos Fm		shale, sandstone	900
				Taylor Gp.		San Miguel Fm		sandstone & limestone	1150
						Anacacho Limestone		mudstone	500
						Upson Fm		limestone	800
				Austin Gp.				chalk	555
				Eagle Ford Group				shale w. limestone	40
				Woodine Group				shale	60
				Washita Gp.		Buda LS Fm		limestone	45
						Del Rio Fm		shale	45
						Georgetown Fm		limestone	25
				Fredricksburg Gp.		Edwards Fm / Stuart City Fm	McKnight Evaporite	anhydrite	485
							McKnight Limestone	limestone	
							West Nueces Limestone	limestone	
						Glen Rose Formation / Atascosa Fm		shale	
		Lower Cretaceous		Trinity Gp.				limestone	3250
								limestone	
						Pearsall Fm	Bexar Shale	shale & limestone	
							James (Cow Creek) Limestone		
							Pine Island Shale		
						Sligo Fm		limestone	
						Hosston		sandstone, shale, chert	
	JURASSIC	Upper Jurassic	Tithonian	Cotton Valley Gp.	144	Schuler Fm		sandstone, siltstone, shale	1600
						Bossier Fm		shale	
			Kimmeridgian	Louark Gp.		Haynesville Fm	Gilmer mbr	limestone, anhydrite	1600
							Buckner mbr		
			Oxfordian			Smackover Fm		limestone & shale	1600
		Middle Jurassic		Louann Gp		Norphlet Fm		sandstone	150
					208	Louann Salt		salt	3300
	TRIASSIC	Upper Triassic				Eagle Mills Fm		sandstone, shale, siltstone, salt	4100
		Lower Triassic			245				

Figure is not to scale.

Figure 2.6-3 Mesozoic Stratigraphic Column

ERATHEM	SYSTEM	SERIES	AGE m.y.	Victoria County Station		Approximate Thickness Undifferentiated (feet)	Approximate elevation of formation top (feet)	Hydrostratigraphy	
CENOZOIC	QUATERNARY	Holocene	0.10	Alluvium & Terrace Deposits	Undifferentiated Deweyville Terrace Deposits	0-50			
		Pleistocene	2		Beaumont Fm	400	0±	Coastal Lowlands Aquifer System	Chicot aquifer
					Lissie Fm Willis Formation	600-700	-400		
	TERTIARY	Pliocene	5		Goliad sand	800 to 1,000	-1,000 to -1,100		Evangeline aquifer
		Miocene	24		Fleming Formation Oakville Sandstone	3,400 to 4,500	-1,800 to -2,100		Burkeville Confining System Jasper aquifer
		Oligocene		Catahoula Tuff	Catahoula Sand Anahuac Formation Frio Formation	3,000	-5,200 to -6,600		Catahoula Confining System
			38		Frio Clay (Vicksburg Group)	200	-8,000 to -9,600	Coastal Uplands Aquifer System	Vicksburg - Jackson Confining System
		Eocene		Jackson Group	Whitsett Manning clay Welborn Caddell	500 to 1,100	-8,400 to -9,800		
				Claiborne Group	Yegua Cook Mountain Sparta Sand Weches Fm Queen City Snd Reklaw Fm Carrizo	1,400 to 4,500	-8,900 to -10,900		Upper Claiborne Aquifer Middle Claiborne Confining System Midddle Claiborne Aquifer Confining System Lower Claiborne-Upper Wilcox Aquifer
			58	Wilcox Group	Undifferentiated	2,000	-10,300 to -15,400		Middle Wilcox Aquifer Not Present
		Paleocene	66	Midway Grp	Wills Point Kincaid Fm	2,500	-12,300 to -17,400	Midway Confining System	

Figure 2.6-4 Cenozoic Stratigraphic Column

Section 2.7 Table of Contents

Section 2.7 List of Tables

List of Tables (Cont.)

Section 2.7 List of Figures

List of Figures (Cont.)

List of Figures (Cont.)

2.7 Meteorology, Air Quality, and Noise

This section describes the regional and local climatological, meteorological, and air quality as well as noise characteristics applicable to the VCS site. This section also provides site-specific meteorological information for use in evaluating construction and operational impacts. It concludes with a brief description of existing noise-generating sources at the site and expected noise levels relative to measured background conditions.

2.7.1 Regional Climatology

This subsection identifies sources of climatological data used to characterize various aspects of the climate representative of the site region and area around the VCS site (as described in Subsections 2.7.1 through 2.7.4), describes large-scale general climatic features, their relationship to conditions in the site area (Subsection 2.7.1.2), and summarizes normals, means, and extremes of standard weather elements (Subsection 2.7.1.3).

2.7.1.1 Data Sources

Several data sources are used to characterize regional climatological conditions pertinent to the VCS site. This includes data acquired by the National Weather Service (NWS) at its Victoria and Palacios, Texas, first-order stations and from 13 other nearby locations in its network of cooperative observer stations, as compiled and summarized by the National Climatic Data Center (NCDC).

These climatological observing stations are located in Aransas, Bee, Calhoun, DeWitt, Goliad, Jackson, Karnes, Lavaca, Matagorda, Refugio, San Patricio, and Victoria counties. Table 2.7-1 identifies the specific stations and lists their approximate distance and direction from the centroid of the proposed power block area at the site. Figure 2.7-1 illustrates these station locations relative to the VCS site.

The objective of selecting nearby, offsite climatological monitoring stations is to demonstrate that the mean and extreme values measured at those locations are reasonably representative of conditions that might be observed at the VCS site. The 50-mile-radius circle shown in Figure 2.7-1 provides a relative indication of the distance between the climate-observing stations and the VCS site.

The identification of stations to be included was based on the following general considerations:

- Proximity to the site (i.e., within the nominal 50-mile radius indicated above, to the extent practicable)
- Coverage in all directions surrounding the site (to the extent possible)

- Where more than one station exists for a given direction relative to the site, a station was included if it contributed one or more extreme conditions (e.g., rainfall, snowfall, maximum or minimum temperatures) for that general direction or added context for variation of conditions over the site area.

If an overall extreme precipitation or temperature condition was identified for a station located within a reasonable distance beyond the nominal 50-mile radius and that event was considered to be reasonably representative for the site area, such stations were also included, regardless of directional coverage.

Normals (i.e., 30-year averages), means, and extremes of temperature, rainfall, and snowfall are based on the following references:

- *2007 Local Climatological Data, Annual Summary with Comparative Data for Victoria, Texas* (NCDC Jun 2008b)
- *Climatography of the United States, No. 20, 1971–2000, Monthly Station Climate Summaries* (NCDC Jul 2005)
- *Climatography of the United States, No. 81, 1971–2000, U.S. Monthly Climate Normals* (NCDC Feb 2002)
- *Utah Climate Center, Utah State University, Climate Data Base for Texas* (USU Jun 2008)
- *Cooperative Summary of the Day, TD3200, Period of Record Through 2001, for the Central United States* (NCDC Nov 2002)
- *U.S. Summary of Day Climate Data (DS 3200/3210), Period of Record, 2002–2005* (NCDC Jul 2006)

First-order NWS stations also record measurements, on an hourly basis, of other weather elements, including winds, several indicators of atmospheric moisture content (i.e., relative humidity, dew point, and wet bulb temperatures), and barometric pressure, as well as other observations when those conditions occur (e.g., fog, thunderstorms). Table 2.7-2**,** excerpted from the 2007 local climatological data (LCD) summary for the Victoria, Texas, NWS station, presents the long-term characteristics of these parameters.

Additional data sources were also used in describing the climatological characteristics of the site area and region, including:

- *Minimum Design Loads for Buildings and Other* Structures (ASCE 2005)

- *Historical Hurricane Tracks Storm Query, 1851 through 2008* (NOAA-CSC Sep 2009)
- *The Climate Atlas of the United States* (NCDC Sep 2002)
- *Storm Events for Texas, Hail, Snow and Ice, Tornado, Hurricane and Tropical Storm, and Dust Storm Event Summaries* (NCDC Apr 2008, NCDC Jun 2008a, and NCDC Jun 2008c)
- *Storm Data (and Unusual Weather Phenomena with Late Reports and Corrections), January 1959 (Volume 1, Number 1) to January 2004 (Volume 46, Number 1)* (NCDC Jun 2004)
- *Air Stagnation Climatology for the United States (1948–1998)* (Wang and Angell Apr 1999)
- *Ventilation Climate Information System* (USDA Apr 2003, USDA Oct 2007)
- *Climatography of the United States, No. 85, Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971–2000 (and previous normal periods)* (NCDC Jun 2002)

2.7.1.2 General Climate

The VCS site is located in the south-central Texas Coastal Plain, situated approximately 35 miles to the northwest of the Gulf of Mexico (see Figure 2.7-1). Topographic features within 5 miles and 50 miles of the site are addressed in Subsection 2.7.4.5. Terrain in the site area is generally flat to gently rolling. Elevations range from 0 feet above mean sea level (MSL) to the south to 550 feet above MSL to the west and northwest of the site.

The State of Texas is divided into 10 climate divisions. A climate division represents a region within a state that is as climatically homogeneous as possible. Division boundaries generally coincide with county boundaries except in the Western United States. The VCS site is located near the boundaries of two separate climate divisions within the State of Texas. It is physically situated in the western portion of Climate Division TX-08 (Upper Coast), but also lies directly adjacent to the eastern extent of the southern portion of Climate Division TX-07 (South Central) (NCDC Jun 2002).

The general climate in this region is classified as maritime subtropical (or humid subtropical) and is characterized by mild, short winters; long periods of mild sunny weather in the autumn; somewhat more windy but mild weather in the spring; and long, hot summers.

The regional climate is influenced by a semipermanent, subtropical high-pressure system over the North Atlantic Ocean—the Bermuda High (also known as the western extent of the Azores High). Because of the clockwise circulation around this high-pressure system, maritime tropical air mass characteristics prevail much of the year, especially during the summer when the Bermuda High is well developed. The Bermuda High can extend westward into the Gulf of Mexico at this time of year and, when it does, a synoptic weather type referred to as a Gulf High is said to be present (LOSC Sep 2002).

Collectively, these systems govern late spring and summer temperature and precipitation patterns. However, the influence of this macroscale circulation feature is also evident during the transitional seasons (spring and autumn), although relatively less so during the autumn months (in terms of the wind distribution turning more easterly) when it is disrupted by the passage of relatively smaller synoptic- and mesoscale weather systems from the north. Wind direction and speed conditions for the site and surrounding area are described in more detail in Subsections 2.7.1.3.4 and 2.7.4.2.

This macro-circulation feature also has an effect on the frequency of high air pollution potential in the VCS site region. These characteristics and their relationship to the Bermuda High, especially during the summer and early autumn, are addressed in Subsection 2.7.2.3.

During winter, cold air masses increasingly intrude into the region with the cyclonic (i.e., counterclockwise) northerly flow that follows the passage of low-pressure systems. These systems frequently originate in the continental interior, pick up moisture-laden air as the result of southeasterly airflow in advance of the system, and result in a variety of precipitation events that include rain, sleet, freezing rain, or mixtures depending on the temperature characteristics of the weather system itself and the temperature of the underlying air (see Subsection 2.7.3.4).

Larger and relatively more persistent outbreaks of cold, dry air, associated with high-pressure systems that move southward out of Canada, also occasionally affect the site region. These weather conditions are moderated by the Gulf of Mexico immediately to the south and owing to surface heating (during the day) as the front passes over the land.

The Gulf High synoptic weather type can also occur during the winter and spring when continental polar high pressure systems move southward over eastern Texas and Louisiana (LOSC Sep 2002), bringing modified polar air with southerly to southeasterly wind flows in the VCS site area.

Monthly precipitation exhibits a cyclical pattern, with the predominant maximum period occurring from late spring into early summer, and a secondary maximum period from early to mid-autumn (Table 2.7-2). The late spring/early summer maximum is primarily a result of thunderstorm activity. The early to mid-autumn secondary maximum is associated with thunderstorms and very heavy rains that accompany tropical systems that occasionally move through the region (see Subsection 2.7.3.5). The VCS site is located close enough to the Gulf of Mexico that the strong winds associated with tropical systems can also have a significant effect on the site area.

2.7.1.3 Normal, Mean, and Extreme Climatological Conditions

This subsection describes normals and period-of-record means and extremes for several standard weather elements (i.e., temperature, atmospheric water vapor, precipitation, and wind conditions) representative of this climate setting.

As indicated previously, Table 2.7-2 presents the more extensive set of meteorological measurements and observations made at the Victoria, Texas, NWS station located approximately 17 miles north-northeast of the VCS site. For comparison, Table 2.7-3 summarizes the annual normal daily maximum, minimum, and mean temperatures, as well as the normal annual rainfall and snowfall totals for Victoria, Texas, and 12 of the 13 other nearby cooperative observing stations (such data not being available for the Maurbro and Edna Highway 59 Bridge stations).

With the exception of temperature measurements from Maurbro and Edna Highway 59 Bridge, and snowfall measurements at Refugio 2 NW and Karnes City 2N, long-term periods of record for temperature and precipitation for the other climatological observing stations, as well as summaries of the latest 30-year station normals from 1971 through 2000, are readily available from the NCDC (NCDC Jul 2005).

More detailed descriptions of these and other climatological characteristics, including measured extremes, are addressed in Subsection 2.7.4.1.

2.7.1.3.1 Temperature

Daily mean temperatures are based on the average of the daily mean maximum and minimum temperature values. Annual daily normal temperatures vary over the site area by only approximately 3°F, ranging from 68.2°F at the Yoakum station (approximately 46 miles north of the VCS site to 71.3°F at the Goliad station (approximately 22 miles to the west) (Table 2.7-3).

The diurnal (day-to-night) temperature ranges, as indicated by the differences between the daily mean maximum and minimum temperatures, are fairly comparable, ranging from 11.4°F at Port O'Connor (approximately 39 miles east-southeast of the VCS site) to 24.2°F at the Cuero station (approximately 37 miles to the north-northwest) (USU Jun 2008). This range reflects each station's proximity to the Gulf Coast—Port O'Connor is located directly on the coast (less temperature variability because of maritime influence), whereas Cuero is located farther inland. Similar variations in diurnal temperature range are noted among the other observing stations in the site area.

On a monthly basis, the LCD summary for the Victoria, Texas, NWS station indicates that the daily normal temperature is highest during July and August (84.2°F) and reaches a minimum in January (53.2°F) (NCDC Jun 2008b).

Table 2.7-4 shows the highest temperature observed in the site area (113°F) was recorded on September 5, 2000, at the Cuero cooperative station. The lowest temperature observed in the site area (6°F) was recorded on December 23, 1989, at the Yoakum cooperative station, located approximately 46 miles north of the site (NCDC Jul 2005; USU Jun 2008).

2.7.1.3.2 Atmospheric Water Vapor

Based on a 24-year period of record, the LCD summary for the Victoria, Texas, NWS station (Table 2.7-2) indicates that the mean annual wet bulb temperature is 64.2°F, with a seasonal maximum during the summer months (June through August) and a seasonal minimum during the winter months (December through February). The highest monthly mean wet bulb temperature is 76.1°F in July (only slightly less during August); the lowest monthly mean value (49.7°F) occurs during January (NCDC Jun 2008b).

The LCD summary shows a mean annual dew point temperature of 61.2°F, reaching its seasonal maximum and minimum during the summer and winter, respectively. The highest monthly mean dew point temperature is 73.6°F in July (again, only slightly less during August). The lowest monthly mean dew point temperature (46.4°F) occurs during January (NCDC Jun 2008b).

The 30-year normal daily relative humidity averages 76 percent on an annual basis, typically reaching its diurnal maximum in the early morning hours (approximately 0600 Local Standard Time [LST]) and its diurnal minimum during the early afternoon hours (approximately 1200 LST). There would be less variability in this daily pattern with the passage of weather systems, persistent cloud cover, and precipitation. Nevertheless, this diurnal pattern is evident throughout the year. The LCD summary indicates that average early morning relative humidity levels are greater than or equal to 93 percent during the months of June, July, August, and September (NCDC Jun 2008b).

2.7.1.3.3 Precipitation

Table 2.7-3 shows normal annual rainfall totals for the 15 observing stations listed in Table 2.7-1 (i.e., within approximately 50 miles of the VCS site) vary, ranging from 28.35 inches at the Karnes City 2N observing station (approximately 55 miles to the west-northwest of the VCS site) to 45.40 inches at the Palacios Municipal Airport station (approximately 48 miles to the east) (NCDC Feb 2002). Total annual rainfall tends to decrease more from east to west than as a function of distance inland from the Gulf of Mexico and adjacent bay waters.

If the four climatological observing stations closest to, and surrounding, the VCS site are considered (i.e., Victoria Regional Airport, Goliad, Refugio 2 NW, and Aransas Wildlife Refuge), all within 25 miles, normal annual rainfall totals are quite similar, ranging from 38.58 inches at Goliad to

40.83 inches at Aransas Wildlife Refuge (NCDC Feb 2002). Therefore, long-term average annual total rainfall at the VCS site could reasonably be expected to be within this range.

The LCD summary of normal rainfall totals for the Victoria, Texas, NWS station (Table 2.7-2 indicates two seasonal maximums, the highest (13.05 inches) during late spring into early summer (April through June) and the second (12.31 inches) during mid-summer into mid-autumn (August through October). Together, these periods account for approximately 63 percent of the annual total for the Victoria NWS station, although rainfall is greater than 2.0 inches during every month of the year. The overall maximum monthly total rainfall occurs during May (5.12 inches) (NCDC Jun 2008b).

The overall highest 24-hour rainfall total in the site area, 17.58 inches, was recorded on October 18, 1994, at the Edna Highway 59 Bridge cooperative observing station (USU Jun 2008), located approximately 32 miles northeast of the VCS site. The overall highest monthly rainfall total in the site area, 26.30 inches during September 1971, was recorded at the Refugio cooperative observing station (USU Jun 2008; NCDC Jun 2008d), located approximately 25 miles to the southwest of the VCS site.

Snow in the VCS site area is an unusual event and occurs, on average, less than 1 day per year as indicated by the LCD summary for the Victoria, Texas, NWS station in Table 2.7-2 (NCDC Jun 2008b). Table 2.7-3 indicates that normal annual snowfall totals at the listed observing stations average 0.5 inch per year or less. Heavy snowfall events rarely occur in the VCS site area, as described in Subsection 2.7.3.4. The greatest snowfall totals on record among the observing stations listed in Table 2.7-4 were measured at the Goliad station, located 22 miles west of the VCS site, as a result of the Christmas storm of 2004 (December 25, 2004). The 24-hour and cumulative monthly totals at Goliad were 12.0 inches in both cases (NCDC Jul 2006; USU Jun 2008; NCDC Jun 2008d).

See Subsection 2.7.4.1.3 for more details regarding these events and a description of other station precipitation records.

2.7.1.3.4 Wind Conditions

Based on a 28-year period of record, the LCD summary for the Victoria, Texas, NWS station (Table 2.7-2) indicates that the annual prevailing wind direction (i.e., the direction from which the wind blows most often) is from 170 degrees (i.e., south-southeasterly). Monthly prevailing winds are from the south-southeast or south-southwest during the spring and summer (March through August), while from the north during mid-autumn through the winter (October through February) (NCDC Jun 2008b). These characteristics are further enhanced by the establishment of the Bermuda High in the summer and the passage of northerly cold fronts beginning in mid-autumn and continuing through the winter (see Subsection 2.7.1.2).

Based on a 24-year period of record, the LCD summary shows an annual mean wind speed of 9.5 miles per hour. On a seasonal basis, the highest average wind speeds occur during the spring (approximately 10.8 mph) and are lowest during the summer and autumn months (8.6 and 8.7 mph, respectively). On average, the LCD indicates that the highest monthly average wind speed (11.0 mph) occurs during April (NCDC Jun 2008b).

Characteristics of extreme wind conditions for design basis purposes are described in Subsection 2.7.3.2. Wind data summaries, based on measurements from the onsite pre-application phase meteorological monitoring program are described in Subsections 2.7.4.2 and 2.7.4.3.

2.7.2 Air Quality

This subsection addresses current ambient air quality conditions in the VCS site area and region (e.g., the compliance status of various air pollutants) that have a bearing on plant design, construction, and operating basis considerations (Subsection 2.7.2.1). It also cross-references other subsections that address the types and characteristics of nonradiological emission sources associated with plant construction and operation and the expected impacts associated with those activities (Subsection 2.7.2.2), and characterizes conditions (from a climatological standpoint) in the site area and region that may be restrictive to atmospheric dispersion (Subsection 2.7.2.3).

2.7.2.1 Regional Air Quality Conditions

The VCS site is located within the Corpus Christi-Victoria Intrastate Air Quality Control Region (AQCR), which includes Aransas, Bee, Brooks, Calhoun, DeWitt, Duval, Goliad, Gonzales, Jackson, Jim Wells, Kenedy, Kleberg, Lavaca, Live Oak, McMullen, Nueces, Refugio, San Patricio, and Victoria counties (40 CFR 81.136). Attainment areas are areas where the ambient levels of criteria air pollutants are designated as being “better than,” “unclassifiable/attainment,” or “cannot be classified or better than” the EPA-promulgated National Ambient Air Quality Standards (NAAQS). Criteria pollutants are those for which NAAQS have been established: sulfur dioxide, particulate matter (i.e., PM_{10} and $PM_{2.5}$, which are particles with nominal aerodynamic diameters less than or equal to 10.0 and 2.5 microns, respectively), carbon monoxide, nitrogen dioxide, ozone, and lead (40 CFR 50).

The Corpus Christi-Victoria Intrastate AQCR is in attainment for all criteria air pollutants except lead, which is undesignated (40 CFR 81.344).

There are no pristine areas designated as “Mandatory Class I Federal Areas Where Visibility is an Important Value” that are located within 100 miles of the VCS site. The Big Bend National Park is the closest Class I area (40 CFR 81.429) located approximately 355 miles west of the VCS site.

2.7.2.2 Projected Air Quality Conditions

The nuclear steam supply systems and other related radiological systems are not sources of criteria pollutants or other toxic air emissions. Supporting equipment (e.g., diesel generators, combustion turbines, and auxiliary boilers), and other nonradiological emission-generating sources (e.g., storage tanks and related equipment) or activities are not expected to be a significant source of criteria pollutant emissions.

Emergency equipment will only be operated on an intermittent test or emergency-use basis. Therefore, these emission sources will not be expected to affect ambient air quality levels in the vicinity of the VCS site, nor will they be anticipated to be a significant factor in the design and operating bases of VCS. Sections 4.7 and 5.11 evaluate proposed projects with the potential to affect air quality in the Corpus Christi-Victoria AQCR. Likewise, because of the relatively long distance of separation from the VCS site, visibility at any Class I Federal Areas will not be expected to be significantly affected by project construction and facility operations.

Emission-generating sources and activities related to construction of the VCS, potential impacts, and mitigation measures are addressed in Subsection 4.4.1.3. Nonradiological emission-generating sources associated with routine facility operations are described further in Subsection 3.6.3.1. Characteristics of these emission sources and the potential effects on air quality and visibility associated with their operation are addressed under Subsection 5.8.1.

2.7.2.3 Restrictive Dispersion Conditions

Atmospheric dispersion can be described as the transport and diffusion of effluents released into the atmosphere. Horizontal and along-wind dispersion is controlled primarily by wind direction variation, wind speed, and atmospheric stability. Subsection 2.7.4.2 addresses wind characteristics for the VCS site vicinity based on measurements from the pre-application phase, onsite meteorological monitoring program. The persistence of those wind conditions is described in Subsection 2.7.4.3.

In general, lower wind speeds represent less turbulent air flow, which is restrictive to both horizontal and vertical dispersion. Wind direction tends to be more variable under lower wind speed conditions (which increases horizontal dispersion); however, air parcels containing pollutants are often recirculated within a limited area, thereby increasing cumulative exposure.

Major air pollution episodes are usually related to the presence of stagnating high-pressure weather systems (or anti-cyclones) that influence a region with light and variable wind conditions for four consecutive days or more. An updated air stagnation climatology has been published with data for the continental United States based on more than 50 years of observations, from 1948 through 1998 (Wang and Angell Apr 1999). In this study, stagnation conditions were defined as 4 or more consecutive days when meteorological conditions were conducive to poor dispersion. Although interannual frequency varies, the data in Figures 1 and 2 of that report indicates that on average, the VCS site region can expect approximately 30 days per year with stagnation conditions, or approximately five to six cases per year, with a mean duration of approximately 5 days for each case (Wang and Angell Apr 1999).

Air stagnation conditions primarily occur during an “extended” summer season (May through October). This is a result of the weaker pressure and temperature gradients, and therefore weaker wind circulations, during this period (as opposed to the winter season). Based on Figures 17 to 67 in Wang and Angell (Apr 1999), the highest incidence of air stagnation is recorded between July and September, typically reaching its peak during August, when the Bermuda High pressure system has become established. As the LCD summary for Victoria, Texas, in Table 2.7-2 indicates, this 3-month period coincides with the lowest monthly mean wind speeds during the year. Air stagnation is at a relative minimum within this “extended” summer season during May and June (Wang and Angell Apr 1999).

An interactive, spatial database developed by the U.S. Department of Agriculture Forest Service, referred to as the Ventilation Climate Information System, is readily available and provides both monthly and annual graphical and tabular summaries of relevant dispersion-related characteristics (e.g., morning and afternoon modeled mixing heights, modeled surface wind speeds, and resultant ventilation indices) (USDA Oct 2007). The system, although developed primarily for fire management and related air quality purposes, extends the period of record to climatologically representative durations of 30 to 40 years, depending on the parameter.

Table 2.7-5 summarizes minimum, maximum, and mean morning and afternoon mixing heights, surface wind speeds, and ventilation indices on a monthly, seasonal, and annual basis for the VCS site area. As atmospheric sounding measurements are still only made from a relatively small number of observation stations, these statistics represent model-derived values within the interactive database for a specific location (USDA Apr 2003), in this case, the VCS site. The seasonal and annual values listed in Table 2.7-5 were derived as weighted means based on the corresponding monthly values.

From a climatological standpoint, the lowest mean morning mixing heights occur in the autumn, and the highest mean morning mixing heights occur during the spring. As might be expected, mean afternoon mixing heights reach a seasonal minimum in the winter and a maximum during the summer as the result of more intense summertime heating.

The wind speeds listed in Table 2.7-6, representing the VCS site area, are consistent with the LCD summary for Victoria, Texas (Table 2.7-2) although approximately 1 meter per second lower. Lower daily mean wind speeds (i.e., the average of the morning and afternoon mean values in Table 2.7-6) are shown to generally occur during the summer and autumn as in the LCD (USDA Oct 2007 and NCDC Jun 2008b). This period of minimum wind speeds also coincides with the “extended” summer season described by Wang and Angell (Apr 1999) that is characterized by relatively higher air stagnation conditions.

The ventilation index is based on the product of the wind speed and the mixing height. It uses surface winds instead of higher level winds, so the index values represent conservative estimates of ventilation potential. This is more indicative of the dispersion potential near the ground and, therefore, directly relevant to the release heights of the sources evaluated in Subsections 2.7.5 and 2.7.6.

Based on the classification system for ventilation indices (USDA Apr 2003), the morning ventilation indices for the VCS site area indicate “marginal” ventilation potential on an annual average basis with conditions rated as “fair” during the spring and “marginal” for the other three seasons (USDA Oct 2007); again, consistent with the characteristics reported by Wang and Angell (Apr 1999).

Ventilation indices markedly improve during the afternoon with conditions rated as “good” on an annual average basis and for all seasons except the winter which is classified as “fair” (USDA Oct 2007). Mean wind speeds do not vary significantly in the site area over the course of the year. As a result, the relatively better ventilation index classifications are attributable to the higher mixing height values, which, for the summer and autumn seasons, tend to mask the general potential for more restrictive dispersion conditions during the “extended” summer referred to by Wang and Angell (Apr 1999). Nevertheless, the decrease in the ventilation index values between the summer and autumn is still evident and consistent with the monthly variations for air stagnation potential described previously.

2.7.3 Severe Weather

This subsection addresses severe weather phenomena that affect the VCS site area and region and that are considered in the design and operating bases for the plant. These include:

- The frequencies of thunderstorms and lightning (Subsection 2.7.3.1)
- Observed and probabilistic extreme wind conditions (Subsection 2.7.3.2)
- Tornadoes and related wind and pressure characteristics (Subsection 2.7.3.3)
- The frequency and magnitude of hail, snowstorms, and ice storms (Subsection 2.7.3.4)
- Tropical cyclones and related effects (Subsection 2.7.3.5)

- Droughts and dust (sand) storms (Subsection 2.7.3.6)

2.7.3.1 Thunderstorms and Lightning

Thunderstorms can occur in the VCS site area at any time during the year. Based on a 48-year period of record, Victoria, Texas, averages approximately 56 thunderstorm-days (i.e., days on which thunder is heard at an observing station) per year. On average, August has the highest monthly frequency of occurrence, approximately 10 days. Annually, more than half (approximately 57 percent) of thunderstorm-days are recorded between early summer and early autumn (i.e., from June through September). From November through February, a thunderstorm might be expected to occur approximately 2 days per month (NCDC Jun 2008b).

The mean frequency of lightning strokes to earth can be estimated using a method attributed to the Electric Power Research Institute, as reported by the U.S. Department of Agriculture Rural Utilities Service in the publication titled *Summary of Items of Engineering Interest* (USDA Aug 1998). This methodology assumes a relationship between the average number of thunderstorm-days per year (***T***) and the number of lightning strokes to earth per square mile per year (***N***), where:

$$\boldsymbol{N} = 0.31\boldsymbol{T}$$

Based on the average number of thunderstorm-days per year at Victoria, Texas (i.e., 56, see Table 2.7-2), the frequency of lightning strokes to earth per square mile is approximately 17 per year for the VCS site area. This frequency is essentially equivalent to the mean of the 10-year (1989 to 1999) lightning flash density for the area that includes the VCS site, as reported by the NWS (six to eight flashes per square kilometer per year [NSSL 2006]) and, therefore, is considered to be a reasonable indicator.

The VCS power block area is a rectangular area that encompasses all units and covers approximately 77.9 acres, or 0.122 square mile (mi^2). Given the estimated annual average frequency of lightning strokes to earth in the VCS site area, the frequency of lightning strokes in the power block area can be estimated as follows:

(17 lightning strokes/mi^2/year) x (0.122 mi^2) = 2.07 lightning strokes/year, or approximately twice each year.

2.7.3.2 Extreme Winds

The frequency of peak wind speed gusts can be characterized from information in the *Climate Atlas of the United States* (NCDC Sep 2002), which is based on observations made over the 30-year period of record from 1961 to 1990. Frequencies of occurrence were developed from values reported as the 5-second peak gust for the day. Mean annual occurrences of peak gusts greater than or equal to 50 mph, 40 mph, and 30 mph in the VCS site area range between 1.5 and 2.4 days per year, 9.5 and 20.4 days per year, and 60.5 and 80.4 days per year, respectively.

Estimating the wind loading on plant structures for design and operating bases considers the “basic” wind speed, which is the “3-second gust speed at 33 feet (10 meters) above the ground in Exposure Category C,” as defined in Sections 6.2 and 6.3 of the ASCE-SEI design standard, *Minimum Design Loads for Buildings and Other Structures* (ASCE 2005).

The "basic" windspeed is approximately 113 mph, as estimated by linear interpolation from the plot of basic wind speeds in Figure 6-1A of ASCE 7-05 for that portion of the United States that includes the VCS site. The site is located in a hurricane-prone region as defined in Section 6.2 of the ASCE-SEI design standard. This value is associated with a mean recurrence interval of 50 years. Section C6.0 (Table C6-3) of the ASCE-SEI design standard provides conversion factors for estimating the 3-second gust wind speeds for other recurrence intervals. Based on this guidance, the 100-year return period value is determined by multiplying the 50-year return period value by a factor of 1.07, which yields a 100-year return period 3-second gust wind speed for the site of approximately 121 mph.

The National Oceanic and Atmospheric Administration’s Coastal Services Center (NOAA-CSC) provides a comprehensive historical database of tropical cyclone tracks, extending from 1851, based on information compiled by the National Hurricane Center. This database indicates that a total of 62 tropical cyclone storm tracks have passed within a 100-nautical-mile radius of the VCS site during this historical period (NOAA-CSC Sep 2009). The maximum wind speed observed in the site region was from an unnamed storm in 1886. The peak 1-minute wind speed for the storm is reported as 155 mph. This was converted, using the method detailed in Simiu, Vickery and Kareem (July 2007), to an equivalent peak 3-second gust of 160 mph for the VCS site. This wind speed accounts for the change in roughness as the hurricane makes landfall and is representative of the transition that all hurricanes undergo as they move inland. This is similar to peak winds observed inland during Hurricane Carla (September 1961) and Hurricane Celia (180 mph adjusted for increased surface roughness to 154 mph inland, August 1970) (NOAA-CSC Sep 2009, NCDC Jun 2004, U.S. Weather Bureau 1961).

2.7.3.3 Tornadoes

Based on Figure 1 of RG 1.76 and the coordinates for the power block area, the VCS site is located within Tornado Intensity Region II. Accordingly, the design basis tornado characteristics for Tornado Intensity Region II (U.S. NRC Mar 2007a) have been applied to the VCS site and are:

- Maximum wind speed = 200 mph

- Translational speed = 40 mph
- Maximum rotational speed = 160 mph
- Radius of maximum rotational speed = 150 feet
- Pressure drop = 0.9 pounds per square inch (psi)
- Rate of pressure drop = 0.4 psi per second

Revision 1 of RG 1.76 retains the 10^{-7} exceedance probability for tornado wind speeds, the same as the original version of that regulatory guide. Revision 2 of NUREG/CR-4461 (U.S. NRC Feb 2007) describes the relationship between the previous use of the original Fujita scale of wind speed ranges for different tornado intensity classifications and the enhanced Fujita scale wind speed ranges in the revised analysis of tornado characteristics. That document was the basis for most of the technical revisions to RG 1.76.

Tornadoes observed within a 2-degree latitude and longitude square, centered on the VCS site, are used to characterize their frequency of occurrence from a climatological standpoint. Data was obtained from the NCDC *Storm Events* database of tornado occurrences by location, date, and time; starting and ending coordinates; Fujita-scale wind speed classification (or F-scale); Pearson-scale path length and path-width dimensions (or P-scale); and other storm-related statistics (NCDC Jun 2008a).

The 2-degree square area for this evaluation includes all or portions of 25 counties in Texas. All tornado occurrences for a given county were included, even if some portion of the county was not within the 2-degree latitude/longitude square. Through the nearly 58-year period from 1950 through September 2007, the records in the database indicate that a total of 784 tornadoes occurred in one of these counties (NCDC Jun 2008a).

Tornado F-scale classifications and respective frequencies of occurrence are as follows:

- F5 = 0
- F4 = 1
- F3 = 23
- F2 = 81
- F1 = 230

- F0 = 372

An additional 77 tornadoes were not assigned an F-scale in the *Storm Events* database (NCDC Jun 2008a) and are therefore assumed to be comparable to an F0 classification.

Tornadoes have occurred in the VCS site area during all months of the year, with nearly identical peak frequencies in the autumn and spring (approximately 36 percent and 33 percent, respectively). On a monthly basis, the greatest number of events has been recorded in September (160), followed by the second-highest count during the month of May (146). Together, they comprise 39 percent of the tornadoes that occur annually in the site area. Fewer than 10 percent of all tornadoes have occurred during the winter months (NCDC Jun 2008a).

2.7.3.4 Hail, Snowstorms, and Ice Storms

Frozen precipitation in the VCS site region typically occurs in the form of hail, snow, sleet, and freezing rain. The frequency and characteristics of these types of weather events are based on the following two references: the latest version of *The Climate Atlas of the United States* (NCDC Sep 2002), which has been developed from observations made over the 30-year period of record from 1961 to 1990, and the NCDC *Storm Events* database for Texas (NCDC Apr 2008) based on observations for the period of January 1950 to March 2007.

Hail can occur at any time of the year in the site area and is associated with intense thunderstorms. It is observed primarily during the late winter through early summer months (February through June), reaching a peak during May and April, and occurring least often from mid-summer into early autumn (July through September) (NCDC Apr 2008).

The *Climate Atlas* (NCDC Sep 2002) indicates that the northern two-thirds of Victoria County and most of DeWitt County to the northwest can expect, on average, hail with diameters 0.75 inch or greater approximately 1 to 2 days per year. The *Climate Atlas* also shows a similar frequency in smaller portions of the adjacent or nearby Goliad, Karnes, Jackson, Bee, and San Patricio counties. However, a relatively lower frequency is indicated for most of the area in these counties. Other nearby counties of Matagorda, Calhoun, Refugio, and Aransas, which are directly adjacent to the Gulf of Mexico, can expect 0.75-inch or greater hail approximately 1 day or fewer per year. The *Climate Atlas* indicates that the occurrence of hail with diameters greater than or equal to 1.0 inch is relatively less frequent over the site area (NCDC Sep 2002).

Hailstorms are point observations and biased by population density. This may explain the areal extent of higher frequencies around Victoria and the eastern half of DeWitt County and what could be interpreted as generally lower frequencies of occurrence in other nearby counties not directly adjacent to the Gulf of Mexico. A decrease in frequency toward the coast appears to be reasonable.

The slightly higher annual mean frequency of approximately 1 to 2 days per year with hail larger than or equal to 0.75 inch in diameter is considered to be a representative indicator for the VCS site.

Hailstorms within Victoria and surrounding counties have generally reported maximum hailstone diameters ranging between 2.0 and 4.5 inches. Golfball-sized hail (approximately 1.75 inches in diameter) is not a rare occurrence and has been observed numerous times in the site area (NCDC Apr 2008). However, in terms of extreme hailstorms, the NCDC *Storm Events* database indicates that grapefruit- to softball-sized hail (approximately 4.0 to 4.5 inches in diameter, respectively) was observed on three occasions within 50 miles of the VCS site:

- April 11, 1995 (4.5 inches), Calhoun County, approximately 30 miles to the southeast of the VCS site
- February 19, 1991 (4.5 inches), DeWitt County, approximately 45 miles to the north-northwest
- May 25, 1961 (4.0 inches), Lavaca County, approximately 40 miles to the north-northwest

From central Texas southward, most winters bring no accumulation of snow. Snowstorms occur only once every few decades, but no corner of the state is immune (USU Jun 2008). Any accumulation of snow is a rare occurrence in the Upper Coast climate division where the VCS site is located, with normal annual totals at all listed nearby observing stations averaging less than 0.5 inch (see Table 2.7-3). Historical records for the site area indicate that maximum 24-hour and monthly snowfalls have occurred during the months of November through February (see Table 2.7-4). The *Climate Atlas* (NCDC Sep 2002) indicates that the occurrence of snowfalls 0.1 inch or greater in the VCS site area average less than 1 day per year (see also Table 2.7-2). Additional details regarding maximum 24-hour and cumulative monthly record snowfall totals are given in Subsection 2.7.4.1.3.

Depending on the temperature characteristics of the air mass, snow events are often accompanied by, or alternate between, sleet and freezing rain as the weather system traverses the VCS site region. In most cases, freezing rain results from the process of warm moist air “overrunning” colder air and is caused by rain falling into a relatively shallow layer of cold air with temperatures either at or just below the freezing point. Arctic air masses that reach the Upper Coast climate division in the winter season are typically very shallow and have been known to produce ice storms. The *Climate Atlas* (NCDC Sep 2002) indicates that, on average, freezing precipitation occurs approximately 3 to 5 days per year in the area that includes the VCS site.

From an operational standpoint, ice storm effects often include hazardous driving conditions, and occasionally downed trees and power lines as the result of ice buildup on these surfaces. The NCDC *Storm Data* and *Storm Events* summaries (NCDC Jun 2004 and NCDC Apr 2008, respectively) for the VCS site area frequently do not include statements of ice accumulation, which suggests that the amounts are light.

2.7.3.5 Tropical Cyclones

Tropical cyclones include not only hurricanes and tropical storms, but systems classified as tropical depressions, subtropical storms, subtropical depressions, and extratropical storms. This characterization considers all “tropical cyclones” (rather than systems classified only as hurricanes and tropical storms) because storm classifications are generally downgraded once landfall occurs and the system weakens, although they may still result in significant rainfall and extreme wind events as they travel through the site region.

Storm classifications and respective frequencies of occurrence over this 158-year period of record (1851–2008) are as follows:

- Hurricanes: Category 5 (1), Category 4 (5), Category 3 (5), Category 2 (6), Category 1 (16)
- Tropical storms: 24
- Tropical depressions: 5
- Subtropical storms: 0
- Subtropical depressions: 0
- Extratropical storms: 0

Wind speeds (1-minute average) corresponding to each of the Saffir-Simpson Hurricane Categories are listed below:

Hurricane Classification	Wind Speed (mph)
Category 1	74–95
Category 2	96–110
Category 3	111–130
Category 4	131–155
Category 5	>155

Tropical cyclones within this 100-nautical-mile radius have occurred as early as June and as late as October, with the highest frequency (19 out of 62 events) recorded during September, including all classifications at and above Tropical Depression status. June, July, and August account for 14, 12, and 13 events, respectively. Tropical storms have occurred in all months from June to October.

During the months of June through September, hurricanes occur with similar frequency (7, 6, 8, and 9, respectively). The only Category 5 hurricane to track within 100 nautical miles of the VCS site was Hurricane Carla in September 1961. Of the five Category 4 hurricanes that have occurred within this radial distance, four were recorded in August, and one was recorded in September. Two Category 3 hurricanes have occurred in September and one each in July, August, and October. Most major hurricanes in the site area have occurred from mid- to late-summer (NOAA-CSC Sep 2009).

Tropical cyclones are responsible for at least 16 separate rainfall records among the 15 NWS and cooperative observer network stations listed in Table 2.7-1: four 24-hour (daily) rainfall totals and 12 monthly rainfall totals (see Table 2.7-4). In late June 1960, two 24-hour records were set at the Maurbro and Point Comfort cooperative observing stations as the result of an unnamed tropical storm (14.80 inches and 14.65 inches, respectively). Rainfall associated with Hurricane Beulah in late September 1967, whose track did not pass within 100 nautical miles of the VCS site, nevertheless, resulted in historical 24-hour maximum totals of 10.61 inches at the Beeville 5 NE station and 9.16 inches at the Goliad observing station (NCDC Jul 2005, USU Jun 2008, NCDC Nov 2002, and NOAA-CSC Sep 2009).

Monthly station records were established because of partial contributions from the following tropical cyclones (NCDC Jun 2008b, NCDC Jul 2005, USU Jun 2008, NCDC Nov 2002, NOAA-CSC Sep 2009, and NCDC Jun 2008d):

- Hurricane Fern in September 1971 (26.30 inches at Refugio)
- Hurricane Beulah in September 1967 (25.59 inches at Sinton, 22.62 inches at Beeville 5 NE, 22.60 inches at Karnes City 2N, 22.19 inches at Goliad, 21.27 inches at Cuero, and 20.85 inches at Rockport)
- An unnamed tropical storm in June 1960 (25.24 inches at Point Comfort and 22.47 inches at Maurbro)
- An unnamed hurricane in October 1949 (24.28 inches at Palacios Municipal Airport)
- Tropical Storm Erin in July 2007 (22.65 inches at Aransas Wildlife Refuge and 20.35 inches at the Victoria Regional Airport)

As indicated above, significant amounts of rainfall can still be associated with a tropical cyclone once the system moves inland. Wind speed intensity, however, noticeably decreases as the system passes over land and is subjected to increased frictional forces. Examples of such effects, associated with some of the more intense tropical cyclones that have passed within 100 nautical miles of the VCS site are:

- Hurricane Carla (September 1961). The storm remained at hurricane strength as it crossed the area within 100 nautical miles of the VCS site. Carla rapidly decreased in intensity after moving onshore (having reached Category 5 status while offshore, but decreasing to a Category 3 hurricane at landfall). The storm was downgraded to Tropical Storm status just northeast of Austin, Texas. (NCDC-CSC Sep 2009; U.S. Weather Bureau Sep 1961).

- Hurricane Celia (August 1970). Celia crossed the Texas coastline approximately 50 miles south-southwest of the VCS site, between Corpus Christi and Aransas Pass. It remained a Category 3 hurricane for approximately 40 miles inland, decreasing to a Category 1 storm as it traversed the remainder of the area within 100 nautical miles of the site. Celia was downgraded to Tropical Storm status approximately 135 miles inland from the coast (NOAA-CSC Sep 2009; NCDC Jun 2004).

- Hurricane Claudette (July 2003). Hurricane Claudette (Category 1) struck the middle Texas coast near Port O’Connor with sustained winds estimated at approximately 90 mph. Claudette continued moving inland across Victoria, Goliad, and Bee counties, eventually weakening to a tropical storm. Maximum rainfall measurements were recorded in Bee, Goliad, and Refugio counties (NOAA-CSC Sep 2009, NCDC Jun 2008d).

2.7.3.6 Droughts and Dust (Sand) Storms

Droughts are prolonged periods of very dry weather, which cause serious water imbalances in the affected area. The Upper Coast climate division where the VCS site is located (see Subsection 2.7.1.2) is commonly affected by drought conditions. However, the most severe droughts occur in west and northwestern Texas where the southwestern desert of the United States extends (Bomar 1983). Subsection 2.3.1.1.1 describes the effect of droughts on the VCS site (water sources such as the Guadalupe River) and describes historical low water conditions from droughts and their frequencies.

Dust storms predominantly originate in normally arable regions during periods of drought where dust and sand layers are loosened. Dust storms in the upper coastal region of Texas are very rare because of the lush grasslands and small interspersed pine and oak thickets. Severely reduced visibilities because of large-scale dust storms in Texas occur on average only once every 3 to 5 years (Bomar 1983). The NCDC *Storm Events* database indicates no occurrences of dust storms near the VCS site since 1993 (NCDC Jun 2008c).

2.7.4 Local Meteorology

Data acquired by the NWS at its Victoria and Palacios, Texas, first-order stations and from 13 other nearby locations in its network of cooperative observer stations, as compiled and summarized by the

NCDC and the Utah State GIS Climate Search (USU Jun 2008; NCDC Nov 2002, NCDC Jul 2006, NCDC Jun 2008b), are used to characterize normals, and period-of-record means and extremes of temperature, rainfall, and snowfall in the vicinity of the VCS site. Subsection 2.7.1.1 identifies the sources of these climatological summaries and other data resources. The approximate distances and directions of these climatological observing stations relative to the site are listed in Table 2.7-1; their locations are shown in Figure 2.7-1.

As indicated in Subsection 2.7.1.1, first-order NWS stations also record measurements on an hourly basis of other weather elements, including winds, relative humidity, dew point and wet bulb temperatures, barometric pressure, and other observations when those conditions occur (e.g., fog, thunderstorms).

Besides using data from these nearby climatological observing stations, measurements from the tower-mounted meteorological monitoring system that currently supports the VCS site are also used to characterize dispersion conditions in support of this ESP application. Refer to Subsections 6.4.2 and 6.4.3 for a description of relevant details about this pre-application monitoring program, including tower location, terrain features and elevations in the vicinity of the proposed site, instrumentation and measurement levels, data recording and processing, and system operation, maintenance, and calibration activities.

2.7.4.1 Normal, Mean, and Extreme Values

Subsection 2.7.1.3 summarizes normals, and period-of-record means and extremes for several standard weather elements (temperature, atmospheric water vapor, precipitation, and wind conditions).

To substantiate that mean and extreme values at these stations (based on their long-term records of observations) are representative of conditions that might be expected at the VCS site, this subsection provides additional details regarding the individual station records from which the values presented in Subsection 2.7.1.3 were obtained.

Historical extremes of temperature, rainfall, and snowfall are listed in Table 2.7-4 for the 15 NWS and cooperative observing stations in the VCS site area.

2.7.4.1.1 Temperature

Characteristics of the normal daily maximum and minimum temperatures, the daily mean temperatures, and the diurnal temperature ranges for 13 of the 15 nearby climatological observing stations that make such measurements are described in Subsection 2.7.1.3.1 and presented in Table 2.7-3. The overall maximum and minimum temperature extremes observed in the VCS site area are summarized in Subsection 2.7.1.3.1 as well.

Extreme maximum temperatures recorded in the vicinity of the VCS site have ranged from 103°F to 113°F, with the highest reading observed at the Cuero cooperative station on September 5, 2000. As Table 2.7-4 and the accompanying notes show, individual station extreme maximum temperature records were set at multiple locations on the same or adjacent dates (e.g., Palacios Municipal Airport, Port O'Connor, Point Comfort, Yoakum, Rockport, Sinton, Victoria Regional Airport, Refugio 2 NW, and Karnes City 2N on September 5 and 6, 2000) (NCDC Jul 2005; NCDC Nov 2002; NCDC Jul 2006; USU Jun 2008).

Extreme minimum temperatures in the vicinity of the VCS site have ranged from 6°F to 12°F, with the lowest reading on record observed at the Yoakum cooperative station (approximately 46 miles to the north) on December 23, 1989. More noteworthy, though, Table 2.7-4 and the accompanying notes indicate that record low temperatures were also set at Palacios Municipal Airport, Port O'Connor, Point Comfort, Cuero, Sinton, Aransas Wildlife Refuge, Victoria Regional Airport, and Karnes City 2N on the same date (NCDC Jul 2005; NCDC Nov 2002; NCDC Jul 2006; USU Jun 2008).

The extreme maximum and minimum temperature data indicates that synoptic-scale conditions responsible for periods of record-setting excessive heat, as well as significant cold air outbreaks, tend to affect the overall VCS site area. The similarity of the respective extremes and their dates of occurrence suggest that these statistics are reasonably representative of the temperature extremes that might be expected to be observed for the VCS site region.

2.7.4.1.2 Atmospheric Water Vapor

Annual, seasonal, and monthly characteristics of the wet bulb and dew point temperatures, along with relative humidity (including diurnal variations), based on measurements at the nearby Victoria, Texas, NWS station, are described in Subsection 2.7.1.3.2.

2.7.4.1.3 Precipitation

Characteristics of the normal (30-year average) annual rainfall and snowfall totals are described in Subsection 2.7.1.3.3 and presented in Table 2.7-3. The overall maximum daily and monthly totals observed in the VCS site area for these forms of precipitation are summarized in Subsection 2.7.1.3.3 as well.

Precipitation is a point measurement. Mean and extreme statistics, such as individual storm event, or daily or cumulative monthly totals vary from station to station. Assessing the variability of precipitation extremes over the VCS site area to evaluate whether the available long-term data is representative of conditions at the site depends greatly on station coverage.

Historical precipitation extremes (rainfall and snowfall) are presented in Table 2.7-4 for the 15 nearby climatological observing stations listed in Table 2.7-1. Maximum recorded 24-hour rainfall totals range from 8.15 inches at the Rockport station, approximately 40 miles south of the VCS site, to 17.58 inches at the Edna Highway 59 Bridge observing station, approximately 32 miles to the northeast (NCDC Jul 2005; NCDC Nov 2002; NCDC Jul 2006; USU Jun 2008). Maximum monthly rainfall totals range from 18.33 inches at Yoakum, approximately 46 miles to the north, to 26.30 inches at the Refugio observing station, approximately 25 miles to the southwest (NCDC Jul 2005; NCDC Nov 2002; NCDC Jul 2006; USU Jun 2008; NCDC Jun 2008d; NCDC 2008c).

Most of the individual station monthly rainfall records (and to a lesser extent the 24-hour record totals) were established as a result of precipitation associated with tropical cyclones. Of those records, half were because of tropical cyclones that passed within a 100-nautical-mile radius of the VCS site. The other half (i.e., six monthly totals and two 24-hour totals) were attributable to the expansive influence of Hurricane Beulah, which did not pass within that radial distance of the site.

However, the overall highest 24-hour rainfall total in the site area, 17.58 inches, on October 18, 1994, at the Edna Highway 59 Bridge cooperative observing station (USU Jun 2008) was not directly associated with a tropical cyclone. This extreme rainfall event was one of many over southeast Texas caused by a synoptic situation that included a steady stream of tropical moisture into the region in the wake of former Pacific Hurricane Rosa. The remnants of that storm crossed into Mexico, moved through Texas, and slowed after entering the Mississippi Valley. This system coupled with a quasi-stationary frontal boundary along the Texas Coast that provided a source of lift and supported widespread and continual thunderstorm development (NCDC Jun 2004).

Similarly, the highest monthly rainfall total in the site area, 26.30 inches during September 1971, was recorded at the Refugio cooperative observing station (USU Jun 2008; NCDC Jun 2008c).

In general, when monthly rainfall records were established at a given observing station, regardless of their cause(s), significant amounts of precipitation were usually measured at most of the other stations in the site area, particularly when associated with the passage of tropical cyclones. This is usually not the case for maximum 24-hour rainfall records because of the occurrence of more local-scale events such as thunderstorms and because of the intense nature of these storms in this coastal area. However, there does not appear to be any clear relationship between the rainfall recorded during such extreme events, whether on a 24-hour or monthly basis, and the distance inland within the area considered around the VCS site (Figure 2.7-1). Therefore, based on the range of the maximum recorded 24-hour and monthly rainfall totals among these stations, the areal distribution of these climatological observing stations around the site, and their proximity to the site, data suggests that rainfall extremes close to the upper limits of the respective maxima can reasonably be expected to occur at the VCS site.

From central Texas southward, most winters bring no accumulation of snowfall. Major snowstorms occur only once every few decades, but no corner of the state is immune (USU Jun 2008). Among the 15 nearby observing stations listed in Table 2.7-4, 7 of the 24-hour maximum snowfall records were established as a result of the Christmas storm of 2004 occurring on December 24–25. The highest, 12.0 inches, was measured at the Goliad observing station approximately 22 miles to the west of the VCS site. Other station records on this date range from 4.5 inches at Beeville 5 NE, approximately 42 miles west-southwest, to 9.5 inches at the Refugio 2 NW observing station, approximately 25 miles to the southwest (Table 2.7-4). Because of the rarity of such events in the site area, any of the record snowfall amounts listed in Table 2.7-4 can reasonably be expected to occur at the VCS site when such events do take place.

2.7.4.1.4 Fog

The closest station to the VCS site at which observations of fog are made and routinely recorded is the Victoria, Texas, NWS station approximately 17 miles to the north-northeast. The 2007 LCD summary for this station (Table 2.7-2) indicates an average of approximately 44 days per year of heavy fog conditions, based on a 43-year period of record. The NWS defines heavy fog as fog that reduces visibility to 1/4 mile or less (NCDC Jun 2008b).

On a seasonal basis, heavy fog conditions occur most often during the winter months (December through February), reaching peak frequency in January, averaging 7.2 days per month. Heavy fog conditions occur least often in the summer (i.e., June to August), averaging less than 1 day per month (NCDC Jun 2008b).

The frequency of heavy fog conditions at the VCS site would be expected to be very similar to the observations made at the Victoria, Texas, NWS station because of their close proximity to each other (approximately 17 miles). This is consistent with the higher frequency of occurrence reported in *The Climate Atlas of the United States* (NCDC Sep 2002), which indicates an annual average frequency of 35.5 to 40 days per year in the area that includes both Victoria, Texas, and the VCS site. The seasonal variation in *The Climate Atlas* is very similar to that in the 2007 LCD for the Victoria NWS station (NCDC Jun 2008b; NCDC Sep 2002).

Enhancement of naturally occurring fog conditions as the result of the cooling basin and mechanical draft cooling towers associated with the VCS site is addressed in Subsection 5.3.3.

2.7.4.2 Average Wind Direction and Wind Speed Conditions

Long-term average wind motions at the macro- and synoptic scales (on the order of thousands to hundreds of kilometers) are influenced by the general circulation patterns of the atmosphere at the macroscale and by large-scale topographic features (e.g., land-water interfaces such as coastal areas). These characteristics are presented in Subsection 2.7.1.2.

Although they may reflect these larger-scale circulation effects, site-specific or microscale (on the order of 2 kilometers or less) wind conditions are influenced primarily by local and, to a lesser extent (in general), by meso- or regional-scale (up to approximately 200 kilometers) topographic features. Wind measurements at these smaller scales are currently available from the onsite, pre-application phase meteorological monitoring program operated in support of the proposed VCS site and, for comparison, from data recorded at the nearby Victoria, Texas, NWS station.

Subsections 6.4.2 and 6.4.3 describe the pre-application phase monitoring program. Wind direction and wind speed measurements were made at two levels on a 60-meter instrumented tower (at 10 meters and 60 meters). The monitoring program began operation on June 28, 2007.

Figures 2.7-2 through 2.7-6 present annual and seasonal wind rose plots, for the 10-meter level based on measurements over the 2-year period of record from July 1, 2007 through June 30, 2009.

The wind direction distribution at the 10-meter level indicates a prevailing wind from the south-southeast on an annual basis with approximately 50 percent of the winds blowing from the southeast quadrant (see Figure 2.7-2). Winds from the north and north-northeast sectors combined occur approximately 18 percent of the time annually.

On a seasonal basis, winds from the southeast quadrant appear to predominate throughout the year, but especially during the spring and summer (see Figures 2.7-4 and 2.7-5). During the winter, winds from the north sector become more prevalent (see Figure 2.7-3). Autumn represents a transitional season in that winds from the northeast and southeast quadrants occur with about the same frequency as north to northeasterly flow increases as the result of increased cold frontal passages (Figure 2.7-6); winds from the north sector increase in frequency during this season as well. Plots of individual monthly wind roses at the 10-meter measurement level are presented in Figure 2.7-7, Sheets 1 to 12.

Annual and seasonal wind rose plots from the 60-meter level are shown in Figures 2.7-8 through 2.7-12. By comparison, wind direction distributions for the 60-meter level are similar to the 10-meter level wind roses on an annual basis, and for the winter, spring, and summer seasons in terms of the predominant directional quadrants and variation over the course of the year. Autumn differs in that winds from the southeast quadrant clearly occur more often at the 60-meter level than at the 10-meter level, where the aggregate frequencies from the northeast and southeast quadrants appear to be similar. Plots of individual monthly wind roses at the 60-meter measurement level are presented in Figure 2.7-13, Sheets 1 to 12.

Wind data summarized in the LCD for the Victoria, Texas, NWS station (Table 2.7-2) indicates a prevailing south-southeasterly wind direction on an annual basis, as well as seasonal variations (NCDC Jun 2008b), that appear to be reasonably similar to the 10-meter-level wind flow at the VCS site. Differences between the two wind direction distributions are attributable to many factors: topographic setting, sensor exposure, instrument starting threshold, and period of record.

Table 2.7-6 summarizes seasonal and annual mean wind speeds based on measurements from the upper and lower levels of the onsite meteorological tower over the 2-year period from July 1, 2007 through June 30, 2009, and from instrumentation at the Victoria, Texas, NWS station based on a 24-year period of record (NCDC Jun 2008b). The height of the instruments at the Victoria NWS station is reasonably comparable to the lower (10-meter) level measurements at the VCS site.

On an annual basis, mean wind speeds at the 10- and 60-meter levels are 4.0 and 6.1 meters per second, respectively, at the VCS site. The annual mean wind speed at Victoria (4.2 meters per second) is similar to the 10-meter level at the VCS site, differing by only 0.2 meters per second. Seasonal average wind speeds are similar throughout the year, except during autumn when speeds average approximately 0.7 meters per second lower at the VCS site than at Victoria. Seasonal mean wind speeds for both locations follow the same pattern, described in Subsection 2.7.2.3, in relation to the seasonal variation of relatively higher air stagnation and restrictive dispersion conditions in the site region.

Only 33 occurrences of calm wind conditions were recorded by the onsite meteorological monitoring system at the 10-meter level, and only 6 occurrences at the 60-meter level, over the 2-year period from July 1, 2007 through June 30, 2009.

2.7.4.3 Wind Direction Persistence

Wind direction persistence is an indicator of the duration of atmospheric transport from a specific sector to a corresponding downwind sector-width. Atmospheric dilution is directly proportional to the wind speed (other factors remaining constant). When combined with wind speed, a wind direction persistence/wind speed distribution further indicates the downwind sectors with relatively more or less dilution potential (higher or lower wind speeds, respectively) associated with a given wind direction.

Tables 2.7-7 and 2.7-8 present wind direction persistence/wind speed distributions based on measurements from the VCS pre-application phase monitoring program for the two year period of record from July 1, 2007, through June 30, 2009. The distributions account for discrete durations ranging between 1 and 48 hours for wind directions from 22.5-degree upwind sectors centered on each of the 16 standard compass radials (i.e., north, north-northeast, northeast, etc.) and for wind speed groups greater than or equal to 5, 10, 15, 20, 25, and 30 mph. Distributions are provided for wind measurements made at the lower (10-meter) and the upper (60-meter) tower levels, respectively, identified in the preceding subsection. Except the first discrete value (1), all other discrete values are the upper limits of the durations. For example, 18 stands for 12 < hour $\leq$ 18;

therefore, any hour counts identified within this range means the longest persistence period is at least 12 hours.

Two individual years (July 01, 2007 through June 30, 2008 and July 01, 2008 through June 30, 2009) of the wind direction persistence tables for the 10-meter level are presented in Table 2.7-7, Sheets 1 through 3 and 4 through 6, respectively. The 60-meter level wind direction persistence tables are presented in Table 2.7-8, Sheets 1 through 3 and 4 through 6, respectively.

2.7.4.4 Atmospheric Stability

Atmospheric stability is a relative indicator for the potential diffusion of pollutants released into the ambient air. Atmospheric stability, as addressed in this ER, was based on the delta-temperature (Δ**T**) method described in Section 2.2 of Revision 1 to RG 1.23 (U.S. NRC Mar 2007b).

Stability classifications are assigned according to the ΔT criteria provided in Table 1 of RG 1.23. The diffusion capacity is greatest for extremely unstable conditions and decreases progressively through the remaining unstable, neutral stability, and stable classifications.

During the 2-year period from July 1, 2007 through June 30, 2009, Δ**T** was determined from the difference between temperature measurements made at the 60- and 10-meter tower levels. Seasonal and annual frequencies of atmospheric stability class and associated 10-meter level mean wind speeds for this period of record are presented in Table 2.7-9.

The data indicates a predominance of neutral stability (Class D) and slightly stable (Class E) conditions throughout most of the year. These stability classes combined were recorded approximately 48 percent of the time on an annual basis, ranging seasonally from approximately 39 percent during autumn to approximately 55 percent during the winter. Extremely unstable conditions (Class A) were recorded slightly more than 8 percent of the time on an annual basis, occurring more frequently during the spring (approximately 12 percent of the time), and least often during the autumn (only approximately 4.5 percent of the time). Moderately and extremely stable conditions (Classes F and G, respectively) were recorded approximately 30 percent of the time on an annual basis, occurring most often during the autumn (approximately 43 percent of the time), owing in part to increased radiational cooling at night, and least often during the spring (approximately 21 percent of the time).

Joint frequency distributions (JFDs) of wind speed and wind direction by atmospheric stability class and for all stability classes combined for the 10- and 60-meter wind measurement levels are presented in Tables 2.7-10 and 2.7-11, respectively, based on the 2-year period of record from July 1, 2007 through June 30, 2009. The 10-meter level JFDs are used to evaluate short-term dispersion estimates for accidental atmospheric releases (see Subsection 2.7.5) and long-term diffusion estimates of routine releases to the atmosphere (see Subsection 2.7.6).

2.7.4.5 Topographic Description and Potential Modifications to Meteorological Conditions

The VCS site is located in Victoria County, Texas approximately 13 miles from the city of Victoria. The site is approximately 125 miles southwest of Houston and 60 miles north-northeast of Corpus Christi. The VCS site property encompasses approximately 11,500 acres. The power block area covers approximately 78 acres.

Terrain features within a 50-mile radius of the VCS site, based on digital map elevations, are illustrated in Figure 2.7-1. Terrain elevation profiles along each of the 16 standard 22.5-degree compass radials out to a distance of 50 miles from the site are shown in Figure 2.7-14 (Sheets 1 through 6). The locus of these radial lines is the "power block area reference point," which is approximately 250 feet south of the centroid of the power block area.

The nominal plant grade elevation for the power block area is 95 feet NAVD 88. Located within the south-central Texas Coastal Plain, terrain within 50 miles of the VCS site is generally flat to gently rolling with elevations decreasing to the east-northeast clockwise through the south-southwest. Elevations tend to increase to the west-southwest through the north-northeast with increasing distance from the site, with relief of up to approximately 450 feet relative to nominal plant grade. Figure 2.7-1 indicates that the highest elevation within 50 miles of the site is 550 feet above MSL (this spot elevation does not fall along one of the 16 standard direction radials presented in Figure 2.7-14). The lowest elevation within 50 miles of the site, 0 feet MSL (Gulf of Mexico and adjacent bay waters), occurs to the east through the south (Figures 2.7-1 and 2.7-14).

More detailed topographic features within a 5-mile radius of the VCS site, are shown in Figure 2.7-15. Terrain within this radial distance of the site primarily consists of flat plains with very little elevation change, relative to nominal plant grade.

Construction of the VCS site will include clearing, grubbing, excavation, leveling, and landscaping activities typical of large-scale projects (see Section 3.9 for a listing of activities and their estimated durations). The most prominent feature, however, in terms of land alteration associated with this facility, will be the excavation and construction of an approximately 4900-acre cooling water basin. Nevertheless, alterations to the existing terrain would not represent a significant change to the flat to gently rolling topographic character of the site vicinity or the surrounding site area (Figure 2.7-15).

Subsection 6.4.2 provides additional details regarding the considerations made in siting and equipping the meteorological tower installed for the pre-application phase monitoring program in relation to the construction of, and/or major structures associated with, the units.

The dimensions and operating characteristics of the facilities associated with the VCS site, including paved, concrete, or other improved surfaces, are considered to be insufficient to generate discernible, long-term effects to local- or microscale meteorological conditions, or to the mean and extreme climatological characteristics of the site area described previously under Subsections 2.7.1.3 and 2.7.4.1.

Wind flow will be altered in areas immediately adjacent to and downwind of larger site structures. These effects will likely dissipate within 10 structure heights downwind of the intervening structure(s). Similarly, although ambient temperatures immediately above any improved surfaces could increase, these temperature effects will be too limited in their vertical profile and horizontal extent to alter local, area-, or regional-scale mean or extreme ambient temperature patterns. See Subsections 6.4.2.4 and 6.4.2.5 for additional details.

The VCS site would use a cooling basin and mechanical draft cooling towers as a means of heat dissipation during normal operation. Potential meteorological effects resulting from the cooling basin and cooling towers could include enhanced ground-level fogging and icing, cloud shadowing and precipitation enhancement, and increased ground-level humidity. These effects are addressed in detail in Subsections 5.3.3.1 and 5.3.3.2.

2.7.5 Short-Term Diffusion Estimates

2.7.5.1 Regulatory Basis and Technical Approach

To evaluate potential health effects for design basis accidents, Section 7.1 of NUREG-1555 (U.S. NRC Mar 2000) specifically requires the applicant to account for the 50-percentile X/Q (relative concentration) values at appropriate distances from the release points of effluents to the atmosphere. These 50-percentile X/Q values are to be determined using onsite meteorological data and represent more realistic dispersion conditions for the VCS site area, relative to those presented in the site safety analysis report. The NRC-sponsored PAVAN model (NUREG/CR-2858) (U.S. NRC Nov 1982) has been used to generate these 50-percentile X/Q values.

Recent (July 1, 2007 through June 30, 2009) data from the VCS site pre-application meteorological monitoring program has been used for the quantitative evaluation of a design basis accident and atmospheric dispersion estimates at the proposed VCS site.

The PAVAN program implements the guidance provided in RG 1.145 (U.S. NRC Feb 1983). Mainly, the code computes X/Q values at the exclusion area boundary (EAB) and the boundary of the low population zone (LPZ) for each combination of wind speed and atmospheric stability class for each of 16 downwind direction sectors (i.e., north, north-northeast, northeast, etc.). The X/Q values calculated for each direction sector are then ranked in descending order, and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speeds and stabilities for the complementary upwind direction sector (i.e., 180 degrees opposite). The X/Q values are also ranked independently of wind direction into a cumulative frequency distribution for the entire site.

The following input data and assumptions were used in the PAVAN modeling analysis:

- Meteorological data: 2-year (July 1, 2007 to June 30, 2009) onsite JFD of wind speed, wind direction, and atmospheric stability
- Wind sensor height: 10 meters
- Vertical temperature difference: as measured at the 10-meter and 60-meter levels of the onsite meteorological tower
- Number of wind speed categories: 12 (including calm and the 11 wind speed categories listed in Table 2.7-10)
- Type of release: ground level
- Release height: 10 meters (default height)
- Distances from release points to EAB for all downwind sectors
- Distances from release points to LPZ for all downwind sectors

The 2-year composite JFDs of wind speed, wind direction, and atmospheric stability class, input to the PAVAN dispersion modeling analysis, are presented in Table 2.7-10 (see also Subsection 2.7.4.4 for additional information).

The EAB for the VCS site is entirely contained within the site property line and is represented in Figure 2.7-17. No residential areas are located within this overall EAB.

As shown in Figure 2.7-17, the VCS site is conservatively treated as one unit when estimating the shortest distance to each boundary receptor in each direction. To represent the VCS site, a source boundary was created. Because the PAVAN model cannot produce 5 percent overall site limit X/Q values unless the distances from the release point to the EAB or LPZ are similar, the shortest distance from the source boundary to the LPZ was used for all 16 direction sectors (Figure 2.7-18).

For purposes of determining X/Qs and subsequent radiation doses with respect to the VCS, the EAB is represented by two 4000-foot-radius circle EABs combined into one oval EAB centered on the power block reference point (Figure 2.7-17). The LPZ boundary for the VCS site consists of one 5-mile-radius circle, centered at the power block reference point.

As NUREG/CR-2858 (U.S. NRC Nov 1982) indicates, ground-level releases include all release points or areas that are lower than two and one-half times the height of adjacent solid structures. It was assumed any reactor building plant stack would be below the threshold height. All accidental releases were assumed to be at ground level and were assigned the default release height of 10 meters. Compared with an elevated release, a ground-level release results in higher ground-level concentrations at downwind receptors as the result of shorter traveling distances.

The PAVAN model was also configured to calculate X/Q values assuming both wake credit allowed and wake credit not allowed. Obstructions to air flow have a wake region that extends 10 times the obstruction height downwind. The height is assumed to be 24.38 meters and the structural wake extends approximately 244 meters downwind. The EAB is at least 879 meters away from the source boundary. As a result, the entire EAB is located beyond the wake influence zone. Furthermore, the LPZ is a circle with a 5-mile (8047-meter) radius centered at the power block area reference point. Because the LPZ is located beyond the EAB, the “wake credit not allowed” scenario of the PAVAN modeling results was used for the X/Q analyses at both the EAB and the LPZ.

The distance between the EAB and the source boundary (Table 2.7-12) for the VCS site was entered as the receptor distance for each downwind sector in calculating the X/Q values at the EAB. The shortest distance between the source boundary and the LPZ was determined for all direction sectors; these distances are shown in Table 2.7-12. The shortest distance (i.e., 4.708 miles or 7576 meters to the north-northeast of the boundary) was input to the PAVAN model (Figure 2.7-18).

2.7.5.2 PAVAN Modeling Results

Based on the methodology provided in Subsection 2.7.5.1, the resulting 50-percentile X/Q values based on the upper envelope of the ordered X/Q-frequency values for the EAB and LPZ are shown in Table 2.7-13. The 50-percenticle X/Q values for the EAB and LPZ are 8.85×10^{-5} and 9.64×10^{-6} sec/m^3, respectively.

These model-predicted X/Q values represent a 0-to-2-hour time interval with no credit taken for building wake effects, as indicated previously. To estimate X/Qs for longer time intervals, the program calculates sector-dependent and overall site limit annual average X/Q values using the procedure described in NUREG/CR-2858 (U.S. NRC Nov 1982). The values for intermediate time periods at the LPZ (i.e., 8 hours, 16 hours, 72 hours, and 624 hours) were determined by logarithmic interpolation between the 50-percentile, 0-to-2-hour X/Q and the corresponding annual average X/Qs.

The highest annual average X/Q value was chosen as the end point for the interpolation; the highest annual average X/Q at the LPZ was the sector-dependant value. These results, along with the 50-percentile, 0-to-2-hour X/Q value at the EAB are summarized below.

Summary of Interpolated X/Q Values (sec/m^3) for Intermediate Time Periods

Source Location	Receptor Distance	50-Percentile 0–2 hr	0–8 hours (8 hours)	8–24 hour (16 hours)	1–4 days (72 hours)	4–30 days (624 hours)	Annual Average
Source Boundary	EAB	8.85×10^{-5}	—	—	—	—	—
Source Boundary	LPZ	—	5.30×10^{-6}	3.92×10^{-6}	2.05×10^{-6}	8.05×10^{-7}	2.57×10^{-7}

2.7.6 Long-Term (Routine) Diffusion Estimates

2.7.6.1 Regulatory Basis and Technical Approach

The NRC-sponsored XOQDOQ computer program (NUREG/CR-2919) (U.S. NRC Sep 1982) was used to estimate X/Q and D/Q values due to routine releases of gaseous effluents to the atmosphere. The XOQDOQ computer code has the primary function of calculating annual average X/Q values and annual average relative deposition (D/Q) values at receptors of interest (e.g., the EAB; the nearest milk cow/goat, residence, garden, meat animal). X/Q and D/Q values owing to intermittent releases, which occur during routine operation, may also be evaluated using the XOQDOQ model.

The XOQDOQ dispersion model implements the assumptions outlined in RG 1.111 (U.S. NRC Jul 1977). The program assumes that the material released to the atmosphere follows a Gaussian distribution around the plume centerline. In estimating concentrations for longer time periods, the Gaussian distribution is assumed to be evenly distributed within a given directional sector. A straight-line trajectory is assumed between the release point and all receptors.

The following input data and assumptions were used in the XOQDOQ modeling analysis:

- Meteorological data: 2-year (July 1, 2007, to June 30, 2009) onsite JFD of wind speed, wind direction, and atmospheric stability
- Wind sensor height: 10 meters
- Vertical temperature difference: (10 meters–60 meters)
- Number of wind speed categories: 12 (including calm and the 11 wind speed categories) listed in Table 2.7-10
- Type of release: Ground-level

- Release height: 10 meters (default height)
- Minimum building cross-sectional area: 1263 square meters
- Reactor building height: 24.38 meters above grade
- Distances from the source boundary to the nearest residence, vegetable garden, and meat animal, and the property boundary (see Table 2.7-14)
- No milk cows/goats are identified within 5 miles of the VCS site, and no dairies are identified within 50 miles

The XOQDOQ and PAVAN dispersion models used the same meteorological data set (two years—July 1, 2007 to June 30, 2009) previously indicated.

The reactor building design has been used to calculate the minimum building cross-sectional area, a required input to the model, as called for in NUREG/CR-2919 (U.S. NRC Sep 1982). Although the turbine building is larger, using the reactor building is more conservative because a smaller area results in higher X/Q values. The height of the reactor buildings for modeling purposes is 24.38 meters. The resulting cross-sectional area was determined by multiplying the height by the width of the reactor building (51.80 meters). The area used is 1263 square meters (from the mPower design).

Compared to an elevated release, a ground-level release usually results in higher concentrations at downwind receptors located at ground level because of less dilution from shorter traveling distances. Consequently, as a conservative approach and for the reasons described in Subsection 2.7.5.1, only ground-level releases were assumed in the XOQDOQ modeling analysis.

Potential releases were assumed to occur at any point on the source boundary as a conservative approach to minimizing the travel distance of any release to all receptors of interest. Source to receptor distances associated with the property boundary were calculated for the 16 standard direction radials (i.e., north, north-northeast, northeast, etc.). Values represent the shortest distance from the source boundary to the property boundary in each sector (see Table 2.7-12). Distances from a potential release point to the nearest residence, meat animal, and vegetable garden in each of the 16, 22.5-degree compass sectors (i.e., north, north-northeast, northeast, etc.) are listed in Table 2.7-15. Directional sectors without a receptor were not modeled. A total of 15 sectors were considered for analysis as residential, meat animal and vegetation receptors. Fourteen of these sectors contained all three receptors in the same location (at the same distance). The north-northwest sector contained a vegetable garden at a greater distance than the residential and meat animal receptors. No milk cow or goat receptors are located within 5 miles of the site and were not analyzed.

One other set of receptors of interest was identified to evaluate the impact of new units when a first unit is operational and a subsequent unit is under construction. Because of the relative orientation of the units, only three scenarios were considered (i.e, north-northeast, northeast, and east-northeast). A distance of 0.25 miles (Table 2.7-14) was used from the midpoints of each half of the power block area. The maximum X/Q for this scenario occurs in the north-northeast sector.

2.7.6.2 XOQDOQ Modeling Results

Among all of the modeled receptors of interest, the overall maximum annual average X/Q value, 1.6×10^{-5} sec/m^3 (no decay and 2.26 day decay, undepleted), occurred at the proposed new reactor under construction as the result of an assumed routine release from the first operating reactor, as previously described. The maximum annual average X/Q values (along with the downwind sectors and corresponding receptor distances relative to the source boundary) for the other sensitive receptor types are:

- 1.3×10^{-5} sec/m^3 at the property boundary in the southwest sector at a receptor distance of 0.62 mile
- 2.8×10^{-6} sec/m^3 for the nearest residence/meat animal in the north-northwest sector at receptor distances of 1.40 miles
- 2.0×10^{-6} sec/m^3 for the nearest vegetable garden receptor in the northwest sector at a receptor distance of 1.65 miles
- 1.6×10^{-5} sec/m^3 for the adjacent reactor (under construction) located to the north-northwest sector at a distance of 0.25 miles
- 1.8×10^{-5} sec/m^3 for the EAB located to the north-northwest sector at a distance of 0.60 miles.

Table 2.7-14 summarizes the maximum X/Q and D/Q values estimated by the XOQDOQ dispersion model for various radioactive decay and plume depletion scenarios at sensitive receptors of interest around the VCS site. Table 2.7-16 presents annual average X/Q and D/Q values for the north-northwest sector, at the 22 standard radial distances between 0.25 and 50 miles downwind and for the model's 10 standard distance-segment boundaries between 0.5 and 50 miles downwind. The north-northwest sector has the highest relative concentration values out to 5 miles downwind distances. The north-northwest sector has the highest relative deposition values at all downwind distances.

Detailed annual average X/Q and D/Q estimates generated by the XOQDOQ model for the receptors of interest, at the 22 standard radial distances and for the 10 standard distance-segment boundaries, are also provided in Table 2.7-18 through 2.7-25.

Table 2.7-17 presents X/Q and D/Q estimates at all of the receptors of interest identified in Table 2.7-15. Tables 2.7-18 and 2.7-19 list X/Q estimates with no radioactive decay and no plume depletion for each of the 16, 22.5-degree compass sectors at the 22 standard radial distances and for the 10 standard distance-segment boundaries, respectively. Tables 2.7-20 and 2.7-21 contain X/Q estimates that include radioactive decay with a half-life of 2.26 days for short-lived noble gases and no plume depletion. Tables 2.7-22 and 2.7-23 show X/Q estimates that include radioactive decay with a half-life of 8 days for all iodines released to the atmosphere, as well as incorporation of plume depletion. Finally, Tables 2.7-24 and 2.7-25 list modeled estimates of long-term average relative deposition at the 22 standard radial distances and for the 10 standard distance-segment boundaries, respectively.

2.7.7 Noise

The VCS site is located on an approximately 11,500-acre greenfield site approximately 13 miles south of the city of Victoria. The site is surrounded by farmlands, with the western border next to U.S. Highway 77 and the southern border running parallel to a railroad line. The site and surrounding area is rural in nature with pasture and shrub land.

The dominating preexisting sources of man-made noise at the site are the result of gas wells, a compressor station, and heavy equipment associated with a cattle ranch. Background noise measurements were conducted between February 26 and February 29, 2008, at selected locations around the VCS site boundary (Figure 2.7-16).

The hourly measurements made at location NSR-1 were primarily affected by the traffic on U.S. Highway 77, natural sounds, and wind-induced noise. The hourly energy equivalent sound pressure level was typically between 50 and 52 dBA, but did get as low as 40 dBA with the noise monitor location upwind from U.S. Highway 77.

Measurement location NSR-2 was selected primarily because of the presence of a residential structure located west of U.S. Highway 77. The monitor was positioned at approximately the same distance from Highway 77, but on the east side of the road. The house was found to be abandoned, but measurements at this location were continued as a reference point for the western boundary. At NSR-2 the primary noise source was traffic noise from U.S. Highway 77, and the hourly energy equivalent sound pressure levels were approximately 60 dBA.

Location NSR-3 is located in the southwestern corner of the site. The dominating noise source at this location is a nearby compressor station; NSR-3 is approximately 200 yards from the compressor station. The noise level at this location was within a constant range between 50–55 dBA.

Location NSR-4 was situated on the eastern side of the property boundary. The primary man-made source of noise at this location was from railroad traffic, occurring south of the measurement location. At those times when there was no rail traffic, the sound in this area was mainly caused by birds, insects, and wind-generated noise. The hourly energy equivalent noise level at this location fluctuated between 30 and 50 dBA.

At location NSR-5, which was adjacent to a residential home, the noise level was very low without wind-generated noise. The hourly energy equivalent sound pressure level was approximately 30 dBA at times, with no wind-generated noise.

Location NSR-6 was situated near the meteorological tower and the sound levels at this location were primarily from U.S. Highway 77. The hourly energy equivalent sound pressure level was approximately 55 dBA at this location.

Noise sources during the operational phase of the proposed new units will include transformers and other electrical equipment, circulating water pumps, mechanical draft cooling towers, and the public address system. However, the effects of noises generated by unit operation are mitigated by the undeveloped land surrounding the plant. Also, most equipment will be located within the plant buildings which serves to dampen noises.

During the construction phase of the new units, noise will be generated from construction equipment and site traffic. The construction noise will be associated with building the units, the site infrastructure, and the construction of the cooling basin. Based on a comprehensive construction noise study conducted for the Empire State Electric Energy Research Corporation by Bolt Beranek and Newman (Bolt Beranek and Newman May 1977), in a report titled *Power Plant Construction Noise Guide*, the noise associated with construction is divided into six different phases: excavation; concrete pouring; steel erection; mechanical; cleanup; and steam-blow. The last phase may not be applicable to the construction and startup of nuclear units. The long-term average A-weighted equivalent sound pressure levels, LAeq, are listed in the table that follows as a function of distance for each of these phases.

Mobile construction equipment will be used to construct the cooling basin. Residences near the construction site will experience short-term higher noise levels when construction equipment is working nearby. Estimates of long-term equivalent sound pressure levels were made for various distances from the construction area.

	Estimated Long-Term Equivalent Sound Pressure Level, LAeq		
Phase	**Northern Location (~6800 feet away)**	**West Boundary (~3900 feet away)**	**Eastern Location (~10,000 feet away)**
Excavation	40	50	35
Concrete Pouring	36	46	31
Steel Erection	40	50	35
Mechanical	35	45	30
Cleanup	30	40	25
Steam (or Air) Blows for Pipe Cleaning	80	90	75

2.7.8 References

ASCE 2005. American Society of Civil Engineers and Structural Engineering Institute, *ASCE Standard ASCE/SEI 7-05, Minimum Design Loads for Buildings and Other Structures, Revision of ASCE 7-02*, 2005.

Bolt Beranek and Newman May 1977. Bolt, Beranek, and Newman, Incorporated, *Power Plant Construction Noise Guide*, Report No. 3321, prepared for Empire State Electric Energy Research Corporation, New York, New York, May 1977.

Bomar 1983. George W. Bomar, *Texas Weather*, pp. 150–152 and 187–194, University of Texas Press, Austin, Texas, 1983.

LOSC Sep 2002. Louisiana Office of State Climatology, *Louisiana Monthly Climate Review, September 2002*, Volume 22, Number 9, LOSC, Department of Geography and Anthropology, Louisiana State University, September 2002.

NCDC Feb 2002. National Climatic Data Center, *Climatography of the United States, No. 81, 1971–2000, U.S. Monthly Climate Normals*, CD-ROM, NCDC, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, February 2002.

NCDC Jun 2002. National Climatic Data Center, *Climatography of the United States, No. 85, Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000 (and previous normals periods)*, Section 1, “Temperature,” and Section 2, “Precipitation,” NCDC, NESDIS, NOAA, June 15, 2002.

NCDC Sep 2002. National Climatic Data Center, *The Climate Atlas of the United States*, Version 2.0, CD-ROM, NCDC, Climate Services Division, NOAA, September 2002.

NCDC Nov 2002. National Climatic Data Center, *Cooperative Summary of the Day, TD3200, Period of Record through 2001 (Includes daily weather data from the Central United States)*, Version 1.0, CD-ROM, data listings for Palacios Municipal Airport, Beeville 5 NE, Port O' Connor, Point Comfort, Cuero, Maurbro, Yoakum, Edna Highway 59 Bridge, Rockport, Goliad, Sinton, Aransas Wildlife Refuge, Victoria Regional Airport, Refugio 2 NW, Karnes City 2N, Texas, NCDC, NOAA, data released November 2002.

NCDC Jun 2004. National Climatic Data Center, *Storm Data (and Unusual Weather Phenomena with Late Reports and Corrections)*, January 1959 (Volume 1, Number 1) to January 2004 (Volume 46, Number 1), NCDC, NESDIS, NOAA, June 2004.

NCDC Jul 2005. National Climatic Data Center, *Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries,* CD-ROM, data summaries for Palacios Municipal Airport, Beeville 5 NE, Port O' Connor, Point Comfort, Cuero, Yoakum, Rockport, Goliad, Sinton, Aransas Wildlife Refuge, Victoria Regional Airport, Texas, NCDC, NESDIS, NOAA, July 2005.

NCDC Jul 2006. National Climatic Data Center, *U.S. Summary of Day Climate Data (DS 3200/3210), POR 2002-2005*, CD-ROM, data listings for Palacios Municipal Airport, Beeville 5 NE, Port O' Connor, Point Comfort, Cuero, Maurbro, Yoakum, Edna Highway 59 Bridge, Rockport, Goliad, Sinton, Aransas Wildlife Refuge, Victoria Regional Airport, Refugio 2 NW, Karnes City 2N, Texas, NCDC, NOAA, July 2006.

NCDC Apr 2008. National Climatic Data Center, *Storm Events for Texas, Hail Event, and Snow and Ice Event Summaries for Matagorda, Jackson, Lavaca, Karnes, Wharton, Victoria, Bee, Refugio, Goliad, San Patricio, Aransas, DeWitt, and Calhoun Counties in Texas*, NCDC, NOAA. Available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, accessed various dates through April 7, 2008.

NCDC Jun 2008a. National Climatic Data Center, *Storm Events for Texas, Tornado Event Summaries for Aransas, Atascosa, Austin, Bee, Bexar, Calhoun, Colorado, DeWitt, Fort Bend, Goliad, Gonzales, Guadalupe, Jackson, Jim Wells, Karnes, Kleberg, Lavaca, Live Oak, Matagorda, Nueces, Refugio, San Patricio, Victoria, Wharton, and Wilson Counties*, NCDC, NOAA. Available at http://www4.ncdc.noaa.gov/cgi win/wwcgi.dll?wwevent~storms, accessed various dates through June 3, 2008.

NCDC Jun 2008b. National Climatic Data Center, *Local Climatological Data Publications, Select State—Texas, Select Station—Victoria—, Select Month—2007 Annual*, NCDC, NOAA. Available at http://www7.ncdc.noaa.gov/IPS/lcd/lcd.html, accessed June 9, 2008.

NCDC Jun 2008c. National Climatic Data Center, *Storm Events for Texas, Hurricane and Tropical Storm Event, and Dust Storm Event Summaries,* NCDC, NOAA. Available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, accessed various dates through June 25, 2008.

NCDC Jun 2008d. National Climatic Data Center, *Cooperative Select State—Texas, Cooperative Select Station—Port O'Connor, Goliad, Aransas Wildlife Refuge*, NCDC, NOAA. Available at http://www7.ncdc.noaa.gov/IPS/coop/coop.html, accessed various dates through June 25, 2008.

NCDC Nov 2008a. National Climatic Data Center, Climate Data Online, Surface Data, Monthly, NCDC, NOAA. Available at http://cdo.ncdc.noaa.gov/cgi-bin/cdo/cdostnsearch.pl, accessed November 20, 2008.

NCDC Nov 2008b. National Climatic Data Center, Climate Data Online, Surface Data, Daily, NCDC, NOAA. Available at http://cdo.ncdc.noaa.gov/cdo/cdo, accessed November 24, 2008.

NCDC Sep 2009. National Climatic Data Center, U.S. Snow Climatology, NCDC NOAA,. Available at http://www.ncdc.noaa.gov/ussc/index.jsp, accessed September 29 and 30, 2009.

NOAA-CSC Sep 2009. National Oceanic and Atmospheric Administration—Coastal Services Center, *Historical Hurricane Tracks Storm Query, 1851 through 2008*. Available at http://maps.csc.noaa.gov/hurricanes/viewer.html, National Ocean Service, NOAA, accessed September 25, 2009.

NSSL 2006. National Severe Storms Laboratory, *10-Year U.S. Flash Density (1989–1999 Average U.S. Flashes per Square Kilometer per Year)*, prepared by Global Atmospherics, Inc., based on data provided by the National Lightning Detection Network, last modified January 10, 2006, NSSL, NOAA. Available at http://www.nssl.noaa.gov/primer/lightning/images/ltgflash_density.jpg, accessed June 19, 2008.

Simiu, Vickery and Kareem, July 2007, Simiu, E.; Vickery, P.; Kareem, A., "Relation Between Saffir-Simpson Hurricane Scale Wind Speeds and Peak 3-s Gust Speeds Over Open Terrain," *Journal of Structural Engineering*, Vol. 133, No. 7, 1043–1045, July 2007.

USDA Aug 1998. U.S. Department of Agriculture, Rural Utilities Service, *Summary of Items of Engineering Interest*, Page 8, August 1998. Available at www.usda.gov/rus/electric/engineering/en-in-98, accessed April 4, 2008.

USDA Apr 2003. U.S. Department of Agriculture, Sue A. Ferguson, et al., *Forest Service, Assessing Values of Air Quality and Visibility at Risk from Wildland Fires*, UDSA, Forest Service, Pacific Northwest Research Station, Research Paper PNW-RP-550, April 2003.

USDA Oct 2007. U.S. Department of Agriculture, *Forest Service, Ventilation Climate Information System*. Available at http://www.fs.fed.us/pnw/airfire/vcis/legend.html, U.S. Department of the Interior, USDA Joint Fire Science Program, accessed October 29, 2007.

U.S. NRC Jul 1977. U.S. Nuclear Regulatory Commission, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors,* Regulatory Guide 1.111, Revision 1, July 1977.

U.S. NRC Sep 1982. U.S. Nuclear Regulatory Commission, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations*, NUREG/CR-2919, prepared for NRC by Battelle Pacific Northwest Laboratory, PNL-4380, September 1982.

U.S. NRC Nov 1982. U.S. Nuclear Regulatory Commission, *PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations*, NUREG/CR-2858, prepared for NRC by Battelle Pacific Northwest Laboratory, PNL-4413, November 1982.

U.S. NRC Feb 1983. U.S. Nuclear Regulatory Commission, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, Regulatory Guide 1.145, Revision 1, November 1982 (Reissued February 1983).

U.S. NRC Mar 2000. U.S. Nuclear Regulatory Commission, *Environmental Standard Review Plan, Standard Review Plans for Environmental Reviews for Nuclear Power Plants,* NUREG-1555, Revision 0, March 2000.

U.S. NRC Feb 2007. U.S. Nuclear Regulatory Commission, *Tornado Climatology of the Contiguous United States*, NUREG/CR-4461, Revision 2, PNNL-15112, Revision 1, February 2007.

U.S. NRC Mar 2007a. U.S. Nuclear Regulatory Commission, *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants*, Regulatory Guide 1.76, Revision 1, March 2007.

U.S. NRC Mar 2007b. U.S. Nuclear Regulatory Commission, *Meteorological Monitoring Programs for Nuclear Power Plants,* Regulatory Guide 1.23, Revision 1, March 2007.

USU Jun 2008. Utah State University, Utah Climate Center, *Texas Climate for Palacios Municipal Airport, Beeville 5 NE, Port O' Connor, Point Comfort, Cuero, Maurbro, Yoakum, Edna Highway 59 Bridge, Rockport, Goliad, Sinton, Aransas Wildlife Refuge, Victoria Regional Airport, Refugio 2 NW, Karnes City 2N*. Available at http://climate.usurf.usu.edu/, accessed various dates through June 19, 2008.

U.S. Weather Bureau Sep 1961. U.S. Weather Bureau, *Hurricane Carla, September 4–14, 1961 (A Preliminary Report), Weekly Weather and Crop Bulletin*, reprinted and archived by National Hurricane Center. Available at http://www.nhc.noaa.gov/archive/storm_wallets/atlantic/atl1961/carla/prenhc/, accessed June 18, 2008.

Wang and Angell Apr 1999. Wang, J.X.L., and J.K. Angell, *Air Stagnation Climatology for the United States (1948–1998)*, NOAA Air Resources Laboratory Atlas No. 1, Air Resources Laboratory, Environmental Research Laboratories, Office of Oceanic and Atmospheric Research, Silver Spring, MD, April 1999.

Table 2.7-1
NWS and Cooperative Observing Stations Near the VCS Site

Station[a]	County	Approximate Distance (miles)	Direction Relative to Site	Elevation (feet)
Palacios Municipal Airport[b]	Matagorda	48	E	12
Beeville 5 NE	Bee	42	WSW	255
Port O’Connor	Calhoun	39	ESE	5
Point Comfort	Calhoun	29	E	20
Cuero	DeWitt	37	NNW	178
Maurbro	Jackson	40	ENE	30
Yoakum	Lavaca	46	N	295
Edna Highway 59 Bridge	Jackson	32	NE	68
Rockport	Aransas	40	S	9
Goliad	Goliad	22	W	142
Sinton	San Patricio	50	SW	53
Aransas Wildlife Refuge	Aransas	25	SE	15
Victoria Regional Airport[b]	Victoria	17	NNE	104
Refugio 2 NW	Refugio	25	SW	54
Karnes City 2N	Karnes	55	WNW	450

(a) Numeric and letter designators following a station name (e.g., Beeville 5 NE) indicate the station’s approximate distance in miles (e.g., 5) and direction (e.g., northeast) relative to the place name (e.g., Beeville).
(b) National Weather Service First-Order Station.

Table 2.7-2
Local Climatological Data Summary for Victoria, Texas

NORMALS, MEANS, AND EXTREMES
VICTORIA (KVCT)

LATITUDE: 28 ° 51'N LONGITUDE: -96 ° 55'W ELEVATION (FT): GRND: 115 BARO: 106 TIME ZONE: CENTRAL (UTC -6) WBAN: 12912

	ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	62.8	66.6	73.4	79.2	85.1	90.3	93.4	93.7	89.9	83.0	73.0	65.2	79.6
	MEAN DAILY MAXIMUM	51	63.9	67.4	74.0	80.4	85.9	90.8	93.6	94.1	89.8	83.0	73.6	66.5	80.3
	HIGHEST DAILY MAXIMUM	47	88	95	97	98	101	106	104	107	111	99	93	88	111
	YEAR OF OCCURRENCE		1971	1986	1989	1963	1964	1998	1964	1962	2000	1991	1988	1964	SEP 2000
	MEAN OF EXTREME MAXS.	51	79.4	82.2	86.3	89.6	92.8	96.0	98.3	99.5	96.5	92.1	86.2	81.2	90.0
	NORMAL DAILY MINIMUM	30	43.6	46.7	53.9	60.1	68.1	73.3	75.0	74.6	70.3	61.6	52.3	45.2	60.4
	MEAN DAILY MINIMUM	51	43.7	46.7	53.4	61.1	68.0	73.1	75.0	74.8	70.5	61.6	52.4	45.5	60.5
	LOWEST DAILY MINIMUM	47	14	19	21	33	45	59	62	62	48	31	24	9	9
	YEAR OF OCCURRENCE		1982	1985	2002	1987	2005	1984	1967	2004	2000	1993	1976	1989	DEC 1989
	MEAN OF EXTREME MINS.	51	26.2	30.0	34.9	44.6	56.1	65.3	70.5	69.8	57.8	45.1	35.1	28.3	47.0
	NORMAL DRY BULB	30	53.2	56.7	63.7	69.7	76.6	81.8	84.2	84.2	80.1	72.3	62.7	55.2	70.0
	MEAN DRY BULB	51	53.8	57.0	63.7	70.8	77.0	82.1	84.3	84.4	80.2	72.3	63.0	56.0	70.4
	MEAN WET BULB	24	49.7	52.7	58.0	64.0	70.8	75.0	76.1	76.0	72.6	65.9	57.8	51.2	64.2
	MEAN DEW POINT	24	46.4	49.4	54.6	60.7	68.5	72.8	73.6	73.5	69.9	63.1	54.6	47.8	61.2
	NORMAL NO. DAYS WITH:														
	MAXIMUM >= 90	30	0.0	0.1	0.4	0.8	6.3	20.2	28.0	27.9	18.5	4.9	0.1	0.0	107.2
	MAXIMUM <= 32	30	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
	MINIMUM <= 32	30	4.1	2.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	*	0.6	3.1	10.5
	MINIMUM <= 0	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C	NORMAL HEATING DEG. DAYS	30	372	249	113	28	1	0	0	0	1	22	145	317	1248
	NORMAL COOLING DEG. DAYS	30	18	26	84	181	368	514	601	597	454	248	83	29	3203
RH	NORMAL (PERCENT)	30	77	76	75	74	78	77	74	75	76	76	77	77	76
	HOUR 00 LST	30	85	85	84	85	89	90	89	88	88	88	87	85	87
	HOUR 06 LST	30	88	88	88	89	92	93	93	94	93	91	90	88	91
	HOUR 12 LST	30	65	63	60	59	62	60	55	56	59	58	61	64	60
	HOUR 18 LST	30	69	64	63	62	67	66	60	62	65	67	71	71	66
S	PERCENT POSSIBLE SUNSHINE														
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG (VISBY <= 1/4 MI)	43	7.2	3.5	5.3	4.1	2.5	0.8	0.5	0.6	1.4	3.7	6.3	6.4	44.3
	THUNDERSTORMS	48	1.6	1.7	3.2	3.7	6.2	6.8	7.6	9.7	7.9	3.9	2.1	1.5	55.9
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)				6.4			4.0							
	MIDNIGHT-MIDNIGHT (OKTAS)														
	MEAN NO. DAYS WITH:														
	CLEAR	1	3.0	5.0	8.0		5.0	9.0							
	PARTLY CLOUDY			1.0	3.0		9.0	6.0							
	CLOUDY	1	1.0	3.0	10.0		3.0	5.0							
PR	MEAN STATION PRESSURE (IN)	24	30.02	29.96	29.90	29.84	29.81	29.81	29.87	29.86	29.84	29.90	29.97	30.01	29.90
	MEAN SEA-LEVEL PRES. (IN)	24	30.14	30.08	30.02	29.96	29.93	29.93	29.99	29.98	29.96	30.02	30.09	30.14	30.02
WINDS	MEAN SPEED (MPH)	24	9.9	10.4	10.9	11.0	10.5	9.3	8.5	8.0	8.2	8.7	9.2	9.4	9.5
	PREVAIL.DIR. (TENS OF DEGS)	28	36	36	17	17	17	17	19	19	14	36	36	36	17
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	12	43	43	45	47	41	43	62	43	41	43	41	40	62
	DIR. (TENS OF DEGS)		17	15	08	11	07	32	05	26	04	35	31	33	05
	YEAR OF OCCURRENCE		1996	2001	2006	2004	1999	2005	2003	1996	1998	1998	2006	1997	JUL 2003
	MAXIMUM 5-SECOND														
	SPEED (MPH)	12	52	52	55	64	59	51	83	45	53	52	51	47	83
	DIR. (TENS OF DEGS)		30	15	05	11	22	32	04	27	12	35	30	33	04
	YEAR OF OCCURRENCE		1998	2001	2006	2004	2004	2005	2003	1996	2001	1998	2003	1997	JUL 2003
PRECIPITATION	NORMAL (IN)	30	2.44	2.04	2.25	2.97	5.12	4.96	2.90	3.05	5.00	4.26	2.64	2.47	40.10
	MAXIMUM MONTHLY (IN)	47	7.76	9.08	11.61	11.70	14.66	13.50	20.34	8.97	19.05	12.44	16.14	6.97	20.34
	YEAR OF OCCURRENCE		1991	1992	1997	1997	1993	2004	2007	2001	1978	1997	2004	1975	JUL 2007
	MINIMUM MONTHLY (IN)	47	0.02	0.23	0.18	T	0.01	T	0.05	0.34	1.11	0.34	0.02	0.34	T
	YEAR OF OCCURRENCE		1971	1988	1971	1987	1998	1980	1997	2006	1982	1987	1981	2007	APR 1987
	MAXIMUM IN 24 HOURS (IN)	47	4.70	3.21	5.04	9.87	8.45	9.30	8.41	6.14	8.51	8.15	9.20	6.12	9.87
	YEAR OF OCCURRENCE		1991	1992	1997	1991	1972	1977	1990	1964	1967	1994	2004	1975	APR 1991
	NORMAL NO. DAYS WITH:														
	PRECIPITATION >= 0.01	30	8.8	7.3	6.9	6.4	7.4	8.4	7.2	8.8	9.9	7.3	7.5	8.1	94.0
	PRECIPITATION >= 1.00	30	0.6	0.6	0.7	0.8	1.7	1.7	0.9	0.9	1.5	1.3	0.6	0.6	11.9
SNOWFALL	NORMAL (IN)	30	0.1	0.*	0.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.*	0.*	0.1
	MAXIMUM MONTHLY (IN)	36	2.1	1.0	T	0.0	T	0.0	0.0	T	0.0	0.0	0.2	T	2.1
	YEAR OF OCCURRENCE		1985	1973	1990		1993			1994			1976	1990	JAN 1985
	MAXIMUM IN 24 HOURS (IN)	36	2.1	1.0	T	0.0	T	0.0	0.0	T	0.0	0.0	0.2	T	2.1
	YEAR OF OCCURRENCE		1985	1973	1990		1993			1994			1976	1990	JAN 1985
	MAXIMUM SNOW DEPTH (IN)	39	2	3	0	0	0	0	0	0	0	0	0	0	3
	YEAR OF OCCURRENCE		1985	1958											FEB 1958
	NORMAL NO. DAYS WITH:														
	SNOWFALL >= 1.0	30	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2

Table 2.7-3
Climatological Normals at Selected NWS and Cooperative Observing Stations in the VCS Area

	Normal Annual Temperatures (°F)[a]				Normal Annual Precipitation	
Station	**Daily Maximum**	**Daily Minimum**	**Daily Range**	**Daily Mean**	**Rainfall[a] (inches)**	**Snowfall[b] (inches)**
Palacios Municipal Airport	77.2	61.1	16.1	69.2	45.40	0.1
Beeville 5 NE	80.8	59.6	21.2	70.2	33.48	0.1
Port O' Connor	76.4	65.0	11.4	70.7	34.78	0.1
Point Comfort	79.7	62.4	17.3	71.1	43.87	Trace
Cuero	81.7	57.5	24.2	69.6	36.08	0.1
Maurbro[c]	NA[d]	NA[d]	NA[d]	NA[d]	NA[d]	NA[d]
Yoakum	79.7	56.7	23.0	68.2	40.96	Trace
Edna Highway 59 Bridge	NA[d]	NA[d]	NA[d]	NA[d]	42.17	NA[d]
Rockport	77.9	62.9	15.0	70.4	35.96	Trace
Goliad	83.1	59.4	23.7	71.3	38.58	0.5
Sinton 3 NW	79.4	60.7	18.7	70.1	35.54	0.1
Aransas Wildlife Refuge	77.5	62.9	14.6	70.2	40.83	Trace
Victoria Regional Airport	79.6	60.4	19.2	70.0	40.10	0.3
Refugio 2 NW	81.9	60.0	21.9	71.0	40.00	NA[d]
Karnes City 2N	80.4	57.8	22.6	69.1	28.35	NA[d]

(a) NCDC Climatography No. 81 1971-2000 (NCDC Feb 2002).
(b) NCDC Climatography No. 20 1971-2000 (NCDC Jul 2005).
(c) Station decommissioned in 1966.
(d) NA = Measurements not made at this station.

Table 2.7-4 (Sheet 1 of 2)
Climatological Extremes at Selected NWS and Cooperative Observing Stations in the VCS Region

Station	Maximum Temperature (°F)	Minimum Temperature (°F)	Maximum 24- hr Rainfall (Inches)	Maximum Monthly Rainfall (Inches)	Historical Snowpack (Inches)[(m)]	100-year Return Snowfall (Inches)[(m)]	Maximum 24- hr Snowfall (Inches)	Maximum Monthly Snowfall (Inches)
Palacios Municipal Airport	107 [(a),(b),(c)] (09/05/2000)	9[(a),(b),(c)] (12/23/1989)	9.65[(a),(b),(c)] (05/07/1951)	24.28[(b),(c)] (10/1949)	NA	NA	4.0[(b),(c)] (02/12/1958)	4.0[(b),(c)] (02/1958)
Beeville 5 NE	111[(a),(b),(c)] (07/09/1939)	8[(a),(b),(c)] (12/25/1983)	10.61[(a),(b),(c)] (09/22/1967)	22.62[(b),(c)] (09/1967)	NA	NA	4.5[(b),(c)] (12/25/2004)[(e)]	6.5[(b),(c)] (01/1926)
Port O' Connor	105[(a),(b),(c)] (09/06/2000)	10[(a),(b),(c)] (12/23/1989)	12.50[(a),(b),(c)] (07/10/1976)	24.51[(n)] (10/1984)	0	NA	1.3[(a),(b),(c)] (02/09/1973)	1.3[(a),(b),(c)] (02/1973)
Point Comfort	107[(a),(b),(c)] (09/06/2000)	9[(a),(b),(c)] (12/23/1989)	14.65[(a),(b),(c)] (06/26/1960)	25.24[(b),(c)] (06/1960)	0	NA	Trace[(a),(b)] (11/28/1976)	Trace[(a),(b)] (11/1976)
Cuero	113[(a),(b),(c)] (09/05/2000)	7[(a),(b),(c)] (12/23/1989)	12.40[(a),(b),(c)] (06/30/1940)	21.27[(b),(c)] (09/1967)	4.0 (1/31/1949)	NA	6.5[(b),(c)] (02/13/1960)	6.5[(b),(c)] (02/1960)
Maurbro	107[(b),(c)] (07/27/1954)	8[(b),(c)] (01/31/1949)	14.80[(b),(c)] (06/26/1960)	22.47[(b),(c)] (06/1960)	Station Not Available	Station Not Available	4.0[(b),(c)] (02/13/1960)	4.0[(b),(c)] (02/1960)
Yoakum	111[(a),(b),(c)] (09/06/2000)[(f)]	6[(a),(b),(c)] (12/23/1989)	10.70[(a),(b),(c)] (04/25/1938)	18.33[(a),(b),(c)] (10/1994)	NA	NA	2.5[(b),(c)] (12/21/1929)	2.5[(b),(c)] (12/1929)
Edna Highway 59 Bridge	105[(n)] (08/12/1969)	17[(n)] (01/12/1973)	17.58[(b),(c)] (10/18/1994)	20.97[(b),(c)] (10/1994)	0	NA	0.0[(c)] (NA)	0.0[(c)] (NA)
Rockport	105[(a),(b),(c)] (09/06/2000)	12[(a),(b),(c)] (12/25/1983)	8.15[(a),(b),(c)] (09/19/1979)	20.85[(b),(c)] (09/1967)	0	NA	6.0[(b),(c)] (12/25/2004)	6.0[(b),(c)] (12/2004)
Goliad	112[(a),(b),(c)] (06/14/1998)[(g)]	7[(a),(b),(c)] (01/12/1962)	9.16[(a),(b),(c)] (09/21/1967)	22.19[(b),(c)] (09/1967)	4.0 (2/9/1973)	NA	12.0[(b),(c)] (12/25/2004)	12.0[(b),(c),(d)] (12/2004)
Sinton	109[(a),(b),(c)] (09/06/2000)	10[(a),(b),(c)] (12/23/1989)	12.35[(a),(b),(c)] (04/28/1930)	25.59[(b),(c)] (09/1967)	2.0 (2/9/1973)	NA	7.0[(b),(c)] (12/25/2004)	7.0[(b),(c)] (12/2004)
Aransas Wildlife Refuge	103[(b),(l)] (08/30/1954)[(h)]	9[(a),(b),(c)] (12/23/1989)	14.25[(a),(b),(c)] (11/01/1974)	22.65[(d)] (07/2007)	0	NA	5.5[(b),(c),(d)] (12/25/2004)	5.5[(b),(c),(d)] (12/2004)
Victoria Regional Airport	111[(a),(b),(c)] (09/05/2000)	9[(a),(b),(c)] (12/23/1989)	9.87[(a),(b),(c)] (04/05/1991)	20.34[(c)] (07/2007)	NA	NA	3.3[(a),(b),(c)] (02/12/1958)	3.4[(a),(b),(c)] (02/1958)

Table 2.7-4 (Sheet 2 of 2)
Climatological Extremes at Selected NWS and Cooperative Observing Stations in the VCS Region

Station	Maximum Temperature (°F)	Minimum Temperature (°F)	Maximum 24- hr Rainfall (Inches)	Maximum Monthly Rainfall (Inches)	Historical Snowpack (Inches)[m]	100-year Return Snowfall (Inches)[m]	Maximum 24- hr Snowfall (Inches)	Maximum Monthly Snowfall (Inches)
Refugio 2 NW	112[b],[c] (09/05/2000)	8[b],[c] (01/12/1962)[j]	13.38[b],[c] (10/16/1960)[i]	26.30[b],[c] (09/1971)[i]	2.0 (2/12/1960)	NA	9.5[b],[c] (12/25/2004)	9.5[b],[c] (12/2004)
Karnes City 2N	111[b],[c] (09/06/2000)	7[b],[c] (12/23/1989)	11.00[b],[c] (08/31/1981)	22.60[b],[c] (09/1967)	2.0 (1/11/1973)	NA	5.0[b],[c] (12/25/2004)	5.0[b],[c] (12/2004)[k]

(a) NCDC Monthly Station Climate Summaries, Climatography of the United States No. 20 1971-2000 (NCDC Jul 2005).
(b) NCDC Cooperative Summaries of the Day TD 3200 & DS 3200 & 3200/3210 (NCDC Nov 2002).
(c) Utah State University Climate Center (USU Jun 2008).
(d) NCDC Cooperative Observer Records for Texas (NCDC Jun 2008d).
(e) Occurs on multiple dates: 01/23/1926, 12/25/2004, (most recent date shown in table).
(f) Occurs on multiple dates: 06/15/1998, 09/06/2000; (most recent date shown in table).
(g) Occurs on multiple dates: 07/09/1939, 08/13/1962, 06/14/1998; (most recent date shown in table).
(h) Occurs on multiple dates: 06/27/1953, 08/301954; (most recent date shown in table).
(i) Occurred at retired Refugio Co-op observing station (#417529), period of record Jan 1, 1948 – Nov 30, 1984.
(j) Not reported here. Less than 6 years of data available.
(k) Occurs for multiple months: 12/2004, 01/1926; (most recent month shown in table).
(l) Occurred at retired Arkansas Wildlife Refuge Co-op observing station (#410437), period of record Jun 1, 1940 – Dec 31, 1970.
(m) NCDC United States Snow Climatology.
(n) NCDC Climate Data Online (NCDC Nov 2008b).
NA — No value calculated in database

Table 2.7-5 (Sheet 1 of 2)
Morning and Afternoon Mixing Heights, Wind Speeds, and Ventilation Indices for the VCS Site Area Table

Period	Statistic[a]	Mixing Height (m, AGL)[b]		Wind Speed – (m/sec)		Ventilation Index – (m^2/sec)[c]	
		AM	PM	AM	PM	AM	PM
January	Min Max Mean	275 561 430	586 1134 881	2.9 4.0 3.6	2.5 3.5 3.2	914 (P) 2374 (F) 1628 (M)	1273 (M) 3754 (G) 2800 (F)
February	Min Max Mean	305 590 448	765 1289 1011	2.7 4.1 3.6	2.4 3.6 3.2	1096 (P) 2269 (M) 1707 (M)	2259 (M) 4082 (G) 3138 (F)
March	Min Max Mean	290 802 544	931 1552 1168	3.2 4.2 3.8	2.7 3.8 3.4	1018 (P) 3193 (F) 2167 (M)	3235 (F) 4999 (G) 3857 (G)
April	Min Max Mean	312 922 642	916 1562 1182	3.4 4.2 3.9	2.9 4.2 3.6	1217 (M) 4035 (G) 2688 (F)	3280 (F) 5518 (G) 4171 (G)
May	Min Max Mean	401 972 640	894 1638 1251	3.3 4.6 3.9	2.6 4.3 3.6	1394 (M) 4062 (G) 2668 (F)	3140 (F) 5857 (G) 4353 (G)
June	Min Max Mean	213 1132 490	1090 1929 1458	3.2 4.5 3.7	2.6 3.9 3.4	643 (P) 4307 (G) 1961 (M)	3625 (G) 7006 (G) 4916 (G)
July	Min Max Mean	196 670 367	1149 2020 1597	2.9 4.5 3.5	3.0 4.0 3.4	640 (P) 2594 (F) 1308 (M)	3757 (G) 7766 (G) 5428 (G)
August	Min Max Mean	200 658 356	1247 2151 1647	2.5 4.0 3.3	2.7 4.0 3.3	537 (P) 2302 (M) 1205 (M)	3776 (G) 7669 (G) 5502 (G)
September	Min Max Mean	182 650 363	1116 1852 1433	2.7 4.2 3.3	2.8 4.0 3.3	538 (P) 2690 (F) 1273 (M)	3236 (F) 6924 (G) 4679 (G)
October	Min Max Mean	194 567 348	1001 1759 1314	2.4 4.3 3.4	2.5 3.9 3.2	648 (P) 2414 (F) 1282 (M)	3171 (F) 5643 (G) 4046 (G)
November	Min Max Mean	287 587 418	764 1345 1085	3.0 4.1 3.5	2.6 3.7 3.2	976 (P) 2352 (F) 1578 (M)	2552 (F) 4470 (G) 3477 (F)
December	Min Max Mean	275 631 405	594 1129 891	3.0 4.1 3.5	2.4 3.5 3.1	1075 (P) 2775 (F) 1526 (M)	1751 (M) 3702 (G) 2819 (F)

Table 2.7-5 (Sheet 2 of 2)
Morning and Afternoon Mixing Heights, Wind Speeds, and Ventilation Indices for the VCS Site Area Table

Period	Statistic[a]	Mixing Height (m, AGL)[b]		Wind Speed – (m/sec)		Ventilation Index – (m^2/sec)[c]	
		AM	PM	AM	PM	AM	PM
Winter	Mean	428	928	3.6	3.2	1620 (M)	2919 (F)
Spring	Mean	609	1200	3.9	3.5	2508 (F)	4127 (G)
Summer	Mean	404	1567	3.5	3.4	1491 (M)	5282 (G)
Autumn	Mean	376	1277	3.4	3.3	1378 (M)	4067 (G)
Annual	Mean	454	1243	3.6	3.4	1749 (F)	4099 (G)

(a) Monthly minimum, maximum and mean values are based directly on summaries available from USDA - Forest Service Ventilation Climate Information System (VCIS) (USDA 2007). Seasonal and annual mean values represent weighted averages based on the number of days in the appropriate months.

(b) AGL = above ground level.

(c) Classifications of ventilation potential from Ventilation Index: P = Poor (0 to 1175 m^2/sec); M = Marginal (1176 to 2350 m^2/sec); F = Fair (2351 to 3525 m^2/sec); G = Good (> 3525 m^2/sec).

Table 2.7-6
Seasonal and Annual Mean Wind Speeds for the VCS Site Pre-Application Phase Monitoring Program (July 1, 2007 through June 30, 2009) and the Victoria, Texas, NWS Station

Primary Tower Elevation	Location	Winter	Spring	Summer	Autumn	Annual
Upper Level (60 m) (m/sec)	VCS Site	6.7	7.0	5.4	5.3	6.1
Lower Level (10 m) (m/sec)	VCS Site	4.5	4.9	3.6	3.2	4.0
Single Level (10 m) (m/sec)	Victoria Regional Airport [a]	4.4	4.8	3.8	3.9	4.2

(a) NCDC Jun 2008b

Winter = December, January, February
Spring = March, April, May
Summer = June, July, August
Autumn = September, October, November

Table 2.7-7 (Sheet 1 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—10-Meter Level

Site ID: VICT Period of Record: 07/01/2007 01:00 to 06/30/2008 24:00
Number of Sectors Included: 1 Width in Degrees 22.5
10m Wind Speed (MPH) 10m Wind Direction (deg)

Speed Greater Than or Equal to: 5.0 mph

Hours	Direction															
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	634	505	303	215	364	448	1300	1421	553	137	57	37	47	62	170	264
2	449	289	124	79	171	196	856	971	320	56	19	10	14	23	92	141
4	274	136	26	21	51	63	448	507	137	13	3	4	6	3	29	61
8	136	46	0	6	12	10	146	151	13	1	0	0	2	0	4	18
12	67	14	0	1	1	1	44	54	0	0	0	0	0	0	0	5
18	22	0	0	0	0	0	14	7	0	0	0	0	0	0	0	0
24	8	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to: 10.0 mph

Hours	Direction															
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	337	183	62	40	87	151	719	863	321	50	16	8	19	29	85	133
2	252	126	27	8	53	64	505	621	196	16	4	1	3	14	50	84
4	164	63	5	0	24	19	257	341	87	2	0	0	0	2	16	38
8	67	18	0	0	7	4	65	104	8	0	0	0	0	0	2	11
12	28	2	0	0	0	0	14	31	0	0	0	0	0	0	0	2
18	8	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-7 (Sheet 2 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—10-Meter Level

Speed Greater Than or Equal to: 15.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
	Direction															
1	109	31	11	2	10	31	265	394	142	7	1	2	5	10	48	66
2	75	19	5	0	4	16	169	280	98	3	0	0	1	3	27	41
4	44	7	1	0	0	8	71	159	42	0	0	0	0	0	9	20
8	21	2	0	0	0	4	18	48	2	0	0	0	0	0	2	4
12	11	0	0	0	0	0	4	14	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to: 20.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
	Direction															
1	16	2	1	0	0	5	36	113	52	1	0	0	2	3	25	29
2	11	0	0	0	0	3	19	78	30	0	0	0	0	1	12	21
4	7	0	0	0	0	1	7	37	10	0	0	0	0	0	3	9
8	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-7 (Sheet 3 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—10-Meter Level

Speed Greater Than or Equal to: 25.0 mph

	Direction															
Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	3	0	0	0	0	0	2	15	1	0	0	0	0	3	7	0
2	1	0	0	0	0	0	1	10	0	0	0	0	0	1	4	0
4	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to: 30.0 mph

	Direction															
Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-7 (Sheet 4 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—10-Meter Level

Site ID: VICT Period of Record:07/01/2008 01:00 to 06/30/2009 24:00
Number of Sectors Included: 1 Width in Degrees 22.5
10m Wind Speed (MPH) 10m Wind Direction (deg)

Speed Greater Than or Equal to: 5.0, mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	683	474	325	234	379	394	1131	1329	710	196	122	62	114	102	152	278
2	494	265	142	98	197	169	765	948	483	93	52	21	49	36	76	152
4	305	116	35	18	91	38	413	548	262	23	13	2	13	7	29	64
8	139	27	0	0	26	1	134	214	86	5	0	0	0	2	3	14
12	68	5	0	0	13	0	60	107	36	0	0	0	0	0	0	4
18	17	0	0	0	2	0	39	60	9	0	0	0	0	0	0	0
24	2	0	0	0	0	0	33	26	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	27	12	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	21	6	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to:10.0, mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	400	137	91	50	120	135	695	844	477	70	22	11	14	23	70	137
2	309	77	48	25	69	61	491	605	330	30	11	6	3	10	42	72
4	208	37	12	7	45	10	267	326	177	4	1	1	0	5	20	28
8	102	10	0	0	25	0	86	116	46	0	0	0	0	1	3	3
12	45	4	0	0	13	0	49	54	18	0	0	0	0	0	0	0
18	10	0	0	0	2	0	39	31	5	0	0	0	0	0	0	0
24	0	0	0	0	0	0	33	16	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	27	6	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0

Table 2.7-7 (Sheet 5 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—10-Meter Level

Speed Greater Than or Equal to:15.0, mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	188	27	8	5	33	32	293	420	253	18	5	3	3	15	36	59
2	137	13	0	2	25	11	195	278	173	8	3	1	0	9	22	32
4	80	7	0	0	16	0	105	132	88	0	0	0	0	5	8	13
8	19	3	0	0	6	0	36	28	9	0	0	0	0	1	1	0
12	5	0	0	0	2	0	17	3	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to:20.0, mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	37	6	1	2	5	1	40	135	86	7	0	0	0	5	12	13
2	20	5	0	1	3	0	25	93	54	2	0	0	0	3	9	3
4	7	3	0	0	0	0	12	50	25	0	0	0	0	1	5	0
8	0	0	0	0	0	0	6	7	0	0	0	0	0	0	1	0
12	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-7 (Sheet 6 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—10-Meter Level

Speed Greater Than or Equal to:25.0, mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	7	0	1	1	0	0	2	5	7	0	0	0	0	0	5	1
2	2	0	0	0	0	0	0	4	3	0	0	0	0	0	4	0
4	0	0	0	0	0	0	0	2	1	0	0	0	0	0	2	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to:30.0, mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-8 (Sheet 1 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—60-Meter Level

Site ID: VICT Period of Record: 07/01/2007 01:00 to 06/30/2008 24:00
Number of Sectors Included: 1 Width in Degrees 22.5
60m Wind Speed (MPH) 60m Wind Direction (deg)

Speed Greater Than or Equal to: 5.0 mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	660	565	470	363	453	642	1312	1912	960	246	124	66	66	65	162	259
2	490	353	250	176	225	354	909	1442	636	125	50	25	23	25	91	163
4	309	173	83	55	87	124	479	894	325	34	16	3	9	3	37	81
8	162	56	13	10	18	24	150	383	83	2	5	0	3	0	5	24
12	89	22	1	1	6	4	56	176	18	0	0	0	0	0	0	6
18	36	3	0	0	0	0	15	54	0	0	0	0	0	0	0	0
24	14	0	0	0	0	0	6	24	0	0	0	0	0	0	0	0
30	2	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to: 10.0 mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	537	420	261	214	267	436	1136	1725	800	161	67	38	42	43	107	175
2	413	280	142	109	145	233	804	1322	528	82	27	17	17	19	66	115
4	263	151	52	37	62	75	430	829	252	21	9	3	8	3	26	57
8	133	54	13	4	18	12	142	353	55	0	4	0	3	0	4	20
12	72	21	1	0	6	0	53	162	12	0	0	0	0	0	0	6
18	32	3	0	0	0	0	15	51	0	0	0	0	0	0	0	0
24	14	0	0	0	0	0	6	23	0	0	0	0	0	0	0	0
30	2	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-8 (Sheet 2 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—60-Meter Level

Speed Greater Than or Equal to: 15.0 mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	329	227	75	43	68	125	588	1043	388	61	17	16	16	28	72	98
2	239	151	35	16	37	58	399	751	250	29	5	6	5	11	43	62
4	137	67	5	0	17	11	193	438	121	4	3	0	1	1	17	32
8	60	18	0	0	5	0	53	178	30	0	0	0	0	0	3	13
12	28	0	0	0	0	0	12	90	8	0	0	0	0	0	0	4
18	8	0	0	0	0	0	1	38	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to: 20.0 mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	119	34	14	4	9	13	174	365	173	14	0	1	2	7	37	42
2	84	17	7	0	4	6	113	262	116	5	0	0	0	2	23	27
4	51	8	1	0	0	2	50	148	57	0	0	0	0	0	8	12
8	25	0	0	0	0	0	14	53	6	0	0	0	0	0	3	2
12	12	0	0	0	0	0	1	14	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-8 (Sheet 3 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—60-Meter Level

Speed Greater Than or Equal to: 25.0 mph

Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	28	5	1	0	0	4	30	125	74	0	0	0	0	4	21	8
2	18	2	0	0	0	1	18	84	45	0	0	0	0	2	13	2
4	9	0	0	0	0	0	9	40	18	0	0	0	0	0	5	0
8	0	0	0	0	0	0	1	5	0	0	0	0	0	0	1	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to: 30.0 mph

Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	3	0	1	0	0	0	3	25	8	0	0	0	0	2	8	0
2	1	0	0	0	0	0	2	15	1	0	0	0	0	1	6	0
4	0	0	0	0	0	0	0	7	0	0	0	0	0	0	4	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-8 (Sheet 4 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—60-Meter Level

Site ID: VICT Period of Record: 07/01/2008 01:00 to 06/30/2009 24:00
Number of Sectors Included: 1 Width in Degrees 22.5
60m Wind Speed (MPH) 60m Wind Direction (deg)

60m Wind Speed (MPH) 60m Wind Direction (deg)

Speed Greater Than or Equal to: 5.0, mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	725	532	474	354	424	536	1166	1715	1220	354	175	114	106	107	162	217
2	564	318	273	169	228	297	777	1237	876	193	81	51	40	46	74	125
4	385	132	105	41	76	117	387	701	493	55	23	15	9	18	21	55
8	217	21	14	1	17	21	107	224	181	5	2	2	0	3	1	9
12	139	9	0	0	4	4	24	67	92	1	0	0	0	0	0	0
18	73	0	0	0	0	0	3	4	42	0	0	0	0	0	0	0
24	26	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0
30	11	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
36	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to:10.0, mph
Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	609	366	312	204	262	398	995	1573	1045	230	89	61	55	70	98	136
2	491	219	185	94	152	236	675	1144	755	132	43	30	20	32	50	80
4	349	91	72	25	61	96	333	645	427	42	14	12	4	11	18	36
8	206	21	8	1	17	16	87	199	163	5	2	2	0	3	1	5
12	129	9	0	0	4	4	16	58	85	1	0	0	0	0	0	0
18	63	0	0	0	0	0	0	2	38	0	0	0	0	0	0	0
24	19	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
30	8	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
36	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-8 (Sheet 5 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—60-Meter Level

Speed Greater Than or Equal to:15.0, mph

	Direction															
Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	382	169	109	51	93	144	599	962	636	117	35	16	19	42	58	58
2	311	104	60	26	57	76	390	643	450	69	21	8	6	20	27	39
4	224	43	18	10	26	30	190	299	263	20	11	2	0	7	4	18
8	125	12	3	0	8	3	39	60	104	1	2	0	0	0	0	0
12	68	6	0	0	2	0	8	11	56	0	0	0	0	0	0	0
18	25	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0
24	11	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
30	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to:20.0, mph

	Direction															
Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	177	45	9	5	30	15	181	326	306	36	6	3	6	20	21	16
2	133	24	4	2	18	3	118	216	222	17	2	1	2	10	11	9
4	82	15	2	0	5	0	58	96	120	2	0	0	0	4	4	1
8	30	5	0	0	1	0	14	17	29	0	0	0	0	0	0	0
12	10	0	0	0	0	0	5	5	13	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-8 (Sheet 6 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VCS Site—60-Meter Level

Speed Greater Than or Equal to:25.0, mph

Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	53	13	1	1	5	1	25	113	122	12	0	0	1	4	12	1
2	34	9	0	0	3	0	14	70	82	5	0	0	0	1	8	0
4	16	4	0	0	0	0	5	25	41	1	0	0	0	0	4	0
8	5	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Speed Greater Than or Equal to:30.0, mph

Direction

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	9	0	1	0	3	0	2	13	31	1	0	0	0	0	5	0
2	4	0	0	0	2	0	0	5	18	0	0	0	0	0	4	0
4	0	0	0	0	0	0	0	2	8	0	0	0	0	0	2	0
8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.7-9
Seasonal and Annual Vertical Stability Class and 10-Meter Level Wind Speed Distributions for the VCS Site (July 1, 2007 – June 30, 2009)

Vertical Stability Categories [1]							
Period	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Winter							
Frequency (%)	5.62	6.03	6.17	34.96	20.18	11.82	15.21
Wind Speed (m/sec)	7.1	6.1	5.7	5.3	4.0	2.7	2.3
Spring							
Frequency (%)	12.29	7.10	7.83	33.05	18.52	9.41	11.79
Wind Speed (m/sec)	7.3	6.2	5.9	5.7	4.0	2.5	2.1
Summer							
Frequency (%)	9.75	6.64	7.55	22.08	24.83	22.28	6.87
Wind Speed (m/sec)	6.7	5.6	4.8	4.2	2.9	1.9	1.7
Autumn							
Frequency (%)	4.54	5.77	8.19	19.81	19.12	16.44	26.13
Wind Speed (m/sec)	5.7	4.8	4.1	4.1	3.3	2.3	2.0
Annual							
Frequency (%)	8.07	6.39	7.44	27.46	20.67	15.00	14.96
Wind Speed (m/sec)	6.7	5.7	5.1	4.8	3.6	2.3	2.0

Table 2.7-10 (Sheet 1 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
All Stabilities
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	35	94	174	315	247	202	205	314	72	28	1686
NNE	0	23	95	188	396	268	160	140	78	16	0	1364
NE	1	34	98	168	377	160	78	60	41	4	1	1022
ENE	1	42	69	139	260	117	59	42	16	1	1	747
E	0	33	96	148	348	187	113	72	70	6	2	1075
ESE	0	37	96	150	344	213	141	106	91	12	0	1190
SE	0	34	91	186	539	395	391	371	616	185	17	2825
SSE	0	39	74	170	573	404	353	458	636	319	95	3121
S	0	35	60	101	238	194	199	191	261	171	54	1504
SSW	0	17	42	42	107	100	60	47	24	8	4	451
SW	0	22	31	39	101	47	27	16	8	1	0	292
WSW	0	17	37	38	54	30	12	7	7	0	0	202
W	0	17	37	43	82	41	25	13	5	4	0	267
WNW	1	28	41	53	83	39	18	13	21	9	3	309
NW	2	23	52	78	129	52	25	35	56	24	24	500
NNW	0	18	106	162	197	100	71	71	86	55	16	882
Tot	5	454	1119	1879	4143	2594	1934	1847	2330	887	245	17437

Hours of Calm 33
Hours of Variable Direction 28
Hours of Valid Data 17498
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-10 (Sheet 2 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class A Extremely Unstable based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	0	0	2	8	19	25	69	13	13	149
NNE	0	0	0	0	5	15	13	23	22	4	0	82
NE	0	0	0	2	1	6	4	12	6	1	0	32
ENE	0	0	0	0	1	11	6	7	3	0	0	28
E	0	0	0	0	5	8	7	9	5	1	0	35
ESE	0	0	0	0	2	10	8	17	22	2	0	61
SE	0	0	0	0	2	14	26	43	133	65	7	290
SSE	0	0	0	0	3	7	11	70	177	100	45	413
S	0	0	0	0	2	2	9	18	51	45	13	140
SSW	0	0	0	0	2	2	4	4	6	4	0	22
SW	0	0	0	0	0	1	1	5	3	0	0	10
WSW	0	0	0	0	0	2	3	2	1	0	0	8
W	0	0	0	0	0	0	3	1	0	0	0	4
WNW	0	0	0	0	0	0	2	2	4	6	2	16
NW	0	0	0	0	0	0	2	10	23	3	14	52
NNW	0	0	0	0	1	2	7	11	21	17	6	65
Tot	0	0	0	2	26	88	125	259	546	261	100	1407

Hours of Calm 0
Hours of Variable Direction 0
Hours of Valid Data 1407
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-10 (Sheet 3 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class B Moderately Unstable based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	0	1	6	19	17	16	24	4	1	88
NNE	0	0	0	0	5	25	14	10	10	3	0	67
NE	0	0	0	2	11	11	11	9	6	1	0	51
ENE	0	0	0	1	5	10	13	9	3	0	1	42
E	0	0	0	0	16	16	14	8	11	1	0	66
ESE	0	0	0	0	10	18	16	16	15	4	0	79
SE	0	0	0	1	14	7	24	38	88	27	3	202
SSE	0	0	0	0	4	12	17	56	76	38	14	217
S	0	0	0	1	3	5	32	21	35	27	6	130
SSW	0	0	0	1	6	15	11	9	5	3	2	52
SW	0	0	0	0	4	5	5	4	1	0	0	19
WSW	0	0	0	0	3	4	1	1	1	0	0	10
W	0	0	0	0	1	2	4	2	1	0	0	10
WNW	0	0	0	1	1	4	1	1	6	0	1	15
NW	0	0	0	0	2	4	4	2	8	4	3	27
NNW	0	0	0	0	5	7	4	5	8	7	3	39
Tot	0	0	0	8	96	164	188	207	298	119	34	1114

Hours of Calm 0
Hours of Variable Direction 4
Hours of Valid Data 1118
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-10 (Sheet 4 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class C Slightly Unstable based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	<0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	0	1	21	31	22	15	15	11	3	119
NNE	0	1	4	7	17	24	10	16	8	3	0	90
NE	0	0	1	6	20	23	10	6	4	0	0	70
ENE	0	0	0	5	18	14	10	5	1	1	0	54
E	0	0	1	4	23	24	14	10	9	2	0	87
ESE	0	0	0	4	15	17	22	15	12	0	0	85
SE	0	0	1	3	10	22	32	35	85	14	0	202
SSE	0	0	1	0	17	20	19	59	68	35	12	231
S	0	0	0	1	5	20	24	20	30	32	16	148
SSW	0	0	2	2	10	12	8	7	1	0	2	44
SW	0	0	0	2	13	12	8	3	2	1	0	41
WSW	0	0	0	4	2	2	2	2	0	0	0	12
W	0	0	1	4	4	5	7	2	1	0	0	24
WNW	0	0	0	1	5	4	3	1	1	1	0	16
NW	0	0	0	4	6	6	4	6	2	4	2	34
NNW	0	0	1	3	7	6	8	6	4	4	1	40
Tot	0	1	12	51	193	242	203	208	243	108	36	1297

Wind Speed Range (m/s)

Hours of Calm 0
Hours of Variable Direction 6
Hours of Valid Data 1303
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-10 (Sheet 5 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class D Neutral based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	1	15	25	60	77	97	111	129	28	10	553
NNE	0	4	9	27	96	82	76	71	30	4	0	399
NE	0	2	13	27	80	48	28	26	23	1	1	249
ENE	0	3	5	18	53	33	18	16	4	0	0	150
E	0	2	9	13	44	57	53	38	42	1	2	261
ESE	0	1	8	4	43	60	58	51	38	6	0	269
SE	0	2	7	14	50	77	146	180	285	75	7	843
SSE	0	2	2	16	51	75	136	199	273	142	24	920
S	0	5	5	3	36	60	76	100	125	67	19	496
SSW	0	0	3	13	21	39	24	21	11	1	0	133
SW	0	1	3	7	29	12	8	4	2	0	0	66
WSW	0	0	5	9	14	7	4	1	3	0	0	43
W	0	1	3	11	11	12	8	3	1	4	0	54
WNW	0	0	5	8	14	8	7	5	6	1	0	54
NW	0	2	4	13	37	17	9	9	13	8	2	114
NNW	0	1	12	12	25	27	31	25	31	15	6	185
Tot	0	27	108	220	664	691	779	860	1016	353	71	4789

Hours of Calm 2
Hours of Variable Direction 6
Hours of Valid Data 4797
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-10 (Sheet 6 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class E Slightly Stable based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	6	16	31	54	60	40	38	77	16	1	339
NNE	0	2	22	38	74	60	41	19	7	2	0	265
NE	0	5	20	40	83	41	19	7	2	1	0	218
ENE	0	10	20	34	65	23	9	5	5	0	0	171
E	0	8	16	31	100	56	24	7	3	1	0	246
ESE	0	5	13	26	75	75	37	6	3	0	0	240
SE	0	2	22	35	121	195	160	74	24	4	0	637
SSE	0	9	7	27	171	219	162	74	42	4	0	715
S	0	3	10	16	76	79	57	32	20	0	0	293
SSW	0	2	5	3	18	19	9	6	1	0	0	63
SW	0	3	8	11	16	6	3	0	0	0	0	47
WSW	0	1	9	3	9	5	1	1	2	0	0	31
W	0	4	8	5	6	8	2	4	2	0	0	39
WNW	1	4	10	12	8	6	2	4	4	1	0	52
NW	1	4	11	10	11	12	3	5	10	5	3	75
NNW	0	3	25	13	36	22	18	24	21	12	0	174
Tot	2	71	222	335	923	886	587	306	223	46	4	3605

Hours of Calm 2
Hours of Variable Direction 5
Hours of Valid Data 3612
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-10 (Sheet 7 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class F Moderately Stable based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	<0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	12	21	50	66	35	7	0	0	0	0	191
NNE	0	4	26	51	98	48	4	1	1	0	0	233
NE	0	9	27	41	85	11	5	0	0	0	0	178
ENE	0	12	27	46	63	12	3	0	0	0	0	163
E	0	9	41	54	84	18	1	0	0	0	0	207
ESE	0	17	38	68	108	21	0	1	0	0	0	253
SE	0	12	36	95	220	60	2	1	1	0	0	427
SSE	0	14	40	81	226	43	8	0	0	0	0	412
S	0	10	26	44	63	19	1	0	0	0	0	163
SSW	0	5	16	12	25	3	4	0	0	0	0	65
SW	0	9	5	6	13	4	2	0	0	0	0	39
WSW	0	7	6	8	8	7	1	0	0	0	0	37
W	0	6	9	5	14	6	0	1	0	0	0	41
WNW	0	3	10	6	9	6	1	0	0	0	0	35
NW	0	7	14	17	17	9	3	2	0	0	0	69
NNW	0	3	18	27	35	16	3	0	1	0	0	103
Tot	0	139	360	611	1134	318	45	6	3	0	0	2616

Wind Speed Range (m/s)

Hours of Calm	6
Hours of Variable Direction	2
Hours of Valid Data	2624
Hours of Missing Data . . .	46
Hours in Period	17544

Table 2.7-10 (Sheet 8 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class G Extremely Stable based on Lapse Rate
Elevations:: Winds 10m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	16	42	66	106	17	0	0	0	0	0	247
NNE	0	12	34	65	101	14	2	0	0	0	0	228
NE	1	18	37	50	97	20	1	0	0	0	0	224
ENE	1	17	17	35	55	14	0	0	0	0	0	139
E	0	14	29	46	76	8	0	0	0	0	0	173
ESE	0	14	37	48	91	12	0	0	1	0	0	203
SE	0	18	25	38	122	20	1	0	0	0	0	224
SSE	0	14	24	46	101	28	0	0	0	0	0	213
S	0	17	19	36	53	9	0	0	0	0	0	134
SSW	0	10	16	11	25	10	0	0	0	0	0	72
SW	0	9	15	13	26	7	0	0	0	0	0	70
WSW	0	9	17	14	18	3	0	0	0	0	0	61
W	0	6	16	18	46	8	1	0	0	0	0	95
WNW	0	21	16	25	46	11	2	0	0	0	0	121
NW	1	10	23	34	56	4	0	1	0	0	0	129
NNW	0	11	50	107	88	20	0	0	0	0	0	276
Tot	3	216	417	652	1107	205	7	1	1	0	0	2609

Hours of Calm 23
Hours of Variable Direction 5
Hours of Valid Data 2637
Hours of Missing Data . . . 46
Hours in Period 17544

Table 2.7-11 (Sheet 1 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
All Stabilities
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	4	15	32	84	121	154	200	404	260	176	1450
NNE	0	5	13	30	117	140	172	183	353	115	33	1161
NE	0	4	16	27	129	181	182	172	232	49	6	998
ENE	0	1	14	34	95	151	174	158	131	21	1	780
E	0	6	10	20	121	168	182	181	178	50	13	929
ESE	0	6	22	29	96	166	227	270	361	57	9	1243
SE	0	3	10	23	89	170	253	456	941	421	155	2521
SSE	0	3	6	21	90	153	315	563	1465	655	401	3672
S	0	6	12	20	92	158	272	395	635	318	319	2227
SSW	0	4	11	14	67	103	109	113	129	64	25	639
SW	0	3	9	15	59	68	64	45	51	22	0	336
WSW	0	2	14	24	33	40	24	34	43	7	2	223
W	0	3	8	13	37	34	30	33	31	8	5	202
WNW	0	1	5	11	20	32	24	21	40	25	16	195
NW	0	8	13	21	54	60	32	30	73	41	39	371
NNW	0	5	19	25	62	74	88	64	104	57	31	529
Tot	0	64	197	359	1245	1819	2302	2918	5171	2170	1231	17476

Hours of Calm 6
Hours of Variable Direction 15
Hours of Valid Data 17497
Hours of Missing Data . . . 47
Hours in Period 17544

Table 2.7-11 (Sheet 2 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class A Extremely Unstable based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	<0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	0	0	0	4	9	16	51	44	26	150
NNE	0	0	0	0	1	9	9	17	27	15	6	84
NE	0	0	0	1	1	6	4	5	20	1	0	38
ENE	0	0	0	0	1	4	11	4	6	1	0	27
E	0	0	0	0	5	4	7	10	10	2	1	39
ESE	0	0	0	0	1	2	8	7	18	4	0	40
SE	0	0	0	0	0	2	15	22	86	100	27	252
SSE	0	0	0	0	0	5	14	22	133	136	106	416
S	0	0	0	0	1	1	3	12	41	60	73	191
SSW	0	0	0	0	1	2	3	2	5	6	7	26
SW	0	0	0	0	0	0	1	1	6	1	0	9
WSW	0	0	0	0	0	0	1	3	5	0	0	9
W	0	0	0	0	0	2	0	3	1	0	0	6
WNW	0	0	0	0	0	0	0	2	4	1	5	12
NW	0	0	0	0	0	0	0	3	20	7	16	46
NNW	0	0	0	0	1	0	5	11	21	20	4	62
Tot	0	0	0	1	12	41	90	140	454	398	271	1407

Wind Speed Range (m/s)

Hours of Calm 0
Hours of Variable Direction 0
Hours of Valid Data 1407
Hours of Missing Data . . . 47
Hours in Period 17544

Table 2.7-11 (Sheet 3 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class B Moderately Unstable based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	0	1	3	15	14	12	20	15	7	87
NNE	0	0	0	0	2	14	17	6	12	7	3	61
NE	0	0	0	1	7	10	9	8	13	1	2	51
ENE	0	0	0	0	6	9	11	13	7	3	0	49
E	0	0	0	0	7	13	15	10	13	5	2	65
ESE	0	0	0	0	5	13	15	6	14	8	0	61
SE	0	0	0	0	3	11	13	33	62	48	26	196
SSE	0	0	0	0	6	3	16	12	75	50	44	206
S	0	0	0	0	4	2	13	28	48	29	34	158
SSW	0	0	0	0	6	6	15	10	14	6	10	67
SW	0	0	0	0	2	1	7	4	2	1	0	17
WSW	0	0	0	0	1	5	2	0	2	1	0	11
W	0	0	0	0	0	2	1	5	2	0	0	10
WNW	0	0	0	0	0	1	3	0	2	2	1	9
NW	0	0	0	0	3	5	3	3	8	5	2	29
NNW	0	0	0	0	2	4	7	2	10	7	6	38
Tot	0	0	0	2	57	114	161	152	304	188	137	1115

Hours of Calm 0
Hours of Variable Direction 3
Hours of Valid Data 1118
Hours of Missing Data . . . 47
Hours in Period 17544

Table 2.7-11 (Sheet 4 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class C Slightly Unstable based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	1	1	16	17	24	17	19	13	11	119
NNE	0	1	2	2	19	11	14	8	20	4	4	85
NE	0	0	1	3	13	21	18	8	5	3	0	72
ENE	0	0	0	3	17	9	10	8	5	1	1	54
E	0	0	0	1	13	26	14	11	14	3	3	85
ESE	0	0	1	4	9	17	13	14	15	5	0	78
SE	0	0	1	2	10	13	18	30	75	36	9	194
SSE	0	0	1	0	9	11	16	19	83	41	37	217
S	0	0	1	0	4	14	16	20	44	26	56	181
SSW	0	0	1	0	4	14	9	10	9	1	4	52
SW	0	0	0	2	6	10	9	5	2	1	0	35
WSW	0	0	2	5	4	3	0	4	2	1	1	22
W	0	0	0	0	6	4	5	4	2	0	0	21
WNW	0	0	0	2	3	3	4	0	1	2	0	15
NW	0	0	0	3	8	6	2	2	4	3	1	29
NNW	0	0	1	2	5	6	7	3	5	4	5	38
Tot	0	1	12	30	146	185	179	163	305	144	132	1297

Hours of Calm 0
Hours of Variable Direction 6
Hours of Valid Data 1303
Hours of Missing Data . . . 47
Hours in Period 17544

Table 2.7-11 (Sheet 5 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class D Neutral based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	0	4	17	37	44	54	67	136	101	76	536
NNE	0	2	4	14	52	54	55	54	114	34	9	392
NE	0	3	8	12	60	57	42	23	53	22	3	283
ENE	0	1	5	16	30	33	27	17	21	4	0	154
E	0	2	7	9	38	33	26	41	45	27	6	234
ESE	0	0	4	4	19	35	33	53	86	22	7	263
SE	0	0	3	6	29	45	59	90	238	192	80	742
SSE	0	1	2	8	14	38	59	82	287	257	203	951
S	0	2	3	5	26	30	41	68	149	122	150	596
SSW	0	2	4	3	19	29	24	26	37	17	4	165
SW	0	0	4	4	22	18	11	6	10	0	0	75
WSW	0	2	2	9	13	9	5	5	1	2	0	48
W	0	0	3	5	12	10	8	5	2	3	1	49
WNW	0	0	1	3	9	10	9	4	7	3	3	49
NW	0	1	6	12	18	24	5	5	15	7	9	102
NNW	0	0	10	8	18	26	21	16	29	13	13	154
Tot	0	16	70	135	416	495	479	562	1230	826	564	4793

Hours of Calm	0
Hours of Variable Direction	4
Hours of Valid Data	4797
Hours of Missing Data . . .	47
Hours in Period	17544

Table 2.7-11 (Sheet 6 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class E Slightly Stable based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	1	5	5	15	18	26	34	64	71	56	295
NNE	0	0	3	6	22	29	31	40	64	32	10	237
NE	0	0	3	5	21	41	41	49	55	6	1	222
ENE	0	0	3	7	20	46	41	36	20	5	0	178
E	0	2	1	0	16	39	49	42	42	6	1	198
ESE	0	1	8	10	13	27	50	82	78	7	2	278
SE	0	0	0	7	16	35	48	115	239	30	12	502
SSE	0	0	1	5	20	33	65	165	414	101	11	815
S	0	2	3	7	16	30	58	103	162	55	6	442
SSW	0	1	3	5	8	13	10	21	19	15	0	95
SW	0	2	1	2	8	18	14	8	9	1	0	63
WSW	0	0	2	5	4	7	3	5	2	2	1	31
W	0	1	1	3	6	6	4	4	4	2	2	33
WNW	0	0	3	2	1	9	3	5	3	5	2	33
NW	0	1	4	2	7	8	8	7	4	9	10	60
NNW	0	2	3	10	16	15	21	15	30	13	3	128
Tot	0	13	44	81	209	374	472	731	1209	360	117	3610

Hours of Calm 0
Hours of Variable Direction 2
Hours of Valid Data 3612
Hours of Missing Data . . . 47
Hours in Period 17544

Table 2.7-11 (Sheet 7 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class F Moderately Stable based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	2	1	4	7	12	15	29	56	7	0	133
NNE	0	1	2	5	11	9	19	22	56	14	1	140
NE	0	0	2	1	13	19	41	51	44	6	0	177
ENE	0	0	0	2	10	31	35	39	21	3	0	141
E	0	2	0	6	20	28	46	25	26	1	0	154
ESE	0	1	1	4	23	35	57	66	61	1	0	249
SE	0	1	1	5	11	35	47	85	101	4	1	291
SSE	0	1	0	5	23	41	99	190	262	15	0	636
S	0	2	2	5	21	39	80	118	93	8	0	368
SSW	0	0	3	4	10	16	28	25	17	4	0	107
SW	0	0	3	4	8	12	9	9	4	6	0	55
WSW	0	0	2	1	7	4	5	7	4	0	0	30
W	0	1	2	3	4	4	5	6	11	1	0	37
WNW	0	1	0	0	6	3	1	2	10	3	0	26
NW	0	2	1	0	5	10	5	5	7	4	0	39
NNW	0	0	2	0	6	9	11	7	3	0	0	38
Tot	0	14	22	49	185	307	503	686	776	77	2	2621

Hours of Calm 2
Hours of Variable Direction 0
Hours of Valid Data 2623
Hours of Missing Data 47
Hours in Period 17544

Table 2.7-11 (Sheet 8 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-Meter Level) by Atmospheric Stability Class for the VCS Site (July 1, 2007 through June 30, 2009)

Site:: Exelon Victoria County
Period:: Months Jul - Jun for years 2007 - 2009
Stability Class G Extremely Stable based on Lapse Rate
Elevations:: Winds 60m Stability 60m

Wind Direction Sector	Wind Speed Range (m/s) <0.50	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	>10.00	Total
N	0	1	4	4	6	11	12	25	58	9	0	130
NNE	0	1	2	3	10	14	27	36	60	9	0	162
NE	0	1	2	4	14	27	27	28	42	10	0	155
ENE	0	0	6	6	11	19	39	41	51	4	0	177
E	0	0	2	4	22	25	25	42	28	6	0	154
ESE	0	4	8	7	26	37	51	42	89	10	0	274
SE	0	2	5	3	20	29	53	81	140	11	0	344
SSE	0	1	2	3	18	22	46	73	211	55	0	431
S	0	0	3	3	20	42	61	46	98	18	0	291
SSW	0	1	0	2	19	23	20	19	28	15	0	127
SW	0	1	1	3	13	9	13	12	18	12	0	82
WSW	0	0	6	4	4	12	8	10	27	1	0	72
W	0	1	2	2	9	6	7	6	9	2	2	46
WNW	0	0	1	4	1	6	4	8	13	9	5	51
NW	0	4	2	4	13	7	9	5	15	6	1	66
NNW	0	3	3	5	14	14	16	10	6	0	0	71
Tot	0	20	49	61	220	303	418	484	893	177	8	2633

Hours of Calm 4
Hours of Variable Direction 0
Hours of Valid Data 2637
Hours of Missing Data . . . 47
Hours in Period 17544

Table 2.7-12
Property Boundary, EAB, and LPZ Distances from the Source Boundary

Direction	Property Boundary Distance (m)	EAB Distance (m)	LPZ Distance (m)
S	2079	1087	7,797
SSW	1417	944	7,622
SW	1003	928	7,611
WSW	889	884	7,601
W	1033	965	7,740
WNW	1107	956	7,777
NW	1305	956	7,783
NNW	1387	959	7,766
N	1401	951	7,701
NNE	1701	879	7,576
NE	2776	947	7,623
ENE	2818	983	7,669
E	3961	1,111	7,854
ESE	5392	1,108	7,920
SE	6176	1,108	7,934
SSE	3248	1,111	7,899

Table 2.7-13
PAVAN Output – 50% X/Q Values (s/m^3) at the EAB & LPZ

Directional Dependant 50% X/Q	EAB	LPZ
S	3.124E-05	1.738E-06
SSW	5.522E-05	3.127E-06
SW	7.098E-05	4.974E-06
WSW	7.960E-05	5.734E-06
W	6.149E-05	4.109E-06
WNW	6.470E-05	4.173E-06
NW	3.957E-05	1.794E-06
NNW	3.398E-05	1.502E-06
N	3.201E-05	1.374E-06
NNE	4.849E-05	2.258E-06
NE	6.079E-05	4.258E-06
ENE	**8.846E-05**	8.308E-06
E	8.594E-05	9.179E-06
ESE	8.647E-05	**9.642E-06**
SE	4.472E-05	3.406E-06
SSE	5.907E-05	4.960E-06
Overall Site 50% X/Q	4.044E-05	2.249E-06

Max 50% X/Q	**8.846E-05**	**9.642E-06**

Table 2.7-14
XOQDOQ-Predicted Maximum X/Q and D/Q Values at Receptors of Interest

	Type of Location	Direction from Site	Distance (miles)	χ/Q (sec/m^3)
No Decay	EAB	NNW	0.60	1.790E-05
	Property Boundary	SW	0.62	1.274E-05
	Resident	NNW	1.40	2.843E-06
	Meat Animal	NNW	1.40	2.843E-06
	Vegetable Garden	NW	1.65	1.983E-06
	Construction Worker	NNE	0.25	1.603E-05
2.26 Day Decay	EAB	NNW	0.60	1.787E-05
	Property Boundary	SW	0.62	1.265E-05
	Resident	NNW	1.40	2.831E-06
	Meat Animal	NNW	1.40	2.831E-06
	Vegetable Garden	NW	1.65	1.973E-06
	Construction Worker	NNE	0.25	1.602E-05
8 Day Decay	EAB	NNW	0.60	1.616E-05
	Property Boundary	SW	0.62	1.146E-05
	Resident	NNW	1.40	2.424E-06
	Meat Animal	NNW	1.40	2.424E-06
	Vegetable Garden	NW	1.65	1.668E-06
	Construction Worker	NNE	0.25	1.517E-05
		Direction from Site	**Distance (miles)**	**D/Q (1/m^2)**
	EAB	NNW	0.60	1.048E-07
	Property Boundary	NW	0.81	5.315E-08
	Resident	NNW	1.40	1.448E-08
	Meat Animal	NNW	1.40	1.448E-08
	Vegetable Garden	NW	1.65	8.836E-09
	Construction Worker	NNE	0.25	5.979E-08

Table 2.7-15
Shortest Distances Between the VCS Source Boundary and Receptors of Interest by Downwind Direction Sector

Distance (Meters)	Type of Receptor	Directional Sector
4,773	Residence, Meat, Garden	N
2,261	Residence, Meat	NNW
4,033	Garden	NNW
2,651	Residence, Meat, Garden	NW
7,267	Residence, Meat, Garden	WNW
7,227	Residence, Meat, Garden	W
9,838	Residence, Meat, Garden	WSW
3,467	Residence, Meat, Garden	SW
3,656	Residence, Meat, Garden	SSW
9,524	Residence, Meat, Garden	S
6,795	Residence, Meat, Garden	SSE
N/A	N/A	SE
8,430	Residence, Meat, Garden	ESE
12,929	Residence, Meat, Garden	E
9,172	Residence, Meat, Garden	ENE
3,479	Residence, Meat, Garden	NE
6,687	Residence, Meat, Garden	NNE

Table 2.7-16 (Sheet 1 of 2)
XOQDOQ-Predicted Maximum Annual Average X/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

No Decay Undepleted	DISTANCE IN MILES FROM SITE										
NNW	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4	4.5
X/Q (s/m^3)	6.889E-05	2.348E-05	1.255E-05	6.238E-06	2.444E-06	1.309E-06	8.258E-07	5.750E-07	4.277E-07	3.335E-07	2.693E-07
	DISTANCE IN MILES FROM SITE										
NNW	5	7.5*	10*	15*	20*	25*	30*	35*	40*	45*	50*
X/Q (s/m^3)	2.235E-07	1.164E-07	7.632E-08	4.459E-08	3.063E-08	2.294E-08	1.814E-08	1.489E-08	1.256E-08	1.082E-08	9.465E-09
	SEGMENT BOUNDARIES IN MILES FROM SITE										
NNW	.5-1	1-2	2-3	3-4	4-5	5-10**	10-20*	20-30*	30-40*	40-50*	
X/Q (s/m^3)	1.217E-05	2.783E-06	8.544E-07	4.339E-07	2.714E-07	1.223E-07	4.544E-08	2.307E-08	1.493E-08	1.083E-08	

* Represents NW Directional Sector ** Represents NW and NNW Directional Sector

2.26 Day Decay Undepleted	DISTANCE IN MILES FROM SITE										
NNW	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4	4.5
X/Q (s/m^3)	6.884E-05	2.344E-05	1.252E-05	6.220E-06	2.433E-06	1.302E-06	8.198E-07	5.700E-07	4.234E-07	3.296E-07	2.658E-07
	DISTANCE IN MILES FROM SITE										
NNW	5	7.5*	10*	15*	20*	25*	30*	35*	40*	45*	50*
X/Q (s/m^3)	2.202E-07	1.138E-07	7.403E-08	4.259E-08	2.880E-08	2.124E-08	1.654E-08	1.337E-08	1.111E-08	9.417E-09	8.116E-09
	SEGMENT BOUNDARIES IN MILES FROM SITE										
NNW	.5-1	1-2	2-3	3-4	4-5	5-10**	10-20*	20-30*	30-40*	40-50*	
X/Q (s/m^3)	1.215E-05	2.772E-06	8.484E-07	4.295E-07	2.678E-07	1.197E-07	4.345E-08	2.138E-08	1.341E-08	9.436E-09	

* Represents NW Directional Sector ** Represents NW and NNW Directional Sector

Table 2.7-16 (Sheet 2 of 2)
XOQDOQ-Predicted Maximum Annual Average X/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

8.00 Day Decay Depleted	DISTANCE IN MILES FROM SITE										
NNW	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4	4.5
X/Q (s/m^3)	6.519E-05	2.143E-05	1.117E-05	5.456E-06	2.073E-06	1.082E-06	6.675E-07	4.556E-07	3.328E-07	2.552E-07	2.029E-07
	DISTANCE IN MILES FROM SITE										
NNW	5	7.5*	10*	15*	20*	25*	30*	35*	40*	45*	50*
X/Q (s/m^3)	1.659E-07	8.152E-08	5.083E-08	2.737E-08	1.758E-08	1.242E-08	9.320E-09	7.291E-09	5.881E-09	4.854E-09	4.081E-09
	SEGMENT BOUNDARIES IN MILES FROM SITE										
NNW	.5-1	1-2	2-3	3-4	4-5	5-10*	10-20*	20-30*	30-40*	40-50*	
X/Q (s/m^3)	1.091E-05	2.385E-06	6.934E-07	3.383E-07	2.047E-07	8.659E-08	2.823E-08	1.255E-08	7.334E-09	4.872E-09	

* Represents NW Direction

Relative Deposition						
DISTANCE IN MILES FROM SITE						
NNW	0.25	0.5	0.75	1	1.5	2
D/Q (1/m^2)	4.138E-07	1.399E-07	7.184E-08	3.415E-08	1.227E-08	6.084E-09
DISTANCE IN MILES FROM SITE						
NNW	2.5	3	3.5	4	4.5	5
D/Q (1/m^2)	3.582E-09	2.346E-09	1.651E-09	1.223E-09	9.426E-10	7.489E-10
DISTANCE IN MILES FROM SITE						
NNW	7.5	10	15	20	25	30
D/Q (1/m^2)	3.327E-10	2.015E-10	1.019E-10	6.165E-11	4.133E-11	2.962E-11
DISTANCE IN MILES FROM SITE						
NNW	35	40	45	50		
D/Q (1/m^2)	2.224E-11	1.729E-11	1.381E-11	1.127E-11		

Table 2.7-17 (Sheet 1 of 2)
Long-Term Average X/Q and D/Q Values for Routine Releases at Specific Receptors of Interest

Release Point - Ground Level - No Intermittent Releases
CORRECTED USING STANDARD OPEN TERRAIN FACTORS
SPECIFIC POINTS OF INTEREST

0RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 2.260 DAY DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 8.000 DAY DECAY DEPLETED	D/Q (PER SQ.METER)
+								
+								
A	Res/Meat	S	5.92	9524.	1.3E-07	1.2E-07	9.1E-08	2.8E-10
A	Res/Meat	SSW	2.27	3656.	7.1E-07	7.0E-07	5.8E-07	2.0E-09
A	Res/Meat	SW	2.15	3467.	9.2E-07	8.9E-07	7.5E-07	1.7E-09
A	Res/Meat	WSW	6.11	9838.	1.1E-07	1.0E-07	7.8E-08	1.2E-10
A	Res/Meat	W	4.49	7227.	1.7E-07	1.7E-07	1.3E-07	3.3E-10
A	Res/Meat	WNW	4.52	7267.	1.9E-07	1.8E-07	1.4E-07	3.6E-10
A	Res/Meat	NW	1.65	2651.	2.0E-06	2.0E-06	1.7E-06	8.8E-09
A	Res/Meat	NNW	1.40	2261.	2.8E-06	2.8E-06	2.4E-06	1.4E-08
A	Res/Meat	N	2.97	4773.	3.2E-07	3.2E-07	2.5E-07	1.2E-09
A	Res/Meat	NNE	4.16	6687.	7.5E-08	7.3E-08	5.7E-08	1.6E-10
A	Res/Meat	NE	2.16	3479.	2.2E-07	2.2E-07	1.8E-07	4.7E-10
A	Res/Meat	ENE	5.70	9172.	3.3E-08	3.2E-08	2.4E-08	3.7E-11
A	Res/Meat	E	8.03	12929.	2.4E-08	2.3E-08	1.6E-08	2.5E-11
A	Res/Meat	ESE	5.24	8430.	6.1E-08	6.0E-08	4.5E-08	6.7E-11
A	Res/Meat	SSE	4.22	6795.	1.8E-07	1.8E-07	1.4E-07	3.1E-10
A	Veg	S	5.92	9524.	1.3E-07	1.2E-07	9.1E-08	2.8E-10
A	Veg	SSW	2.27	3656.	7.1E-07	7.0E-07	5.8E-07	2.0E-09
A	Veg	SW	2.15	3467.	9.2E-07	8.9E-07	7.5E-07	1.7E-09
A	Veg	WSW	6.11	9838.	1.1E-07	1.0E-07	7.8E-08	1.2E-10
A	Veg	W	4.49	7227.	1.7E-07	1.7E-07	1.3E-07	3.3E-10
A	Veg	WNW	4.52	7267.	1.9E-07	1.8E-07	1.4E-07	3.6E-10
A	Veg	NW	1.65	2651.	2.0E-06	2.0E-06	1.7E-06	8.8E-09
A	Veg	NNW	2.51	4033.	8.2E-07	8.2E-07	6.6E-07	3.6E-09
A	Veg	N	2.97	4773.	3.2E-07	3.2E-07	2.5E-07	1.2E-09
A	Veg	NNE	4.16	6687.	7.5E-08	7.3E-08	5.7E-08	1.6E-10
A	Veg	NE	2.16	3479.	2.2E-07	2.2E-07	1.8E-07	4.7E-10
A	Veg	ENE	5.70	9172.	3.3E-08	3.2E-08	2.4E-08	3.7E-11
A	Veg	E	8.03	12929.	2.4E-08	2.3E-08	1.6E-08	2.5E-11
A	Veg	ESE	5.24	8430.	6.1E-08	6.0E-08	4.5E-08	6.7E-11
A	Veg	SSE	4.22	6795.	1.8E-07	1.8E-07	1.4E-07	3.1E-10
A	Property Bndry	S	1.29	2079.	2.5E-06	2.5E-06	2.1E-06	9.6E-09

Table 2.7-17 (Sheet 2 of 2)
Long-Term Average X/Q and D/Q Values for Routine Releases at Specific Receptors of Interest

A	Property Bndry	SSW	.88	1417.	5.8E-06	5.8E-06	5.1E-06	2.1E-08
A	Property Bndry	SW	.62	1003.	1.3E-05	1.3E-05	1.1E-05	3.2E-08
A	Property Bndry	WSW	.55	889.	1.3E-05	1.2E-05	1.1E-05	2.9E-08
A	Property Bndry	W	.64	1033.	9.6E-06	9.5E-06	8.6E-06	3.2E-08
A	Property Bndry	WNW	.69	1107.	9.4E-06	9.4E-06	8.4E-06	3.2E-08
A	Property Bndry	NW	.81	1305.	1.0E-05	1.0E-05	9.1E-06	5.3E-08
A	Property Bndry	NNW	.86	1387.	8.9E-06	8.9E-06	7.9E-06	5.0E-08
A	Property Bndry	N	.87	1401.	4.7E-06	4.7E-06	4.2E-06	2.4E-08
A	Property Bndry	NNE	1.06	1701.	1.3E-06	1.3E-06	1.1E-06	4.3E-09
A	Property Bndry	NE	1.72	2776.	3.6E-07	3.6E-07	3.0E-07	8.1E-10
A	Property Bndry	ENE	1.75	2818.	3.0E-07	3.0E-07	2.5E-07	5.4E-10
A	Property Bndry	E	2.46	3961.	1.8E-07	1.8E-07	1.5E-07	3.2E-10
A	Property Bndry	ESE	3.35	5392.	1.3E-07	1.3E-07	1.1E-07	1.8E-10
A	Property Bndry	SE	3.84	6176.	1.9E-07	1.7E-07	1.4E-07	2.2E-10
A	Property Bndry	SSE	2.02	3248.	7.5E-07	7.5E-07	6.2E-07	1.7E-09
A	EAB	S	.68	1087.	1.1E-05	1.0E-05	9.4E-06	4.6E-08
A	EAB	SSW	.59	944.	1.3E-05	1.2E-05	1.1E-05	4.7E-08
A	EAB	SW	.58	928.	1.4E-05	1.4E-05	1.3E-05	3.7E-08
A	EAB	WSW	.55	884.	1.3E-05	1.3E-05	1.1E-05	2.9E-08
A	EAB	W	.60	965.	1.1E-05	1.1E-05	9.6E-06	3.6E-08
A	EAB	WNW	.59	956.	1.2E-05	1.2E-05	1.1E-05	4.0E-08
A	EAB	NW	.59	956.	1.8E-05	1.8E-05	1.6E-05	9.6E-08
A	EAB	NNW	.60	959.	1.8E-05	1.8E-05	1.6E-05	1.1E-07
A	EAB	N	.59	951.	9.8E-06	9.7E-06	8.8E-06	5.1E-08
A	EAB	NNE	.55	879.	4.7E-06	4.6E-06	4.2E-06	1.8E-08
A	EAB	NE	.59	947.	3.5E-06	3.5E-06	3.2E-06	1.0E-08
A	EAB	ENE	.61	983.	2.8E-06	2.8E-06	2.5E-06	6.5E-09
A	EAB	E	.69	1111.	2.8E-06	2.8E-06	2.5E-06	7.1E-09
A	EAB	ESE	.69	1108.	3.7E-06	3.7E-06	3.3E-06	8.2E-09
A	EAB	SE	.69	1108.	6.6E-06	6.5E-06	5.9E-06	1.4E-08
A	EAB	SSE	.69	1111.	7.8E-06	7.7E-06	6.9E-06	2.3E-08

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	.00	REP. WIND HEIGHT	(METERS)	10.0
DIAMETER	(METERS)	.00	BUILDING HEIGHT	(METERS)	24.4
EXIT VELOCITY	(METERS)	.00	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	1263.0
			HEAT EMISSION RATE	(CAL/SEC)	.0

Table 2.7-18
Long-Term Average X/Q Values (sec/m^3) for Routine Releases at Distances Between 0.25 and 50 Miles, No Decay, Undepleted

NO DECAY, UNDEPLETED
CORRECTED USING STANDARD OPEN TERRAIN FACTORS
ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	.250	.500	.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	5.016E-05	1.657E-05	8.970E-06	4.501E-06	1.783E-06	9.620E-07	6.099E-07	4.265E-07	3.184E-07	2.491E-07	2.017E-07
SSW	4.755E-05	1.585E-05	8.577E-06	4.302E-06	1.702E-06	9.181E-07	5.818E-07	4.067E-07	3.036E-07	2.374E-07	1.922E-07
SW	5.390E-05	1.765E-05	9.693E-06	4.907E-06	1.965E-06	1.068E-06	6.811E-07	4.784E-07	3.585E-07	2.813E-07	2.285E-07
WSW	4.361E-05	1.443E-05	7.918E-06	4.006E-06	1.603E-06	8.715E-07	5.556E-07	3.902E-07	2.924E-07	2.295E-07	1.863E-07
W	4.121E-05	1.393E-05	7.543E-06	3.781E-06	1.496E-06	8.068E-07	5.114E-07	3.575E-07	2.669E-07	2.087E-07	1.690E-07
WNW	4.491E-05	1.523E-05	8.274E-06	4.158E-06	1.650E-06	8.921E-07	5.664E-07	3.965E-07	2.963E-07	2.320E-07	1.880E-07
NW	6.804E-05	2.319E-05	1.242E-05	6.188E-06	2.429E-06	1.303E-06	8.225E-07	5.731E-07	4.266E-07	3.329E-07	2.689E-07
NNW	6.889E-05	2.348E-05	1.255E-05	6.238E-06	2.444E-06	1.309E-06	8.258E-07	5.750E-07	4.277E-07	3.335E-07	2.693E-07
N	3.753E-05	1.257E-05	6.749E-06	3.368E-06	1.325E-06	7.118E-07	4.498E-07	3.137E-07	2.337E-07	1.824E-07	1.475E-07
NNE	1.603E-05	5.301E-06	2.870E-06	1.441E-06	5.708E-07	3.081E-07	1.954E-07	1.366E-07	1.020E-07	7.984E-08	6.466E-08
NE	1.355E-05	4.453E-06	2.427E-06	1.223E-06	4.867E-07	2.635E-07	1.675E-07	1.174E-07	8.782E-08	6.880E-08	5.579E-08
ENE	1.142E-05	3.754E-06	2.064E-06	1.046E-06	4.193E-07	2.281E-07	1.455E-07	1.023E-07	7.668E-08	6.019E-08	4.889E-08
E	1.380E-05	4.514E-06	2.483E-06	1.259E-06	5.048E-07	2.747E-07	1.753E-07	1.232E-07	9.237E-08	7.251E-08	5.891E-08
ESE	1.844E-05	5.962E-06	3.296E-06	1.676E-06	6.749E-07	3.682E-07	2.354E-07	1.658E-07	1.244E-07	9.781E-08	7.954E-08
SE	3.254E-05	1.046E-05	5.801E-06	2.957E-06	1.195E-06	6.533E-07	4.183E-07	2.949E-07	2.216E-07	1.743E-07	1.418E-07
SSE	3.846E-05	1.245E-05	6.874E-06	3.493E-06	1.405E-06	7.664E-07	4.898E-07	3.447E-07	2.587E-07	2.033E-07	1.653E-07

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	1.678E-07	8.810E-08	5.808E-08	3.420E-08	2.362E-08	1.777E-08	1.411E-08	1.162E-08	9.824E-09	8.479E-09	7.436E-09
SSW	1.598E-07	8.386E-08	5.526E-08	3.251E-08	2.244E-08	1.687E-08	1.338E-08	1.102E-08	9.314E-09	8.037E-09	7.046E-09
SW	1.905E-07	1.010E-07	6.699E-08	3.979E-08	2.764E-08	2.088E-08	1.663E-08	1.374E-08	1.164E-08	1.007E-08	8.850E-09
WSW	1.554E-07	8.232E-08	5.461E-08	3.242E-08	2.251E-08	1.700E-08	1.354E-08	1.118E-08	9.474E-09	8.193E-09	7.197E-09
W	1.406E-07	7.378E-08	4.863E-08	2.861E-08	1.975E-08	1.485E-08	1.178E-08	9.695E-09	8.196E-09	7.071E-09	6.198E-09
WNW	1.565E-07	8.235E-08	5.438E-08	3.208E-08	2.217E-08	1.669E-08	1.325E-08	1.092E-08	9.234E-09	7.971E-09	6.991E-09
NW	2.233E-07	1.164E-07	7.632E-08	4.459E-08	3.063E-08	2.294E-08	1.814E-08	1.489E-08	1.256E-08	1.082E-08	9.465E-09
NNW	2.235E-07	1.163E-07	7.617E-08	4.443E-08	3.048E-08	2.281E-08	1.803E-08	1.479E-08	1.247E-08	1.073E-08	9.386E-09
N	1.225E-07	6.399E-08	4.203E-08	2.463E-08	1.695E-08	1.272E-08	1.007E-08	8.279E-09	6.991E-09	6.025E-09	5.278E-09
NNE	5.381E-08	2.831E-08	1.869E-08	1.103E-08	7.629E-09	5.748E-09	4.567E-09	3.764E-09	3.186E-09	2.752E-09	2.415E-09
NE	4.647E-08	2.452E-08	1.622E-08	9.604E-09	6.659E-09	5.025E-09	3.998E-09	3.299E-09	2.795E-09	2.416E-09	2.122E-09
ENE	4.078E-08	2.163E-08	1.436E-08	8.536E-09	5.932E-09	4.484E-09	3.572E-09	2.951E-09	2.502E-09	2.165E-09	1.902E-09
E	4.914E-08	2.607E-08	1.731E-08	1.030E-08	7.160E-09	5.414E-09	4.315E-09	3.566E-09	3.024E-09	2.617E-09	2.300E-09
ESE	6.640E-08	3.535E-08	2.352E-08	1.403E-08	9.769E-09	7.396E-09	5.900E-09	4.879E-09	4.141E-09	3.585E-09	3.153E-09
SE	1.185E-07	6.322E-08	4.215E-08	2.519E-08	1.757E-08	1.332E-08	1.064E-08	8.803E-09	7.477E-09	6.478E-09	5.700E-09
SSE	1.380E-07	7.338E-08	4.882E-08	2.909E-08	2.025E-08	1.533E-08	1.223E-08	1.011E-08	8.579E-09	7.426E-09	6.530E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	.00	REP. WIND HEIGHT	(METERS)	10.0
DIAMETER	(METERS)	.00	BUILDING HEIGHT	(METERS)	24.4
EXIT VELOCITY	(METERS)	.00	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	1263.0
			HEAT EMISSION RATE	(CAL/SEC)	.0

Table 2.7-19
Long-Term Average X/Q Values (sec/m^3) for Routine Releases at the Standard Distance Segments Between 0.5 and 50 Miles, No Decay, Undepleted

NO DECAY, UNDEPLETED
CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	8.673E-06	2.022E-06	6.304E-07	3.229E-07	2.032E-07	9.246E-08	3.481E-08	1.787E-08	1.164E-08	8.491E-09
SSW	8.294E-06	1.931E-06	6.015E-07	3.078E-07	1.936E-07	8.803E-08	3.309E-08	1.696E-08	1.104E-08	8.048E-09
SW	9.335E-06	2.220E-06	7.033E-07	3.634E-07	2.301E-07	1.058E-07	4.043E-08	2.098E-08	1.377E-08	1.009E-08
WSW	7.625E-06	1.812E-06	5.737E-07	2.964E-07	1.876E-07	8.623E-08	3.295E-08	1.709E-08	1.120E-08	8.204E-09
W	7.291E-06	1.697E-06	5.286E-07	2.706E-07	1.702E-07	7.744E-08	2.912E-08	1.493E-08	9.720E-09	7.081E-09
WNW	7.991E-06	1.871E-06	5.853E-07	3.004E-07	1.893E-07	8.639E-08	3.263E-08	1.678E-08	1.094E-08	7.982E-09
NW	1.204E-05	2.764E-06	8.509E-07	4.328E-07	2.710E-07	1.223E-07	4.544E-08	2.307E-08	1.493E-08	1.083E-08
NNW	1.217E-05	2.783E-06	8.544E-07	4.339E-07	2.714E-07	1.223E-07	4.528E-08	2.294E-08	1.483E-08	1.075E-08
N	6.539E-06	1.507E-06	4.652E-07	2.370E-07	1.486E-07	6.723E-08	2.508E-08	1.279E-08	8.301E-09	6.034E-09
NNE	2.775E-06	6.474E-07	2.019E-07	1.035E-07	6.514E-08	2.970E-08	1.122E-08	5.777E-09	3.773E-09	2.756E-09
NE	2.342E-06	5.511E-07	1.731E-07	8.903E-08	5.619E-08	2.571E-08	9.766E-09	5.050E-09	3.307E-09	2.419E-09
ENE	1.987E-06	4.736E-07	1.503E-07	7.771E-08	4.923E-08	2.265E-08	8.673E-09	4.505E-09	2.957E-09	2.167E-09
E	2.390E-06	5.701E-07	1.810E-07	9.361E-08	5.932E-08	2.730E-08	1.046E-08	5.440E-09	3.574E-09	2.620E-09
ESE	3.168E-06	7.611E-07	2.430E-07	1.261E-07	8.009E-08	3.699E-08	1.425E-08	7.431E-09	4.890E-09	3.590E-09
SE	5.571E-06	1.346E-06	4.316E-07	2.245E-07	1.428E-07	6.614E-08	2.557E-08	1.338E-08	8.822E-09	6.486E-09
SSE	6.611E-06	1.585E-06	5.055E-07	2.622E-07	1.664E-07	7.681E-08	2.955E-08	1.540E-08	1.013E-08	7.436E-09

Table 2.7-20
Long-Term Average X/Q Values (sec/m^3) for Routine Releases at Distances Between 0.25 and 50 Miles, 2.26-Day Decay, Undepleted

2.260 DAY DECAY, UNDEPLETED
CORRECTED USING STANDARD OPEN TERRAIN FACTORS
ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	.250	.500	.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	5.012E-05	1.654E-05	8.948E-06	4.486E-06	1.774E-06	9.556E-07	6.048E-07	4.222E-07	3.147E-07	2.457E-07	1.986E-07
SSW	4.752E-05	1.583E-05	8.557E-06	4.288E-06	1.694E-06	9.122E-07	5.772E-07	4.028E-07	3.002E-07	2.343E-07	1.894E-07
SW	5.374E-05	1.755E-05	9.606E-06	4.848E-06	1.929E-06	1.042E-06	6.599E-07	4.606E-07	3.430E-07	2.674E-07	2.158E-07
WSW	4.345E-05	1.433E-05	7.834E-06	3.949E-06	1.568E-06	8.460E-07	5.352E-07	3.731E-07	2.775E-07	2.161E-07	1.742E-07
W	4.118E-05	1.391E-05	7.523E-06	3.768E-06	1.488E-06	8.010E-07	5.068E-07	3.537E-07	2.635E-07	2.057E-07	1.663E-07
WNW	4.487E-05	1.521E-05	8.252E-06	4.144E-06	1.642E-06	8.857E-07	5.613E-07	3.923E-07	2.926E-07	2.286E-07	1.850E-07
NW	6.799E-05	2.316E-05	1.240E-05	6.170E-06	2.418E-06	1.295E-06	8.164E-07	5.681E-07	4.222E-07	3.289E-07	2.653E-07
NNW	6.884E-05	2.344E-05	1.252E-05	6.220E-06	2.433E-06	1.302E-06	8.198E-07	5.700E-07	4.234E-07	3.296E-07	2.658E-07
N	3.750E-05	1.254E-05	6.732E-06	3.357E-06	1.318E-06	7.069E-07	4.459E-07	3.104E-07	2.308E-07	1.799E-07	1.452E-07
NNE	1.602E-05	5.291E-06	2.862E-06	1.435E-06	5.675E-07	3.057E-07	1.934E-07	1.350E-07	1.006E-07	7.858E-08	6.351E-08
NE	1.353E-05	4.444E-06	2.419E-06	1.218E-06	4.836E-07	2.613E-07	1.657E-07	1.159E-07	8.649E-08	6.761E-08	5.470E-08
ENE	1.140E-05	3.746E-06	2.057E-06	1.041E-06	4.165E-07	2.261E-07	1.439E-07	1.009E-07	7.547E-08	5.910E-08	4.790E-08
E	1.378E-05	4.505E-06	2.476E-06	1.254E-06	5.018E-07	2.725E-07	1.735E-07	1.217E-07	9.109E-08	7.137E-08	5.787E-08
ESE	1.841E-05	5.943E-06	3.281E-06	1.666E-06	6.687E-07	3.638E-07	2.319E-07	1.628E-07	1.219E-07	9.552E-08	7.746E-08
SE	3.238E-05	1.036E-05	5.719E-06	2.901E-06	1.161E-06	6.284E-07	3.984E-07	2.781E-07	2.070E-07	1.613E-07	1.300E-07
SSE	3.843E-05	1.243E-05	6.856E-06	3.481E-06	1.398E-06	7.610E-07	4.855E-07	3.411E-07	2.555E-07	2.004E-07	1.627E-07

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	1.649E-07	8.586E-08	5.611E-08	3.247E-08	2.204E-08	1.629E-08	1.271E-08	1.029E-08	8.551E-09	7.254E-09	6.254E-09
SSW	1.573E-07	8.183E-08	5.347E-08	3.094E-08	2.100E-08	1.553E-08	1.212E-08	9.816E-09	8.164E-09	6.929E-09	5.977E-09
SW	1.789E-07	9.197E-08	5.929E-08	3.340E-08	2.212E-08	1.602E-08	1.228E-08	9.789E-09	8.038E-09	6.750E-09	5.770E-09
WSW	1.442E-07	7.369E-08	4.724E-08	2.632E-08	1.727E-08	1.240E-08	9.430E-09	7.470E-09	6.098E-09	5.094E-09	4.335E-09
W	1.380E-07	7.180E-08	4.689E-08	2.709E-08	1.836E-08	1.355E-08	1.056E-08	8.534E-09	7.085E-09	6.004E-09	5.169E-09
WNW	1.537E-07	8.015E-08	5.244E-08	3.037E-08	2.062E-08	1.524E-08	1.189E-08	9.615E-09	7.988E-09	6.773E-09	5.835E-09
NW	2.200E-07	1.138E-07	7.403E-08	4.259E-08	2.880E-08	2.124E-08	1.654E-08	1.337E-08	1.111E-08	9.417E-09	8.116E-09
NNW	2.202E-07	1.137E-07	7.393E-08	4.247E-08	2.870E-08	2.115E-08	1.647E-08	1.331E-08	1.105E-08	9.368E-09	8.072E-09
N	1.204E-07	6.231E-08	4.056E-08	2.334E-08	1.577E-08	1.162E-08	9.041E-09	7.298E-09	6.053E-09	5.124E-09	4.409E-09
NNE	5.275E-08	2.747E-08	1.795E-08	1.038E-08	7.035E-09	5.193E-09	4.044E-09	3.266E-09	2.710E-09	2.294E-09	1.973E-09
NE	4.546E-08	2.373E-08	1.553E-08	8.990E-09	6.099E-09	4.503E-09	3.506E-09	2.831E-09	2.347E-09	1.986E-09	1.707E-09
ENE	3.986E-08	2.090E-08	1.372E-08	7.971E-09	5.414E-09	4.001E-09	3.116E-09	2.517E-09	2.087E-09	1.765E-09	1.517E-09
E	4.817E-08	2.531E-08	1.664E-08	9.704E-09	6.617E-09	4.908E-09	3.837E-09	3.110E-09	2.588E-09	2.197E-09	1.895E-09
ESE	6.449E-08	3.386E-08	2.224E-08	1.292E-08	8.775E-09	6.484E-09	5.051E-09	4.080E-09	3.385E-09	2.865E-09	2.464E-09
SE	1.076E-07	5.485E-08	3.502E-08	1.933E-08	1.256E-08	8.945E-09	6.756E-09	5.320E-09	4.322E-09	3.597E-09	3.052E-09
SSE	1.355E-07	7.146E-08	4.711E-08	2.758E-08	1.886E-08	1.403E-08	1.099E-08	8.928E-09	7.445E-09	6.333E-09	5.472E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	.00	REP. WIND HEIGHT	(METERS)	10.0
DIAMETER	(METERS)	.00	BUILDING HEIGHT	(METERS)	24.4
EXIT VELOCITY	(METERS)	.00	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	1263.0
			HEAT EMISSION RATE	(CAL/SEC)	.0

Table 2.7-21
Long-Term Average X/Q Values (sec/m^3) for Routine Releases at the Standard Distance Segments Between 0.5 and 50 Miles, 2.26-Day Decay, Undepleted

2.260 DAY DECAY, UNDEPLETED
CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

DIRECTION FROM SITE	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	8.653E-06	2.013E-06	6.253E-07	3.191E-07	2.001E-07	9.021E-08	3.309E-08	1.639E-08	1.032E-08	7.268E-09
SSW	8.275E-06	1.923E-06	5.968E-07	3.044E-07	1.908E-07	8.599E-08	3.153E-08	1.563E-08	9.846E-09	6.942E-09
SW	9.257E-06	2.183E-06	6.820E-07	3.478E-07	2.174E-07	9.675E-08	3.414E-08	1.615E-08	9.832E-09	6.769E-09
WSW	7.550E-06	1.776E-06	5.533E-07	2.814E-07	1.755E-07	7.759E-08	2.695E-08	1.251E-08	7.507E-09	5.110E-09
W	7.273E-06	1.689E-06	5.240E-07	2.673E-07	1.675E-07	7.545E-08	2.761E-08	1.364E-08	8.561E-09	6.015E-09
WNW	7.971E-06	1.862E-06	5.802E-07	2.967E-07	1.863E-07	8.417E-08	3.094E-08	1.533E-08	9.644E-09	6.786E-09
NW	1.202E-05	2.753E-06	8.448E-07	4.283E-07	2.674E-07	1.197E-07	4.345E-08	2.138E-08	1.341E-08	9.436E-09
NNW	1.215E-05	2.772E-06	8.484E-07	4.295E-07	2.678E-07	1.197E-07	4.334E-08	2.129E-08	1.335E-08	9.386E-09
N	6.524E-06	1.500E-06	4.613E-07	2.342E-07	1.463E-07	6.555E-08	2.380E-08	1.170E-08	7.321E-09	5.134E-09
NNE	2.768E-06	6.440E-07	2.000E-07	1.021E-07	6.399E-08	2.885E-08	1.057E-08	5.224E-09	3.276E-09	2.298E-09
NE	2.335E-06	5.479E-07	1.713E-07	8.769E-08	5.510E-08	2.491E-08	9.158E-09	4.530E-09	2.840E-09	1.990E-09
ENE	1.981E-06	4.707E-07	1.486E-07	7.650E-08	4.824E-08	2.192E-08	8.112E-09	4.024E-09	2.524E-09	1.769E-09
E	2.384E-06	5.670E-07	1.792E-07	9.234E-08	5.828E-08	2.654E-08	9.874E-09	4.935E-09	3.119E-09	2.201E-09
ESE	3.154E-06	7.547E-07	2.395E-07	1.235E-07	7.801E-08	3.550E-08	1.315E-08	6.522E-09	4.093E-09	2.870E-09
SE	5.497E-06	1.311E-06	4.116E-07	2.099E-07	1.310E-07	5.776E-08	1.981E-08	9.034E-09	5.350E-09	3.610E-09
SSE	6.594E-06	1.578E-06	5.012E-07	2.590E-07	1.638E-07	7.488E-08	2.805E-08	1.410E-08	8.952E-09	6.343E-09

Table 2.7-22
Long-Term Average X/Q Values (sec/m^3) for Routine Releases at Distances Between 0.25 and 50 Miles, 8.00-Day Decay, Depleted

RELEASE POINT - GROUND LEVEL - NO INTERMITTENT RELEASES
8.000 DAY DECAY, DEPLETED
0ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	.250	.500	.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	2.648E-06	8.060E-07	4.232E-07	2.695E-07	1.433E-07	9.106E-08	6.388E-08	4.780E-08	3.738E-08	3.019E-08	2.499E-08
SSW	3.019E-06	9.278E-07	4.889E-07	3.113E-07	1.648E-07	1.044E-07	7.300E-08	5.452E-08	4.256E-08	3.433E-08	2.838E-08
SW	4.054E-06	1.271E-06	6.756E-07	4.303E-07	2.266E-07	1.427E-07	9.932E-08	7.378E-08	5.733E-08	4.604E-08	3.792E-08
WSW	3.199E-06	1.003E-06	5.359E-07	3.431E-07	1.817E-07	1.149E-07	8.025E-08	5.980E-08	4.658E-08	3.748E-08	3.093E-08
W	2.794E-06	8.598E-07	4.608E-07	2.974E-07	1.598E-07	1.021E-07	7.188E-08	5.396E-08	4.230E-08	3.422E-08	2.838E-08
WNW	1.809E-06	5.461E-07	2.900E-07	1.872E-07	1.010E-07	6.487E-08	4.588E-08	3.463E-08	2.728E-08	2.217E-08	1.845E-08
NW	2.846E-06	8.447E-07	4.400E-07	2.816E-07	1.540E-07	9.996E-08	7.131E-08	5.423E-08	4.298E-08	3.511E-08	2.936E-08
NNW	6.779E-06	1.974E-06	1.004E-06	6.364E-07	3.511E-07	2.301E-07	1.655E-07	1.269E-07	1.014E-07	8.335E-08	7.009E-08
N	9.937E-06	2.865E-06	1.436E-06	9.052E-07	4.959E-07	3.243E-07	2.331E-07	1.797E-07	1.441E-07	1.189E-07	1.003E-07
NNE	1.095E-05	3.161E-06	1.605E-06	1.019E-06	5.568E-07	3.629E-07	2.600E-07	1.997E-07	1.597E-07	1.315E-07	1.107E-07
NE	1.506E-05	4.313E-06	2.169E-06	1.372E-06	7.478E-07	4.871E-07	3.491E-07	2.686E-07	2.152E-07	1.774E-07	1.496E-07
ENE	1.427E-05	4.059E-06	2.013E-06	1.264E-06	6.822E-07	4.424E-07	3.163E-07	2.441E-07	1.961E-07	1.621E-07	1.370E-07
E	1.303E-05	3.739E-06	1.863E-06	1.172E-06	6.331E-07	4.106E-07	2.936E-07	2.265E-07	1.819E-07	1.504E-07	1.270E-07
ESE	6.342E-06	1.832E-06	9.173E-07	5.771E-07	3.131E-07	2.035E-07	1.456E-07	1.120E-07	8.967E-08	7.393E-08	6.232E-08
SE	3.542E-06	1.038E-06	5.284E-07	3.340E-07	1.801E-07	1.162E-07	8.263E-08	6.298E-08	5.005E-08	4.099E-08	3.435E-08
SSE	2.236E-06	6.691E-07	3.472E-07	2.205E-07	1.180E-07	7.542E-08	5.320E-08	4.007E-08	3.152E-08	2.559E-08	2.128E-08

0ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	2.112E-08	1.108E-08	6.966E-09	3.614E-09	2.269E-09	1.575E-09	1.165E-09	8.998E-10	7.179E-10	5.870E-10	4.893E-10
SSW	2.395E-08	1.250E-08	7.833E-09	4.044E-09	2.531E-09	1.753E-09	1.294E-09	9.987E-10	7.959E-10	6.503E-10	5.417E-10
SW	3.188E-08	1.641E-08	1.018E-08	5.179E-09	3.213E-09	2.209E-09	1.622E-09	1.245E-09	9.886E-10	8.048E-10	6.684E-10
WSW	2.605E-08	1.348E-08	8.390E-09	4.284E-09	2.655E-09	1.824E-09	1.338E-09	1.027E-09	8.147E-10	6.628E-10	5.501E-10
W	2.400E-08	1.261E-08	7.932E-09	4.106E-09	2.564E-09	1.772E-09	1.306E-09	1.006E-09	8.002E-10	6.527E-10	5.429E-10
WNW	1.565E-08	8.330E-09	5.289E-09	2.774E-09	1.747E-09	1.215E-09	9.002E-10	6.963E-10	5.560E-10	4.549E-10	3.794E-10
NW	2.501E-08	1.351E-08	8.672E-09	4.611E-09	2.931E-09	2.052E-09	1.528E-09	1.187E-09	9.517E-10	7.811E-10	6.533E-10
NNW	6.001E-08	3.302E-08	2.146E-08	1.161E-08	7.461E-09	5.270E-09	3.952E-09	3.089E-09	2.489E-09	2.052E-09	1.723E-09
N	8.615E-08	4.794E-08	3.141E-08	1.718E-08	1.113E-08	7.903E-09	5.953E-09	4.670E-09	3.774E-09	3.120E-09	2.626E-09
NNE	9.492E-08	5.252E-08	3.427E-08	1.864E-08	1.204E-08	8.529E-09	6.412E-09	5.023E-09	4.054E-09	3.348E-09	2.815E-09
NE	1.284E-07	7.135E-08	4.670E-08	2.552E-08	1.652E-08	1.174E-08	8.839E-09	6.933E-09	5.602E-09	4.631E-09	3.897E-09
ENE	1.178E-07	6.601E-08	4.347E-08	2.396E-08	1.561E-08	1.114E-08	8.424E-09	6.629E-09	5.372E-09	4.452E-09	3.755E-09
E	1.092E-07	6.112E-08	4.020E-08	2.212E-08	1.439E-08	1.026E-08	7.748E-09	6.092E-09	4.933E-09	4.085E-09	3.443E-09
ESE	5.347E-08	2.971E-08	1.944E-08	1.062E-08	6.878E-09	4.884E-09	3.677E-09	2.883E-09	2.329E-09	1.924E-09	1.619E-09
SE	2.934E-08	1.603E-08	1.037E-08	5.584E-09	3.584E-09	2.530E-09	1.896E-09	1.481E-09	1.192E-09	9.826E-10	8.248E-10
SSE	1.805E-08	9.623E-09	6.122E-09	3.224E-09	2.042E-09	1.426E-09	1.060E-09	8.227E-10	6.587E-10	5.402E-10	4.515E-10

Table 2.7-23
Long-Term Average X/Q Values (sec/m^3) for Routine Releases at the Standard Distance Segments Between 0.5 and 50 Miles, 8.00-Day Decay, Depleted

RELEASE POINT - GROUND LEVEL - NO INTERMITTENT RELEASES
8.000 DAY DECAY, DEPLETED
0CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.400E-07	1.481E-07	6.470E-08	3.762E-08	2.510E-08	1.148E-08	3.761E-09	1.596E-09	9.062E-10	5.896E-10
SSW	5.075E-07	1.705E-07	7.397E-08	4.284E-08	2.850E-08	1.297E-08	4.214E-09	1.777E-09	1.006E-09	6.532E-10
SW	6.990E-07	2.346E-07	1.007E-07	5.773E-08	3.809E-08	1.708E-08	5.415E-09	2.242E-09	1.255E-09	8.088E-10
WSW	5.539E-07	1.879E-07	8.131E-08	4.689E-08	3.106E-08	1.401E-08	4.473E-09	1.851E-09	1.035E-09	6.661E-10
W	4.768E-07	1.647E-07	7.277E-08	4.255E-08	2.849E-08	1.306E-08	4.271E-09	1.797E-09	1.013E-09	6.557E-10
WNW	3.012E-07	1.041E-07	4.644E-08	2.743E-08	1.851E-08	8.606E-09	2.877E-09	1.231E-09	7.011E-10	4.569E-10
NW	4.595E-07	1.583E-07	7.212E-08	4.320E-08	2.946E-08	1.392E-08	4.767E-09	2.077E-09	1.195E-09	7.843E-10
NNW	1.056E-06	3.607E-07	1.673E-07	1.018E-07	7.029E-08	3.388E-08	1.195E-08	5.327E-09	3.107E-09	2.060E-09
N	1.518E-06	5.106E-07	2.361E-07	1.447E-07	1.006E-07	4.908E-08	1.765E-08	7.983E-09	4.695E-09	3.131E-09
NNE	1.690E-06	5.734E-07	2.633E-07	1.604E-07	1.110E-07	5.383E-08	1.918E-08	8.617E-09	5.051E-09	3.360E-09
NE	2.291E-06	7.707E-07	3.537E-07	2.161E-07	1.500E-07	7.307E-08	2.623E-08	1.185E-08	6.970E-09	4.647E-09
ENE	2.135E-06	7.049E-07	3.210E-07	1.969E-07	1.373E-07	6.750E-08	2.458E-08	1.125E-08	6.663E-09	4.466E-09
E	1.973E-06	6.540E-07	2.980E-07	1.827E-07	1.273E-07	6.251E-08	2.270E-08	1.036E-08	6.123E-09	4.098E-09
ESE	9.693E-07	3.230E-07	1.476E-07	9.005E-08	6.248E-08	3.043E-08	1.092E-08	4.933E-09	2.899E-09	1.931E-09
SE	5.552E-07	1.859E-07	8.373E-08	5.029E-08	3.446E-08	1.647E-08	5.759E-09	2.557E-09	1.489E-09	9.863E-10
SSE	3.624E-07	1.218E-07	5.387E-08	3.170E-08	2.136E-08	9.940E-09	3.343E-09	1.444E-09	8.281E-10	5.425E-10

Table 2.7-24
Long-Term Average D/Q Values ($1/m^2$) for Routine Releases at Distances Between 0.25 and 50 Miles

RELEASE POINT - GROUND LEVEL - NO INTERMITTENT RELEASES

********************* RELATIVE DEPOSITION PER UNIT AREA (M**-2) AT FIXED POINTS BY DOWNWIND SECTORS *****************

DIRECTION FROM SITE	.25	.50	.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
	DISTANCES IN MILES										
S	2.283E-08	7.719E-09	3.963E-09	2.434E-09	1.213E-09	7.359E-10	4.975E-10	3.605E-10	2.741E-10	2.160E-10	1.748E-10
SSW	3.141E-08	1.062E-08	5.453E-09	3.348E-09	1.669E-09	1.012E-09	6.845E-10	4.960E-10	3.772E-10	2.972E-10	2.406E-10
SW	5.235E-08	1.770E-08	9.090E-09	5.582E-09	2.783E-09	1.688E-09	1.141E-09	8.269E-10	6.287E-10	4.953E-10	4.010E-10
WSW	3.863E-08	1.306E-08	6.708E-09	4.119E-09	2.053E-09	1.245E-09	8.420E-10	6.102E-10	4.640E-10	3.655E-10	2.959E-10
W	2.498E-08	8.448E-09	4.338E-09	2.664E-09	1.328E-09	8.054E-10	5.445E-10	3.946E-10	3.000E-10	2.364E-10	1.914E-10
WNW	1.310E-08	4.430E-09	2.274E-09	1.397E-09	6.963E-10	4.223E-10	2.855E-10	2.069E-10	1.573E-10	1.239E-10	1.003E-10
NW	1.755E-08	5.935E-09	3.047E-09	1.871E-09	9.328E-10	5.658E-10	3.825E-10	2.772E-10	2.108E-10	1.661E-10	1.344E-10
NNW	3.395E-08	1.148E-08	5.895E-09	3.620E-09	1.805E-09	1.095E-09	7.400E-10	5.363E-10	4.078E-10	3.212E-10	2.601E-10
N	4.295E-08	1.452E-08	7.457E-09	4.579E-09	2.283E-09	1.384E-09	9.360E-10	6.783E-10	5.158E-10	4.063E-10	3.290E-10
NNE	5.254E-08	1.777E-08	9.122E-09	5.601E-09	2.792E-09	1.694E-09	1.145E-09	8.298E-10	6.309E-10	4.971E-10	4.024E-10
NE	6.756E-08	2.285E-08	1.173E-08	7.203E-09	3.591E-09	2.178E-09	1.473E-09	1.067E-09	8.114E-10	6.392E-10	5.175E-10
ENE	6.307E-08	2.133E-08	1.095E-08	6.724E-09	3.352E-09	2.033E-09	1.375E-09	9.961E-10	7.574E-10	5.967E-10	4.831E-10
E	5.559E-08	1.880E-08	9.652E-09	5.926E-09	2.955E-09	1.792E-09	1.212E-09	8.779E-10	6.676E-10	5.259E-10	4.258E-10
ESE	2.452E-08	8.293E-09	4.258E-09	2.615E-09	1.304E-09	7.906E-10	5.345E-10	3.873E-10	2.945E-10	2.320E-10	1.878E-10
SE	2.074E-08	7.013E-09	3.601E-09	2.211E-09	1.102E-09	6.686E-10	4.520E-10	3.276E-10	2.491E-10	1.962E-10	1.589E-10
SSE	1.723E-08	5.826E-09	2.991E-09	1.837E-09	9.158E-10	5.554E-10	3.755E-10	2.721E-10	2.069E-10	1.630E-10	1.320E-10

0DIRECTION FROM SITE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
	DISTANCES IN MILES										
S	1.446E-10	7.088E-11	4.447E-11	2.248E-11	1.360E-11	9.122E-12	6.536E-12	4.908E-12	3.816E-12	3.048E-12	2.488E-12
SSW	1.990E-10	9.752E-11	6.119E-11	3.093E-11	1.872E-11	1.255E-11	8.993E-12	6.753E-12	5.250E-12	4.194E-12	3.423E-12
SW	3.317E-10	1.626E-10	1.020E-10	5.155E-11	3.120E-11	2.092E-11	1.499E-11	1.126E-11	8.752E-12	6.991E-12	5.706E-12
WSW	2.448E-10	1.200E-10	7.527E-11	3.804E-11	2.303E-11	1.544E-11	1.106E-11	8.306E-12	6.458E-12	5.159E-12	4.211E-12
W	1.583E-10	7.757E-11	4.867E-11	2.460E-11	1.489E-11	9.983E-12	7.154E-12	5.372E-12	4.177E-12	3.336E-12	2.723E-12
WNW	8.300E-11	4.067E-11	2.552E-11	1.290E-11	7.807E-12	5.235E-12	3.751E-12	2.817E-12	2.190E-12	1.749E-12	1.428E-12
NW	1.112E-10	5.449E-11	3.419E-11	1.728E-11	1.046E-11	7.013E-12	5.025E-12	3.773E-12	2.934E-12	2.344E-12	1.913E-12
NNW	2.151E-10	1.054E-10	6.615E-11	3.343E-11	2.024E-11	1.357E-11	9.722E-12	7.300E-12	5.676E-12	4.534E-12	3.701E-12
N	2.721E-10	1.333E-10	8.367E-11	4.229E-11	2.560E-11	1.716E-11	1.230E-11	9.234E-12	7.180E-12	5.735E-12	4.681E-12
NNE	3.329E-10	1.631E-10	1.024E-10	5.173E-11	3.131E-11	2.099E-11	1.504E-11	1.130E-11	8.783E-12	7.016E-12	5.726E-12
NE	4.281E-10	2.098E-10	1.316E-10	6.653E-11	4.027E-11	2.700E-11	1.935E-11	1.453E-11	1.129E-11	9.022E-12	7.364E-12
ENE	3.996E-10	1.958E-10	1.229E-10	6.210E-11	3.759E-11	2.520E-11	1.806E-11	1.356E-11	1.054E-11	8.422E-12	6.874E-12
E	3.522E-10	1.726E-10	1.083E-10	5.474E-11	3.313E-11	2.221E-11	1.592E-11	1.195E-11	9.293E-12	7.423E-12	6.059E-12
ESE	1.554E-10	7.615E-11	4.778E-11	2.415E-11	1.462E-11	9.800E-12	7.022E-12	5.273E-12	4.100E-12	3.275E-12	2.673E-12
SE	1.314E-10	6.439E-11	4.040E-11	2.042E-11	1.236E-11	8.287E-12	5.938E-12	4.459E-12	3.467E-12	2.769E-12	2.261E-12
SSE	1.092E-10	5.350E-11	3.357E-11	1.697E-11	1.027E-11	6.885E-12	4.933E-12	3.704E-12	2.880E-12	2.301E-12	1.878E-12

Table 2.7-25
Long-Term Average D/Q Values ($1/m^2$) for Routine Releases at the Standard Distance Segments Between 0.5 and 50 Miles

RELEASE POINT - GROUND LEVEL - NO INTERMITTENT RELEASES
0************************ RELATIVE DEPOSITION PER UNIT AREA (M**-2) BY DOWNWIND SECTORS ************************
SEGMENT BOUNDARIES IN MILES

DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.118E-09	1.272E-09	5.063E-10	2.767E-10	1.758E-10	7.553E-11	2.342E-11	9.283E-12	4.957E-12	3.068E-12
SSW	5.666E-09	1.751E-09	6.966E-10	3.807E-10	2.419E-10	1.039E-10	3.223E-11	1.277E-11	6.820E-12	4.222E-12
SW	9.445E-09	2.918E-09	1.161E-09	6.345E-10	4.033E-10	1.732E-10	5.372E-11	2.129E-11	1.137E-11	7.037E-12
WSW	6.970E-09	2.153E-09	8.569E-10	4.682E-10	2.976E-10	1.278E-10	3.964E-11	1.571E-11	8.390E-12	5.193E-12
W	4.507E-09	1.392E-09	5.541E-10	3.028E-10	1.925E-10	8.267E-11	2.563E-11	1.016E-11	5.425E-12	3.358E-12
WNW	2.363E-09	7.301E-10	2.905E-10	1.588E-10	1.009E-10	4.334E-11	1.344E-11	5.327E-12	2.845E-12	1.761E-12
NW	3.166E-09	9.782E-10	3.893E-10	2.127E-10	1.352E-10	5.807E-11	1.801E-11	7.137E-12	3.811E-12	2.359E-12
NNW	6.125E-09	1.892E-09	7.531E-10	4.115E-10	2.616E-10	1.123E-10	3.484E-11	1.381E-11	7.373E-12	4.564E-12
N	7.748E-09	2.394E-09	9.525E-10	5.205E-10	3.308E-10	1.421E-10	4.407E-11	1.746E-11	9.326E-12	5.773E-12
NNE	9.478E-09	2.928E-09	1.165E-09	6.367E-10	4.047E-10	1.738E-10	5.390E-11	2.136E-11	1.141E-11	7.062E-12
NE	1.219E-08	3.766E-09	1.498E-09	8.189E-10	5.205E-10	2.236E-10	6.932E-11	2.748E-11	1.467E-11	9.081E-12
ENE	1.138E-08	3.515E-09	1.399E-09	7.644E-10	4.858E-10	2.087E-10	6.471E-11	2.565E-11	1.370E-11	8.477E-12
E	1.003E-08	3.098E-09	1.233E-09	6.737E-10	4.282E-10	1.839E-10	5.704E-11	2.261E-11	1.207E-11	7.472E-12
ESE	4.424E-09	1.367E-09	5.439E-10	2.972E-10	1.889E-10	8.115E-11	2.516E-11	9.973E-12	5.326E-12	3.296E-12
SE	3.742E-09	1.156E-09	4.600E-10	2.514E-10	1.598E-10	6.862E-11	2.128E-11	8.434E-12	4.504E-12	2.788E-12
SSE	3.108E-09	9.603E-10	3.821E-10	2.088E-10	1.327E-10	5.701E-11	1.768E-11	7.007E-12	3.742E-12	2.316E-12

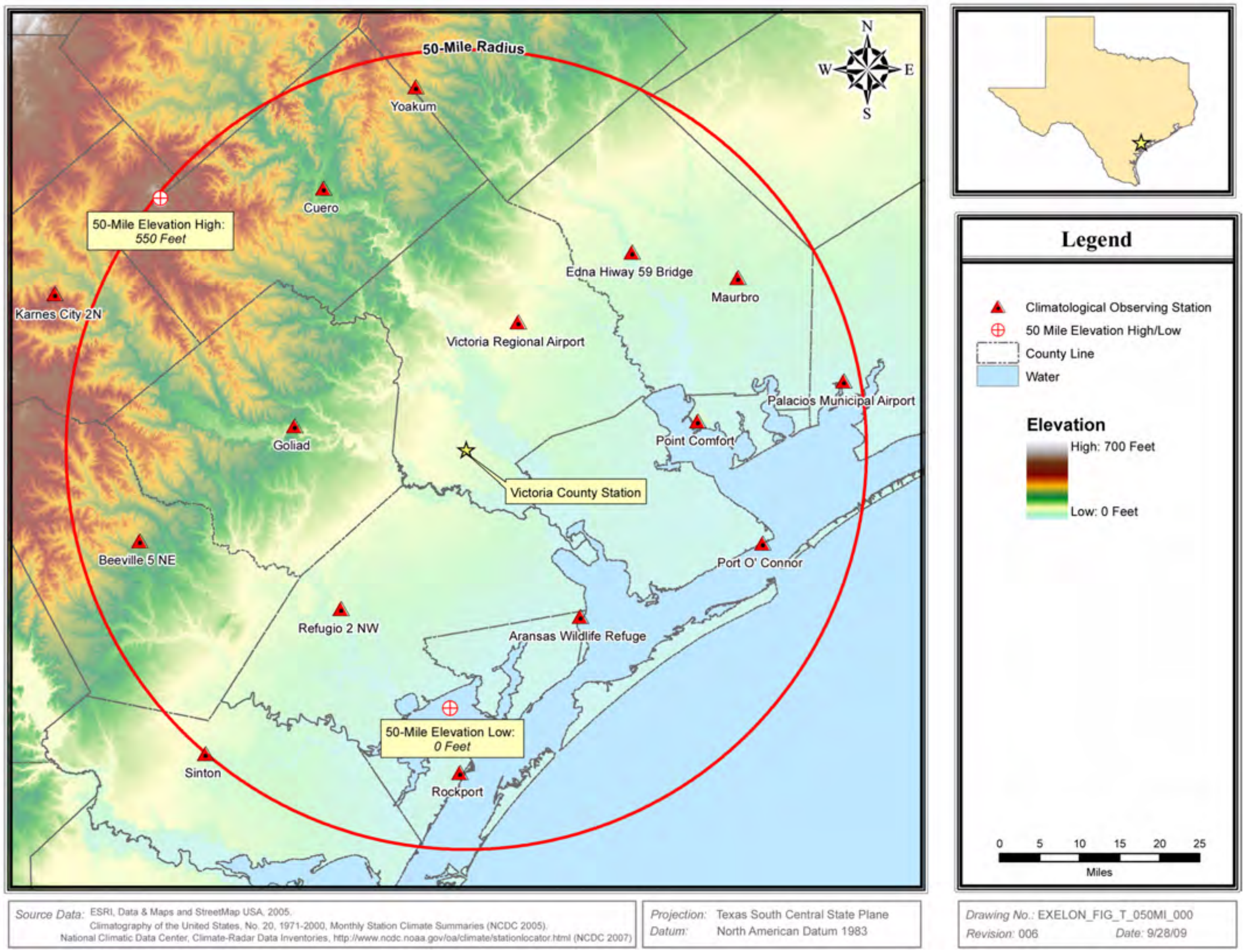


Figure 2.7-1 Climatological Observing Stations Near the Victoria County Station

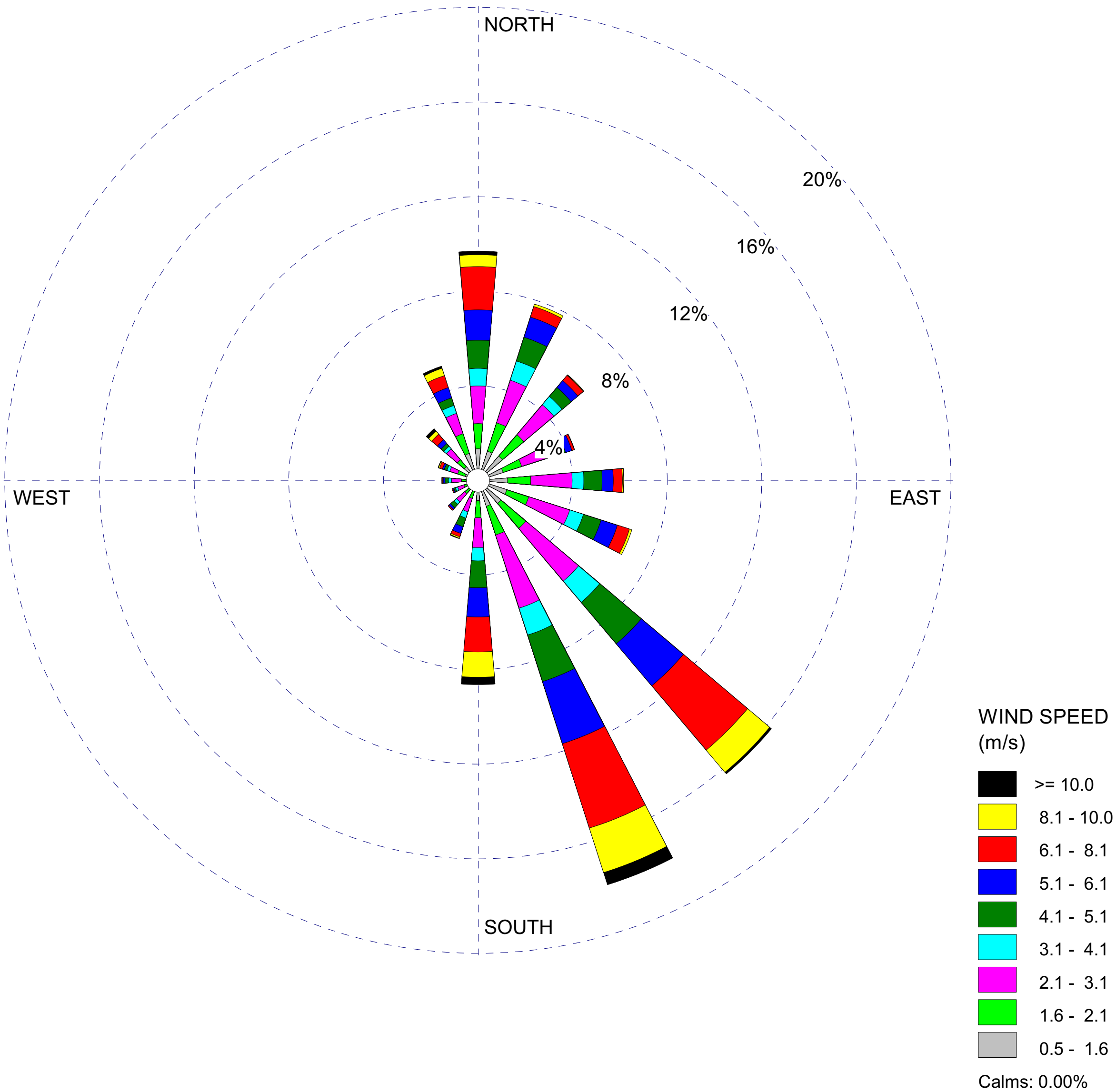


Figure 2.7-2 10-Meter Level Wind Rose—Annual VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

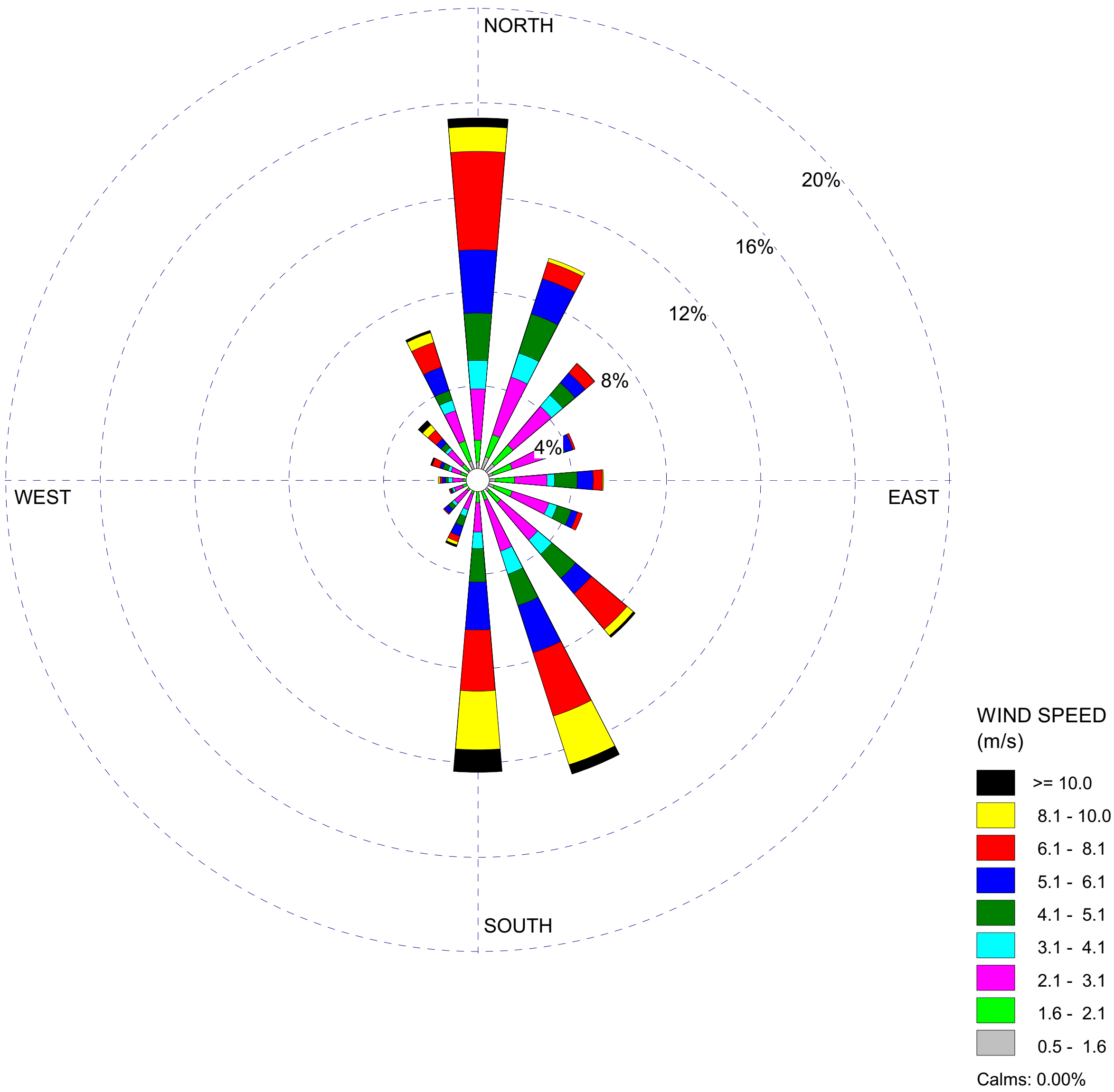


Figure 2.7-3 10-Meter Level Wind Rose—Winter VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

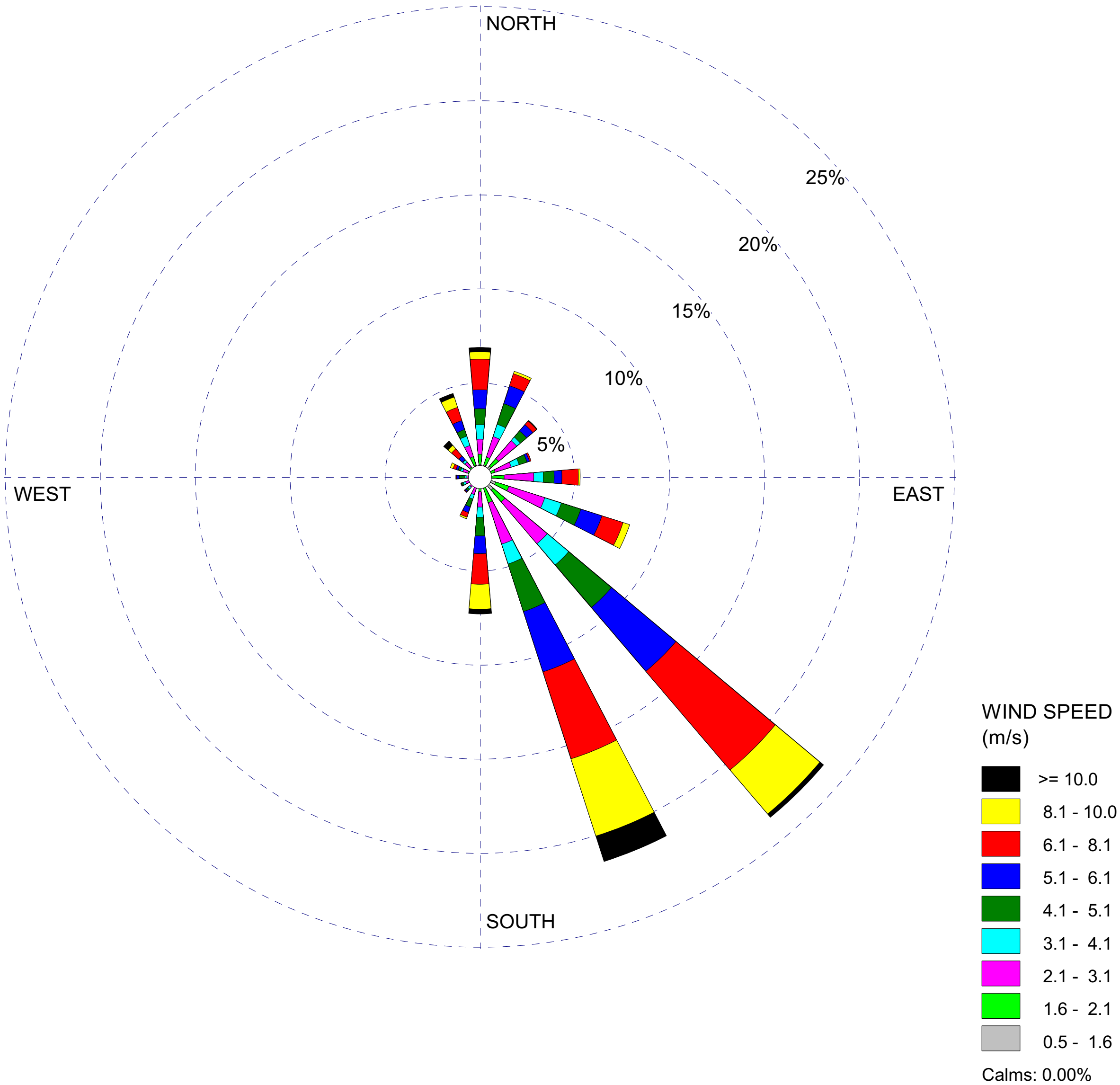


Figure 2.7-4 10-Meter Level Wind Rose—Spring VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

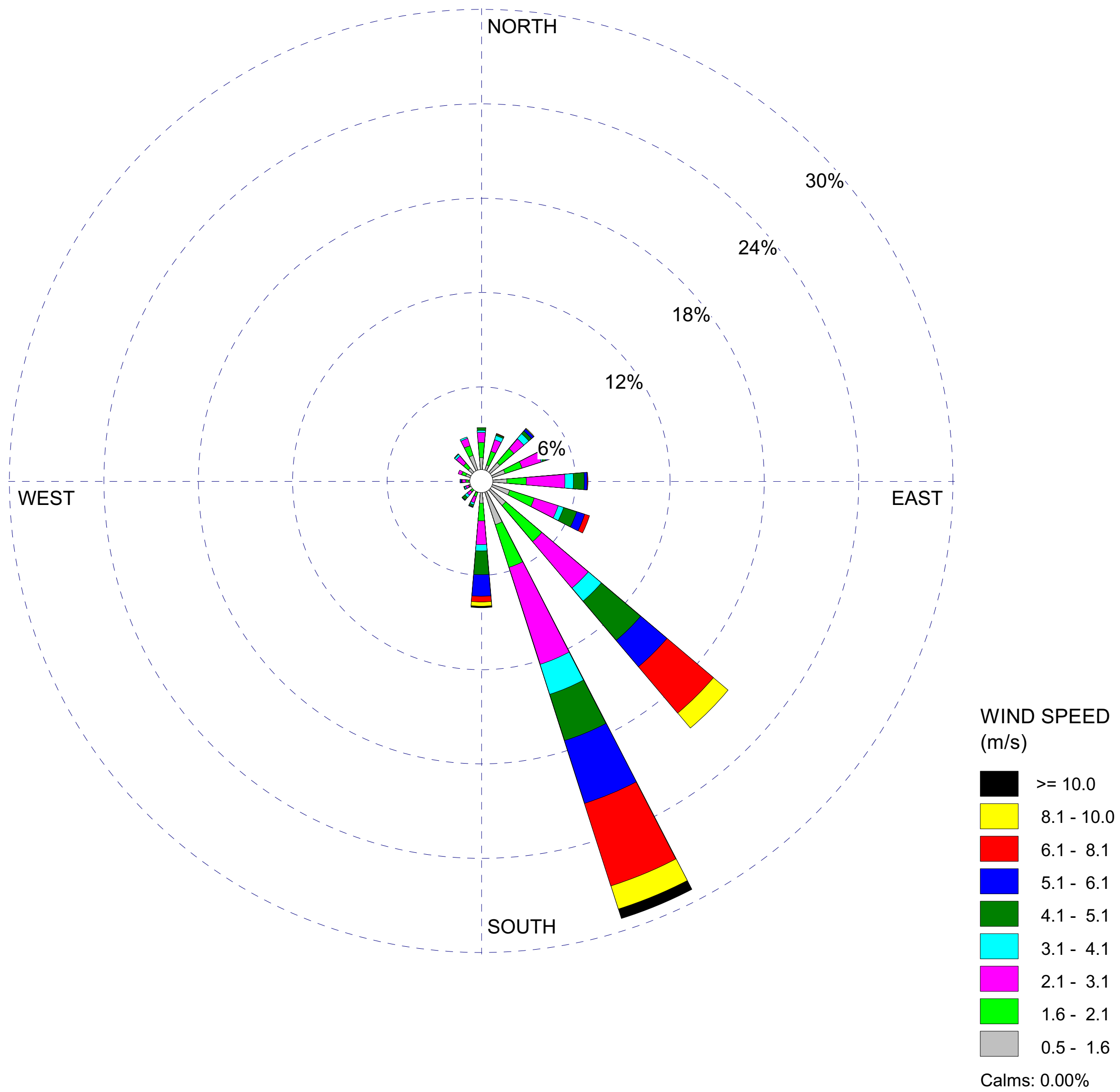


Figure 2.7-5 10-Meter Level Wind Rose—Summer VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

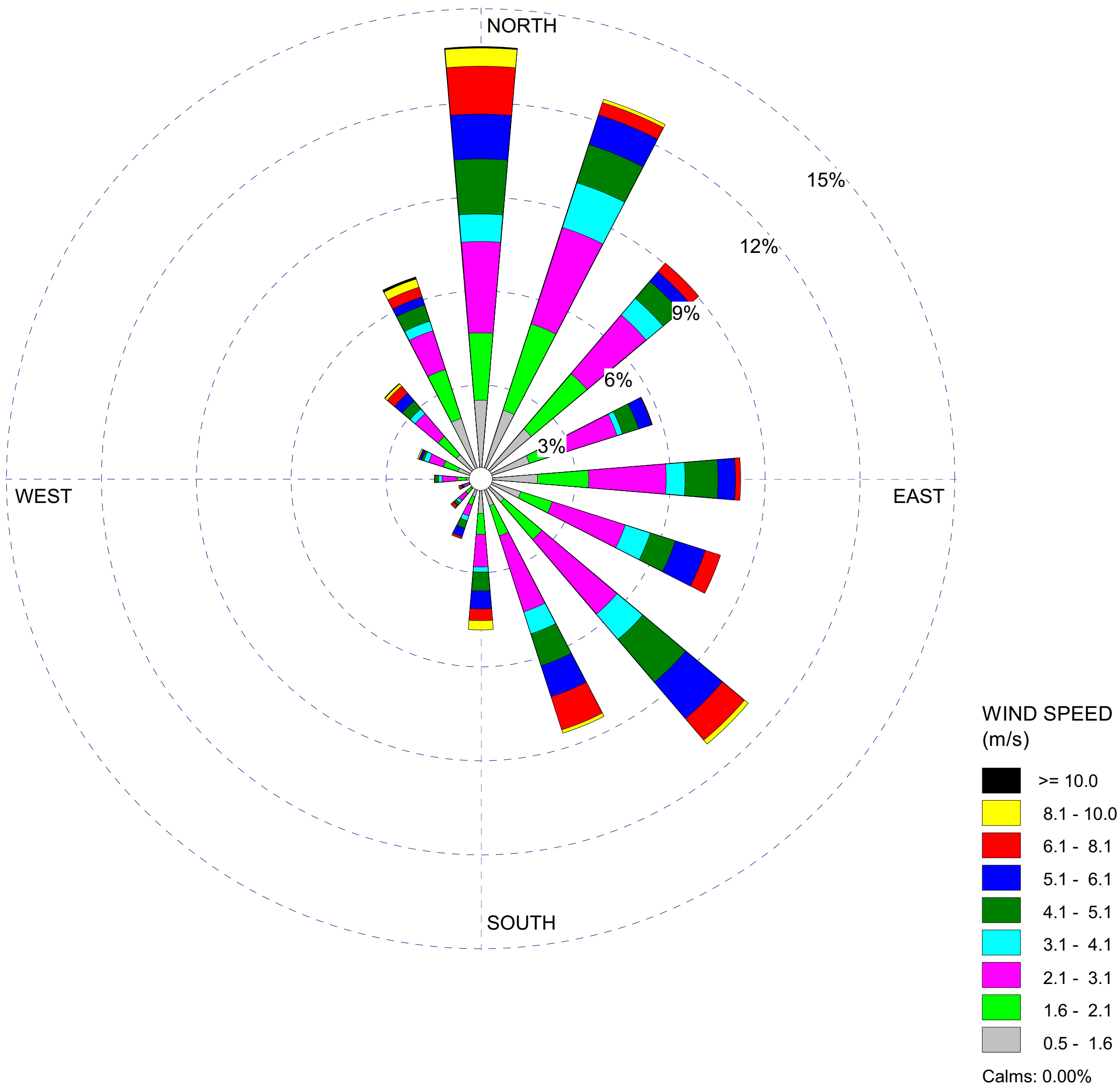


Figure 2.7-6 10-Meter Level Wind Rose—Autumn VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

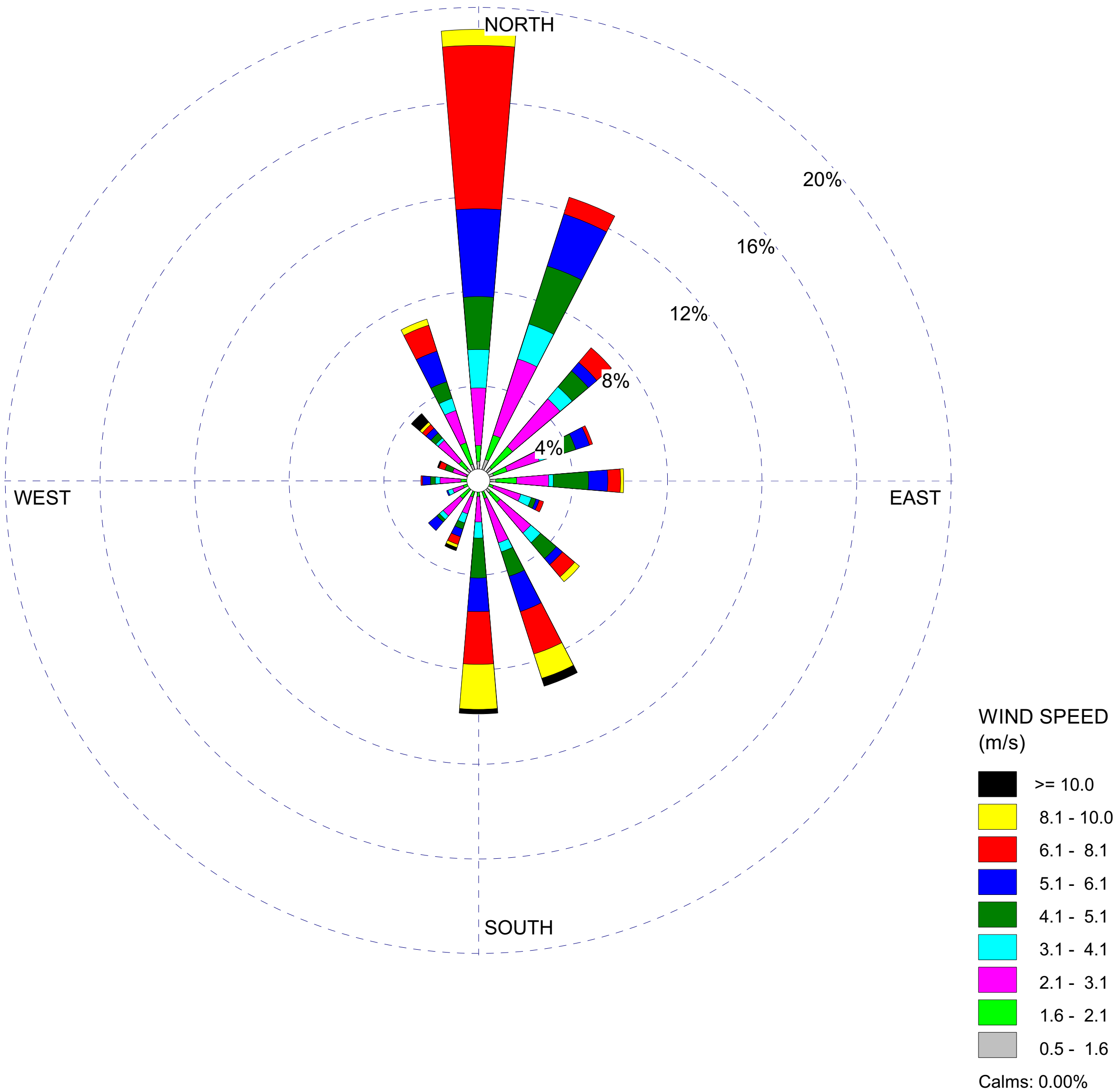


**Figure 2.7-7 (Sheet 1 of 12) 10-Meter Level Wind Rose—January
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)**

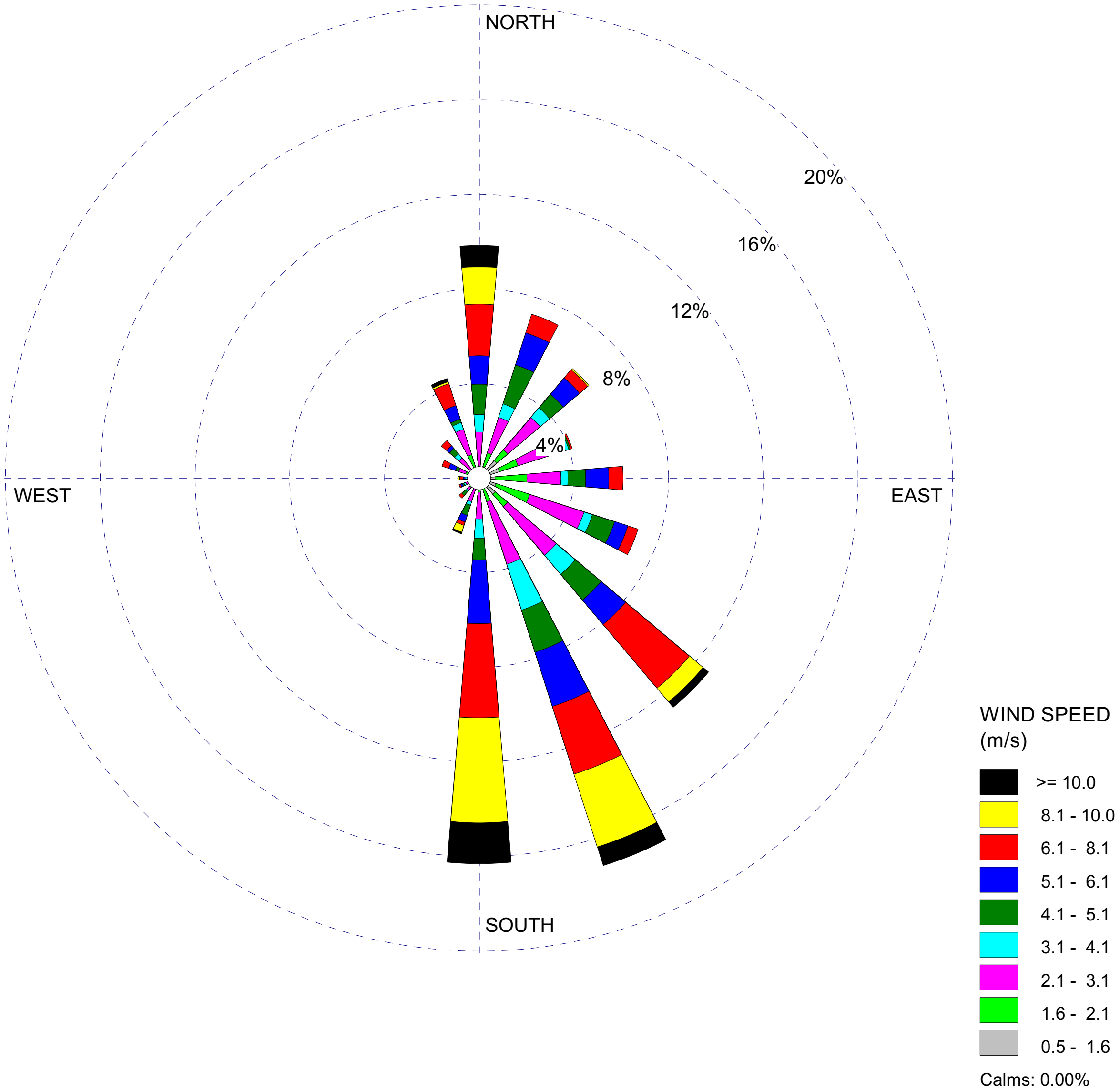


Figure 2.7-7 (Sheet 2 of 12) 10-Meter Level Wind Rose—February
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

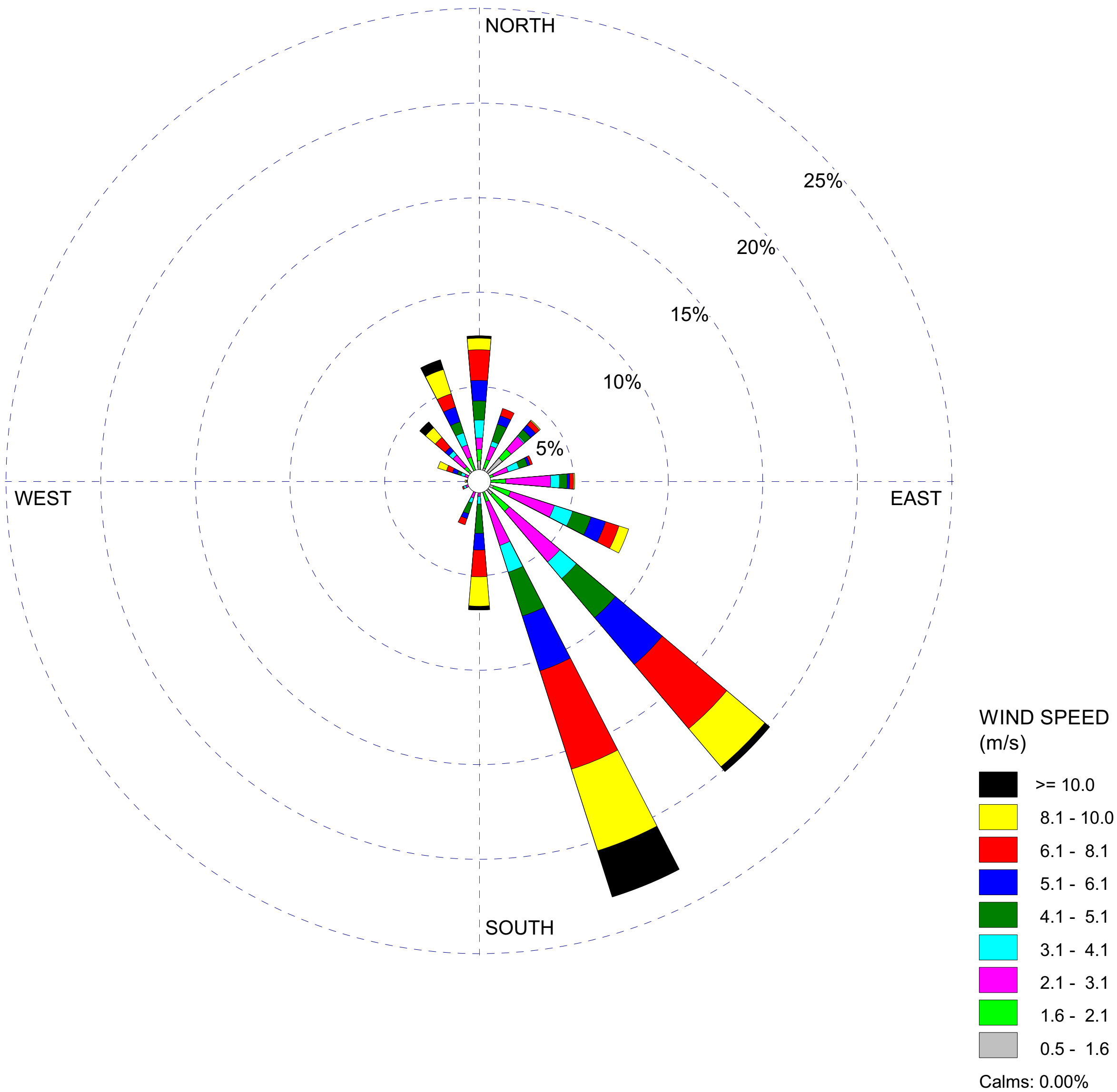


Figure 2.7-7 (Sheet 3 of 12) 10-Meter Level Wind Rose—March
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

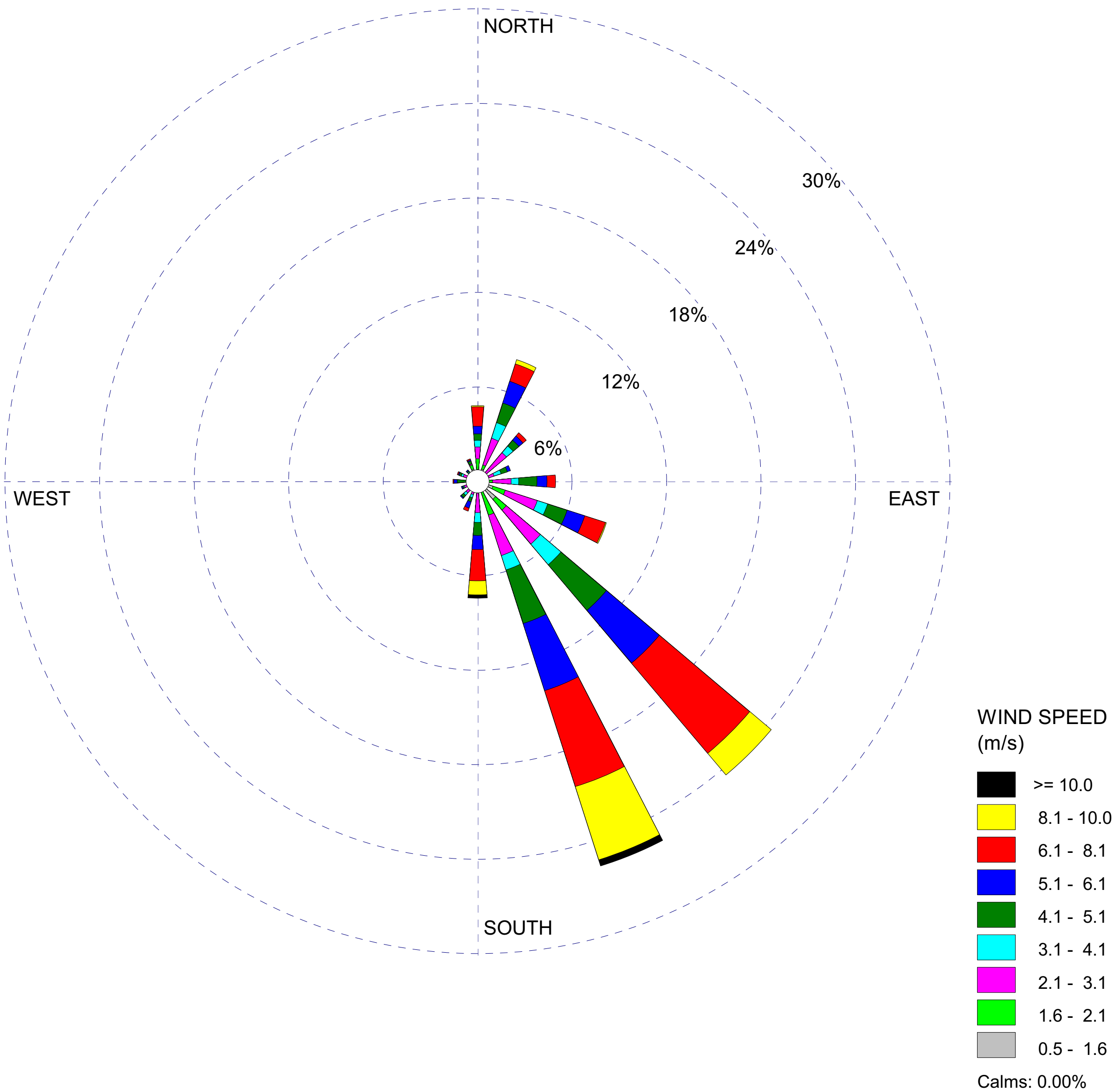


Figure 2.7-7 (Sheet 4 of 12) 10-Meter Level Wind Rose—April
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

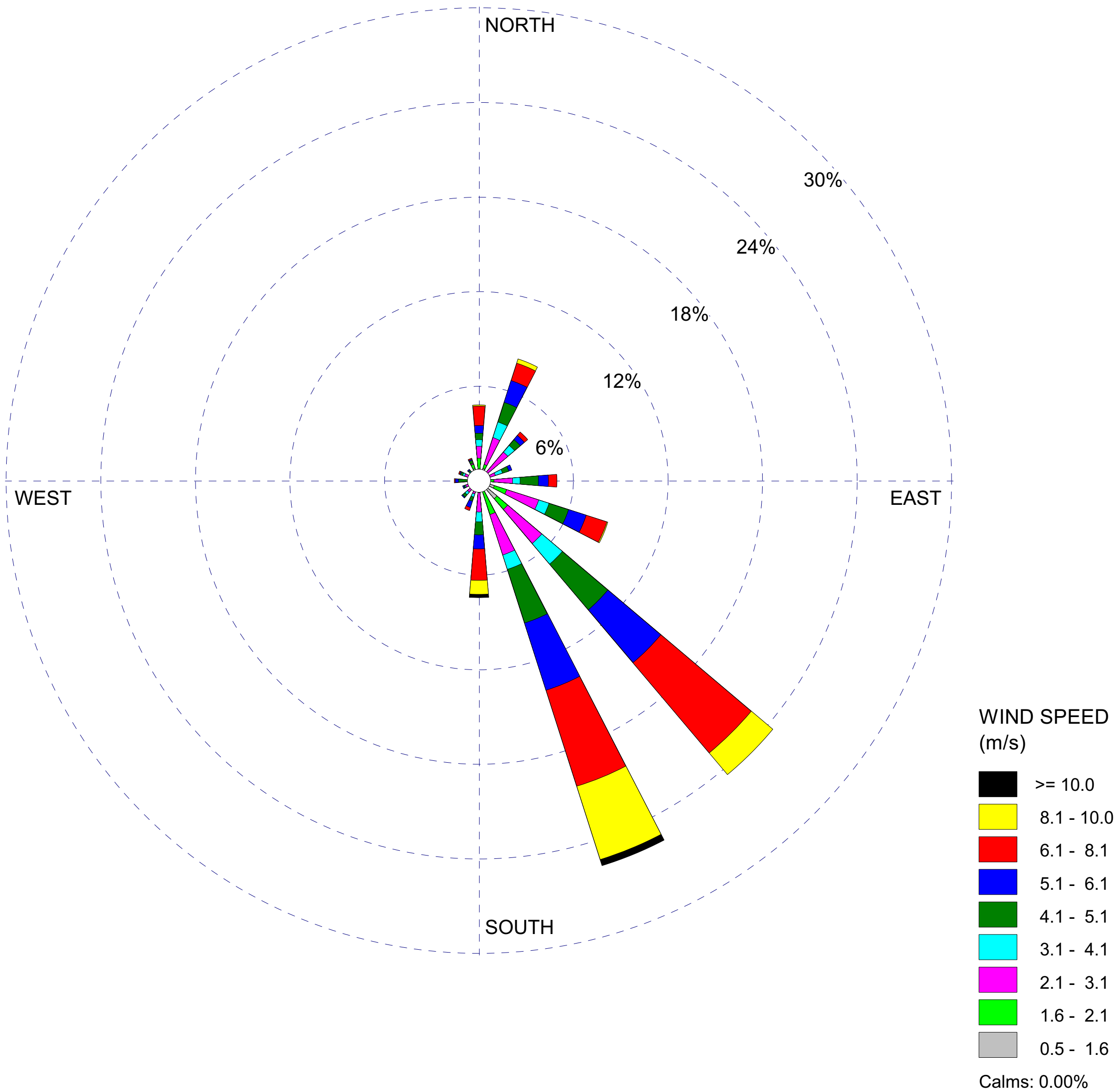


**Figure 2.7-7 (Sheet 5 of 12) 10-Meter Level Wind Rose—May
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)**

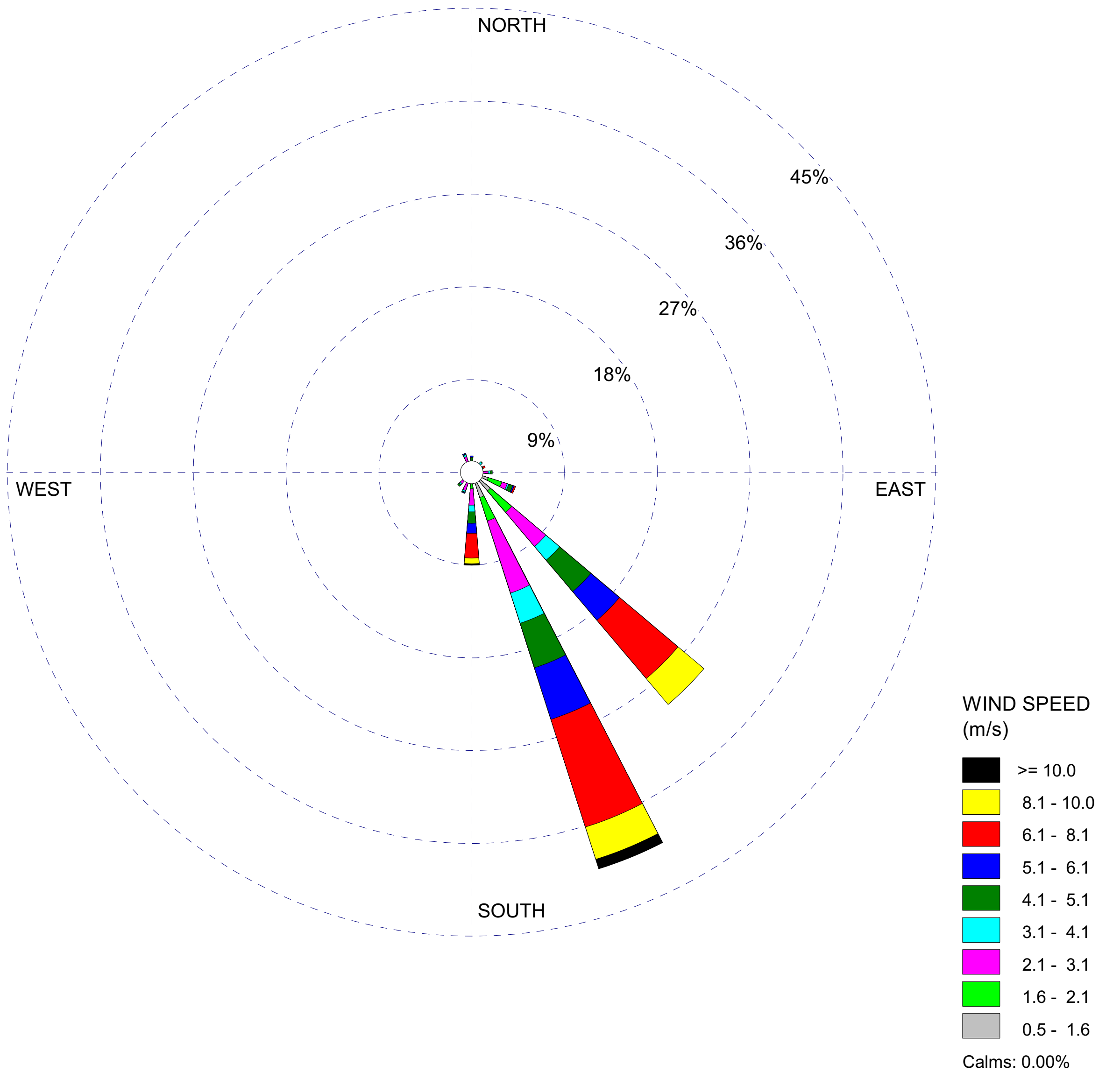


Figure 2.7-7 (Sheet 6 of 12) 10-Meter Level Wind Rose—June
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

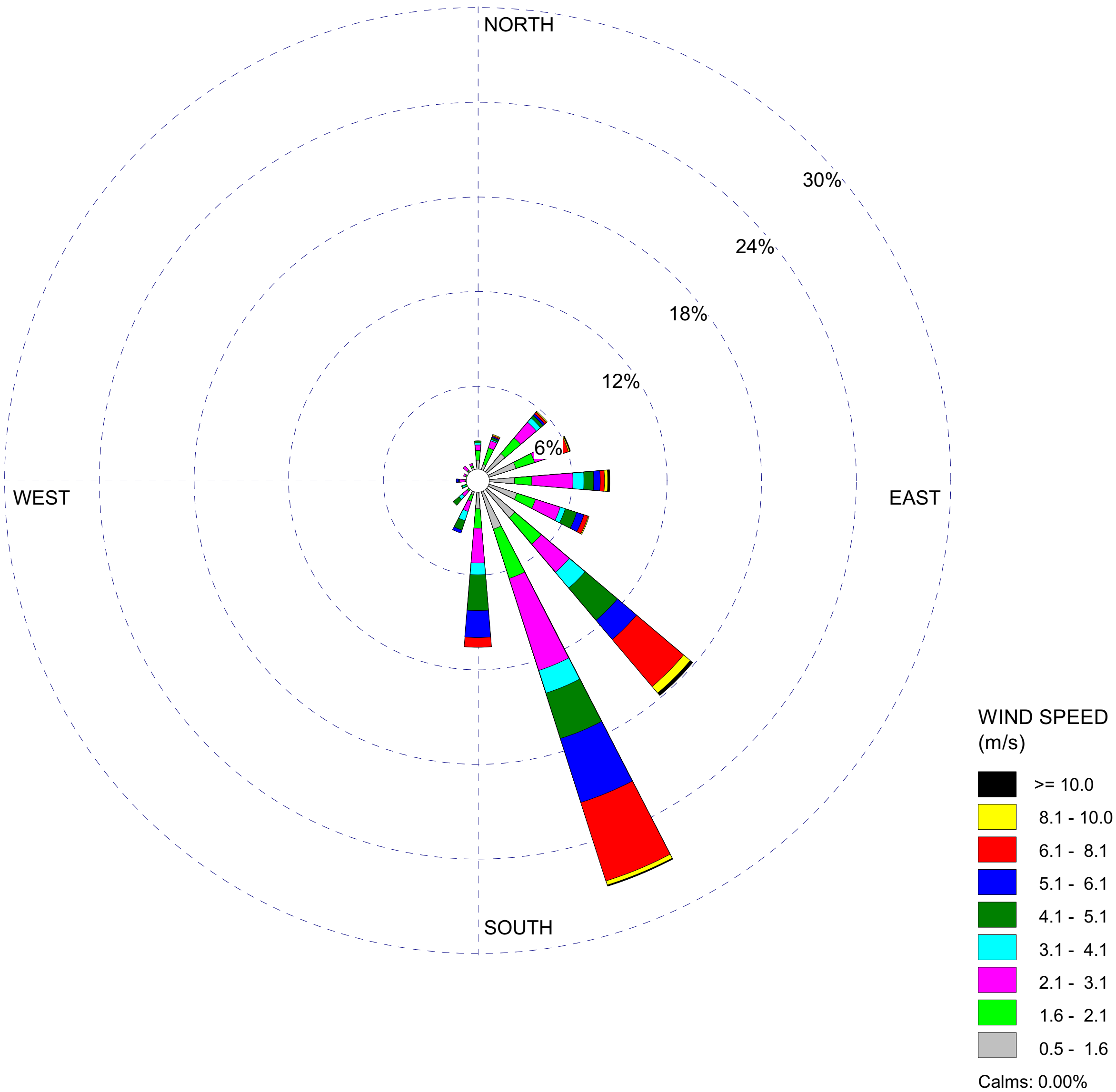


Figure 2.7-7 (Sheet 7 of 12) 10-Meter Level Wind Rose—July
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

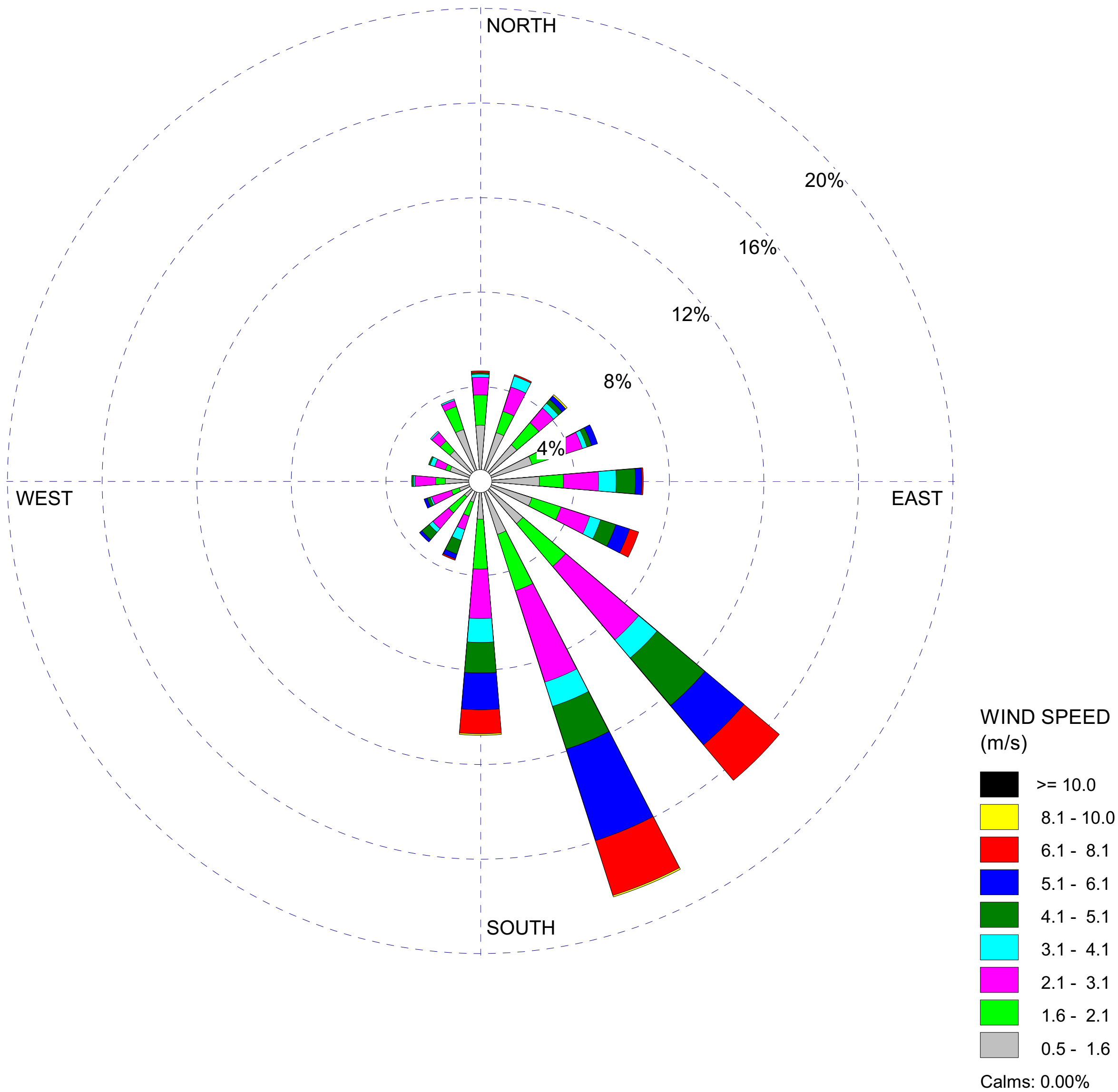


Figure 2.7-7 (Sheet 8 of 12) 10-Meter Level Wind Rose—August
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

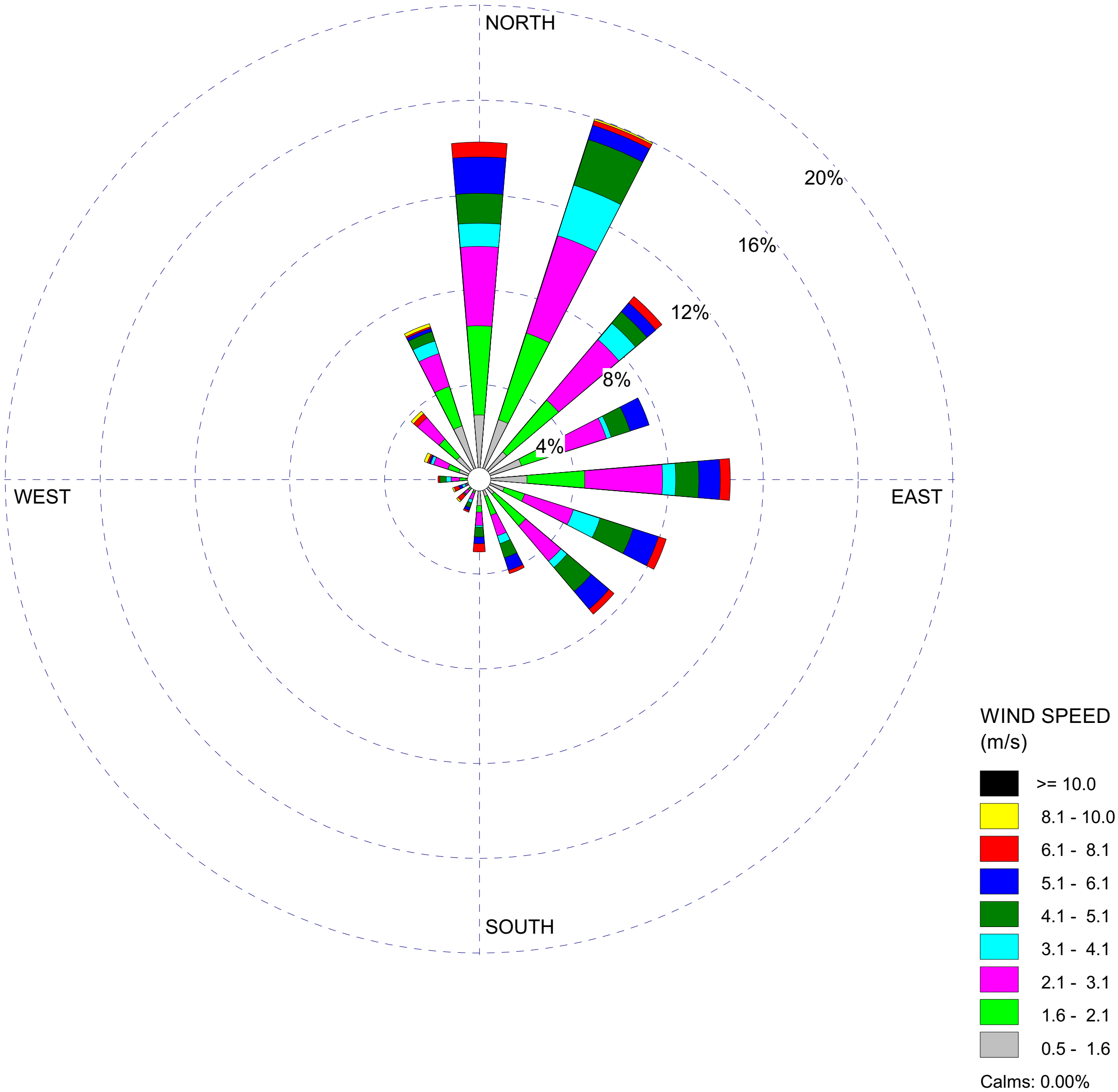


Figure 2.7-7 (Sheet 9 of 12) 10-Meter Level Wind Rose—September
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

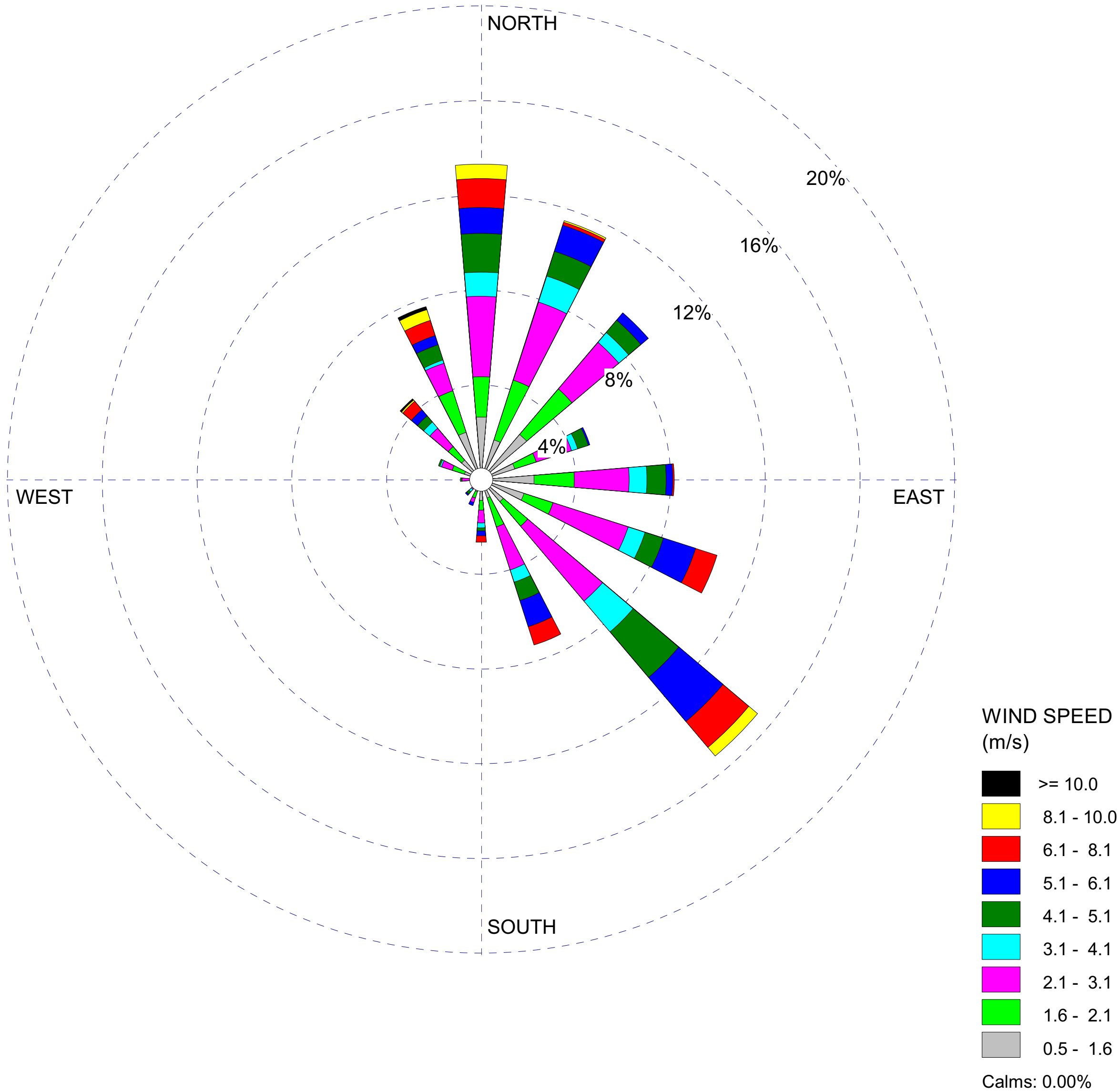


Figure 2.7-7 (Sheet 10 of 12) 10-Meter Level Wind Rose—October
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

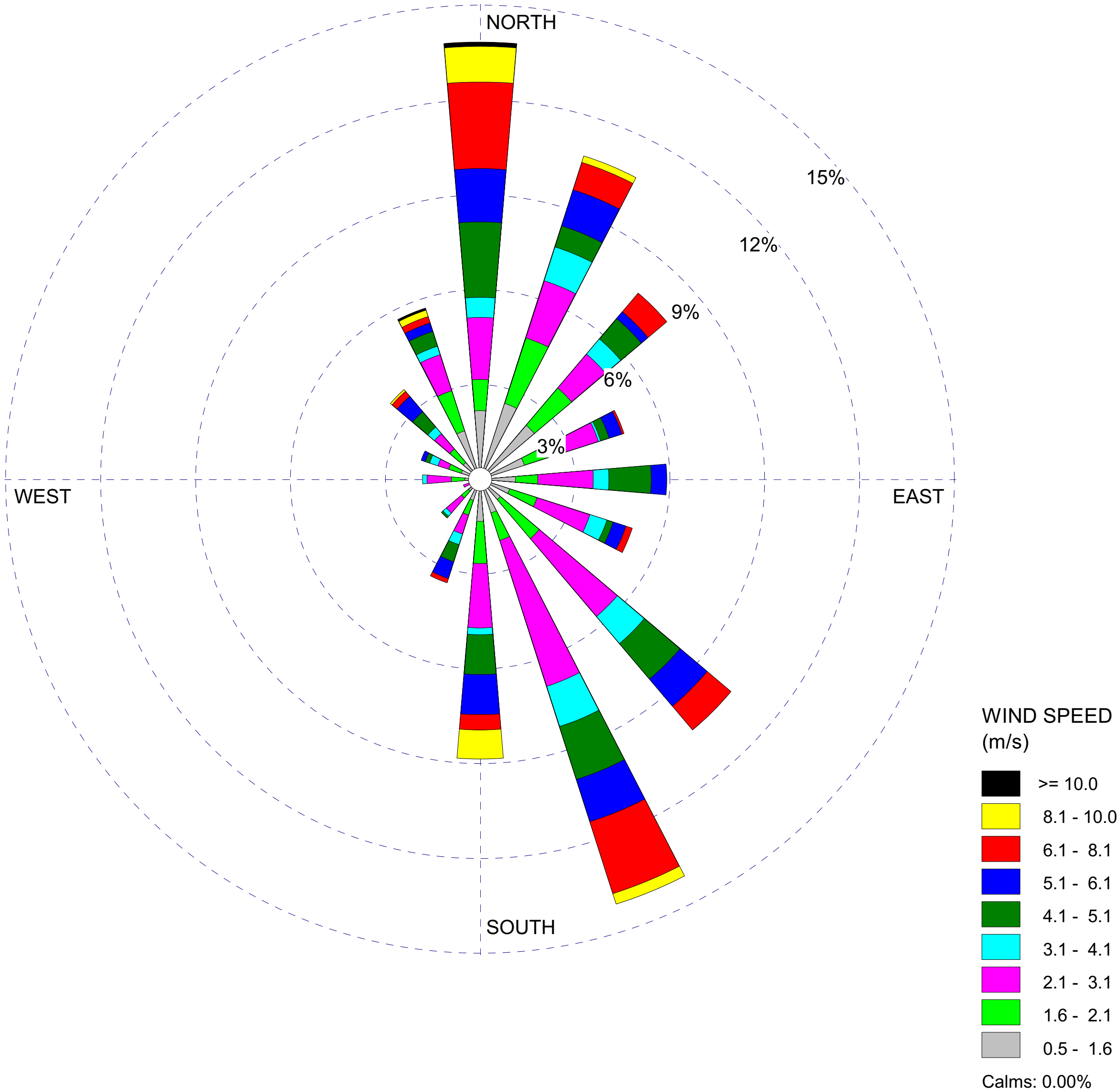


Figure 2.7-7 (Sheet 11 of 12) 10-Meter Level Wind Rose—November
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

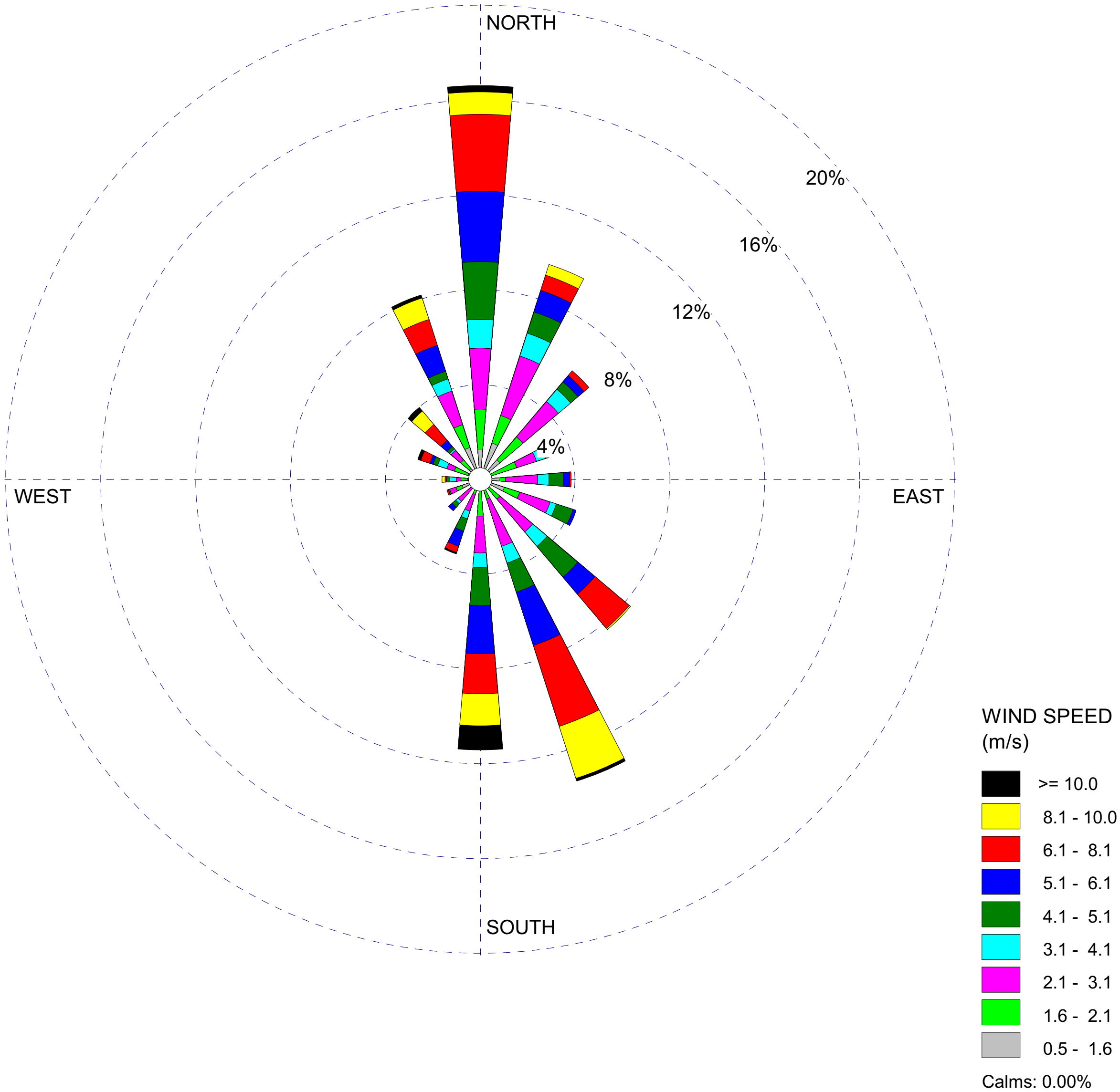


Figure 2.7-7 (Sheet 12 of 12) 10-Meter Level Wind Rose—December VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

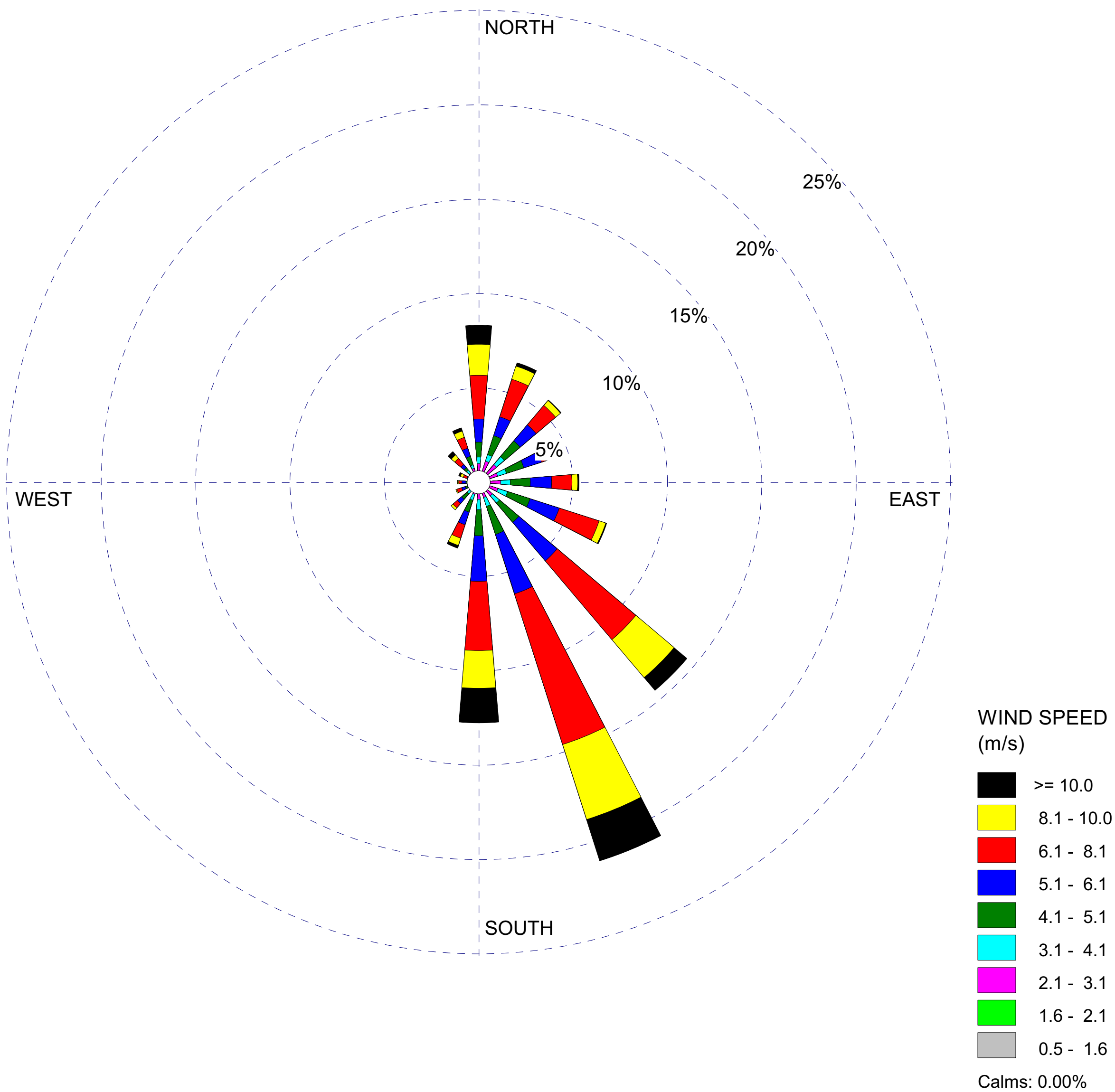


Figure 2.7-8 60-Meter Level Wind Rose—Annual
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

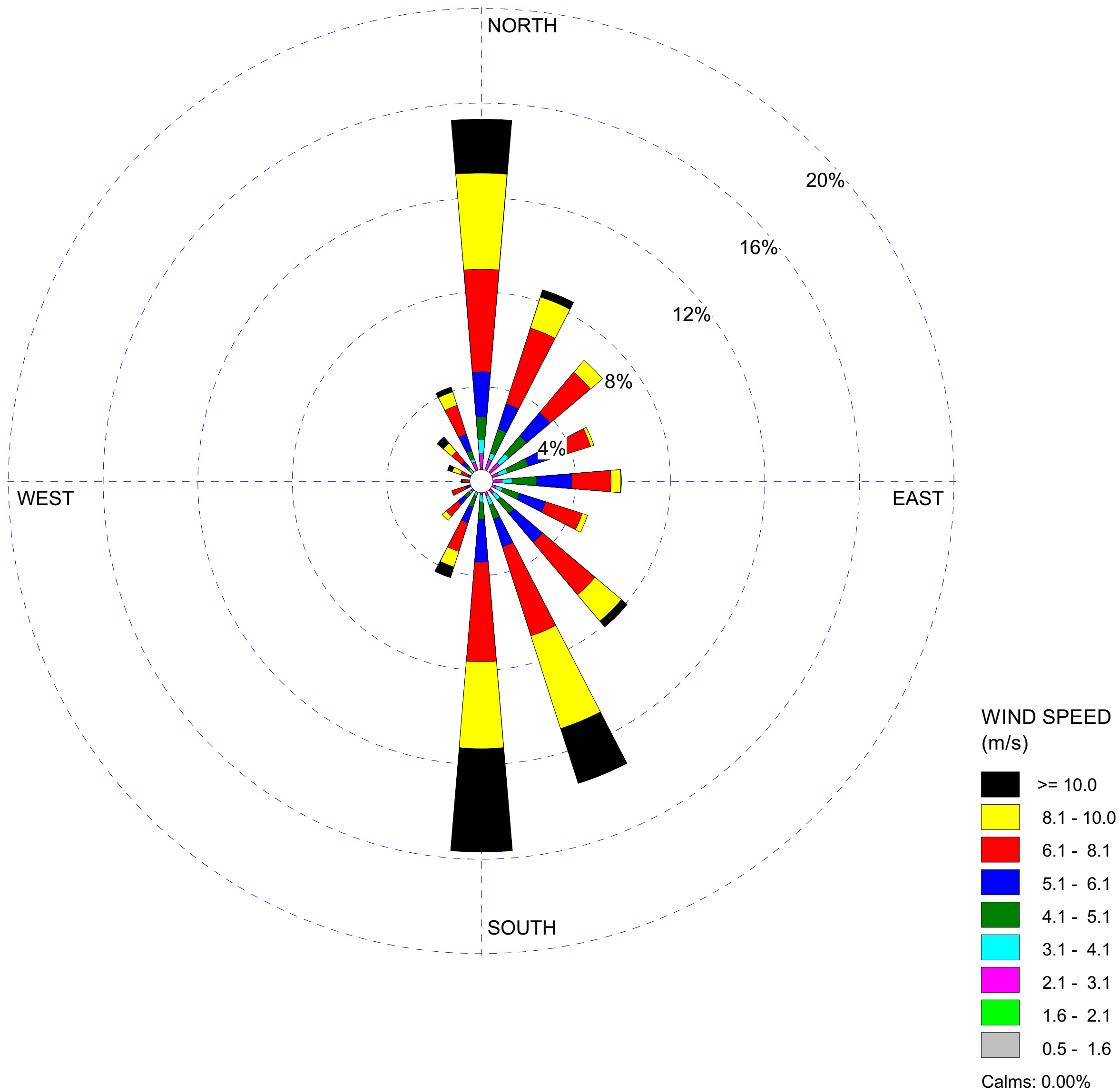


Figure 2.7-9 60-Meter Level Wind Rose—Winter
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

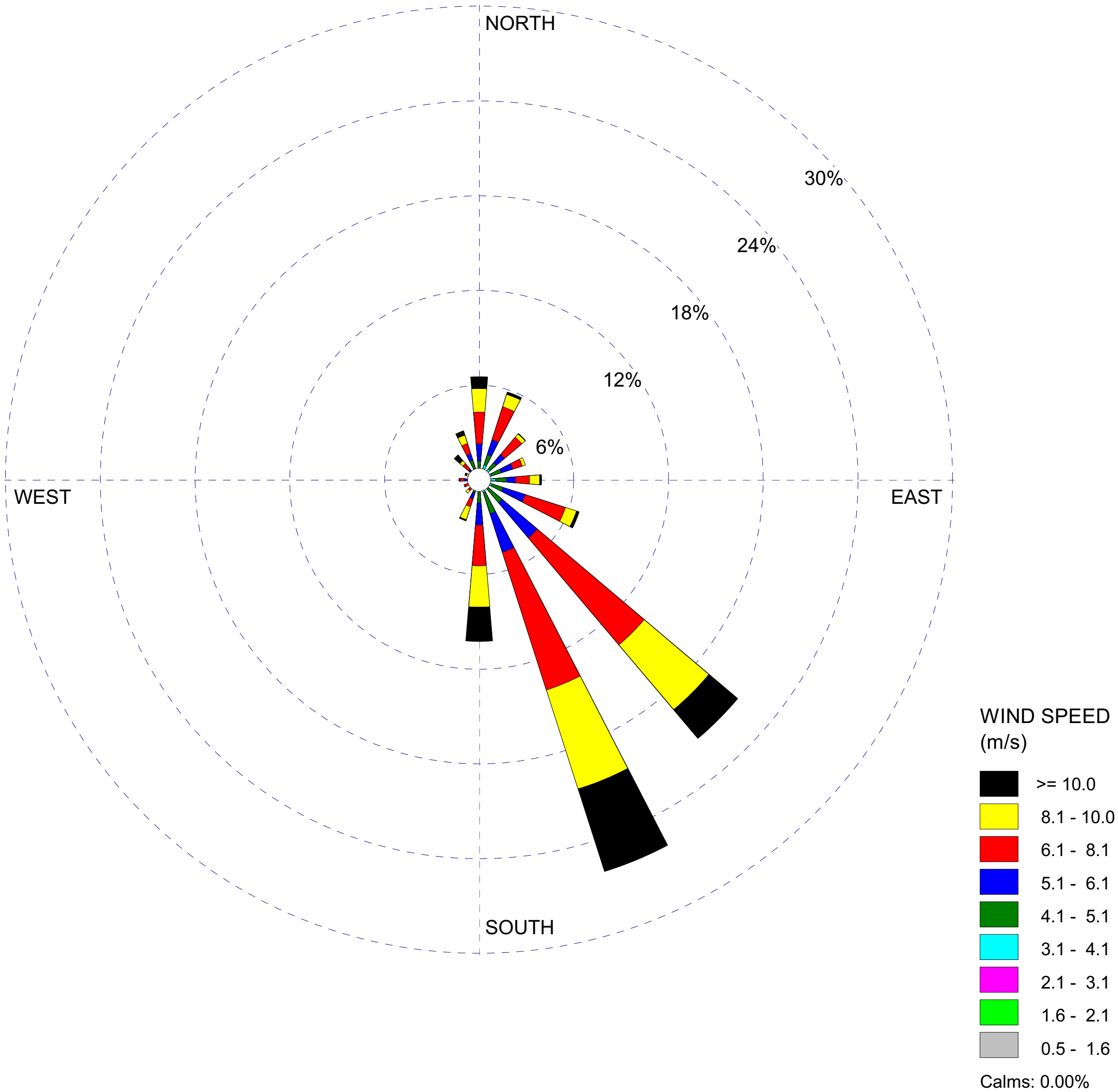


Figure 2.7-10 60-Meter Level Wind Rose—Spring
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

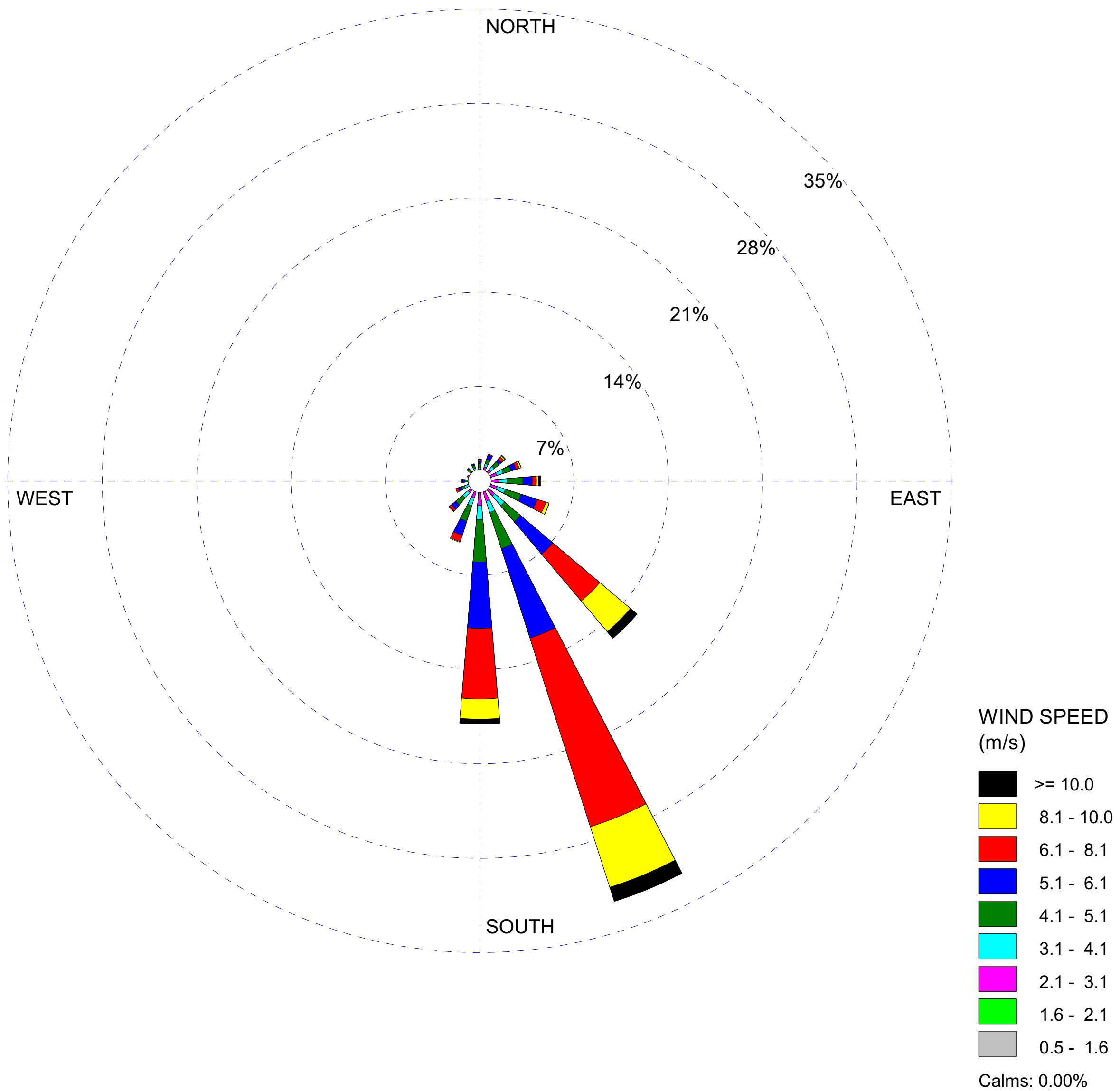


Figure 2.7-11 60-Meter Level Wind Rose—Summer
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

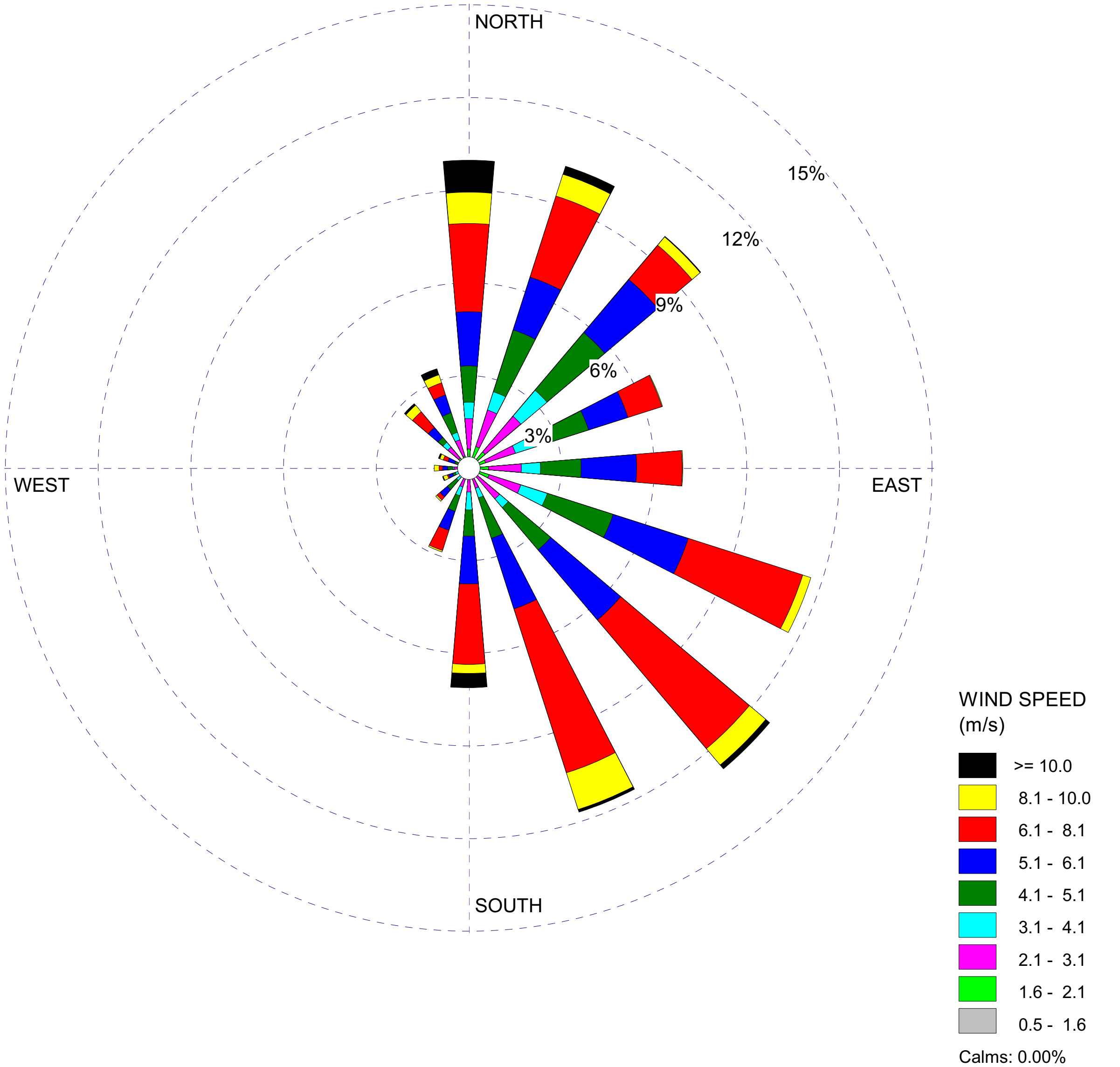


Figure 2.7-12 60-Meter Level Wind Rose—Autumn
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

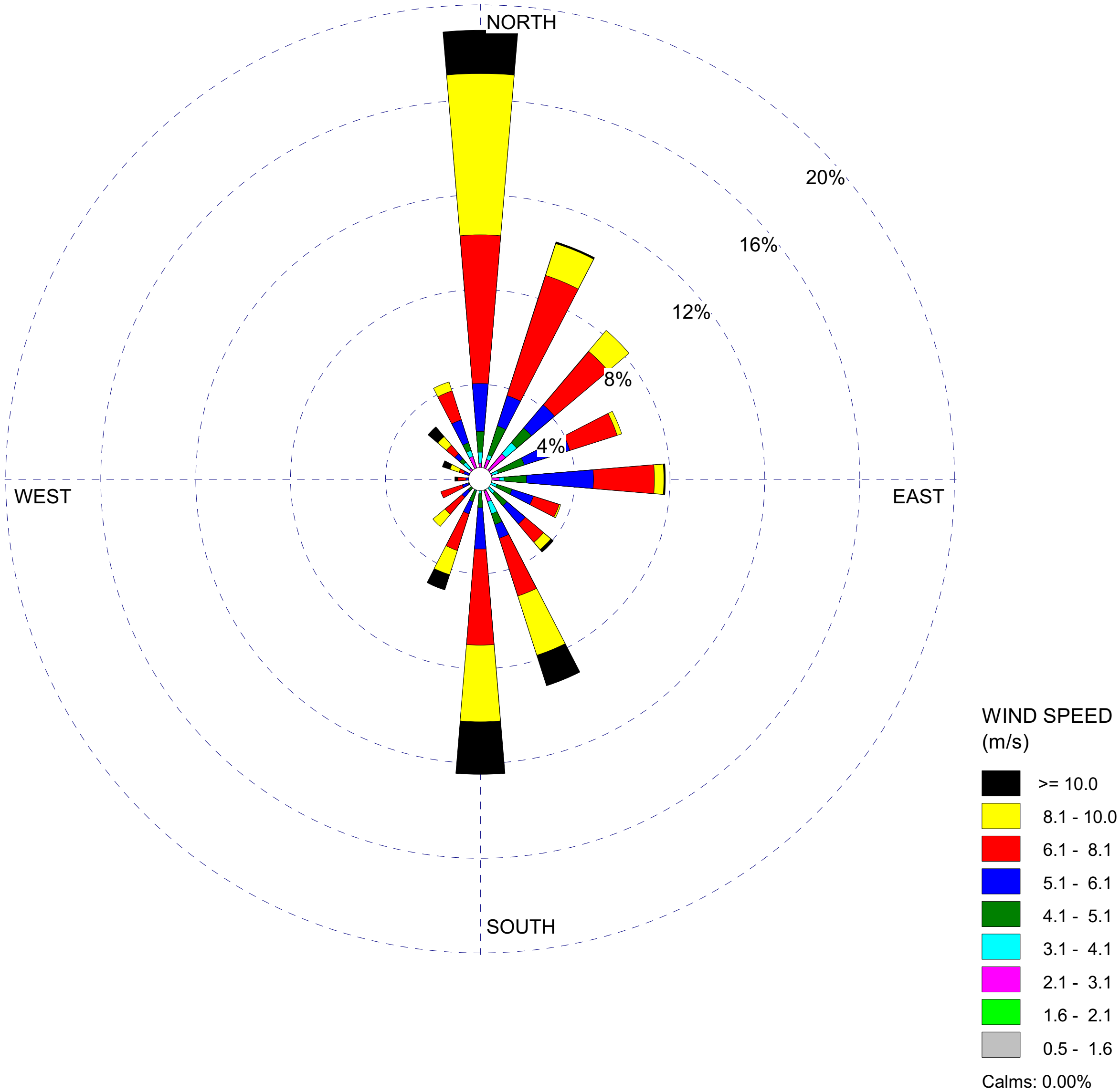


Figure 2.7-13 (Sheet 1 of 12) 60-Meter Level Wind Rose—January
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

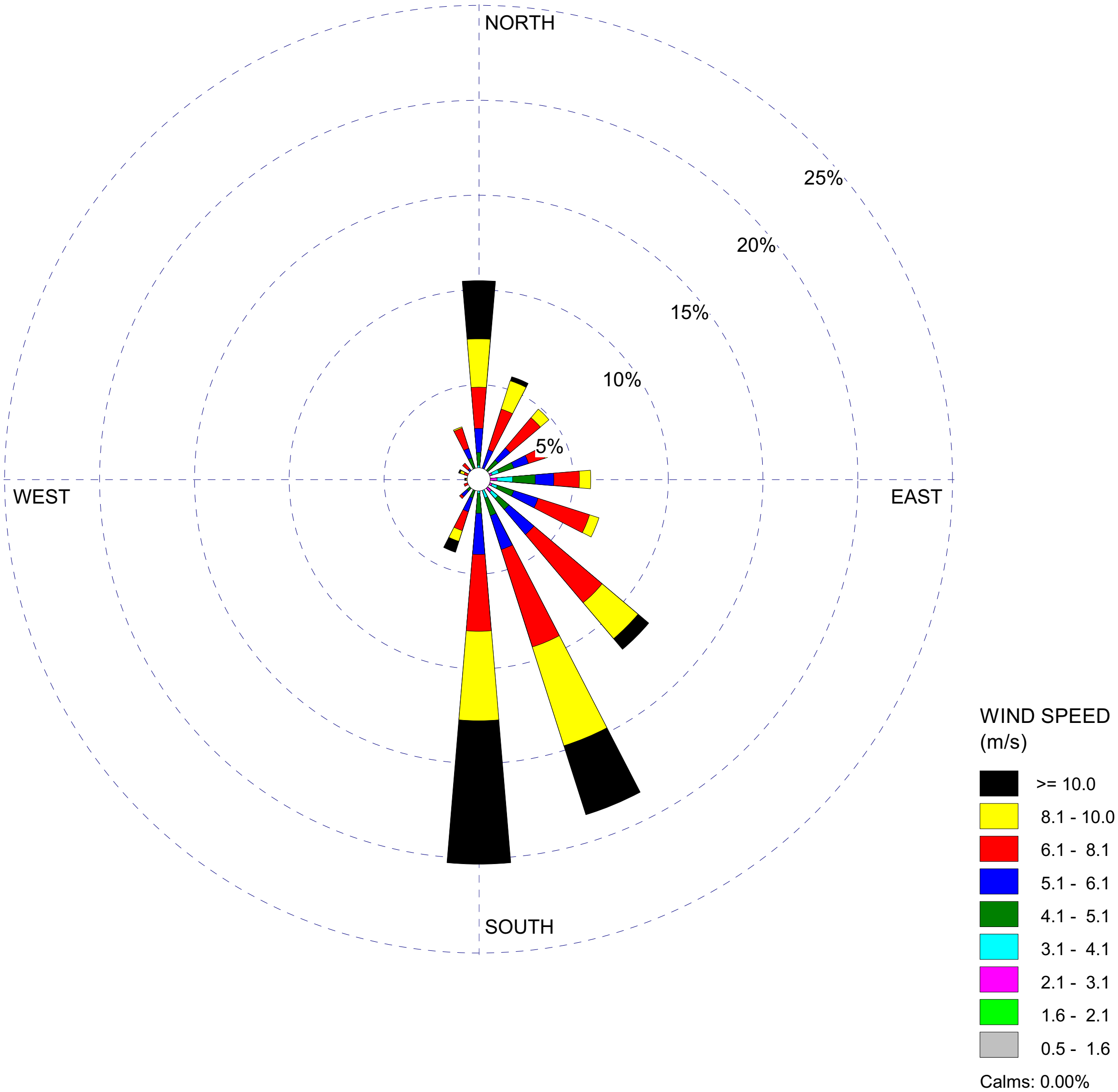


Figure 2.7-13 (Sheet 2 of 12) 60-Meter Level Wind Rose—February VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

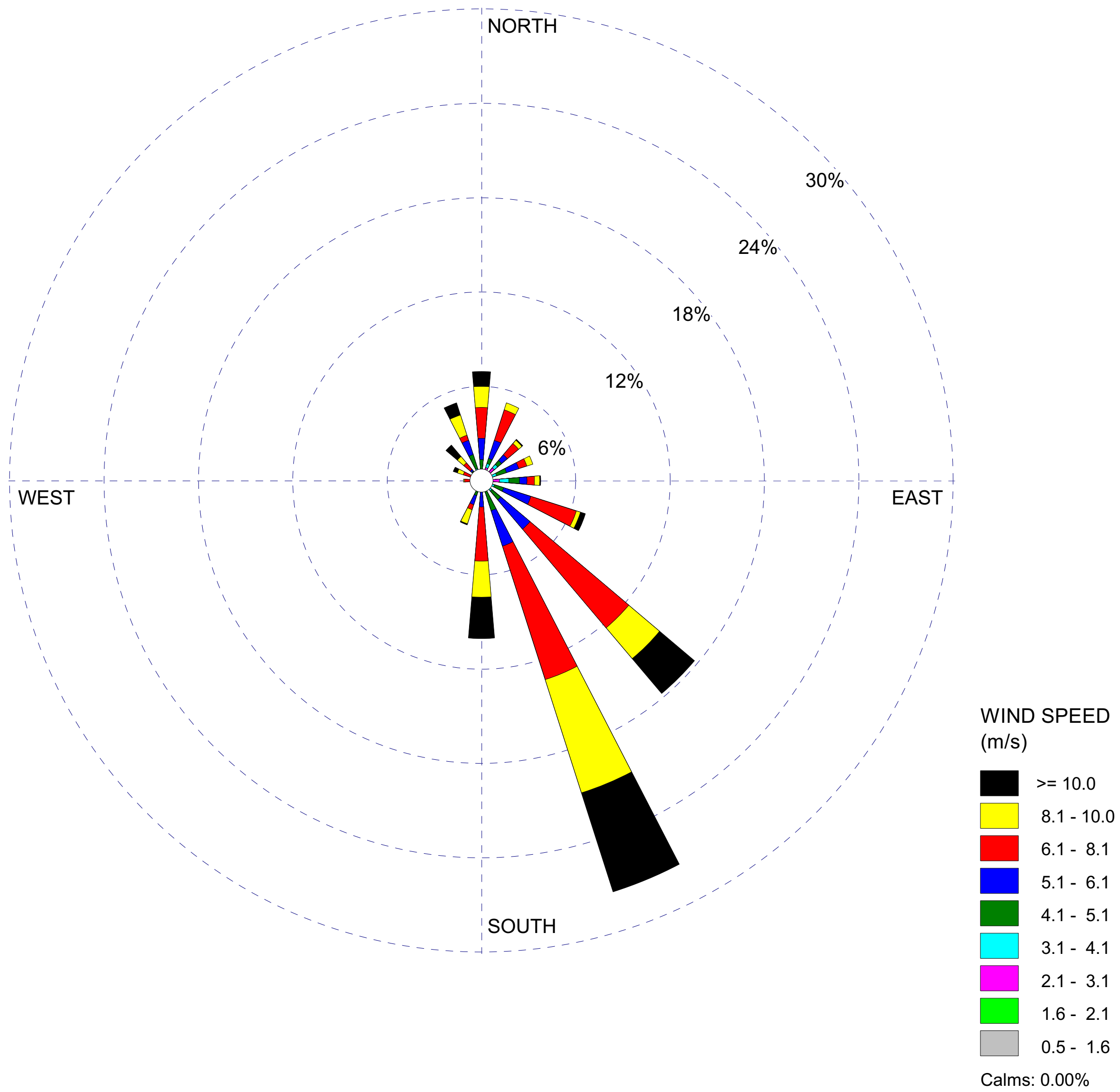


Figure 2.7-13 (Sheet 3 of 12) 60-Meter Level Wind Rose—March
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

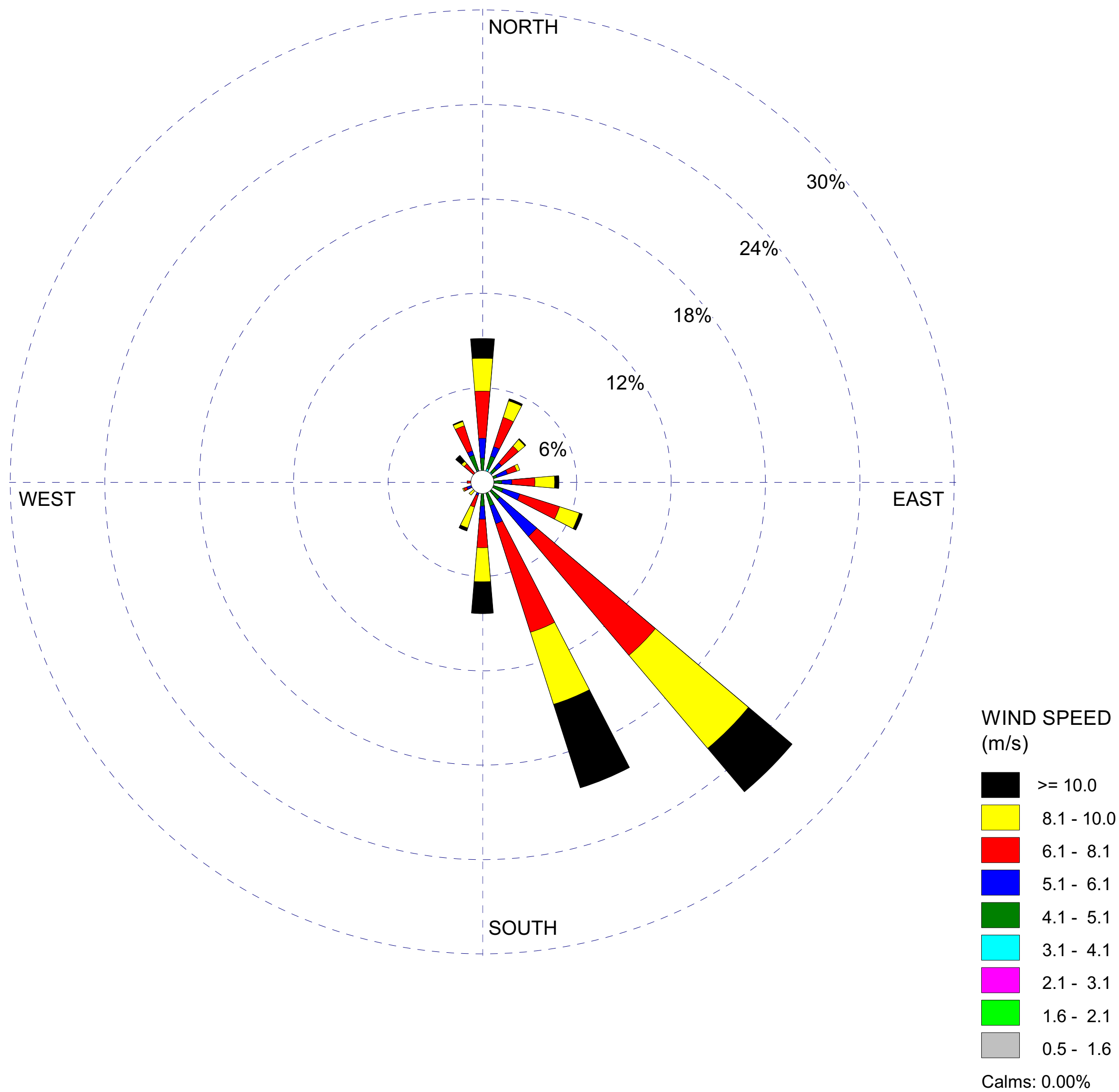


Figure 2.7-13 (Sheet 4 of 12) 60-Meter Level Wind Rose—April
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

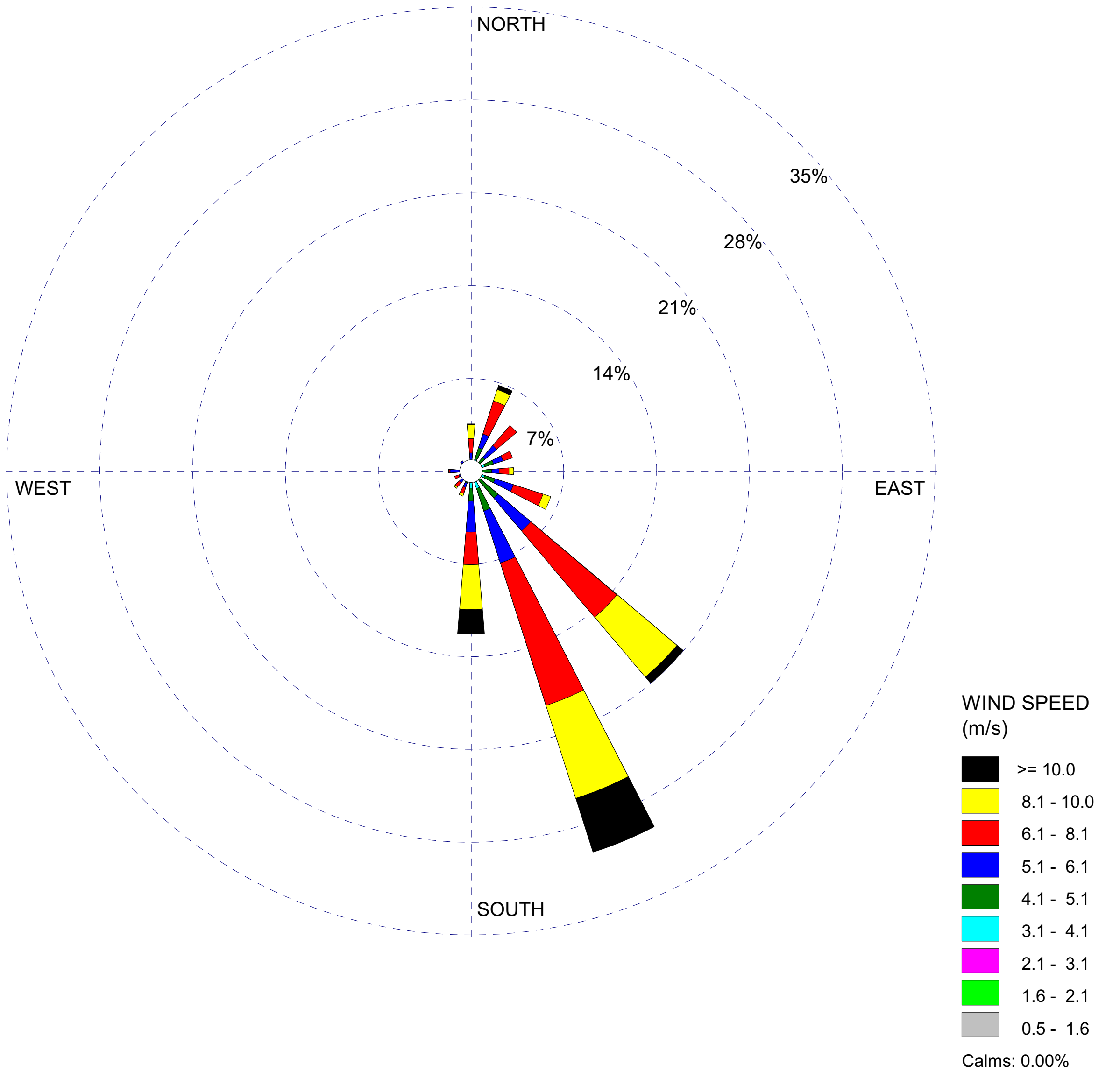


Figure 2.7-13 (Sheet 5 of 12) 60-Meter Level Wind Rose—May
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

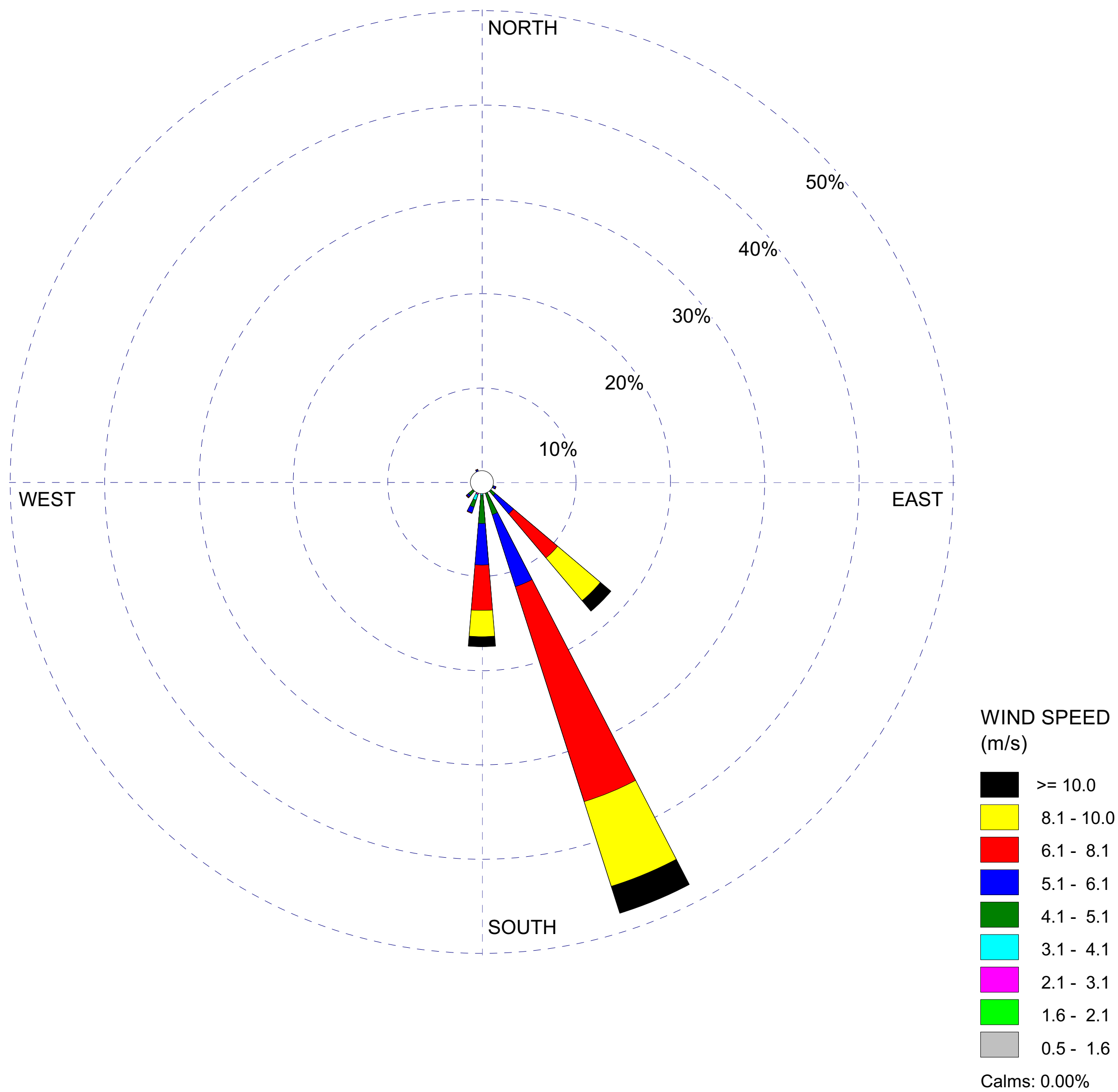


Figure 2.7-13 (Sheet 6 of 12) 60-Meter Level Wind Rose—June
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

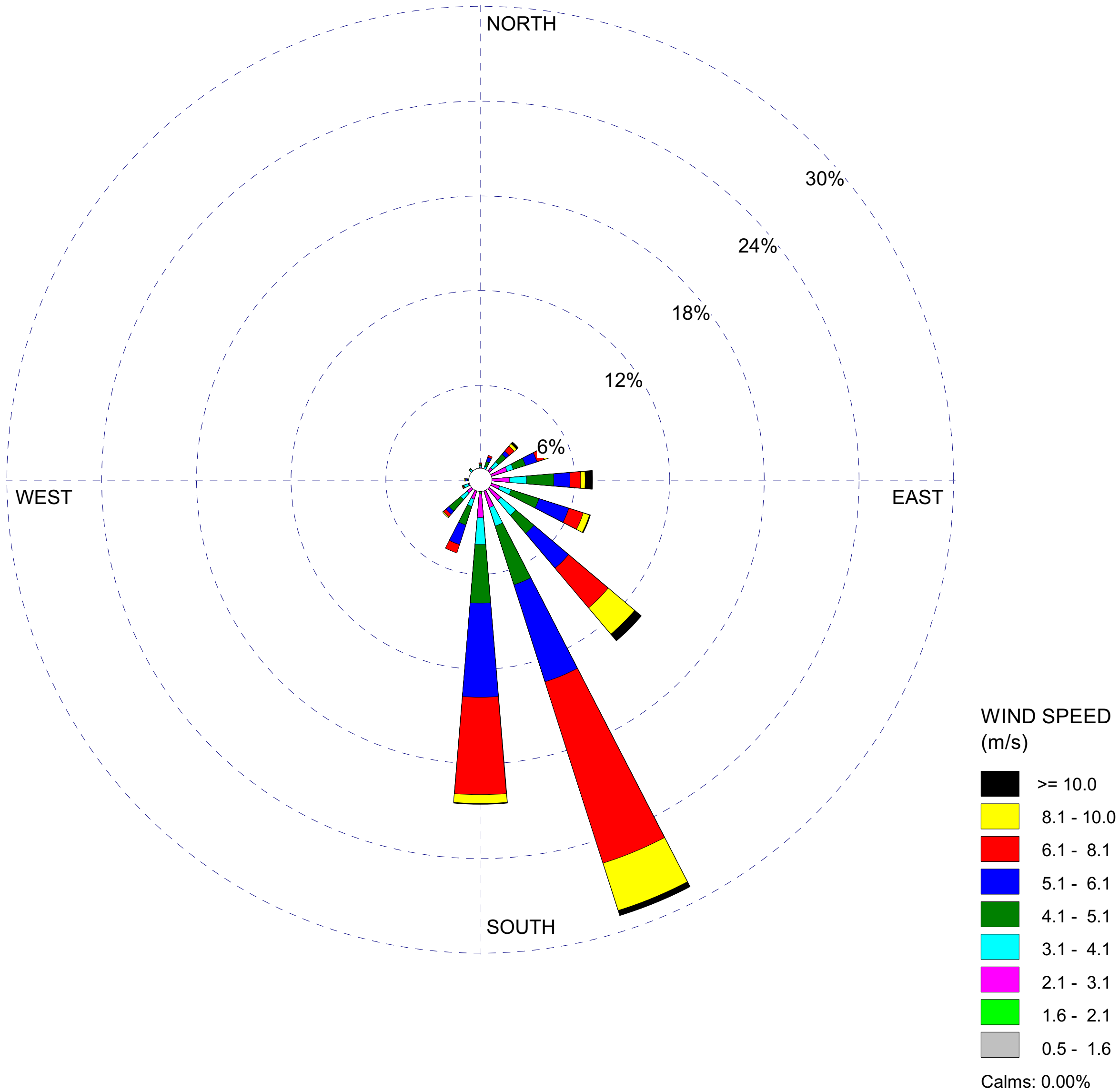


Figure 2.7-13 (Sheet 7 of 12) 60-Meter Level Wind Rose—July
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

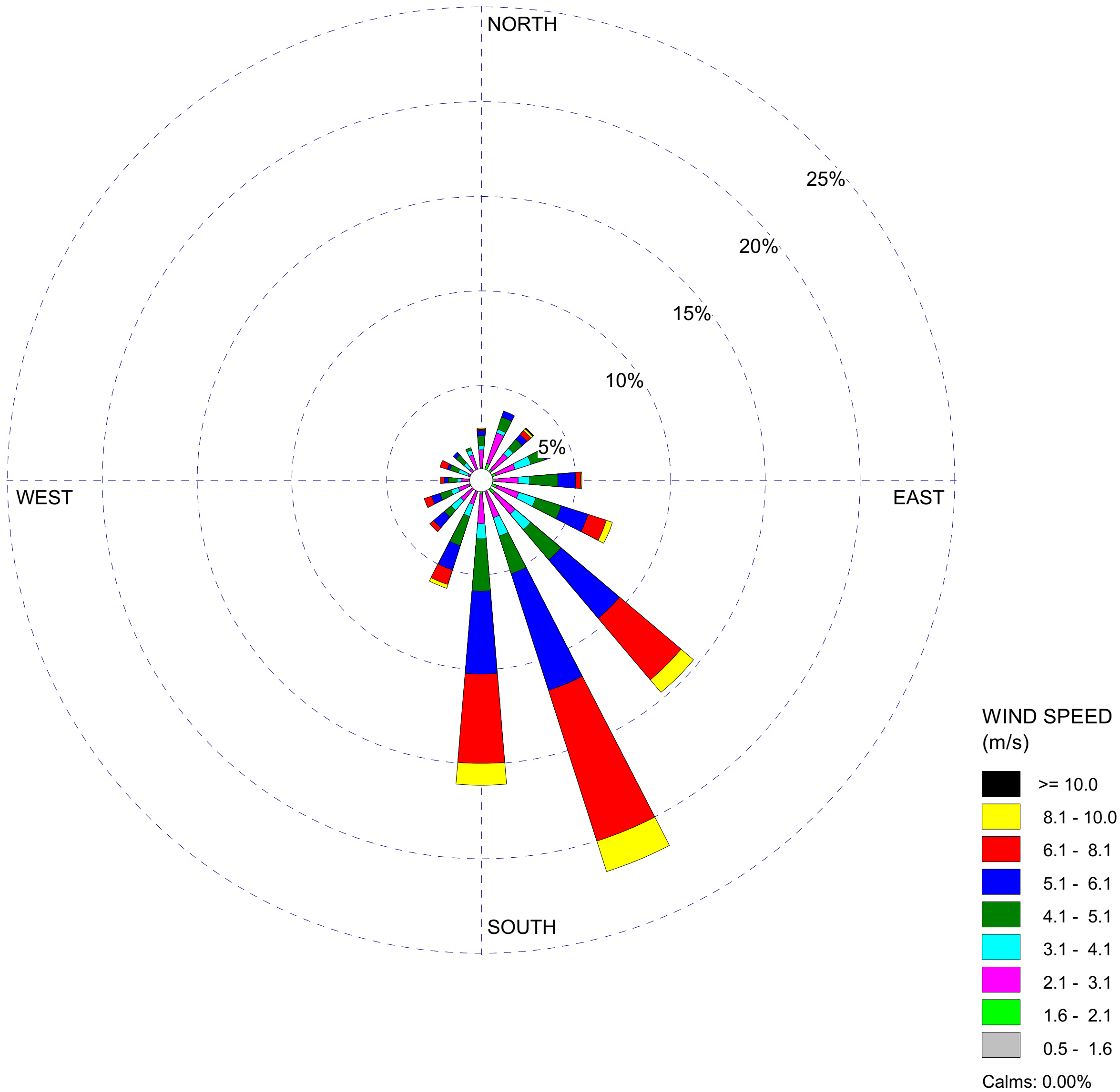


Figure 2.7-13 (Sheet 8 of 12) 60-Meter Level Wind Rose—August
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

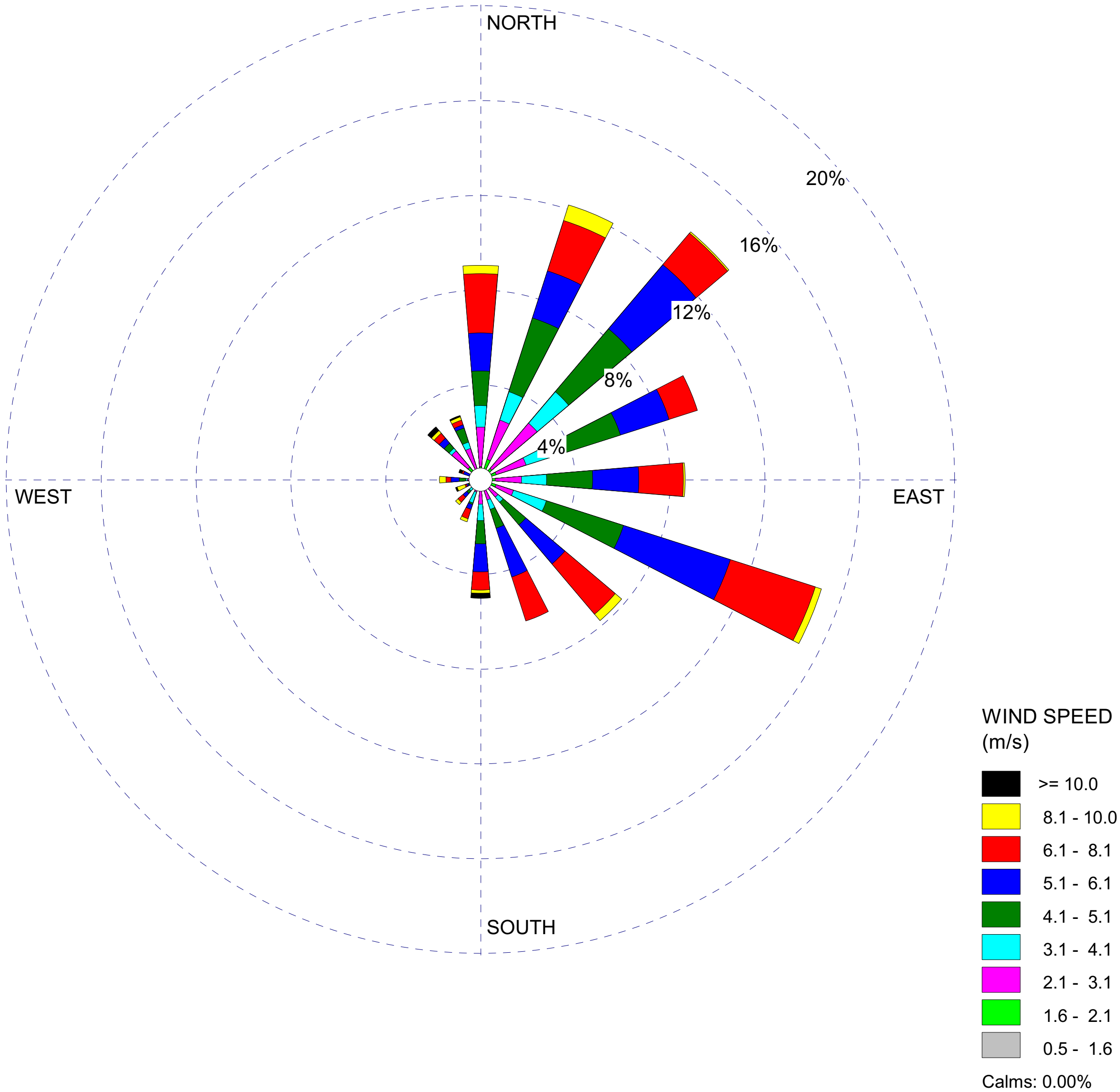


Figure 2.7-13 (Sheet 9 of 12) 60-Meter Level Wind Rose—September
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

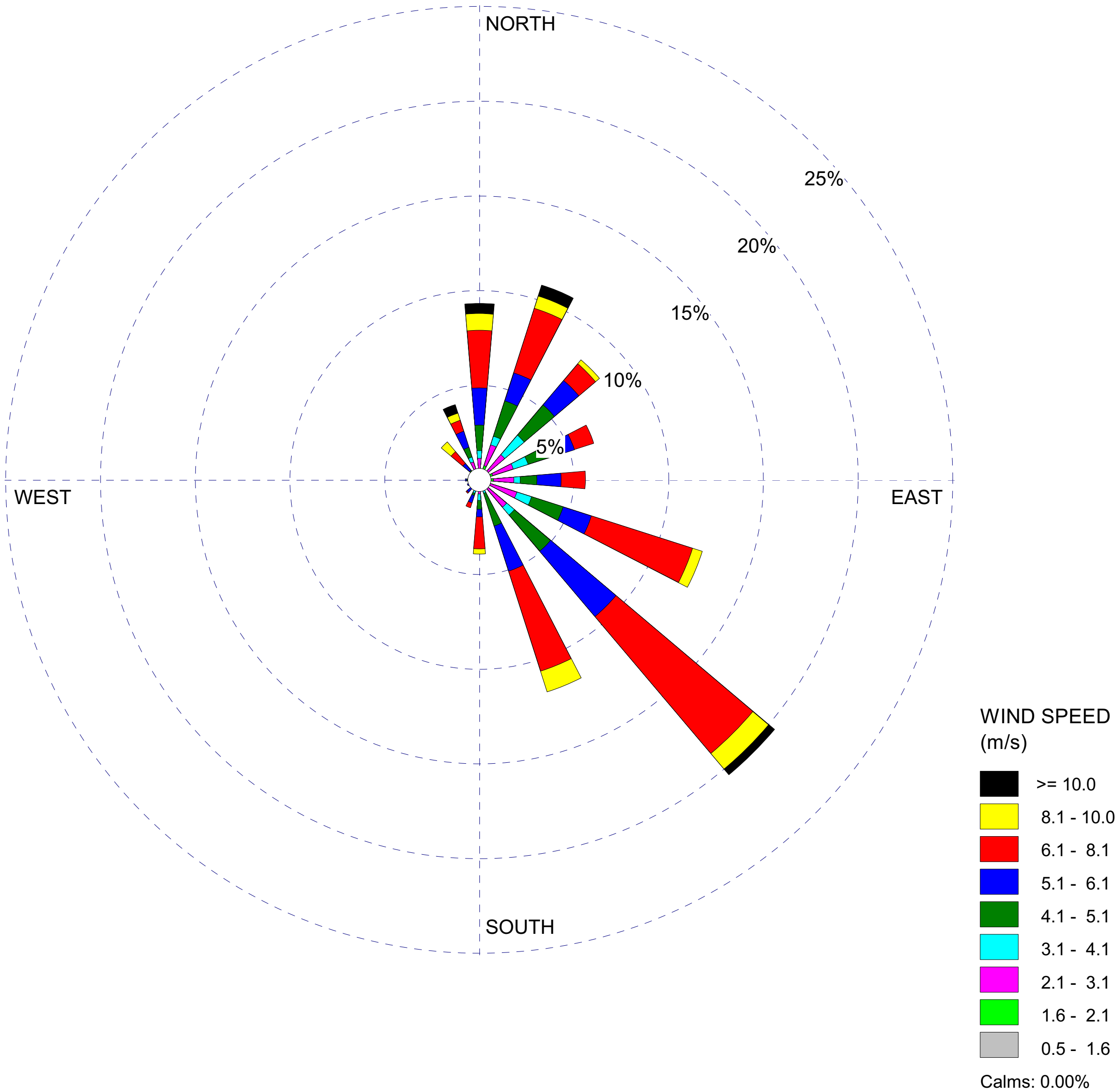


Figure 2.7-13 (Sheet 10 of 12) 60-Meter Level Wind Rose—October
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

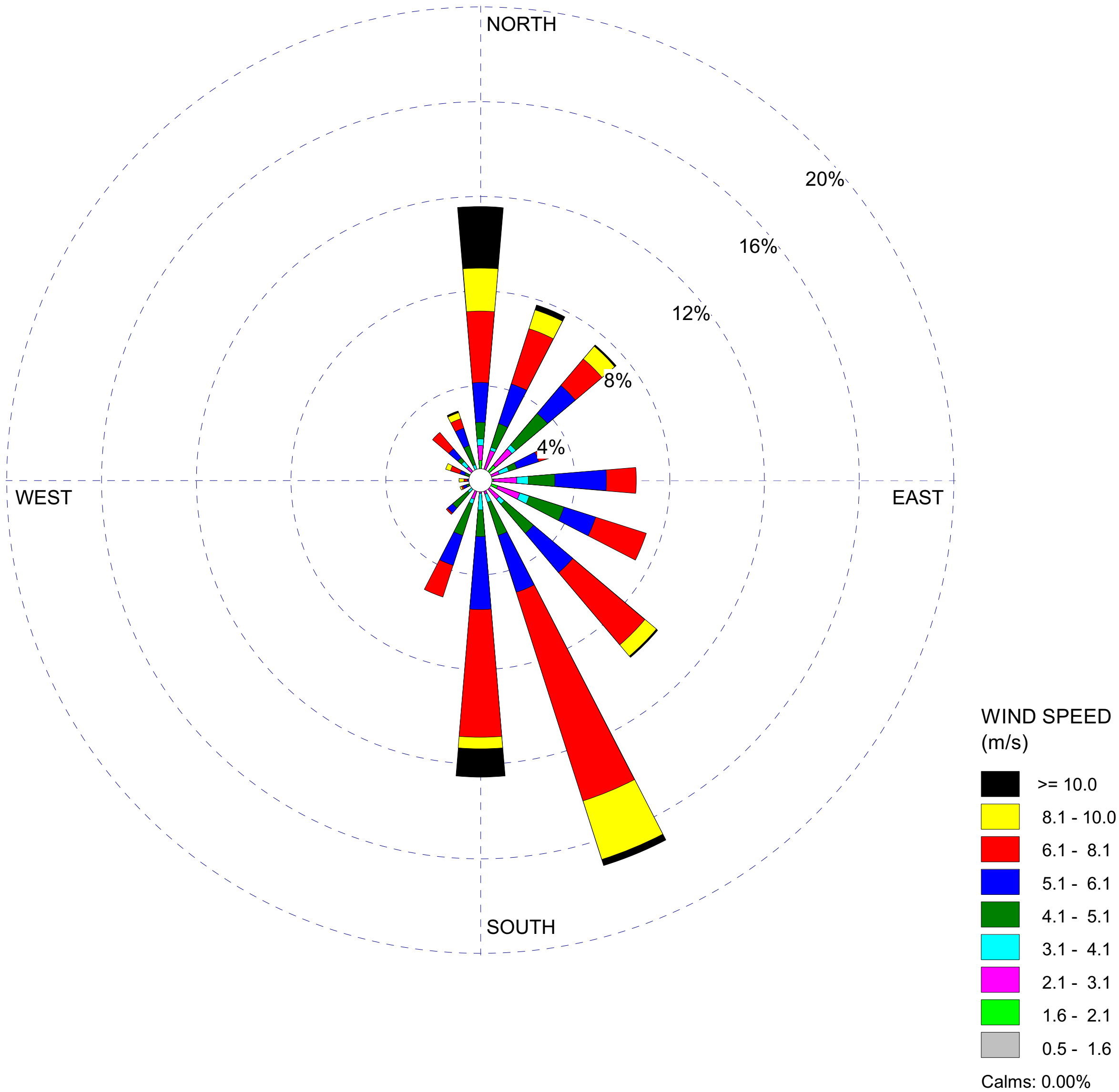


Figure 2.7-13 (Sheet 11 of 12) 60-Meter Level Wind Rose—November
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

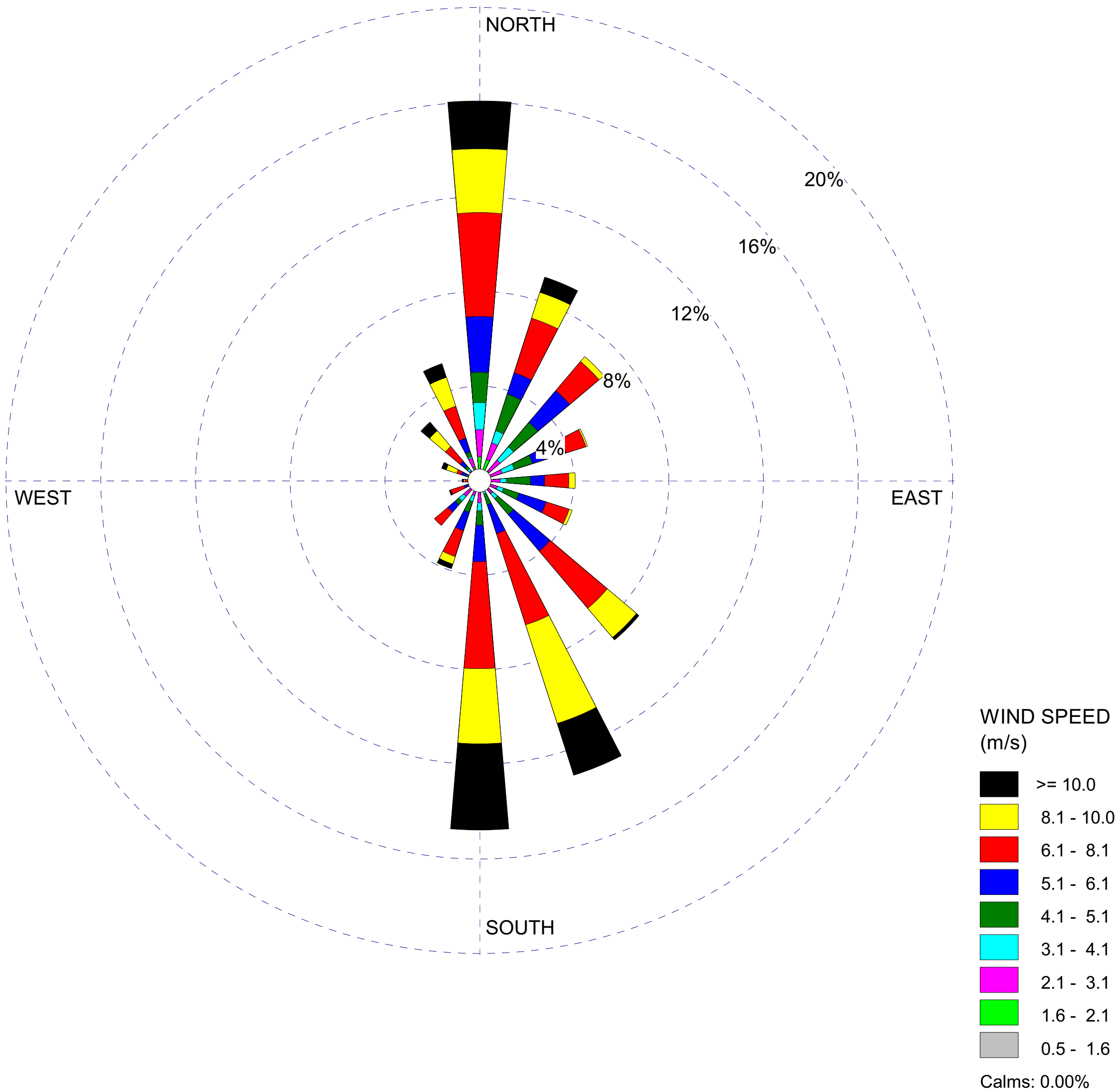


Figure 2.7-13 (Sheet 12 of 12) 60-Meter Level Wind Rose—December
VCS Pre-Application Monitoring Program (July 1, 2007 through June 30, 2009)

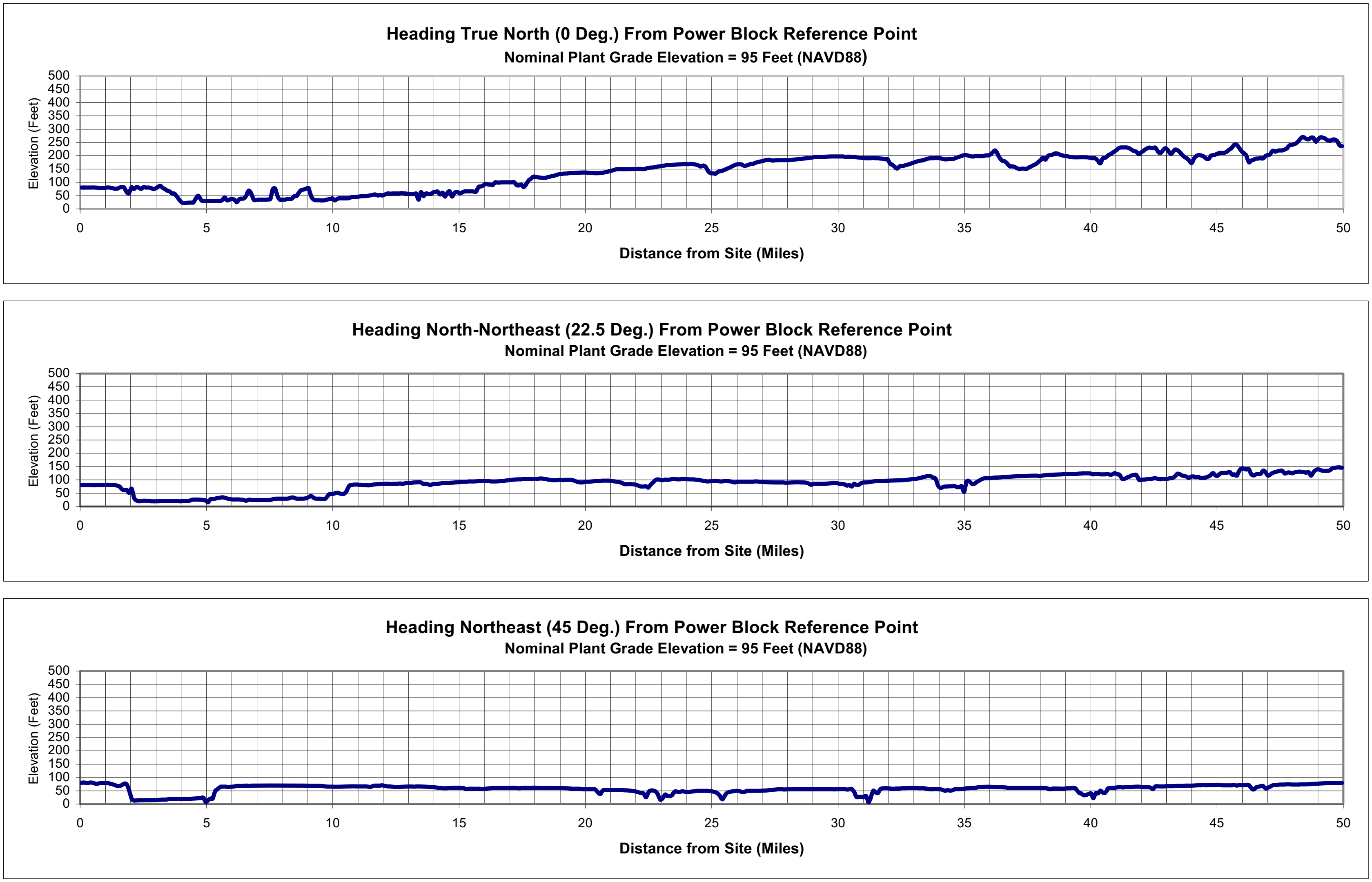
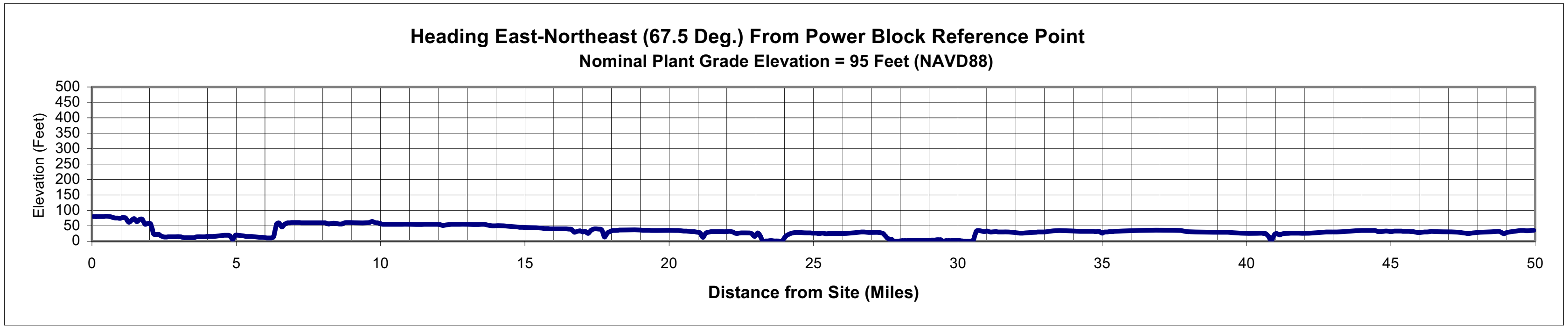
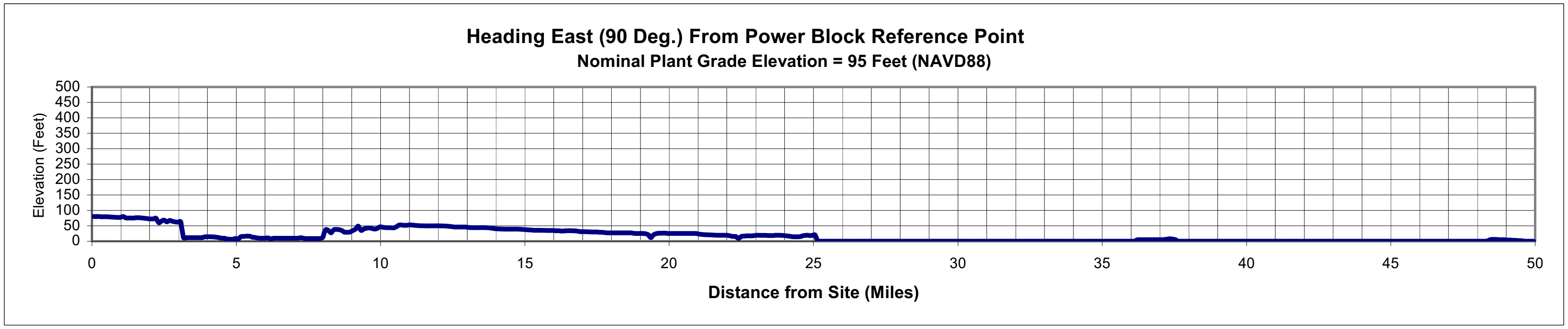


Figure 2.7-14 Terrain Elevation Profiles within 50 Miles of the VCS Site (Sheet 1 of 6)





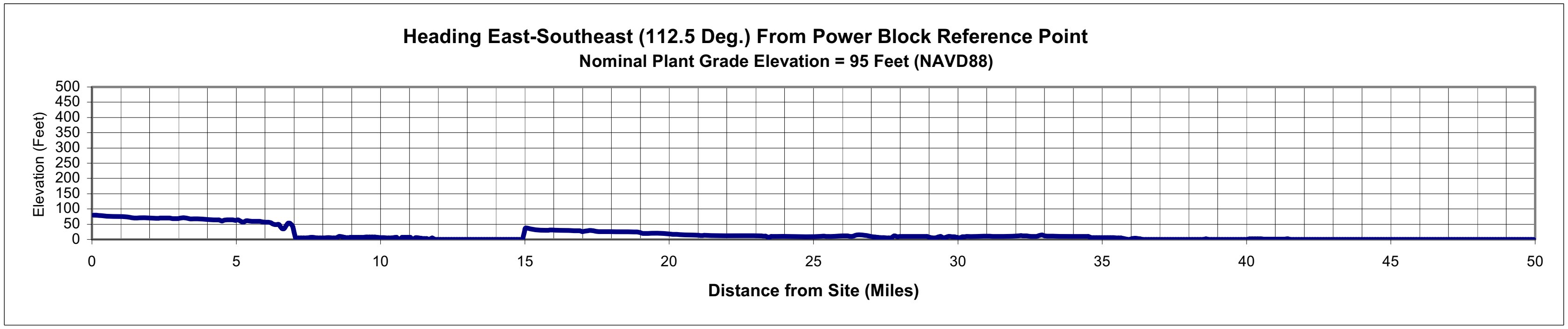


Figure 2.7-14 Terrain Elevation Profiles within 50 Miles of the VCS Site (Sheet 2 of 6)

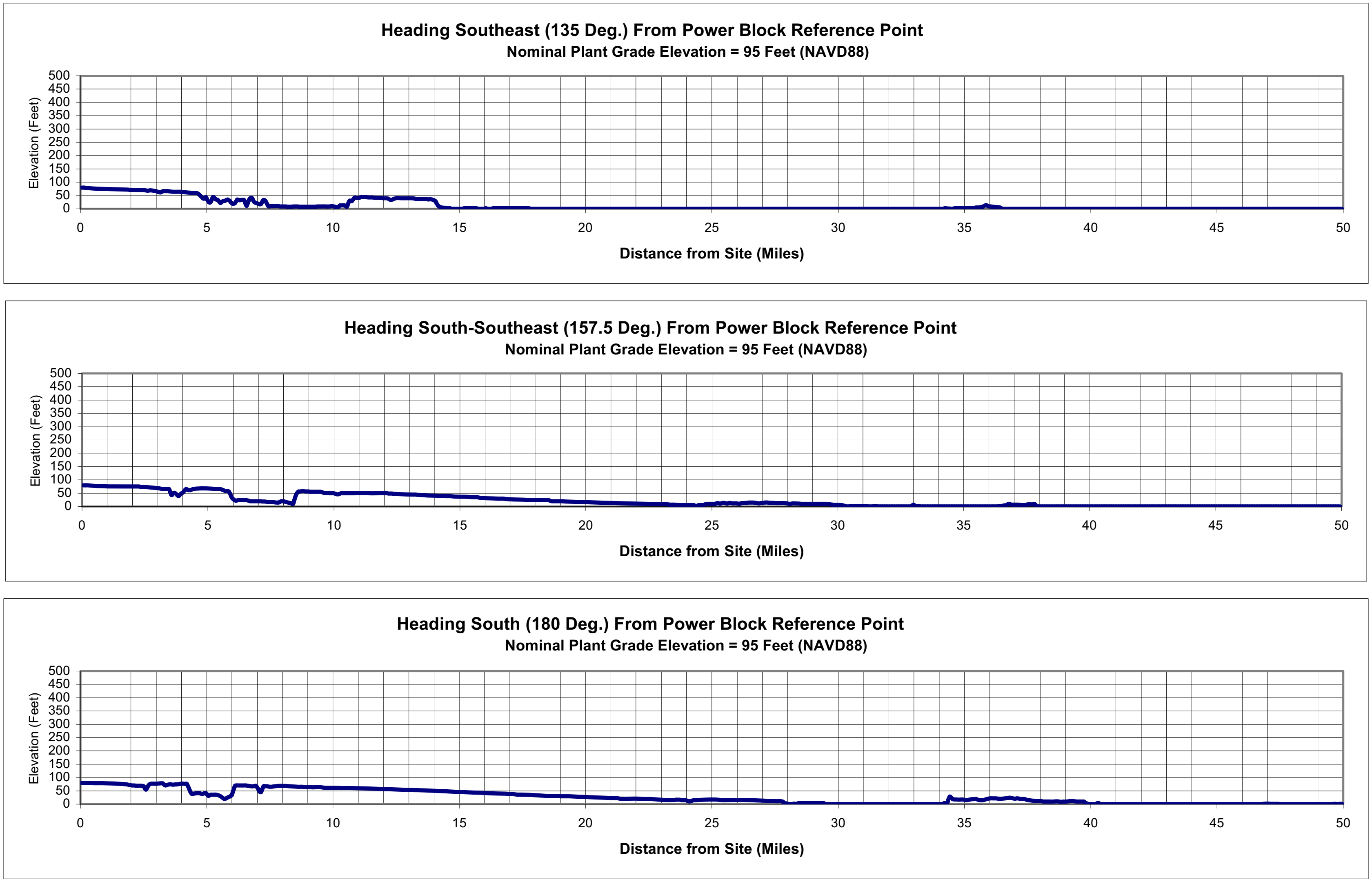
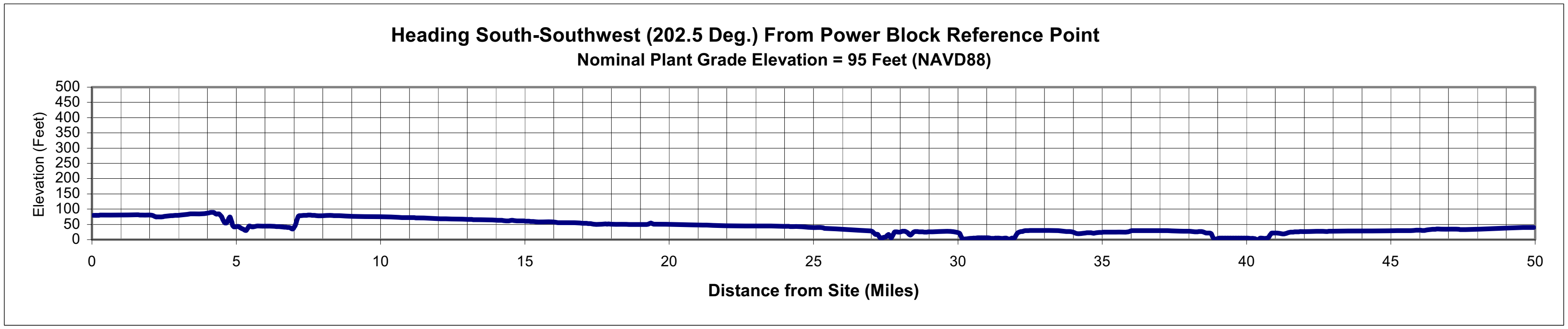
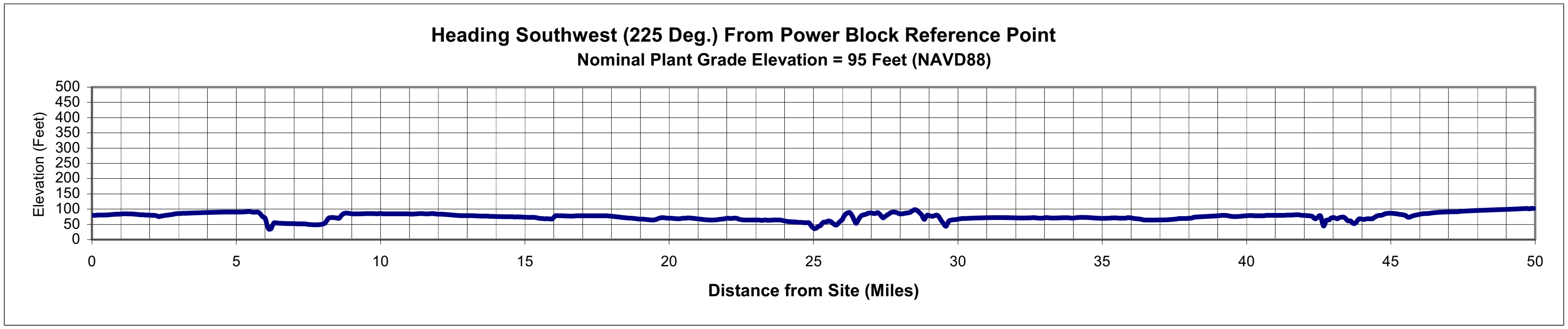


Figure 2.7-14 Terrain Elevation Profiles within 50 Miles of the VCS Site (Sheet 3 of 6)





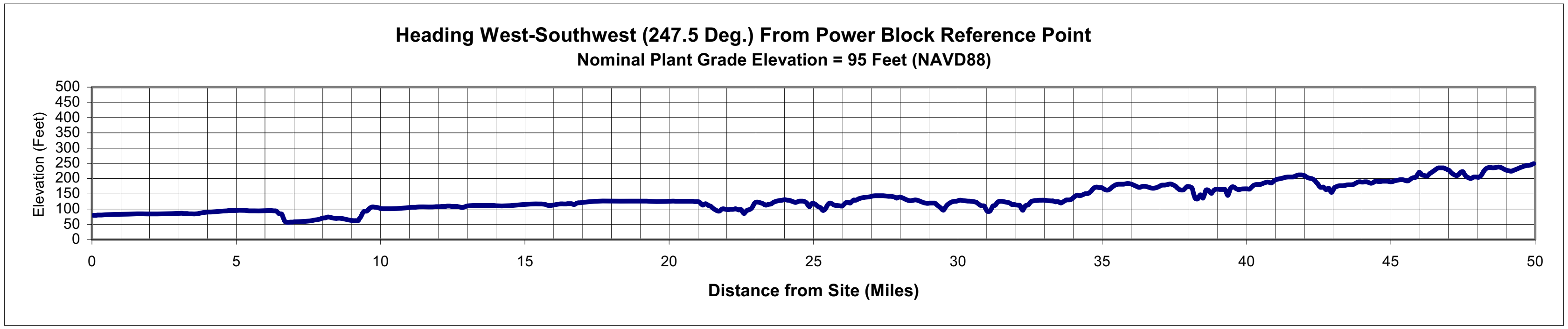
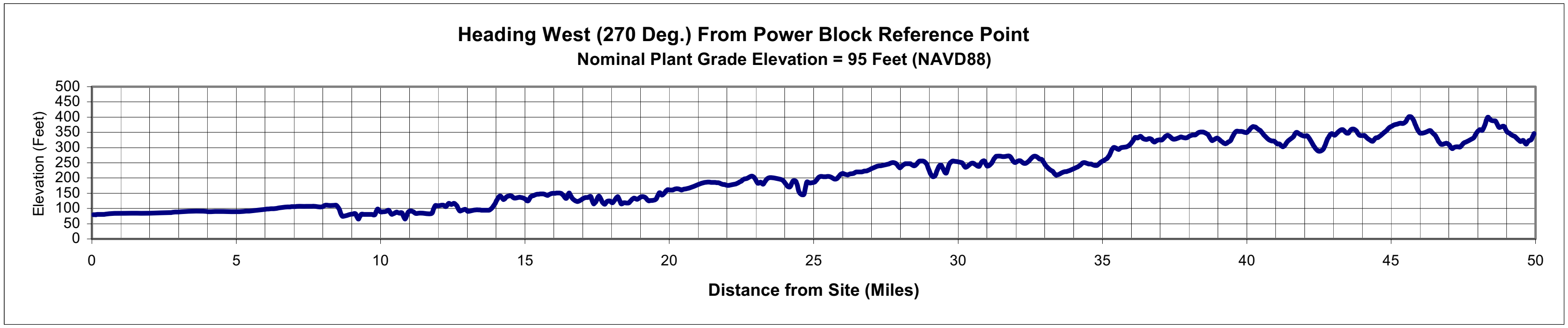
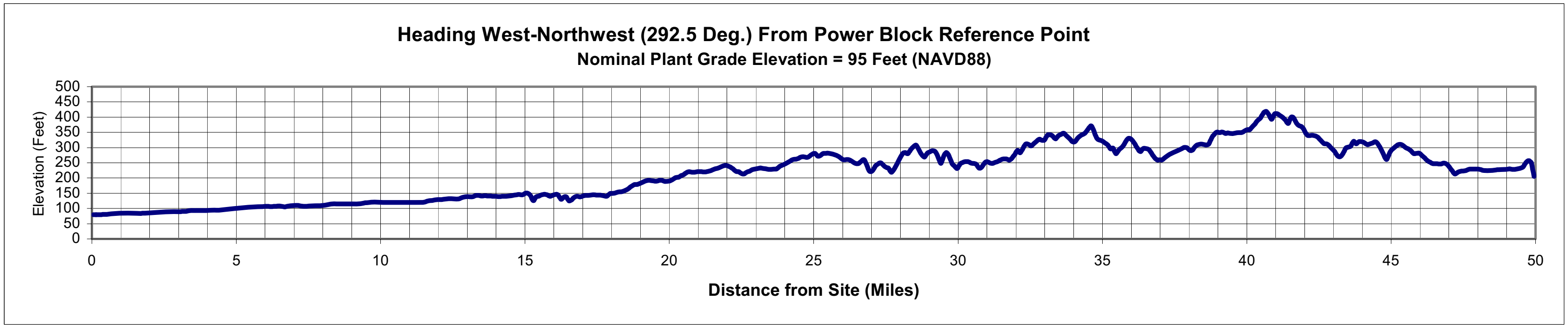


Figure 2.7-14 Terrain Elevation Profiles within 50 Miles of the VCS Site (Sheet 4 of 6)





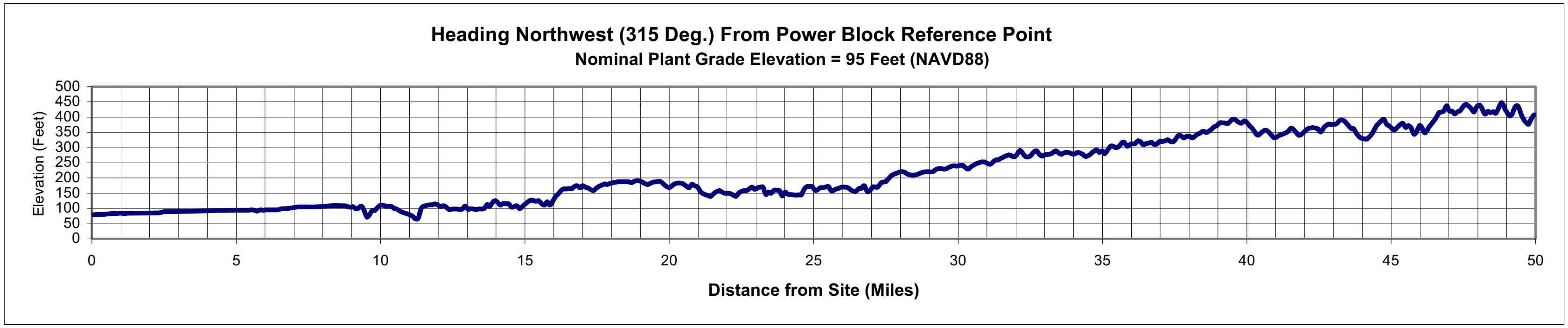


Figure 2.7-14 Terrain Elevation Profiles within 50 Miles of the VCS Site (Sheet 5 of 6)

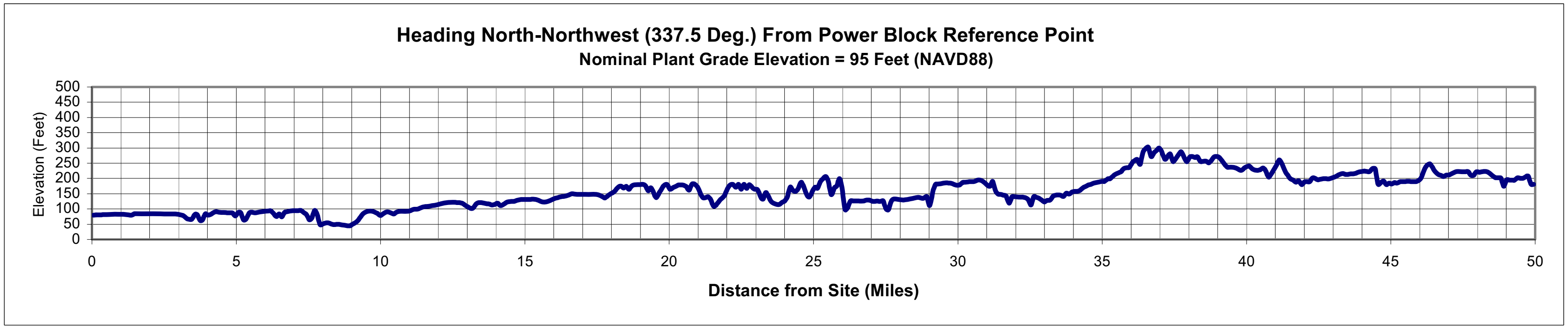
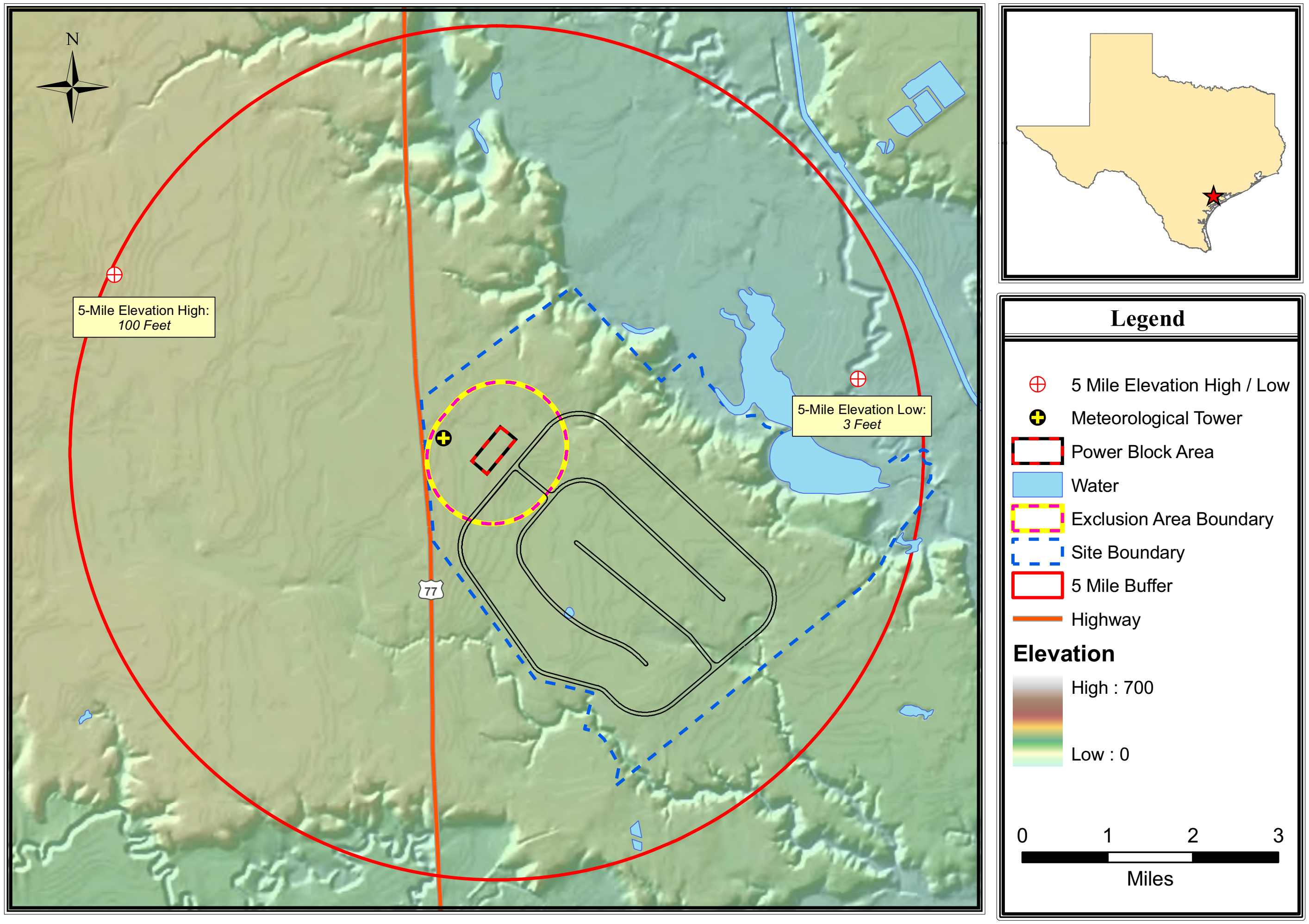


Figure 2.7-14 Terrain Elevation Profiles within 50 Miles of the VCS Site (Sheet 6 of 6)



Source Data: ESRI, Data & Maps and StreetMap USA, 2006.
USGS, seamless data distribution, NED shaded relief.

Projection: Texas South Central State Plane
Datum: North American Datum 1983

Drawing No.: EXELON_FIG_T_005MI_0000
Revision: 000 *Date:* 02/17/2010

Figure 2.7-15 Site and Vicinity Map (5-Mile Radius)

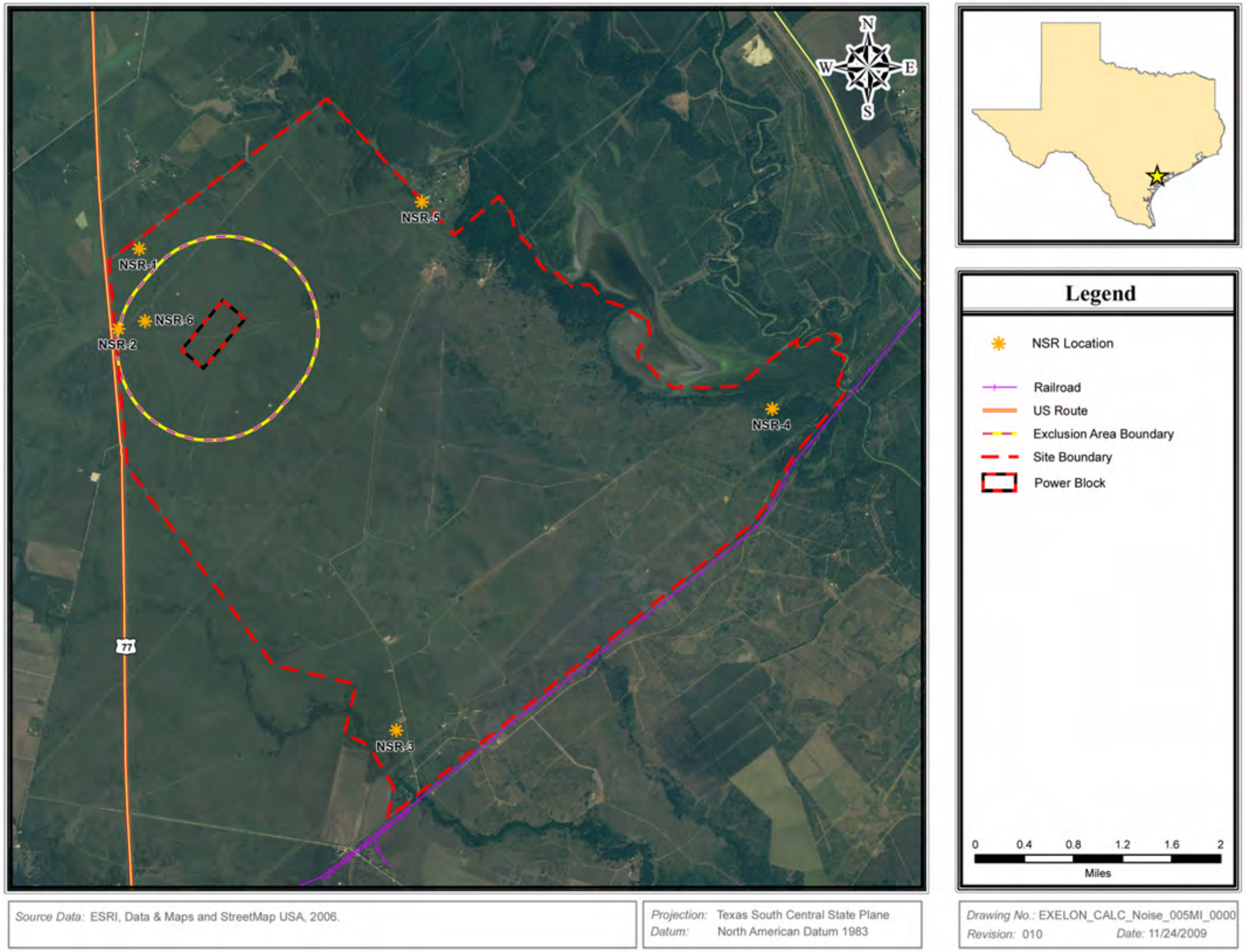


Figure 2.7-16 Noise Monitoring Locations

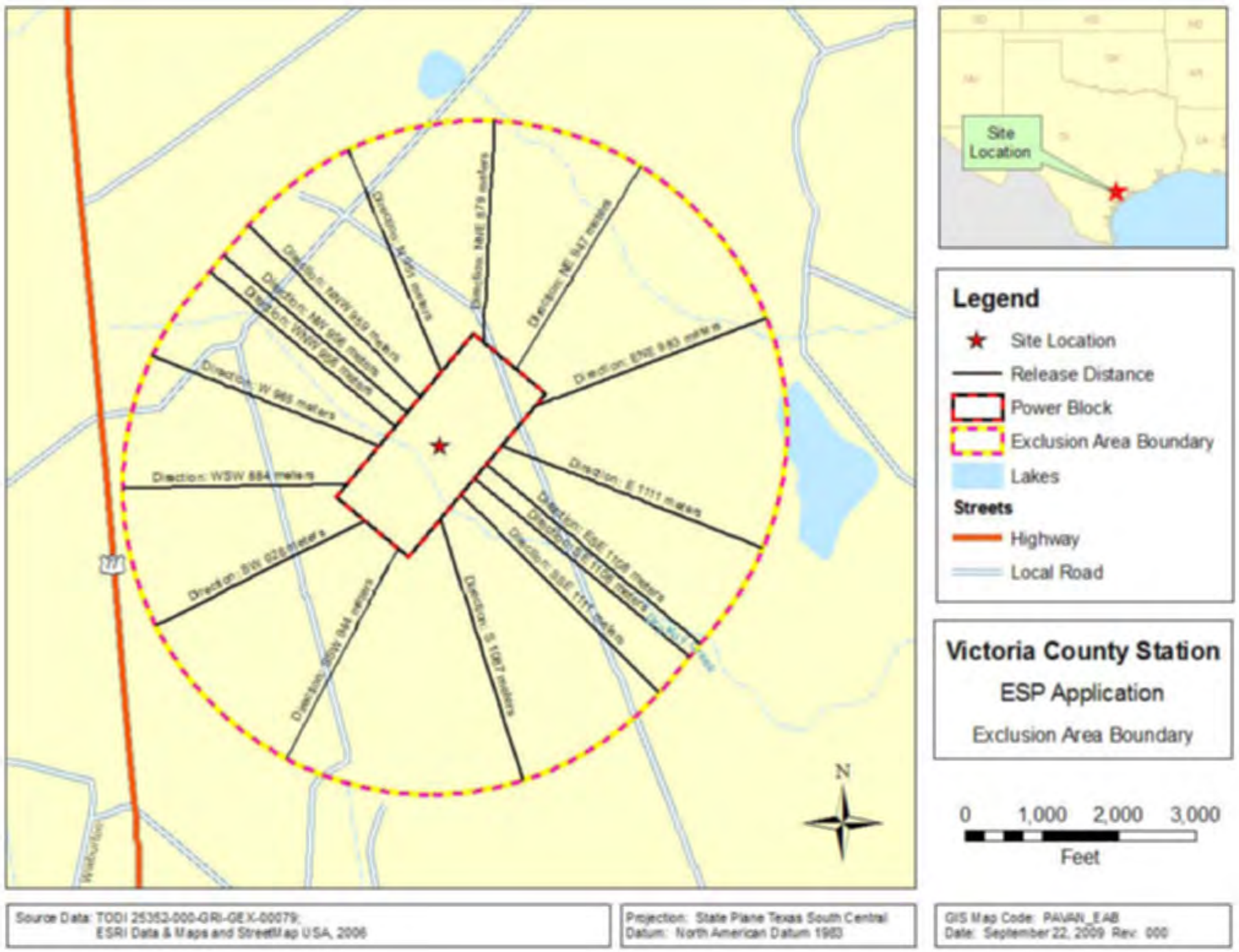


Figure 2.7-17 Distance to EAB from the Source Boundary for PAVAN Modeling

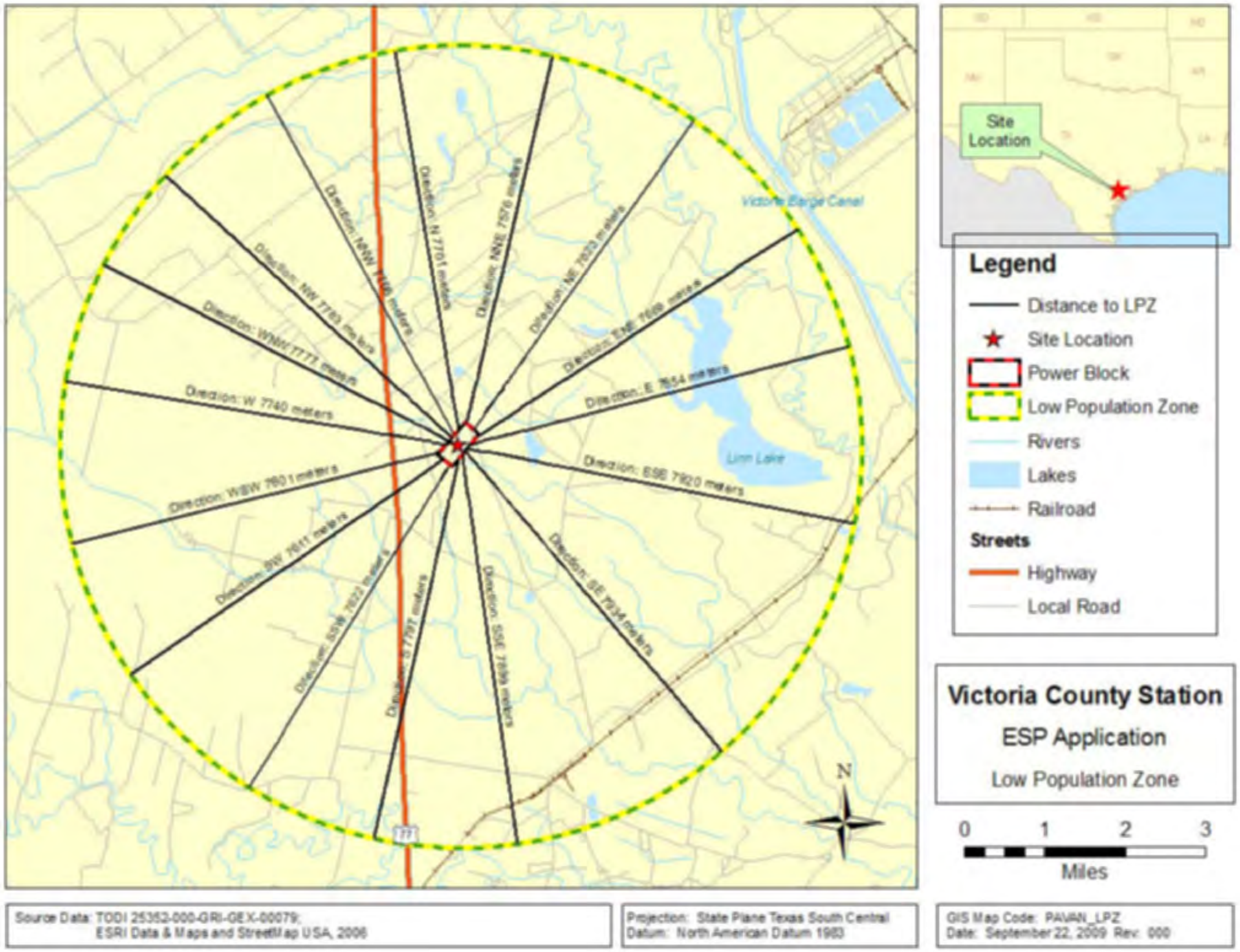


Figure 2.7-18 Distance to LPZ from the Source Boundary for PAVAN Modeling